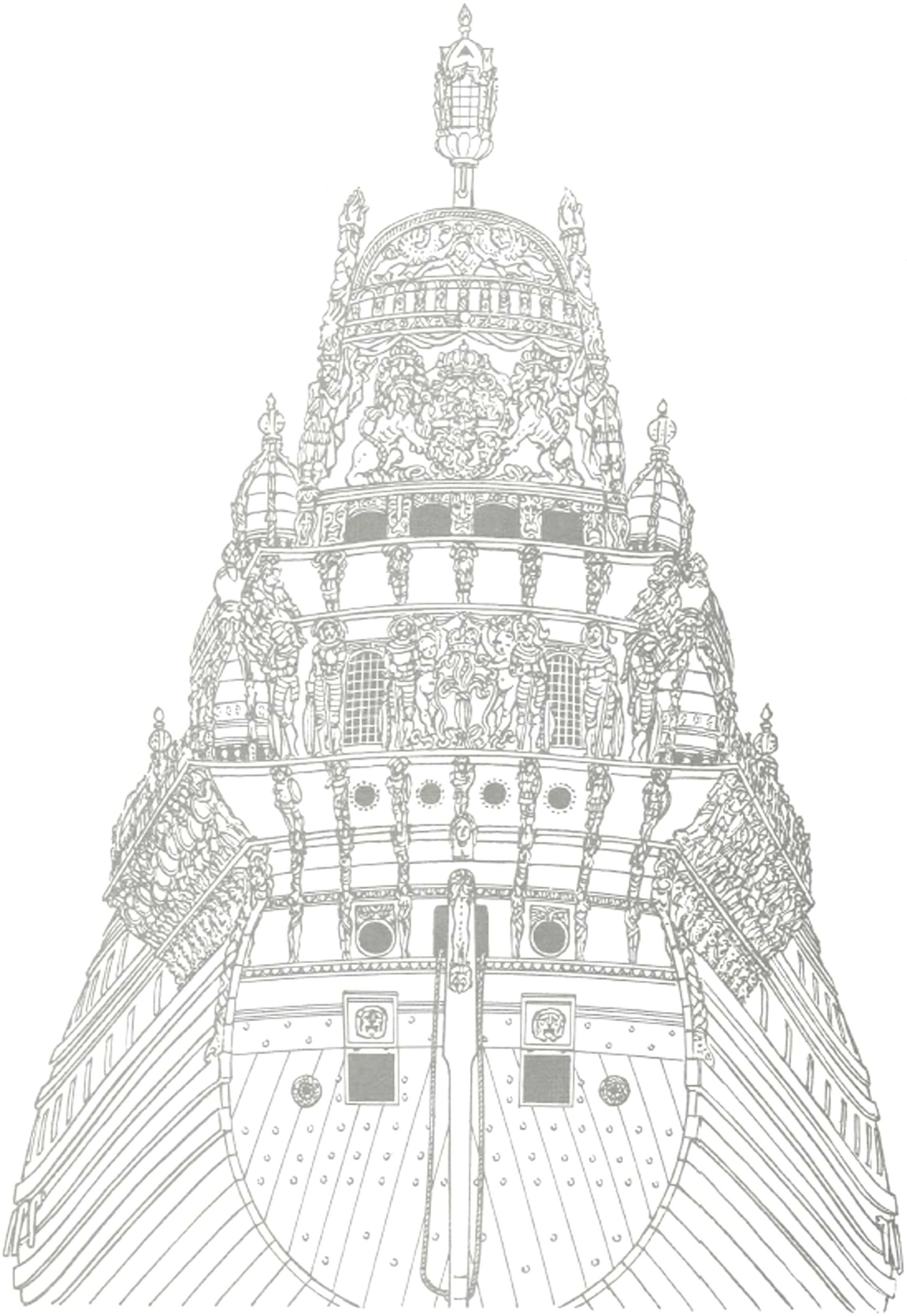


To my invaluable colleagues and friends
Eva-Marie Stolth and Johan Blomman

A R C H I T E C T U R A N A V A L I S

Björn Landström

The Royal Warship VASA

A book on the building and embellishment, the rigging and armaments of the *Vasa*, the Swedish warship that sank on her maiden voyage in Stockholm harbour in 1628. The book includes comparative studies of Danish, English and Dutch shipbuilding methods of the time.

Foreword by Anders Franzén
Translated by Jeremy Franks
Edited by Lars-Åke Kvarning

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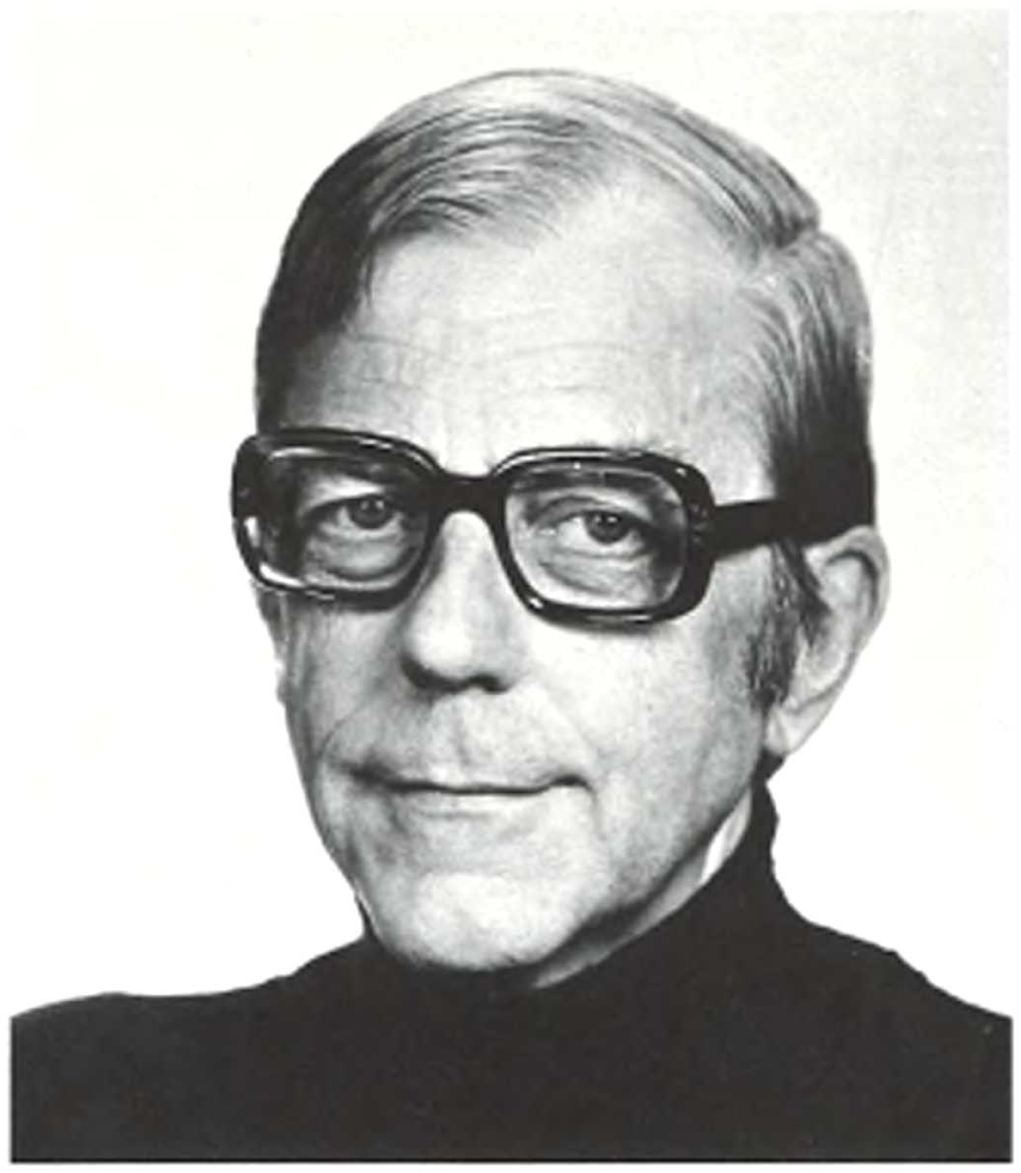
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Anders Franzén



Foreword

Björn Landström's name circumnavigated the world in 1961, when his great standard work, *The Ship*, was published in eight languages. In the course of the same year, the *Vasa* rose from the depths of Stockholm harbour, proceeded into dry-dock, and became an international sensation.

Since then Björn Landström has published many significant books on the maritime arts and sciences putting forward points of view on technology and civilization that are thought-provoking and even bold. *The Ship*, which has become a modern classic, is a sort of encyclopaedic compendium of waterborne craft through the ages.

Anyone who has only a superficial interest in maritime matters must be astonished by the unbelievable variety of types of vessel. Merely to begin to try to arrange this teeming variety into chronological order is an undertaking of exceptional importance—a sort of Linnéan *Systema navalis*.

One of the impulses that has inspired Björn Landström to compile these surveys of types of vessel has certainly been the fact that our knowledge of pre-modern boats and ships is surprisingly imperfect: the preservation of the *Vasa* all at once extended the frontier of our knowledge of maritime technology a further 200 years backwards in time. Previously, HMS *Victory*, from the time of the Napoleonic Wars, and the approximately contemporaneous USS *Constitution*, were the oldest named ships to have been preserved and documented.

Björn Landström would naturally sooner or later have fulfilled our expectations by dissecting the warship *Vasa*, and in the present work he has taken up his scalpel and palette to analyse and describe the anatomy of the ship in a most informative manner.

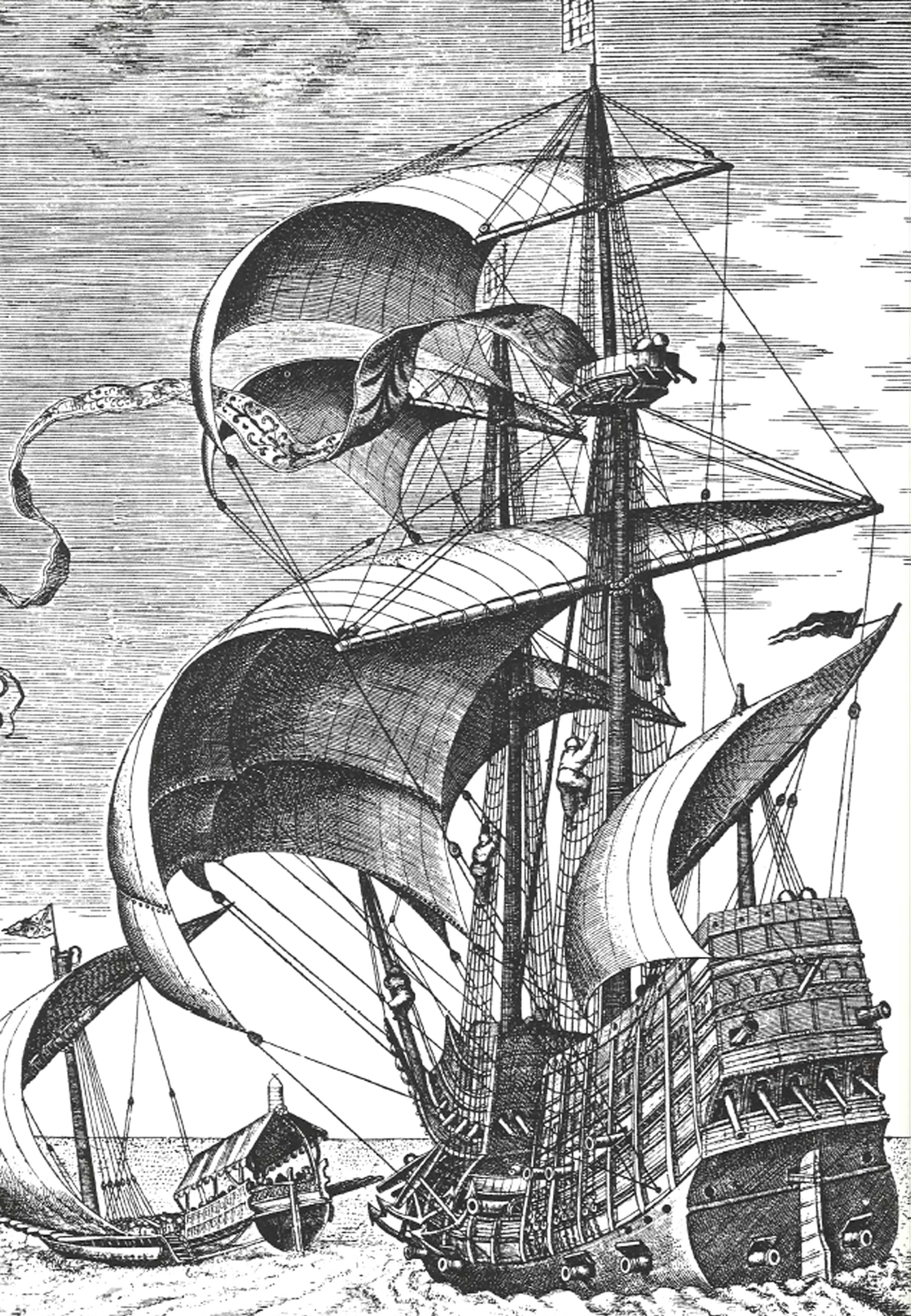
Up to now research on the *Vasa* has to a great extent concerned itself with the ship's artistic embellishment and with the quality of life on board and its physical manifestations. It is therefore most important that a qualified researcher has devoted himself to the ship herself, so as to increase our knowledge of her construction and to seek solutions to the puzzles it poses.

During the 1950s, when I was working for a complete raising of the *Vasa*, I proposed that the king recover his sunken vessel and repair her, determine why she sank, and show the world at large what an early seventeenth-century ship looked like.

In the present work, Björn Landström has answered many of the questions that were thus posed, but he is—as he says himself—conscious that much is yet unanswered. But as another encyclopaedist, Denis Diderot, has said: "What is important is not to find the truth, but constantly to seek it."

In conclusion I should like to recall the claim, familiar to ship-lovers all over the world, that the full-rigged ship is the most beautiful object ever created by man. It is hard for me to think of anyone who could excel Björn Landström, whose art is informed by a profound knowledge of ships, in illustrating this thesis.

Anders Franzén



The inheritance from the sixteenth century

During the greater part of the sixteenth century, marine warfare comprised actions at close quarters with relatively small-calibre cannons, boarding and hand-to-hand combat. Only galleys, with their few but heavy cannon, could sink enemy vessels, but a galley was at a disadvantage if an action led to boarding. In very light winds or flat calms, when other vessels lacked steerage-way, galleys had an edge on their opponents. Their area of operations was principally the Mediterranean, and then only during the summers, when winds were light; the French had both Mediterranean and Atlantic coasts, and it is possible that they introduced galleys in actions in the English Channel. We know that galleys were built in England in the mid-sixteenth century, but they never acquired any great importance in the windswept waters of north-west Europe.

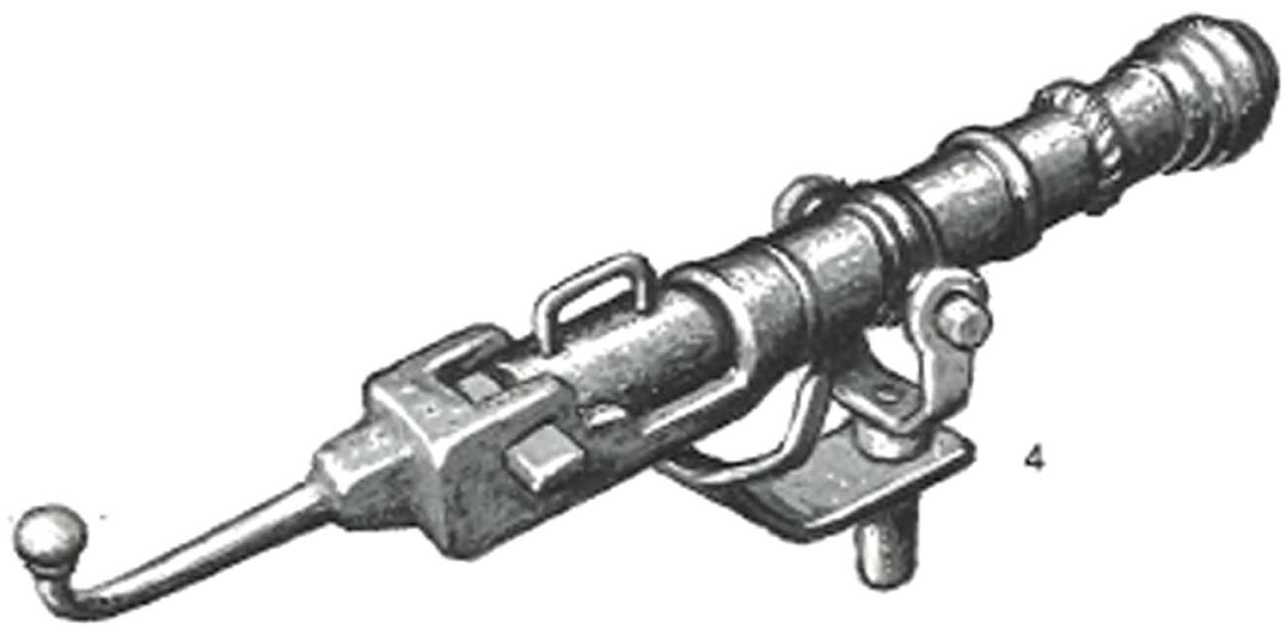
During the first half of the sixteenth century, carracks were the largest warships that still relied only on the wind as a motive force. Originally they were straightforward roundships that had gradually developed from the cargo vessels of antiquity; they differed from the small roundships of the Mediterranean and northern Europe primarily in size and armament. Before the middle of the century, however, in France and England, carracks that had been built round sterned were being built square tucked.

Because actions at sea were still encounters at close quarters followed by boarding, it was natural that carracks should grow into massive floating fortifications with forecastles and aftercastles of several decks, from which cannon could fire down upon lower enemy vessels. On the forecastle of such a carrack, depicted together with a galley by Pieter Bruegel about 1560 (3), there can be seen cannon with a field of fire onto the deck between the castles; from other contemporary illustrations we know that the aftercastle would carry similar armaments: light pieces called swivel-guns (4), suspended in forked swivelling supports at their points of balance. They were probably intended primarily for use against enemy forces after they had boarded; Bruegel's carrack also carries some twenty heavier pieces, which shows that the importance of heavy long-range cannon had begun to be understood by the middle of the century.

Carracks were good fighting platforms for the available artillery, but they were poor sailing vessels and difficult to handle. It is said that the galleon came into being as a protest against the carrack, but it might be more correct to say that galleons were built to overcome these unwieldy floating fortresses.

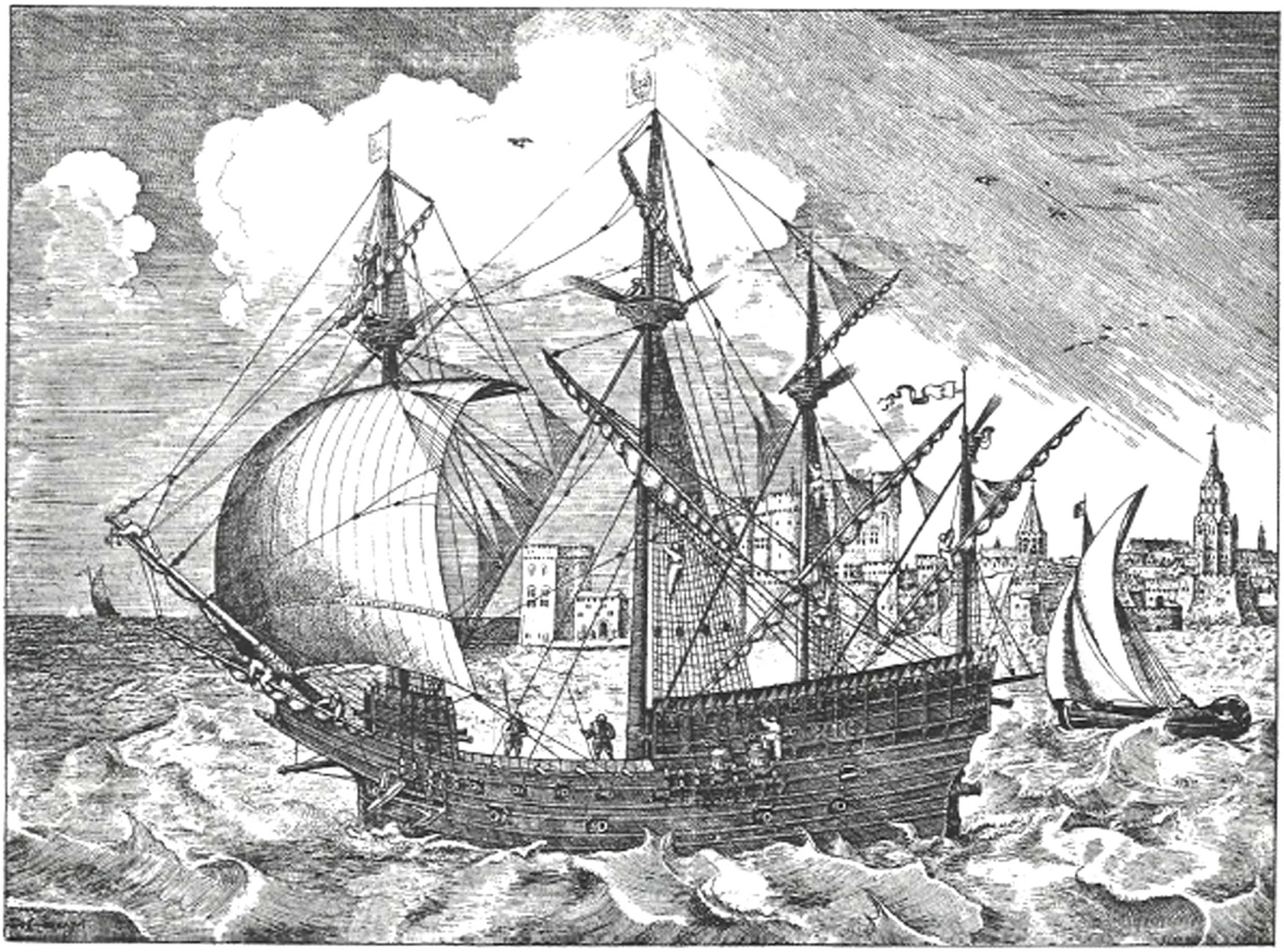
We must begin by saying that we know little about the origins of the galleon. It is possible that it developed at the beginning of the sixteenth century in Spain and spread thence rapidly to other sea powers, but I cannot get away from the feeling that the term 'galleon' (*galion* in sixteenth-century Italian) must have some connection with the term 'galley' (*galia* in sixteenth-century Italian).

This new type of vessel was, to judge from illustrations and contemporary models, comparatively low and definitely narrow. A Venetian manuscript from 1550 (see *MM* 20, pages 38ff) mentions among other things *un galion che voga a remi*, 'a galleon rowed with oars'; it can be a question of a galleas, or vessel propelled by both oars and sail. We must be constantly on the alert with terms for types of ships and their details: terms can vary a great deal during different periods, in different countries, and even within countries.



4

This Venetian manuscript also gives the dimensions for a sailing galleon: overall length 135½ feet, length of keel 100 feet, width 33 feet; proportions of roughly 4:3:1. The often-cited Spanish rule, that a sound ship should have proportions of 3:2:1, means that the greatest width within the planking should be twice the depth measured from the height of greatest width to the underside of the keel, and that the length at the height of the greatest width should be thrice this width. Spanish tonnage (see *MM* 44, pages 151ff) was determined by multiplying this length by the width and half the depth. This rule applied to the beamy carracks; Spanish galleons were in length about or a little more than 3½ times their beam.



5

A narrow beam and a low profile were not the only distinguishing marks of galleons. In Bruegel's illustration (3), the forecastle towers above the deck, and the same artist's representation of a galleon (illustration 5) shows a low forecastle built on the deck aft of the stem. From the hull, as a continuation of the deck and the bulwarks, a pointed construction, the beakhead, extends beyond the bow.

We do not know exactly when this early beakhead was constructed, but I assume that its base was a grating that allowed water to run in and out freely, for such a shallow construction would otherwise have been soon broken up by the force of the waves.

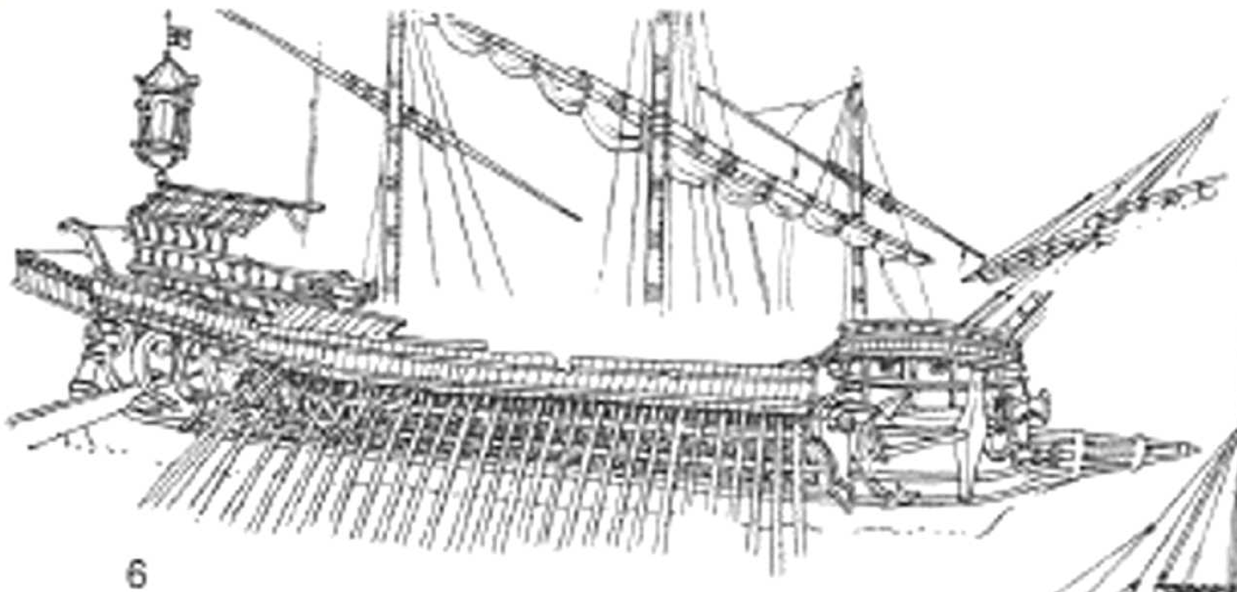
That the galleon's beakhead was a relic of the galley's and perhaps particularly the galleas' ram cannot be excluded. The forepart of a galleas in a large illustration of the battle of Lepanto in 1571 (illustration 6) has much in common with Pieter Bruegel's 'sea-monster', drawn about 1565, and often copied on maps and charts and pictures of harbours in the sixteenth and seventeenth centuries. Should we take these ships fitted with rams (illustration 8), that many maritime writers call galleons, only as a transitional stage in the development of the galleon?

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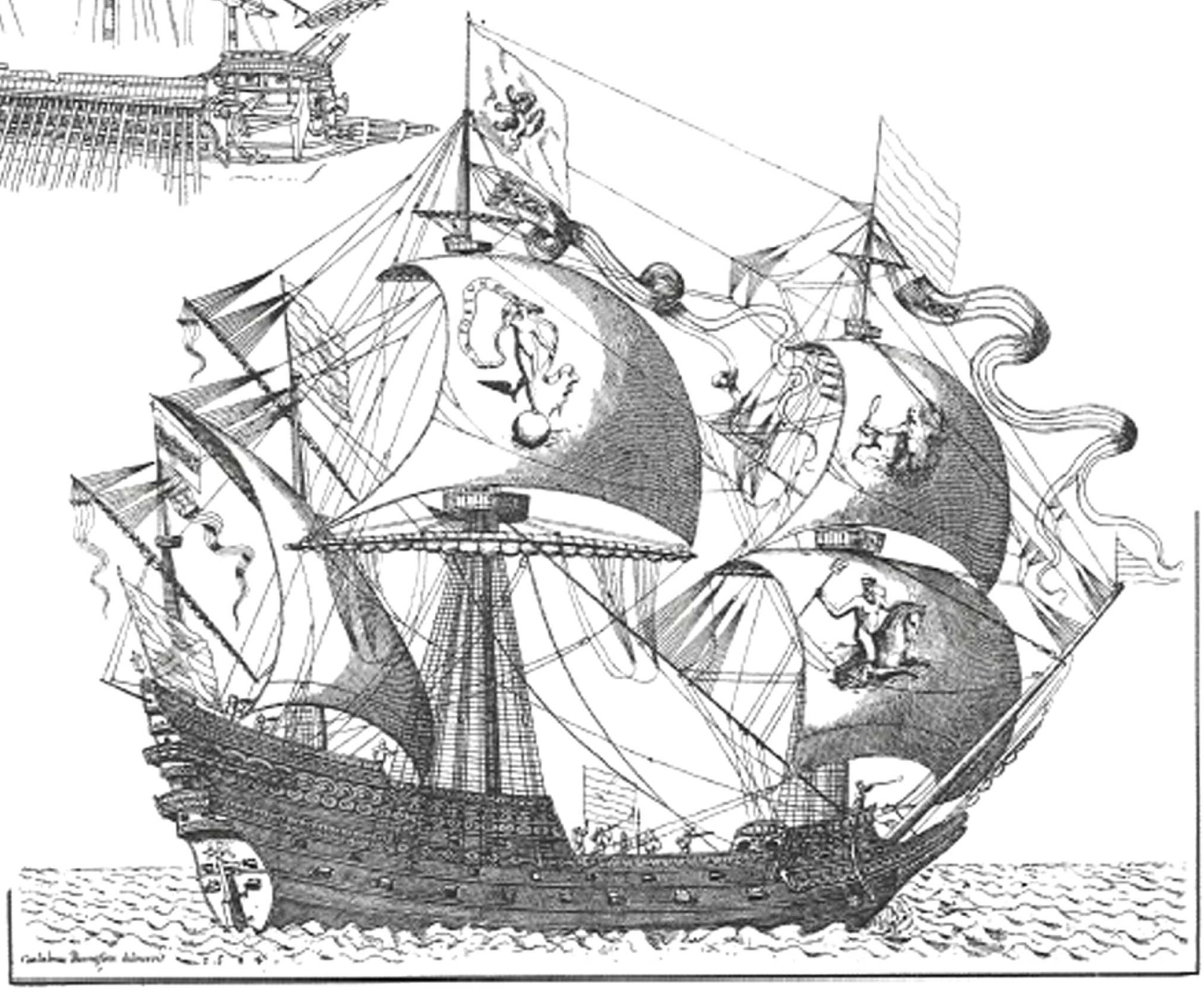
For as long as they have existed, warships have been able to ram each other; they did so even during the Second World War. The ram or beakhead quickly developed into a rather fragile platform for the seamen who had to set, trim and hand the spritsail. This sail was set below the bowsprit to cause the ship's head more easily to fall off from the wind when weighing anchor; in sixteenth-century illustrations it is often seen stowed on its yard on the forecastle of carracks or on the beakheads of galleons.

Illustrations and models from the end of the sixteenth century show that the beakhead gradually acquired a different form. To make it lighter and at the same time less vulnerable to the action of the sea, its bulwarks were often made open, while it was supported from below and laterally with heavy knees; such a beakhead can be suspected in Willem

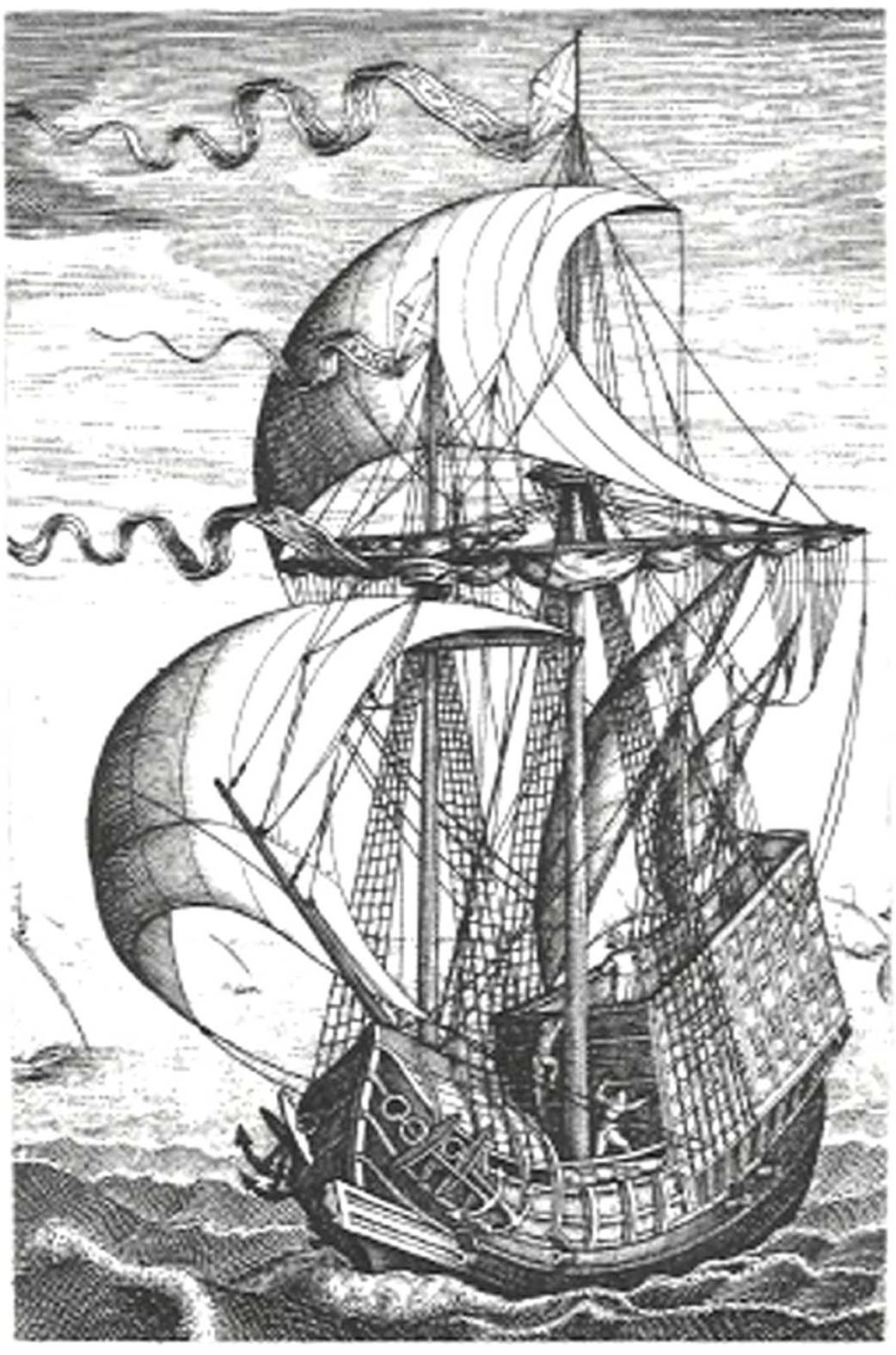
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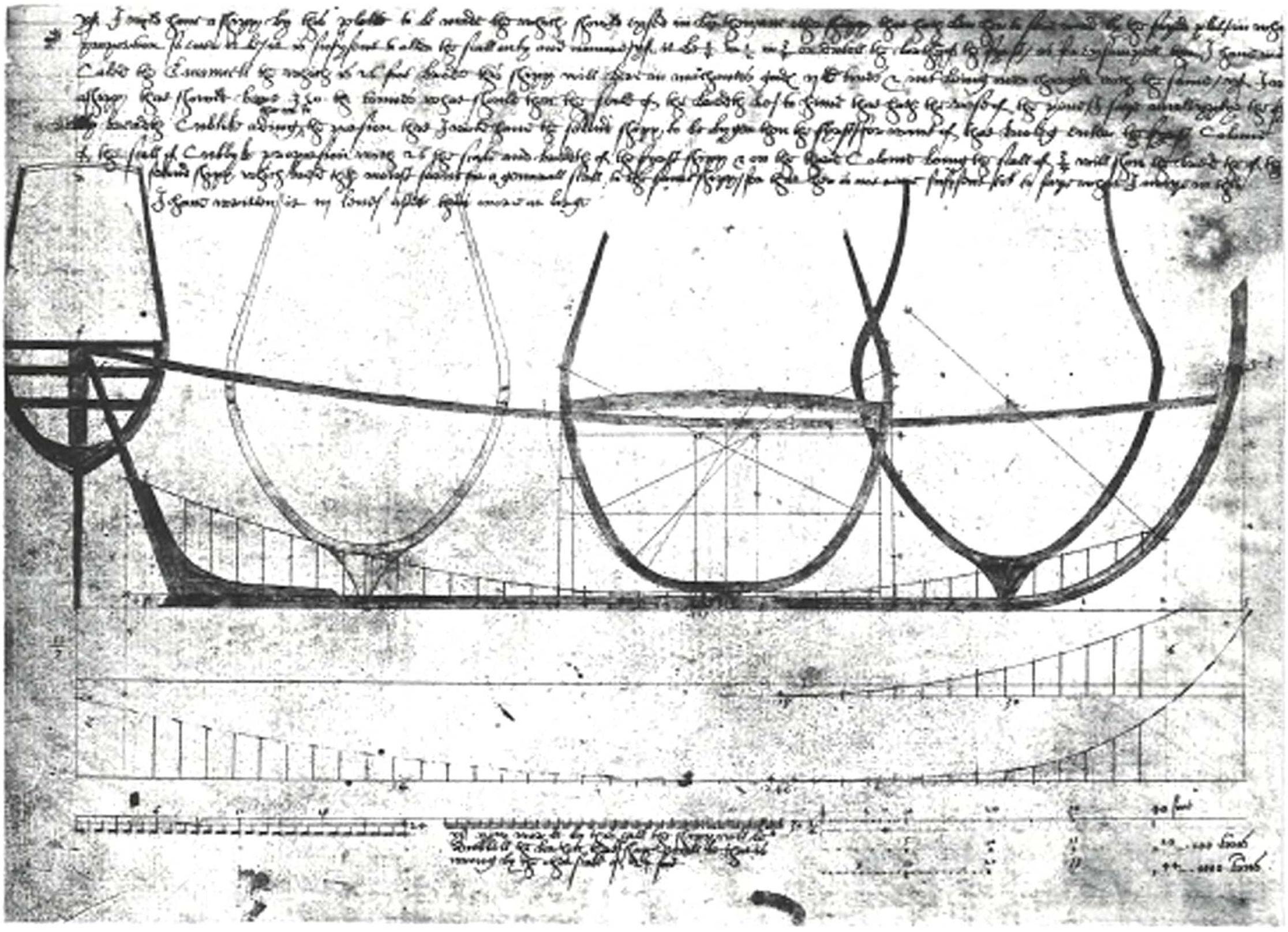
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Barentsoen's engraving from 1594 (illustration 7), which probably depicts a Dutch galleon, the finest type of vessel of her time.

Her aftercastle, still nearly as lofty as those of carracks, has double galleries along its sides and across its stern. Her heavy armament is carried on two gun-decks; the gun-ports of the lower deck are larger, and the muzzles protruding from them are of greater calibre, than those of the upper deck. It looks as if a cat-walk or the like runs between the quarter-deck and the forecastle.

Like all other great ships of the time, this Dutch galleon has four masts: foremast, mainmast, mizzenmast and bonaventure-mast (or bonaventure-mizzenmast). On the point of the bowsprit is a flagstaff that at this time began to be used for a new sail, the spritsail-topsail. In the same way, flagstaffs on the masts came to carry first topsails, later top-gallant sails.



9

Constructional drawings

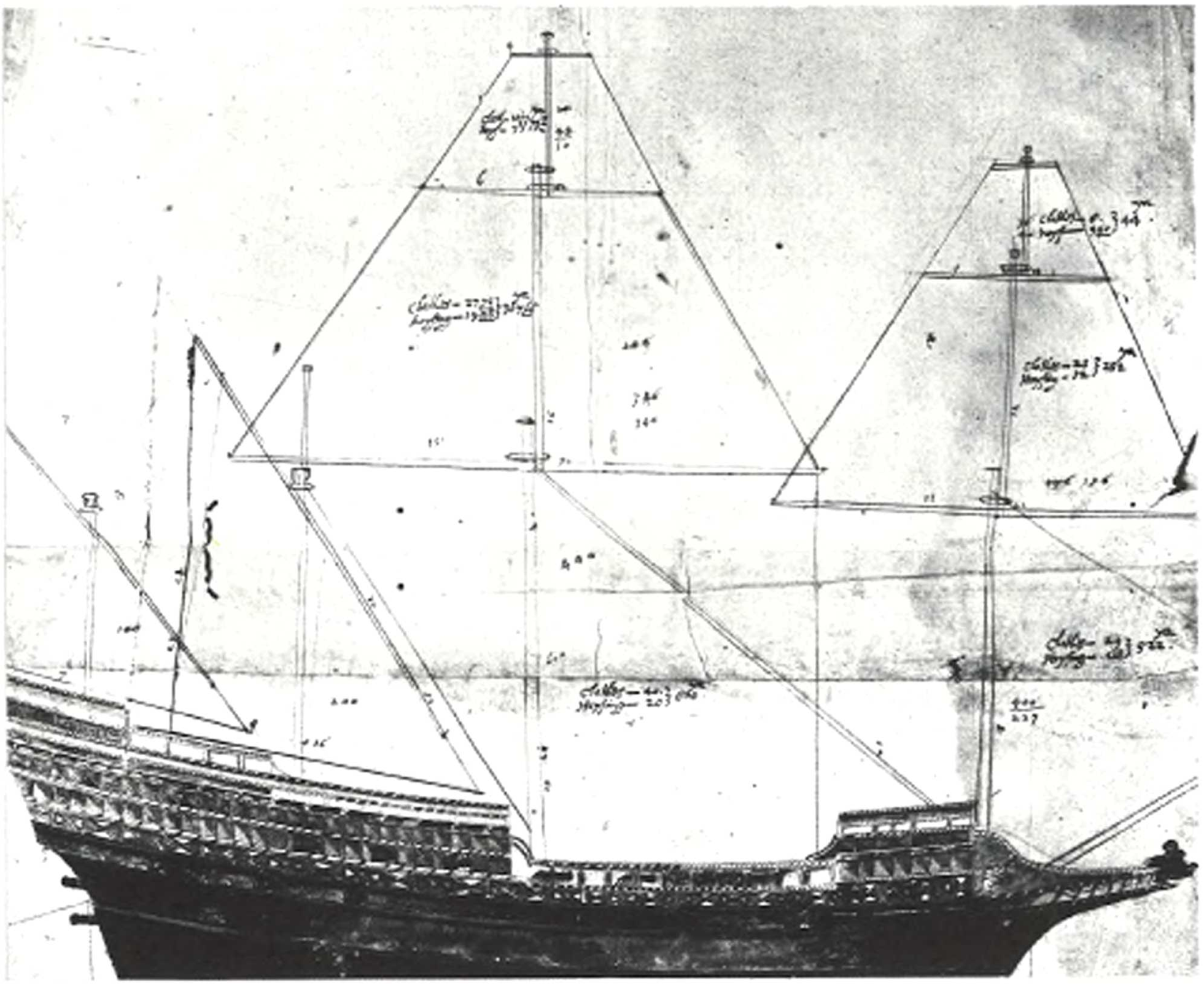
About 1586 the English master shipwright Mathew Baker made a number of notes and drawings that have fortunately survived; this material was kindly made available by the Science Museum, London, where it was on loan from the Bodleian Library, Oxford. It provides much information about different Elizabethan ships. Three of his drawings are reproduced here: the stem and sternpost and three sections for a galleon having a keel of about 100 feet (illustration 9); a profile with embellishments and drawings of sails, perhaps for the same galleon (illustration 10); and the constructional drawing of a main frame (illustration 11).

The first drawing provides us with a general impression of the form and dimensions of the hull; so far as may be known, more detailed drawings of the lines of ships were not made before the middle of the seventeenth century. Some such drawing as this one provided the master shipwright with the information he needed, but often he would have to make do without a drawing, and would work from specifications—a list giving the ship's dimensions and more important details.

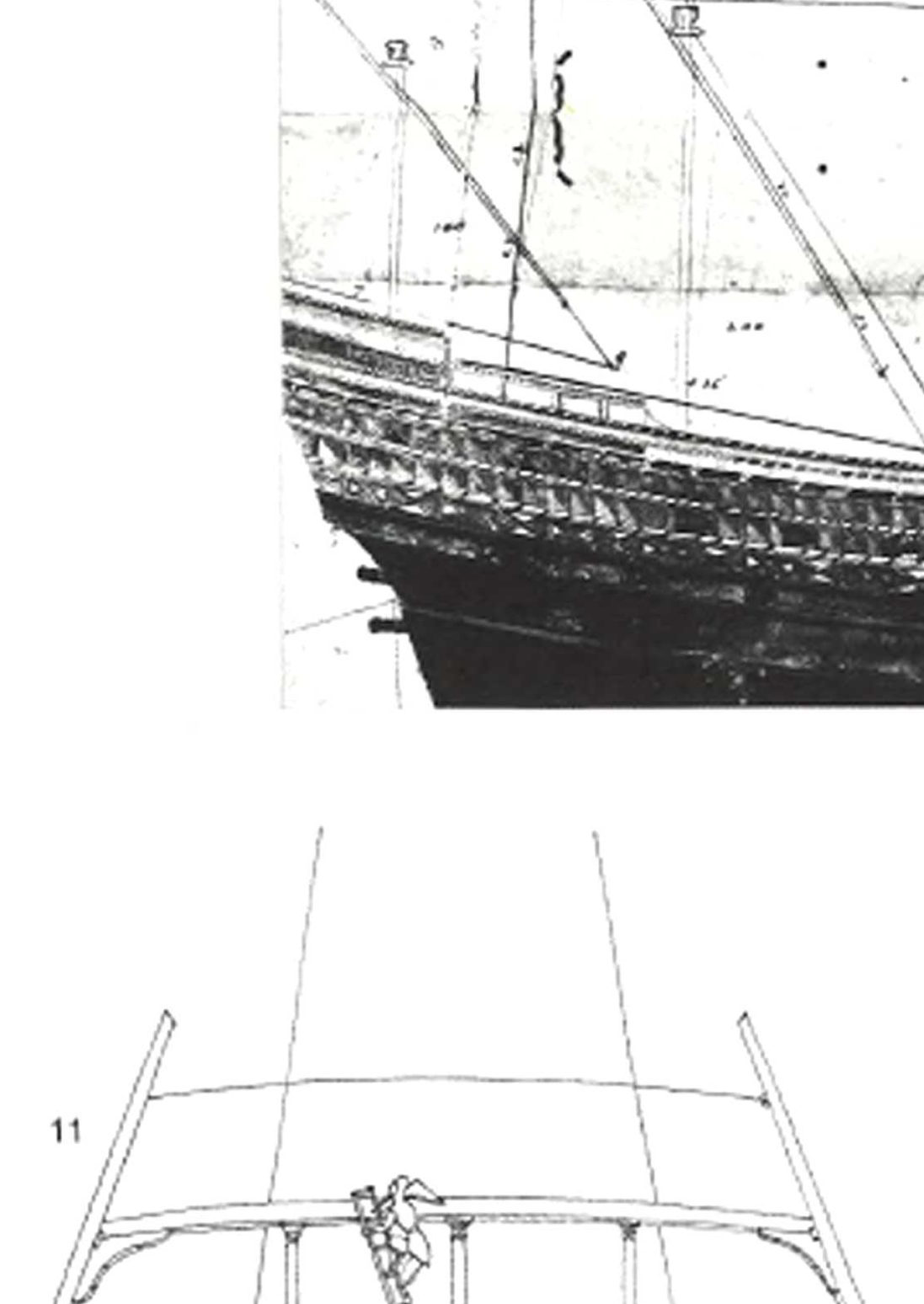
The specifications of successful ships were kept secret by shipwrights, but this secrecy was hardly intended to further progress of the art of shipbuilding. Ships that sailed well were copied, there was some grasp of what the hull's form and dimensions meant for seaworthiness and speed, but there was as yet scarcely any sort of theory to back up the information in specifications.

A shipwright's prime secret was 'the rule for each sweep of the main frame'. This frame was rather inconsequently called the midships frame, for at the time it was invariably placed forward of midships. There were many complicated methods for drawing and laying off the contours of the main frame which comprised a number of sweeps (or arcs of circles) and straight lines. Necessity had obliged shipwrights to employ these simply-drawn lines. The most important frames would be laid off in full scale on to the timbers, with the help of no more than a ruler and a bit of chalk on a piece of string, which had to do duty as a compass.

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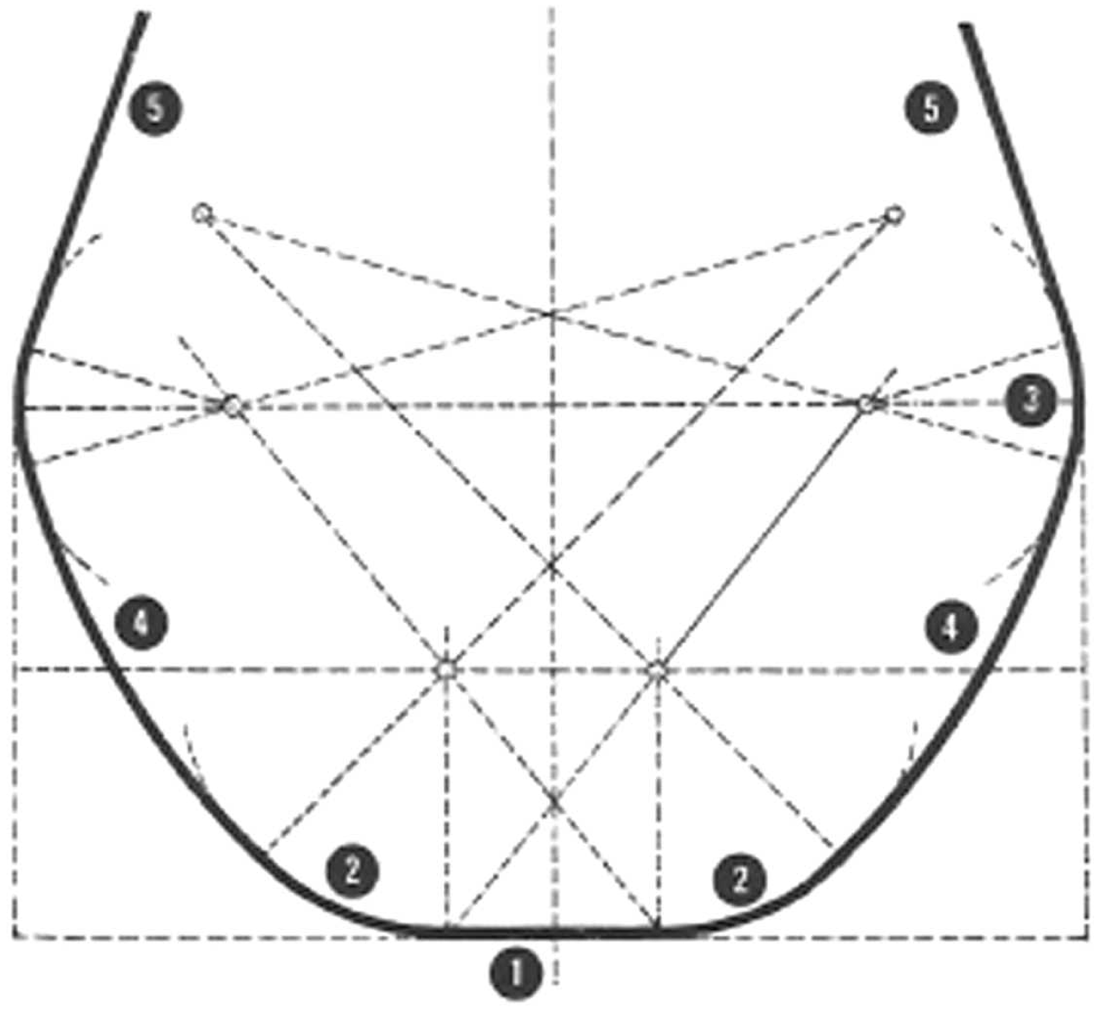


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According to the Swedish author Gunnar Schoerner (pages 38ff), Mathew Baker describes what he calls "Lyntton's method" for constructing the main frame with straight lines and only three sweeps as follows: "fyrzt ther moste be maed with the bredt and depth of the shipp a paralillogram, whose half shall souffyes [suffice] for this works." This seems to mean that the depth—the vertical distance between the upper side of the rabbet on the keel and the level of the ship's greatest beam—is equal to half the beam. The importance then (and now) of this midship frame is shown by some lines (pages 3ff) in Åke Classon Rålamb's *Skeps Byggerij eller Adelig Öfnings Tionde Tom* ('Shipbuilding or the Tenth Volume of the Noble Art'), published in Sweden in 1691: "the Main Frame, which is the Support or largest Belly of the Vessel . . . is a Foundation for all the other Frames, that later make the entire Corpus."

The present work will show step-by-step how the "entire Corpus" of the *Vasa* was made, not according to Lyntton's method, or that of any other known person, but according to Dutch methods at the end of the 1620s, as they came to be influenced by royal whims.

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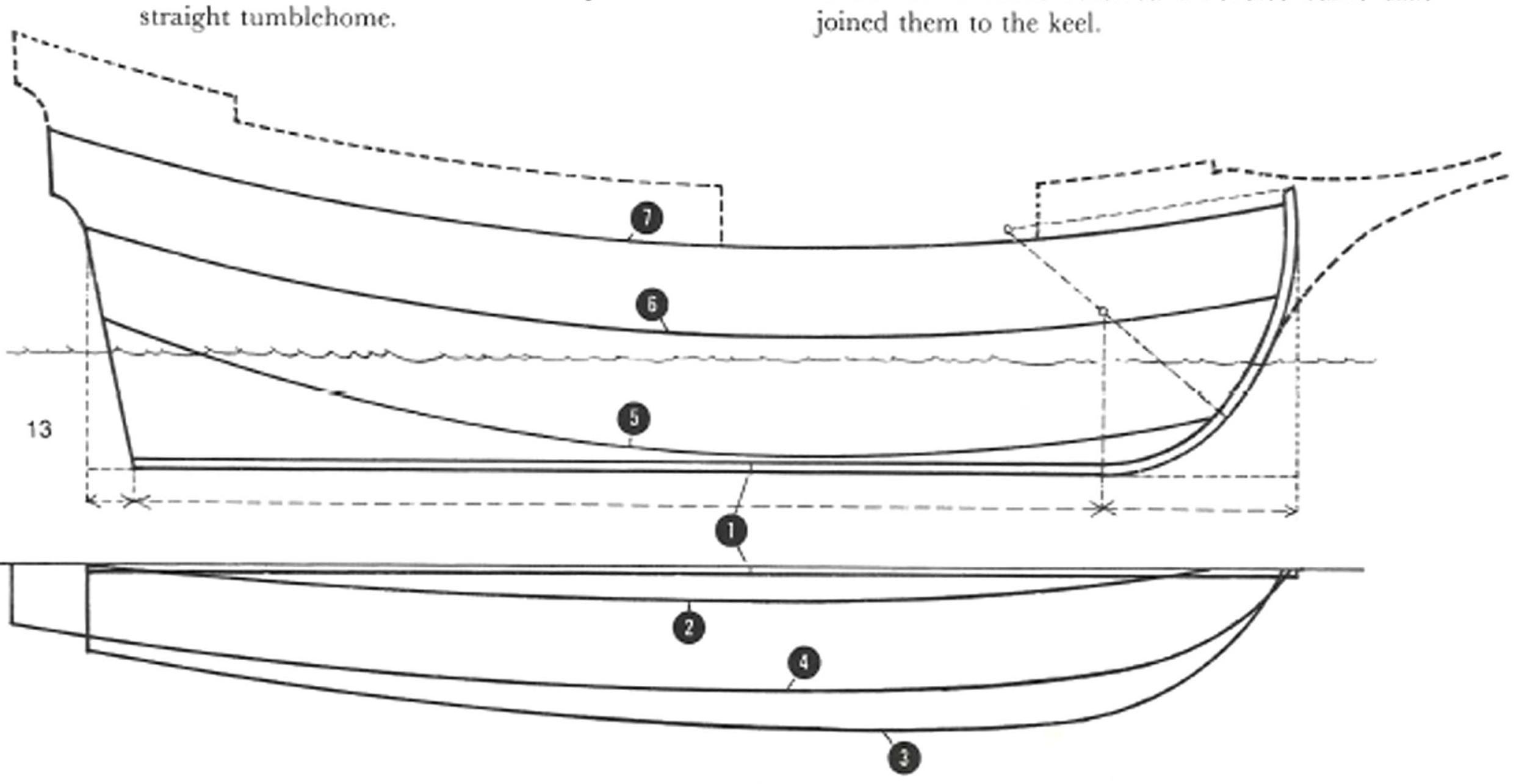
First, however, a reconstruction of, and an attempt to make clear, a set of English line drawings according to Mathew Baker which are illustrated in Schoerner's book (pages 35ff).

A main frame was arrived at by starting with a horizontal line, the floor or flat, as shown in illustration 12:1; it was approximately one fifth of the beam. The runghead sweep was then drawn (12:2), its centre lying on a line rising at right angles from the outer end of the flat, its radius being about one quarter of the beam. The sweeps at the level of greatest breadth (12:3) had their centres on the line at this level, their radii being about equal to the length of the flat; these sweeps were joined to the runghead sweeps by connecting sweeps (12:4) formed so as to give curves that would be as even as possible. The radii of the connecting sweeps were always greater than half the beam but less than the whole beam. The frame terminated upwards with a straight tumblehome.

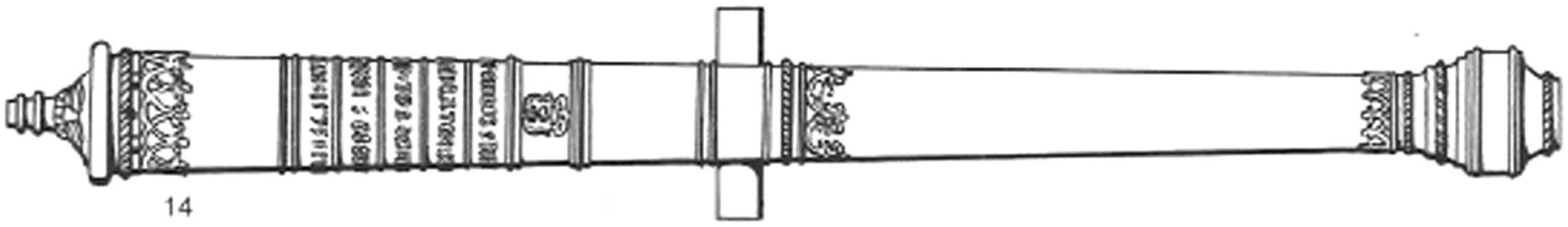
Observe that the depth of the ship was not the same as its draught. The greatest beam was always above the waterline, but during the seventeenth century, when ships were armed with many heavy pieces, the waterline on occasion came altogether too close to the maximum beam at the main frame. The hull lacked an adequate flare above the waterline, and the ship lacked much of the stiffness it needed. This could be partly compensated for by adding ballast, but then the ship would float even deeper in the water, and there are many reliable illustrations from the seventeenth century depicting dangerously deeply laden warships.

The shipwrights' "second secret" was the location of the main frame on the keel: Mathew Baker recommends a point on the keel distant from the stem by 36.2% of the length of the keel. This would give a full forepart and a narrow afterpart, and in one of his drawings Baker compares the underwater part of a ship to a fish.

The "third secret" was the formation of the narrowing and elevation lines. From them the shipwright obtained the values he needed to lay off the other frames. I have made a drawing (illustration 13) showing these lines more clearly than in Baker's illustration (illustration 9); 13:1 is the location of the main frame, 13:2 the outline of the hull, 13:3 the greatest breadth and 13:4 the breadth of the upper deck. These lines are comprised of several arcs of circles of different radii. The elevation lines show the rise of the hull towards the perpendiculars; at the end of the sixteenth century both the sheer of the deck and the frames' greatest beam followed these lines. On Dutch ships they did so until the end of the 1620s. 13:5 is the rise of the flat, 13:6 the rise of the greatest breadth, 13:7 the sheer of the upper deck. Below the flat, the frames fore and aft of the main frame received a reverse curve that joined them to the keel.



13



14

A six-pound bronze cannon recovered from the wreck of the warship Riksnyckeln, *which sank at Viksten, in the skerries south of Stockholm, on 6 September 1628; it is now in the National Maritime Museum, Stockholm. The inscription reads: BOSE GRIETE BIN ICK ONVORDRATEN XII SOUSTEREN TO DANSSIK WORDEN GEGATEN ANNO 1535 PVW, or 'I am the inexhaustible Wicked Greta 12 sisters were cast in Danzig in the year 1535. PVW.'*

Tre Kroner 1601

No satisfactory explanation has yet been given of how galleons came to be what was called a frigate before, and a ship-of-the-line after, the middle of the seventeenth century. It has been said that this change was caused by a wish to carry a powerful and uniform armament, but carefully drawn representations of such ships sometimes seem to show, however, that their armaments were not always so very uniform. The Dutch flagship *Eendracht*, built in 1653, was armed in 1658 at the action in the Öresund with 3 thirty-six-pounders, 22 twenty-four-pounders, 14 eighteen-pounders, 12 twelve-pounders, and 22 six-pounders. (See *Maritieme*, page 341.)

The size and type of a cannon were shown partly by its designation and partly by its poundage which was the actual or supposed weight in pounds of its projectile. *Bose Griete* 'Wicked Greta' (illustration 14) could have been called a serpent when she was cast in 1535, but by the early seventeenth century she would probably have fallen to a falcon or a falconette. An English listing of armaments from 1599 names the different types: everything from sixty-pounders to half-pounders.

Experience has shown that it was a great advantage in the heat of action to be able to reload cannon well inboard, with the gun-ports closed. If a vessel was narrow, and her guns so long that they could not quickly be run in, she would have to break off the action after firing her first broadside, or at once board her adversary. A third and very hazardous course was to station members of the gun crews outboard above the muzzles, whence they were to sponge out and reload—a long-drawn-out procedure. There are surviving reports (see *MM* 14, pages 339ff) of actions in which a single ship armed with cannon that could be run in overcame several adversaries by causing her musketeers to pick off the defenceless loaders.

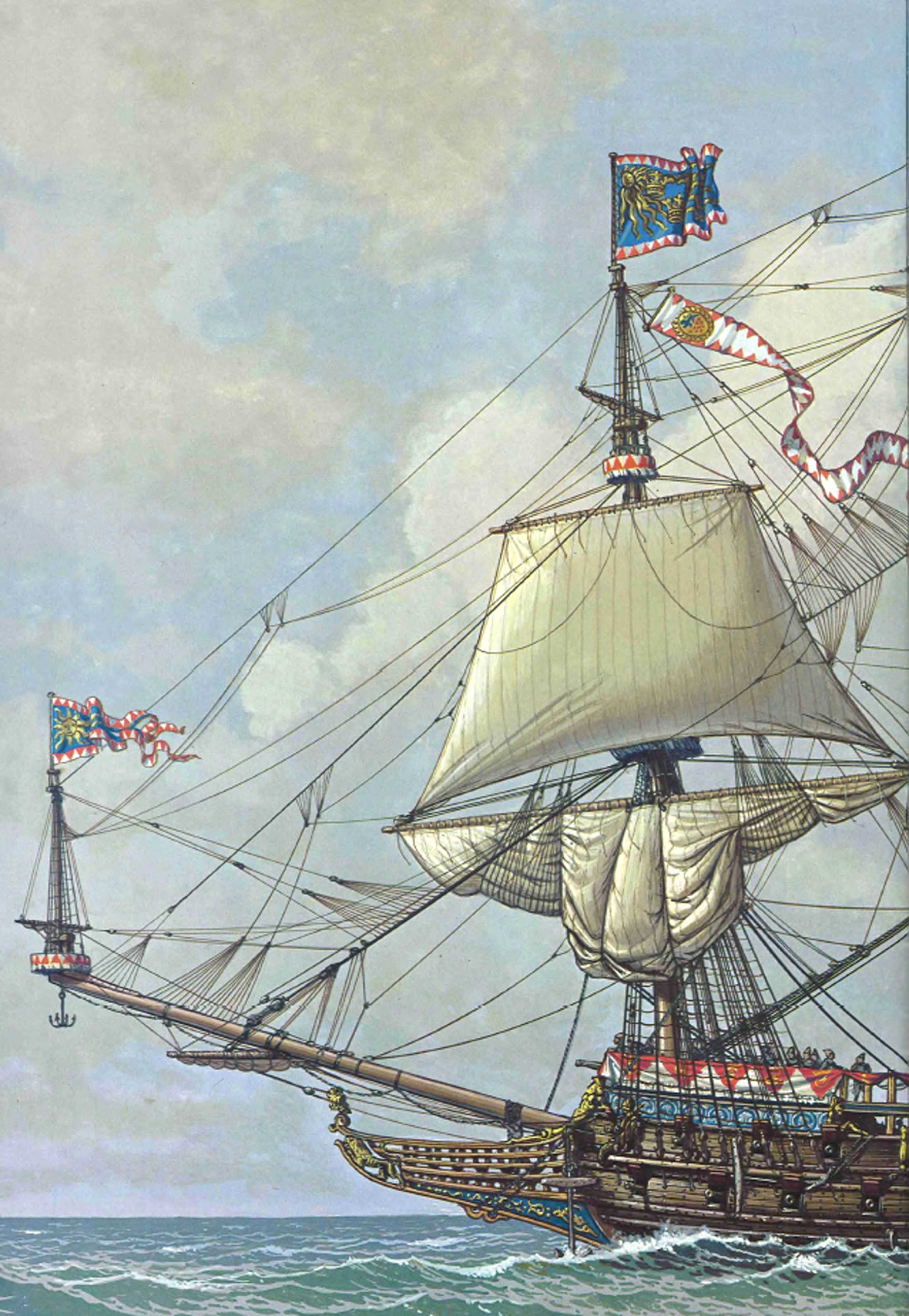
Reloading in relatively protected conditions required a good deal besides adequate space behind the guns: breechings strong enough to resist the recoil, sponges, rammers and gun ladles with shafts of stiff rope that could easily be passed through the muzzles, tackle for running the guns in and out, deck beams strong enough to bear the guns and their carriages, and, finally, well-trained gun crews.

Long guns were considered necessary for accuracy, and so ships were built more beamy. Many such cannon proved advantageous, so ships were soon being built longer. Boarding and actions at close quarters were no longer the rule, even if boarding continued to occur for several hundred years. But ships had been seen to go to the bottom solely as a result of gunfire.

So perhaps it may be said that the new large ships were actually enlarged galleons, at least at the start of the seventeenth century. The Danish ship *Tre Kroner* was built in Flensburg by the Scot David Balfour in 1601; her displacement was given as 1,500 tons, her armament seventy-two "copper pieces"—bronze cannon—and she was said to have been embellished with unbelievable quantities of gold, silver, precious stones and other costly items. In 1606 King Kristian IV sailed to England in her, and it is now thought that the engraving repro-


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duced on pages 16 and 17 was made to commemorate this voyage. A lengthy discussion on this ship was published in the *Mariner's Mirror* (numbers 4, 11 and 27).

It has been said that the engraving shows a ship from the realms of fantasy, and certainly many details are fantastically exaggerated, but the rigging is in almost every particular shown factually. I have marked the illustration with figures at its most remarkable points and comment on each of them in turn below.

1. Here we see for the first time the new arrangements for the spritsail-topsail. A long knee on the bowsprit supports the spritsail-topmast and a top. The furled sail lies squarely over the top, and as far as I can recall all seventeenth-century illustrations showing this sail show it clewed up and furled. An exception is provided by two woodcuts in a book from 1629, which appear to have been made from a quite simple model.

2. Martnets had come into existence by the fifteenth century. When the yard was eased off, they hoisted the leech-ropes up to the yard, so that the sail could be furled and clewed easily. In the seventeenth century the lower yards were no longer eased off when sails were furled, the martnets being instead hoisted; their running parts were made fast therefore near the top of the topmast and not, as the engraving shows incorrectly, in under the tops.

3. The lifts and the topsail sheets were led through fiddle blocks, and I think it is probable that the equivalent of this block was used in Holland. Illustration 17 shows the detail of this block.

4. Both the foresail and main yards are secured to their masts with chains that would hold them in place even if the halliards were shot away; so far as I am aware, the present illustration is the only one from the seventeenth century that shows this detail.

5. The mast-caps are of a Dutch type with a relatively fine forward edge, a type that first became general in Holland some decades later.

6. Two bowlines for a royal that could be set on the flagpoles over the topgallant. The oldest evidence for a ship with topgallants is provided by a fresco from 1525 in the church at Udbyneder in Denmark.

7. Martnets for the furled mainsail should show four sets of gaskets hanging down at either end of the yard (cf., the reconstruction illustrated on pages 18–19).

8. A barrier formed of a number of posts joined by a chain surrounds the forecastle, cat-walk and quarter-deck. This barrier is used to support an ornamental hanging; it is partly rolled up or furled, but the king's monogram is easy to make out. Something very similar, with apertures as need be for cannon, appears on each of the tops.

9. A round balcony or the like for the leadsman. Fifteenth-century illustrations show barrels attached to the sides of ships for this purpose.

10. An open gallery with the-then usual curved ironwork above it, which could probably be covered with a sailcloth awning.

11. The maintop and foretop are armed with light pieces, probably swivel-guns.

12. The sloop is armed with two light ordinary pieces and four breech-loading swivel-guns.

13. The royal standard is nailed to the mast, to symbolize the refusal of the ship ever to strike her colours to an enemy.

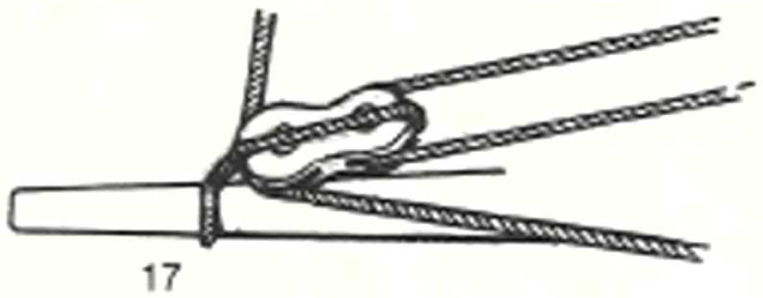
14. A boarding grapnel attached under the bowsprit could be let go onto an enemy vessel before boarding.

15. The gammoning, or ropework securing the bowsprit to the beakhead, seems to have been replaced or perhaps strengthened by a chain.

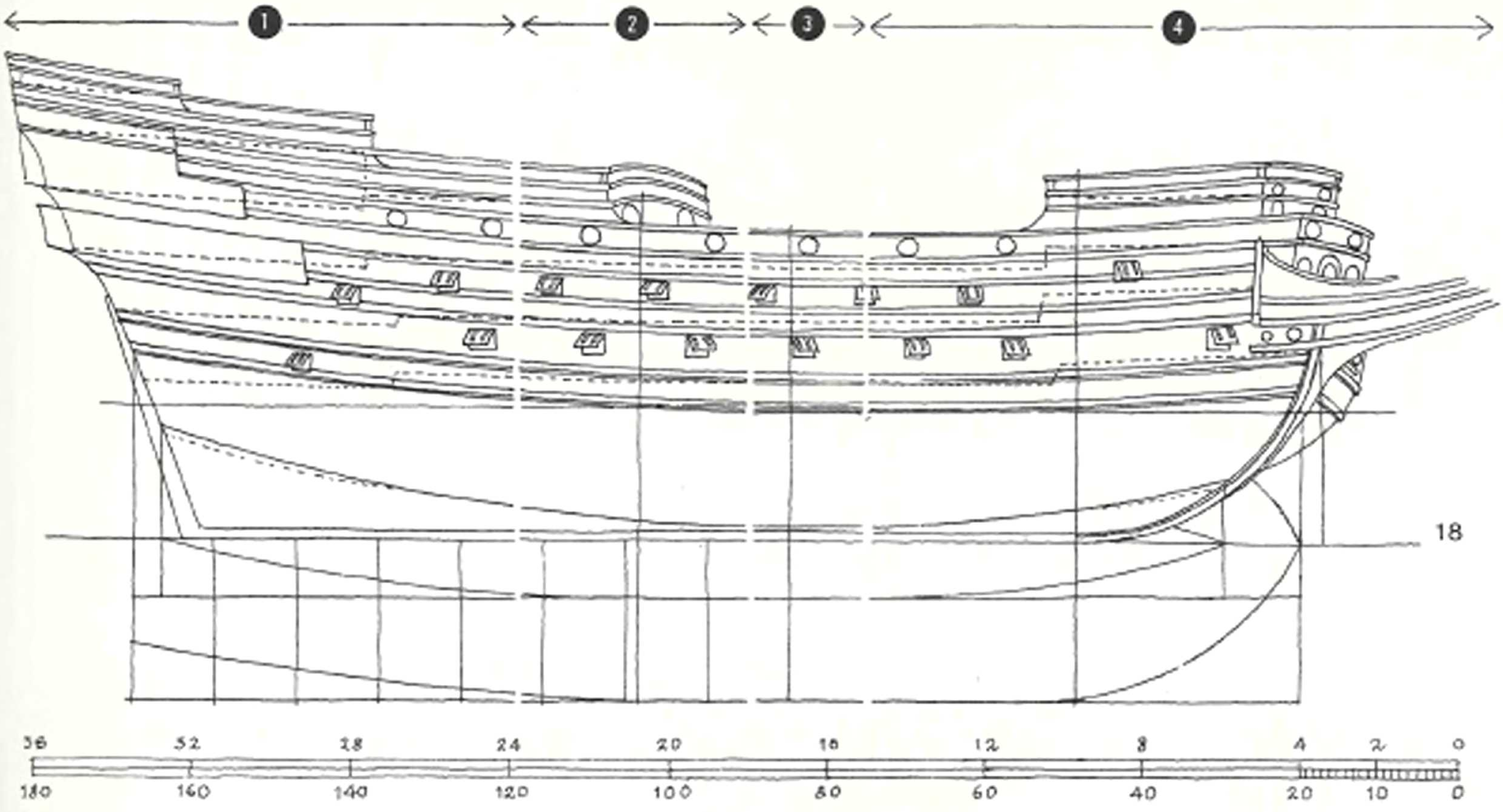
It is recorded that *Tre Kroner* carried seventy-two bronze pieces, and if we count the muzzles in the engraving and double their total to account for those to starboard we get a total of fifty six including the swivel-guns in the tops. Maybe there were still more swivel-guns that could be mounted as needed, but maybe the artist had embellished his version of the ship with sculptures of such gigantic size that he had to leave out some of the guns.

Like Barentsoen's galleon, *Tre Kroner* has two complete gun-decks, with her heavier pieces on the lower deck. The engraving does not permit one to determine if the ship was beamy enough to allow the guns to be run in for reloading, but I can only believe that she was. Her considerable displacement of 1,500 tons supports such a belief, but what sort of tons were they?

In the illustration on pages 18–19 I have tried to transform the engraving by Christian Møller of *Tre Kroner* into something less imaginative and more credible.



17



18

Prince Royal 1610

Perhaps the most remarkable of all English master shipwrights was Phineas Pett (1570–1647), a member of an old shipwright family. His foremost master was probably Mathew Baker. For some unknown reason he obtained the patronage of the Earl of Nottingham, who was then Lord High Admiral. After two years as storekeeper at the Navy Yard at Chatham, Phineas became an assistant to the master shipwrights there, and in 1605, thanks to Nottingham's influence, he succeeded his—Pett's —elder brother as master shipwright. The following year he received a commission from Prince Henry, James I's heir-apparent, to rebuild the *Victory*, a large and somewhat unsuccessful vessel that, having been built as early as 1560, was converted to a galleon in 1586.

Pett was a man with a rather grandiose outlook and instead of setting to work on the *Victory*, he began to busy himself with something else altogether. "After my settling at Woolwich [in April 1607]," he writes, "I began a curious model for the Prince my master, most part whereof I wrought with my own hands; which being most fairly garnished with carving and painting, ...order was given to have the model brought and placed in a private room in the long gallery where his Highness determined to see it in the afternoon." But not merely the Prince but his father, James I, attended only by Nottingham and "one or two attendants", came to inspect Pett's work. "His Majesty was exceedingly delighted with the sight of the model," says Pett (pages 31–32), "and spent some time in questioning me divers material things concerning the same and demanding whether I would build the great ship in all points like to the same, for I will (said his Majesty) compare them together when she shall be finished."

The large vessel for which Phineas Pett had taken the initiative was to become known as the *Prince Royal*, the first ship in history with three complete decks. So far as is known, it was the first time a scale model was built in accordance with drawings with the purpose of gaining the approval of those in authority.

Later it became customary, above all in England, where they were known as Navy Board models, to build such miniatures of new ships, especially those which differed from their predecessors in size, details of construction or armaments, or displayed other novel features.

The model of the *Prince Royal* has not survived, but it is probable that the oldest surviving drawings in the National Maritime Museum, Greenwich, are of this very ship (illustration 18).

Only sections 2 and 4 in the drawing are original but W. Salisbury (see *MM* 47, pages 170ff), who has reconstructed sections 1 and 3, has assumed that the drawings must be those of the *Prince Royal*, for no other three-decker was built before the *Sovereign of the Seas* in 1637. The drawing clearly shows an earlier vessel: *Prince Royal*'s appearance is



19

well known from many paintings, the most distinguished and clearest of them being the one by the Dutch artist Hendrick Corneliszoon Vroom from 1623 (illustration 19) which hangs in the Frans Hals Museum, Harlem.

The big four-masted ship is *Prince Royal* with the royal party on board. The ships in the foreground are (left to right) *Red Lion*, an Elizabethan ship rebuilt in 1609, Prince Mauritz of Holland's yacht, and *Repulse*, an English ship launched in 1596 and
22 rebuilt in 1609.

The *Prince Royal*, carrying the royal party, is depicted with eight round gun-ports on her upper gun-deck, and sixteen in all, whereas the reconstructed drawing shows only seven-a-side, while the bill from the English sculptor is for "fourteen large lion-heads for the round ports." This suggests Vroom made a mistake in his sums, or that the number of ports had been increased before the voyage to Vlissingen in 1613 (cf., the reconstructed painting on pages 26–27).

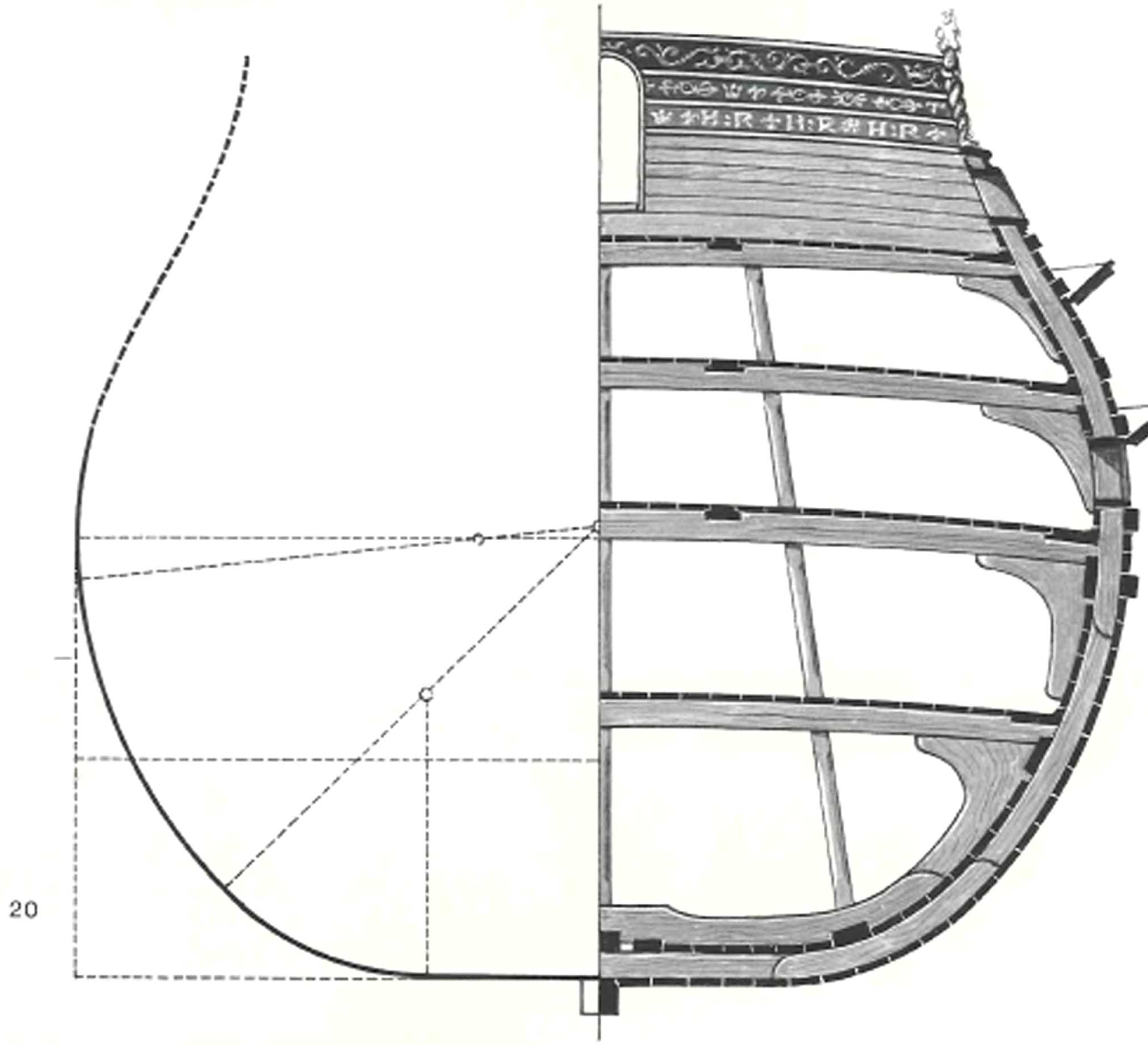
Another detail that was probably added immediately before the bridal couple's crossing to Holland is the large crowned helmet on the beakhead above



the actual figurehead, a detail that is absent from the sculptor's bill. It is possible (see *MM* 6, page 366, and *MM* 38, pages 225ff) that Phineas Pett caused the helmet to be made at the same time as he was getting the fleet ready for this voyage.

Both the *Prince Royal* and the *Red Lion* are carrying a new sail on their mizzenmast: instead of a lateen-topsail, they carry a mizzen-topsail set between a mizzen yard and a cross-jack yard. The four-masted *Prince Royal* is carrying a similar sail on her bonaventure-topmast. Both ships have a furled sail on their cross-jack yards, but whether or not it was ever set is not known; perhaps Vroom misinterpreted his sketch when he came to do the painting. It is in the Frans Hals Museum, Harlem, and its representation of the *Red Lion* and the *Repulse* is probably influenced by Dutch ships. Another painting by Vroom, which is in the Westfries Museum, Hoorn, depicts a Dutch ship that is almost identical to the *Repulse*.

Before and during the building of the *Prince Royal*, the atmosphere at the fleet's shipyard at Woolwich was infected with envy and intrigue, peculation of



the Crown's goods, and mutual accusations. Phineas Pett gives a description of what he calls the plot against him but his account is that of one involved. In a document entitled "Imperfections found upon view of the new work begun at Woolwich", Pett's opponents set out their views for the benefit of the king, who had personally set this enquiry on foot.

"First her mould is altogether unperfect," they begin without ado, "furred [with pieces of timber laid upon the outsides of the hull timbers to make the mould broader] in divers places; she hath too much floor; the lower sweep and the upper are too long, and the middle sweep too short.

"Her depth is too great and her side too upright, so that of necessity she must be tender sided and not able to bear sail.

"Her [greatest] breadth lieth too high, and so she will draw too much water, and thereby [be] dangerous and unfit for our shoal seas.

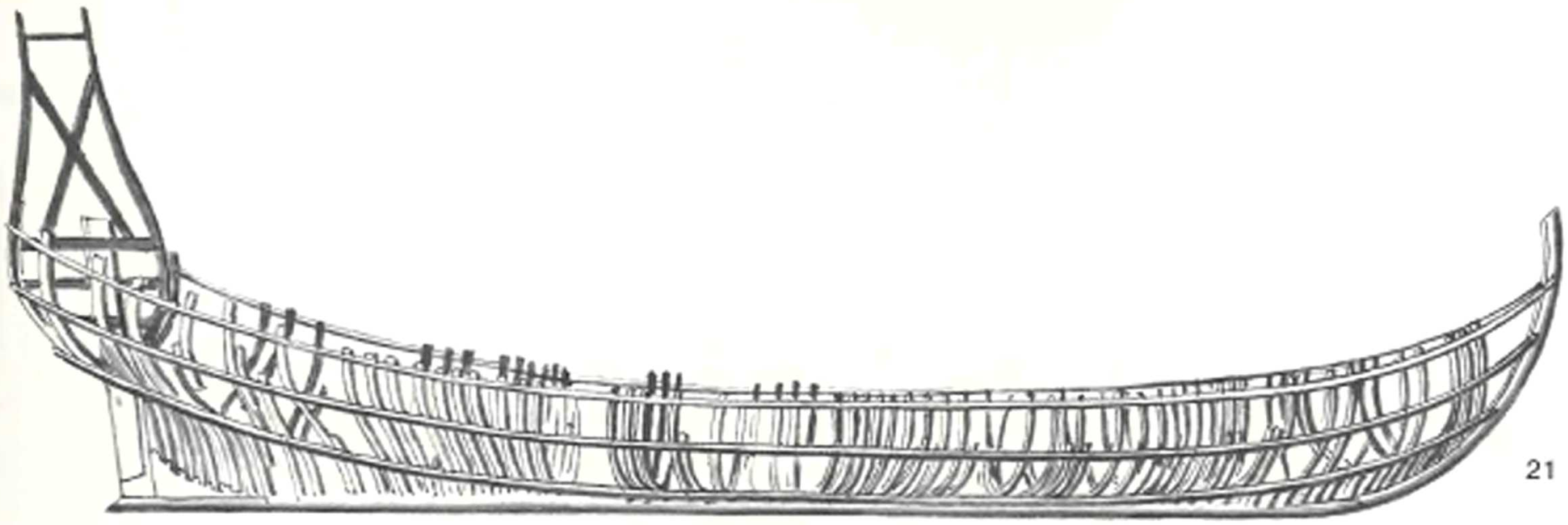
"Her harpings [the breadth at the bow, also, perhaps, the ends of the bends, which are fastened into the stem] are too round and lie too low, which maketh a cling at the after end of it, and makes the bow flare off [overhang] so much that the work is not only misshapen but the ship dangerous to beat in the sea either at an anchor or under sail.

"Her workmanship is very ill done, and thereby the ship made weak, as first the limber holes [holes cut through the timbers of the keel and floor to allow the bilge water to run to the pumps] are cut so deep in the middle floor timbers that they are less thickness upon the keel than towards the rung head; whereas they ought to be thicker and stronger in the midst, to bear the weight on ground.

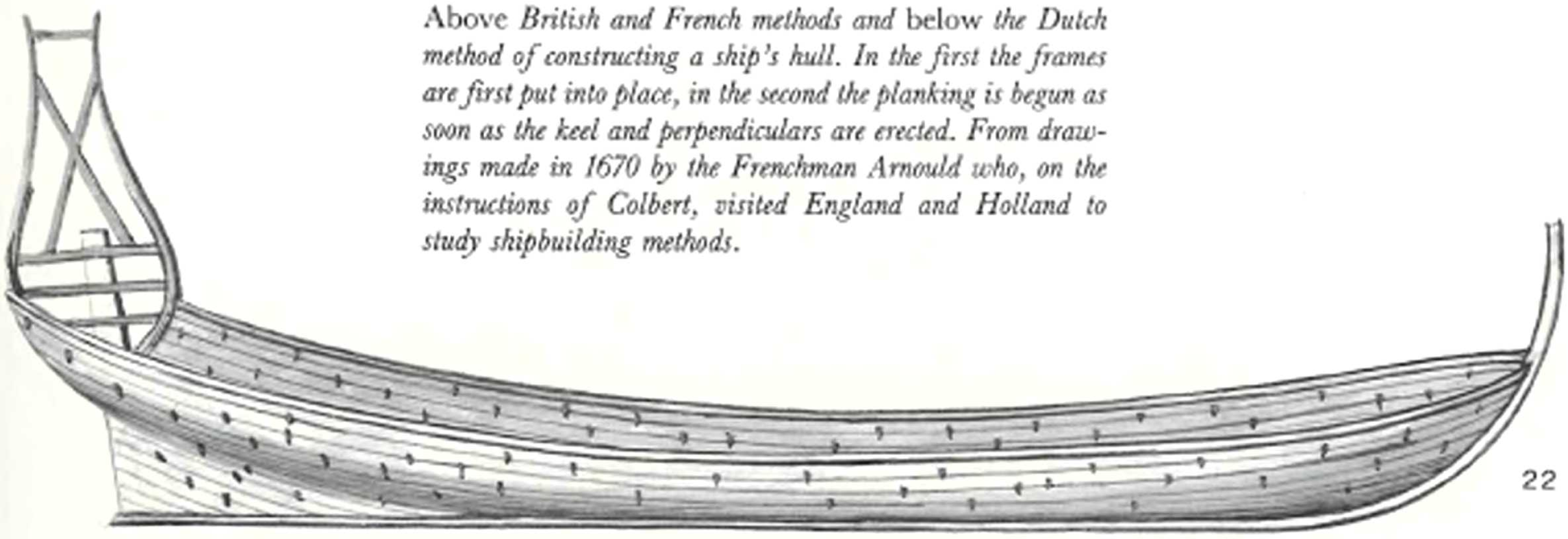
"The futtocks have not scarph enough with the floor timbers, but at the lower end of them are divers short clogs of timber put in which serve to no purpose for strength but to fill up the room. Every mean owner in the Thames will assuredly tie the carpenter to allow a great scarph and to have his timber come whole within a foot of his kelson.

"Some of the timbers abaft and afore are left so deep by the kelson that the footwales [the inside planking upon the floor timbers, sometimes called 'seeling' or 'ceiling'] and outside not being well trenailed together will be a great weakness to the ship . . . .

"To show his weakness in art and the imperfection of the mould, Pett himself, after workmen had seen her, hauled down his futtocks [i.e. shortened the futtock sweep] 2 foot as soon as the lords were



21



22

Above *British and French methods and* below *the Dutch method of constructing a ship's hull. In the first the frames are first put into place, in the second the planking is begun as soon as the keel and perpendiculars are erected. From drawings made in 1670 by the Frenchman Arnould who, on the instructions of Colbert, visited England and Holland to study shipbuilding methods.*

gone, and cut off some of the heads of them, whereby they have made her more imperfect than she was and put all things out of order that she can hardly be ever amended."

This remarkable document was signed by Mathew Baker, five other master shipwrights and a Captain Waymouth, who was respected—but not, of course, by Pett—as knowledgeable in the theory of ship design. In the end, however, it was Pett who won the day.

If we compare the left-hand side of the drawing (illustration 20), which is arrived at from W. Salisbury's original, with Mathew Baker's ideal frame (illustration 12), we find significant similarities. *Prince Royal* has a fuller underwater body and a much broader floor (the part of the ship's bottom on which she rests when lying aground); Pett did this to compensate the hull for the increased weight of a third gun-deck and its armament.

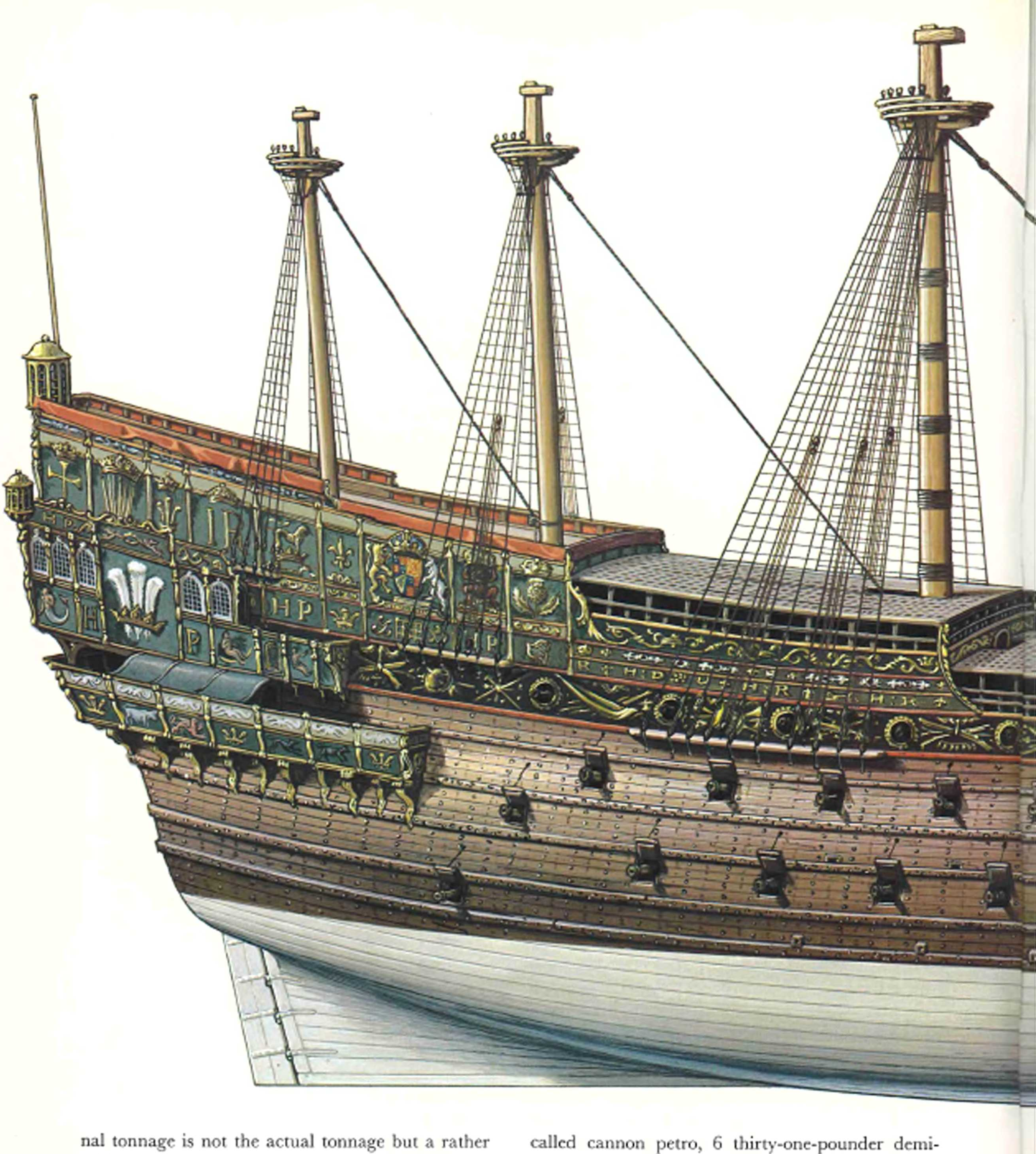
In the right-hand half of this main frame, I have tried to give an indication of the dimensions of the frame and the decks. *A Treatise on Shipbuilding*, written in England in the 1620s, says (p. 16) "merchants covet to have great floors in their ships for gaining of stowage, but thereby they spoil the ship's bearing for most of them grow tender sided and after they are built come to be furred. In a good man of war the floor must never be more than ⅓ nor less than ¼ of the breadth, and of this proportion was the *Prince* built, but more particularly ½ the difference of breadth and depth will be convenient for the floor of all kinds." The citation shows that *Prince Royal* was thus far an exception.

Her dimensions were:

Length of keel	115 feet
Greatest breadth within the planking	43 feet
Depth at the section of greatest breadth to the upper side of the keel	18 feet
Tonnage	890 tons

The English measurement rule from 1582 was very primitive: to obtain a ship's carrying capacity the length of the keel was multiplied by the greatest width within the planking and the product was then multiplied by the depth from the line of greatest width to the top of the keel. If we assume dimensions of 50 feet, 20 feet and 10 feet respectively, the product is 10,000. By experience this is the equivalent of 100 tons in barrels, or 100 tons plus 133⅓ tons in bulk.

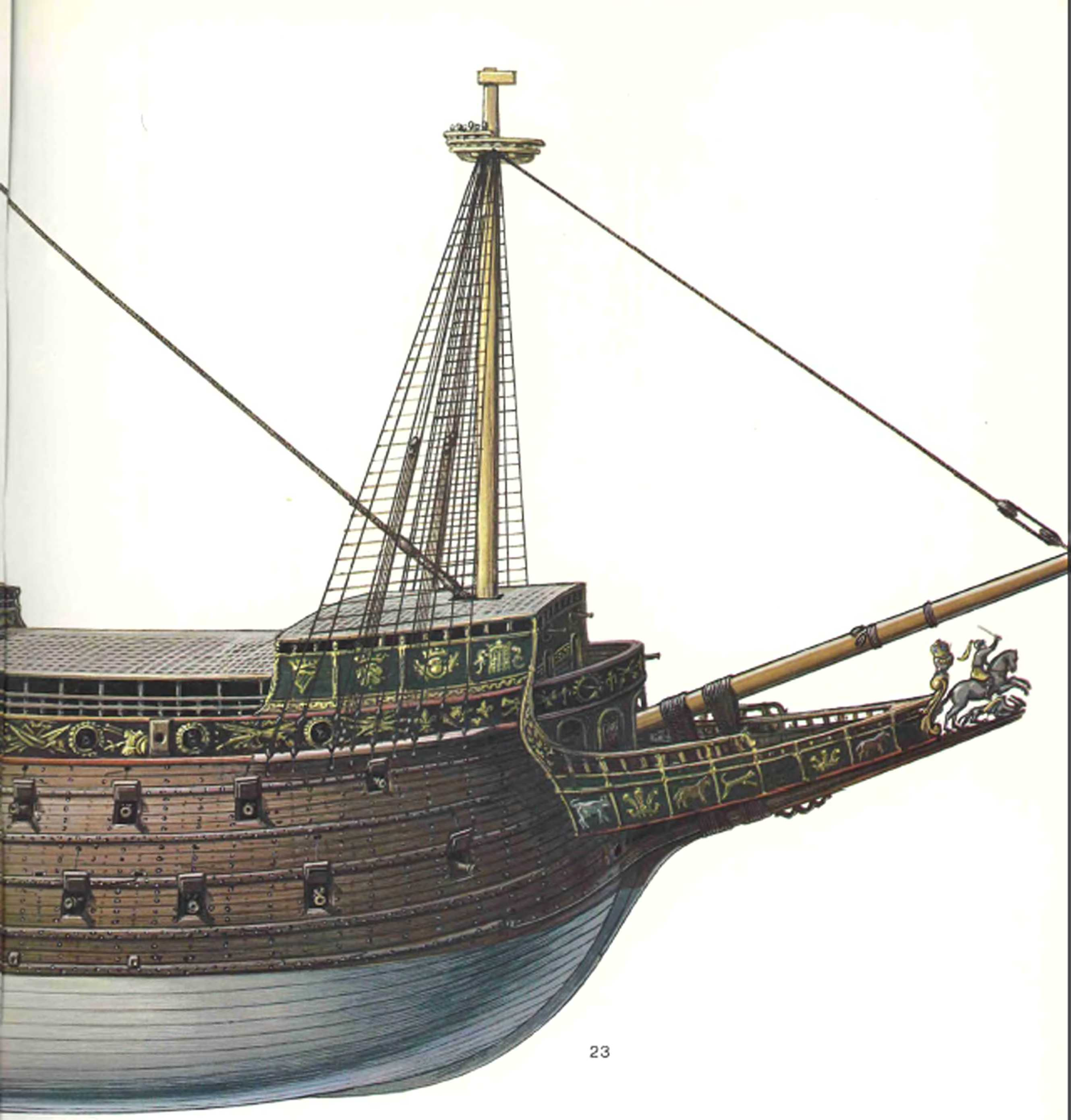
In the best-known listing of the English ships that fought against the Spanish Armada, the nomi-



nal tonnage is not the actual tonnage but a rather arbitrarily made classification, according to which the officers' pay was disbursed. This classification was as a rule about one third higher than the tonnage from 1582, except for requisitioned merchant ships that were armed for the occasion; the classification for them (see *MM* 44, page 152) was not higher by an extent worth mentioning.

According to a listing from 1624, the *Prince Royal* carried a total of 55 pieces: 2 twenty-four-pounders, called cannon petro, 6 thirty-one-pounder demi-cannon, 12 eighteen-pounder culverines, 18 nine-pounder demi-culverines, 13 five-pounder sakers, and 4 port-pieces that might have had chambers.

In illustration 23, which is in all essentials based on Vroom's painting, I have tried to form the rounded extension forward of the forecastle so as to agree with the surviving drawing (on page 21). In Vroom's painting the foremast is undeniably too far aft, and two other paintings of the ship, by Cornelis

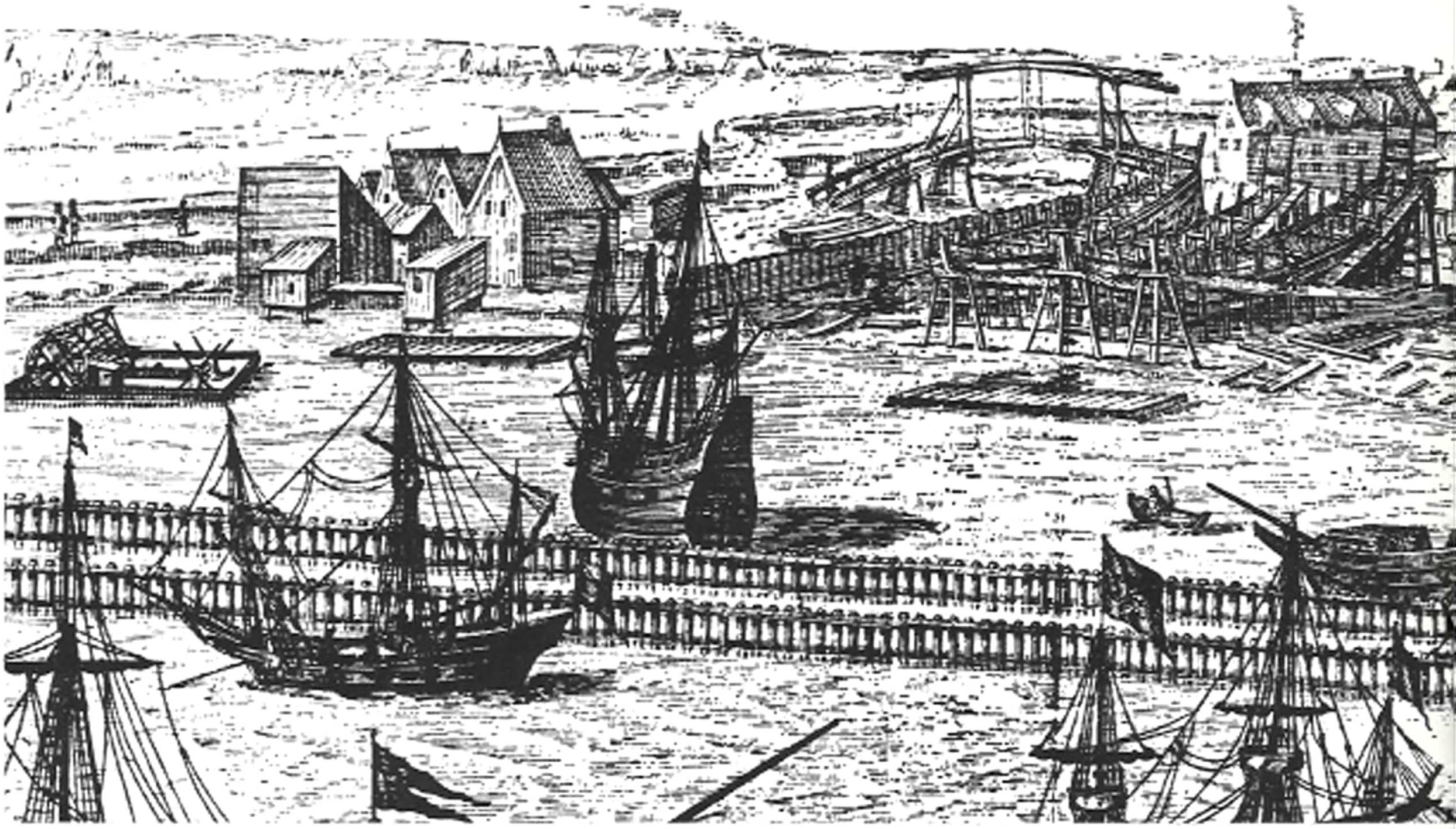


23

Claeszoon van Wieringen and Adam Willaertz, reproduce the rounded part approximately as I have drawn it (illustration 23).

The three plumes on the upper gallery are those of the Prince of Wales. The initials HP are for Henricus Princeps, and IR for Iacobus Rex. In addition to the national coat-of-arms, the embellishment includes the Irish harp, the Scots thistle, the Yorkshire rose, Cadwallader's portcullis, the French lily, and much more besides. All was intended to proclaim the prince's right to the throne and its realm.

When the ship was launched, Prince Henry stood on the poop and drank wine from a large goblet before he "threw all of the wine forward towards the half deck and solemnly calling her by the name of the Prince Royal, the trumpets sounding all the while," writes Pett (pages 83–84), adding rather characteristically that the prince addressed "many gracious words to me."



24

This detail of a copperplate engraving of Amsterdam, published in 1606 by Willem Jaenszoen Bleau, shows the city's shipyard, among other things. Far left *a dredger* left centre *three ships on the stocks nearly ready for launching* right *a fourth ship on her side is being careened. An earlier city plan, from 1538, locates four ropewalks to the left of this view behind the stocks, but it is probable that they had been moved elsewhere before this engraving was made.*

On shipbuilding in the Netherlands

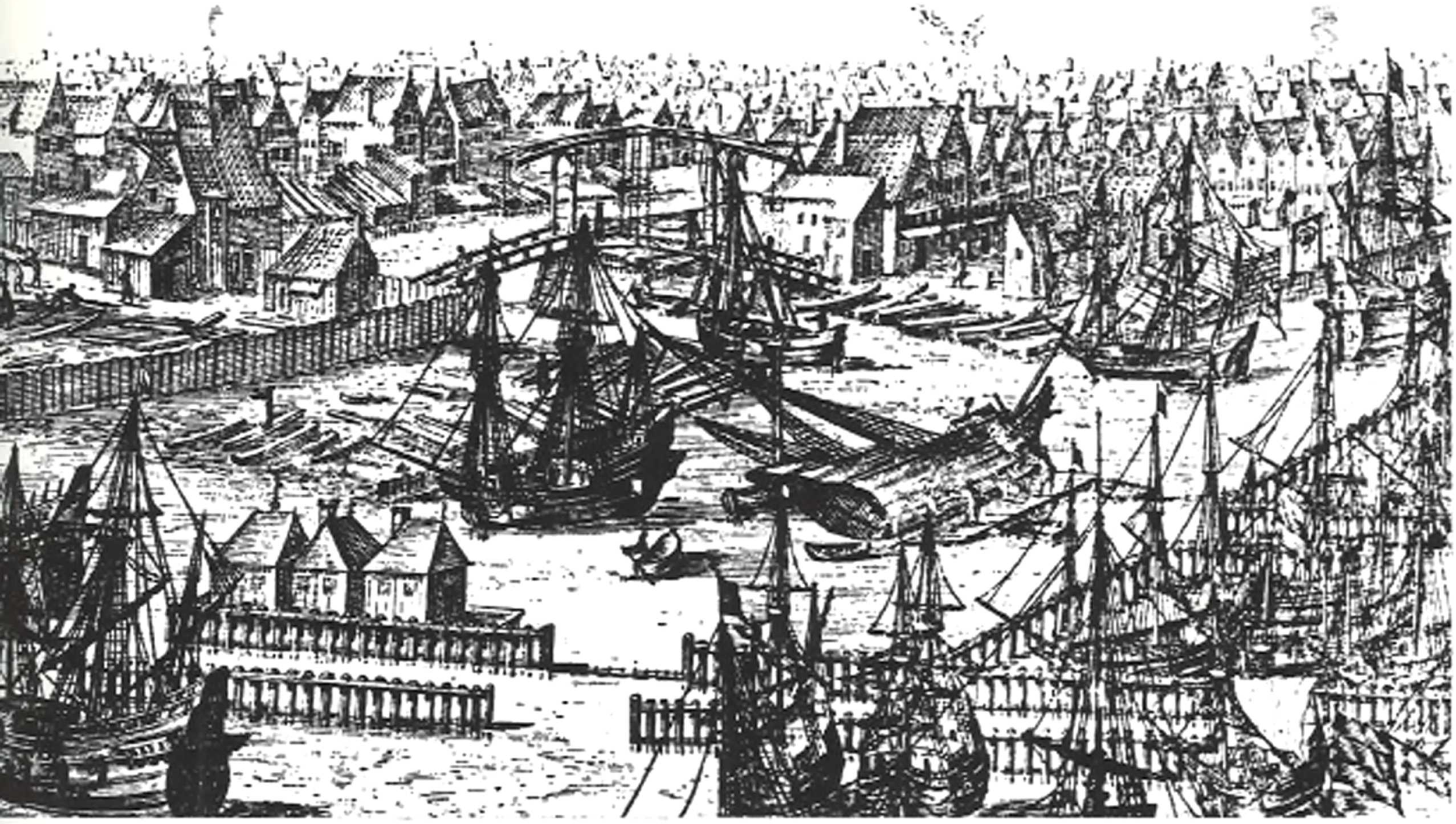
One may wonder why Richelieu and, later, Colbert, ordered ships from the Netherlands, and why France, Denmark, Sweden, Hamburg and later Russia employed Dutch shipwrights.

It was surely because Dutch vessels were distinguished by very careful work on the hull below the waterline, and by the fine qualities of the material used. It is possible that this held good during the first decades of the seventeenth century, but criticism, in addition to praise, is to be noted from this time.

The French ship *Le Saint Esprit* was launched at Zaandam in 1626 and captured by the English the following year; according to a note (194) in the book by the Swedish author Georg Hafström, a commission of enquiry considered her in many respects carelessly put together. In his work on shipbuilding, Åke Classon Rålamb writes (page 3), after making comparative studies of shipbuilding in England and Holland: "but what I had learned and seen from the previously-mentioned masters, I found so convenient and remarkable, and the Dutch manner so different from the English in that, what the former did with a given measurement and size, the latter did at random, so that it wholly and completely displeased me. It is considered there by the Dutchman Nicholas Witsen in his book that he calls *Scheepsbouwen*, with good reason it must be said, that the Englanders have a certain *proportion* of all that they work on."

As a seafaring nation the Dutch were much handicapped to begin with. The harbours of the Rhine delta and the Zuider Zee were shallow, and the channels to them were anything but straight and were full of hidden deceptive banks. An Englishman (see *Maritieme*, page 83) wrote that "the entrance of the Texel and the course over the Zuider Zee is more dangerous than a voyage from here to Spain, for all is through invisible and narrow channels."

Practically all shipbuilding materials were imported: oak was bought in Germany and Poland, on occasion even in Sweden; spruce and pine came from Norway and the Baltic countries; the best tar



was shipped from Viborg in Finland, the best pitch from Stockholm; copper and iron came primarily from Sweden, sailcloth from France and Danzig.

So long as the Netherlands remained a Spanish province their shipping concentrated on the Baltic countries and Lisbon; from the former came the maritime supplies mentioned, together with furs, skins, meat and grain, from the latter spices from the Orient. Before the rising against the Spanish oppression, which began after Philip II's accession, Antwerp was the most important European trading city. The war of liberation was carried on at sea and on land, and it brought about a surge of shipping and shipbuilding, most of all in the Northern Provinces.

Rebellious Spanish troops had plundered and looted the rich city of Antwerp in 1576, and it never regained its leading position. The Protestant Flemings left the city and settled in Amsterdam which, despite or because of the war, soon became the European trading centre.

When the king of Portugal died in 1580, Philip II acquired the crown and closed Lisbon to the insurgent Dutch. The Republic of the United Netherlands was proclaimed the following year, comprising the seven provinces of Holland, Zeeland, Utrecht, Geldern, Groningen, Overijsel and Friesland. The southern provinces with their Catholic population, more or less the present-day Belgium, soon gave up the struggle against Spain.

When Lisbon remained closed to Dutch ships, Amsterdam equipped its own expedition to the Moluccas—the spice islands in the most distant East Indies (see *Maritieme*, pages 41 and 247 ff). Four small ships, the largest of about 230 lasts and the smallest of only 20, sailed in 1595; their crews totalled only 274 men. Only three ships and 94 men returned. Although this initial enterprise to the East Indies was a great misfortune, it was not taken as a deterrent.

The United East India Company was formed in 1602, and the first ship that the Company had built (see *Maritieme*, pages 41 ff) was one of 300 lasts, 130′ between perpendiculars, 33′ in breadth within her planking, and 30′ depth in hold (i.e. between the level of her upper deck and the top of the keel).

The expression of size in lasts is the equivalent of the modern deadweight. It has long been used in the Netherlands, Germany and the Scandinavian countries, but it meant different things in different countries and for different sorts of goods. A last was in fact a measure of weight, and a last of flour in the Netherlands in the seventeenth century would have been about 2,000 kilos; a Company ship of 300 lasts would then have had a deadweight tonnage of about 600 tons.

During the period from 1614 to 1627, the Company's largest ships were 160′ between perpendiculars, 38′ in breadth and 14′ depth in hold; the upper deck lay 7′ above the lower deck, and the quarter-



25

deck was 7½′ higher. At this time it was customary for almost the whole quarter-deck to comprise a grating, perhaps to admit fresh air when in warmer latitudes but also to allow powder smoke to escape when the ship was in action, something that occurred frequently. In Dutch this deck was named *bovenet*, 'the upper net', a name that was a relic from the days of carracks and the early galleons, when the deck would be covered with anti-boarding netting.

The large East Indiamen were narrow, with a ratio of length to breadth of 4.2:1. At the beginning of the century they were the largest of all Dutch ships and could probably never enter Amsterdam. It became usual for larger ships to anchor at Texel and discharge their costly cargoes into smaller vessels that could carry them into the city itself.

To judge from numerous illustrations, there was in the Netherlands during the first decades of the seventeenth century another type of relatively large ship that was proportionately broader than the East Indiamen.

30 I show a detail from an engraving most probably by the Harlem artist Hans Savery, from about 1525 (illustration 25). The Maritieme Museum Prins Hendrick, Rotterdam, considers the drawing to be by Vroom, but the Boymans Van Benningen Museum, Rotterdam, contains a drawing by Savery that is almost exactly the same as the one here. The artist has drawn such a broad ship in a storm. Her spritsail is being handed on the beakhead, and both the foresail and mainsail have been eased off a bit to lessen their effect. Martnets are visible on both sails, and the bowlines run through blocks that are suspended from martnets. The details of the rigging are essentially the same as those shown in illustration 7.

My painting (illustration 26) of such a ship follows Vroom: her rigging is simple, for it includes neither a spritsail-topsail nor a mizzen-topsail. Paintings by other Dutch painters of about the same time depict such ships, which seem to have retained carracks' proportions, as having something of the characteristics of galleons.

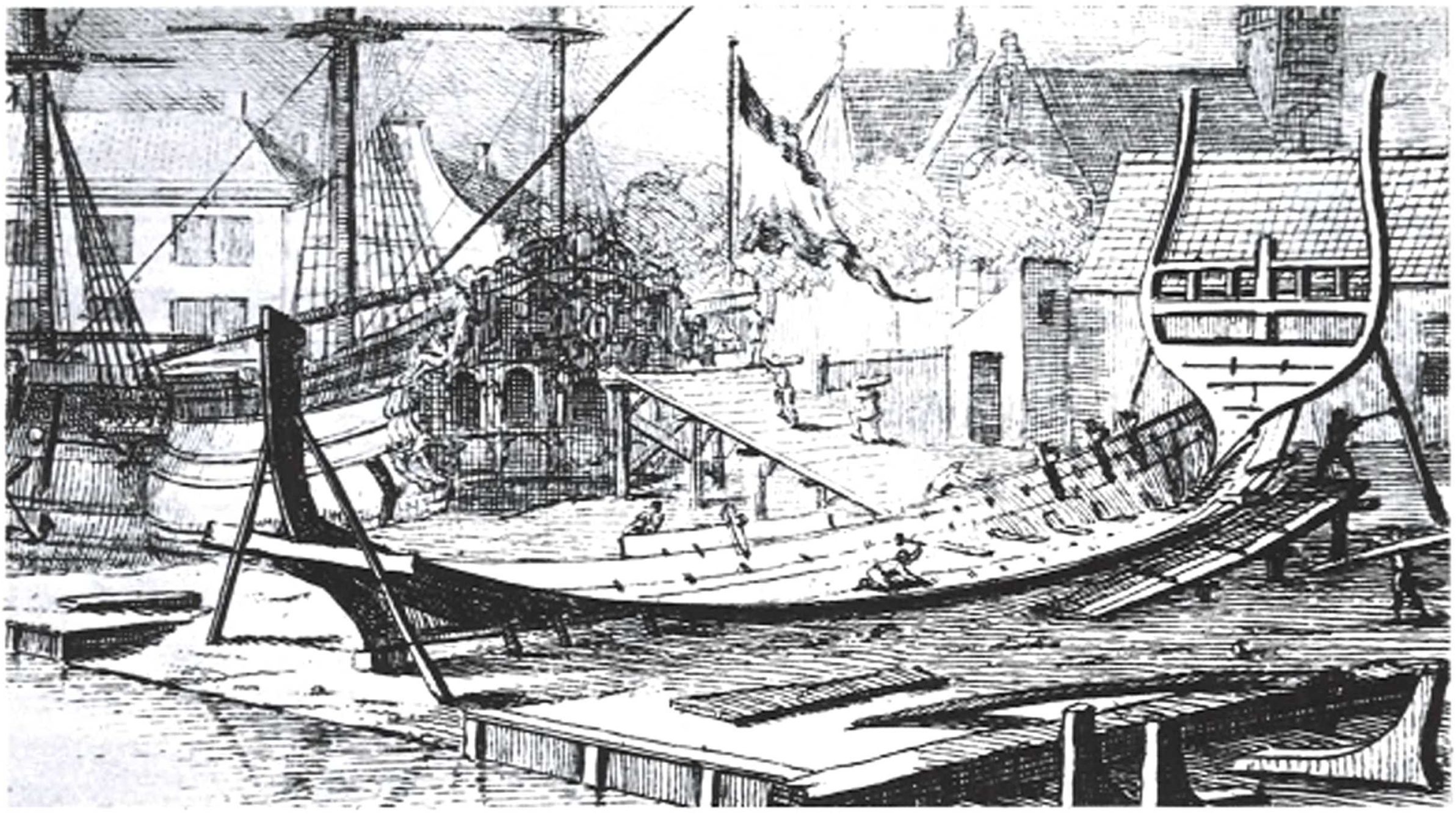
Perhaps it is finally a question of galleons that have been built beamier amidships, so that the largest guns can be run in for reloading, and perhaps one may consider them as a strand in the development of the large warships that were called frigates or royal ships, and eventually ships-of-the-line.

In my painting the quarter-deck terminates aft in a raised platform with a ribbing under its forward edge: the helmsman stood on a platform on the upper deck and could see the sails between these ribs.

A red battle flag flies from the flagstaff aft as a sign that the ship was engaging an enemy. Such flags were sometimes wholly without decoration, but often they showed an arm flourishing a sword that emerges from a grey cloud. Just visible at the peak of the mizzen is the prince's standard which began to be used during the war of liberation against Spain. The national flag flies at the mainmast: the Lion of Orange holds the seven arrows that symbolize the Seven Provinces. A second prince's standard flies at the foremast. During the latter part of the seventeenth century the orange stripe was replaced by a red one. The Netherlands was indeed a republic but chose as its first head of state Prince William of Orange, who was succeeded in 1584 by his son Mauritz of Orange.

In the painting the foresail sheets are led below the beakhead to eyes set in a pole projecting forward, and thence up through the beakhead grating. During the entire century the figurehead was the Lion of Orange. Embellishments are few and would continue to be so when compared with foreign warships during the seventeenth and eighteenth centuries.





27

In his *Architectura Navalis* (1629), Joseph Furttenbach gives a rather inadequate account of the construction of an unspecified Dutch vessel, and its main frame is shown on page 33 (illustration 28). Its flat is very broad, giving a hull with little depth. It is possible (see *Konijnenburg*, page 32) that Dutch ships even at this time could be built to incorporate such a frame, which has endured up to the present day in river vessels from this country.

Nicolaes Witsen's book on shipbuilding appeared in its first edition in 1671, and in the illustration on page 169 he shows a main frame that is far more advanced; it is shown here in illustration 29. It would have been the one that was usual in warships from the 1630s until the end of the century. His flat (see page 106 of his book) whould be between ⅓ and ⅜ of the beam; it was not horizontal, as it might have been in English ships, but rose by between ½" and 1" per foot from the rabbet on the keel for its entire width. It continued in a sweep drawn from a point on a line perpendicular to, and at the outer end of, the flat. This was called the runghead sweep. Its radius was less than the depth and less than the difference between half the flat and half the breadth.

The centre for the sweep up to the greatest breadth lay on the line of greatest breadth, its radius being greater than half the breadth and less than the whole breadth, and was normally ⅝ of the breadth. Its radius would be longer or shorter so as to give respectively a relatively straight or full form. Finally the frame terminated upwards in a short sweep above the line of greatest breadth, being followed by a straight line or a reverse sweep.

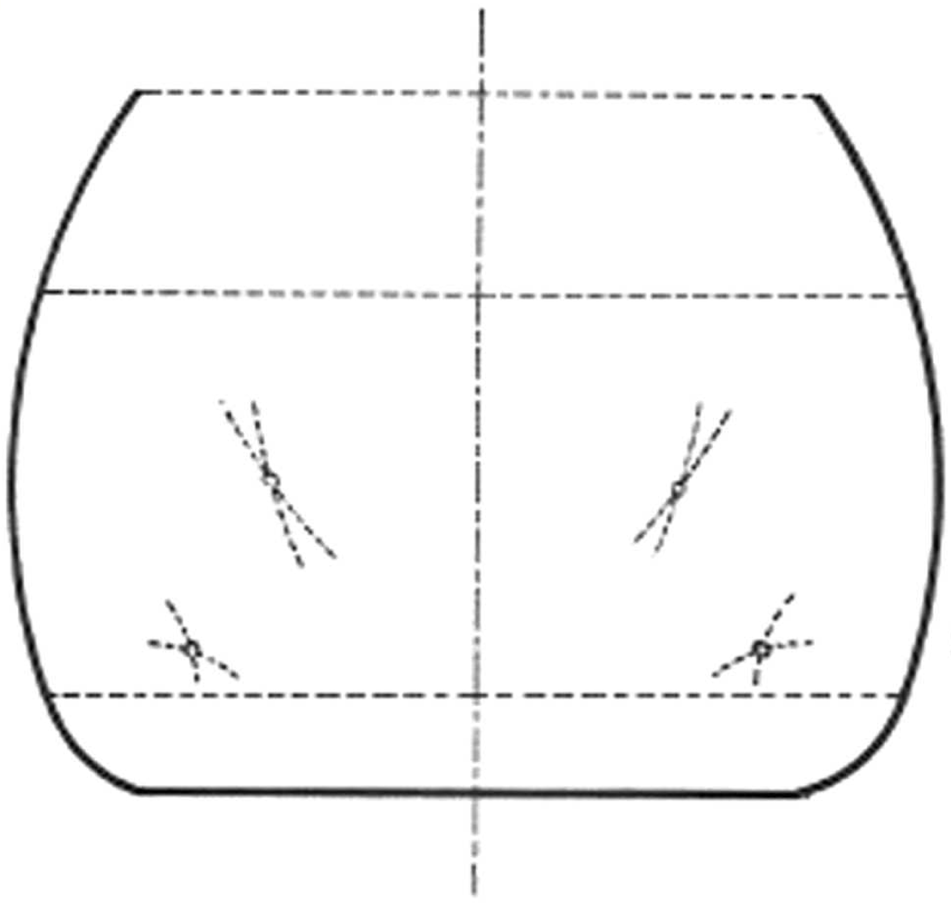
32

Nicolaes Witsen reproduces yet another frame in the illustration mentioned above, of which the flat has an abrupt turn into the runghead sweep, giving what is called a chine runghead. I have tried to show how such a frame could be constructed (30).

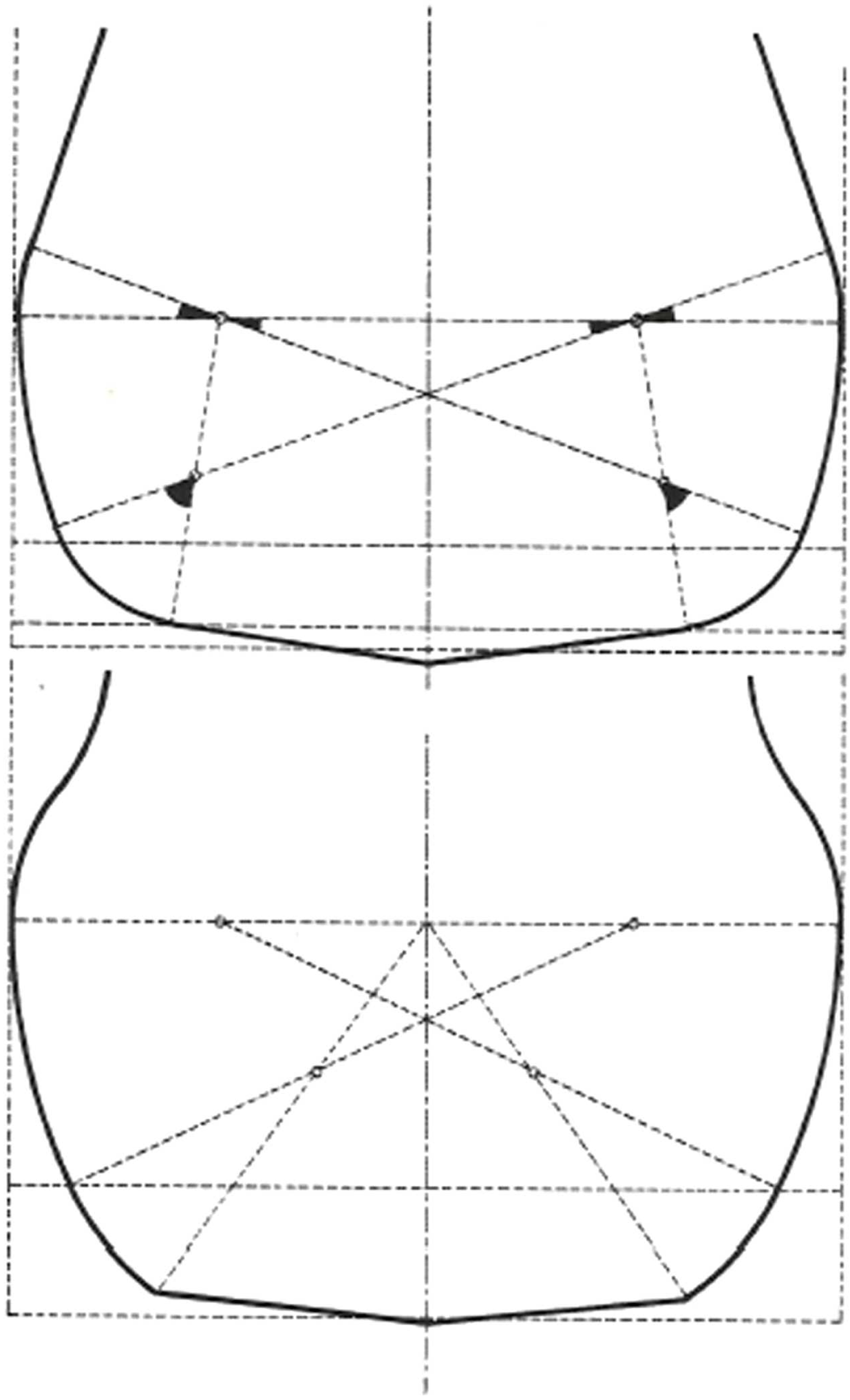
Cornelis van Yk's book on shipbuilding, published in Amsterdam in 1697, points out (pages 69ff) that ships with a chine runghead were built only in Noorderkwartier, the part of the province of Holland that lay to the north of Amsterdam. It has been said that such rungheads are found only on pinnaces—small, ship-rigged vessels—but the only reproduction of a Dutch ship with a chine runghead that I know of is in an engraving by Wenceslaus Hollar that shows the bow of a large East Indiaman (illustration 31).

A detail previously mentioned in passing was the special Dutch method of building ships. Once the keel and perpendiculars were set up on the stocks, the flat was begun before any floor timbers were made fast to the keel. In describing the building of the *Vasa* I shall examine this method more closely. Reproduced here (illustration 27) is the best depiction of the method that I know of, a copperplate engraving by J. Schenck, published in Amsterdam in 1700.

On comparing these main frames (illustrations 28



28



29

30

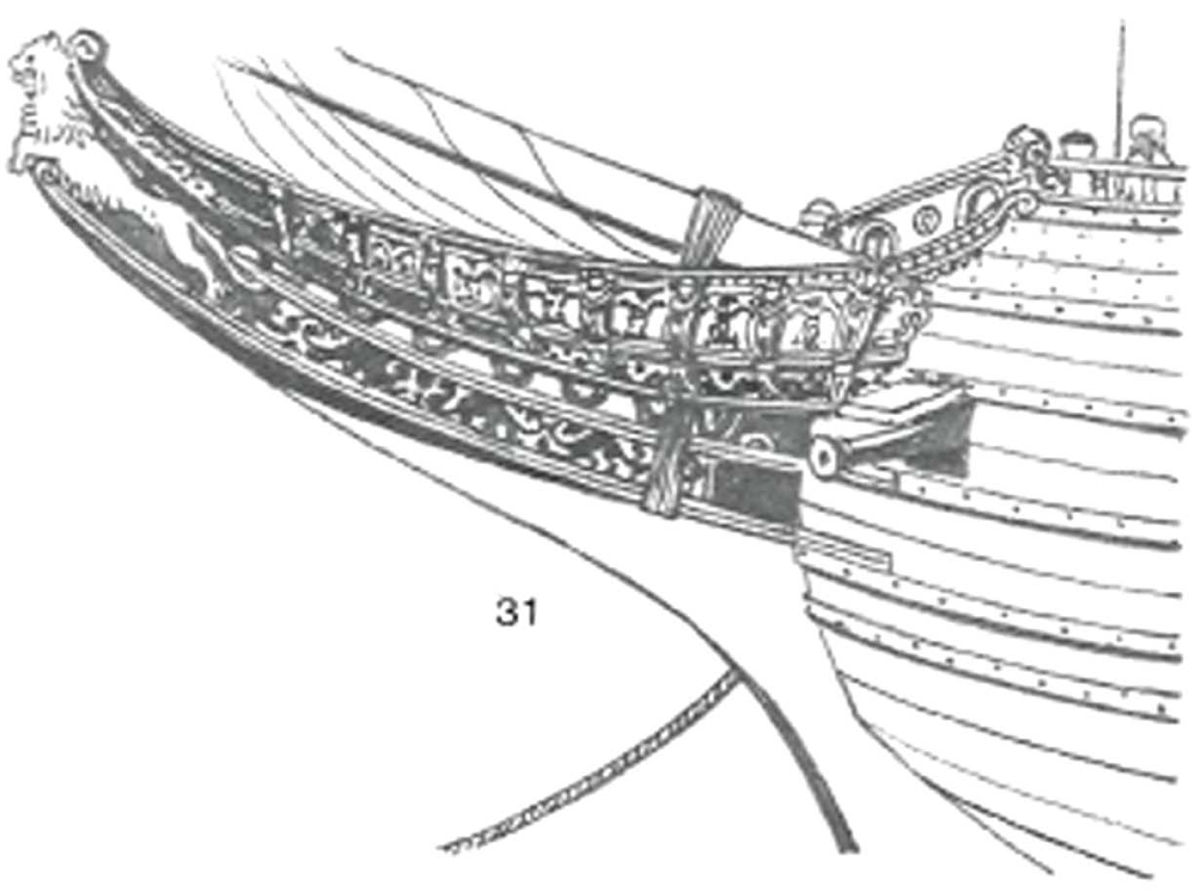
to 30) with the English ones (illustrations 13 and 20), we may see that the Dutch frames have flats that are at least double the width of the English ones. They give a distinctly shallower draught. The river Maas, Rotterdam's link with the sea, permits no draught greater than about 4.5 m, while the passage from Amsterdam, tacking between the shoals of the Zuider Zee, had to cross the Pampus shoals which allow a draught hardly greater than 4 m.

All large ships that were built in Amsterdam were towed empty and unrigged over the shoals to Enkhuisen to be finished and made ready for sea. Towards the end of the century, when the large ships were replaced by ones even larger, what were called camels were built and used. These were double floating docks that, having been made fast one on either side of the vessel to be lifted, were pumped dry or otherwise emptied and, in rising, lifted the vessel held between them. Cornelis van Yk discusses them at some length (pages 360ff).

So: back to the question as to why foreign powers ordered ships in the Netherlands, and employed Dutch master shipwrights and ship's carpenters. For France it was politically natural to order ships from a peaceful neighbour with much more experience in maritime matters. The Baltic countries at that time had had no experience of war against the Netherlands, but in their harbours Dutch merchantmen began to be altogether dominant. The successes of the Seven Provinces against Spain and in ocean voyages to the East Indies, Brazil, north to Nova Zembla and to different parts of North America aroused the wonder of the whole of Europe: it began to be assumed that the Dutch shipbuilders were more skilful than others, for all that it was forgotten that their ships were built for very special geographical conditions.

The Dutch ships were lighter than those of Spain and England, and it is possible that in a clear breeze they were faster. After the middle of the century the Dutch frequently got the better of English ships, something that can probably be ascribed to the better Dutch crews and their often brilliantly daring admirals who, nevertheless, often complained that their ships were too weakly built. Towards the end of the seventeenth century, when the wars with England were at an end, English master shipwrights were employed to put matters to rights.

In this chapter and in those that follow, the foot mentioned is the Amsterdam foot of 28.3 cm, of 11 inches, each of 2.57; any exception to this is noted in the text.



31

Le Grand Saint Louis 1626

When the warship *Vasa* had ignominiously heeled over and sunk after sailing only a few cables' length in Stockholm harbour on 10th August 1628, the authorities began to search for a suitable scapegoat. A "specially commissioned court with seventeen assessors" met at the royal palace, and minutes of their proceedings are preserved in the Swedish National Archives (*Flottans Handlingar* A.1). The king himself was with the army at Stralsund in Prussia, having that summer definitely taken Sweden into what is known to history as the Thirty Years' War.

One of those examined by the court was the ship's contractor, Arent Hybertszoon de Groote. The court asked him why the ship was so poorly built, at which he explained that she had been built to specifications that he had contracted with, and shown to, the king; the specifications envisaged a ship such as the one he had seen built in Holland for the Duke de Guise.

Duke Charles de Guise had been commander of the French Mediterranean fleet when he was appointed by Louis XIII to be commander of the nation's maritime forces. In 1593 the duke had been a candidate for the French throne, being in fact the direct heir of the house of Lorraine; of all its branches the de Guise family was the foremost. His candidacy failed, the new king was Henry IV, the first of the Bourbons, and Charles de Guise swore homage to Henry and, as a reward, was appointed governor of Provence.

The French fleet of which he took command in 1621 indeed comprised seventy-two vessels, but the three largest were of only 400, 300 and 250 tons and carried 32, 24 and 16 guns respectively. They were called galleons, being described as roundships with high sides, and were said to exceed all other ships in the fleet in burden and armaments.

During the spring of 1624 France and the Netherlands entered into a treaty of mutual defence in the event of war with another power. For France this meant primarily a strengthening of her fleet, and it is probable that eight new ships were ordered in Holland at this time. According to de Groote's evidence, *Vasa*'s predecessor was built for the Duke de Guise; de Groote's visit to Amsterdam must have been made earlier than the autumn of 1626, for on 14th October Louis XIII appointed Cardinal Richelieu to supreme authority over all maritime matters in France; after this date there was scarcely any reason for anyone to speak of building a large warship for Charles de Guise.

In the autumn of 1627 the English ambassador at The Hague commented unfavourably to the Dutch government on the fitting-out of the ships that had been built there for France, which he regarded as a threat to England. To begin with, he wrote, this had been conducted in secret but was now being carried on quite openly.

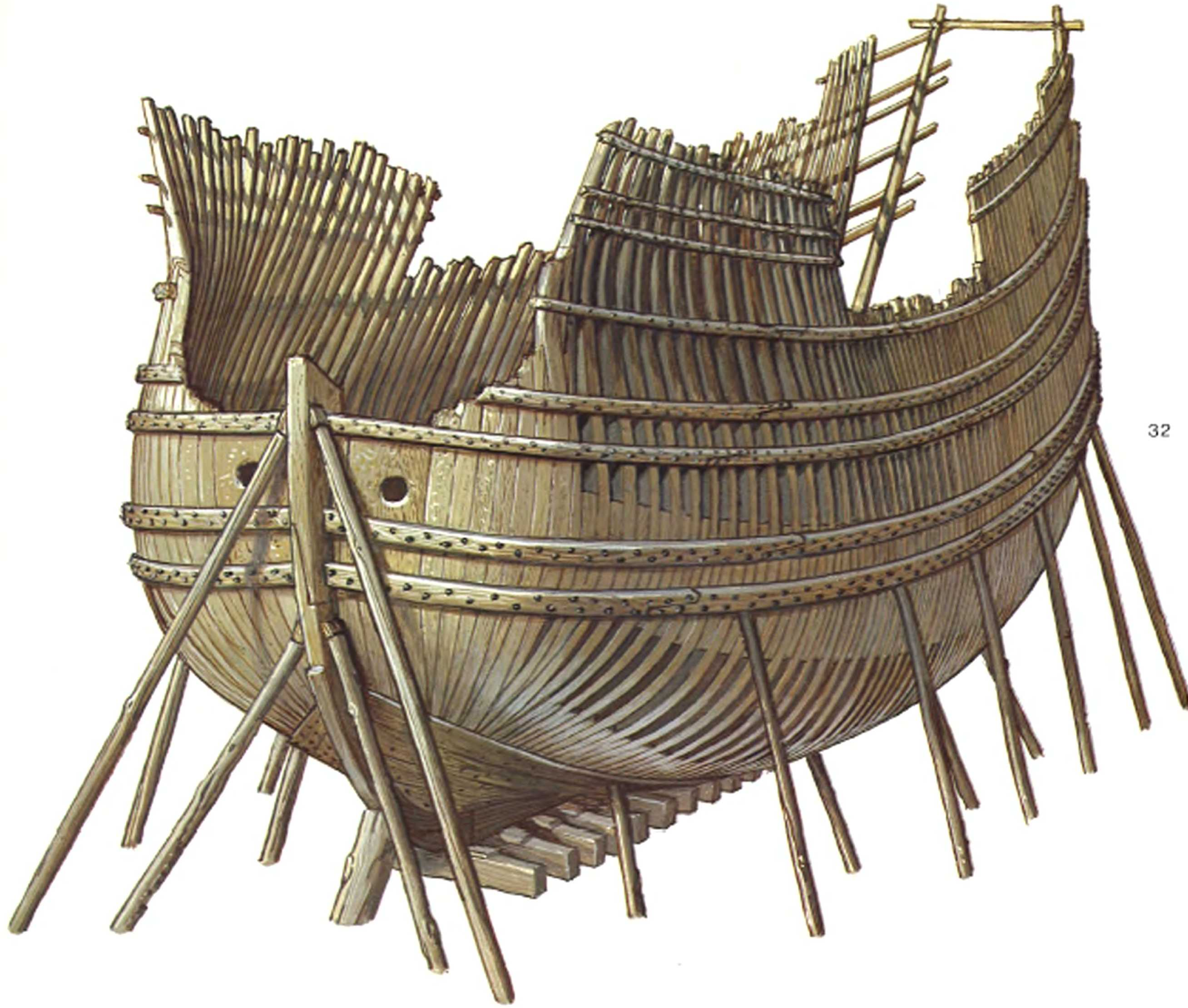
Le Grand Saint Louis and the other ships ordered by France were, according to a letter dated 21st November 1626, lying ready in all respects for sailing and were waiting only for a suitable wind for the voyage to France. It cannot be ruled out, then, that Arent de Groote had seen the ship under construction well before his agreement with Gustav II Adolf, which was made in January 1625. Through his Dutch friends—he was himself Dutch—he had had the possibility of gathering information about the ship, which he and his brother, the master shipwright Hendrick Hybertszoon, could make up into a specification. But what is probably far more important is the Amsterdam publication in 1626 of a copperplate engraving by Henry Hondius (illustration 33) that shows the same ship entitled *Navire Royale faiete en Hollande 1626*. A copy may be seen in the Nederlandsch Historisch Scheepvaart Museum, Amsterdam.

In the literature the ship is called *Le Royal* or *Le Saint Louis*; in modern French sources, *Le Grand Saint Louis*. These sources give us only the ship's burden—1,000 or 1,100 tons. The following information can be gleaned from Georges Fournier's *Hydrographie* in its edition of 1696 (pages 15 and 17): the ship was built in Amsterdam by the master shipwright Lambert, her keel had a length of 123 (Amsterdam) feet, a width of 2′4″, a depth of 2′5″; overhang at the bow was 28′ and at the stern 7′, giving a length overall of 158′. The beam was given as 42′.

The proportion of length to breadth is 3.76:1, which indicates an unusually beamy warship for the time. But it is said that the ship was later girdled, or fitted with an extra planking at her waterline, to make her stronger and to give her greater stability, and perhaps it is this increased breadth that Fournier implies with his figure of 42′.

As late as the nineteenth century French ships were relatively beamier than others, so as to provide a more stable platform for increasingly heavy guns. According to the French author Pierre le Conte (page 2), *La Reine*, built in 1647, had proportions of 3.74:1, while *Jupiter* of the same year was surprisingly narrow at 4:1.

Hondius' engraving is considered to be the finest ship portrait of the time, but if Fournier's informa-



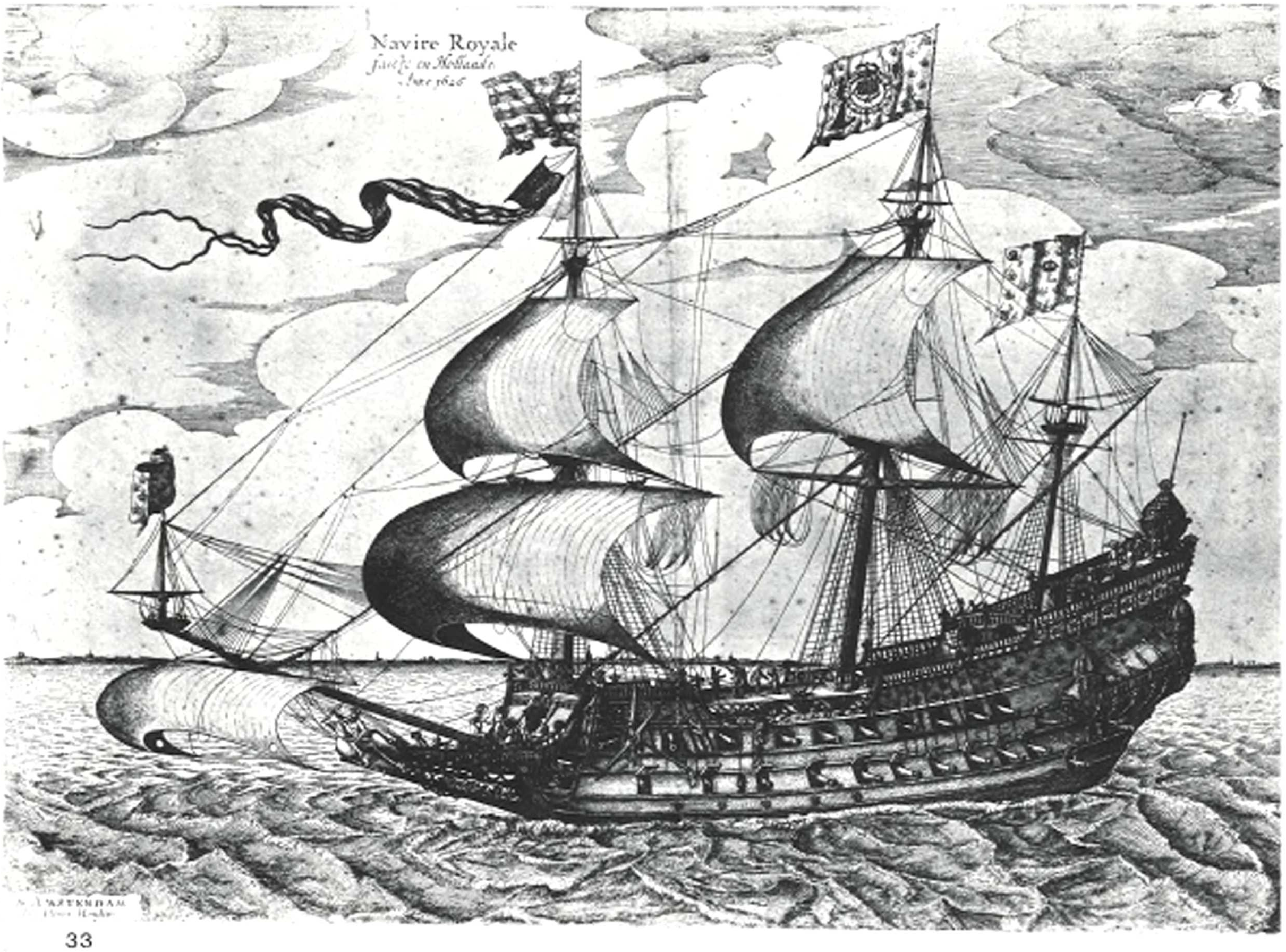
Painting by the author of Le Grand Saint Louis *framed and with her wales in place. The flat is visible below her stem; it would have been planked as soon as the keel perpendiculars and fashion-pieces were in place.*

tion about her beam is correct, this opinion needs to be revised, for the engraving depicts what is undoubtedly a narrow ship. The figure of 42 feet can be a misprint, however, for were the figure 32 feet, the proportion of length to breadth would be 3.84:1, which would be quite acceptable.

If we compare the proportions of *Le Grand Saint Louis* with those we know from *Vasa*, we can at once claim that Arent de Groote was not telling the truth when he stated that *Vasa* was built to the same specifications as the ship he had seen under construction in Holland for the Duke de Guise. This ship was certainly *Le Grand Saint Louis*, but it is possible that de Groote, or maybe the Swedish ambassador to the Netherlands, had bought a copy of Hondius' engraving and sent it to Gustav Adolf. In that way the French warship would have become a sort of example when *Vasa* was built—but one that was to be improved on.

The French military archives at Vincennes contain an "Inventory for the year 1626 for the royal ship *Le Saint Louis* of 1,000 to 1,100 tons." It is a lengthy and detailed document.

"First and foremost: the ship with its capstan and



33

pumps, equipped with handspikes, double equipment for the pumps; all spars, namely the mainmast and foremast with their topmasts and royals, the bowsprit with its spritsail-topmast, the mizzenmast with its pole, all fitted with tops, yards and parrels; further, deadeyes, lanniards, shrouds, stays, tyes, jeers, tackle, lifts, braces, stern-tackle, sheets, tacks, bowlines with their martnets, brails, buntgaskets, top-ropes, and all other necessary rigging and in general all stropped blocks.

"Sails
Mainsail with bonnet, foresail with bonnet, spritsail and spritsail-topsail, mizzen with bonnet, maintopsail, main-royal, foretopsails and fore-royal and mizzen-topsail. A large roll of sailcloth for necessary repairs, in addition to four large barrels containing as many sails as those mentioned here, in reserve.

"Cables
1 large of 16", worn.
36 2 of 16", spliced together, worn.
1 of 17", worn.

Engraving by Henry Hondius of Le Grand Saint Louis *dated 1626 (33). Her foredeck and quarter-deck are joined by a broad cat-walk supported on curved beams. Based upon information about Dutch main frames from the beginning of the seventeenth century I have tried to reconstruct the conjectural main frame of* Le Grand Saint Louis *(34).*

2 of 17", spliced together, altogether new.
1 of 13".
The cables have [each] a length of about 115 fathoms.

"Small cables
1 of 8", 100 fathoms long.
1 of 7", 100 fathoms long.
1 of 6", 80 fathoms long.
2 of 4½", 120 fathoms long.
1 spare winding-tackle for lifting cannon.

1 rope for making cannon breechings.
3 slings.
1 buoy rope of 25 fathoms.
1 buoy rope of 20 fathoms.
6 buoys, both large and small.
66 blocks of different sorts.

"Anchors
? large anchors.

"Gunner's mate's stores
19 gunner's ladles of different calibres, together with sponges and tamps.
9 tampshafts of wood, and one of ropework.
36 gun-tackles, remainder to be taken as needed from *Vaisseau de la Reyne*, which is of 700 tons.
22 rolls of lead sheet for both covering the guns' touch-holes and for other purposes.
218 sacks of powder and a number of drying cloths.



2 stream anchors.
2 grapnels for the boats.
3 grapnels with iron chains.
3 iron chains for the yards.
2 iron chains for securing anchors.
2 cat-lines for raising anchors.
46 iron tripods. (?)
34 iron eye-bolts.
82 iron hooks for tackle.
16 booms and 14 lockbolts for the gunports.
3 axes.
2 iron clubs.

"Coxswain's stores
6 large compasses, 4 smaller compasses.
17 hour-glasses filled with sand.
6 leads of different weights, the heaviest of 20 lbs.
6 lead-lines.

210 round wooden boxes, intended to be filled with old scrap metal for *Vaisseau du Roy* and *Vaisseau de la Reyne* to be divided among the gun crews.
100 kegs of powder for both ships, to be divided as above.
60 handspikes.
66 wooden supports, to be divided as above.
58 aiming coigns.
3 scales and 10 weights up to 50 lbs.

"Cabin stores
3 large pots set into three fireplaces.
1 large pot with a copper lid and many other pots for different purposes.
1 basin of zinc, casseroles, metal pots, paté forms, copper ovens, scoops to baste meat with, grid-irons, spit, tongs, tripods, fire-dog; pewter table-service for the cabin; three earthenware pots for





Le Grand Saint Louis *1626.*
The ship at anchor after a storm, with topmasts struck (= lowered).

the crew; a number of wooden platters (some damaged), baskets for keeping food in, a pot to warm tar in.

"Chief purser's stores
About 50 pipes of wine, a large number of kegs with iron hoops; a leather hose to fill wine bowls with, a funnel of tinplate, funnels with iron hoops, 3 (large) lanterns, 3 copper-covered jugs, 3 lanterns, 48 wooden lanterns, 4 copper candlesticks, 12 iron candlesticks.

"Armament and ammunition
28 bronze cannon, (of which there are) 26 24-pounders and 2 12-pounders, 1,800 lbs powder, 1 barrel of sulphur, a number of cannon-balls of different weights, a number of grenades, some chain-shot for 18-pounder and 14-pounder cannon; 41 gun-carriages; 16 packets of fuses, each holding 10 bundles; 279 muskets, a basket with 292 bandoleers; 78 pikes, 35 half-pikes or partisans, 247 ordinary half-pikes; 13 carbines, 28 cutlasses, 2 bullet-moulds, 1 barrel of musket-balls; 1 large barrel at which to fill buckets.

"Other stores
2 flags, 3 pendants and 12 broad pendants, all of flag material; 17 supports for waist-cloths; 3 square sculpted tables, 1 bell, 2 cabin chairs, 2 wine-chests, 1 large chest, its contents being specified below. Medicine chest, a bundle of carpets for the cabin."

There follows a listing of material "for which those responsible are not required to give an exact account": "2 kegs of tar, 1 keg of pitch, 1 keg of soap, 1 keg of fat or tallow, 62 lbs lard; 6 lines for whipping cables; 6 lines for rope-bands; 6 tarred lines for lashings; 12 hanks of seaman's yarn for the shrouds; 66 lbs of heavy seaman's yarn, 4 packets of marline, 4 packets housing, 12 hanks of yarn containing 48 bunches; 18 bits of sennet for cladding cables; 11 lbs pump leather, 4 skins for covering cables, bowsprit, yards and shrouds; 2 dozen wads; 6 iron shovels, 3 wooden shovels; 2 dozen oars for the boats; 12 boathooks for the coxswains; 12 marlinespikes of horn; 2,000 pump nails of the smaller sort, 2,000 flat-headed nails; 17 large deadeyes and 3 small deadeyes; 6 baskets filled with nails and metal scrap of all sorts for use on board; 2 boats with their rudders; 1 sloop; 17 reserve anchors weighing 78 ship's pounds; cables in large numbers and different sizes, also in reserve; 6 bronze cannon marked with coats-of-arms of the king and Cardinal Richelieu, which shoot 36-pound balls, with which the ship is to be armed, together with the 28 cannon mentioned above, and which are stowed in the hold on board; 100 pigs of lead, 600 planks.

"Contents of the above-mentioned chest
A large flag—to be hoisted on the quarter-deck flagstaff—of red damask and with the king's coat-of-arms; a flag to hoist at the main, of white taffeta; 2 pendants of blue taffeta to hoist at the fore and on the bowsprit; 2 light silver cups, namely one large and one small; a silver salt-cellar; a dozen forks, and as many spoons; a case with a dozen knives; 1 wooden crucifix; 3 Turkey carpets; 20 table-cloths, large and small, finer and coarser; 66 serviettes, 14 hand-cloths."

This listing was made when the ship still lay in Holland and had not yet been fully fitted out, at least so far as her armaments were concerned. 6 + 28 makes 34 cannon, but her eventual armament was to comprise 52 or 56 cannon. The facts vary. At least there were on board chain-shot for 18- and 19-pounders, and we may assume that she would have been equipped with guns of these calibres.

Regarding *Le Grand Saint Louis'* displacement of 1,000 to 1,100 tons, the eighteenth-century dictionary by the French writer N. Aubin (page 827) gives a *tonneau* as equivalent to a weight of 2,000 *livres*, and as the ancient French *livre* was of 489.5 grams, a *tonneau* would be 979 kilos, or just about a metric ton. Aubin states categorically that a *tonneau* is a measure of a ship's displacement and refers in this context to Archimedes' principle: tonnage here is undeniably displacement.

The ship's embellishment and details are shown generally in the engraving; in support of my use of a rich degree of gilding in my painting I have an English report on the ship already mentioned, *Le Saint Esprit*, which was of 800 tons and carried 42 cannon. It was said to have been richly gilded with double gold both inside and out "in places suitable to proclaim stately magnificence, even the gun-ports being garnished with the sculpted heads of gaping lions, they too being double gilded."



Gustav II Adolf, king of Sweden from 1611 to 1632. A portrait from 1618 by Vallentin Trautman, a detail of an illustration in the Gustav Adolf Bible.

The King, his shipyards and the royal ship Tre Kronor

When Gustav II Adolf inherited the Swedish Crown in 1611, he also inherited three wars and a fleet of warships: three larger, twenty-seven medium-sized, and no fewer than sixty-eight small vessels. His father, Karl IX, had himself begun the war with Russia where, to begin with, Jakob de la Gardie had led a small army. Officially this was to support the legitimate Czar Vasili in a war of succession but the Swedish purpose was to exclude Russia from the Baltic. At the peace signed at Stolbova in 1617 Sweden also won south-eastern Karelia and Ingermanland, the area south west of present-day Leningrad. Swedish appetites grew with the war, leading to a wish to exclude Russia from the White Sea; this was unfulfilled. As early as Erik XIV's time (1560–68), the Swedes had conquered Estonia and so came to control the whole of the Gulf of Finland.

The Polish war was from the start a war of succession, the Polish king Sigismund being Gustav Adolf's elder cousin, but it developed into a struggle over some important Baltic harbours. Riga was conquered in 1621. Armistices were often agreed to, and when they expired Swedish vessels were despatched to patrol off Danzig, for it was feared that Sigismund's fleet would sail out and disturb marine traffic.

In 1626 Gustav Adolf descended on Polish Prussia in a combined naval and military action, Pillau at the entrance to the Frisches Haff was taken without a fight, and a part of the fleet blockaded Danzig and imposed tolls on all incoming vessels. Braunsberg and Elbing, two minor ports inside the Frisches Haff, were conquered.

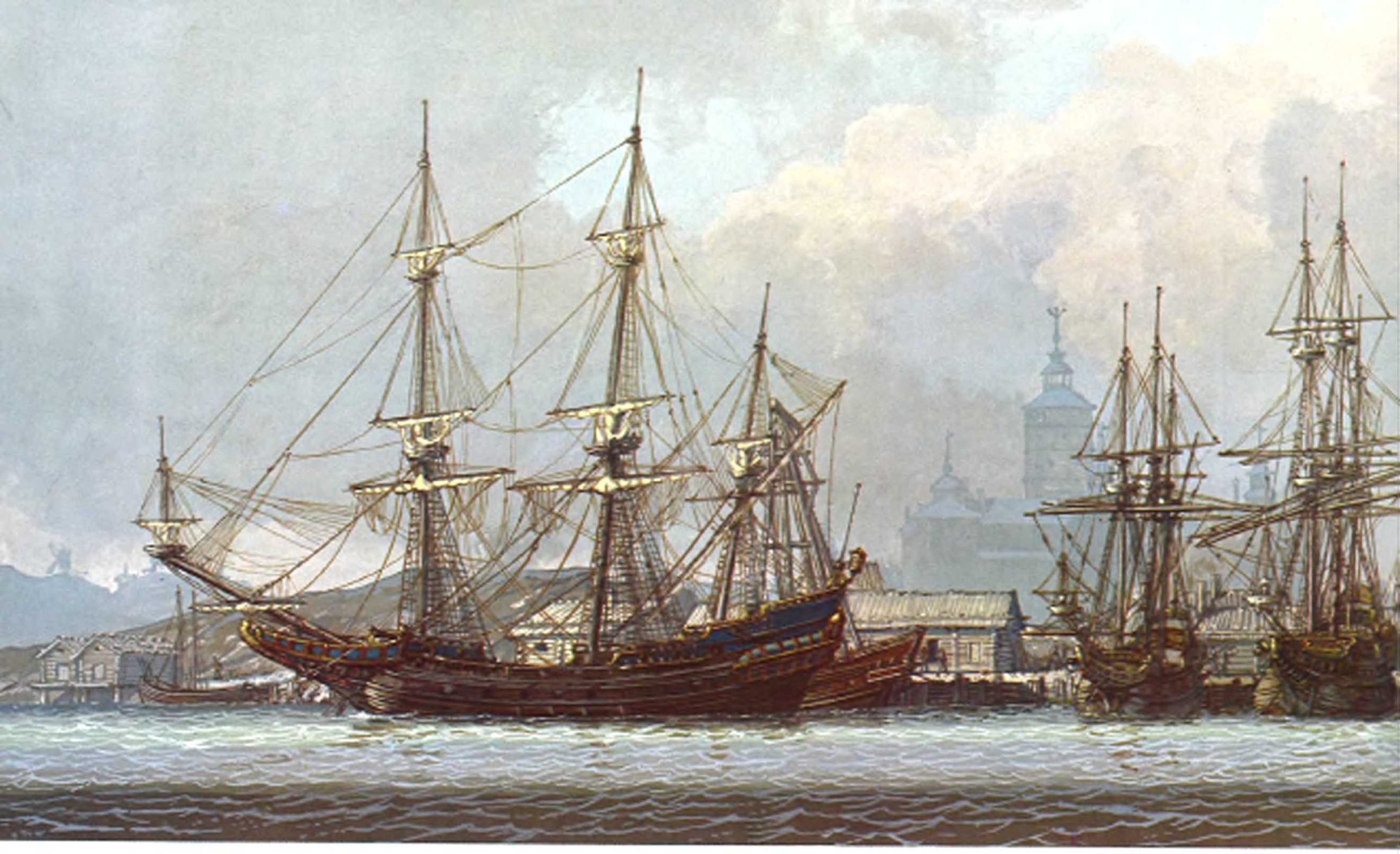
The following year Danzig was blockaded again, at first with fifteen ships, later, when autumn arrived, with only six small ships. On 18 November, ten Polish ships sailed out from the town and attacked the Swedish ships; the *Tiger* fell into the Poles' hands, her captain, Nils Stjernskjöld, having been killed. The Scots captain of the *Sun* blew up himself and his ship, and the other Swedish ships returned "somewhat shot about" to the naval base of Älvsnabben outside Stockholm. After another summer's blockade of Danzig, a ceasefire was agreed at Altmark, and Sweden won six years' peace with Poland, which country refrained for this period from making claims on Memel, Pillau and Elbing. Latvia submitted to Sweden.

The third and most dangerous war of succession was waged against Denmark, the Kalmar War, as it is known, beginning with a Danish attack. Kristian IV, the Danish king, was seriously irritated by the Swedes' plans to turn the Gulf of Finland, and perhaps the whole Baltic, into a Swedish lake. At the time, Danish possessions included not only what is now Norway but also Ösel, an island off the Estonian coast, Gotland and the present-day Swedish coastal provinces of Skåne, Halland, Blekinge, and Bohuslän. The important passages of the Sound provided rich tolls for the Danish kingdom.

The Danes took Kalmar, a town on the east coast of Sweden, and laid seige to Älvsborg, on the west coast, which capitulated in 1612. The same year Kristian IV and a large fleet attempted without success to take Stockholm. During the winters, when the fleet could not be used, Gustav Adolf with his army of soldiers ravaged Skåne but could achieve nothing decisive against the greater power of Denmark.

At the peace treaty of Knäred in 1613, the Danes were guaranteed, among other things, free trade in Riga and the other Baltic ports held under blockade by Sweden. The clause in the peace treaty that was hardest for Sweden was the one that left Denmark in control of Älvsborg and seven districts (*härad*) inland from Älvsborg, as security for damages in the-then enormous sum of one million *riksdaler*; it was due to be paid in four equal annual payments from 1616 to 1619.

The damages were settled through foreign loans that were financed by an increased export of copper. The "Älvsborg ransom", as it was called, failed



The author's painting of the Stockholm dockyard as it would have appeared from the east at the beginning of the 1620s. The royal palace can be seen in the background.

in the end to have the effect Kristian IV had intended. The Netherlands took the lead in making or arranging the necessary loans and in receiving the Swedish copper. It was not in their interest that Denmark, having heavily taxed their trade through the Sound, should grow too strong. The Swedish copper industry benefitted instead, and Dutch businessmen saw possibilities of establishing themselves in Sweden, which, for good or ill, can be considered as a sort of early Klondyke.

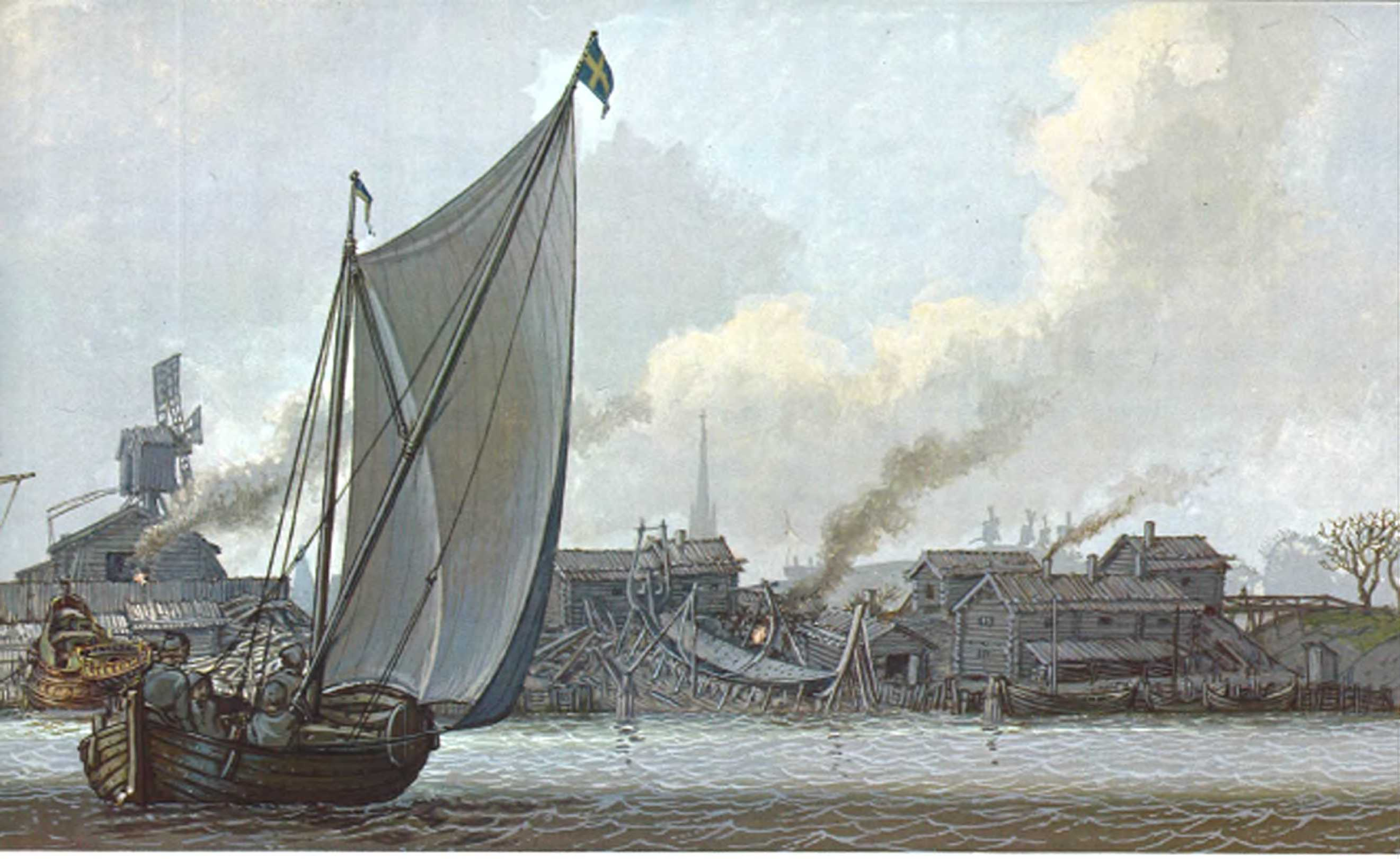
But the dangers for Sweden were not averted by the peace treaty and the cessation of hostilities. During the first years of Gustav Adolf's reign the Catholic reaction to the Reformation's successes commenced: if the small Protestant states of northern Germany were crushed by the Catholic armies, Sweden's position would be more strongly threatened than ever.

So long as the religious war was waged sufficiently far from the Baltic, Gustav Adolf could without interruption develop his policies for the confined sea that looked like becoming his. Wallenstein, however, entered the Emperor's service, and Tilly, who led the army of the Catholic League, marched north and beat the Danes at Lutter am Barenberg; this allowed him to invade the whole of Jutland and gain control over large parts of the Baltic coast. Gustav Adolf then shifted his military operations from Poland to Prussia: Sweden had made her entré into large-scale, fateful circumstances.

During the past several decades it has become popular to revalue historical heroes and recognisably heroic kings. It has been natural that a personage such as Gustav II Adolf, distinguished with the epithet of the Heroic King of the North, the Lion of the North, and the Saviour of the Evangelical Faith, should have been deprived of some of his brilliance.

But some of that brilliance remains, and in the opinion of modern historians he still stands out as a superman. One may accept the assurance of his tutor, Johan Skytte, that the young prince's upbringing was deeply influenced by a pronounced moral spirit and by a striving to inculcate a strong sense of duty. Gustav Adolf's mother was a German princess, and from his earliest days he spoke both Swedish and German; later he became fluent in Dutch, French, Italian and Latin.

It is usually said of him that he possessed the hot blood of the Vasas which—as is often forgotten—must have become rather diluted since the time of his grandfather Gustav Vasa: Gustav Adolf often demonstrated a chilly caution, particularly in the field in Germany. He was born a prince and was accustomed to be obeyed, a characteristic that was



to prove devastating for the subject of the present book, the warship *Vasa*.

Most of what follows took place in the dockyard in Stockholm, and it ought to be pointed out at once that a dockyard is not to be confused with a shipyard, but should be understood as a depot for a fleet, even if contemporary dockyards were often both depots and shipyards.

The dockyard in Stockholm had long lain close to the palace of *Tre Kronor*, on its eastern and north-eastern sides. During, and perhaps earlier than, the fifteenth century ships had been built there.

In connection with the war against Denmark, Erik XIV had greatly enlarged the country's fleet, so much so that this location became inadequate. The larger ships were then moved across Strömmen to what was then called Käpplingeholmen and is now Blasieholmen. It was turned into a dockyard, probably in 1564–65, and soon became called Skeppsholmen. At the time the short, narrow Näckeström cut it off from the mainland, running from Norrström across what is now Kungsträdgården past Arsenalsgatan and out into Nybroviken which was then called Laduviken. Skeppsholmen's only direct link northwards was Näckebro which lay about where Arsenalsgatan now meets Kungsträdgården. Skeppsholmen was much smaller then: the land has since risen and been furnished with quays.

An inventory of 1621 records the following buildings on Skeppsholmen: "A large smithy with two windmills (to drive the bellows), a jobbing smithy, a large iron-working shed with six rooms, a tar shed with two unroofed rooms, buildings for wood turning, for carpenters, for sleeping, for sculptors, for the painters, the watchmen and the post (for the watchmen at Näckebro), the old building at the top of the yard with two rooms, an old smokehouse, a new smokehouse, a new building for the clerks with two storeys, one room in each, the corn store, chambers for the ferrymen for the traffic to Ladugårdslandet, the large building with three rooms, the large hall, the sail-loft and the writers' chamber, the large Clerks' Building with seven rooms, the small Clerks' Building with two rooms."

From 1610 there is information about other buildings in the yard: a mast-top house, a house by the careening jetty, the sloop house and the goods shed. The careening jetty possessed some stone chests the same year; a landing stage to which ships tied up is also mentioned. In 1616 the buildings were given roofs made of birch-bark, and in 1618 three brick chimneys were made in the new building by the water, and iron rods with rings were driven into the rock on Lustholmen, the present-day Skeppsholmen. In 1610 Skeppsgården's own vessels were: *Holmpråmen* 'the Holm barge', *Nya bojorten* 'the new sloop', *Holmskutan större* 'the larger Holm cutter', *Holmskutan mindre* 'the smaller Holm

cutter', and the *Julius Caesar* or *Makalös*.

During Gustav Adolf's reign there were many other dockyards in the kingdom. According to the Swedish writer Axel Zettersten (pages 274–292 ff), they were at Kalmar, Nyköping (until 1612), Åbo, Helsingfors, Kexholm, Riga and Elbing, and yards that built ships for the fleet were at Stockholm, Västervik, Ulvesund, Västerås, Ridö, Arnö, Harbovik, Kronholmen, Hudiksvall in Ångermanland, at the mouth of the Uman River in Västerbotten (Western Bothnia), Pedersöre in Österbotten (Eastern Bothnia), Ekenäs, Emsalö outside Borgå, and Kastelholm on Åland.

The Dutch master shipwright Hendrick Hybertszoon, whose name is intimately connected with the warship *Vasa*, came to Sweden as early as the beginning of the seventeenth century. He worked as master shipwright at the dockyards in Stockholm (1603–05), Kalmar (1606–10), Nyköping (1611), and from 1612 until his death in 1627 once again at Stockholm.

The two kings he served evidently appreciated him, for he enjoyed the use of a variety of property at different times. This included a small vessel and a number of farms near Stockholm and on the island of Öland.

Up to 1620 the Stockholm dockyard had been run by the Crown but in order to reduce administrative work and the supervision it entailed, that year it was leased out for four years to Lieutenant-Colonel of the Kingdom's Armoury, Anton Monier; the master shipwright in charge of the yard was then Hendrick Hybertszoon.

On 16th January 1625, a new lease, now preserved in the National Maritime Museum, Stockholm, was signed "with Mr. Henderick Hybbert and Arendt Grott that [they should] maintain the whole fleet and build some new ships." The first clause of the contract concerned "the care of the fleet that lay at the yard, both large and small vessels, of all sorts of galleons, Dutch sloops, prams, barges, yachts, ships' boats and other small craft including *strussar* and *lodjor* [two types that, to judge from their names' etymology, originated in Russia and Finland respectively], together with the tackle they require, such as gun carriages, pulleys and rollers, all without any exception but for the tackle for the fleet", which was leased under contract to Admiral Rickard Klerck.

According to the second clause they were, for the four years of the contract, to "meet Our needs, lay off, build and make ready for sea four good ships, well built and strong, two with each a keel of sixty-four Swedish ells, a breadth on the upper deck within the planking and outside the ribs seventeen Swedish ells and that the stems and sterns should well exceed the proportions and that what thereto relates be well formed and built." The two other vessels were to have the proportions of the *Gustavus*. The first of the large ships was to be delivered in 1626, the other in 1628; a payment of 80,000 *dalers* would be made for these two, and a payment of 30,000 *dalers* would be made for the two smaller vessels.

The other clauses in the contract concerned gun-carriages for field pieces with fittings that were to be supplied annually to the armoury to a value of 7,500 *dalers*. Gun-carriages for the ships were to be built and repaired, as were bridges and buildings in the yard, and when the fleet went to sea the ships were to be supplied with numbers of shipwrights in proportion to their sizes, and the shipwrights were to be paid, victualled and supplied with other necessities.

For each and every one of the four years the lessees were to receive 66,000 *dalers*. They were permitted to fell one hundred oaks south of Kalmar, Vira sawmill was to work for them, as were the smithy in Nacka and the hammer-mill in Arboga, and, finally, they were permitted to import free of customs duty as much timber and charcoal as they needed.

Another contract, of 10th February 1625, and also in the museum, concerns the rebuilding of *Applet*, also called *Riksäpplet*, which was to be improved and repaired with a keel and perpendiculars "and everything else that caused its strength to fail—so that it can bear and carry its correct load and suitable pieces [cannon] thereto according to its size and that it can be serviceable to Us the Crown to use both in a seaway in warfare and in all other respects."

The ship's barges were to be rebuilt, after the pattern provided by the *Stockholm* and the *Gustavus*. The lessees were to begin this work on 1st April 1625.

Äpplet was the fleet's largest ship, its size being reckoned at 450 lasts, but it was to wait for a long time for its rebuilding, and work had scarcely begun by the autumn of 1628; it is not known if it was ever completed. This rebuilding ordered by the king had become a wholly new construction, in that from the keel and staves upwards it was a matter of building a stronger ship.

Äpplet had been built in Västervik under the direction of two Dutch contractors, Paridon van Hoorn and Christian Welshuisen, two gentlemen who were often out of grace with the king, but it is uncertain if the faults in their work were due to

ignorance or carelessness. In December 1623 they entered into a contract with the king under which they undertook to deliver by the following spring three earlier-built ships, one of which was *Äpplet* with some better repairs with iron, "bolts well inset and the cabin fitted with all sorts of inlaid wood." But Paridon van Hoorn and his partner could not fulfill the terms of the contract, and so *Äpplet* was turned over to the new lessees of the Stockholm dockyard.

This 'Arendt Grott', who became Hendrick Hybertszoon's partner, was actually Hendrick's brother; he was a businessman, Arent Hybertszoon de Groote (the Great), and we may guess that he was an unusually tall fellow, perhaps also well-developed economically which—then as now—could gain him such an epithet. He was a friend and confidant of Louis de Geer, an industrialist on a large scale, and one cannot exclude the possibility that de Groote was accepted as lessee of the dockyard on de Geer's recommendation. This de Groote was later to give what is in my opinion misleading evidence during the enquiry after the accident, in that he claimed the *Vasa* had been built to the same specifications as a ship built in Holland for the Duke de Guise (cf., page 34).

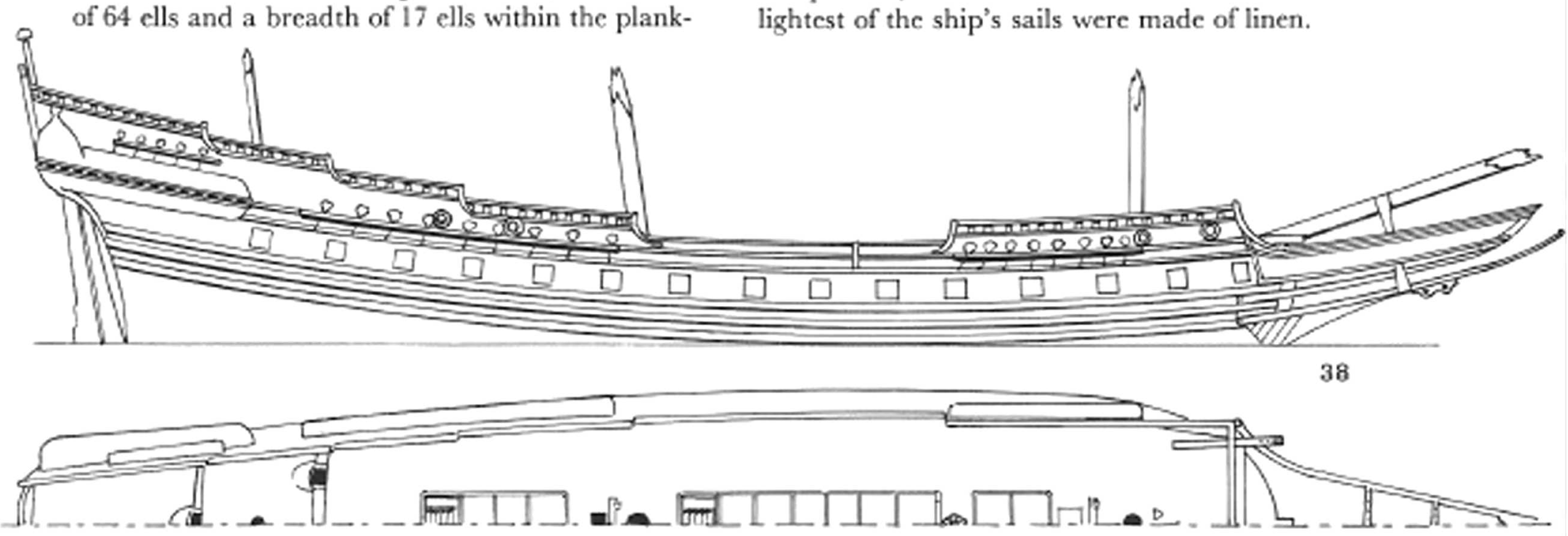
It was perhaps the king who understood, after taking advice from Vice Admiral Klas Fleming, that the rebuilding of *Äpplet* would delay all new construction at the yard. In any event the first of the two large ships contracted for was built in record time, launched during the summer, named *Tre Kronor*, and fitted out during the autumn and winter.

If she was built according to contract, with a keel of 64 ells and a breadth of 17 ells within the planking, she would have been a slender ship. (64 ells equal 38 m/125′; 17 ells equal 10 m/33′.) Her overall length would then have been about 46.5 m and her proportion of length to breadth 4.65:1. The Dutch ship *Achilles* (1630), however, had a proportion of 4.52:1, and the *Dolfijn* (1633), another Dutch ship, had 4.64:1, both according to Vreugdenhil (page 3). They, and the *Tre Kronor*, were armed with 32 cannon. We know that the Swedish ship carried 32 twelve-pounders and 4 six-pounders and, in addition, 4 storm pieces: 2 twenty-four-pounders and 2 forty-eight-pounders.

I find it natural that *Tre Kronor* would have had one complete gun-deck, on which she carried thirty of her twelve-pounders; the remaining two were in the gun-room furthest aft on the orlop-deck and were pointed astern. The other pieces were carried on an upper deck, four before the foremast and four aft of the mainmast (reconstruction drawing 38).

A table of costings for *Tre Kronor*'s sails, drawn up by the tackle lessee at the yard in 1626 and published in the Swedish annual publication *Sjöhistorisk Årsbok* for 1963–64, reveals that the courses were made of French canvas: 'courses' (Sw. *skönvallen*) meant at the time both the lower sails, namely the foresail and the mainsail, but they were specified often by being called the fore-course and main-course. The mizzen and courses' bonnets were also made of French canvas.

The main-topsail was sewn of narrow 'Danish' i.e. Danziger, cloth, the fore-topsail of broad Danziger. The fore- and main-topgallants, and the mizzen-topsail, were made of French cloth which was probably the same as German *klaverduk*, Dutch *klaaverduk*. It has been clearly demonstrated that canvas and *danzigerduk* are different qualities of hemp cloth, and it cannot be ruled out that the lightest of the ship's sails were made of linen.



38



39

Painting by the author of the Swedish coat-of-arms during the time of the Vasas (39). The escutcheon is a sheaf, in Swedish vase *or* kärve. *This coat-of-arms was placed on the ship's stern.*

The Puzzles about the Vasa

According to the contract with the king dated 17th January 1625, the two large ships should be the same size, but the hull that was lifted in stages between Beckholmen and Kastellholmen and that eventually re-saw the light of day on 24th April 1961 was of quite different proportions. Even before the work of attempting to raise the ship had been begun, it was known that it was the almost forgotten *Vasa*. As soon as the wreck had been localized by Anders Franzén, researchers began to seek information in various archives about the ship. A number of articles appeared in the media. The lifting operation went on during the summers of 1959, 1960 and 1961.

Before the first lift the seabed around the hull had begun to be minutely examined; this work went on systematically until 1967, when the job was considered done: 24,000 separate pieces had been recovered, about 14,000 of them being constructional items. The archeological investigation on board —the hull was half-full of mud and sludge—was done very quickly, because the ship had to be built in for conservation as soon as possible; despite the speed, however, the investigation, which was led by Dr. Per Lundström, has been accepted as a model of its kind.

46

It quickly became clear that transforming the wreck into a ship would be rather more than a matter of solving a gigantic jigsaw puzzle. To begin with, no one knew enough about seventeenth-century shipbuilding, while it gradually became apparent that the *Vasa* differed in many essentials from the known models and other representations of contemporary ships; the few extant models of Dutch ships from the early seventeenth century are relatively primitive votive-ships. After lengthy study I have been unable to find any painting or drawing that in its details wholly tallies with the *Vasa*. From the middle of the century everything is easier: models are more carefully made, drawings, etchings and paintings are detailed.

Early on there could be sensed a link with the French ship *Le Grand Saint Louis*. Hondius' etching (see page 36) was well known. In the May 1957 number of "Tidskrift i Sjöväsendet" Georg Hafström published an article on the loss of the *Vasa* in which he cited the copy of the minutes of the enquiry that has already been mentioned; he quoted its passage on Arent de Groote: "Arendt Degrot was asked why the ship in her construction was so poorly equipped [and] he answered that he had done it according to the specification that he states he has contracted with HM according to what he had shown HM of a Frenchman that he

saw built in Holland for the Duke de Guise, [he] asserts the fault not to be in the building but as the shipwright means she shall be equipped with ballast."

As already mentioned, a link was felt to exist between the two ships but no notice was taken, or nothing was known, of the details of how they differed.

Bit by bit it turned out that the shipwrights who had been engaged to work at the direction of the experts themselves became the real experts. By trial and error, not the preconceptions of a doubtful knowledge, they put pieces together, checking that holes from nails and bolts did actually correspond.

With the help of the shipwrights and the drawing office, Dr. Hans Soop solved the puzzles about the sculptures' locations. There are round about one thousand sculptures, and almost everything of them has been recovered. The most important missing bits of the puzzle are the details of the balustrade that ran across the forward end of the upper deck; only one baluster and a relief-like representation of a child's head are extant. By early 1984, only smaller sculptures that may have adorned a cupboard or an ornamental chest in the cabin had not been placed.

The conservation of the ship was completed by 1984, when changes in the hull were no longer measurable. With the ship then as dry as possible, the sculptures could be put back in place. Many puzzles remain, however, and if some will probably be solved, others will remain insoluble. There remains, however, the researcher's right to combine knowledge and imagination to approach the truth.

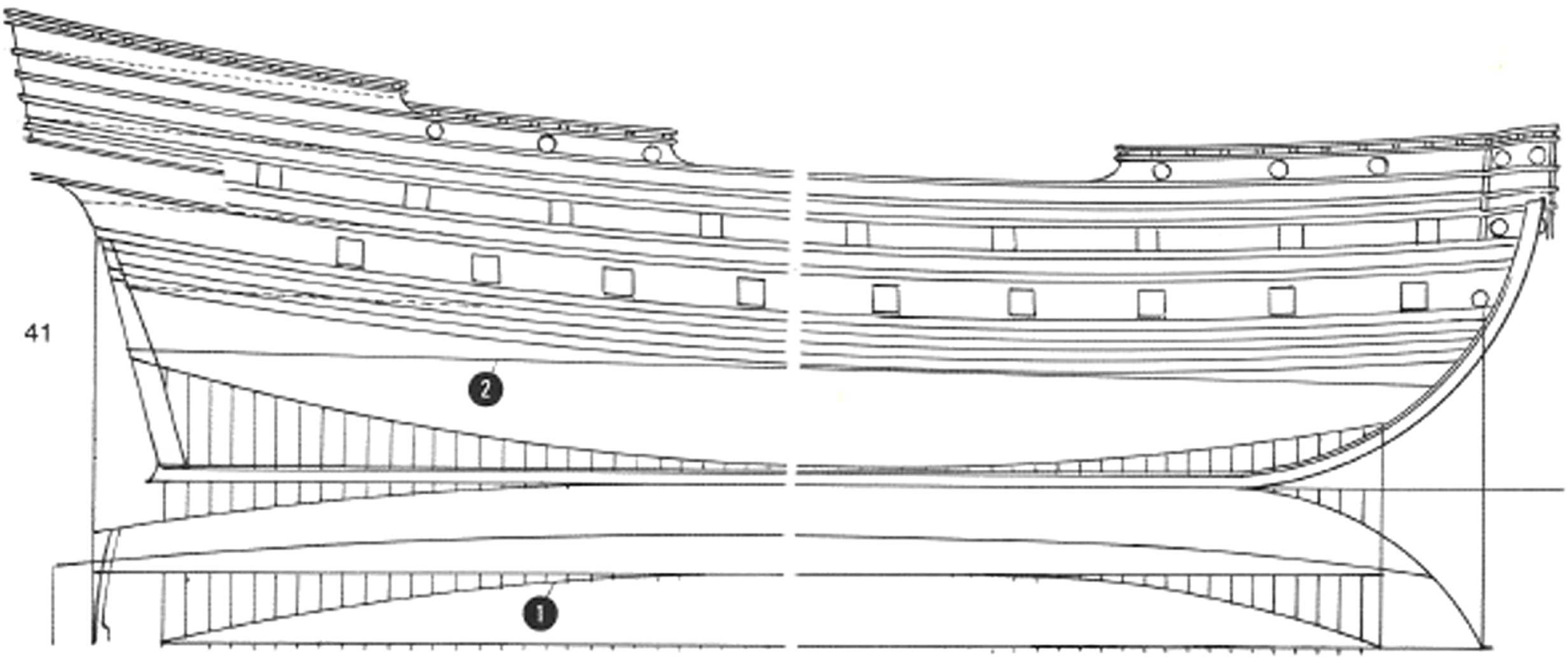
The most baffling of all the puzzles concerns the decisions and the ensuing activity that led to a ship so unbelievably unstable that she "turned turtle without there being a hint of a storm," as the eighteenth-century Swedish writer Carl Bechstadius put it (pages 126ff). Why was not the *Vasa* built to the same specifications as the *Tre Kronor*, as had been agreed and contracted for from the beginning?

In an article in "Tidskrift for søvaesen" in 1960, on the construction drawings of the Danish warship *Sancte Sophia*, Captain P. Holck of the Danish Navy claimed that the *Vasa* was built larger and given more powerful armaments than *Tre Kronor* in order to preserve the maritime balance of power in the Baltic. *Sancte Sophia*, also known as *Store Sophia*, was built by Kristian IV's master shipwright David Sinklar (or Sinclair?). She was built in the British manner; her construction drawings were found in the Royal Archives and identified by Captain Holck.

Building was begun at Slotsøen at Nakskov on 1st May 1624, and the ship was delivered at Bremerholmen in Copenhagen on 22nd December 1627. It seems natural enough that Gustav Adolf would soon have received reports from spies about this large new ship (illustration 41). It was to be fifty-three Brabant ells (36.87 m) on the keel; *Tre Kronor*'s keel was 64 Swedish ells (38 m). The Danish ship was to be about 46 m overall, or about as



Photograph, taken immediately after recovery, of one of Vasa's *gun-ports. Traces of paint can be seen in the mane, eyebrows, eyes and mouth of the lion. The nail holes form a diagonal pattern.*



Drawing of the Danish two-decker Sancte Sophia *(after P. Holck). By 'two-decker' is meant a ship with two complete gun-decks,* Vasa's *being her lower and upper decks. This drawing is reminiscent of those of* Prince Royal (illustration 18). The flat 1 *is as narrow as was customary on all British warships of the time, and we can therefore take it for granted that her builder, the Scotsman Sinclair, always worked in the English fashion. The water-line as indicated* 2 *is certainly misleading, for the ship would have drawn at least an additional two feet. Note how far forward the forecastle is drawn.*

long as *Tre Kronor*. *Sancte Sophia*'s breadth is given as the equivalent of 10.7 m, which made her 70 cm broader than *Tre Kronor*.

The general size of the new Danish construction should not have been frightening. We do not know whether the spies knew from the start that the ship was to be built with two decks or to carry twenty-four-pounders, but it seems probable that the king got to know of this in one way or another.

I believe that Arent de Groote deliberately perjured himself in giving evidence on his journey to Holland, and on the *Vasa* having been built to the same set of specifications as *Le Grand Saint Louis*. I believe that he was put up to doing this, perhaps by Klas Fleming or someone else on the National Council, so as to protect the king's good name. The information Fournier gives on the French ship's dimensions indicates that she was much shorter than *Vasa*, the difference in length overall being almost exactly 10′ or 280 cm. In any event, I doubt if the Dutch would have sold the ship's specifications to Arent de Groote.

Vasa's keel length is 38.34 m, or insignificantly longer than *Tre Kronor*. In a letter in the Swedish national archives dated 21st March 1626, Klas Fleming told the king that Hendrick Hybertszoon had said that the ship he had in hand could not be quite as large as the king had wished. From this we may conclude that from the start the new warship was intended to be longer than *Tre Kronor*, probably so as to be able to carry a sufficient number of twenty-four-pounders; *Tre Kronor*, it will be recalled, carried thirty-two twelve-pounders.

I believe—but naturally cannot demonstrate—that the new ship was intended to be bigger than *Tre Kronor*, which was a sound ship, and that instead of carrying twelve-pounders on her single complete gun-deck, she should carry twenty-four-pounders. I believe that her flat had been completed when the king received alarming information that the new Danish ship was to have two complete gun-decks, and that he then personally ordered that the new warship should be a two-decker, with twelve-pounders on the upper gun-deck.

Nothing indicates that Hendrick Hybertszoon protested against such an order; at all events no written evidence is extant. It is possible that he was already suffering from the illness that was to kill him long before the *Vasa* was delivered, and, by reading between the lines of the minutes of the enquiry, it seems he did not have control over what was done during the early stages of building.

The master shipwright Hein Jacobszoon, also a Dutchman, had been *Vasa*'s shipwright from the beginning. He was examined by the court of enquiry about why the ship was so narrow and poorly designed that she had no belly that could have stopped her from heeling so far that she turned over.

"To this he answered," say the minutes, "he had built it according to the specification that he had been given by Master Hindrick *and on HM's command*. [And he] said he had even so built her one foot and 5 inches broader than was given [in the specification], and all people say she was well built." (Emphasis added by the author.)

No-one can say definitely that he widened the flat or floor of the ship. It seems to me natural that the flat was complete and that the sweep from the runghead to the greatest breadth was made rounder by using a shorter radius. In that way, Hein Jacobszoon probably reckoned, the ship would acquire a larger underwater body and thus greater capacity and stability. Had he been able to broaden the flat he would certainly have been able to build a ship stable enough to carry the two gun-decks. But he was aware that his solution was a half-measure and contrary to the rules he had learnt, and he certainly put forward his doubts to Arent de Groote who, through his good connections with Louis de Geer, had the nerve to criticize a royal decision. It was therefore important that he and no-one else should give perjured evidence on the specification.

The twists and turns in the affair must have been numerous, and I may have missed or misinterpreted some details, but on the basis of strong circumstantial evidence I pronounce Gustav II Adolf responsible for the accident to the warship *Vasa*. I shall discuss and amplify this evidence below.

The hypothesis has been put forward that Hein Jacobszoon made the ship this one foot and five inches broader when he got to know that the upper gun-deck, as well as the lower, would be armed with twenty-four-pounders. To that one can return the answer that the beams of the lower gun-deck are nineteen inches thick, while those of the upper gun-deck are only fourteen inches. The lower gun-deck ports are on average 75 cm wide, those of the upper gun-deck only 60 cm. This seems to show that the ship was completely built when the decision was made to place twenty-four-pounders on her upper gun-deck.

One foot and five inches makes about 41 cm which deducted from *Vasa*'s greatest breadth within planking leaves 10.69 m. We do not know *Tre Kronor*'s exact length overall, only her keel length and greatest breadth, sixty-four and seventeen ells respectively, proportionately 3.76:1. To keep the same proportions the planned single-decker *Vasa* should have been 40.2 m on the keel; despite three scarfes, the timber could not give a greater length than 38.34 m.

This is naturally all speculation but if the departure from specification was nearly 2 m, there was good reason to inform the king that the ship would not be "fully as large as His Royal Majesty's specifications state."

In time the king got to know that *Sancte Sophia* carried 20 twenty-four-pounders on her lower gun-deck. On her upper gun-deck she carried 20 sixteen-pounders, on her forecastle and quarter-deck 2 double twenty-four-pounders, 2 twenty-pounder and 2 ten-pounder serpents, 2 five-pounders, 4 falconettes and 2 stone pieces.

The armament that was finally taken onboard *Vasa* would clearly have exceeded *Sancte Sophia*'s assembled fire-power, but the unexpected interposed itself.

One of the many sculptures representing Roman soldiers that once embellished the underpart of the lower stern galleries of the Vasa.



Preparations

The dockyard in Stockholm that the Hybertszoon brothers leased was the responsibility of the Admiralty which was in its turn directly responsible to the king or, in his absence, to the Council of State. This, however, did not hinder the king from repeatedly negotiating directly with—or simply commanding—the lessees of the dockyard.

On paper, the head of the Admiralty was the Lord High Admiral Karl Karlsson Gyllenhielm, the illegitimate son of Karl IX (Gustav Adolf's father) by the daughter of a priest, Karin Nilsdotter. Gyllenhielm was born in 1574; having studied the art of war in France, he campaigned in Livonia against the Poles by whom he was taken prisoner in 1601 and imprisoned for twelve years; he was kept in chains for more than half this time. He was brave and constantly loyal to his half-brother Gustav II Adolf, who was twenty years his junior.

He was made Lord High Admiral in 1619 but scarcely distinguished himself by displaying any great energy in matters concerning the organisation of the fleet; in practice, the affairs of the fleet came to rest in the capable hands of the Vice Admiral Klas Fleming, but even Fleming could not devote all the time that was needed to the dockyard. When one reads of his other activities and his responsibilities during the time in question, one understands that he was one of the king's most trusty —and most stressed—councillors.

In the autumn of 1625 when timber had begun to be felled for the large new warship, the fleet suffered a very severe loss. About 20th September during the passage home from Riga, an easterly or north-easterly storm drove ten ships onto the sandbanks outside Domesnäs point at the mouth of the Gulf of Riga, causing the loss of the great ship *Ängeln* and the medium-sized ships *Gustavus, Maria, Mars, Hektor, Orfeus, Perseus, Harbolejonet, Hannibal* and *Elefanten*. A great ship was of 100 to 200 lasts, with a crew of 50 to 60 men, while a medium-sized ship was of 100 to 150 lasts with a crew of between 34 and 40 men. As recorded by Axel Zettersten (pages 329ff), the new warship was to measure 200 to 450 lasts with a crew of between 93 and 127 men.

The accounts of the dockyard for 1627 and 1628 have disappeared, so it is therefore impossible to give anything like reliable information on its personnel at the time when the new warship was being built; my account draws on the work done by Carl Olof Cederlund. It is not certain whether Hendrick Hybertszoon was to direct the work of the new construction. He was, however, the yard's lessee and administrator and would certainly have been responsible for contacts with the king and the Admiralty, but we know that he had been seriously ill before the construction work began; the master shipwright Hein Jacobszoon was probably required to direct the practical work. Arent de Groote's tasks for at least the first year are hard to determine: periodically he acted as purchaser of material abroad, primarily in the Netherlands, and it was certainly he who arranged the necessary credits there.

Hendrick Hybertszoon's wife, the very capable Margareta Nilsdotter, took part in the administration of the yard during her husband's illness; and after his death, her son, probably from an earlier marriage, served as a clerk.

The Captain of the Dockyard, a post that still remained from the time when the Crown administered the yard, was Söfring Hansson; he is sometimes given the additional name Jute, which suggests he came from Denmark. He acted as the Crown's overseer of the yard's work, and he would also have served as the keeper of the stores.

There was yet another master shipwright, namely Johan Isbrantsson, who was the Swedish-born son of the Dutch master shipwright Isbrant Johanszoon. He is named in connection with the construction of the great warship only as a purchaser of oak in Småland, but it seems certain that he would later have had some post in the yard, for after the accident he was one of the witnesses at the enquiry who testified to *Vasa*'s excellence.

The most important workers in the dockyards were the shipwrights, and the calculations that were made before the lease for the yard was drawn up indicate that there were ninety-eight Swedish shipwrights. It is not known how many Dutch shipwrights were employed, but their numbers and knowledge must have been significant: work on the ship seems frequently to have come almost to a standstill when the Dutch refused to work until they had got their back pay. To judge from the accounts, special beer was brewed for these Dutch workers, who were not satisfied with the weak Swedish stuff.

The shipwrights' immediate superiors were quartermasters, who were probably especially experienced shipwrights. Like all other larger groups of craftsmen, shipwrights were ranked as masters, journeymen or workmen, and at this time shipwrights included also those designated as sawyers, borers, nailers, caulkers, top-makers and mast-makers.

Apart from the actual casting of cannon, the dockyards at this time undertook all the work concerning armaments, so that shipwrights would also have included makers of gun-carriages, wheel-



How best to get ships' timbers from oak-trees (43), from an eighteenth-century engraving (see Panckoucke & Agasse, *plate 102). The trees themselves would be selected by a master shipwright, and ships' carpenters and seamen would mark and fell them. Admiral Herman Fleming wrote in 1649 that "it shall be well taken account of that all oaken timbers that are to be used in this ship's building shall be cut or felled between autumn after the leaves have fallen and the 15 or 30 March in the spring, for the winter cold will sooner or later return, and all will remain in good condition and unharmed."*

wrights, axle makers and turners. These workers may perhaps have been classified as carpenters who, among other things, made the ship's galleries and the cabin furnishings. The well-paid sculptors, however, were included as shipwrights.

Three master sculptors worked on the embellishments of the new warship, being assisted by at least two journeymen and an unknown number of workmen. The shipwrights, carpenters and sculptors worked together with a glazier and an unknown number of painters. At least one flagmaker and a number of sailmakers were employed at the yard, but they were the responsibility of the tackle-lessee, Captain Hans Klerck, who had taken over this lease in 1625 on the death of Admiral Klerck.

In the two smithies worked anchor smiths, nailers, locksmiths, gunsmiths and the smiths who made bolts, fittings for the hull and rigging, and tools for the ship and shipyard. The locksmiths made carpentry tools, locks for doors and chests, and other fittings. Gunsmiths made fittings for gun-carriages, and their wheels and rollers.

A separate group comprised turners and block-makers, who first and foremost made blocks and their sheaves, deadeyes, parrels, pegs and cleats, belaying pins and thimbles. They also bored out pumps from elm-tree stems, and made the other parts of the pumps.

In 1612 the Crown had employed the Dutch compass-maker Jockim Joris to meet the needs of the fleet, but during the time of the lease to the Hybertszoons compasses were imported from Holland. Among other workers at the yard were tar boilers, boatswains, watchmen, ferrymen, and a drummer.

Victuals were handled by a purser's clerk, a steward and some pursers' helpers. Brewers, millers and bakers, all of them foreigners, probably Germans, carried on their work in the Crown bakery at Ladugårdslandet, and among others on the lessees' payroll were the sawyers at the sawmill.

The ropewalk lay to the north by Laduviken, roughly where present-day Stureplan lies, and was controlled by the dockyard. Its products could hardly have been of the best quality, for there are records of the import of rope during the time when the new ship was under construction.

The dockyard had earlier made its own charcoal but by this time charcoal was being bought from the public at large, while actual coal began to be imported from Holland and England. Although coopers are not mentioned, they must have been on hand to make new casks and to repair old ones. Tanners and leatherworkers, too, would certainly have supplied the bellows for the ship and the smithies; untanned hides for pump leather were bought both in 1625 and 1626. There would have been still other people permanently or temporarily employed at the yard, and this account could be made still longer, and the lively details of the activity of the yard more complete, if they were all mentioned. We can add, finally, that the souls of the dockyard workers were from time to time the subject of church services held by occasionally engaged clergymen, while their physical health was entrusted to a regularly-employed barber-surgeon.

Ships were rigged in the yard, including the newly-built ships. Hybertszoon had only to supply Captain Klerck with masts, yards, all other spars, tops, blocks, deadeyes, cleats and the necessary fittings in iron. The tackle lessee had to supply standing and running rigging, and anchor cables of various dimensions.

The preceding chapter made it clear that it is impossible exactly to reconstruct the *Vasa*'s original specifications. At the yard in Stockholm the details of Hondius' engraving of *Le Grand Saint Louis* were as little copied as were the then-typical Dutch and French division of the decks (cf., page 36). On the French warship the upper gun-deck was open between the quarter-deck and the forecastle, the two being joined only by a grating.

At this time it was often customary to put to sea as soon as the water was ice-free, and to blockade the harbours of eastern Prussia until the end of November. Cannon balls, bits and pieces of metal, and grapeshot that enemy vessels discharged from time to time were not the cause of the greatest losses of life, and the king's words in the Council of State's Instructions of 8th April 1628—they are preserved in the minutes—give an idea of the difficulties and of his care for his subjects and, naturally, of his underlying care for his realm.

"And while His Royal Majesty has caused the ships to be divided into two fleets and both to be manned with barely-adequate crews, the Council of State should then take care to furnish the fleets with victuals and all necessities, particularly with funds, beer and bread, and thereto to require the towns out in the country to furnish supplies to the fleets, so that the crews may have their necessary victuals and not be forced to have to drink the salt water, which is a reason that so many have fallen into sickness and lost their health, to the great damage and remarkable loss to His Royal Majesty and his Realm."

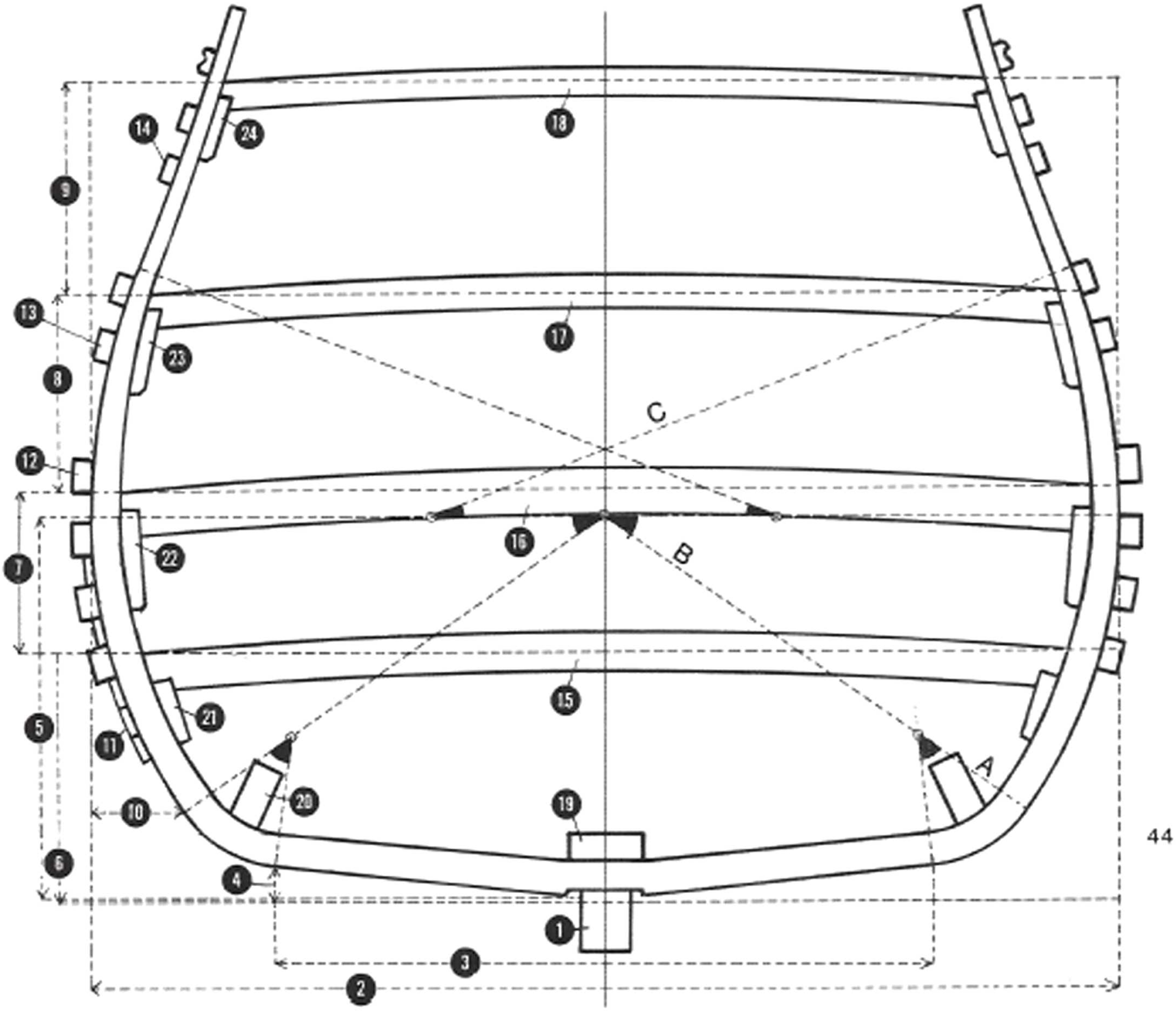
I cannot escape the thought that the upper-deck was fully planked, instead of being given only a grating, in an attempt to make life on board a little less miserable for the seamen.

While we cannot, as already mentioned, reconstruct the original specifications, we have the ship herself at our disposal, and from the measurements and drawings that have already been taken off, we can reconstruct the specifications to which she was actually built.

To make this clear I have drawn *Vasa*'s midship frame with the help of ruler, set-square and compass, but my readers should not therefore believe that the ship is actually as symmetrical as this drawing suggests, for the entire starboard side of the *Vasa* sags a bit. It would certainly have been the intention of the master shipwrights and their men to build a ship that was as symmetrical as possible, but the Dutch method did not make it easy to do this in practice, and in the next chapter I return to this subject and its difficulties.

If we now compare *Vasa*'s midship section (illustration 44) with Witsen's midship section (page 33) and its design, it will at once be seen that they differ greatly, but we should recall that Witsen's midship section was designed at the end of the 1660s, perhaps even in 1670, his book being published the following year. I am convinced that the absolutely best Dutch midship sections in 1626 differed in appearance from those of 1669; although I know of only a few Dutch specifications prior to 1631, all of them have a runghead sweep drawn with a markedly shorter radius than that given by Witsen.

On the *Vasa*, too, the runghead sweep (illustration 44, *A*) has a short radius; Witsen's is proportionately double the length. We can also see that Hein Jacobszoon drew the sweep up to the greatest breadth in a curve centred on a point on the ship's vertical axis. Witsen says of this sweep, with emphasis, that its radius should be greater than half the breadth and less than the whole breadth. On

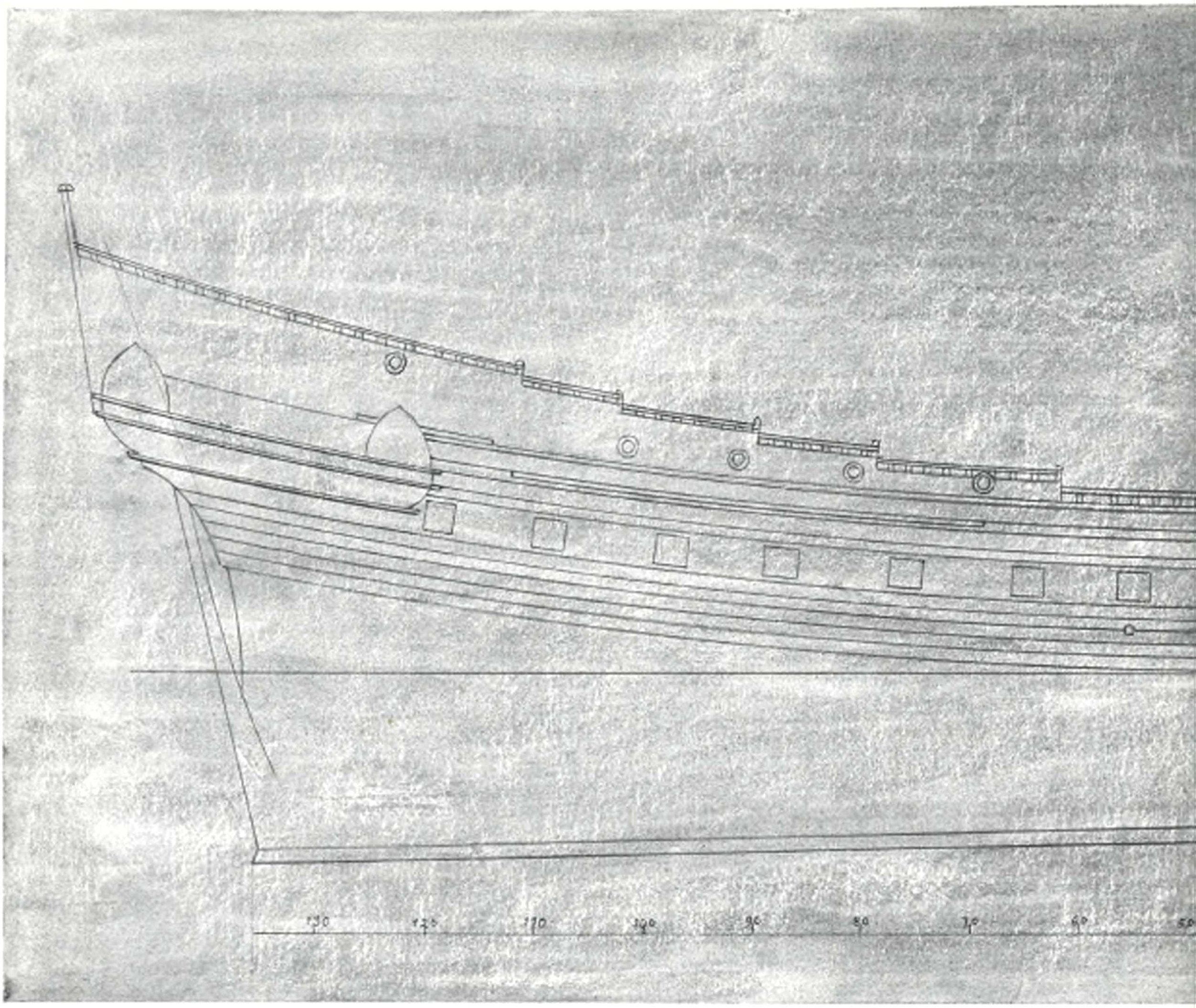


the *Vasa* (illustration 44, *B*) it is equal to half the breadth. The earlier specifications seem to indicate that this part of Witsen's rule was in force as early as the time when *Vasa* was built, but *Vasa*'s designer tried to make the best of an impossibility when he got to know of the second gun-deck: the sweep up from the greatest breadth (illustration 44, *C*) has a radius that is 6′6″ greater than half the breadth, while the same sweep is, with Witsen, of a radius that is one half of half the breadth.

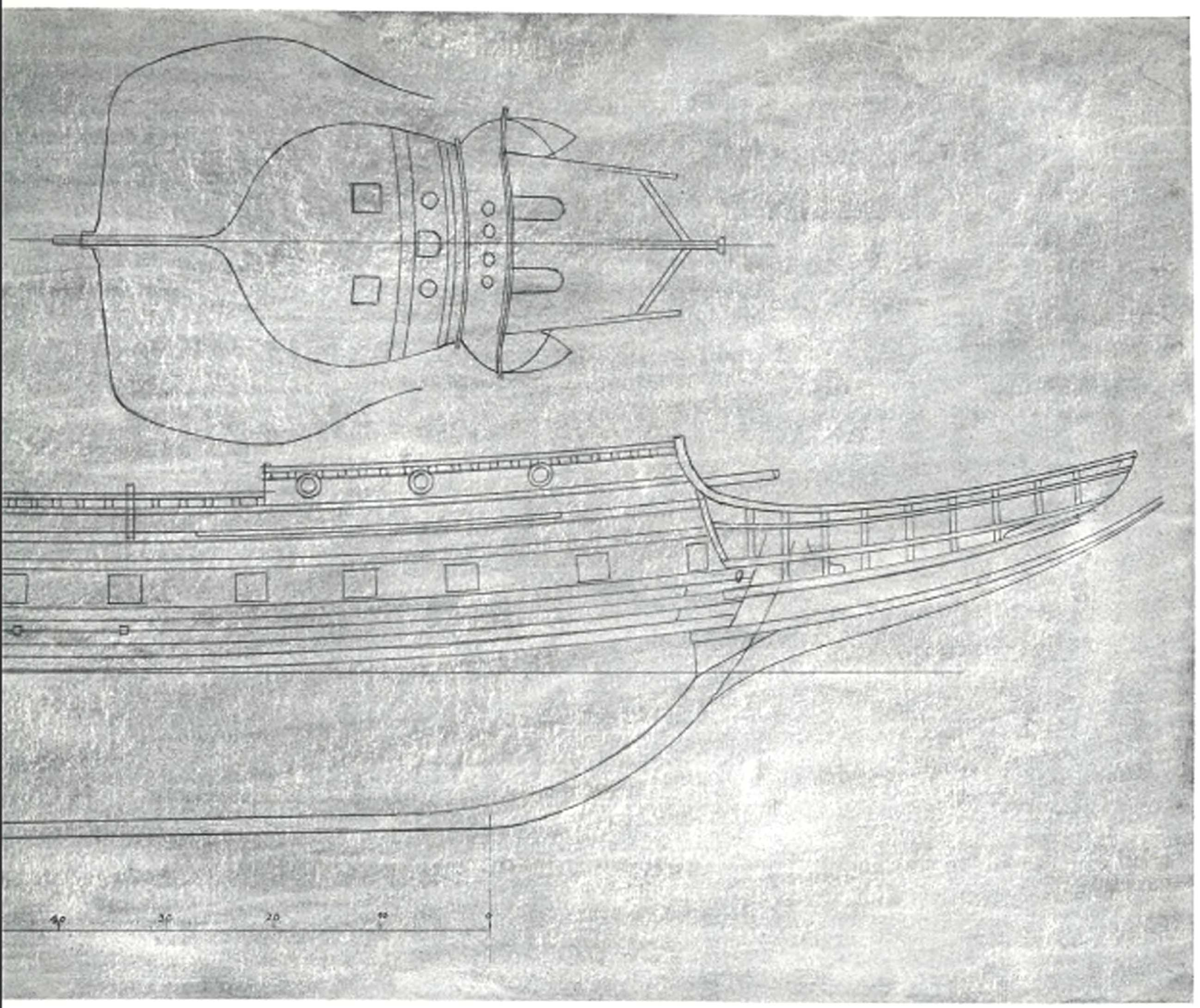
It should be observed already at this point of the discussion that the Dutch method of building required that only three sections and the stern should be designed with sweeps and straight lines. The midship section came first, then the section that was located on the forefoot, and the third section was put up roughly half way between the midship section and the stern. It, or the frame on which it was built—called the fashion pieces—can be regarded as a fourth section, for it and the three first sections proper together determined the form of the hull and the ship's character.

The following specification is made up for the *Göta Ark*, built in Göteborg in 1631 by Albrecht van Velden (see Svensson, page 95). That ship was about the same size as the *Vasa*. The measurements given are from the *Vasa;* the numbers correspond to those on the main frame shown in illustration 44.

1.	Keel: height		24″
	width		20″
	length	135′	5″
	Length between uprights	167′	9″
2.	Breadth within the planking	39′	2″
3.	Floor: breadth	25′	0″
4.	rise		14″
5.	Draught	14′	5″
	Wing-transom, length	21′	10″
	Height of the tuck at the fashion-pieces	15′	0″
	Belly piece, thickness		15″
	Futtocks over the strakes, thickness		14″
6.	Hold: orlop	9′	3″
7.	Height between planking: lower orlop	6′	2″
8.	Height between planking: orlop	7′	4″
9.	Height between planking: between decks	8′	0″



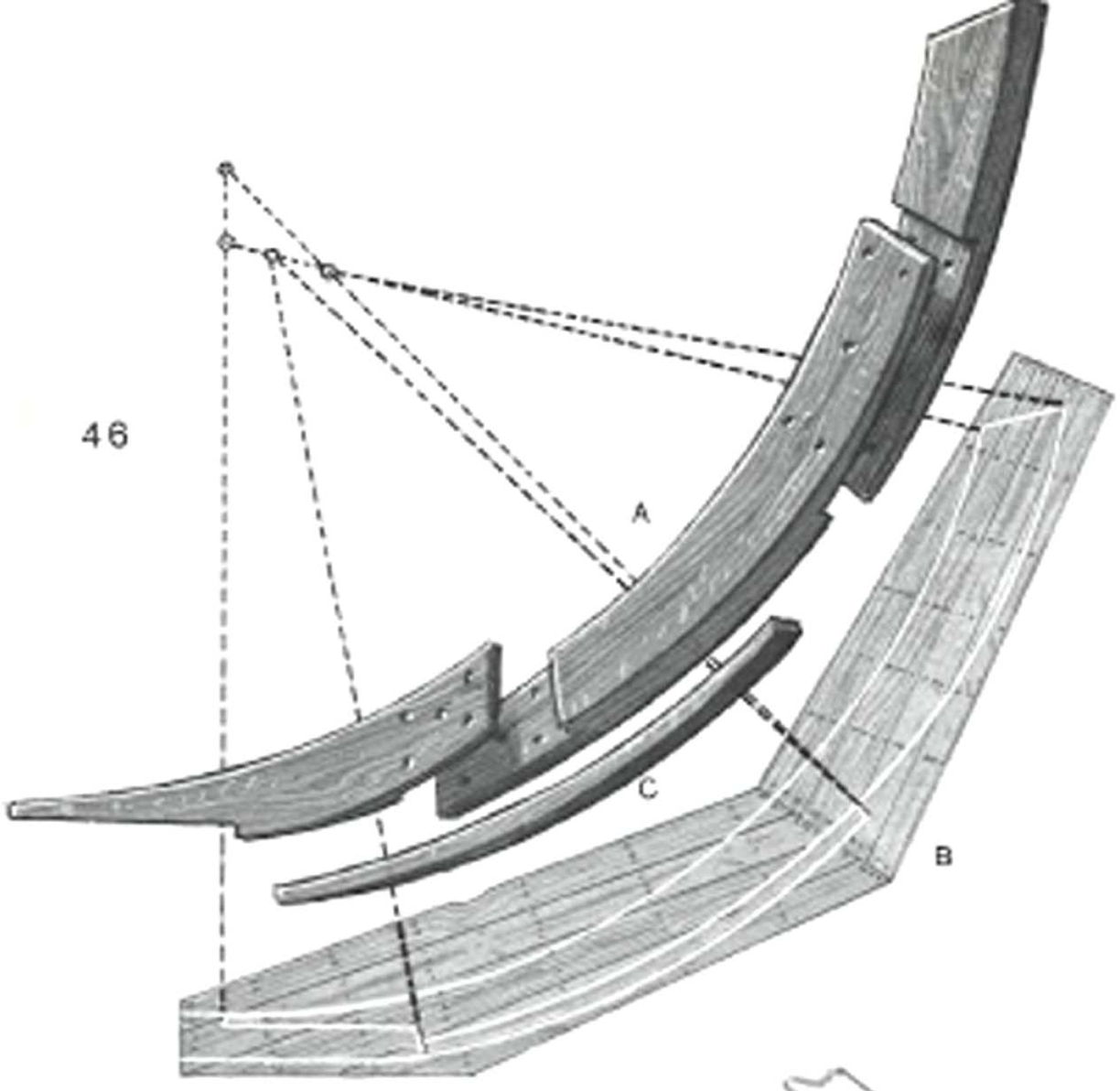
10.	Breadth outward of the futtock sweep	3′	6″	22. Clamps, lower deck, thickness	8″ —
11.	Hull planking, thickness		4½″	23. Clamps, main deck, thickness	6″
12.	Wales (4) below the ports: thickness		8″	24. Clamps, upper deck, thickness	5″
13.	Wales (2) between the ports: thickness		5″		
14.	Wales (2) above the upper ports: thickness		4″	All specifications were not so concise as the one for	
15.	Beams of the orlop deck, thickness		17″	the *Göta Ark* (pages 53–54). In his book published	
16.	Beams of the lower deck, thickness		19″	in 1629, Cornelis van Yk gives a ten-page specifica-	
17.	Beams of the main deck, thickness		14″	tion for a ship, stating expressly that "our fathers"	
18.	Beams of the upper deck, thickness		13″	built in this way. In 1649, Herman Fleming, in his	
19.	Keelson: thickness		11″	memorandum (pages 2–23) on the fleet, gives a	
	breadth	2′	10″	specification for a warship of "the second sort",	
20.	Stringers: thickness		14″	which when interpreted and written out fills	
	breadth	2′	3″	twenty-three typed pages. On the other hand, to	
21.	Clamps: orlop deck, thickness: above		8″	judge from the greater number of specifications	
	below		5″		



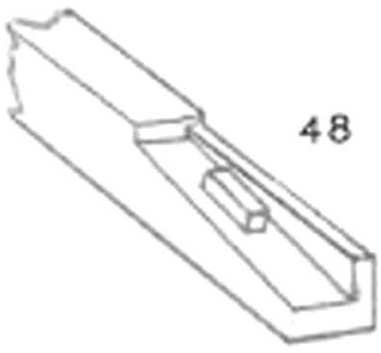
published in Witsen's and Yk's books, they were not more comprehensive than the present reconstructed specification for the *Vasa*. For an experienced shipwright such a specification was adequate.

The ship's sculptural embellishments would have been begun long before the ship was otherwise ready, and it is reasonably certain that some standard sculptures, such as the lion masks on the gunports, would have been in store. Early on it would have been necessary for the master shipwright to make, or to cause to be made, a couple of simple drawings of the ship for those who were to plan the whole of the elaborate decorative scheme. The sculptors, too, would have needed to see such drawings in good time, so that their work could get started. Otherwise the ship's fitting out would have dragged on almost without end.

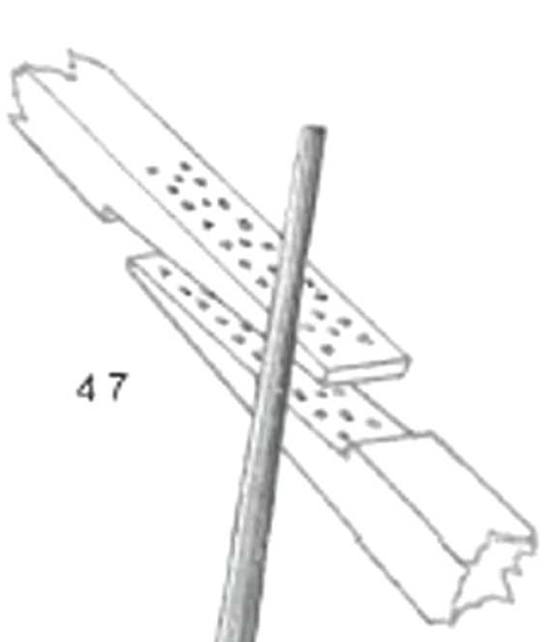
There is a sketchbook with drawings that I believe were done partly for this purpose, which is in the Dutch Maritime Historical Museum in Amsterdam; the drawings would be from the 1660s. The illustration above is my conjecture of what the drawings for a single-decked version of *Vasa* might have looked like.



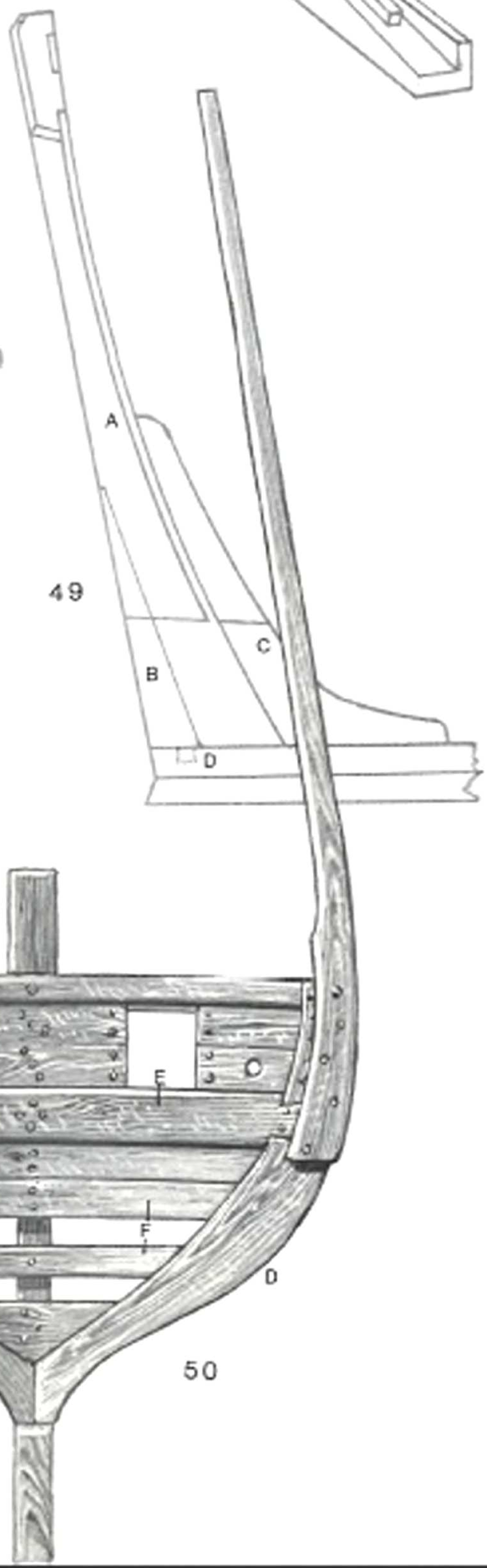
46



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49

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56

On the stocks

The keel of the new warship was laid in 1626, probably at the end of February or the beginning of March. Hendrick Hybertszoon's communication to the king of 21st March (see page 49) does not necessarily mean that the ship was begun only after this date. It is evident that Hybertszoon had great difficulty in getting timber in adequate lengths, and that he lacked the means to import foreign oak. According to the minutes of the Council of State of 22nd June 1626, Hybertszoon had made a complaint that the Crown owed him 19,000 *riksdaler;* he had to make do with the decision to await the arrival of Johan Sparre.

At the beginning of February 1626 Vice Admiral Klas Fleming had written to the king that Hybertszoon was badly ill with an abcess, having been confined to bed for eight weeks, but was beginning to get better. At that time of poor hygiene, an abcess was a serious matter, and it may be wondered if Master Hendrick ever really recovered: we know that he died at the end of May the following year.

Master shipwright Hein Jacobszoon probably led the work from the start and, as we already know, he had on his own initiative made the ship 1′5″ wider than had been decided in her specifications, but we do not know why he did this. To cast aspersions on the king was unthinkable, at least for so insignificant a person as a master shipwright.

Lack of suitable timber obliged Jacobszoon to have the keel made of four scarfed lengths of timber: the rule for a large ship was only two scarfs. The eleven-metre lengths were scarfed together with 15 bolts in addition to trenails and nails. The lengths were not thick enough, either, as may be inferred from the fact that the keel was heightened with an upper false keel, 1′½″ thick. The keel's greatest width was 23⅜″; it tapered towards a width of 18¼″ at the stem and 15⅝″ at the stern. Including the upper false keel its height was 24⅜₁₆″, and its total length was 135′5″ (38.34 m).

The stem extended forward from the forefoot by 25′⅛″, and its total height above the underside of the keel was eventually 31′⅛″.

It was first drawn on a template (46: *B*) of thin pine planks and then transferred to the pieces of oak *A*. The cutwater *C* was added later. The whole construction was then fastened to the keel with a tenon-and-mortice joint (48).

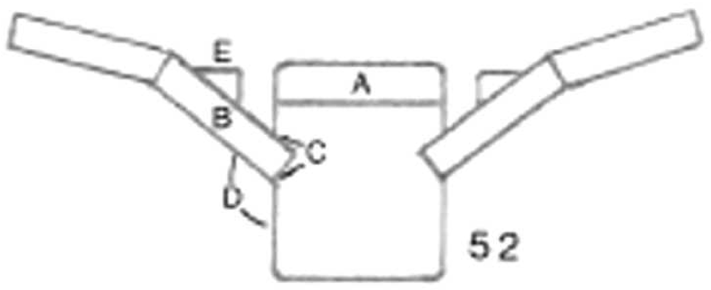
The sternpost (49) extended aft of its joint with the keel by 6′7⅛″ and rose 32′3¼″ above the

underside of the keel. It was made up of *A* a long, slightly curved piece of timber that was strengthened with *B* a skeg and supported on the keel with *C* a strong knee. The whole was fastened to the keel with *D* a tenon-and-mortice joint.

The frame of the stern (50) comprised *D* the fashion-pieces, *C*, *E* the wing-transom beams and *F* a number of lighter beams. Its upper part *B* was heavier than the rest, for it had to support another wing-transom beam. The top timbers *A* of the fashion-pieces were fastened onto the forward side of the fashion-pieces with trenails and iron nails.

The stocks themselves were made on a bed of planks forming a long floor down to the water laid in an excavation on the shore. The blocks were about 10′ long, 2′ wide and placed at intervals of 4½′; that nearest the water was perhaps 2′ high, while that under the stern would have been about 4½′ high. As illustration 51 shows, each comprised a number of timbers placed one on top of another. The keel was laid so that it sagged by 7"; this would compensate for the ship's expected characteristic of sagging fore and aft, where its support was least, as it got older. (See Witsen, page 110.)

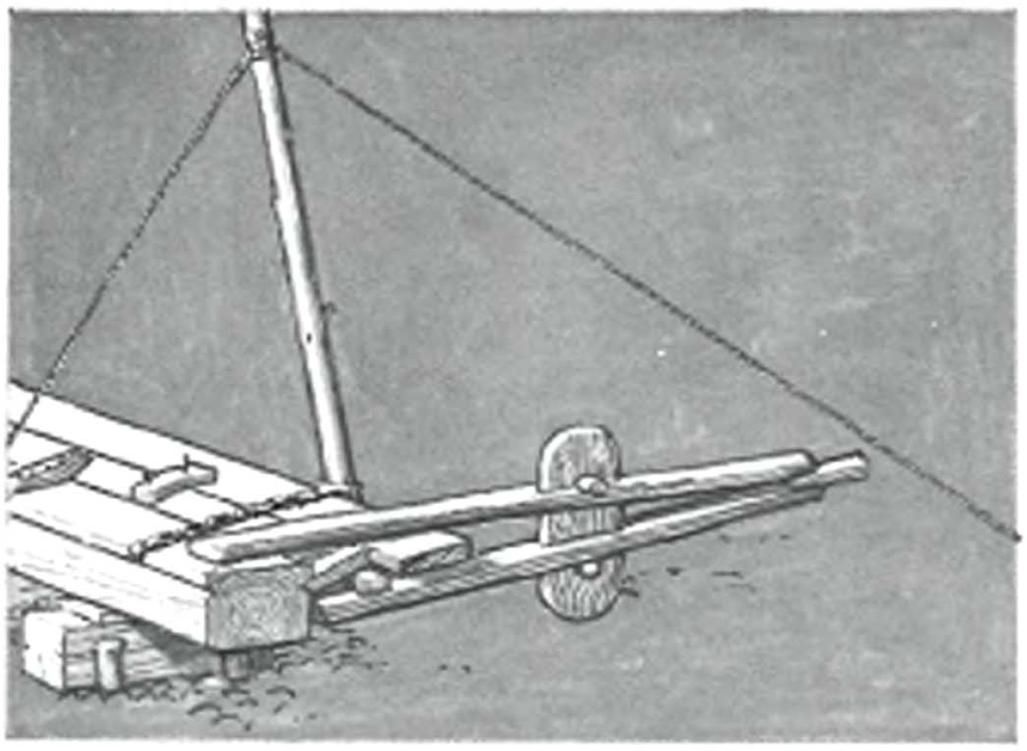
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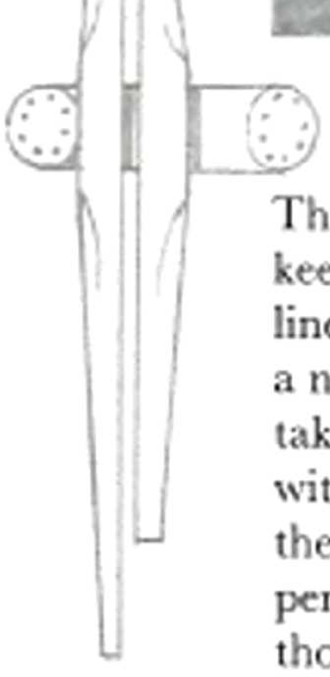
55



53



54



The perpendiculars were joined and bolted to the keel and, having been centred with the help of the line stretched between them, were held in place by a number of poles (51). The frame for the stern was taken to pieces and then mounted on the transom with the help of supports. A charcoal line drawn on the keel was part of the process of centring the perpendiculars. Many more shipyard workers than those shown would of course have been at work at this stage.

In illustration 52 I have drawn a cross-section of the keel, showing *A* the keelson *B* the garboard strakes fitted into *C* rabbets in the keel. The angle formed by the garboard strakes and the keel *D* varied so as to bring the upper edges of the strakes to the same height as the keelson. The strakes would be more nearly vertical towards the ends of the ship.

The next plank should be at the same angle as the intended flat. A lathe of suitable thickness was placed under the strake to arrive at the correct angle (after Witsen). By using a chain with a hook at one end and a ring at the other, the strakes could be forced together (53). Many of each of these devices must have been used, and a great deal of work done with adzes and planes, before everything could be satisfactory fitted together.

The garboard strake at the bow was sharply bent and would first have been formed with the help of an, adze from grown curved timber and then steamed over a fire (54).

To make it bend to its final curve one used a Klaas, an iron device that perhaps got its name from its inventor Klaas (Clas, Klass) Jacob or Jacobzen (55). It was about 2 m long, and the right-angled piece could be adjusted so that the gap between the two could be varied to fit different thicknesses of timber that were to be held over the fire. *Vasa*'s planking up to her lowest wale was 4½" thick.

58

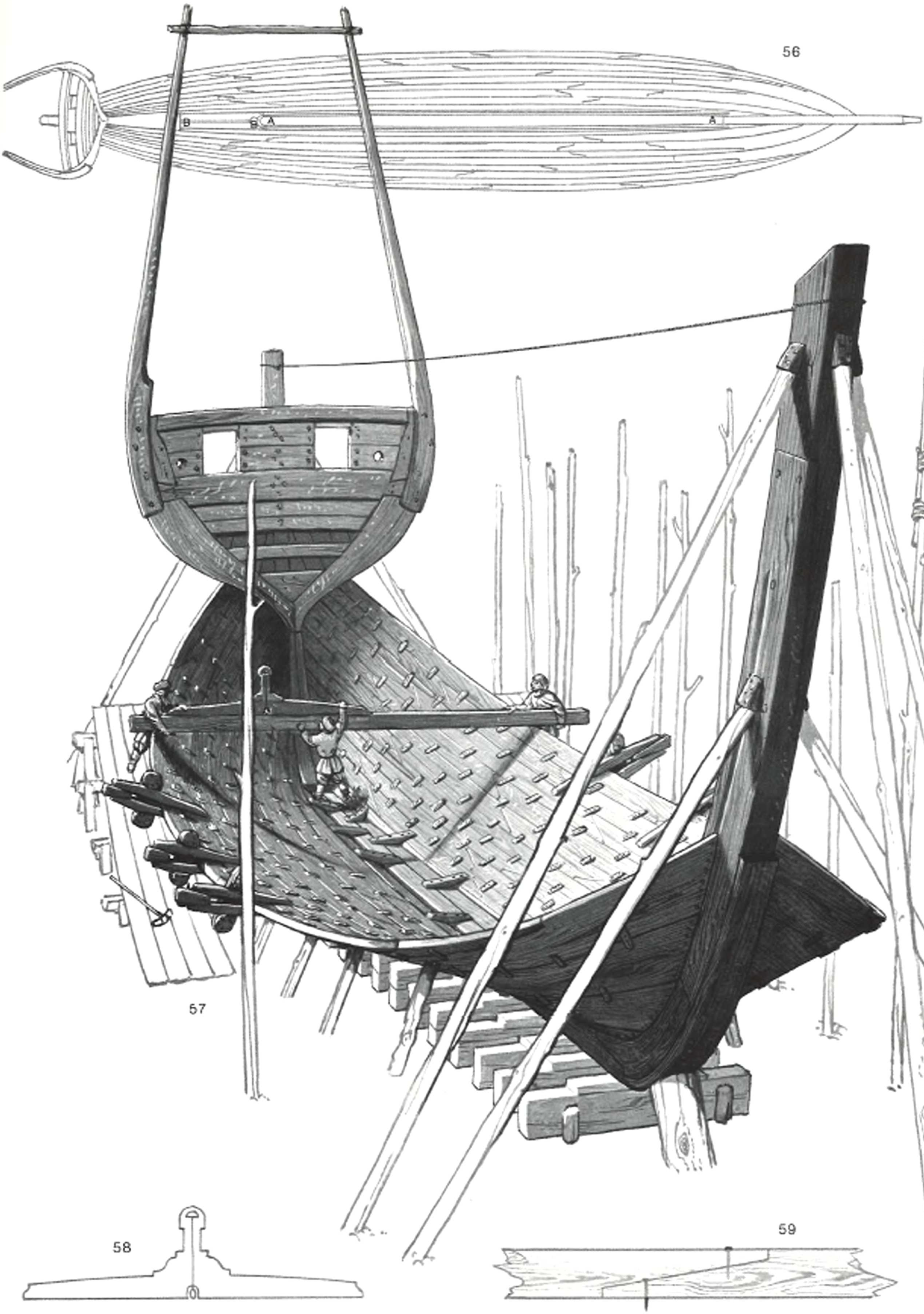
The timber, having been thoroughly soaked in water, would be laid across two iron supports. A fire of dry rushes would be lit beneath it and, while it was kept wet with the help of a swab, it would be forced into the desired curve by men using Klaas's. Some of *Vasa*'s curved strakes still bear signs of having been charred over fire.

The garboard stake was nailed to the rabbet, and the ends of the other strakes were nailed to the rabbets in the stem and stern. In illustration 57 I show work-in-progress with three shipwrights employing a beam and a levelling device to ensure that the planking was even. Cleat-like blocks on the keel ensure a correct angle between it and the strakes. The clamps in use are the same as one recovered from the ship, and may be assumed to be typical of those that were generally used at the time in Sweden. Illustration 59 shows a scarf in the planking. The left-hand nail helped to fasten the scarf to the plank next to it.

The flat of the floor was built flat in fact, its various cross-sections forming angles, not curves, with the keel, at least in the centre of the ship; towards bow and stern, and about 35′ from the stern, the sections become S-shaped.

I do not know exactly how work proceeded when the flat had been formed; clamps and chains seem to me to have been not entirely adequate, and it cannot be excluded—although I cannot demonstrate—that at an early stage a pair of long planks were laid on edge at right angles to the keel where the ship was to be widest, being used to support the floor. Seventeenth-century illustrations show only short supports extending up from the bed of the stocks, but there is no illustration of a floor under construction.

It is possible that this method of building, if applied by skilful shipwrights, could produce a wholly satisfactory result, but, as we have already mentioned, the new ship was not quite symmetrical. It is perhaps most remarkable that in only a few

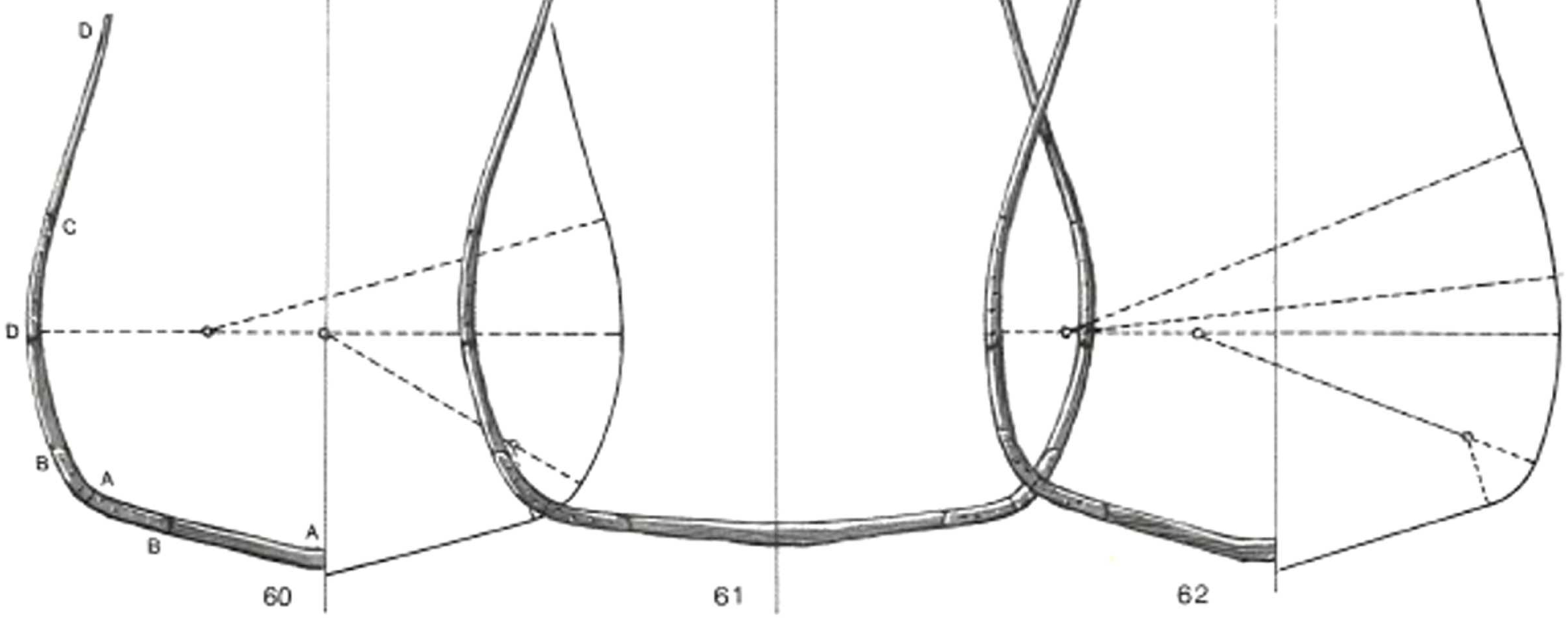


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59



instances is one deck beam parallel with the next. This can perhaps be explained by the recovery of two carpenter's rulers on board the *Vasa*: one showing Amsterdam feet of eleven inches, the other Rheinland feet of 31.4 cm or twelve inches.

We have already seen how the new warship's midship section was designed with the help of straight lines and the arcs of circles (page 53). In the Netherlands at this time it was usual to copy the midship section and, in a ship of the size of the *Vasa*, to place it ten feet aft of the first, with the result that over a distance of ten feet the ship's sides would be parallel. Careful measurement of the *Vasa*, however, shows that she was built with only a single midship section.

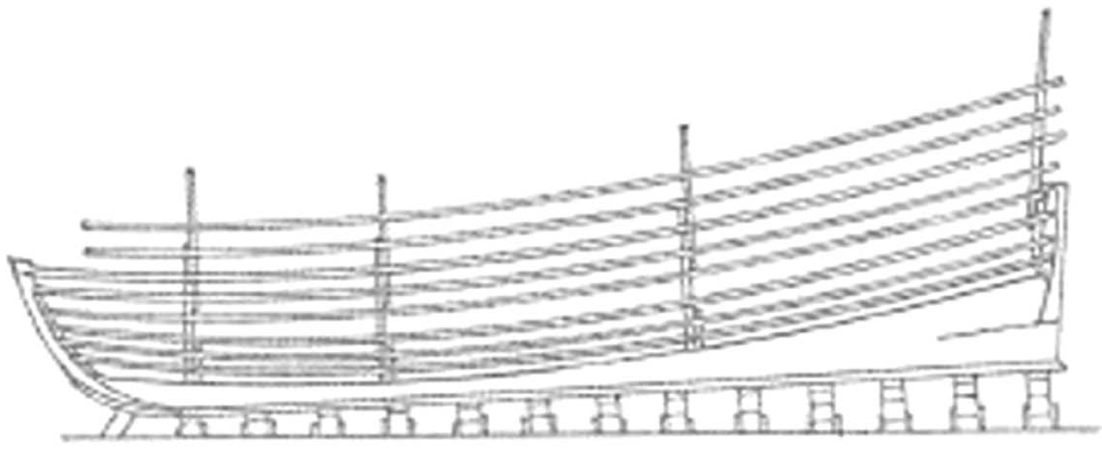
When this section (illustration 61) had been put in place on the keel about 48′ from its forward end and supported with lengths of timber, another section was placed on the forefoot, the joint between the stem and the keel. It is probable that the first section's parts had been fastened together with trenails while the whole still lay on a timber-frame bench on the ground. The forward frame (60) consisted of seven parts on each side: the floor timber (*A–A*), the two curved sections of the runghead sweep (*B–B*), the two futtocks (*A–C*) and the two top timbers (*D–D*). In principle, all the frames were made in the same way. Shortages of suitable timber, however, meant that not all were made in exactly the same way.

Midway between the midship section (61) and the stern another similarly constructed section was put into place, having, like the others, been made with the help of straight lines and arcs (62); it was fastened together with trenails. Then, when all sections were in place, their alignments were checked with plumb lines and with measurements before they were finally bolted to the keel.

Illustration 64 shows the warship taking form above the floor, with eight pairs of ribbands. This was easy for me to illustrate reasonably satisfactorily, for I could make use of the drawings and lines taken off the *Vasa*; a Dutch master shipwright would have had his secret rules and tables. It was a matter, at this stage, of establishing the ship's width at different points on each section as accurately as possible, while at the same time, with the help of these ribbands, of achieving the sheer that was wanted. The sheer would later be indicated not only by the railings but also by the many heavy wales which, when seen from the side, formed, or should have formed, long arcs of circles.

In the two illustrations on the opposite page (63, 64) we see the three lowest strakes of the floor extended aft of the outer edge of the sternpiece, thus further strengthening it, a special Dutch feature. The stern is planked; it was not flat but formed like a convex lens cut off at its top.

Illustration 67 was made by the Dutch master ship-



63

64

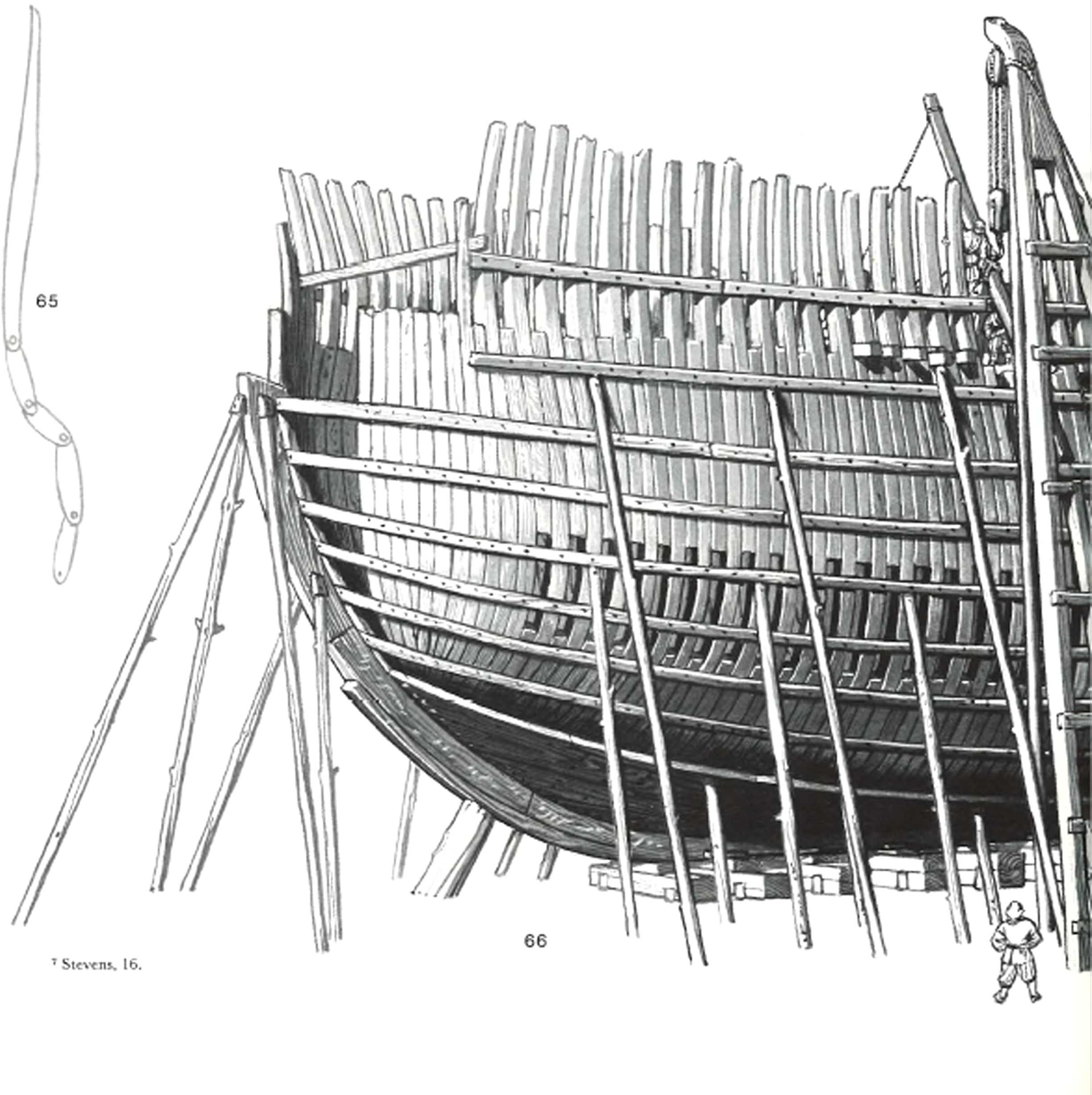
wright Johannis Sturckenbergh, evidently in 1648 (see *Stevens*, page 16); it is the oldest known drawing showing the framing of a Dutch warship. I have assumed that in its first stages the new warship would have been built in more or less the same way. Observe that only the midship section, approximately at section 90, stands vertically on the keel, while the others, both fore and aft, incline towards the middle. This is because the sections were thickest at their floor timbers and tapered upwards. The sections were at right angles to the longitudinal axis of the keel except that those forward of the after point of the forecastle were at right angles to the planking. From the studies that have been possible of *Vasa*'s construction, it appears that her sections were made in the same way.

To get the right curve of the frame above the floor one used an iron device (65). Its links were stiff, and it was laid against the ribbands that ran fore-and-aft over the erected sections. Its curve could then be laid off on suitable lengths of timber, some naturally curved. Once cut, the pieces were shaped and fitted together before being fastened in place in the growing hull.

The illustration below (66) shows the warship nearly completely framed, with only a few of the top timbers and the foremost sections yet to be fitted. A large moveable crane, one of many of different sizes that would have been used, is employed to lift a timber into place. Only token numbers of workmen are shown here.



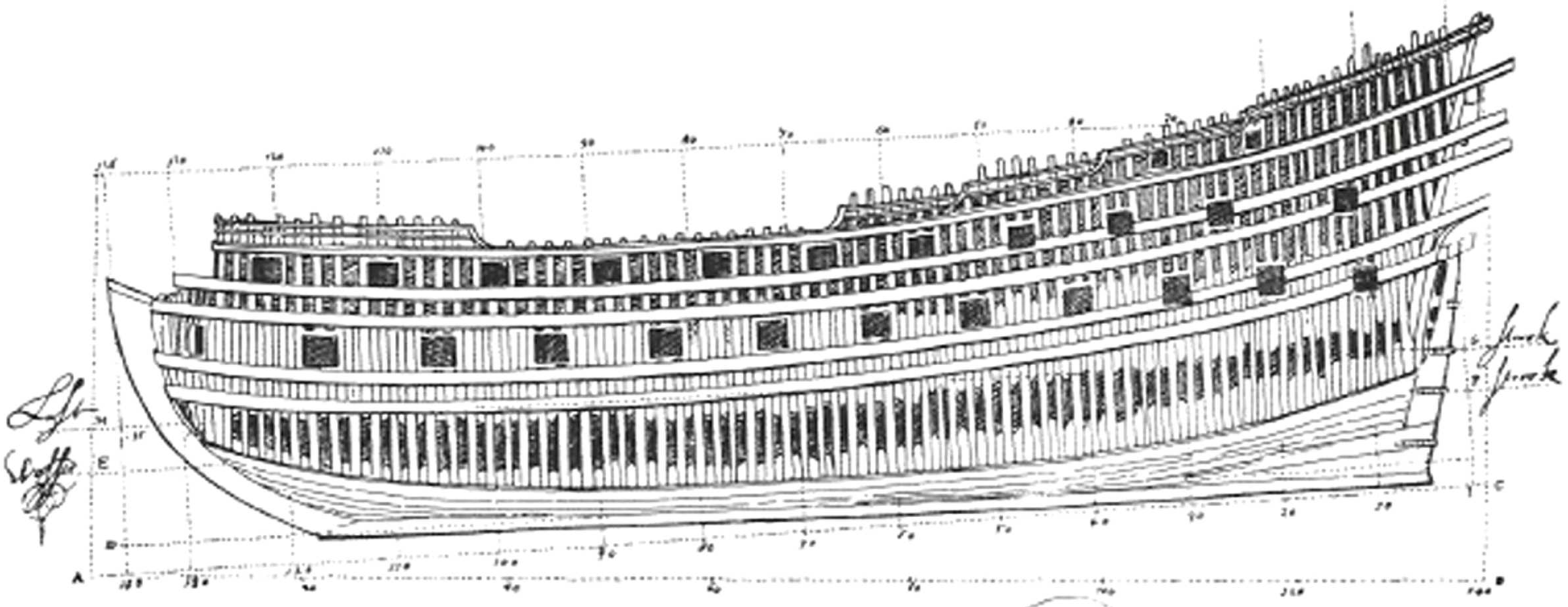
65

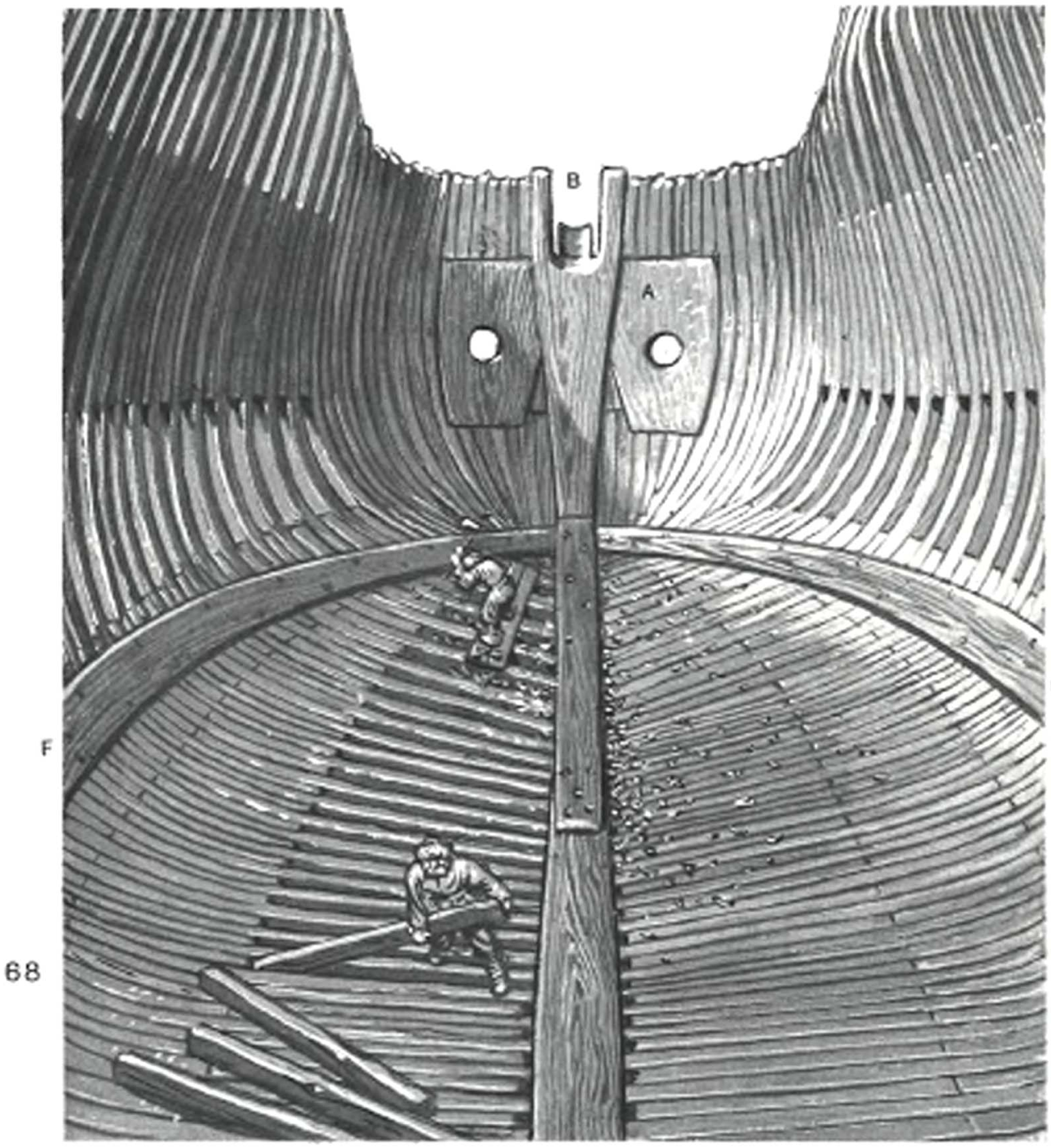


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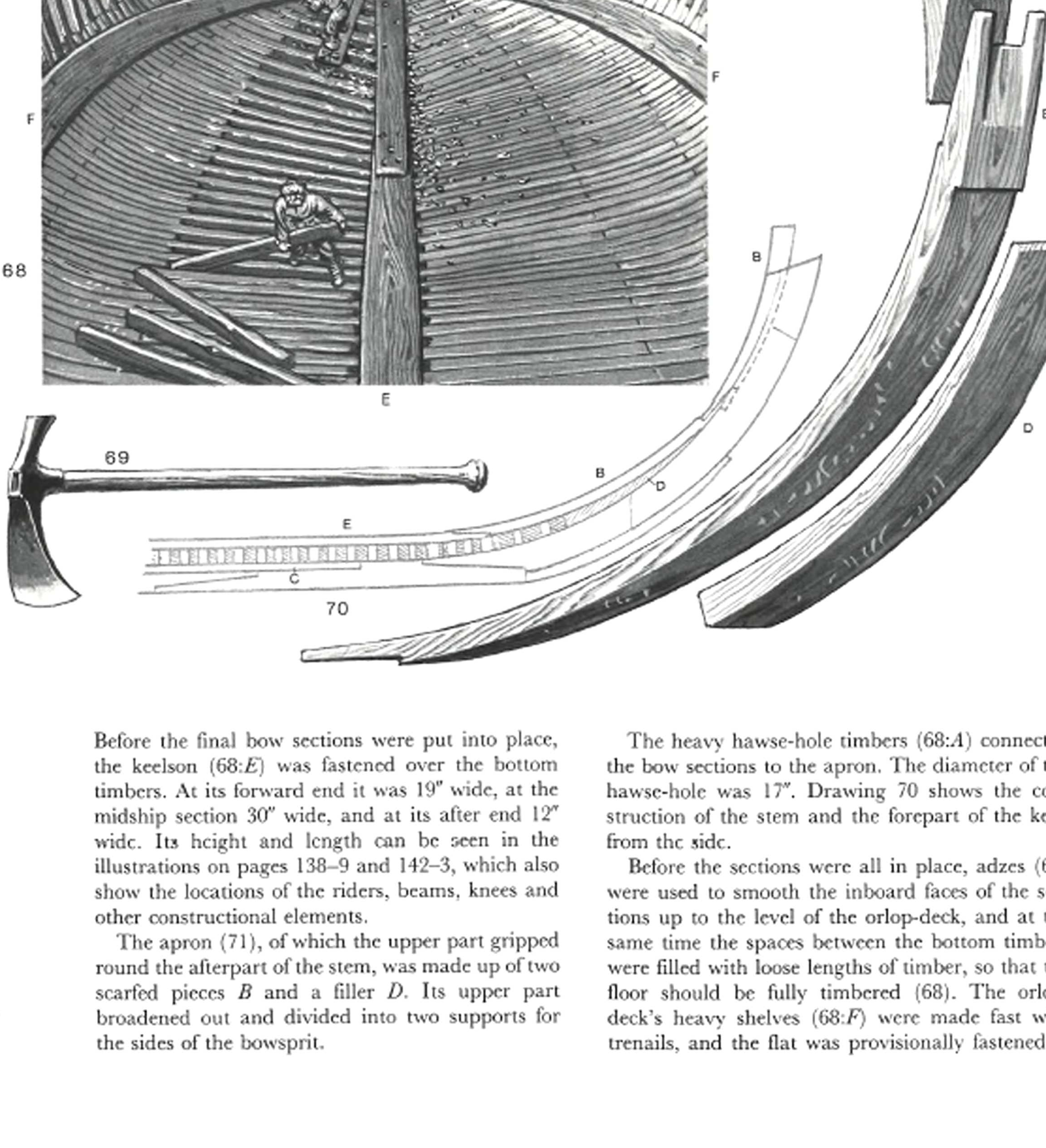
66

[7] Stevens, 16.





68



69

70



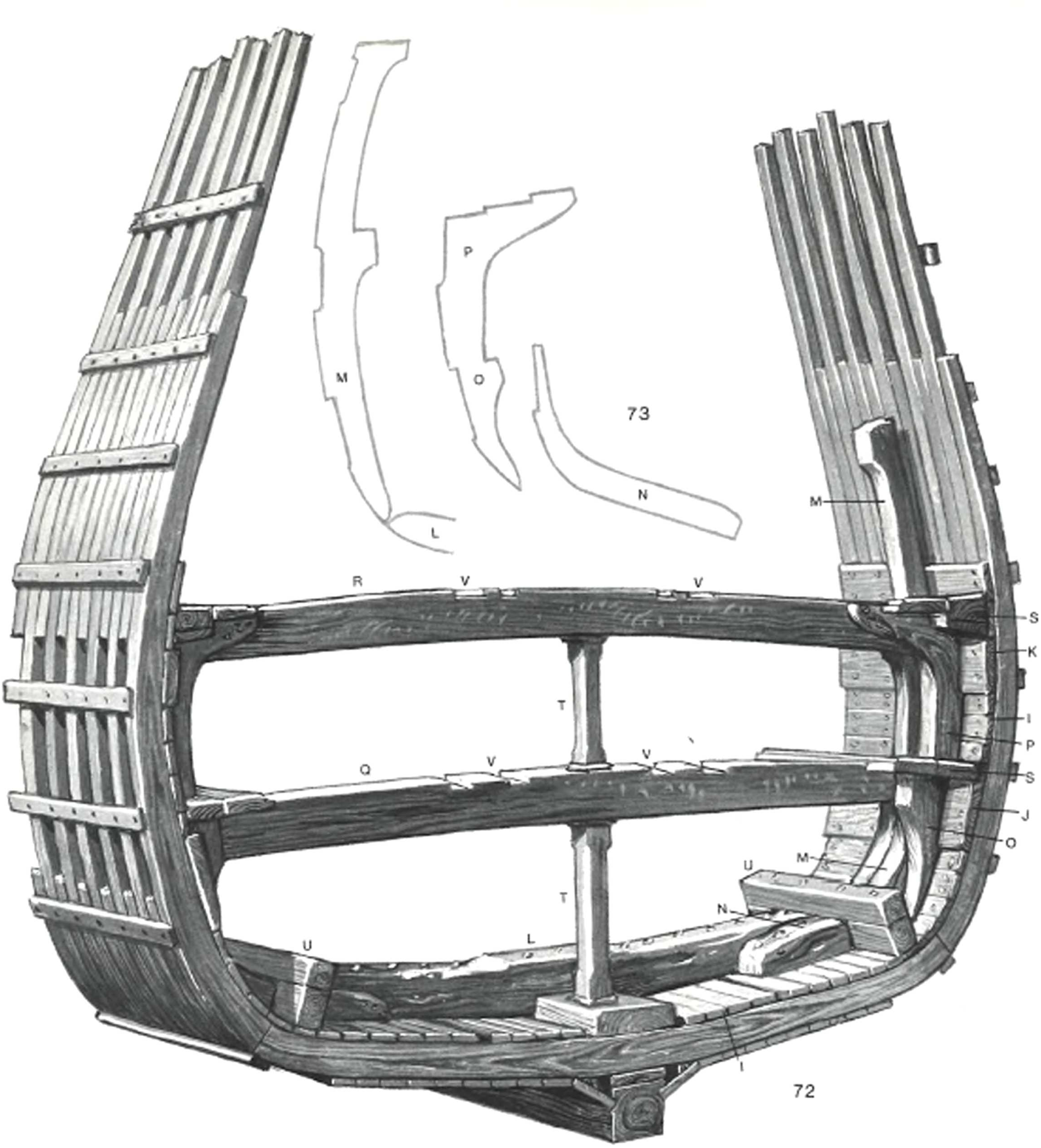
71

Before the final bow sections were put into place, the keelson (68:*E*) was fastened over the bottom timbers. At its forward end it was 19″ wide, at the midship section 30″ wide, and at its after end 12″ wide. Its height and length can be seen in the illustrations on pages 138–9 and 142–3, which also show the locations of the riders, beams, knees and other constructional elements.

The apron (71), of which the upper part gripped round the afterpart of the stem, was made up of two scarfed pieces *B* and a filler *D*. Its upper part broadened out and divided into two supports for the sides of the bowsprit.

The heavy hawse-hole timbers (68:*A*) connected the bow sections to the apron. The diameter of the hawse-hole was 17″. Drawing 70 shows the construction of the stem and the forepart of the keel, from the side.

Before the sections were all in place, adzes (69) were used to smooth the inboard faces of the sections up to the level of the orlop-deck, and at the same time the spaces between the bottom timbers were filled with loose lengths of timber, so that the floor should be fully timbered (68). The orlop-deck's heavy shelves (68:*F*) were made fast with trenails, and the flat was provisionally fastened to



the bottom timbers with nails.

Looking now at illustration 72, when the ceiling *I* had been laid from the shelves down to within 6" of the keelson, riders *L* were bolted down over the keelson and the ceiling; they were laid at intervals of 6'4" on average, and were about 13" wide, 23" high and long enough to extend up into the bilge.

Except for the upper deck, which we shall discuss later, it is not known exactly how the deck beams were fitted into the sides of the ship.

The letters in illustration 72 indicate: *I* ceiling *J* shelves *K* shelves for the lower gun-deck *L* riders *M* fillers *N* knees next to the riders supporting the beam from beneath *O*, *P* a double knee supporting the deck beams from the side *Q* orlop-deck beam *R* lower gun-deck beam *S* waterways *T* deck supports *U* stringers *V* mortices for the deck-binding strakes.

74

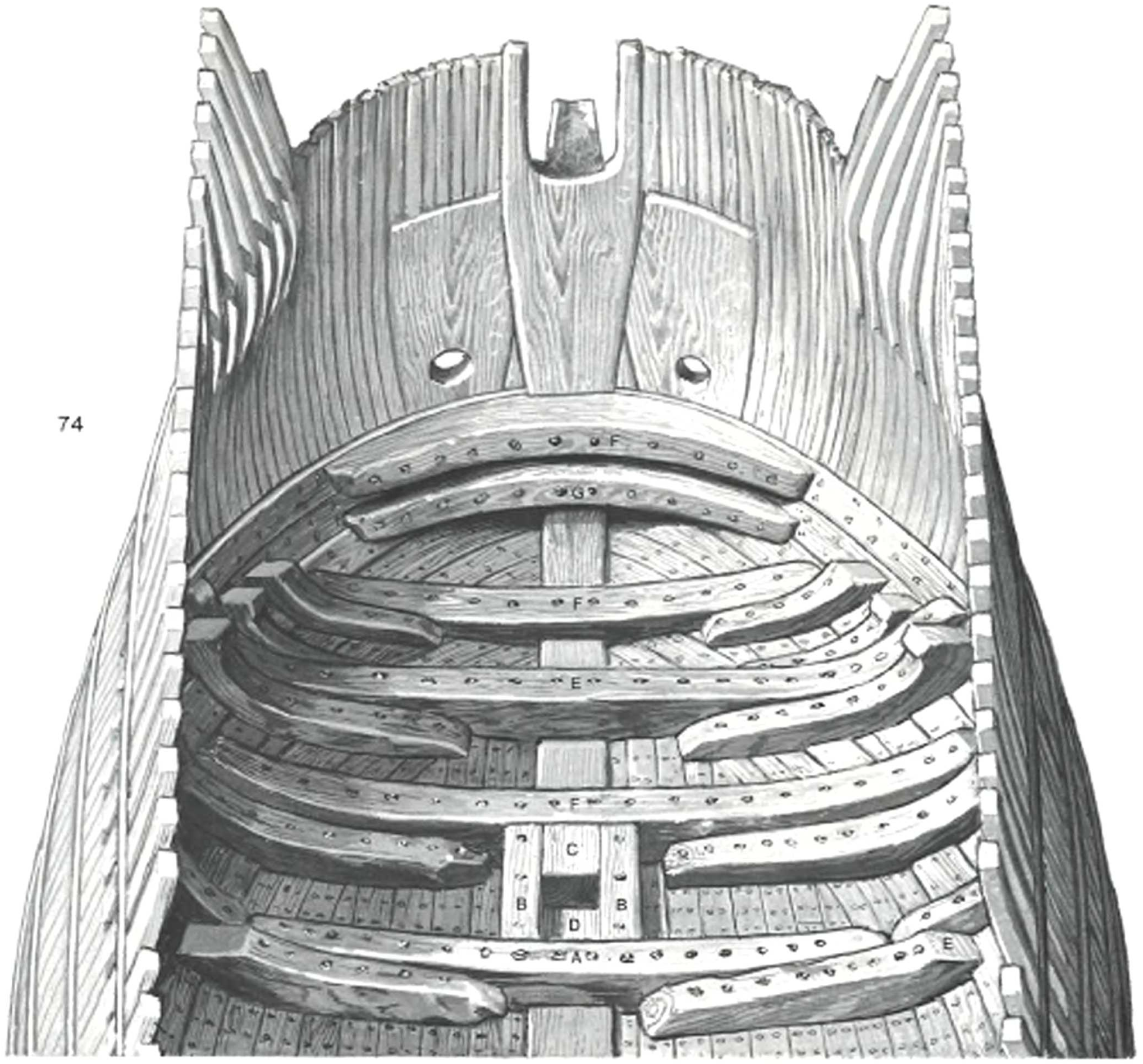


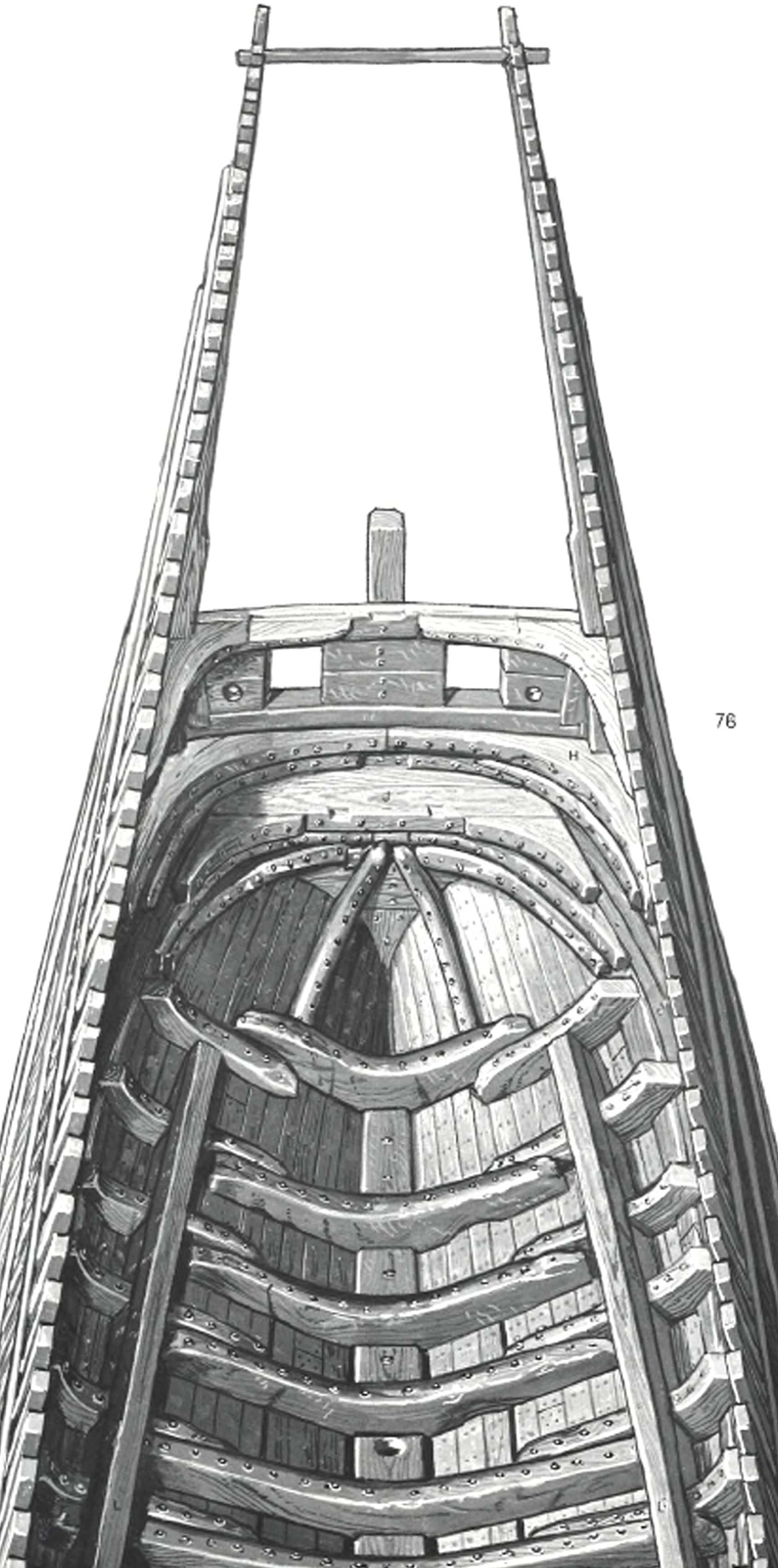
Illustration 74 shows the timbering of the forecastle up to the lower gun-deck, with the deck beams excluded for purposes of greater clarity. *A* should be called either a rider or a breast-hook, its placing nearly 3′ forward of the keel making an exact designation problematic. *F* indicates timbers that should certainly be called breast-hooks. *B* and *C* form the foremast step *D*. The orlop-deck terminates at the breast-hook *E*. Knees fore and aft of it support the lower gun-deck waterways. *G* is the deck-hand for the lower gun-deck strakes and waterways.

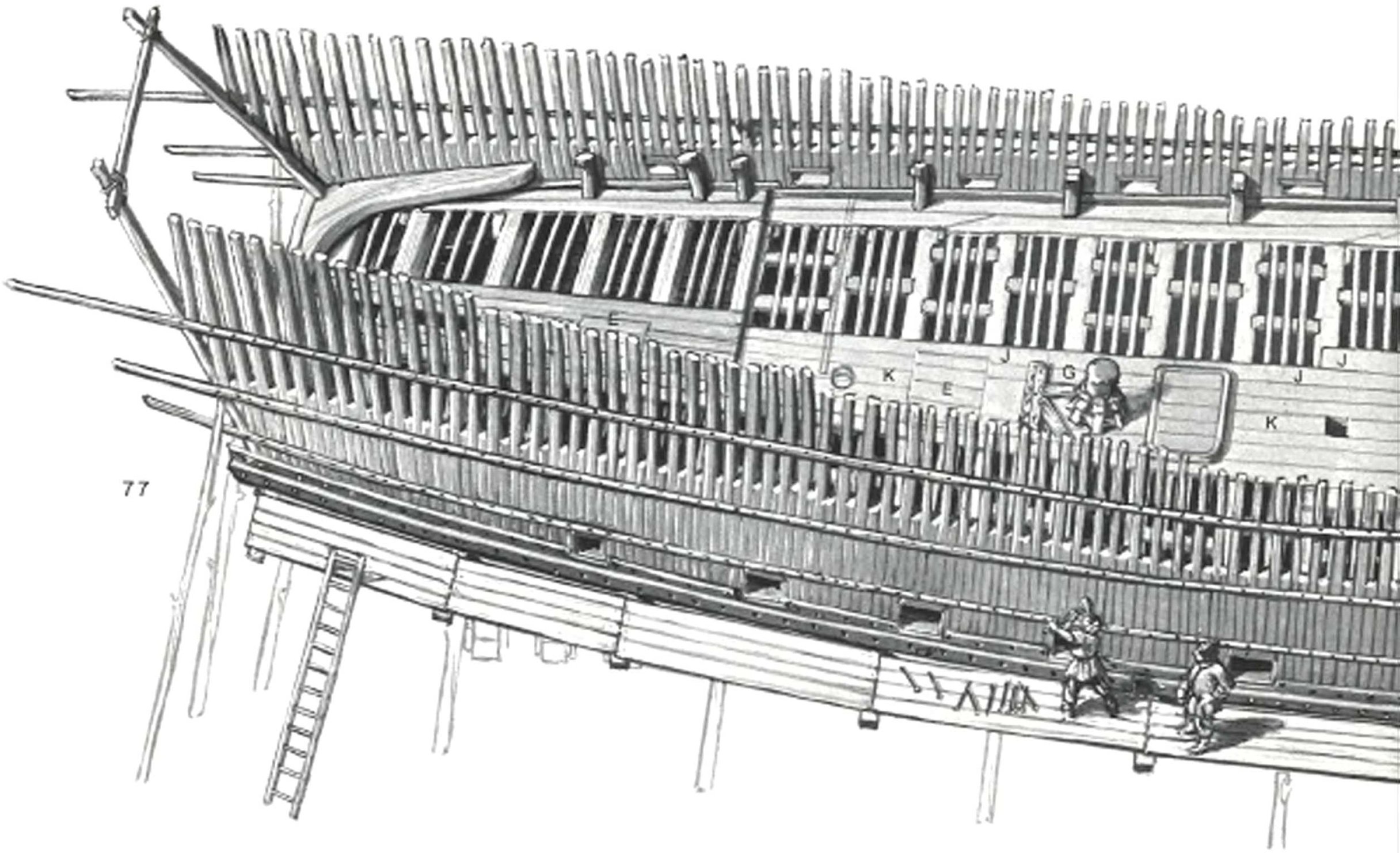
Looking down into the stern (75, 76) one sees (*H*, *I*) heavy horizontal knees for the wing-transom; they are up to 3 m long and up to 60 cm thick in their angles. In the platform (*J*) there are two mortices to receive the orlop-deck strakes. *K* is a rider that passes under the shelves *L*; riders further aft terminate at or short of the shelves. The clamps are built up of short pieces laid between the knees and long scarfed timbers laid over them.

In illustration 76 the hull is planked up to the lowest wales, and riders, knees and sweep clamps have been bolted together. The hull is, for its time, unusually heavily built, partly on account of the closely-spaced riders, partly because the stringers are very stout.

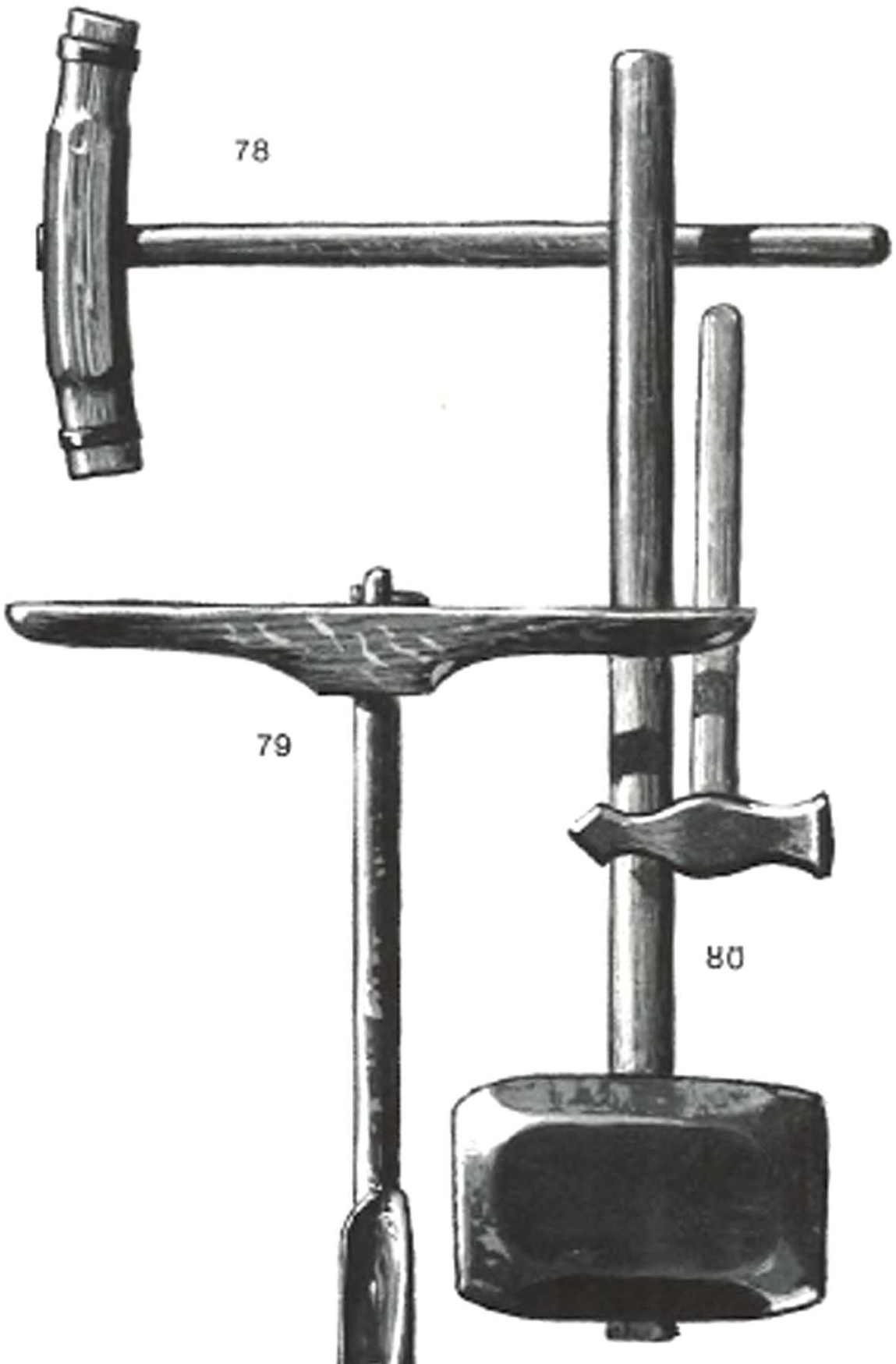


75


H



77



78

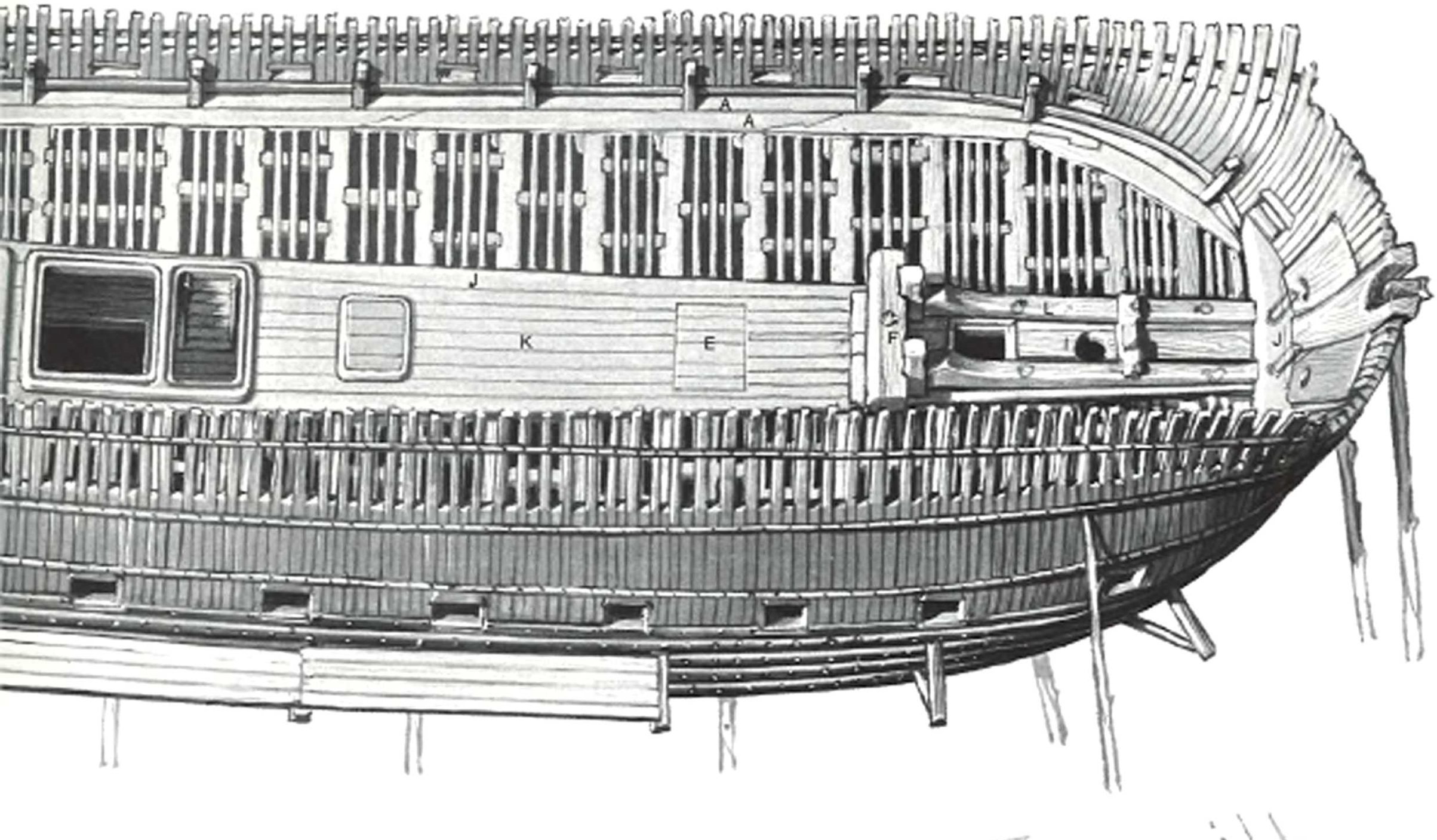
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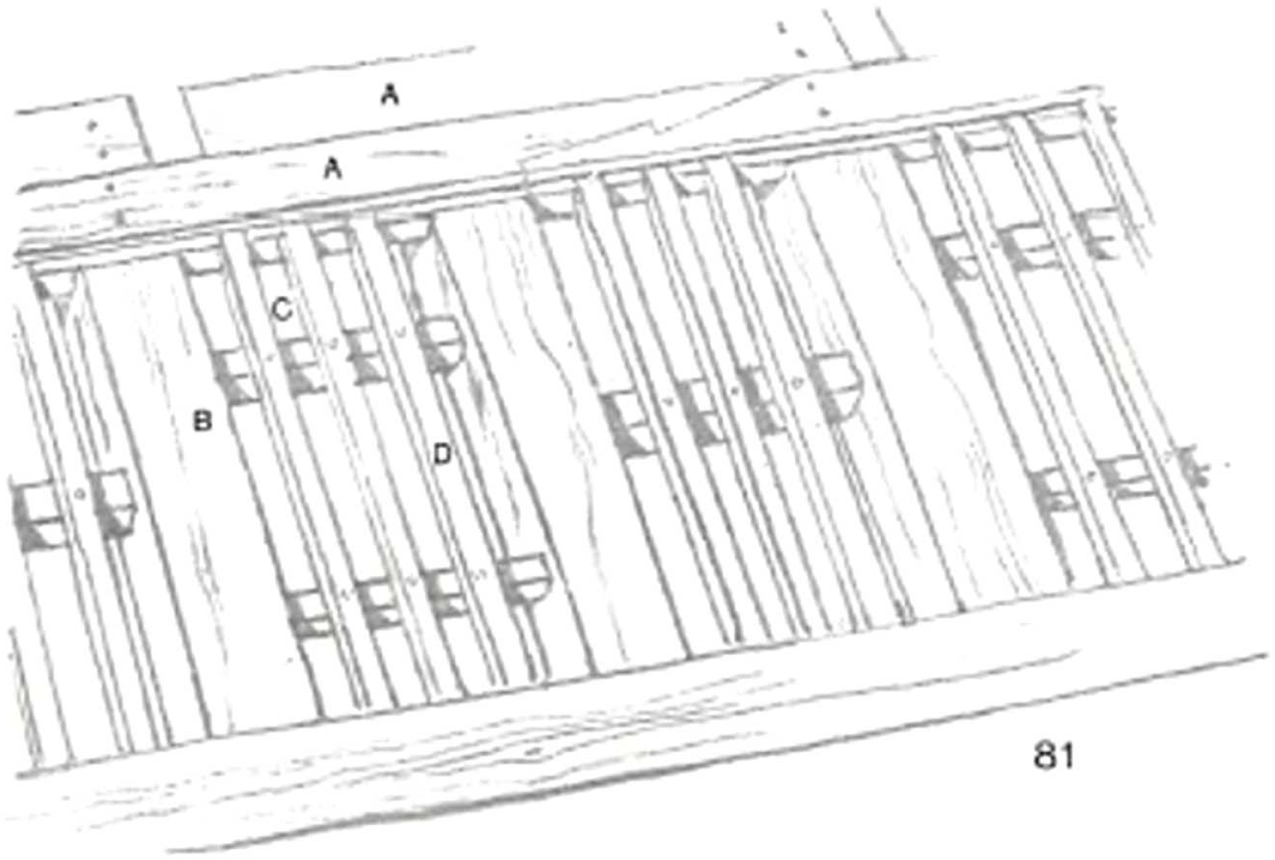
80

Before the hull was launched it was planked up to the ports of the lower gun-deck or, according to the rules, one plank above the fourth wale (77). A long platform for the workers was erected on supports nailed to the wales; from it the final bolts were driven through the hull and clinched from the inside against fillers and the ceiling. The uppermost plank was nailed provisionally to the frames.

In order to show details of the deck construction, the planking *K* is laid only between the deck strakes *J*. The waterways *A* are made of two planks laid next to one another, the inner plank being formed of lengths of timber scarfed together. The hatches *E* are flush with the deck, without coamings. A broad mast partner *H* is fastened to the deck with trenails to strengthen the mast hole. The foremast hole does not need any special strengthening, for it passes through the bottom timber of the bitts (*I*). The deck planks, which were nailed to the beams and the ribs, were of 3-inch oak.

The orlop deck was planked in 2-inch pine on beams that were 15 inches square in section. Planking in 2-inch oak was used only for the part that lay aft of the pump and which would serve as the gun-





81

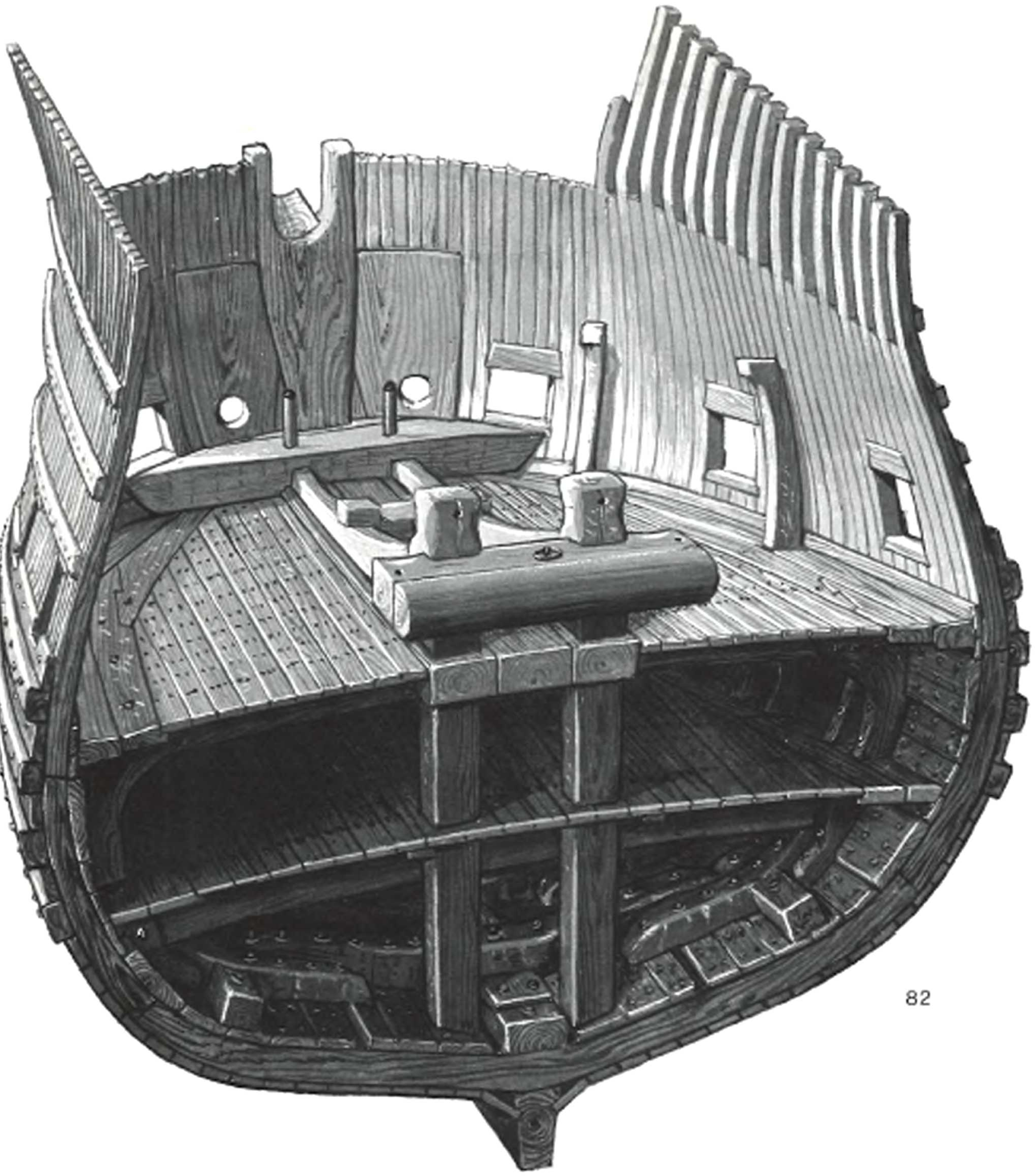
room; this would provide a stronger support for the two 24-pounder cannon that fired through the lowest stern ports.

The bitts (*F*), the construction of which is shown in greater detail on page 70, must, like the capstan (*G*) and its pawls, have been built in before the ship was launched. On the breast-hook, two stout pins or bolts carrying wooden rollers would have served as leads for the cable messenger that was used when weighing anchor (see further, page 171). The long knees of the bitts carried ring bolts that were used to secure the cable nippers; they were a means of making fast the anchor cable or the messenger.

The large opening amidships forward of the mainmast could be covered with a grating and hatches; the largest of them lay directly above the galley which lacked a chimney. The smoke from it would have escaped as best it could through the openings in the deck but the crew would undoubtedly have been accustomed to putting up with similarly smoky conditions in their primitive homes on shore.

The tools shown here are a caulking hammer (78), a short auger that bores a hole of a diameter of 1 inch (79), and a light and a heavy hammer (80).

The longest bolts in the hull were considerably longer than 2 m in length and would have required augers of the same length. One of the ship's pumps is a bored-out elm stock nearly 9 m long; the augers that were used could be fitted with extensions that could be coupled together to achieve the length required.



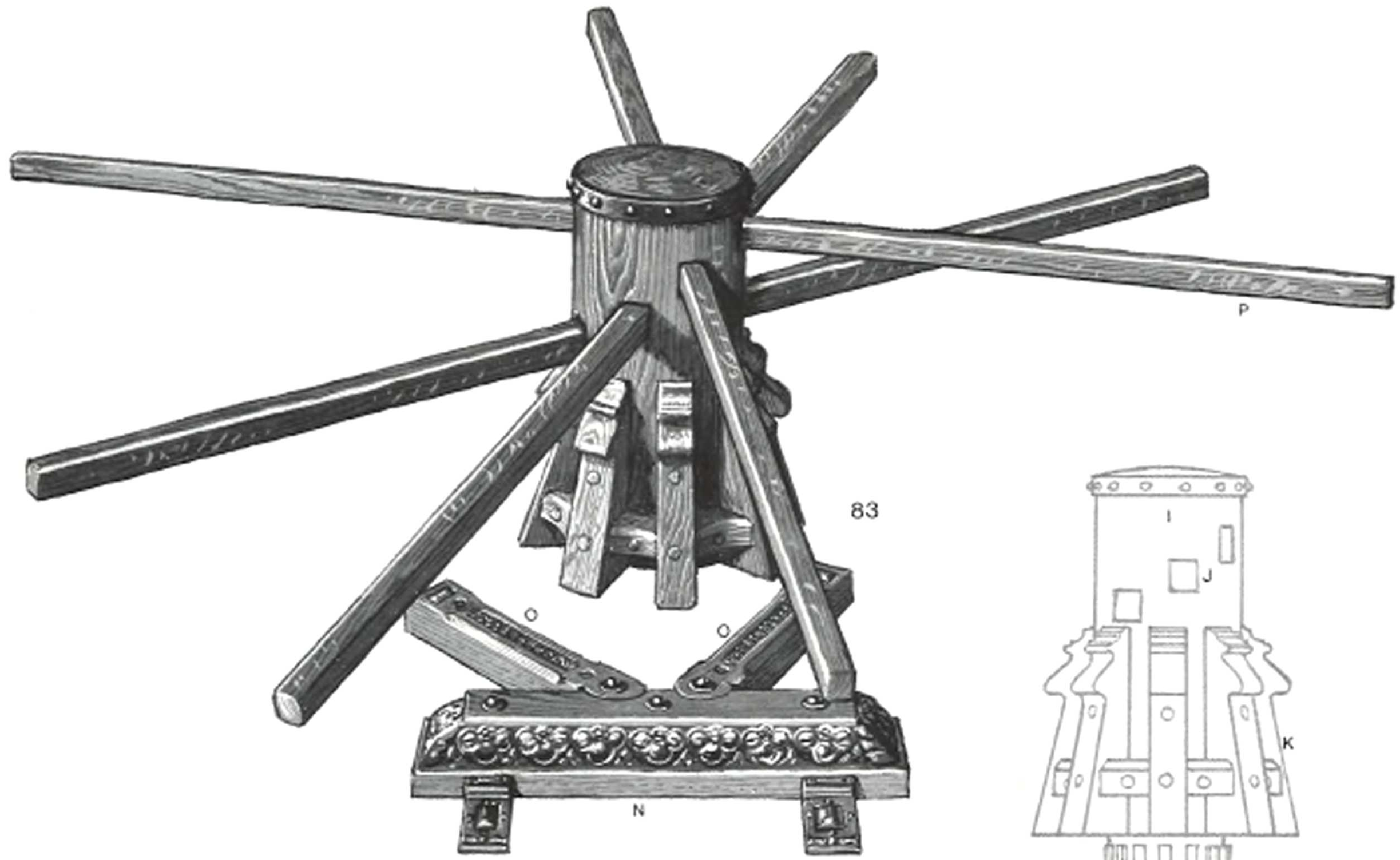
82

Illustration 82 shows a cross-section of the bow at the bitts. The knees of the bitts rest on three planks that are 11" thick, and bolted between the knees is a curved support for the bowsprit. The pins of the bitts themselves are 19" square in cross section and 20'5" long; these vertical timbers pierce the outer planks that support the knees, the orlop deck and the ceiling; they are bolted to a floor timber. There are holes through the tops of the pins and the outer ends of the cross-piece of the bitts to receive belaying-pins or the like that prevented the cable from slipping off.

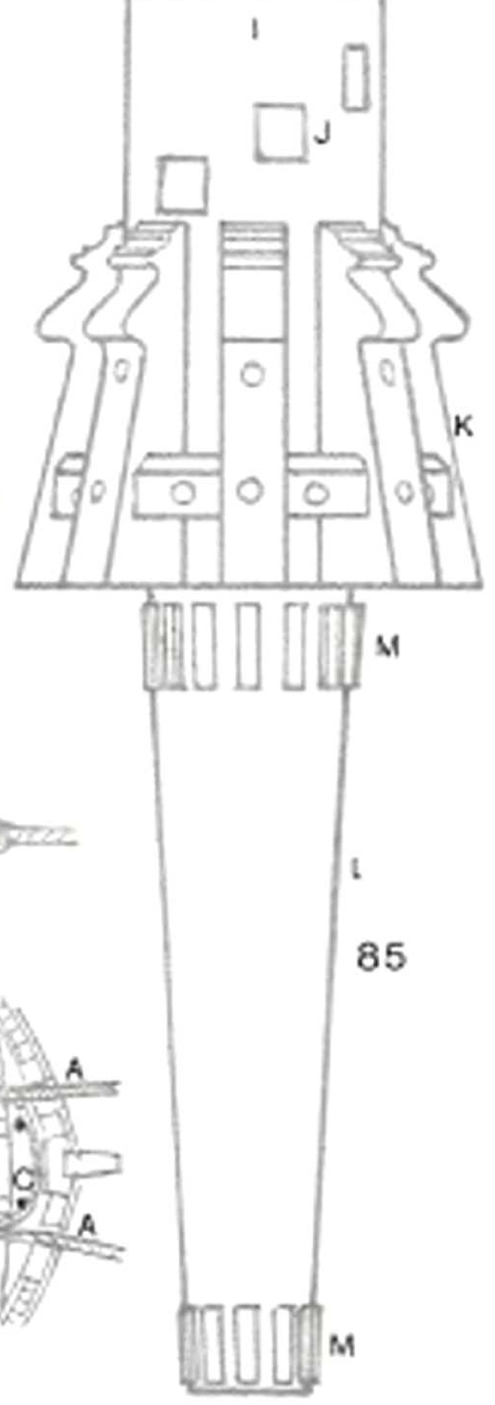
On the keelson can be seen the aftermost part of the stem timber; the foremost ends of the stringers terminate against the knees by the riders.

The capstan (83) consists of the following parts: *N*, the support for the pawls *O*, being probably the first decorated detail to be fitted; the pawls are bolted through the deck.

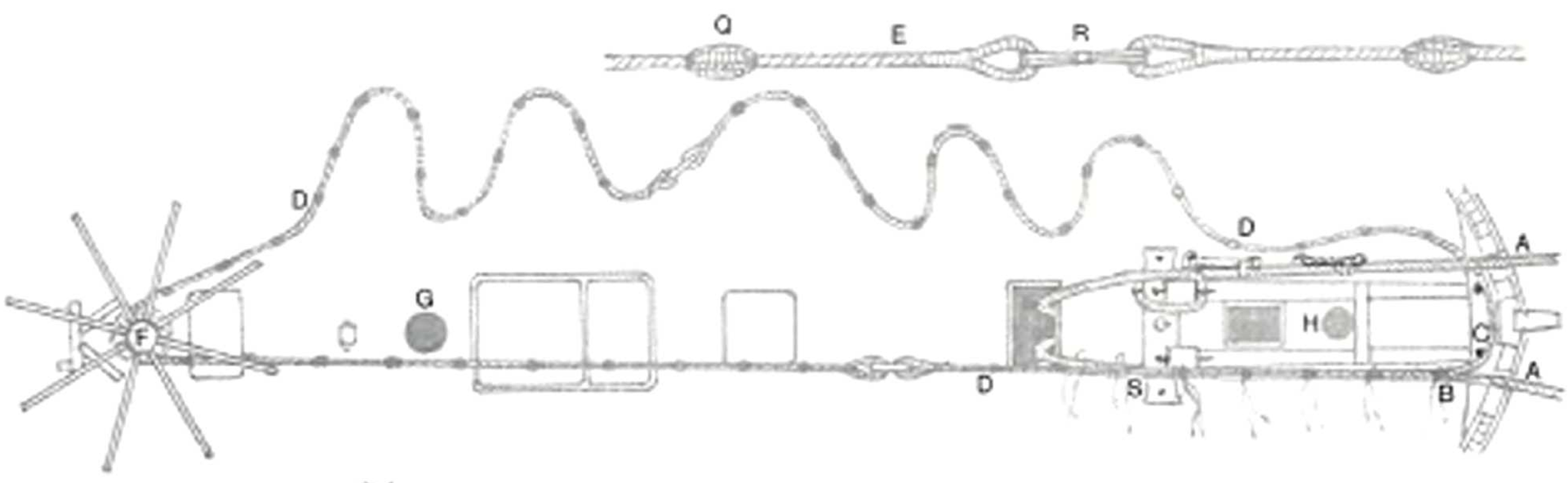
Illustration 85 shows a section through the capstan barrel *I* with square holes *J* for the bars. Whelps *K* prevented the cable from riding up on the barrel. The axle *L* is fitted with two sets of pine slats *M* that functioned as primitive bearings between the axle of the capstan and the decks through which it passed. The slats would be wetted to



83



85



84

reduce friction when the capstan was in use. Four capstan bars (83*P*) were fitted into the square-section holes in the capstan barrel.

As the anchor cable was altogether too thick and stiff to be led round the capstan, use was made of a tightly-laid rope about one third its size, the cable messenger. With its help the cable could be hauled from the hawse-hole to the hatch aft of the bitts. In the hold the cable was later coiled down in large rings.

The schematic drawing of the lower gun-deck from stem to capstan (84) shows the cable messenger *D*, a continuous length of cable about one third the thickness of the cable itself. It ran round the capstan *F* and the pins or rollers *C* on the breast-hook. Other details are: *A* anchor cables entering at the hawse-holes, *B* point at which the starboard cable is secured to the messenger. *E* (detail above) shows eye-splice in the messenger. *G* mainmast *H* foremast. *Q* is one of several mousings in the messenger that would check the nippers from slipping. *R* is a lashing connecting eye-splices. *S* is the point at which the nippers were untied by ship's boys—nippers—so that the cable could be handed down into the hold.

The illustrations on pages 72 and 73 show some of the bolts and other fastenings in the hull. Some 6,000 bolts, over 20,000 trenails and an unknown number of nails secured the planking and the constructional details to the frames and beams. The floor was first nailed sparsely into place, and bolts were driven through the bottom timbers into the keel. When the ceiling was laid inside the floor, two holes were bored from outside the hull through each bottom timber and out through the ceiling, and then a trenail was driven into each hole and made fast with the help of wedges; from outside a pyramid-formed wedge was driven into the centre of the trenail and, from inside, it was fastened with either a single broad wedge, or two wedges at right angles to each other (88*F*).

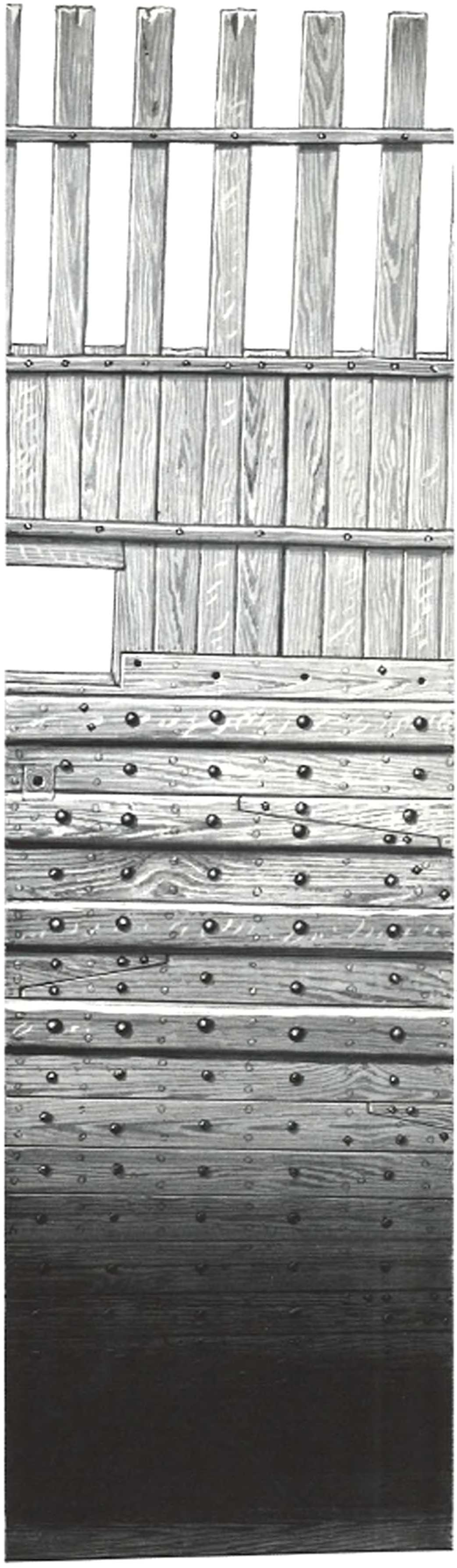
The trenails and bolts were of 1" diameter. The trenails were made from straight-grown oak and were usually octagonal. There were four different kinds of bolts, as shown in illustration 88: *A* round-headed bolts for wales *B* smaller round-headed bolts for the planking *C* almost flat-headed bolts used under the wales *D* bifurcated and *E* barbed bolts. No original bolt has survived, and the hull was held together by its trenails *F*. Investigation of the bolt-holes suggests barbed bolts were used in *Vasa*.

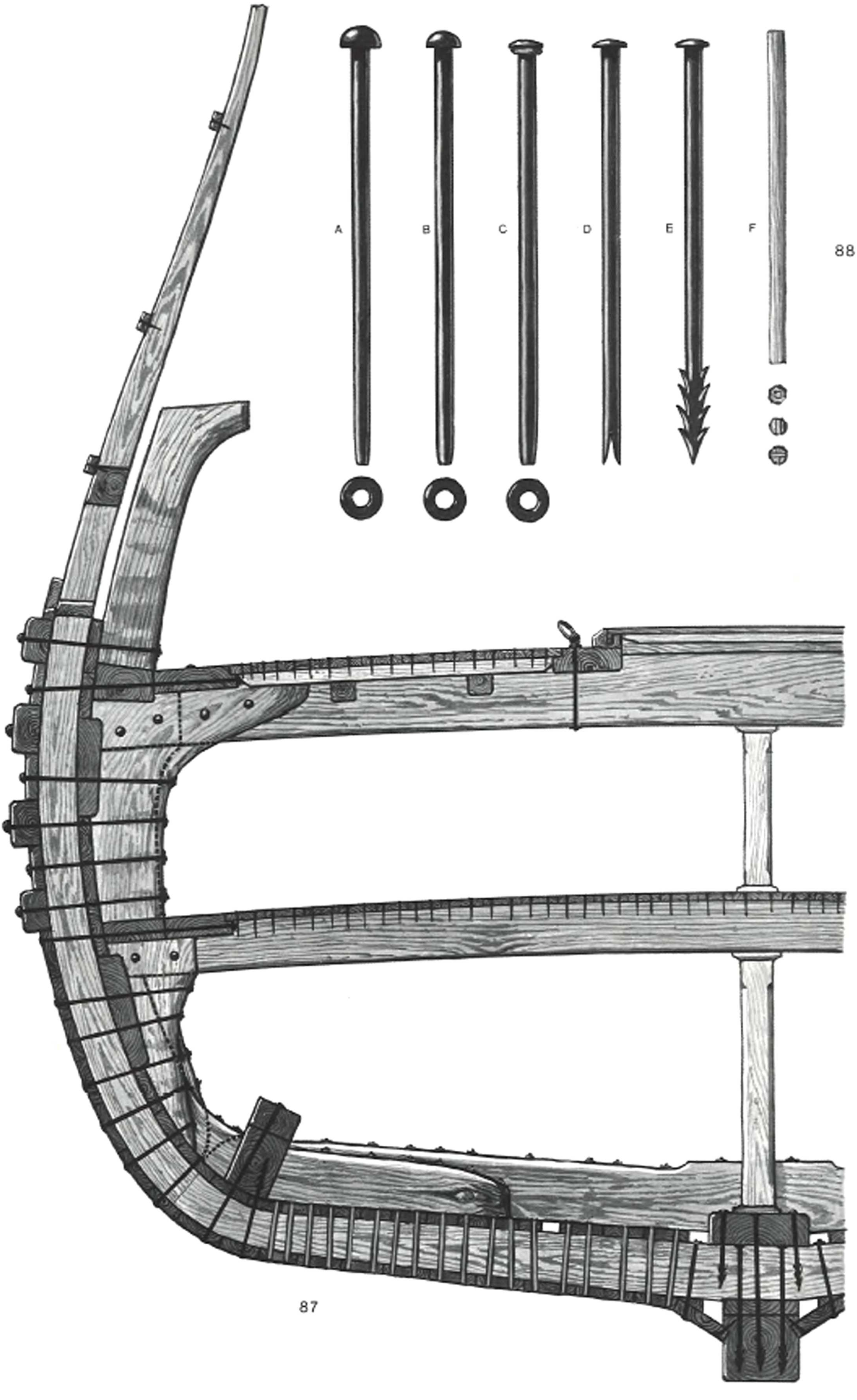
All the bolts that completely pierced the timbers were rivetted against a washer. Note that the bolts that secured the floor pierced the riders or the knees that they lay next to. A twist of oakum and white lead was wound round under the heads of the bolts that lay under the wales.

A ring-bolt was fastened in the binding strake nearly opposite each gun-port; it was used to secure the tackle that ran in the gun and made it fast.

Right from the start of construction all surfaces of timber that would later become inaccessible were tarred: scarfs, edges of the planks and wales, surfaces of the frames that would receive the planking, the various parts of the stem and so on. The planking and ceiling were tarred inside and out, and so were the futtock frames, the stern and the stem; in fact the whole hull. It is not known if the internationally famous Viborg tar was used, or something less costly

Those parts of the planking that could be thought to come below the waterline when the ship heeled were caulked with a mixture of calf-hair and pitch. In the Netherlands it was considered that Stockholm pitch was the best that could be got: it was made by boiling slightly imperfect tar until it was scarcely fluid. Pitch was used inside the hull between the keel and the garboard-strake.





88

87



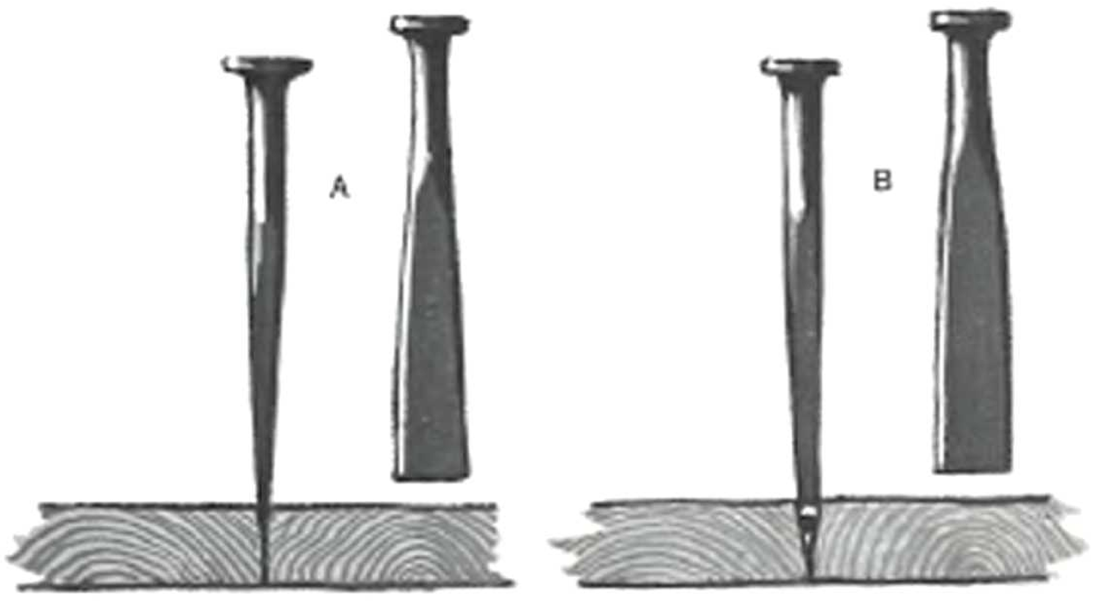
To caulk seams (89:*A*), they were first opened with a fine-edged wedge and *B* then caulked with calf-hair and pitch that was driven home with a concave-edged wedge.

Before the launch the underwater parts of the hull were dressed with a mixture of tar and white lead that was intended to prevent or lessen fouling.

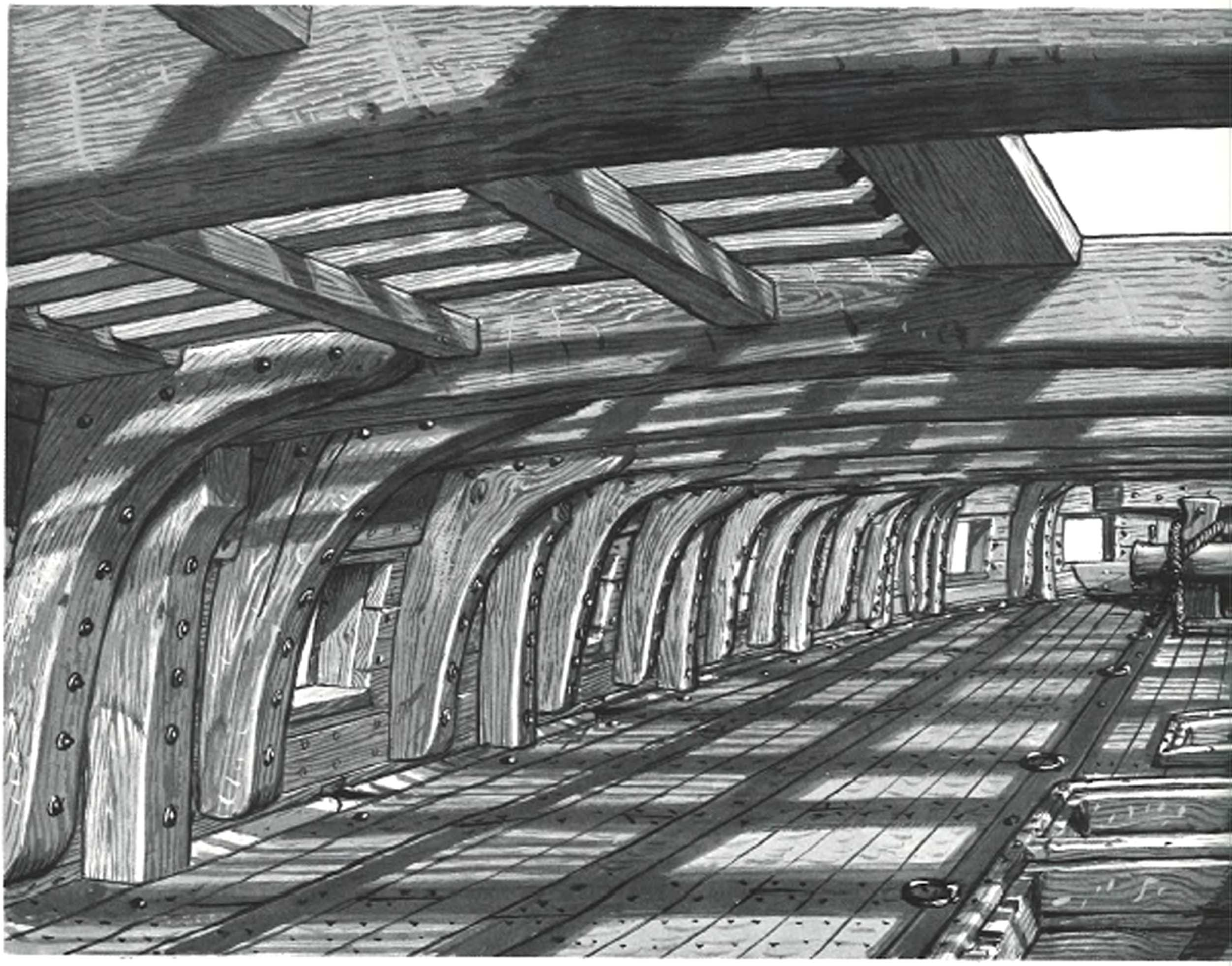
One by one the uppermost timber in each bed on the stocks was knocked out, greased with whale-oil, and driven back into place. A heavy cable was led round the stern, its ends being made fast to long tackles secured to the mooring posts in the water on either side of the stocks. The massive wooden block that had supported the stem was knocked out of the way, as many people as could find places threw their weight onto the tackles, they heaved and shouted, and to the sound of fanfares on trumpets and rolls on drums and the cheers of the onlookers the warship *Vasa* slid down the ways, raised a mighty bow-wave and floated out into Laduviken.

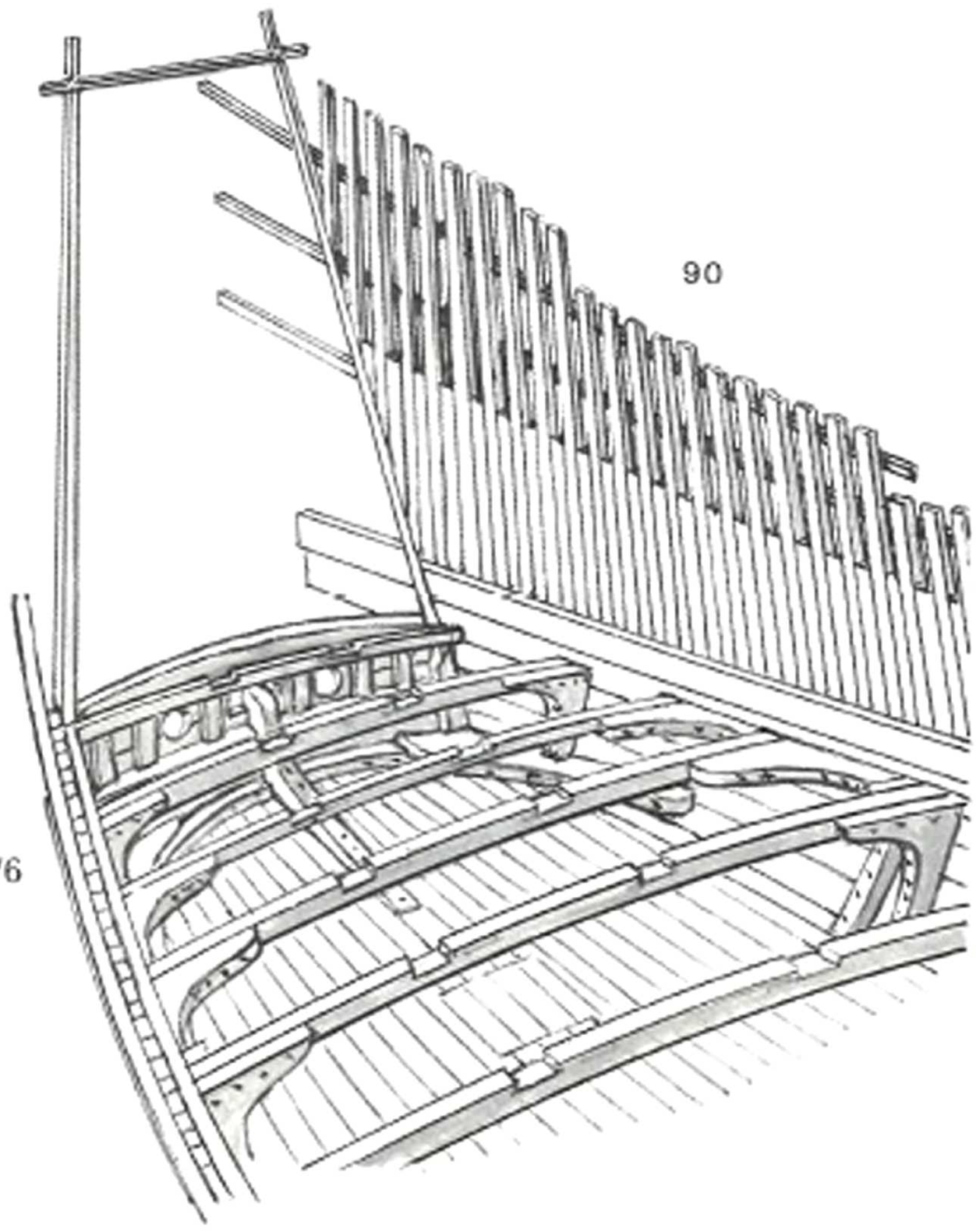
It is possible that the launch took place at the end of July 1626 (see "Tidskrift i Sjöväsendet", 1957, page 412): Georg Hafström refers to the ancient

custom that a ship would receive her name first upon launching and that the king had named "the New Vasa of 400 lasts" in a contract for rigging with Captain Klerck dated 1st August 1626. But this would have given only five months from the date of laying the keel, which seems altogether too short to me, and it is more prudent to assume that the king would have decided while the ship was still being planned that she should be named *Vasa*. That he called her "New Vasa" in the contract, and later spoke of her by this name, must certainly have been because there had been other ships called *Vasa*.



89





The hull is completed

Hendrick Hybertszoon had pointed out to the Council of State in July 1626 that the Crown owed him 19,000 *riksdaler*, and a month later he was still complaining that no payment had been made. On 31st August, according to the still-existing minutes of the Council, he was informed that 3,000 *riksdaler* would be disbursed after St. Mary's Day, 8th September. Nothing more is recorded of Hendrick Hybertszoon in the minutes and it is possible that his illness grew rapidly worse, so that he could no longer cope with



91

the problems of the dockyard. He died at the end of May 1627 and was buried on 3rd June.

His widow Margareta Nilsdotter was encouraged by her relations to let others take on the heavy burden of the dockyard contract, but she is said to have replied: "I must now fulfil the contract that my late husband entered into, and I shall not give up until I have." (See "Tidskrift i Sjöväsendet", 1957, page 414.) Her speech bears witness to her courage, not merely to hold to the stipulated delivery dates but also to require the Crown to pay the contracted sums for the work. It seems as if the relationship between the dockyard and the Crown was strained even at this stage.

After the launching *Vasa* was anchored with her two bow anchors, and her stern was made fast to the quay. The fastenings for the upper gun-deck beams were attached with trenails to the frames and planking. Alternate beams were supported on the upper end of a filler and a knee, those between them being supported only by knees. The third and fourth beams from the stern (90) and the second beam from the bow were supported by horizontal knees. Note that the stern (90) was given an additional wing-transom under which were fixed two planks pierced by two round gun-ports.

Illustration 91 shows the lower gun-deck towards the bow. The ring-bolts for the gun-tackles can be seen in the binding strakes, and the scuppers are just visible at intervals along the waterways. The deck is not smoothed off like the planking but adzed to give a surface that would be less slippery. The gun-deck is well lit, for the upper gun-deck has yet to be laid.



The new warship is called *Vasa*, or the *New Vasa*, in this book, but in documents of the seventeenth century she is also called *Wasan, Vasen, Vhasa, Vhasen, Vhassan, Vazan, Whasa, Whassan, Wazan, die Whasse, Store (Great) Wahsan* and other variants, for at that time there were no rules for the correct spelling of Swedish. The frequent occurrence of "W" is a sign of German influence: it is still a matter of debate whether or not the king grew up bilingual in Swedish and German.

The oldest Swedish warship that undeniably bore the name *Wasa* was launched in 1778 and, with a couple of exceptions, the name is to be found written, so far as I can see, in the definite form—in Swedish *Wasan*—like the names of other warships: *Kronan, Svärdet, Riksäpplet* and so on.

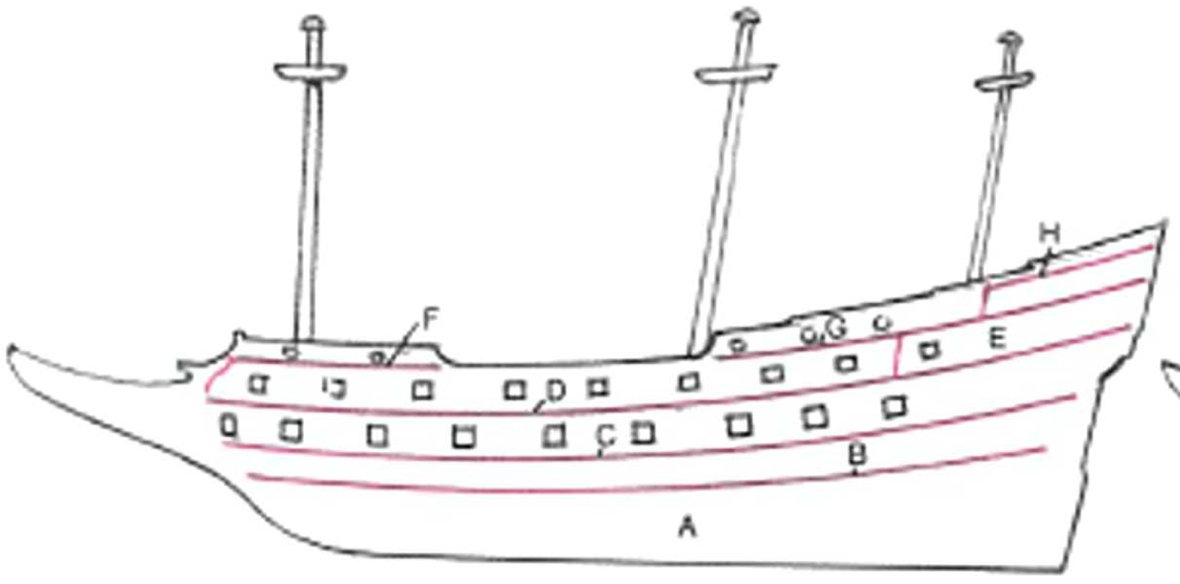
In illustration 92 *Vasa* is lying with her stern to the quay, planked up to the uppermost wale but one. A broad gangway gives access to the hull over the transom, and everything needed to complete the remaining decks is carried in that way. The planking extends aft of the top timbers of the fashion-piece at the stern; later it will be joined by an upper transom. A floating platform alongside supports a ladder leading up to the platform round the hull, where shipwrights are driving bolts through the wales and planks, which are then to be secured within the hull.

The *Vasa*'s arrangement of decks differs from contemporary ships in other countries.

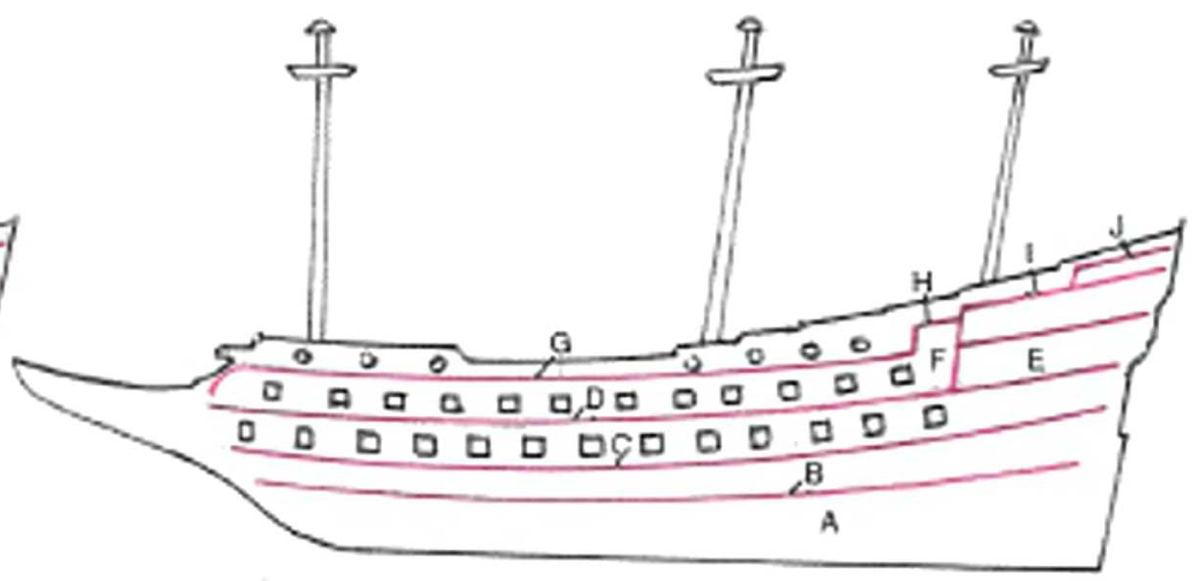
For that reason the arrangement of the decks in *Vasa* and a contemporary ship are shown here schematically. Illustration 93 shows the decks and internal division of a conventional ship. *A* hold *B* orlop-deck *C* lower gun-deck *D* upper gun-deck

E main cabin *F* foredeck *G* quarter-deck *H* coach-deck.

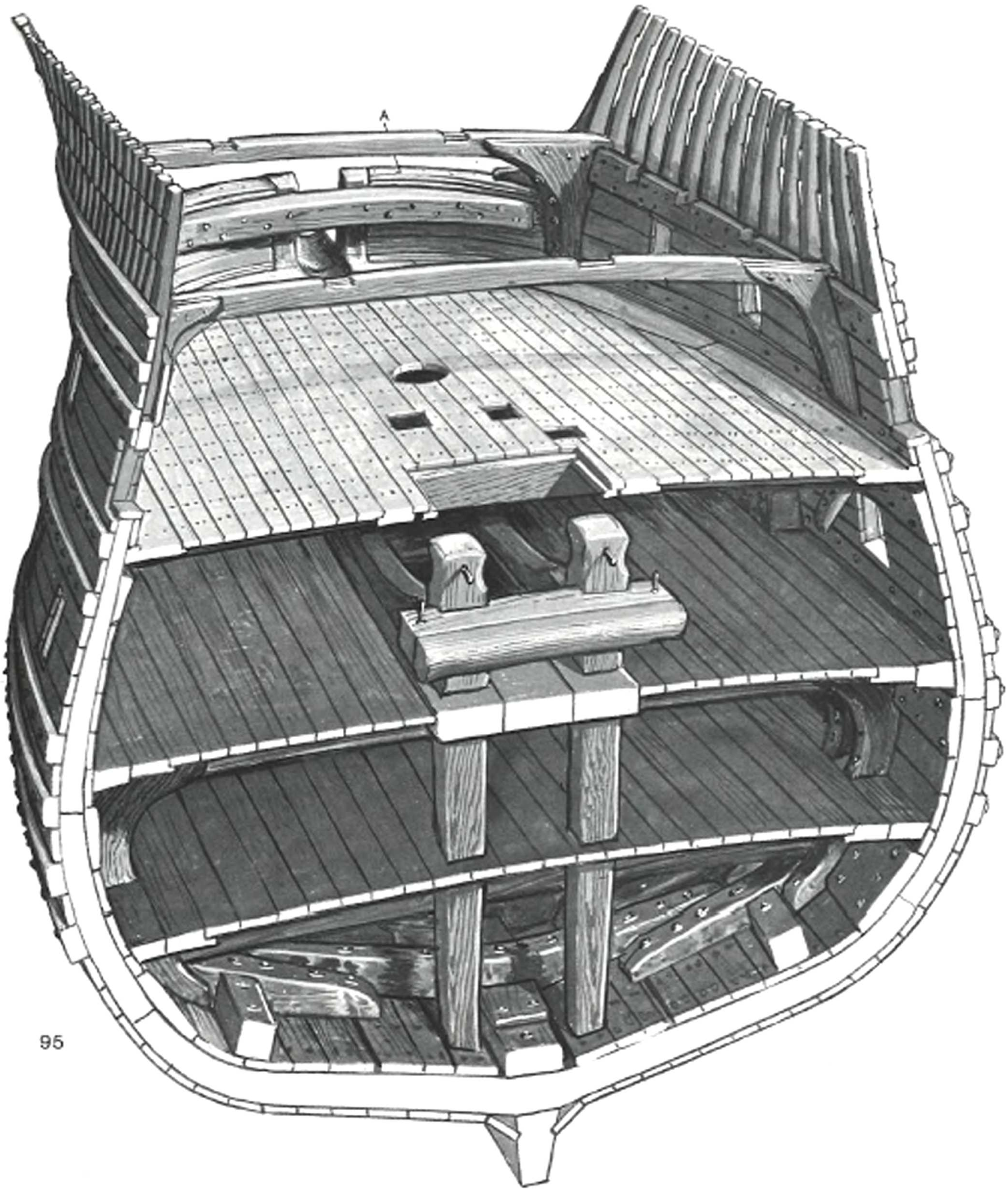
Illustration 94 shows the decks and internal divisions of the *Vasa*. *A* hold *B* orlop-deck *C* lower gundeck *D* upper gun-deck *E* main cabin *F* steerage *G* upper deck *H* deck over the steerage *I* coach-deck *J* poop-royal deck.



93



94

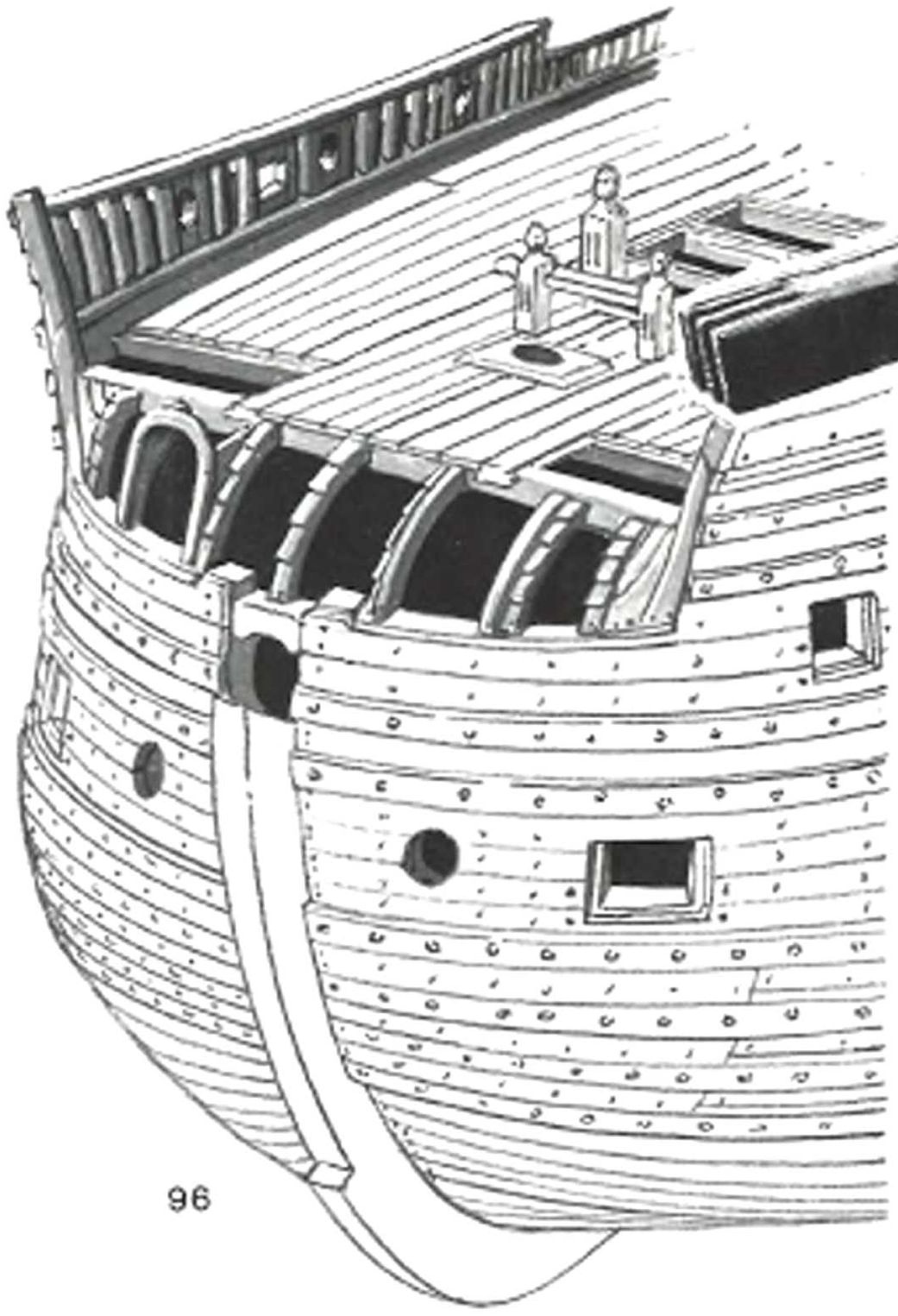


95

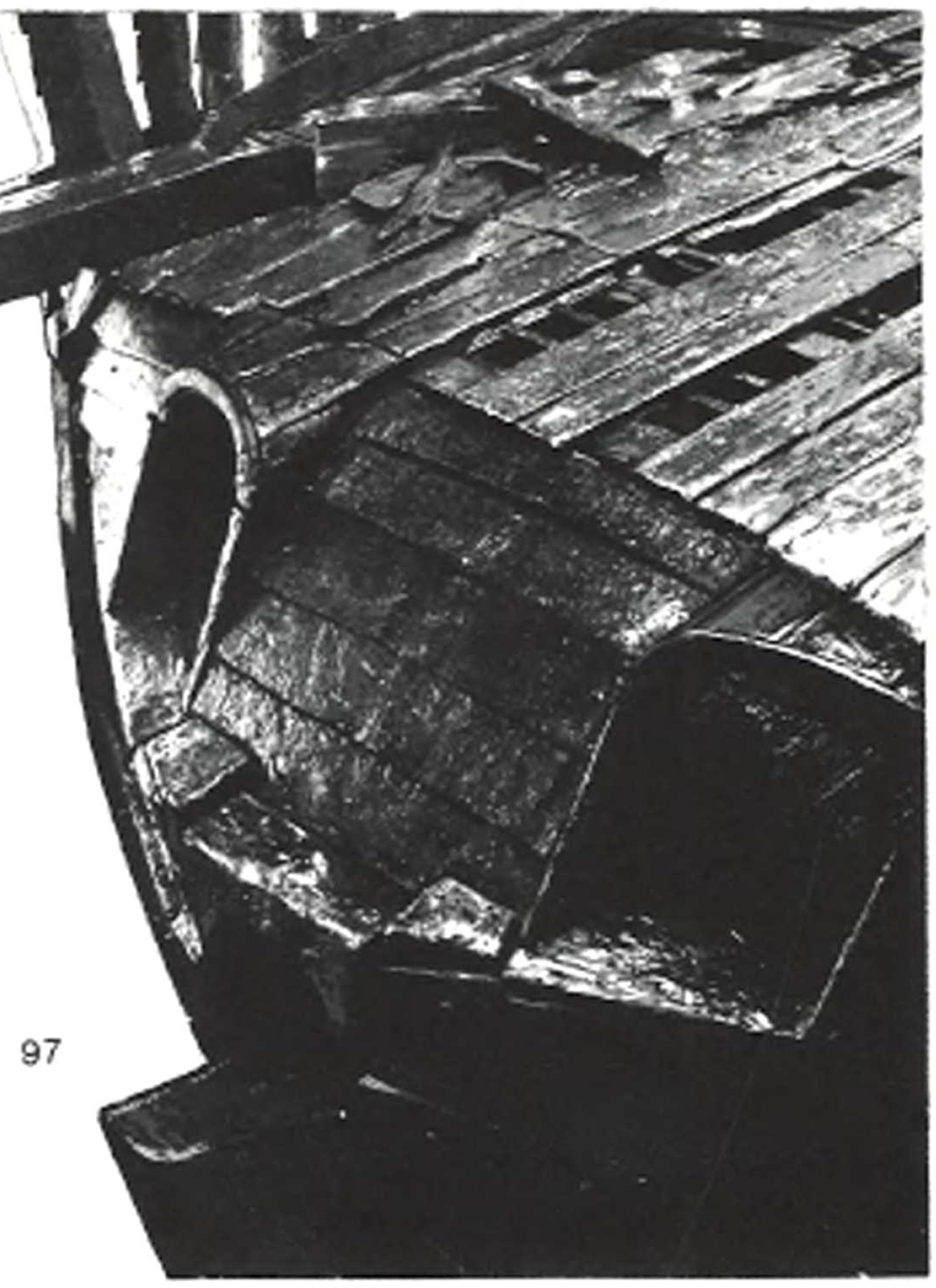
Illustration 95 shows the bow in cross section, with the upper gun-deck and the ceiling up to the clamps of the beams of the upper gun-deck. A heavy breast-hook strengthens the construction, and doubled planks lie over the ends of the cant-timbers. I know of no other contemporary ship that would have been framed and planked up to the stem at the level of the upper gun-deck. In the illustration only two of the upper deck beams are shown.

As mentioned earlier, the framing varied considerably in thickness, and frames do not always lie symmetrically in relation to one another. As a result the deck beams vary too, so that they are neither uniformly wide nor symmetrical across the centre line of the ship.

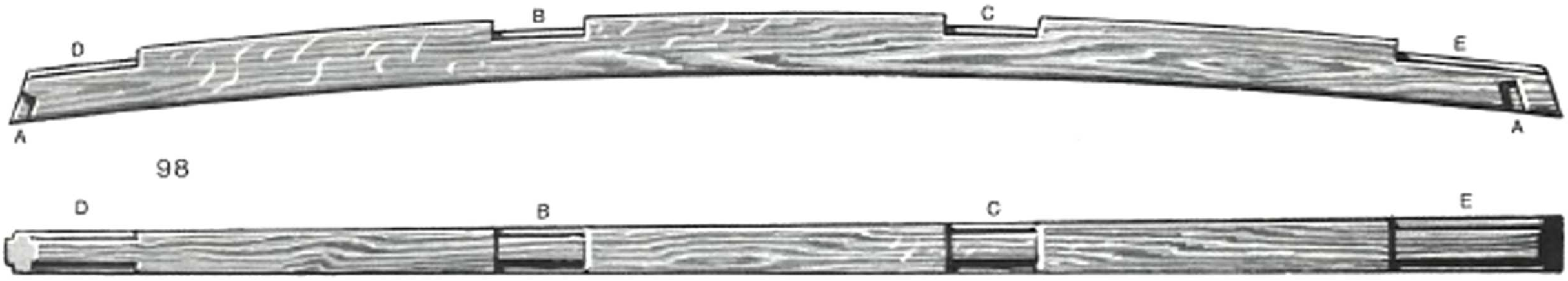
On Dutch or Dutch-built ships, judging from contemporary illustrations (see pages 36, 86 and 87), the clinker-built rounded bulkhead that terminated the upper gun-deck, or more usually the fore-deck, was carried down to the upper gun-deck. This higher bulkhead usually permitted a high door or



96



97

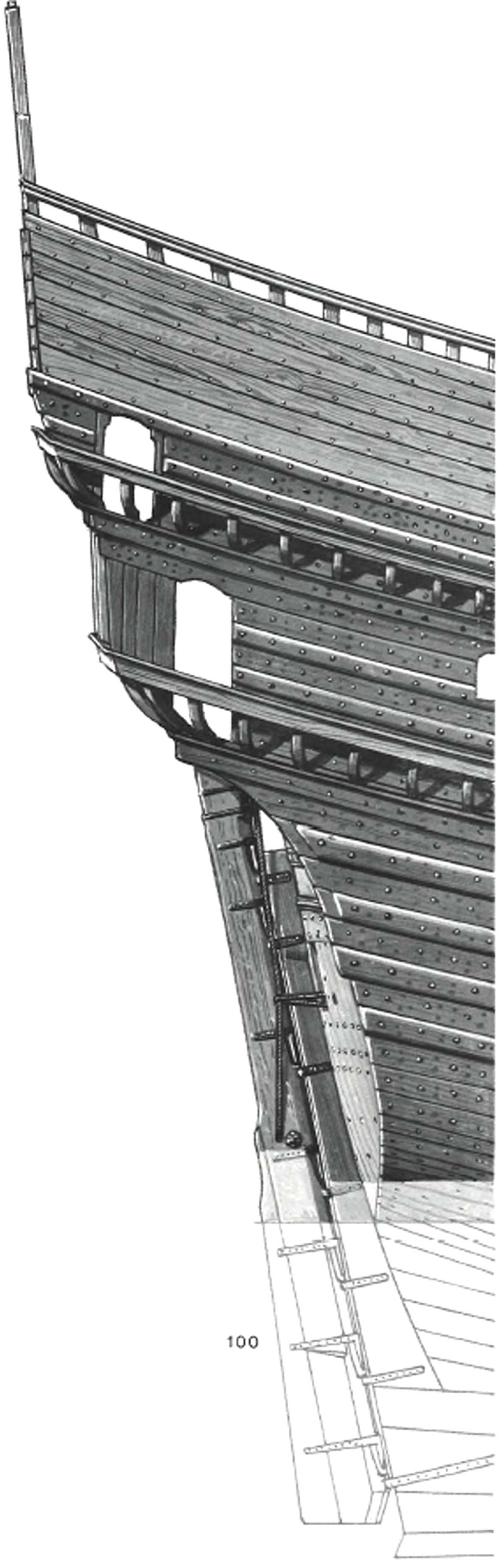


98

companion-way out to the beakhead, but *Vasa*'s special design permitted only two rather constricted openings (see illustrations 96 and 97). Illustration 96 shows how the decking and waterways of the upper gun-deck end at the second beam from the bow: had the builders intended that the bulkhead should have begun at this beam? The photographs, taken during the work of restoration, show the deck scarfed with nailed-on hatches, and the bulkhead and part of one of the companionways, from inside the hull.



99



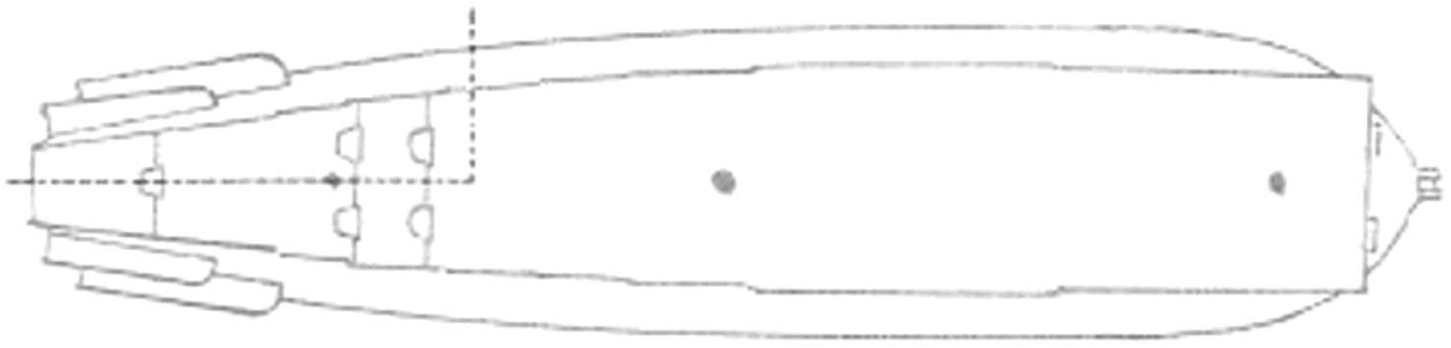
100

Illustration 98 shows lateral and vertical drawings of an upper-deck beam. *A* mortices to receive the tenons on its supports. *B, C* mortices to receive the binding strakes. *D, E* mortices for the waterways. The ends of this beam, and those of many others, are not symmetrical.

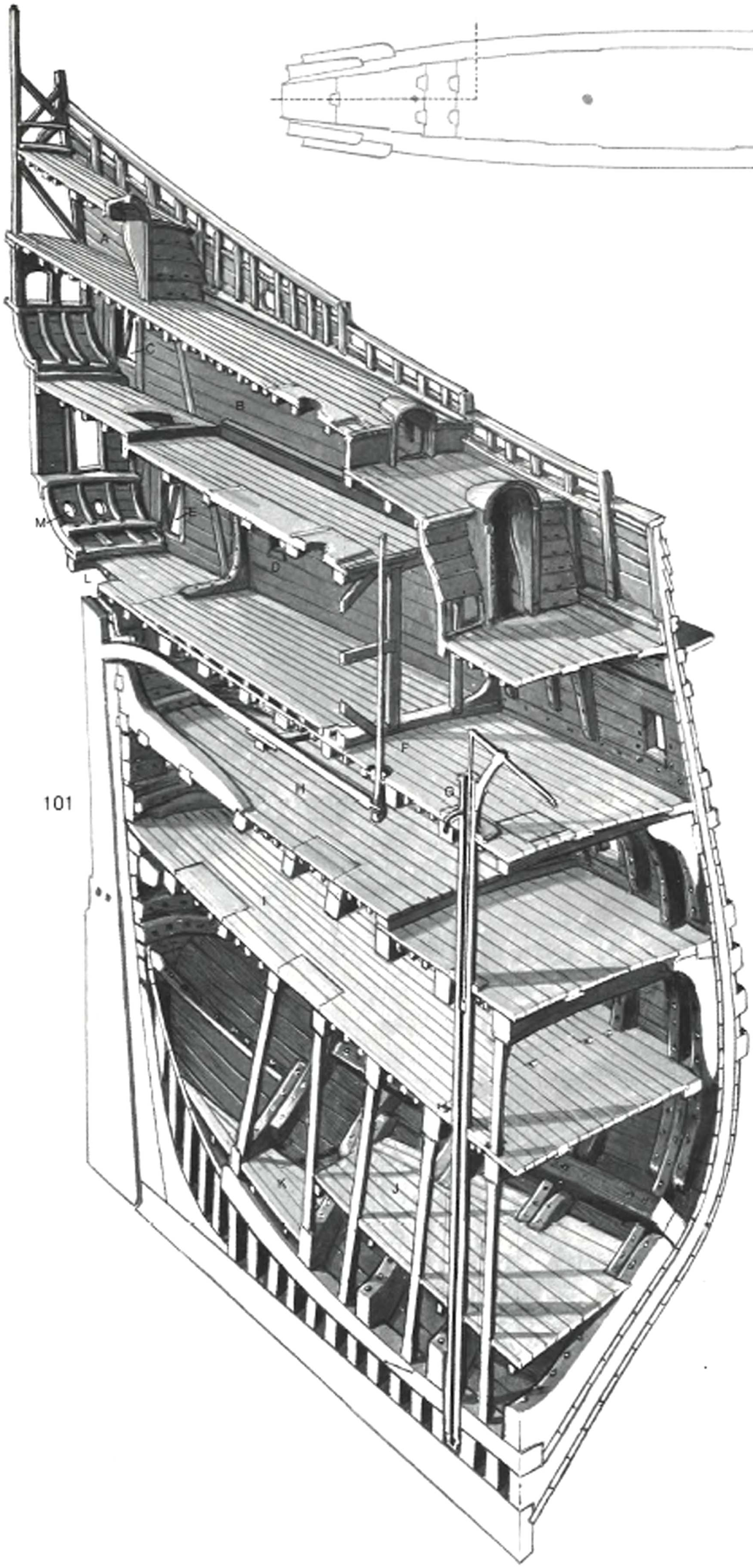
Seen in longitudinal cross-section along the centre line, the internal division of the ship at the stern is shown in illustration 101, from the poop-royal cabin down to the hold. For the sake of clarity I have made a schematic drawing (102) of the hull from above, with the section shown in the large illustration indicated by a dotted line.

In illustration 101 the poop-royal cabin *A* has a single opening on the centre line. The cabin *B* which was used by the captain, the helmsman and the junior officers was later divided by a bulkhead into a larger and a smaller part; two low openings from the deck over the steerage lead to this cabin and the upper gallery is reached by an opening *C*. The main or admiral's cabin *D* provided space for him and the senior officers and allowed for the reception of distinguished visitors; it, too, was later divided by a bulkhead, placed immediately aft of the large knee. The lower gallery was reached through an opening *E*. Two gun-ports *M* in the built-out rounded stern gallery provided for two swivel-guns, and a hatch *L*, which was normally covered, gave access to the head of the rudder; the hatch in the deck above could also be covered. The steerage *F* where the vertical whipstaff passes through the deck to the tiller was later separated from the pump *G* by a bulkhead that closed off the upper gun-deck. The lower gun-deck *H* is occupied by the tiller, but its two gun-ports cannot be seen. The hatch on the centre line gives access to the gunroom below. Of the two hatches in the orlop-deck, that furthest aft is nailed shut but would have been opened if repairs had to be carried out. The forward hatch led down to the powder-room *K* in the hold, and the ballast was stowed under the deck on which stores were kept.

Illustration 100 shows the arrangement of the rudder pendants that passed through 3" holes which were immediately above the waterline. The pendants were used both to lift the rudder into place and as a means of preventing it from floating away if its fittings suffered damage. The ship carried a spare tiller but the pendants could be used if need be to manoeuvre the rudder. The illustration shows the pendants in use to fit the rudder: the hatches by the rudder are open to allow the pendants to be hauled in through them to bring the gudgeons on the rudder over the pintles, and when the rudder was in place and ready for use, the lines were slacked off.



102



101

Catheads, balustrades and beakheads

The hull is complete, the upper deck is laid and so are the decks over the steerage, the cabin and the poop-royal. The openings over the binding strakes are covered with gratings, as they are on the upper gun-deck, to allow galley smoke, and powder smoke in the event of an action, to escape.

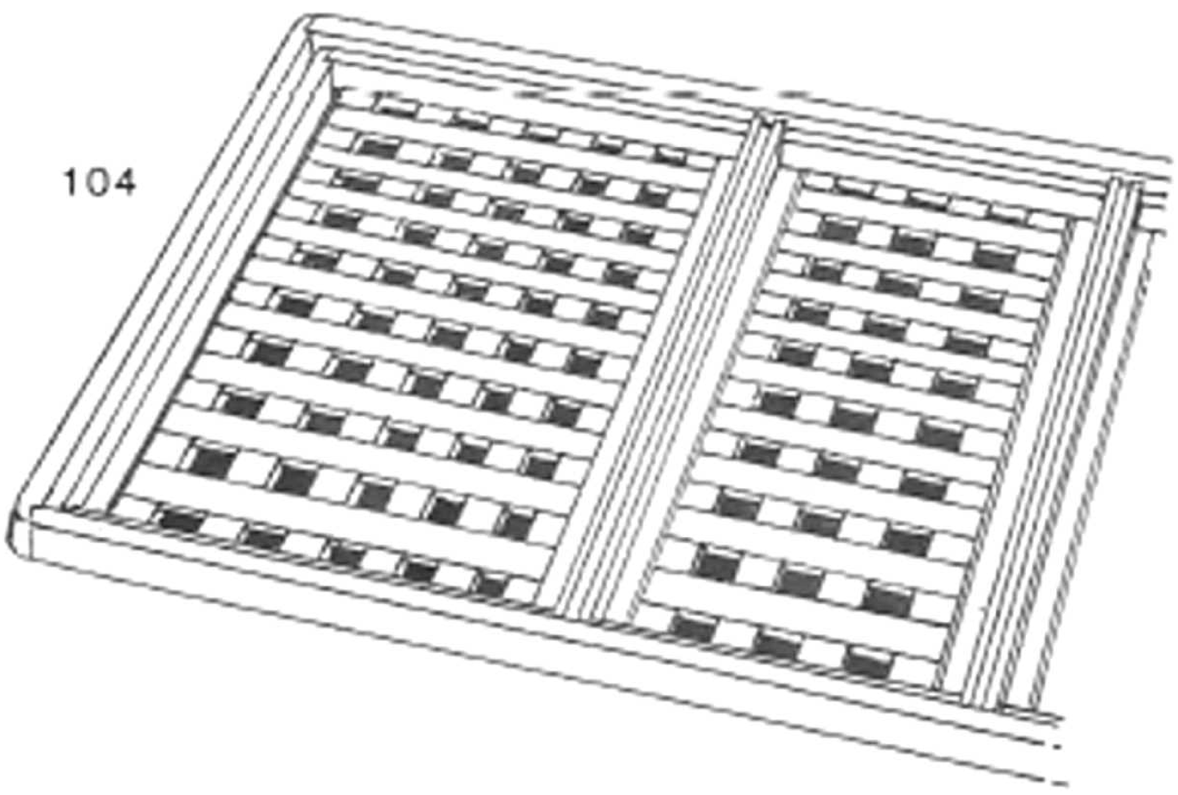
The catheads which jut forward are bolted to two deck beams and to the timber lying athwartships over them, which Witsen calls the "small bitts-beam."

The sketch by Witsen (pages 95ff) illustrates the bitts, with the small bitts-beam (*beting balkje*) and its cleat for the foresail sheets and some sort of attachment, probably for the tackle for the anchor; the cathead (*Kraen*) lies on a support attached to the beakhead.

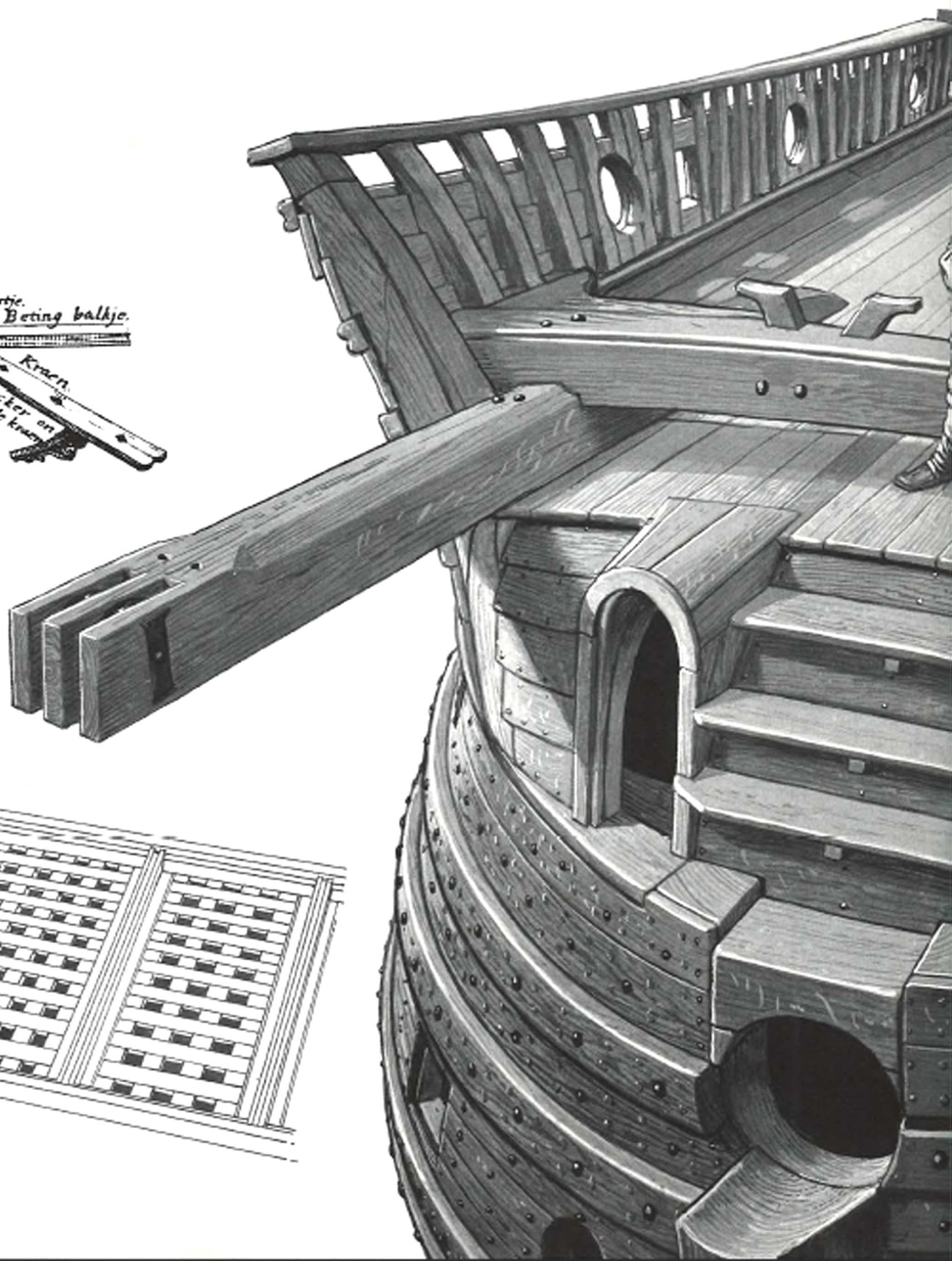
Neither the port cathead nor the small bitts-beam could be found when the *Vasa* was recovered but their details have been simple to reconstruct. The cleats have been satisfactorily located by making trials of how the sheets were led, but it is not yet clear where the belaying pins were placed. A balus-trade ran across the length of the small bitts-beam.

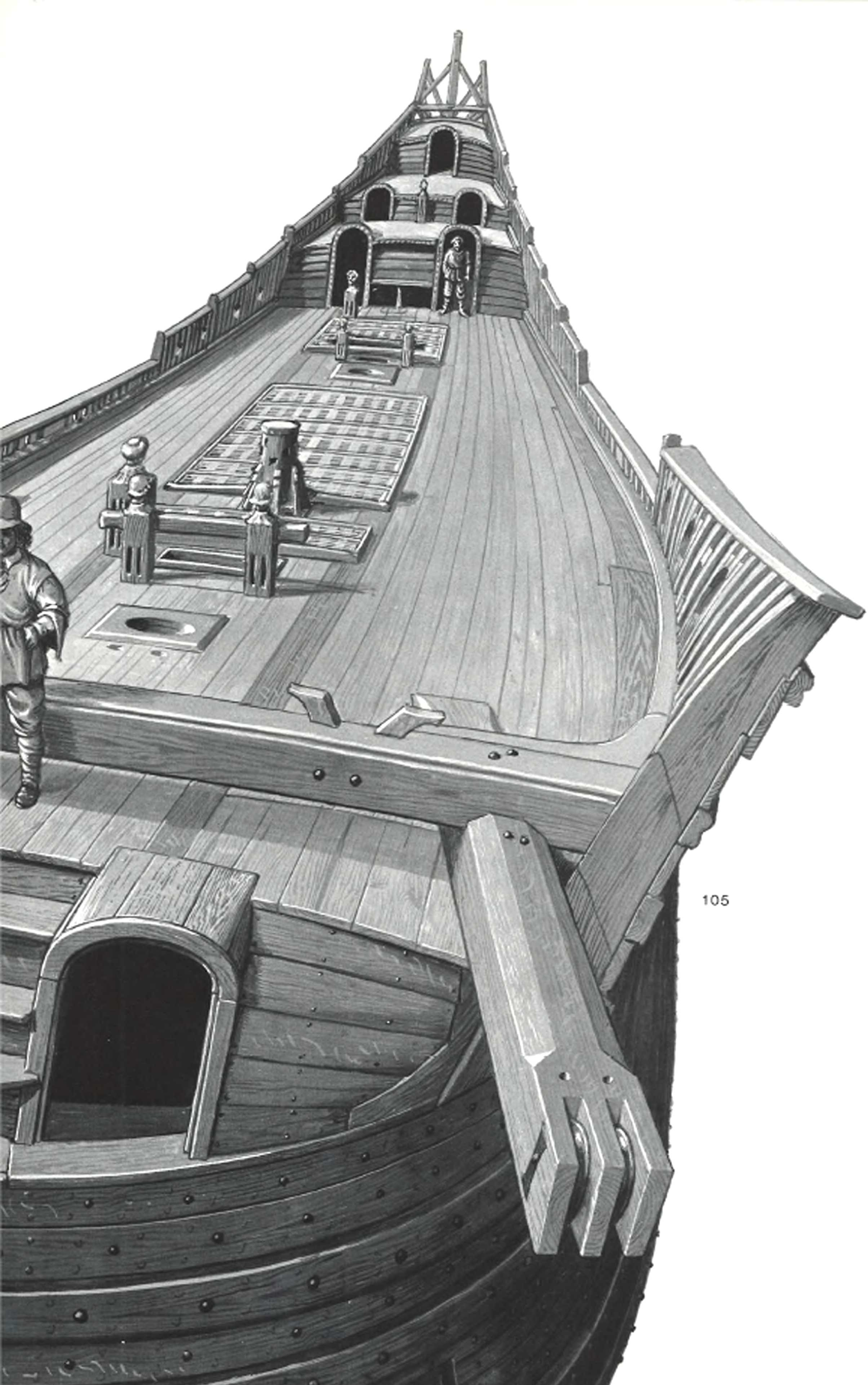


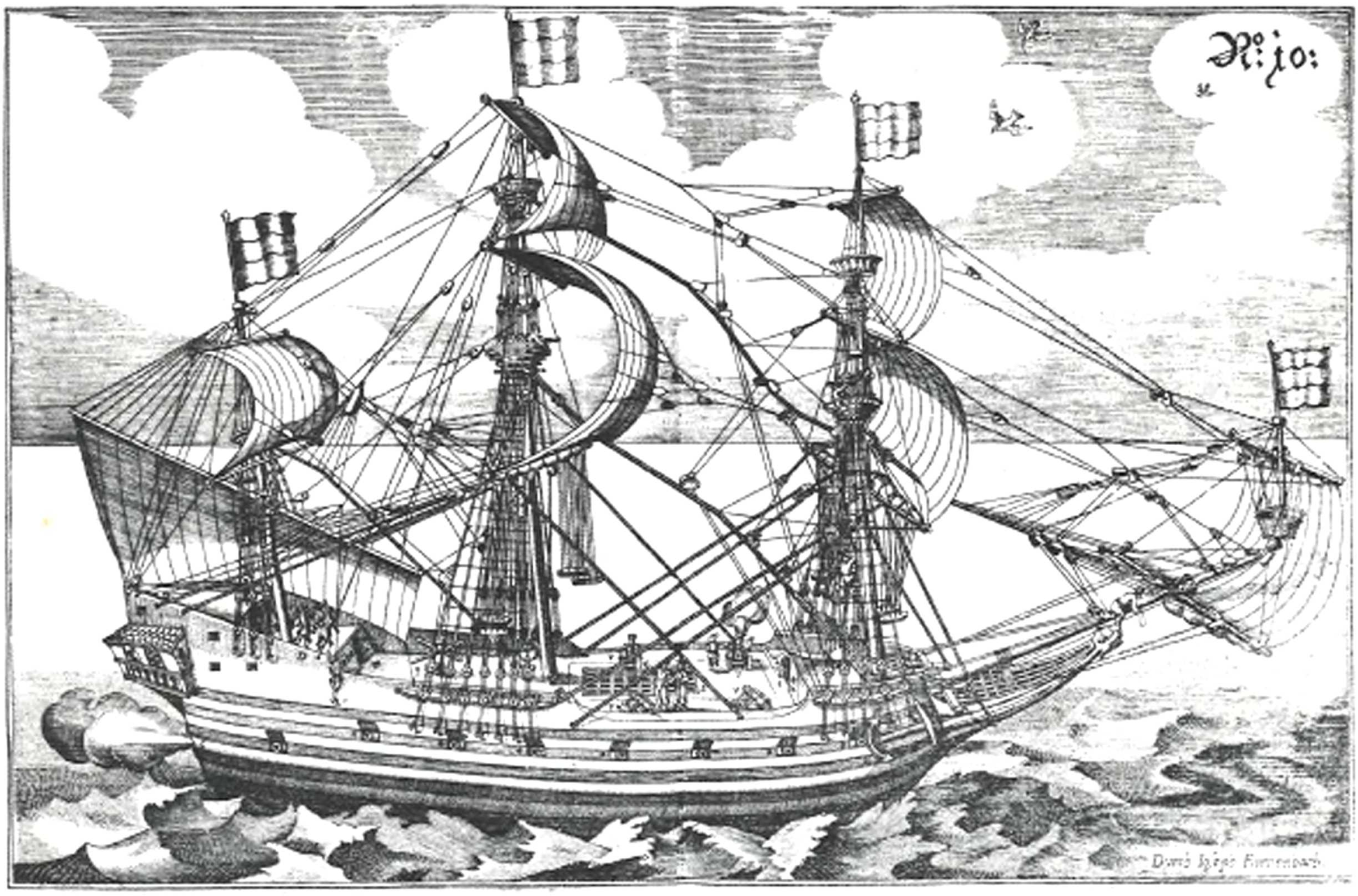
103



104





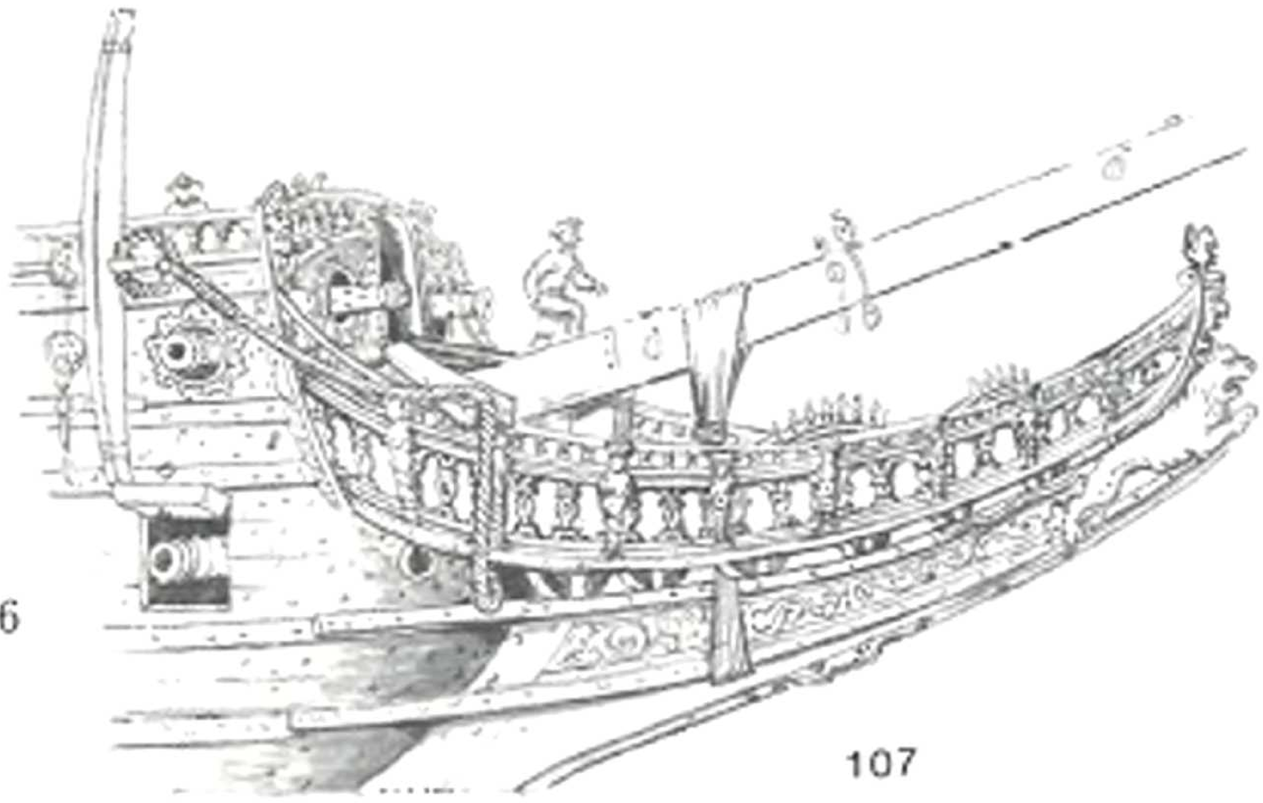


106

Catheads of the same type as those on the *Vasa* do not appear on models or in illustrations, so far as I can see. Joseph Furttenbach's view from 1629, of a Dutch ship (illustration 106), was definitely drawn from a simple model. A long beam lies across the beakhead under the bowsprit, the ends of which can have served as catheads. A similar beam appears in a painting from 1622 by Cornelis van Wieringen of the Battle of Gibraltar (not reproduced here). Vroom depicted catheads on the *Prince Royal* and the English ships escorting her (see page 22), but not when he depicted Dutch ships.

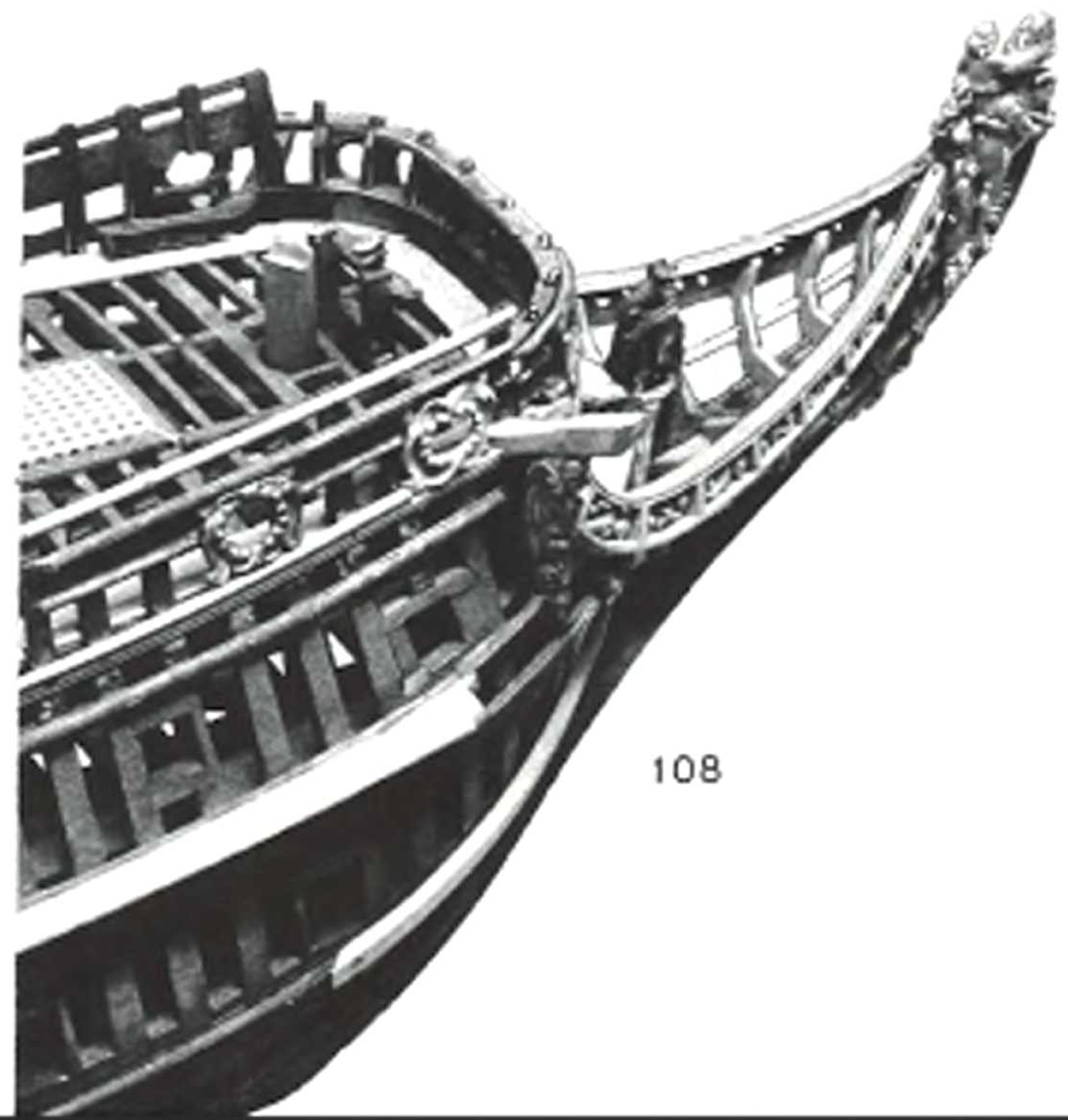
One may then put forward the suggestion that the Dutch ships of the first decade of the seventeenth century did not carry permanent catheads, but rigged up something like them when needed. In the drawings of English galleons from the end of the sixteenth century one can see fixed catheads (see page 13); they are to be seen, too, on the model of a Flemish galleon from 1593 that is in the Naval Museum in Madrid.

The Danish ship *Tre Kroner* from 1601, illustrated on pages 16 and 17, most disconcertingly displays a cathead jutting out from the bow immediately aft of



86

107



108

109

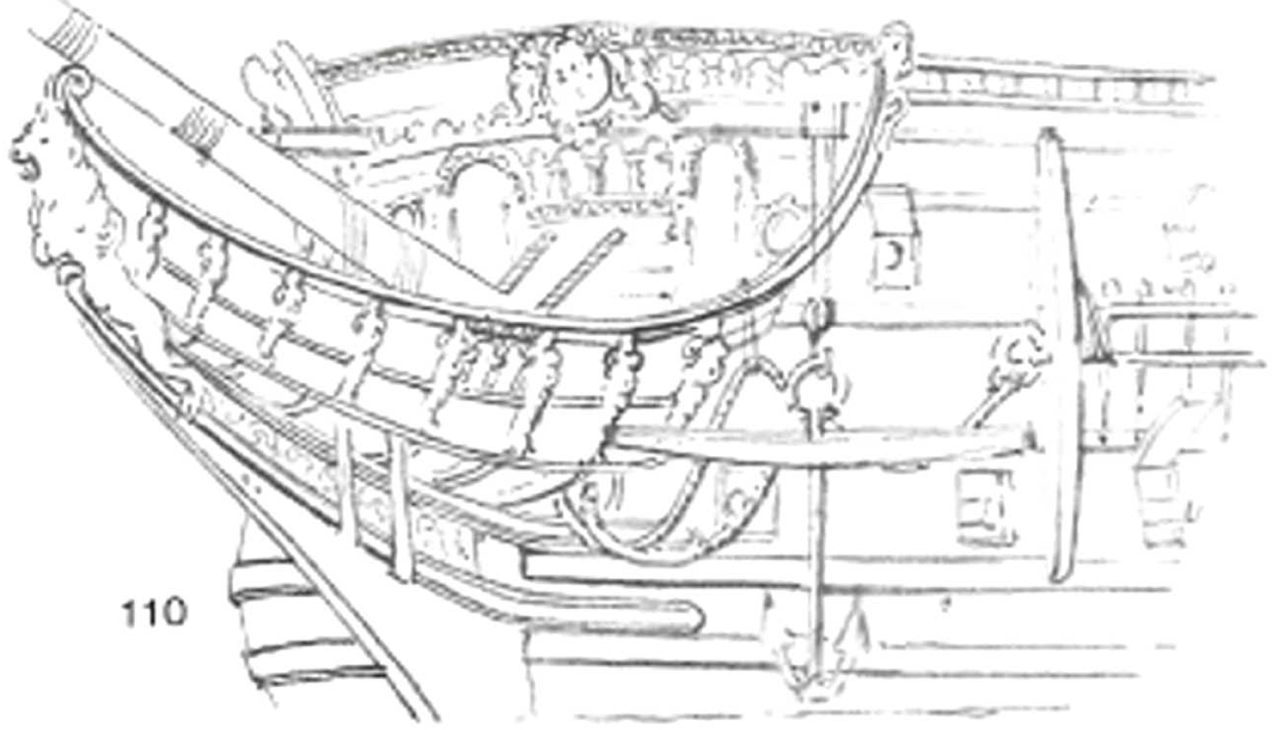
the beakhead, and so does the Dutch ship from the middle of the seventeenth century shown on page 127.

On an early seventeenth-century drawing by an unknown artist of a galleon of Dutch type (see *M M* 8, page 289) we see a fixed cathead extending outwards at an angle to the opening in the forward bulkhead; the cathead rests directly on the balustrade of the beakhead (107).

Le Grand Saint Louis (page 36) seems, if a little indistinctly, to have something of the same sort, unless the beams, in a manner that later became usual, curved out from the sides of the forward bulkhead and over the rails. The English ship, *Constant Reformation*, built in 1619, carried her catheads on her upper deck, to judge from an illustration (plate 2) in M. S. Robinson's book, The van de Velde Drawings. Such an arrangement was common on English ships after about this time. When the English master shipwright Francis Sheldon came to Sweden in 1658 he brought with him a model, now in the National Maritime Museum, Stockholm (illustration 108). It has catheads on the foredeck close to the top timbers, which curve out at an angle.

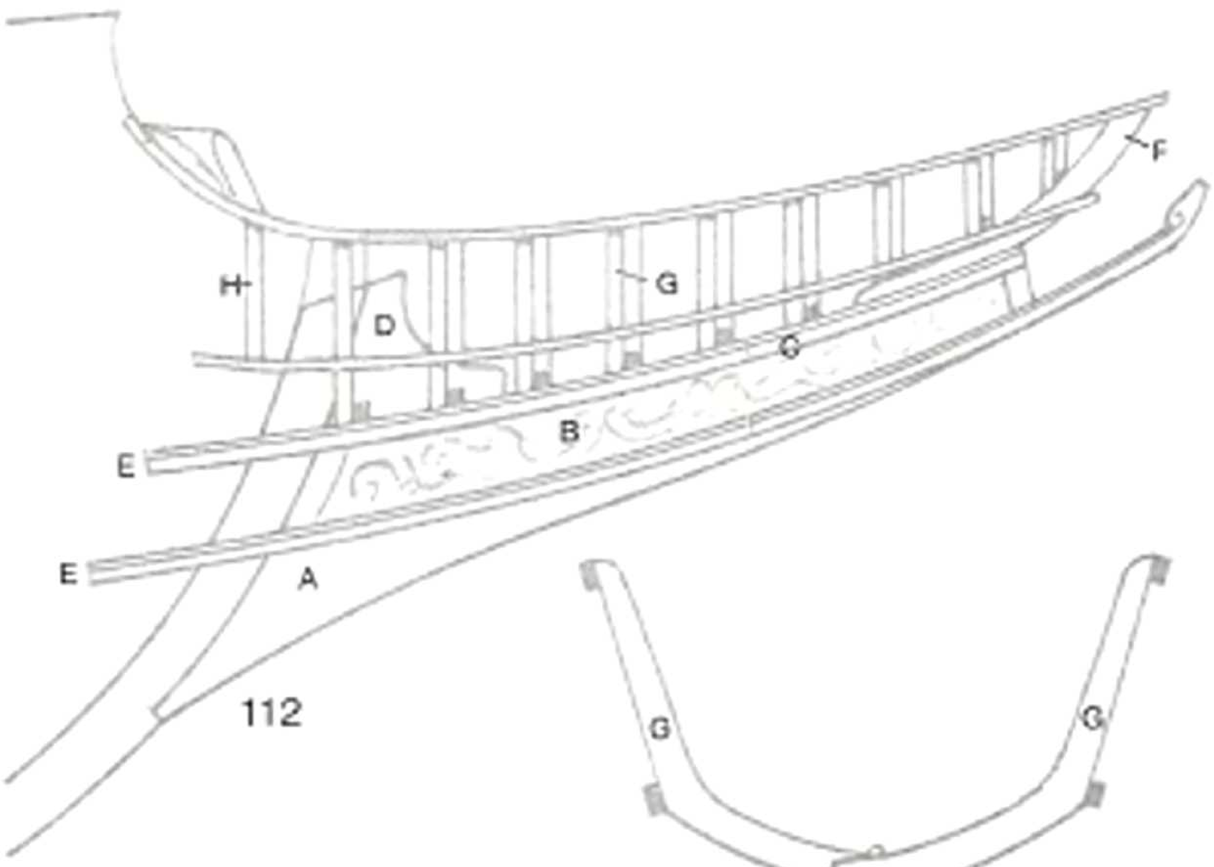
Rosenborg Castle in Denmark contains a ship model in ivory made by Jakob Jensen in 1654 of the Danish ship *Norske Løve* from 1634 (illustration 109). Its powerful sheer, galleries, beakhead and details of the rigging show it to be a Dutch type of ship, but its catheads are wholly identical with those of the English model.

The drawing below is made from a sketch from 1656 by Willem van de Velde the younger showing a ship perhaps from the 1630s (see *Robinson*, page 2). Her catheads are on the foredeck but the drawing gives no indication of how they are formed. It shows a balustrade on the bitts-beam, with a shield supported by two nereids in its centre.

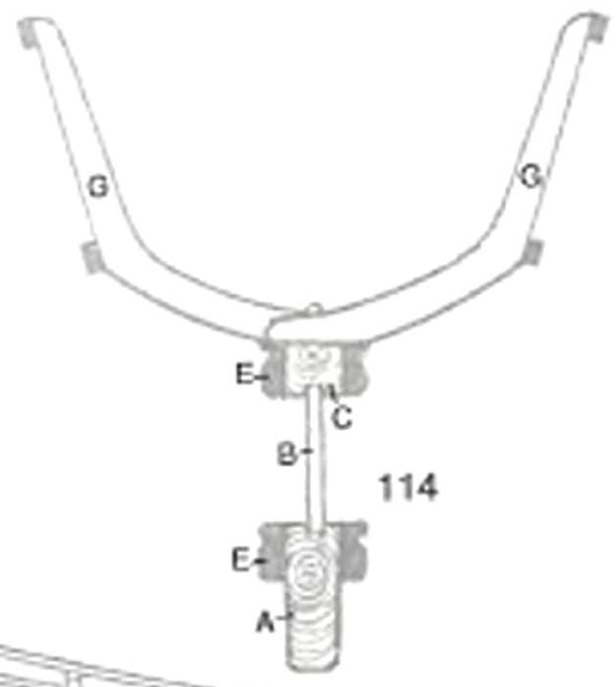


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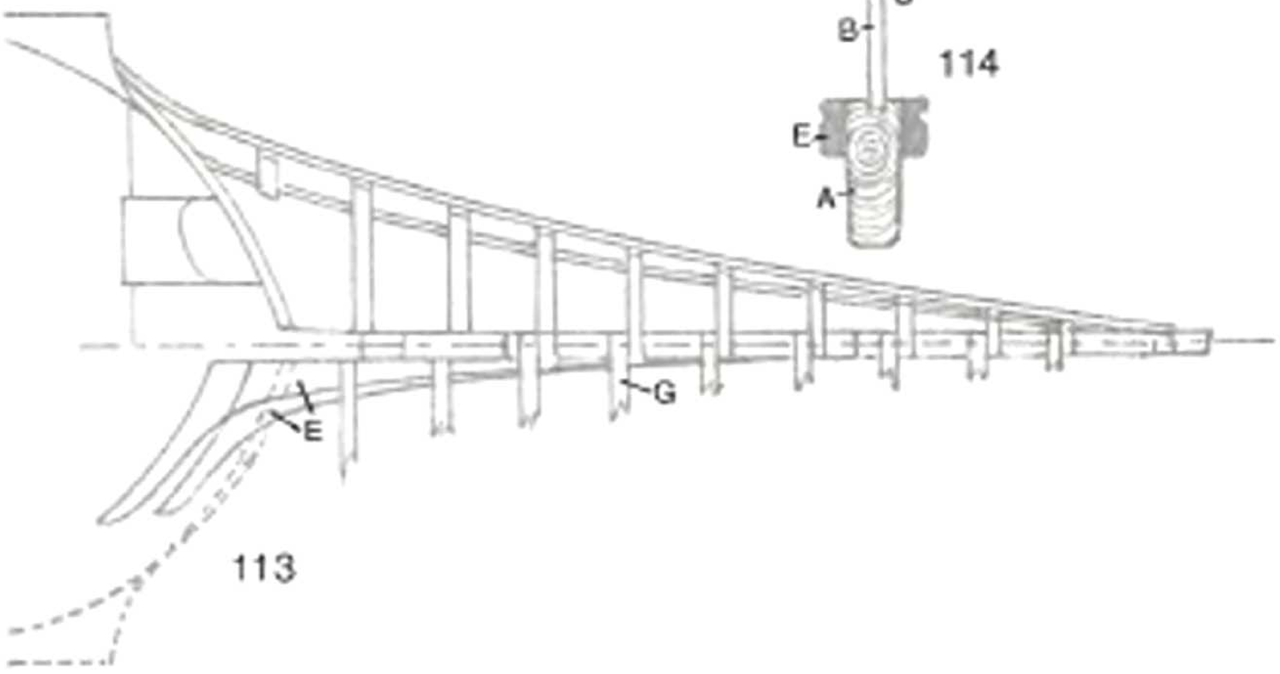
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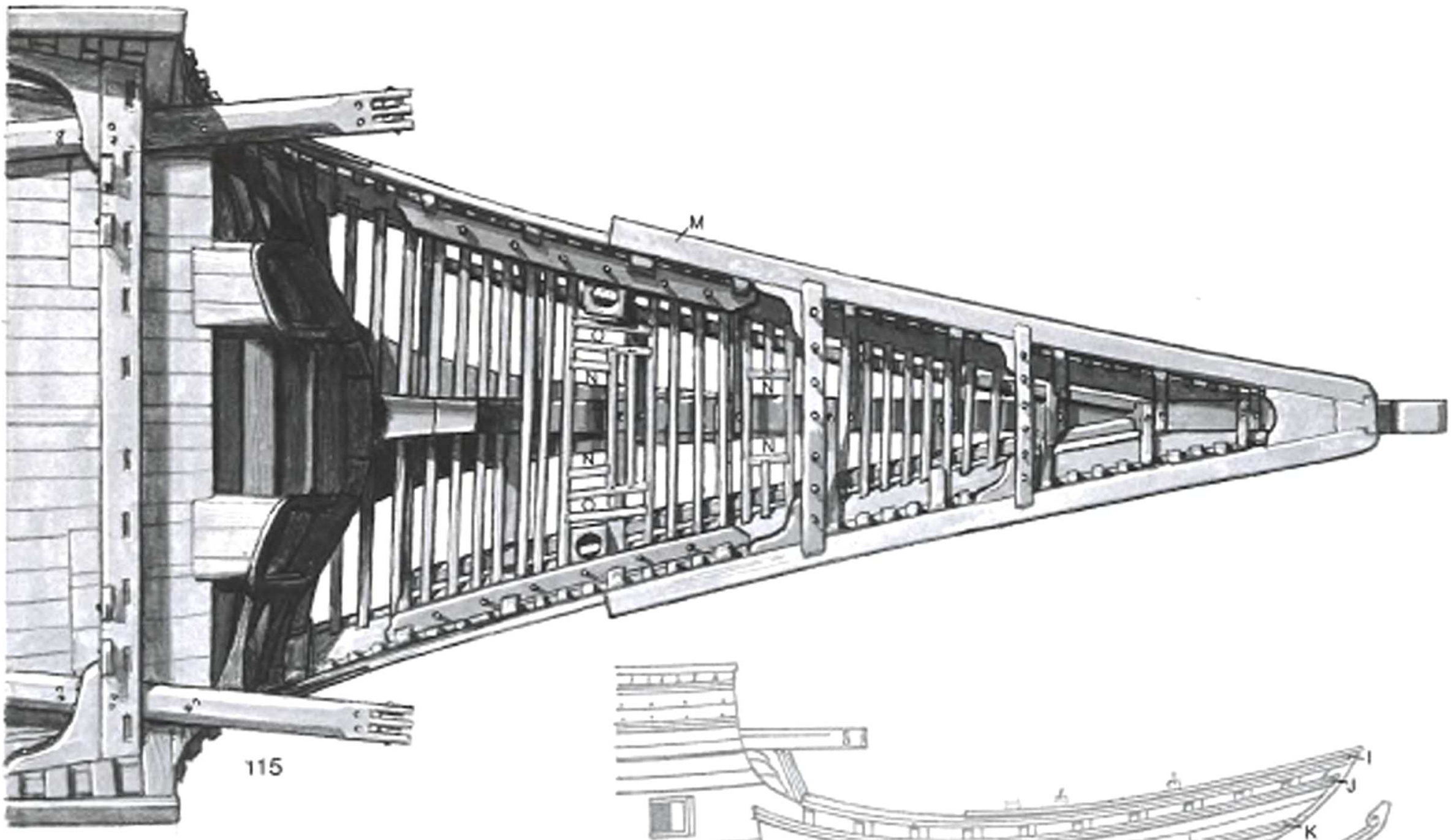
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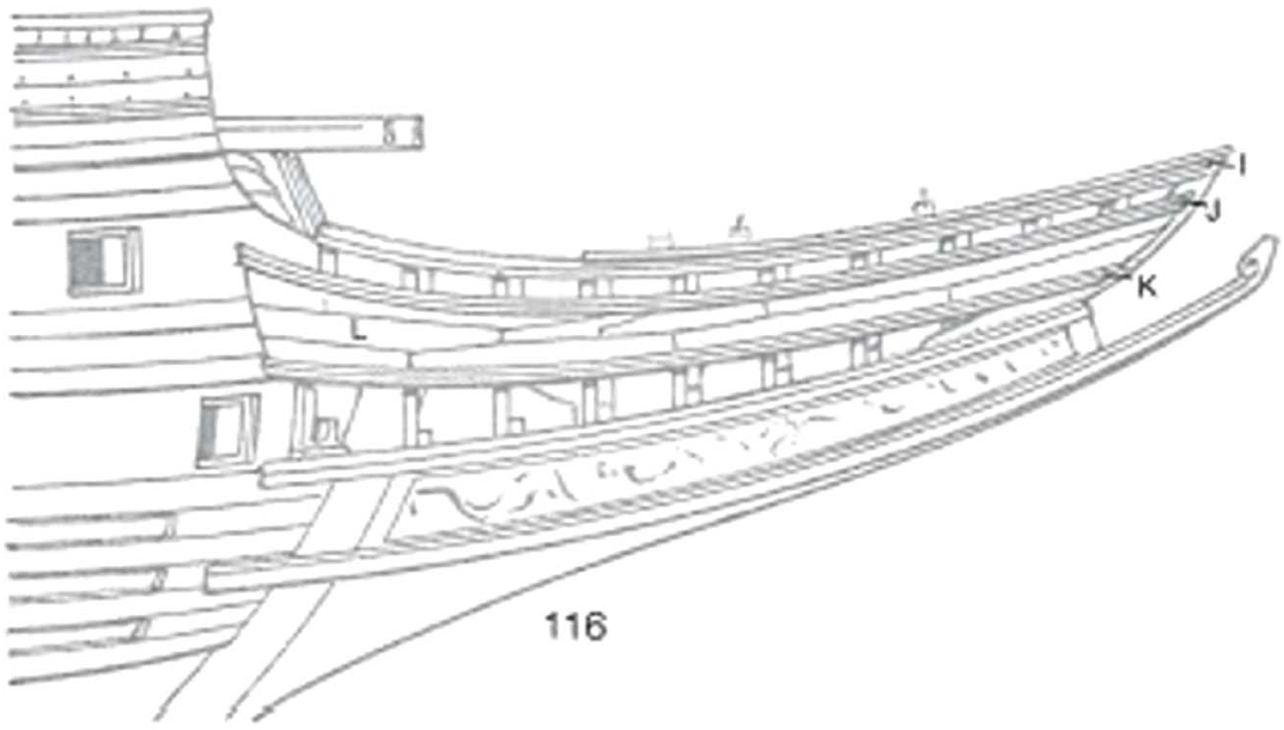
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The following is my attempt to illustrate how *Vasa*'s beakhead was constructed. The first element to be fitted was probably a massive lengthy vertical knee (112:*A*) that was bolted to the stem. The comb *B*, which was usually decorated only modestly, is on the *Vasa* a complex of motifs from Greek mythology. *C* is an upper vertical knee fitted to the port side of the stem and bolted to *D* a vertical knee—the cutwater knee—and these four parts together formed the beakhead cutwater or skeg. Long horizontal knees (111–114: *E*) add lateral support and are fastened together by *F* the compass timber. One or two sets of framing timbers *G* were bolted into place before the rest of the beakhead was made in much the same way as the hull itself. Two pairs of ribbands were used to form the outline of the beakhead, this being done probably by eye, and further framing timbers were then added, having been made up from templates of lathes or the like. A final timber (112: *H*) was fastened only to the ribbands.

The ribbands on the beakhead were replaced by framing pieces (116: *I, J, K*) and the space between



115



116

the lower two *L* was timbered to provide a bulwark. A broad railing (115: *M*) was fitted, and the slatted decking of the beakhead was arranged to provide openings *N* for the gammonings, the lashings that secured the bowsprit, and *O* for the foresail sheets. The large round holes beside these last-mentioned openings are what are still called the heads by sailors and toilets or the like by others; scrutiny of illustration 15, for example, will reveal that other parts of the ship might also be so used. Racks or benches for belaying-pins, two athwartships and two fore-and-aft, were bolted to the framing pieces.

In describing the sculptural embellishment of *Vasa*'s beakhead, and indeed the entirety of her decoration, I must begin by stating that she is more richly and more individually decorated than any other known contemporary vessel. It is true that we know the *Prince Royal* primarily from Hendrick Vroom's large painting which is probably based on the many sketches he would have made when the fleet arrived at Vlissingen. The English ship was embellished first and foremost with heraldic symbols, but the *Vasa*'s planners and artists worked along a number of different lines, partly but principally a glorification of the royal power together with an almost pedagogically religious and moralising theme.

Many elements derive from the Bible, many others from classical mythology, and it is self-evident that the sculptors, even those who were leading artists, would not have known enough about the various motifs to have given form to them.

The embellishment of the ship may have been composed by Johan Bureus and Johan Skytte, once the king's tutors and later his close friends, or by some other learned person. However, we know by name the craftsmen who made, or led the work of making, the greater part of the sculptures; they made them in accordance with pattern books from the fifteenth and sixteenth centuries.

Johann Didrichszoon Tijsen was a Dutchman who had come to Stockholm in 1624 to work on the decoration of the palace. Hans Clausink, whose name sounds Dutch, had been employed in the





shipyard as a master sculptor as early as 1608. Mårten Redtmer probably came from northern Germany via Estonia; he is named in the archives as early as 1618. From a stylistic analysis he can be said to be responsible for about 40 percent of the ship's sculptures.

In the Netherlands the figurehead was the Lion of Orange, and *Vasa*'s lengthy beakhead, too, features a lion which is fastened between the two vertical knees. Outboard of the bulwarks on the beakhead are Roman emperors wearing purple cloaks, ten on either side: those to starboard, reckoned forward from the bow are Tiberius, Caligula, Claudius, Nero, Galba, Otho, Vitellius, Vespasian, Titus and Domitian. Each stands upon the head of a monster that holds in its jaws the scroll bearing the emperor's name.

The uppermost framing piece terminates at the bow with a massive triton, as do the bulwarks both fore and aft. The cathead is supported on yet another triton above which, immediately under the cathead, is a moustached figure with an averted face confined in a gilded cage. In Greek mythology tritons were the sons of Poseidon, the sea god.

The comb—the vertical piece between the two long knees—depicts the struggle between Peleus

and the nereid Thetis metamorphosed into a lion, and into a serpent with the head of a bird of prey, the theme deriving from Ovid's poem that dates from about the start of the Common Era.

Furthest forward on the railing of the uppermost framing timber is a remarkable sea monster attended by a number of lesser monsters; only the one from the starboard side of the beakhead has been recovered. The large monster bears a grotesque mask on its back (118). This grotesque element in the ship's embellishment is a typical feature of the northern European late-renaissance style.

Immediately aft of the uppermost railing and the cathead stands a warrior in Roman armour; at his feet is a small dog and under them the head of a lion. His sword, remarkable enough, is curved.

A number of the sculptures were gilded, and here only the emperors' cloaks, the heads of the monsters, and the unhappy man in the cage are painted. The Vasa coat-of-arms held by the figurehead lion between its front paws was certainly correctly painted in blue (heraldic azure), white (argent) and red (gules) (cf. p. 46).

Note in this illustration (117), too, the support under the lower horizontal knee, which would reduce stress on the beakhead in a seaway. The gammonings pass through the two long holes. The fitting with the two round holes is a reconstruction in oak, for the original is missing: the holes are for the foresail leads. Note also the planking between the lower wales to stop the anchor from catching in them and damaging them. On the upper horizontal knee a piece of soft wood in front of the hawse-hole was intended to reduce wear on the anchor cable.



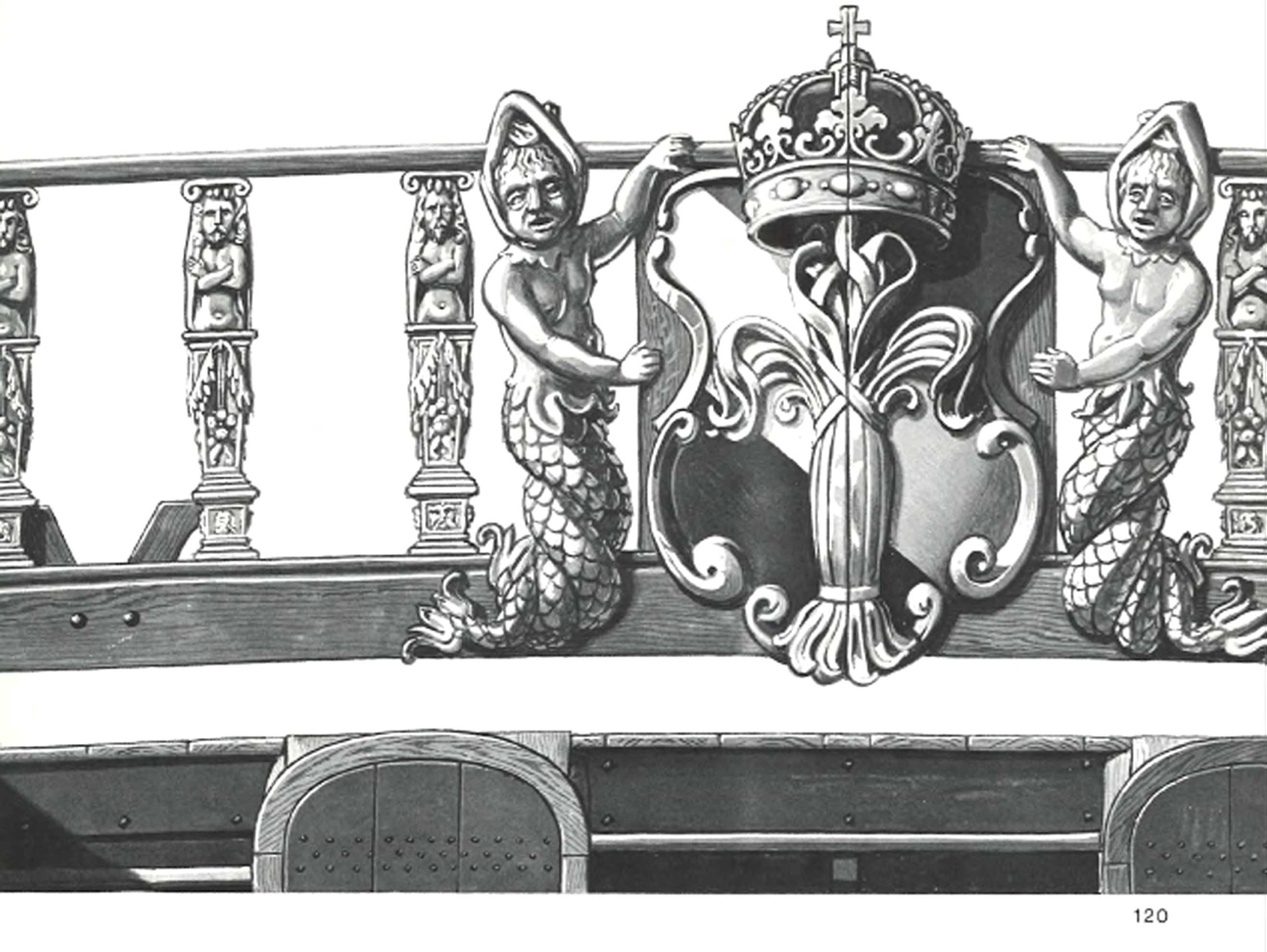
The balustrade on the smaller bitts-beam poses a puzzle not yet fully solved. A baluster and a relief of a child's face were recovered. The former is carved in the round (119), its upper parts as naked male and female torsos, its lower parts being ornamented with foliage; in other words, it is a herm back-to-back with a caryatid. In ancient Greece a herm was a free-standing pillar with its upper end representing the head of Hermes; later the head was replaced with a naked male torso. A caryatid was a bearing column, the upper part of which had the form of a naked female torso.

I guess that the heavy herms on *Vasa* faced outwards, towards the enemy, while the naked caryatids, facing inboard, afforded the crew some pleasure.

Drawings and paintings by the van de Veldes—father and son—often show an heraldic shield in the middle of the balustrade, which is often encircled by a wreath and sometimes flanked by supporters (see page 87, illustration 110), while a painting

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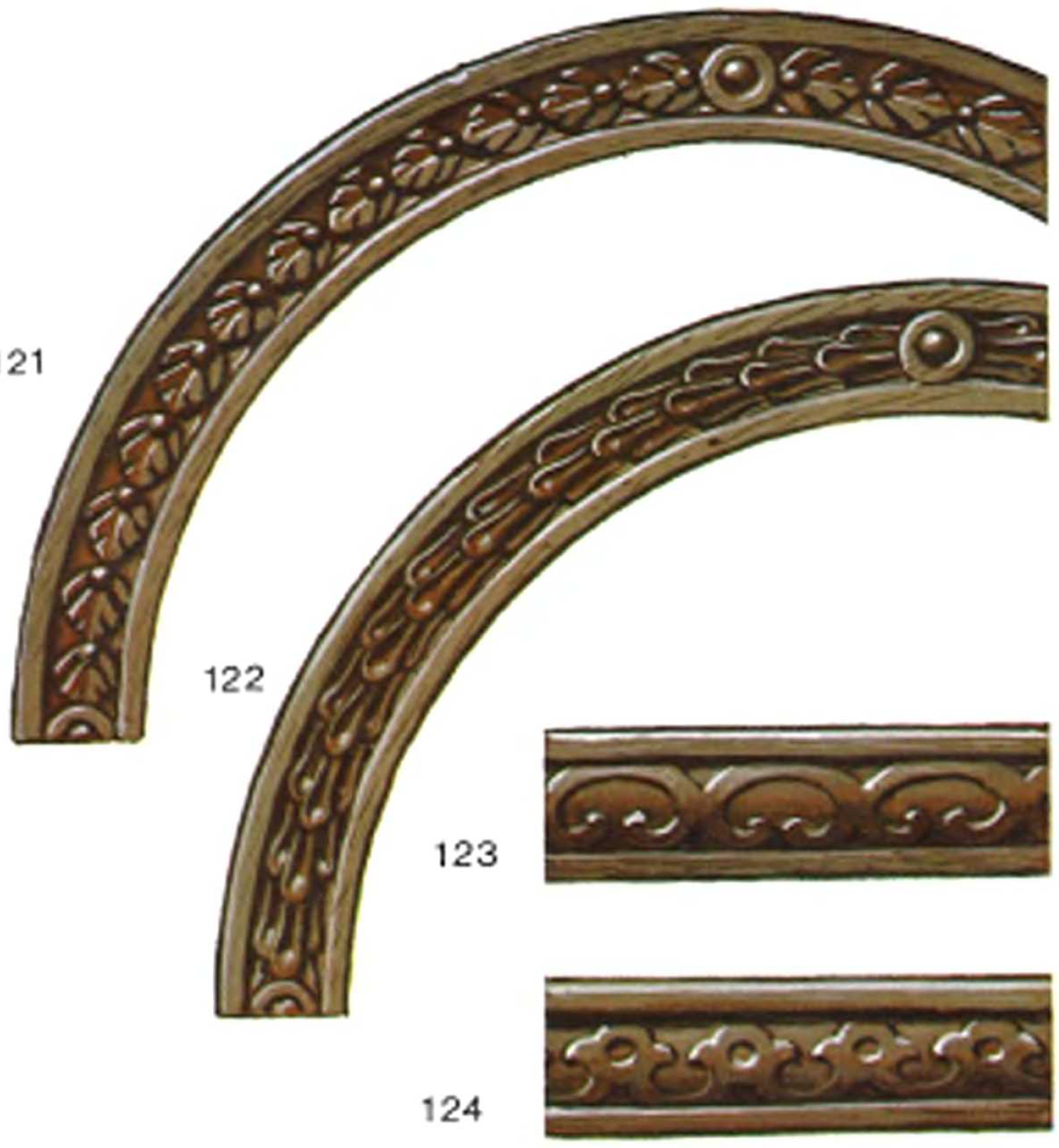


from 1625 by Adrien Pieterszoon van de Venne (see *Bol*, page 62) shows a large shield with supporters in front of the balustrade on the forecastle.

In his memorandum on the national fleet in 1649, which we have already referred to twice, Herman Fleming (page 12) writes among other things about "making a shield that will stop a musket shot, through which one [can have access] to the beakhead . . . ."

We can therefore imagine the balustrade as having in its centre a shield comprising the Vasa escutcheon (*vasa* means sheaf in Swedish) surmounted with a crown and supported by two barely-nubile nereids, the whole, together with the rest of the balustrade, being gilded, while the shield would have been painted in blue, white and red. The shield can open like a double door, and the companion-way (see page 85, illustration 105) gave access down to the beakhead over the clinker-built bulkhead.

In illustration 115 on page 89 this bulkhead can be seen supporting the companion-way between the cathead and the opening in the bulkhead. When the bowsprit was in place the three steps of the companion-way would have been nailed in the angle between the bowsprit and the hull. The companion-way suggests that members of the crew would not have been too plump to have got themselves between the balusters without difficulty: victuals on board were certainly provided by the Crown but hardly on a royal scale.



The embellishment of the stern

The sculptures that were originally inside the ship are in general in poorer condition than those that were on the outside; when the nails securing the latter rusted away, the sculptures fell into the protective sludge on the sea-bed. Some details are much better preserved than others, and the appearance of the better preserved has guided me in guessing at that of others.

Illustration 125 gives a view of the after part of the ship. We know that most of *Vasa*'s sculptures were gilded, but I have assumed that the devils gracing the bulkhead of the steerage would have been painted red. Both red lead and cinnabar often figure in the shipyard accounts, as does the costly Indian blue, or indigo. As the stern galleries and their cupolas bore traces of dark-blue paint one may assume with some certainty that all clinker-built surfaces above deck, and the bulwarks of the beakhead, were painted with indigo.

Dutch ships were often, if not always, painted green where *Vasa* was painted blue, but then the Netherlands was a republic and her leading citizens were notoriously tight-fisted: green paint was cheap, at least when compared with indigo.

We do not know when dark-blue paint began to be used on Swedish warships to any considerable extent but from the time of the *Vasa* and well into the eighteenth century its use was general. We do not know either if any ship before or after *Vasa* was so furnished with sculptures and gilding, but the surviving accounts, still preserved in the National Maritime Museum, Stockholm, for the three ships *Nyheten, Tre Kronor* and *Orpheus* show that the following materials were used in 1615: "Fine gold 100 books, silver 30 books, linseed oil 90 *skålpund* [Skp, or about 1 lb or 500 gr], *aurum* [a gold-bronze alloy] 10 skp, Indian blue 2 skp, cinnabar 1 skp, red lead 6 skp, Spanish green [verdigris] 6 skp, *blygell* [yellow?] 8 skp, white lead 12 skp, carbon black 1 cask, chalk 4 skp, glue 2 skp, *vatherblått* [a blue] 8 skp, alum 4 skp, chrysocolla or copper silicate [*rössgell*] 20 skp, malachite or green bice [*berggrönt*] 6 skp, brown-red ¼ skp, tar 37½ barrels."

Other colours named in the accounts for the construction of the *Vasa* are lead oxide, gold thread, Indian gold, brown ochre, light ochre and yellow sulphate of arsenic.

In illustration 125 the male heads surmounting double sheaves are the knightheads, through which the sheets for the main and mizzen-mainsails were led, being made fast with a double half-hitch around their necks. I have assumed that the knightheads would have been painted in what are called natural colours. As to their forms, the bearded, turbanned head of the mainsail knighthead is one that often occurs, while the mizzen knighthead has a female head with a classical Greek hair-style. There were on board seven knightheads altogether (see page 85, illustration 105), and all except the one just mentioned bore male heads, and we may take it that all would have been painted in the same way as the two here.

The patterns on the carved battens that decorated the doors are badly eroded but parts of them can be made out. The battens from the poop-royal and main cabins have the same ornamentation (121), while those around the doors of the steerage have another (122). The poop-royal deck and the cabin deck terminate forward with exactly similar battens (123), while those from the deck over the steerage have yet another pattern (124).

In illustration 125 the two gilded figures to be seen through the open doorways are two of the set of seven instrument-playing angels that decorated this bulkhead.

Many people have remarked the absence of any balustrade at the forward end of any of the upper three decks—and nothing of the sort was recovered. Contemporary illustrations, and even some from the start of the century, of Dutch ships often show such balustrades or the like quite clearly: often, but not always. One might have thought they would have been necessary on so large and lofty a ship as the *Vasa*—see, for example, the illustration of *Le Grand Saint Louis* on pages 36 and 38–39.

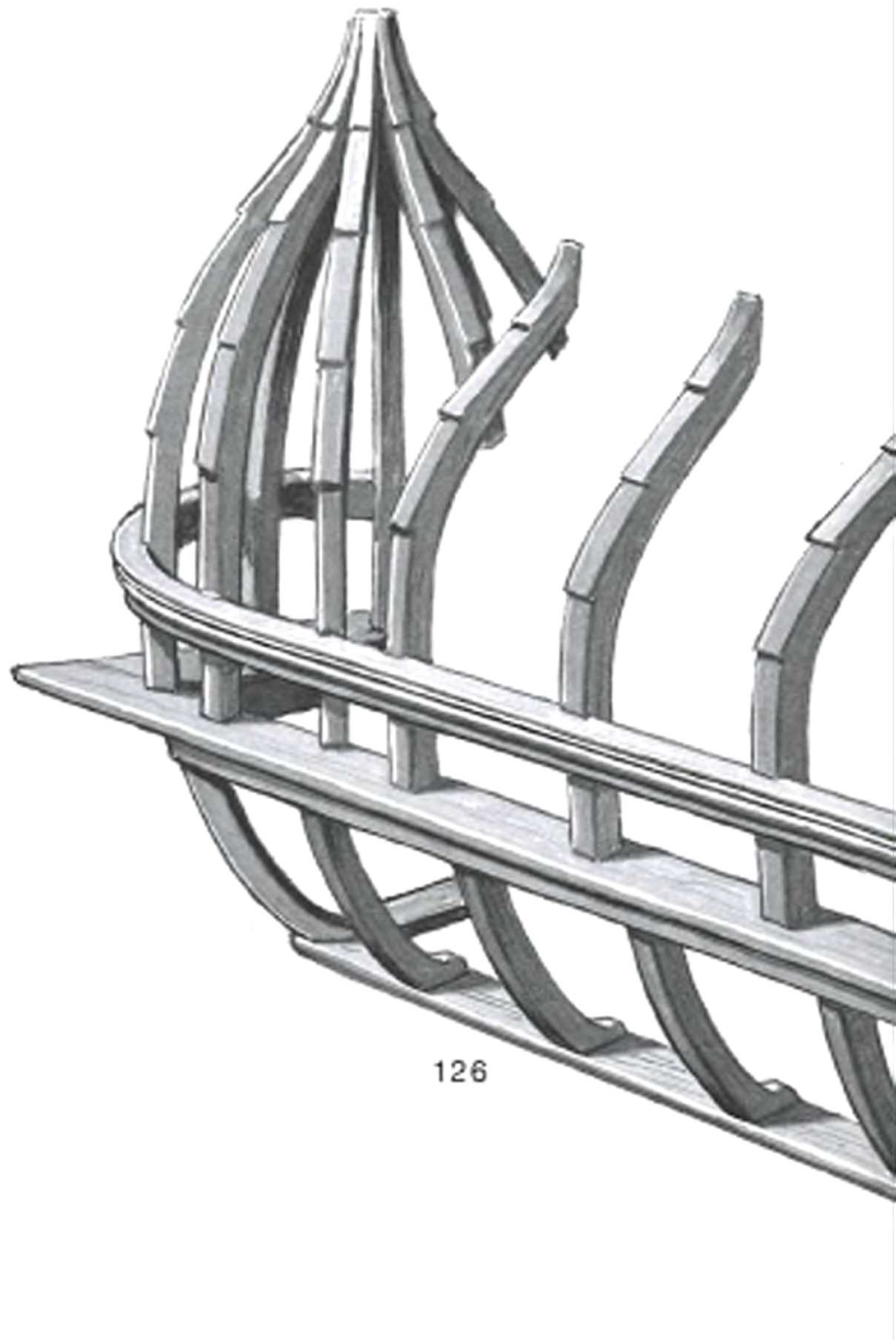
We may be sure that *Vasa*'s decorations were not made in the order I have chosen to follow in describing them, for virtually nothing is known of the order or timing of the work of construction of the new warship. One can make an approximate guess at the date when work began, but nothing is really known of when she was launched, although we know adequately enough when her armament was taken on board and when she was considered ready in all respects for sea. But I am convinced that there were many who never considered her fully seaworthy before she set sail on her only voyage attended by premonitions of doom.

Work on the ship went on without reaching the tempo that had been intended, and in which the lessees of the dockyard themselves had an interest; it could have been done had the Crown kept its side of the bargain. The Council probably deliberately put off making payments, and when they did pay, paid out only part of what was contractually due. It was a pretence to pay no attention to inflation.

Sweden had introduced a copper-backed currency in 1624, and when the dockyard contract was drawn up in 1625 the internationally-used *riksdaler* had a value of 6½–7 marks in copper; three years later the rate had fallen to 11 marks. This would have raised liquidity problems for the lessees. Sometimes Klas Fleming could force the Council to make a payment to the dockyard or for its reckoning, sometimes the king's presence in Stockholm was required to get it done.

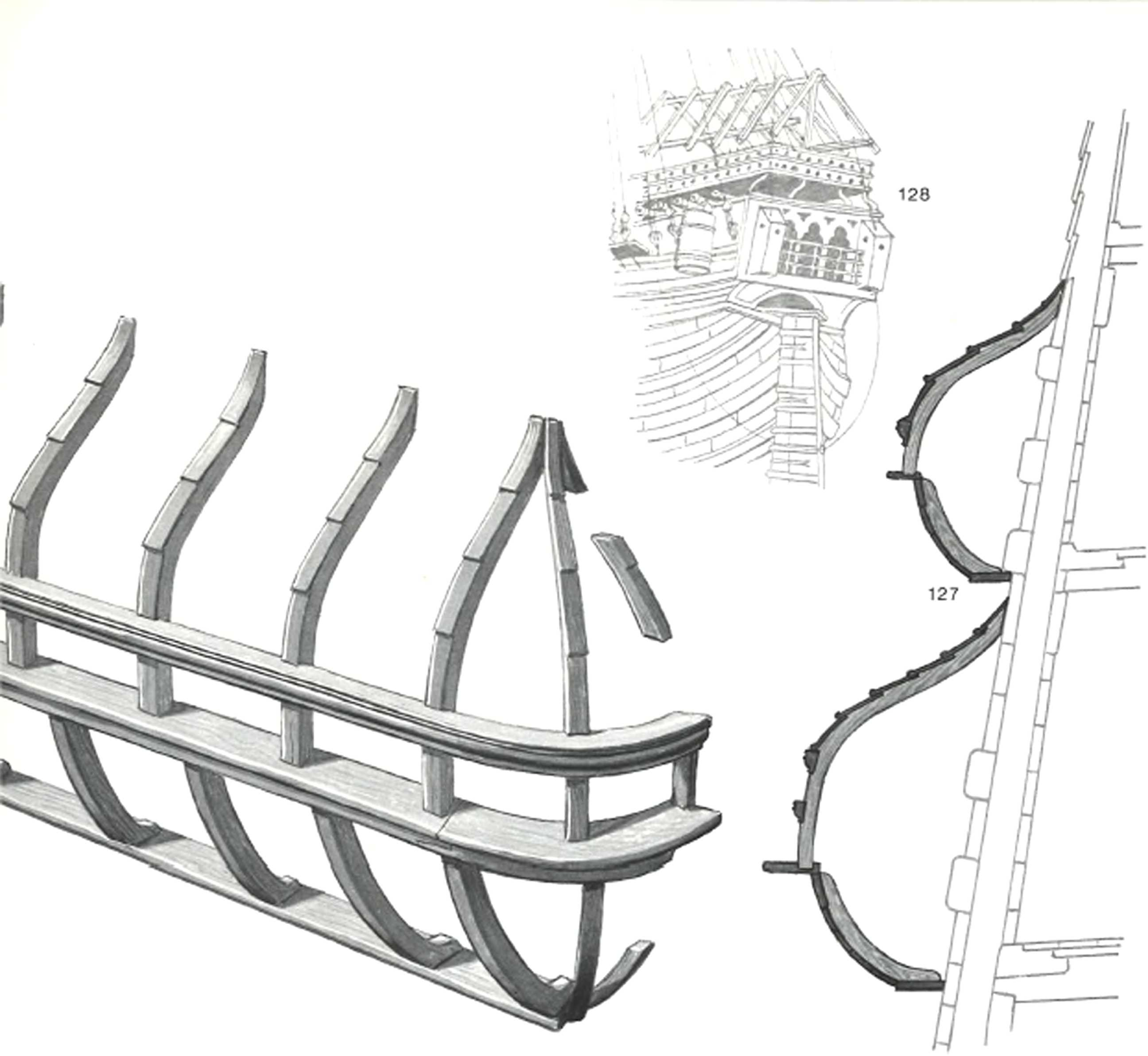
In a letter from the king, dated 16th February 1627, we may read that the previously mentioned shipbuilding entrepreneurs, Paridon von Hoorn and Christian Welshuisen, were to make amends for their carelessness by acquiring abroad, and causing to be delivered to Stockholm as soon as the ice had melted, good, serviceable sails and running rigging, with suitable anchor tackle "so that the ship *Nye Wahsa*, which we have caused to be laid off and built (*förbyggia*), can be planked and rigged according to its proportions."

Unfortunately we cannot understand the word used by the king (*förbyggia*) to mean 'rebuild' (*bygga om*) or 'improve' (*förbättra*) or 'convert' (*konvertera*), even though the word had this meaning in 1545, according to the Dictionary of the Swedish Academy (F 2457). According to the second clause in the contract dated 16th January 1625, the lessees were, "to meet Our needs, lay off, build and make ready for sea four good ships, well built and strong."



On 26th February 1628, Arent de Groote was called to the Council of Justice to answer a charge of smuggling oak timbers out of the country. He defended himself by claiming that payments by the Crown in accordance with the contract were wholly unsatisfactory—in particular during the absence of the king. Among other things, the 10,000 *dalers*, which his brother Mäster Hendrick had received on signing the contract, was reduced after completion of *Tre Kronor*, despite the fact that the sum was not to be accounted for until the contract was terminated. The lessee was now badly in debt, and the bills of exchange Arent de Groote had assigned to his creditors in Holland had been protested and returned to him. The timber, which could not be used on the *Vasa*, had been intended to satisfy his creditors. The documents are silent as to whether or not the smuggling had any further consequence for Arent de Groote.

Returning now to the *Vasa*: she was to be fitted with two galleries—covered balconies, as it were—on either side of her stern. It has been said that they were rather carelessly put together but I consider



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that they were not: they were, and were intended to be, lightly built, being principally a form of embellishment (but according to tradition they contained the officers' heads).

Round about the middle of the seventeenth century galleries were already much shorter but also more sensibly furnished, those situated furthest aft being provided with a bench with a hole in it: such a bench can be seen on a model from the 1660s in Ghent. This model, and many of the van de Veldes' drawings, include two pipes that protrude from the underside of the galleries, and we had hoped, but in vain, that something of the sort would be found when *Vasa*'s galleries were puzzled together.

Above and right (126) is an illustration of the skeleton of the upper starboard gallery; both upper and lower galleries were constructed in very much the same way. Their upper parts are clinker built and their lower parts carvel built (127). The lower galleries had a tower or cupola at either end.

Access from the cabins to the galleries was through doors set furthest aft, giving onto the towers or cupolas which afforded standing headroom. In the lower galleries there was a floor built into the towers and there would also have been a floor in the upper ones, and one can well imagine that a bucket or night stool would have been kept there, to be emptied and cleaned by one of the ship's boys. It is surprising to see, in this engraving (128; initialled WA), heads at either end of the open stern gallery of a carrack.



Henry Hondius' engraving of *Le Grand Saint Louis*, which was completed in 1626, may be recalled here (see page 36), for it is probable that this uniquely fine ship portrait would have reached Gustav Adolf the year it was completed: it shows that the ship had a quarter-gallery with a tower at either end, and another tower close to the beakhead.

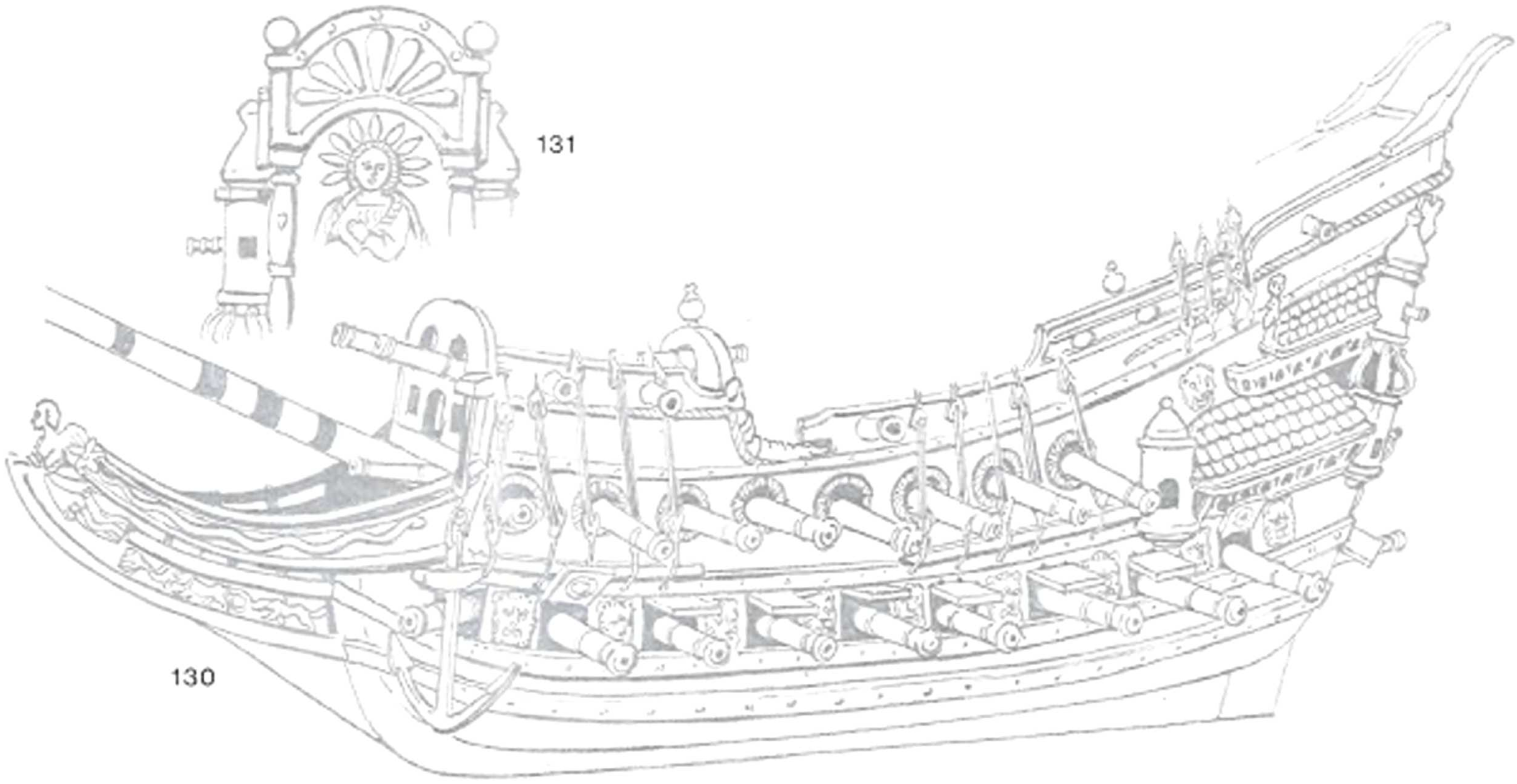
We may believe that the king's reaction to this engraving would have been that his ship should be even more splendid, and that it should have two quarter-galleries instead of one, even if the tower by the beakhead was to be replaced by the lofty sculpture of the Roman with the dog.

Below we see *Vasa*'s sterncastle with quarter galleries, sculptures and other decorative elements, including corner posts typical of the time. They frame the upper part of the stern (the starboard post can be seen in illustration 129) and are almost 5 m high; only one was recovered and it was badly eroded. It is crowned with an ornamental flower bud decked with acanthus leaves; immediately below appears the decorously draped torso of a turbaned herm, then a large grotesque mask, and below that a king wearing Roman armour and holding a sword in one hand; at his feet is a convoluted shield displaying griphons.

The deckheads of the galleries are clinker built and decorated with tritons (133) and nereids (132), those on the upper gallery being female in form.

On the lower part of the upper gallery there is a row of soldiers each of whom carries a torch in one hand and a trumpet or horn in the other. They derive from the account in Judges 7 of Gideon's victory over the Midianites. The Lord had instructed Gideon to select and lead three hundred men





against the Midianites, but Gideon's men were not armed: they hid torches in empty pitchers and carried trumpets. At a signal they broke their pitchers, flourished their torches and sounded their trumpets: the Midianites became wholly confounded, turned on one another, and fled. The theme would not have been lost on a contemporary onlooker.

The upper gallery is supported by tritons, nereids and five grotesque masks. On its deckhead—or roof—there are four obelisk-like sculptures and four wildmen—male figures symbolising the untamed power of the natural world—who are bearded and carry large clubs. Below the gallery there is a row of Roman soldiers that ends aft in a sculpture of the Aged Hercules with Cerberus at his feet; Cerberus was the three-headed dog that guarded the entry to Hades. The gallery rests on consoles formed as winged grotesque heads that variously express horror.

The long curved sculpture that extends up from the third wale to the aftermost console comprises a triton and a dolphin with a double, intertwined tail. The console under the Aged Hercules represents the face of a dead man through whose mouth and eye sockets eels crawl. The upper part of the rudder is decorated with a lion upon a grimacing mask.

All the gun-ports are equipped with lion masks that, unlike most of the ship's decorations, are not gilded but painted in ochre, red, black, green and white. The frames around the circular gun-ports were perhaps gilded, perhaps painted.

The breaks in the railings on the upper deck are marked with sculptures of the sea-god Proteus in the act of turning himself into a dragon; the sculptures were painted yellow (or perhaps ochre) and red.

In the conjectural reconstruction, surviving traces of paint have suggested my use of dark-blue paint, the scale-like decorative painting on the clinker-built deckheads of the galleries and their cupolas, and the use of red paint on the deadeyes.

The reconstruction of *Vasa*'s sculptures can never be entirely complete, for so many details have been eroded on many individual sculptures during the three hundred years they spent under water. The best-preserved pieces must be those that first fell down into the sludge on the sea-bed, regardless of whether they are in oak, pine or lime: the upper two sculptures illustrated on page 101, for example, are in pine, while the lower is in oak. Sculptures were often nailed into place and the nails would have quickly rusted away. The large corner posts, on the other hand, were bolted onto the hull and the only one that was recovered was in very poor condition, despite being in oak. Much material was recovered in an almost uneroded condition, but no-one could have anticipated such large quantities of sculptures, and many had therefore to wait to be conserved. There are therefore now many sculptures that are very hard to interpret but the photographs that were taken immediately each was recovered, and those taken when sculptures were cleaned, have in many instances been of great help in the work of restoration.

In my reconstruction of *Le Grand Saint Louis* (page 38) it is possible that I have been altogether too restrictive with sculptures and gilding, although Hondius' engraving suggests in any event that the ship was less individually decorated than was the *Vasa*. Even so we cannot rule out the possibility that if a portrait had been made of the *Vasa*, her decoration might have been indicated as schematically, with the result that the symbolism that was deliber-

ately incorporated in her embellishment could have been represented in less-than-complete detail.

It has been claimed that *Vasa* was the only ship in contemporary Scandinavia to have been given two quarter galleries. We have already seen (pages 22–23 and 26) that the first three-decker *Prince Royal* had three galleries, of which two were partly enclosed, and the third wholly open.

A model in St. Mary's Church in Bergen, however, dated to about 1610, has double galleries (see *Nance*, plate 2). As may be seen in illustration 130, the lower gallery is enclosed completely, while the forward part, about one fourth of its length, of the upper gallery is open. A tower at the stern is lofty enough to join the two galleries; a smaller tower is placed at the forward end of the lower gallery. The deckhead—or roof, as one would say on land—is carved, and not painted as is that on the *Vasa*, and we can therefore see that without doubt this typical Northern use of wooden roofing shingles on churches and houses of the wealthy has gone to sea.

The model is in fact a votive ship and, like many of them, it has been added to and modernised, but not to such a devastating degree as has afflicted most of them. It is easy to determine the seventeenth-century elements and what has been added later: the rope-like edging at the stern and on the forecastle is the original railing, while the davits on the stern must be a result of a re-building during the nineteenth century. The rigging (not reproduced here) is unfortunately worthless, but the round-topped bulkhead on the forecastle is probably original; such a bulkhead is a feature of a model from 1593 of a Flemish galleon (not illustrated here) in the Naval Museum in Madrid.

The figurehead is an angel, and the comb shows a branch or the like and two dogs or wolves in the act of running. The upper gun-ports are encircled with wreaths, and the lower ones alternate with lion masks. The upper part of the original stern terminates in a rounded arch decorated with a representation of the Virgin Mary (131).

At that time, what is now Norway was a province of Denmark, and on looking again at the Danish ship *Tre Kroner* (pages 16–17) in the engraving from 1606 one can see that the stern is framed with two towers, and that the form and general arrangement of the cupolas are clearly related to the towers on the model in Bergen. *Tre Kroner*, which was built in 1601 with open galleries, is certainly old fashioned, but we may without difficulty accept that the Bergen model does represent a Danish ship from about 1610, so that the *Vasa* was hardly the first ship in her part of the world to be built with two covered galleries.



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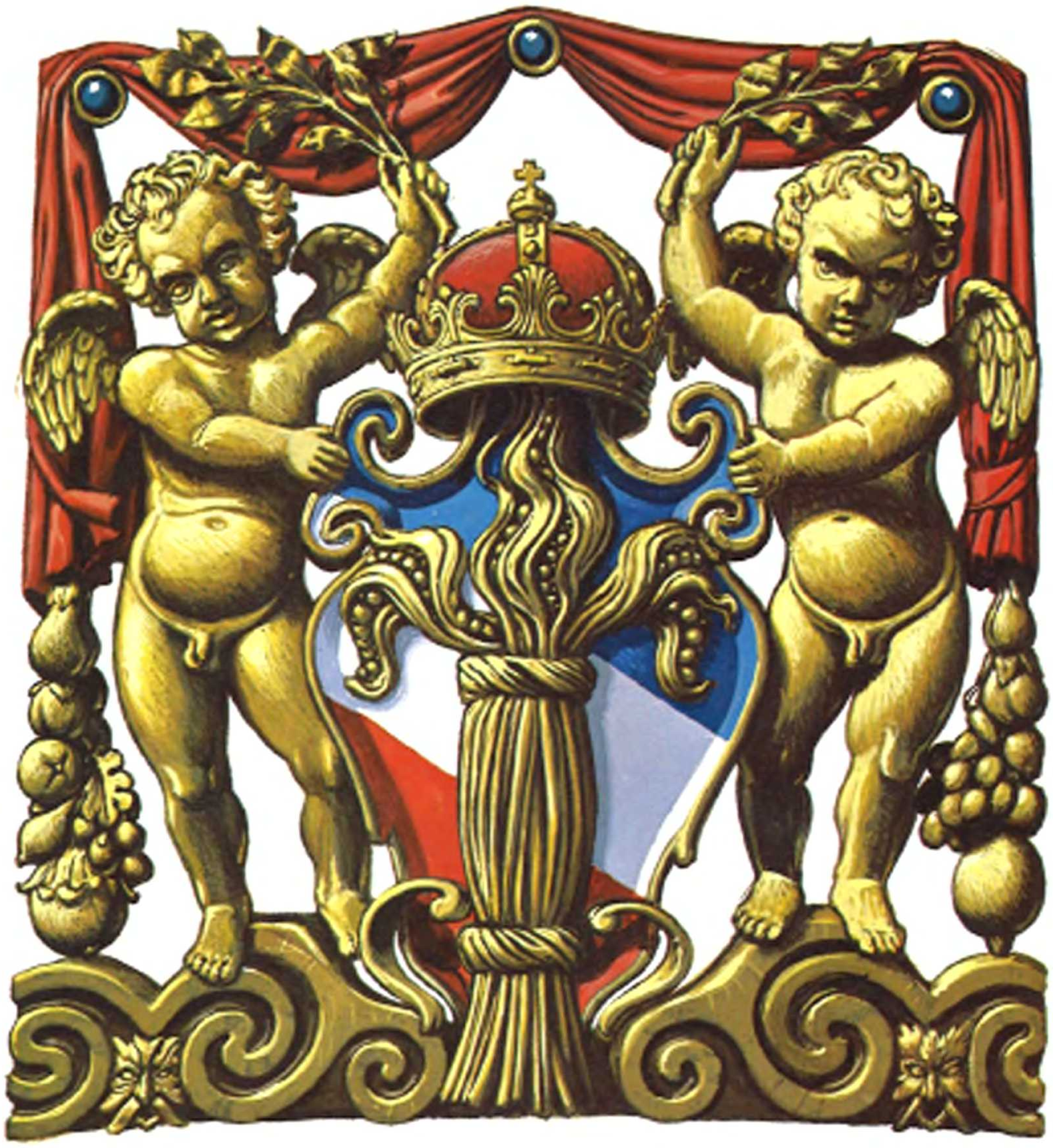
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I wish that someone were to build as accurate a copy as possible of the votive ship in Bergen, naturally without including all the later additions, and rig her with three masts, and give her running and standing rigging somewhat like *Tre Kroner*'s, with all those fantastic bunt-gaskets and with bowlines for a royal-sail!

Here are some elements of the embellishment of the upper part of the stern. The stern is the whole of that part of the hull that lies aft of the top-timbers of the fashion pieces and above the wing-transom beam.

At the top of the counter under an arched frame two griphons crown the young Gustav Adolf (136). The griphon had been his father's heraldic device as Earl of Södermanland. Eleven small figures, alternately male and female, support the scene. Beneath them is a heavy carved arch with an angel head flanked by the initials of the king's name. It terminates at either end in a grotesque face. Of the initials, the first two—G for *Gustavus*, A for *Adolphus*—are supported by griphons—and the third and fourth—R for *Rex* and S for *Sveconum*—are supported by lions.

Under this arch is the national coat-of-arms and its supporters (mentioned earlier, on page 46), which was framed with a red drapery held up by gilded putti (see page 107).

I show one of the two cornerposts, as it probably appeared when it was ready to be bolted to the counter (135). Between the two high ports of the cabin stands the Vasa coat-of-arms, supported by two putti, with draperies, clusters of fruit and remarkable arabesques, all quite well preserved (141), and six knights fit the spaces between the coat-of-arms and the ports; some knights are so well preserved that a reconstruction can be done without any great degree of guesswork.

The upper parts of the galleries round the stern are built into the counter. In the middle of the rounded part of the lower gallery King David plays his harp (138), surrounded by Roman soldiers. The red of his crown could not be substantiated, but I believe it was so, just as I have in many other cases been obliged to guess the colours of the paint of various details.

103



The underside of the upper gallery continues with quite comical figures of Gideon's soldiers (139); I believe the comicality is wholly unconscious, arising when someone unskilled had to carve figures of a given width in a space of limited height.

The six Roman soldiers flanking King David stood on consoles comprising gilded birds with red combs and something like pieces of red jewellery round their necks. Most are badly worn, but if I follow an early photograph of the best preserved, they come to resemble some sort of chicken-like bird, and it is possible that they were to represent cocks. The cock is after all a symbol, among other things, of wakefulness and lust for combat. He was the enemy of darkness and a sign of the dawning day and much else suited to a warship in the service of the "Defender of the Evangelical Faith." Let us therefore assume that what is in question is a cock.

On the other hand, I begin to be more and more doubtful whether one ought to name the figures on these consoles 'Roman soldiers.' This name is really as old as the decision to call the *Vasa* Wasa, and is probably as incorrect. I admit they can be so named on the ground of their appearance, excepting only the plumes on their helmets (see p. 49).

But when I see King David flanked by 'Roman soldiers,' this name no longer holds good. The Gustav Adolf Bible from 1618 contains a number of woodcuts, probably done in Germany and used in some earlier edition of the bible. Irrespective of whether or not they depict soldiers from the world of the Old Testament, or from the New Testament, they appear to be wearing what is popularly called Roman armour. So all twenty-eight 'Roman soldiers' gracing the underside of the lower gallery can just as well be King David's soldiers. I find it

probable that this is what they must have been. Why should those who planned the embellishment have chosen Roman soldiers? The king, having taken council, was about to go to war against Rome, at least against the forces of the Catholic League, and for Christians faithful to the bible there was not much good to be said for the soldiers of Old Rome. Observe, too, that Gideon's soldiers wear what we can call Roman armour.

Gustav Adolf was also called "the Lion from the North", foretold a century earlier by Paracelsus. Did the gilded lion of the figurehead that preceded all the Roman emperors on the beakhead symbolize the person of the king?

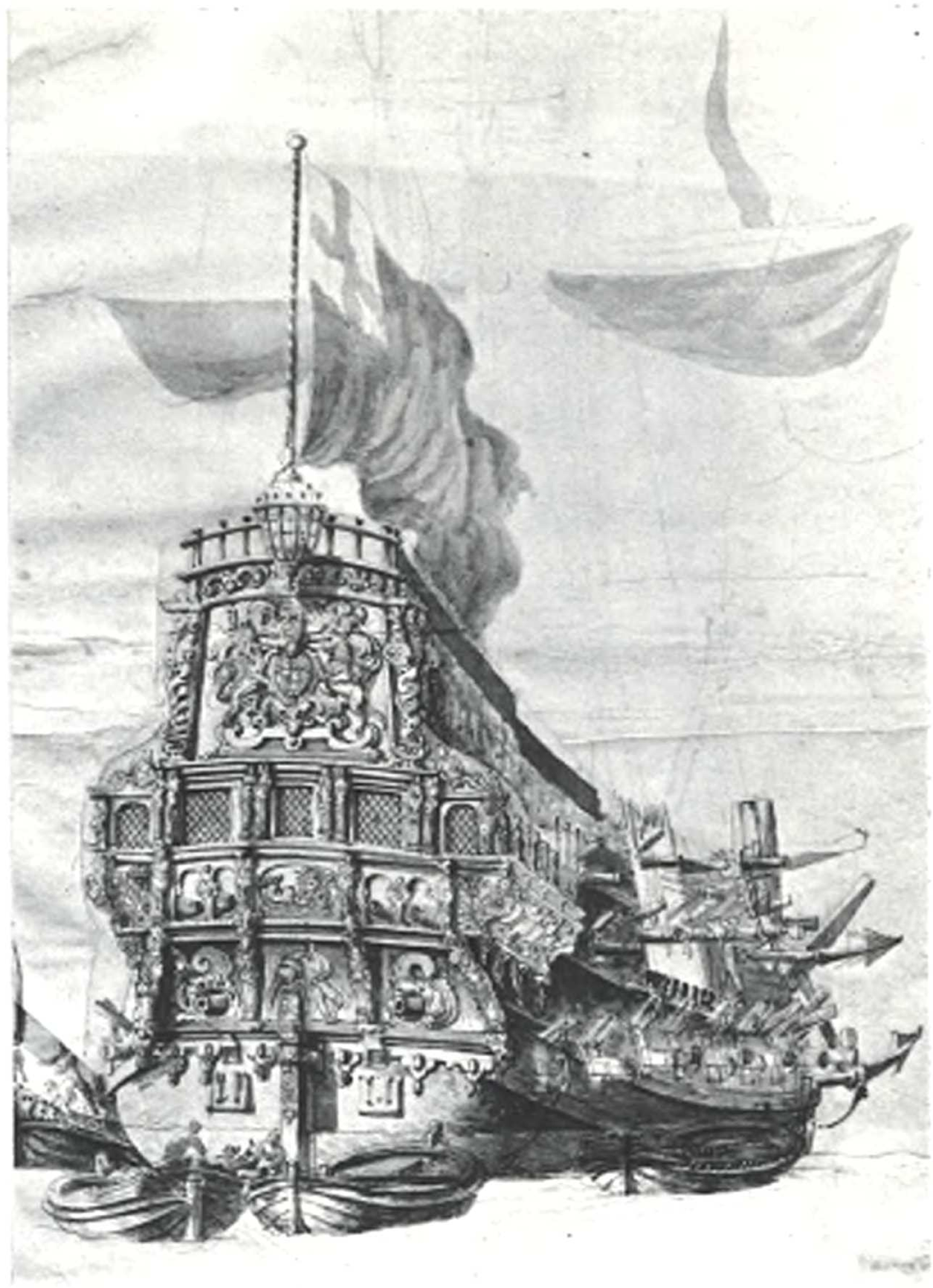
It can be misleading to strain all the symbols, which were perhaps thought of in quite another way from the beginning. The symbolic language of *Vasa* is tangled enough, but I feel in any case we ought to stop talking about Roman soldiers in connection with the embellishment of *Vasa*.

Here we see something more of the sculptural riches that characterized *Vasa*'s counter and stern. The long, angular sculpture (142) is one of six that are partly quite difficult to interpret. They fitted under the arch with the head in front of the wakeful and pugnacious cocks. Each sculpture comprises a tall triton, a somewhat shorter ordinary mortal female form and a pair of volutes. The rounded cut at the angle fits a profiled batten in the angle formed by the arch and the counter (see next spread); the straight edge behind the female form rests against the counter.

The wreathed male angel (143) served as a console for King David, while the horrid gaping grotesque has been nailed over one of the gun-ports in the stern. The even more horrid mask is one of five framing the cabin ports (see next spread).

The chess-trees for the mainsail tacks were attached to the outside of the hull. They have very different forms on different ships, and on *Vasa* they are formed as herms. One is shown laterally and frontally (145) with a large hole for the tack, and smaller holes for bolts. The complete picture of *Vasa's* stern, seen directly from aft, is to be found on the next spread.

Illustration 147, from the Victoria and Albert Museum, London, depicts, if I am correct, the English ship *Antelope*, a ship with a round-tucked stern. She was built in 1618, the first such ship to be built in England. She is also depicted in an illustration in Robinson's book on the van de Velde drawings, which identifies her positively, being shown in a view from off her bow. By counting and comparing her gun-ports and galleries and other details I have determined that it is the *Antelope* that appears



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in the illustration reproduced here. It provides information about the *Vasa*'s stern.

The *Antelope* is shown here with one lantern, but the van de Velde drawing shows her as carrying three. We know that *Vasa* carried at least one, but she can just as well have carried three. The long sculpted posts that flank the coat-of-arms of the English ship are far more simply composed than those on the *Vasa*, and while they seem to be triple-headed, their lower parts are made up of the intertwined fishtails that were typical of the period. The part above the coat-of-arms seems to be a simple standard piece of decoration. Herm pilasters appear on the *Antelope* where knights in armour flank *Vasa*'s cabin windows.

There is a remarkable detail on the bulging part of *Antelope*'s stern that is a continuation of the galleries: paintings in four spaces enclosed by pilasters and arches represent each the muzzle of a cannon. There is no question here of clumsy draughtsmanship, for a van de Velde drawing (*Robinson*, plate 2) of the *Constant Reformation* contains similar details painted in a side-view, where cannons are depicted on gun-carriages. I see this as a relic of the cannons that were in fact so mounted at the end of the sixteenth century.



149

On the equivalent part of *Vasa*'s stern, between King David and his warriors, there are four round ports, and the construction inside the ship shows that these were intended for real guns.

Vasa's two large round ports at the level of the upper part of the rudder are encircled, as we have seen, with gaping grotesque faces, while the equivalent ports on the *Antelope* are framed by grotesque dolphins. Although we can say that *Vasa*'s stern is in general more richly and more imaginatively decorated than that of this English ship, we should not overlook the fact that the sketch of the *Antelope* is just that, done in pencil and wash, while with the *Vasa* we are dealing with actual sculptures.

In an important detail the English ship is, although built ten years earlier than the *Vasa*, more modern than the Swedish warship. The *Antelope*'s decks, in that they do not follow the lines of the wales, do not have the same marked sheer as the outside of the hull; the gun-ports of her lower gun-deck aft of her mainmast shrouds pierce the wale.

There are other differences to be detected, too, for those who are interested in tracing them, but it should already be clear that ships' decorations at the beginning of the seventeenth century in England and the Netherlands were similar, even if the gallery towers that were typical on Dutch ships were no longer in use on English warships.

In the illustration on page 107 it is possible, as I now think, that I have made the lantern above the stern too large. The dockyard accounts show that lights or lanterns were imported from Holland, and they would have been made of wood and metal, like the two from the end of the seventeenth century in the Rijksmuseum in Amsterdam.

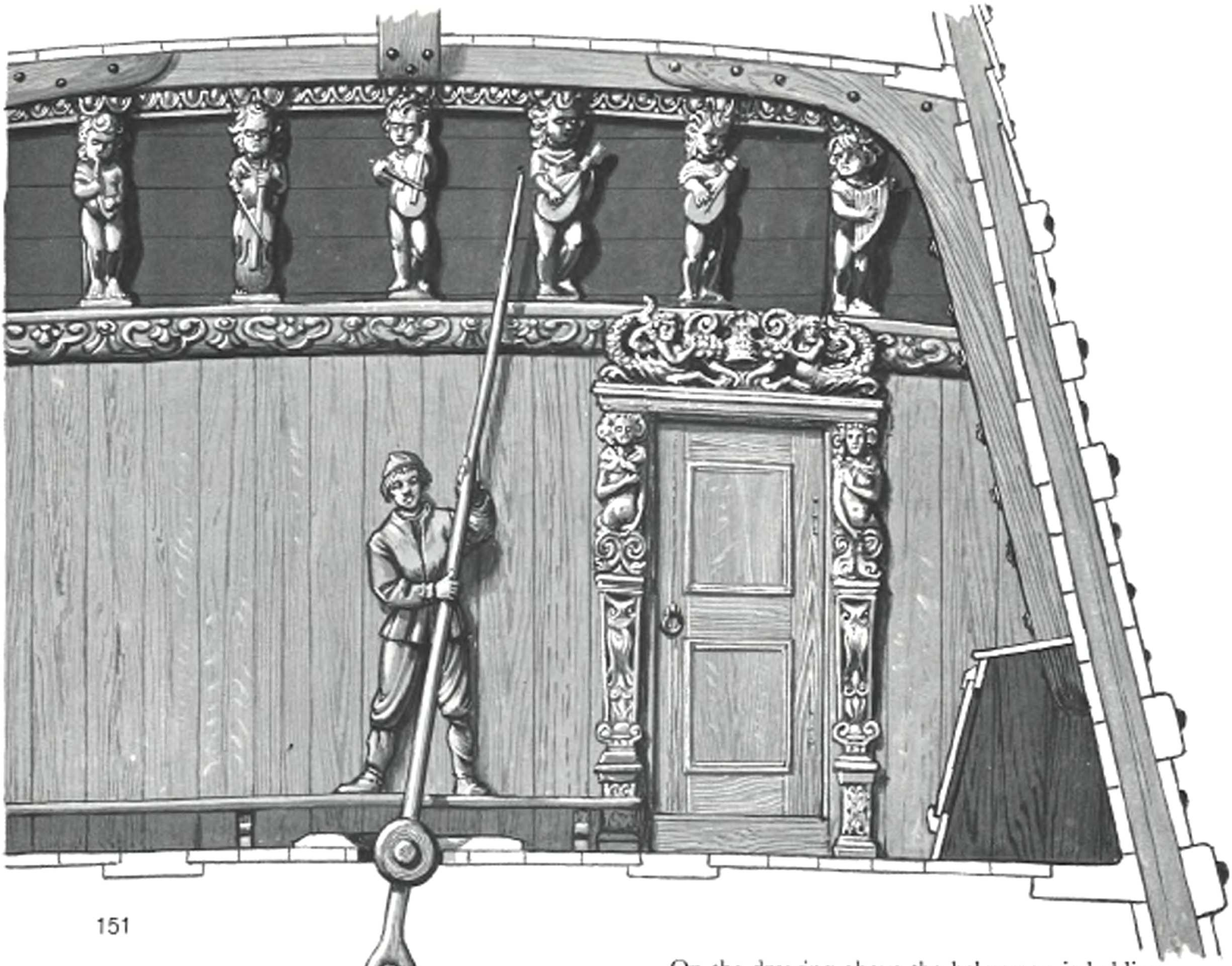
Above I show my reconstruction of the *Vasa*'s lantern (149: *A–G*), following Herman Ketting's account in his book (page 79). The drawings show: *A* general appearance *B* cupola in metal *C* octagonal wooden frame *D* a profiled frame that fitted onto *E* the body of the lantern, into which also fitted *F* the uprights and *G* their knees.

It was gilded with gold leaf but it is by no means certain that it was decorated with winged herm pilasters. I have attempted here to make something that harmonises with the rest of the ship's decorations.

The source of light in contemporary lanterns was a number of tallow candles that were bound or otherwise held together. In 1670, on the instructions of Jean Baptiste Colbert, the French fleet was to experiment with oil lamps but seemingly without success, for the fleet continued to use the wax candles that Colbert considered altogether too expensive (see *MM* 42, pages 233ff). Relatively poor Sweden would have had to make do with inexpensive tallow dips.

The Museo Storico Navale, Venice, possesses a holder for a four-part candle from a lantern for a seventeenth-century galley (149: *H*).





151

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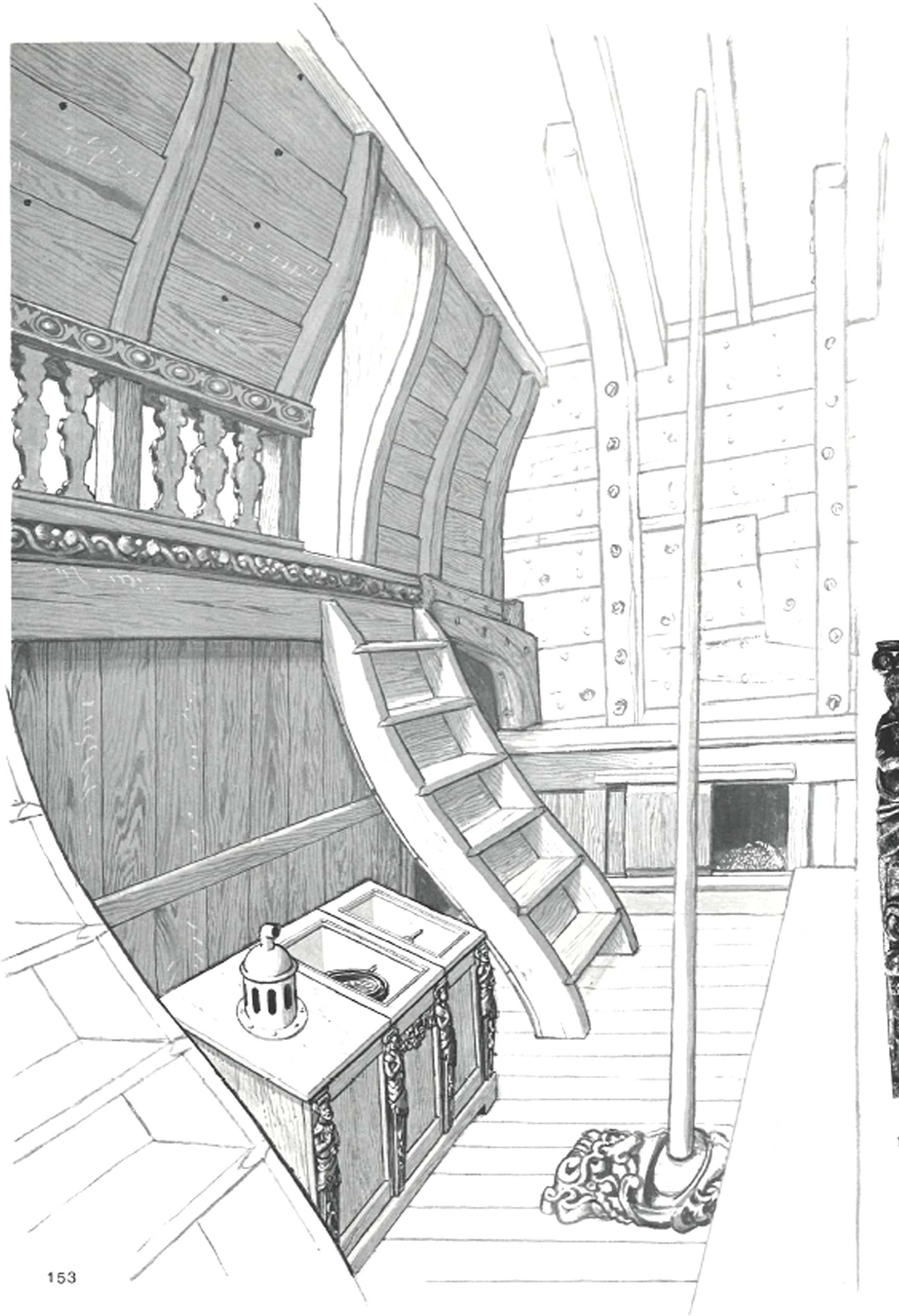
The decoration of the interior

Noone can say in which order the sculptured details were fitted in the ship, but I describe them here forward from the steerage. The upper part of the bulkhead between it and the cabin was decorated with seven angels with musical instruments; they, the herm pilasters that flanked the door, and the still wonderfully preserved decoration on the lintel were all gilded.

On the drawing above the helmsman is holding the whipstaff lever, the vertical rod that connected with the rudder. Between the door and the hull is a sort of enclosed bunk that would have been at the disposal of an officer of the watch or, perhaps, his replacement. The whipstaff bearing is placed in a grimacing monstrous mouth (152, 153).

The binnacle stood between the two curved companion-ways. Nothing of it has survived, but two small herm pilasters were recovered from the steering cuddy. It is possible the binnacle was recovered in 1664–65, at the same time as most of the guns, but that the nails holding the two pilasters in place had already rusted. I feel that at least four such pilasters (154) were attached to the front of the binnacle, and that the surviving sculptural ornament (153) was placed between the two centre vertical ones.

I have assumed that *Vasa*'s binnacle (153) had three parts: that to port contained a source of light —perhaps a tallow dip—separated from the compass by a pane of glass; a compass held in gimbals occupied the central part; and a half-hour sandglass in the part to starboard was easily visible to the helmsman.



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The main cabin was intended for the most senior officer and also for official receptions in foreign waters. Its panelling was nailed to the bulkheads and the ship's sides. Its long benches were also panelled; they were a combination of folding beds and stowage chests (p. 112).

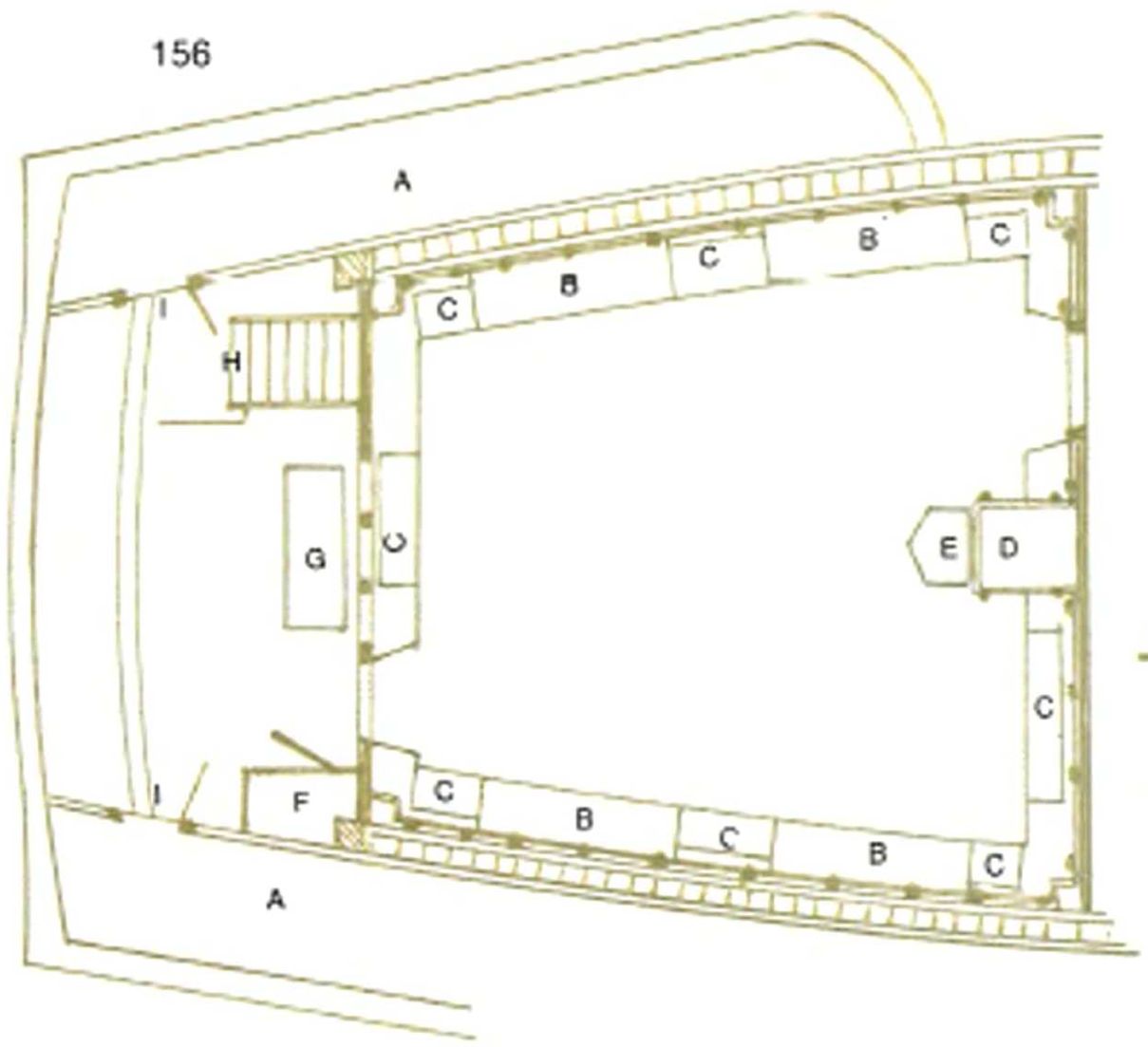
The schematic plan (156) of the cabin shows *A* quarter-galleries *B* bunks *C* stowage chests *D* a locker formed of three panels around the mizzen-mast *E* a free-standing locker *F* a large locker attached to the bulkheads. *G* is the presumed location of a large locker, *H* the companionway up to the cabin on the deck above and *I* the doors giving onto the galleries.

The benches and the larger panels on the bulkheads were decorated with broad profiled battens (158), while a batten of a simpler pattern (157) was used for the smaller panels.

The cabin has been restored by Johan Blomman from the bits and pieces that were recovered. All the sculptural parts were badly eroded. It has required a certain amount of imagination to envisage the cabin's original glory, for nothing of its painting or gilding now remains, except a fragment of yellow no bigger than a thumbnail on a door that was later found to separate the cabin from the upper gallery. But I have assumed that the whole cabin was painted.

Indeed, I have taken it for granted that it would have been resplendently coloured, perhaps to a degree even greater than in my reconstruction, while my discreet late-renaissance patterning on the panels may be overmodest. We know that the king wanted to spare no expense when it was a question of the public style of his kingdom in its foreign contacts and we have read of his displeasure over

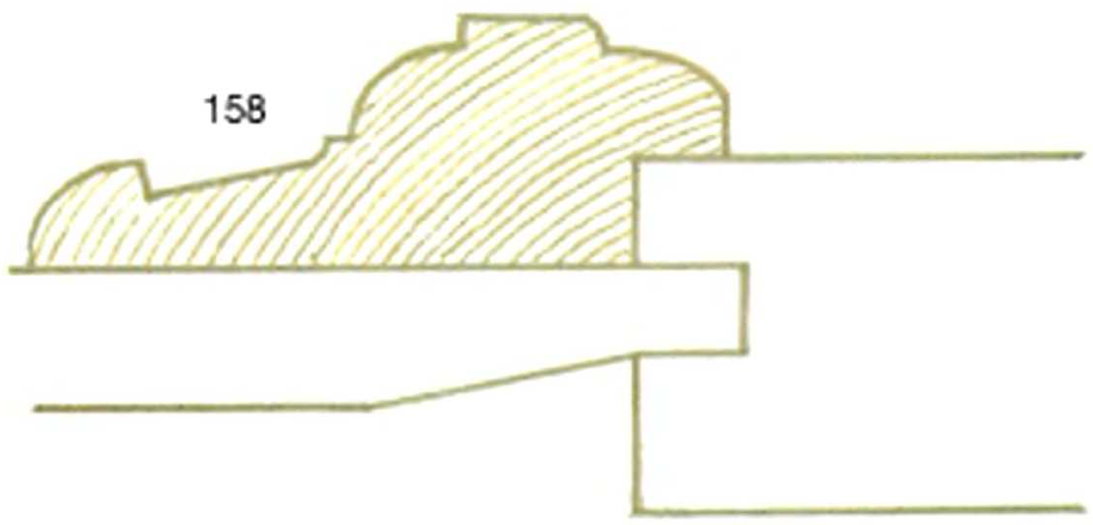
156



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158





159

the inadequacy of "trimming the cabin with miscellaneous sorts of inlaid wood."

No trace of intarsio was found in the cabin, so I have represented these growths as painted; they were perhaps in reality Northern flora in the flowers' correct colours. The coats-of-arms have not made their appearance by chance: having counted the spaces that were available, I found that they would have provided places for thirty-one coats-of-arms, the same number as those that surround the king's portrait in the Gustav Adolf bible. This may be a coincidence, but I have not thought it so, and I have represented the cabin as displaying the national coat-of-arms, that of the Grand Duchy of Finland, those of Estonia, Ingermanland and Narva, and those of all the Swedish and Finnish counties.

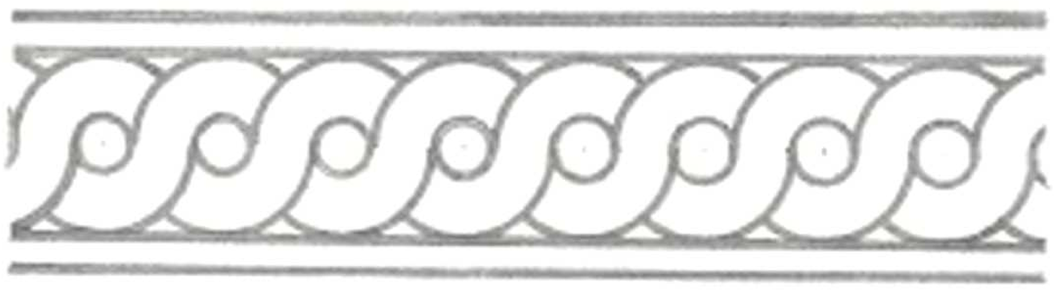
It has in truth been a pleasure to allow myself to be guided by what I hope is a restrained imagination in once again decorating, painting and gilding this splendid cabin, originally built by anonymous carpenters and now restored by Johan Blomman and his assistants. I believe that my reconstruction is largely correct although, like anything of the sort, it remains open to criticism.

The illustration above (159) shows a general
112 view of the cabin, looking forward. The door leads to the steerage, and its upper half is decorated with a round arch and two pilasters, a pattern that appears elsewhere on details that (in 1984) have yet to be found a place in the ship, and on the unusual locker that stands in front of the mast locker. There are panels with the same decorative edging, with flowers in the corners, and by all appearances they belong in the junior officers' cabin: the main cabin is already full of decorative details.

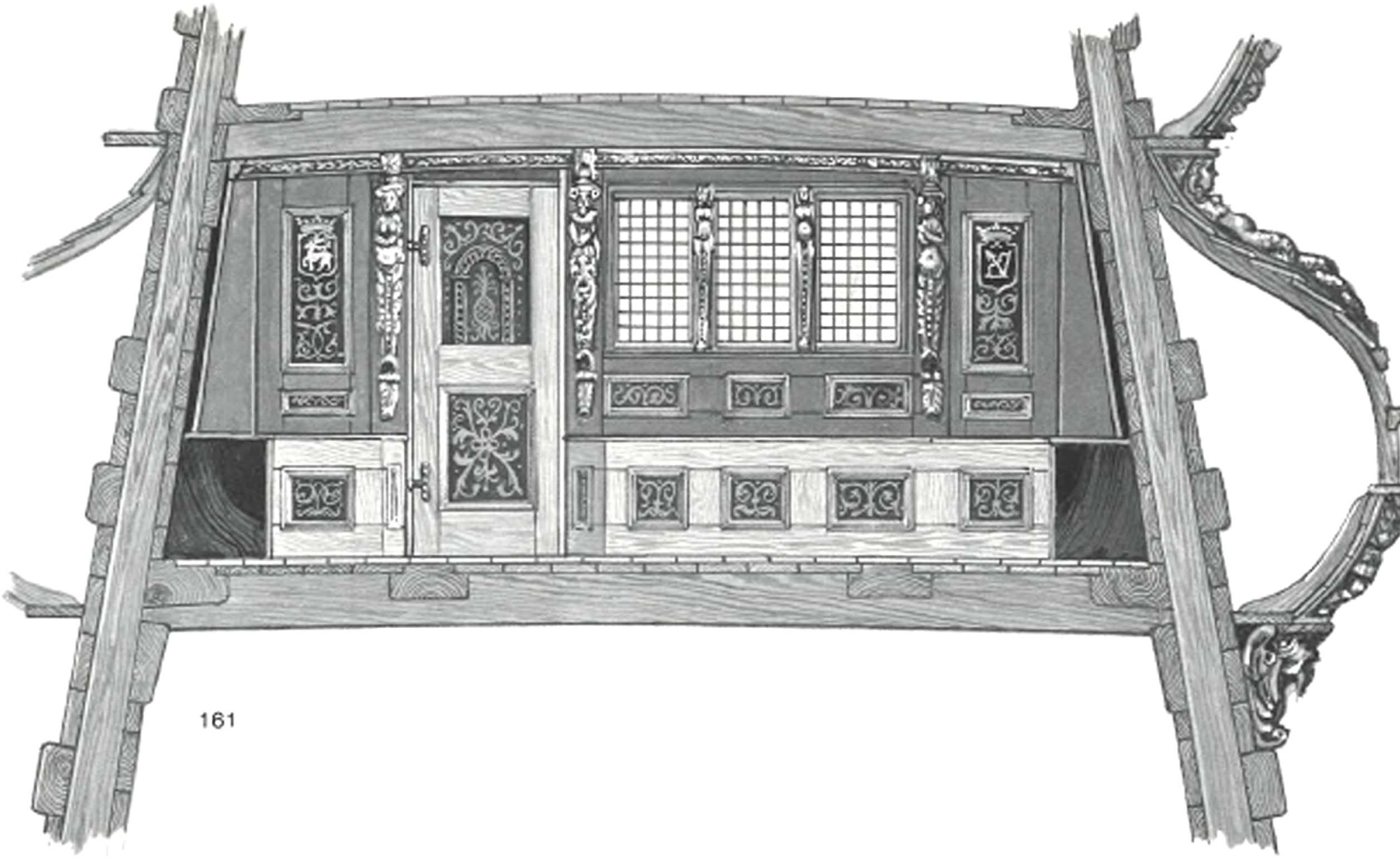
One of the bunks is wide open; it could have provided enough space for two officers, something that would have been necessary when troops and officers were on board; on the ship's first voyage, however, each bunk would have been reserved for only one officer. The hinges are of leather, and we may imagine that bedding would have been the usual straw mattresses, pillows and a rough covering.

The table that was recovered seems to me to be rather unpretentious for its surroundings; possibly a more elaborate table was recovered soon after the ship sank, while the one here might have really belonged in the junior officers' cabin.

Detail of the decoration of the locker and door in the cabin, a simple geometrical pattern that had first appeared in antiquity.



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161

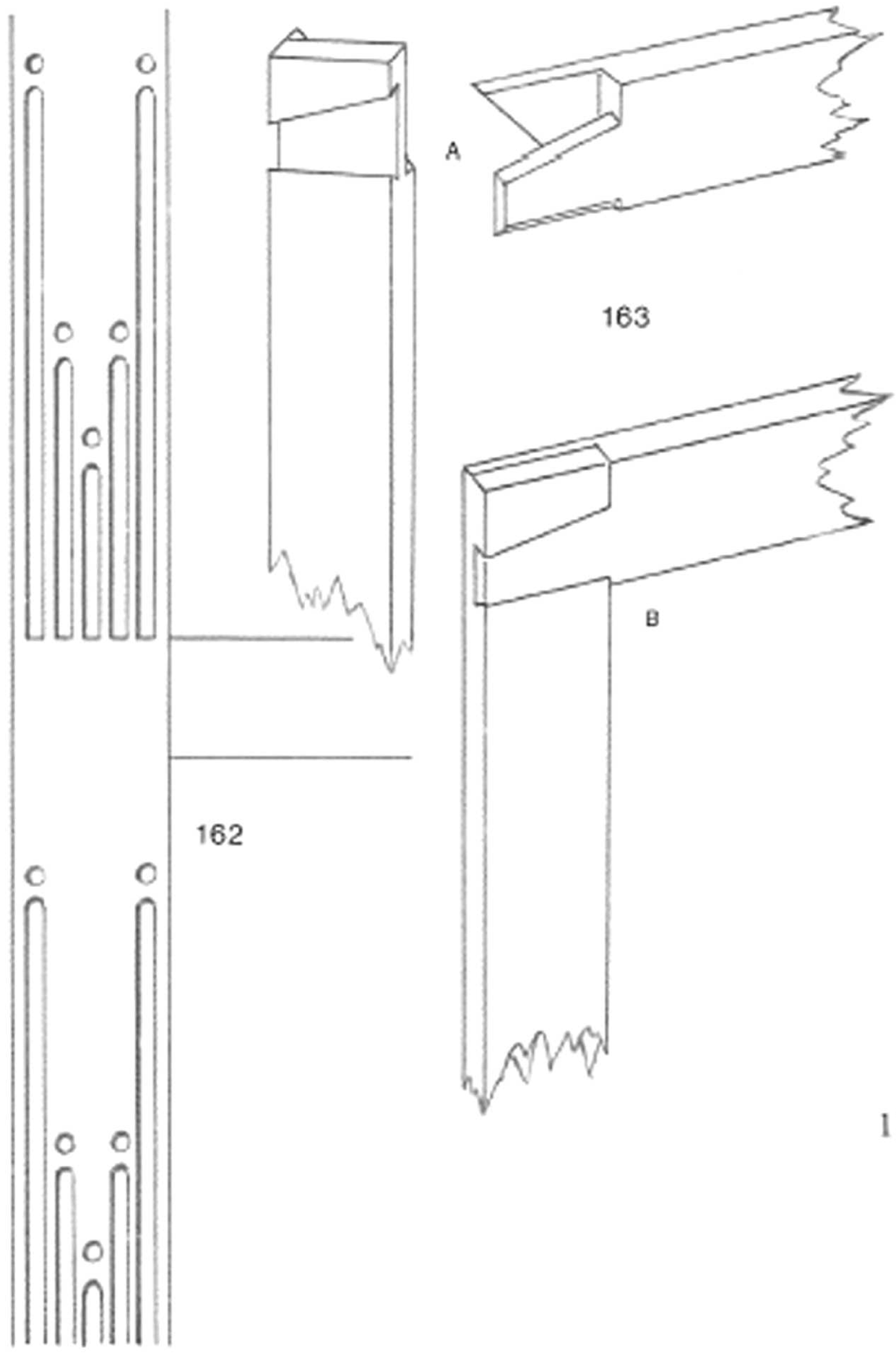
The after bulkhead of the cabin is panelled in the same way as the rest of the cabin. The two smaller herm pilasters mark the divisions of the window that gives onto the stern, and it is possible that two small sculptures would have occupied the spaces below these herms. Only a few pieces of the door survived, and this reconstruction therefore follows the appearance of the door to the steerage.

The locker in the after part of the cabin (illustration 156, *F*) is not yet (1984) reconstructed, but some of the much eroded oak planks bear a clearly visible pattern of grooves that is almost modern in its simplicity (illustration 162). It seems that there is enough of this material to infer the existence of a fore-and-aft panelled bulkhead alongside the companion-way (illustration 156, *H*) leading to the junior officers' cabin.

The details of the elaborate joints of the frames of the cabin door (163 *A*, *B*) are something that must impress present-day carpenters.

A final point: some may wonder that I have called the sculptures of high-breasted female figures herms, but this name is accepted usage in art history for such figures, both male and female.

The after part of the main cabin, too, was splendidly decorated, but I have limited my illustration



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(159) so as to exclude the locker that was probably fastened to the bulkhead, for it is too early as yet to make a final reconstruction of it.

Had the king been on board, we may assume that he would have slept in a temporary cot placed where the chest is indicated in illustration 156 (*G*), and it is possible that a table and a couple of chairs were also provided, so as to furnish the royal chancellery. The details at present available indicate that especial care was lavished on this part of the cabin: the carved lintel to the door gleamed here and there with gold when it was recovered, and the long herm pilasters on either side of the door would certainly have been gilded too. The large knees inside the curve of the stern are, unlike all other knees on board, planed and not merely adzed. The four round gun-ports between these knees are cut through the planking.

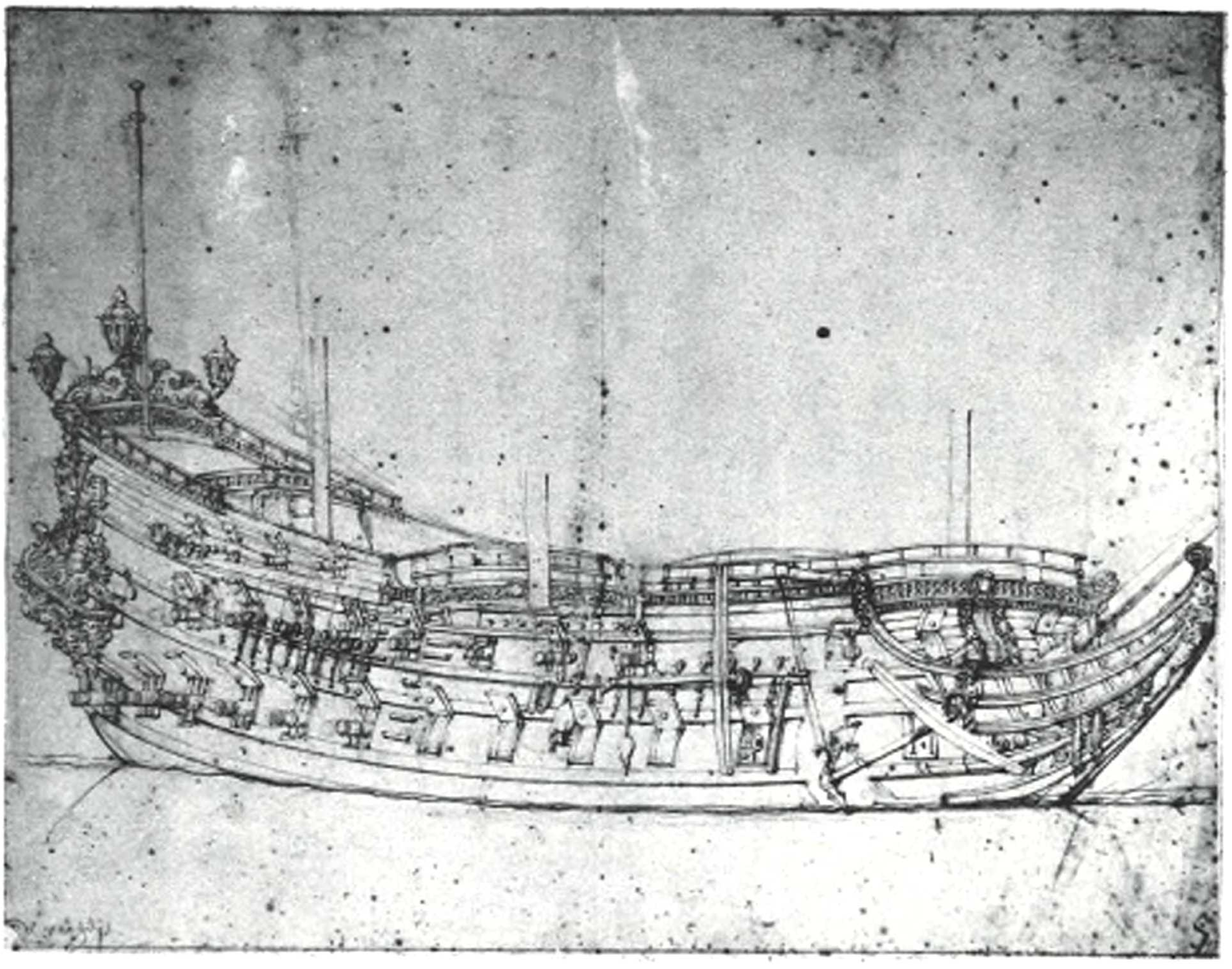
Vasa never carried the bronze swivel-guns of which I have depicted one, but it was intended that she should carry four, one in each of the holes in the heavy timber that was bolted to the knees. I can believe that the soft form and smoothly planed surfaces of this construction could have provided a sofa that would have been thought most comfortably by the king's contemporaries, while it may be imagined that it, and the benches in the cabin itself, would have been provided with soft cushions.

Out in the quarter gallery I have placed the tub that would have been used as the heads.

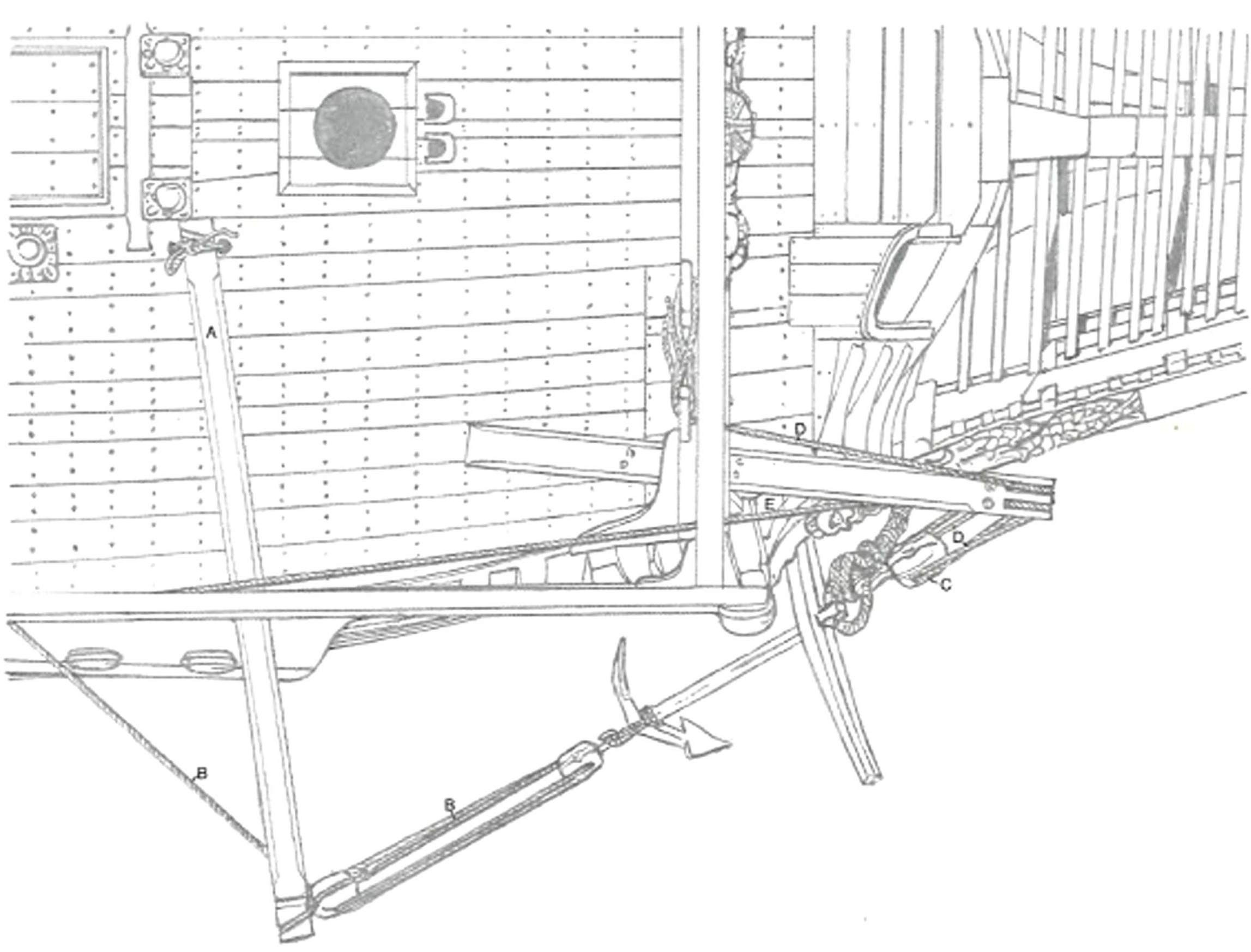
The colours I have given to the bulkheads and deckhead here, and their decoration, are freely taken from those of the late Renaissance. Some dozens of pieces of glass, including one complete small pane, were recovered, and many bear visible marks of having been held in lead frames.

Much more can be said, and will in future be found to say, on the ship's embellishment which, as I have already suggested, owes much to Johan Blomman's contributions, but he has not been the only person to have arrived at acceptable solutions in putting together the immense puzzle posed by the reconstruction of the *Vasa* from innumerable bits and pieces. His colleagues, the carpenters and the irreplaceable head of the Drawing Office, Eva-Marie Stolth, together with the *Vasa*'s curator, Hans Soop, have all done much. All who have worked on the *Vasa*, however, have agreed that Johan Blomman's contributions have been of fundamental and decisive importance for the reconstruction of both the exterior and the interior of the ship.

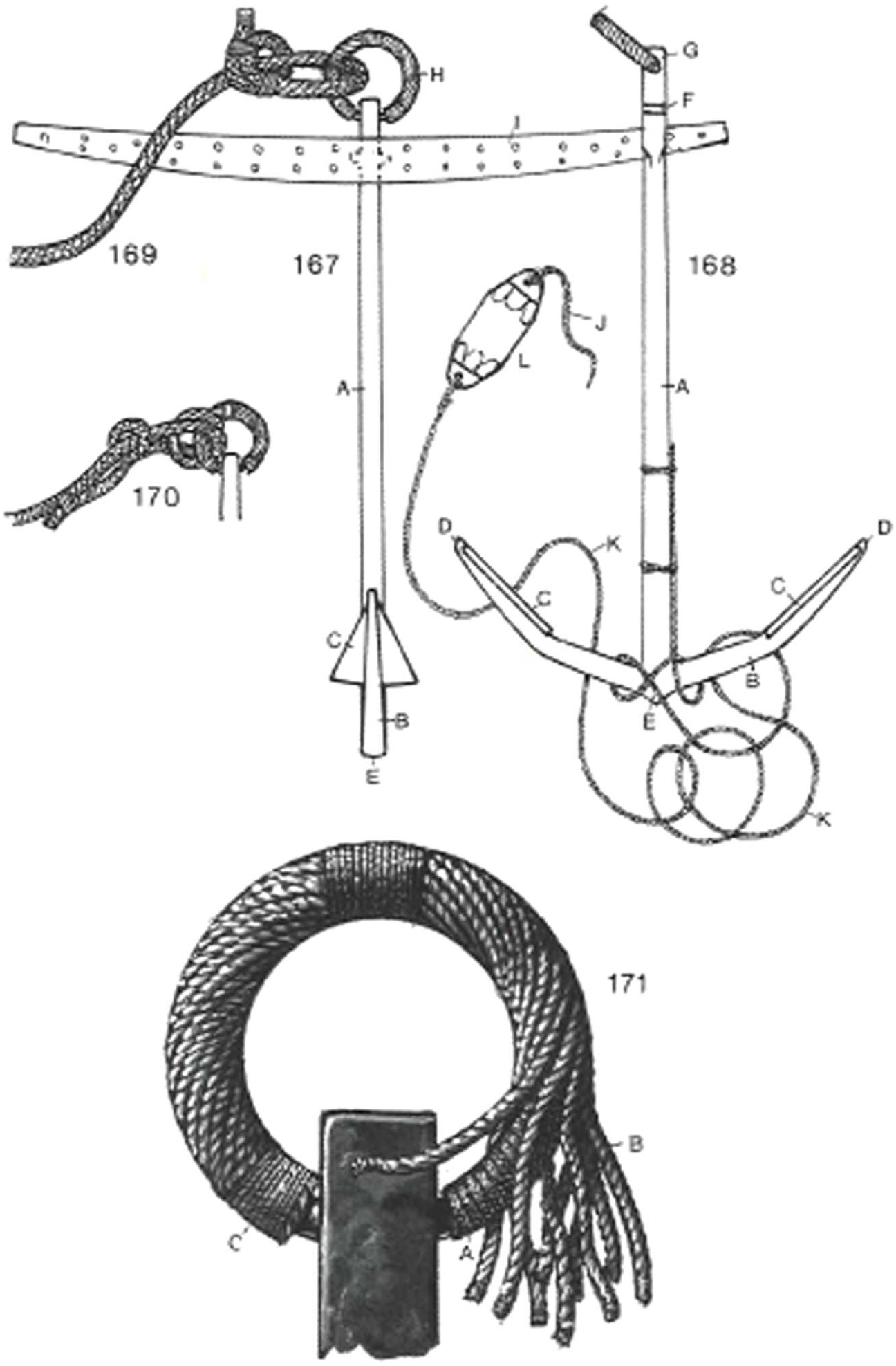
165



166



Anchors and cables



Five of the twenty or so anchors that were recovered together with the *Vasa* have been positively identified as belonging to the ship. The largest, which we have decided to call the sheet anchor (see illustrations 167 and 168), would have been used for anchoring in a storm; it is 4.53 m long, 2.8 m between its points, and would have weighed about 1,300 kilos. Two best-bower anchors, 4.1 m and 4.02 m long, would each have weighed about 1,100 kilos. Two stream anchors were 3 m and 2.8 m long.

The letters in illustrations 167 and 168 stand for: *A* anchor shank *B* arms *C* flukes *D* points *E* crown *F* nuts *G* head *H* ring *I* stock; all illustrated by *Vasa*'s sheet anchor. Its stock was made up of two timbers secured to one another with trenails. The anchor could be recovered if need be with *J* the cat-hook tricing line that was attached to a buoy *L* made from a pine stem. *K* buoy rope. The (upper) cable was a heavy cable-laid rope fastened to the anchor ring with the anchor hitch shown. A lighter (lower) cable would have been fastened with two round turns.

The details of the protective puddening for the anchor ring is clearly seen on the best-preserved of the surviving anchor rings (171): a layer of tarred sennet *A*, then *B* ten spirally-wound ropes 2⅛″ in diameter made fast with *C* whippings of 1″ line. The dimensions are in Amsterdam inches.

Remains were found of two anchor cables, one 15″ in diameter, the other 12″. The usual length for an anchor cable of the time was 110 to 120 Swedish fathoms (each of 1.78 m or 5′10″). Later a cable length came to indicate a measure of distance of 185 m, or one tenth of a minute of arc. Van Yk (pages 211ff) mentions that a large ship would have had a sheet cable of 17″ diameter, but one can suggest that Swedish ships would have got by in the Baltic with (possibly two) cables of 15″. It was a rule in the Swedish fleet of the time that larger ships carried at least four anchor cables.

Willem van de Velde's drawing (illustration 165) is in the Prince Hendrick Maritime Museum, Rotterdam. It shows, more clearly than any other seventeenth-century illustration, the function of a fish-davit (or fish-pendant). The ship is the Dutch *Vrijheid*, built in 1651. The fish-davit is used to raise the flukes of the anchor to the chains; the drawing, like many seventeenth-century paintings, shows a second anchor secured at the chains.

Vasa's fish-davit has been recovered: it is 5.85 m long and 24 cm by 27 cm in cross section and has the same curve as the deck, being carried probably athwartships immediately forward of the foremost knightheads. Its ends are formed so as to allow it to be used on either side of the ship, with a groove at right angles to its length to take a fastening inboard and an obliquely set groove to take the tackle. Rectangular holes in the planking between the foremost gun-ports held it in place; it can be seen fixed to port in the illustration on pages 118 and 119.

The arrangement on the *Vasa* (illustration 166) shows the foremost anchor drawn up by its ring to the cathead beam; its flukes are raised towards the gunwale by means of the fish-davit. The letters stand for: *A* fish-davit beam *B* fish tackle *C* cat-block *D* cat-falls *E* cathead line from which the anchor was hung before being let go upon anchoring. The foremast tackle could be used to move the anchor further astern.

The rigging

It is most probable that the *Vasa* was rigged while work was still in progress on her hull. It is also probable that the work stopped completely from time to time, for "the Dutch", as Arent de Groote put it, simply went on strike.

On 16th May 1628 the Council of State decided that the dockyard should be inspected weekly by two members of the Council, starting the following week with Gabriel Bengtsson and Johan Schytt and continuing the week after with Johan Schytt and Klas Horn, then Klas Horn and Gabriel Göstafsson, and so on, in an eight-week cycle that was to be repeated. Each pair was to report to the Council, but it seems that this long-drawn-out procedure was brief in reality. Its principal aim was really to obfuscate the situation in general and to throw suspicion on the lessee of the yard in particular.

Four days later, on 20th May, Arent de Groote and Captain Söfring Hansson were called before the Council, there to be instructed to administer the dockyard properly and to see that the *Vasa* was made ready. Arent de Groote explained that he wanted to negotiate with the Dutch workers, pointing out to the Council that they wanted their pay in *riksdaler* or in copper coinage actually equivalent to



riksdaler; it was impossible for him to obtain so much money—and it will be recalled that the *riksdaler* had had a value of 6½ marks when the contract had been signed, but had depreciated to 11 marks by this time. And de Groote explained to the Council that it would take another two months to get the ship ready.

Four days after this, on 24th May, Master Berent, who was building the galley, came to the Council and complained that monies due to him had not been paid out, so that he had been unable to pay his workers.

On 9th June, however, it was reported to the king that "the Wasa is now all complete and ready."

As early as the spring of 1628 the *Vasa* lay at the gun-crane by the palace, and it has been suggested that her ballast was taken on board there. But why? It could just as well have been taken on board in the dockyard. At all events she had at least some of her guns on board on 5th July, for on that day "the body of Niels Stiernskiödz"—he had been killed, it will be recalled, in the action off Danzig during the previous November—was borne through Strömmen—the passage between Lake Mälar and the arm of the Baltic on which the city of Stockholm lies. *Vasa* fired a salute with four of her twenty-four pounders.

From the evidence available, one of the smaller ships that had been ordered was on the stocks. The first had already been launched, but work had stopped again and in the middle of June Arent de Groote was once more asking for more money.

The king was in Germany with the army, and it naturally took a long time to carry letters to and fro. To speed up the completion of the *Vasa*, the king sent a messenger to Klas Fleming, who was with the fleet blockading Danzig, to tell him to go to Stockholm. By 9th July the Vice Admiral could take his place in the Council of State which once again had Arent de Groote before it; the Vice Admiral asked him why he had not shown any interest in the following year's shipbuilding, despite the fact that he had been furnished with money. The lessee was unfrightened by the Vice Admiral and said frankly that he would do what he had contracted to do, if only the Crown kept its promises: because of inflation he was once more without funds, and he was still owed a lot of money.

On 28th July, according to the Council's minutes, the contractor for the rigging, Captain Hans Klerck, complained that nothing that had been stipulated in his contract had been done. This can hardly have concerned the rigging of the *Vasa*, for, in 1627, he had received 6,500 *riksdaler* for the purpose, which would have covered the cost of both the





173

materials and the work to be done by the riggers and sailmakers. The material for *Tre Kronor*'s sails had cost 1,028½ *riksdaler* (see "Tidskrift i Sjöväsendet", 1957, page 412). Whether Welshuisen and van Hoorn ever kept to their agreement about sails for the *Vasa* is not known.

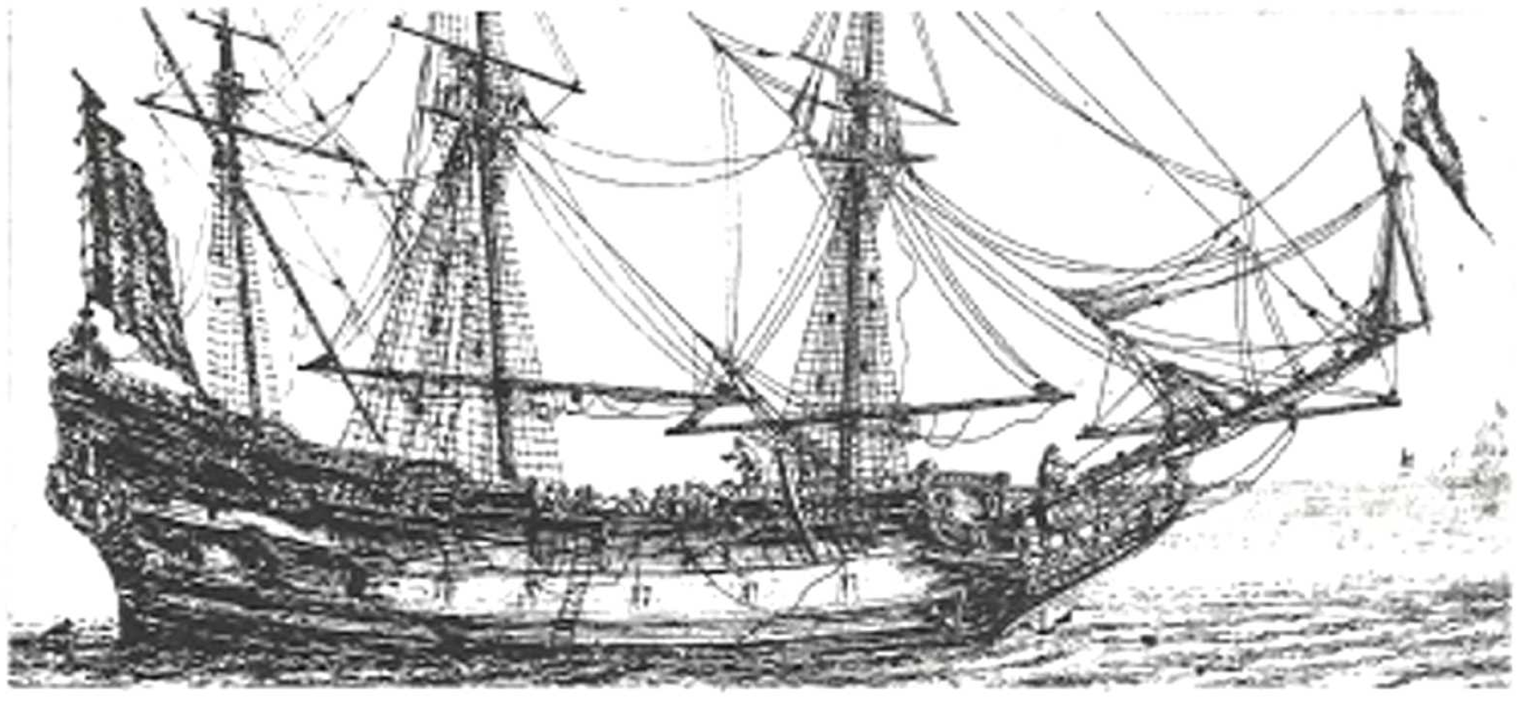
No detail of the *Vasa*, not even her rich embellishment, has caused so much surprise among ship historians as the after rake of her mainmast and the angle formed between her mainmast top and the mast itself. But these are well founded, for the mast-holes in all the decks and the mast-steps have been well preserved.

There is a scarcity of reliable models from the time of the *Vasa*, but if one examines contemporary Dutch paintings and other illustrations, and still others made both earlier and later, it will be found that a sharply raked mainmast was the rule rather than an exception. Vroom depicts such masts in his paintings, as do Cornelis van Wieringen, Pieter Savery, Cornelis Verbeeck and many others in theirs. The illustration on pages 120–121 is of a painting by Adam Willaertz (1557–1644) in the Ashmolean Museum, Oxford. The ship on the extreme left is depicted almost abeam, and I can at once say that her mainmast has a greater rake than *Vasa*'s. It is not known when this painting was done, but I would date it to the 1620s. The ship in the middle of the painting exhibits some interesting details in her

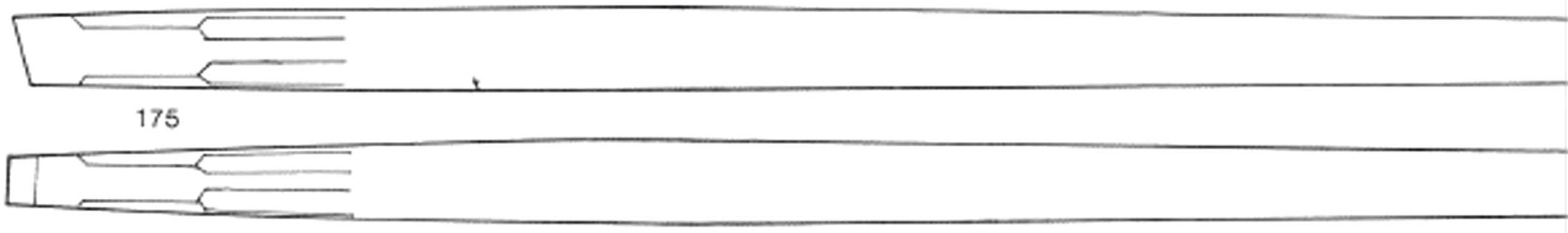
rigging, which I shall return to: her mainmast-top, however, appears to be more or less horizontal, but in other paintings Willaertz shows main-tops at the same angle as *Vasa*'s.

The engraving (pages 16–17) of the Danish ship *Tre Kroner* shows the mainmast-top as angled sharply forward, and still as late as the 1650s the Dutch artist Reinier Nooms *alias* Zeeman has an etching of the pinnace *De Vergulde Dolphijn* (illustration 174) with a main-top as angled as *Vasa*'s.

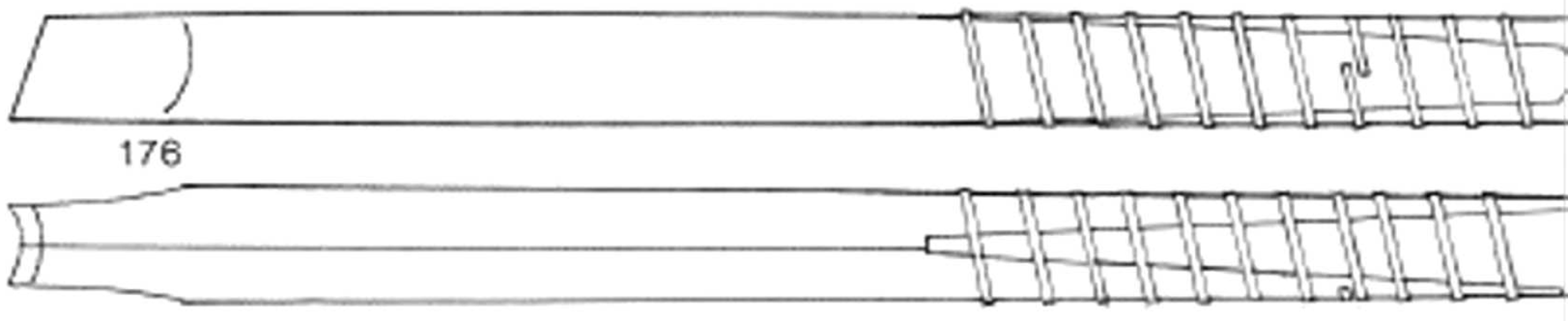
Vasa's mizzenmast has not been recovered, but its length can be calculated by reference to the other



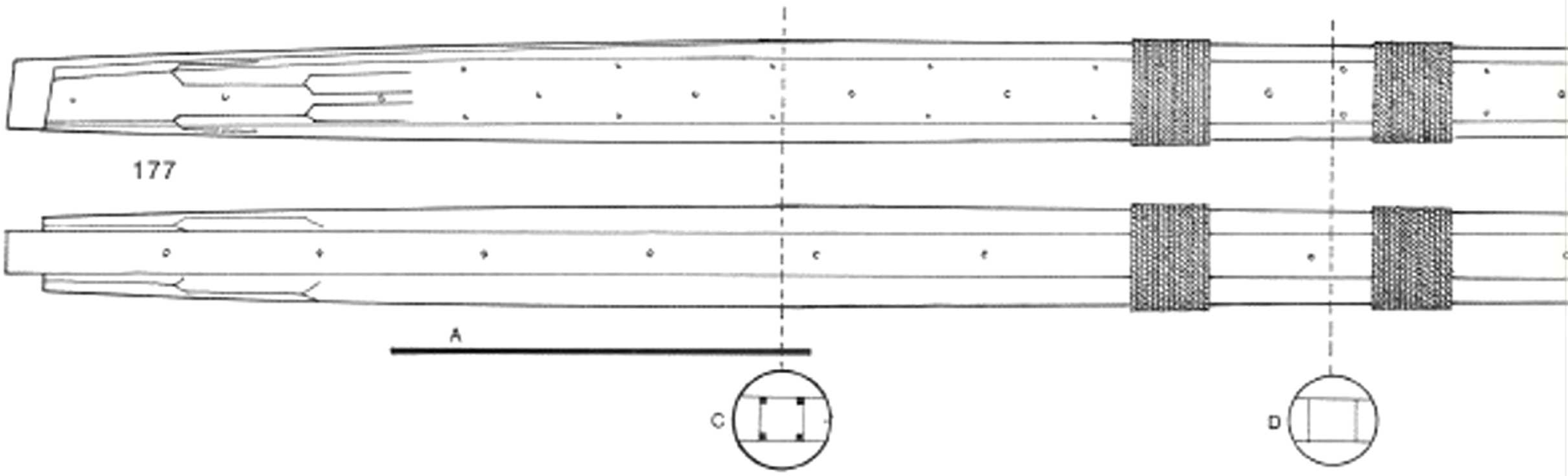
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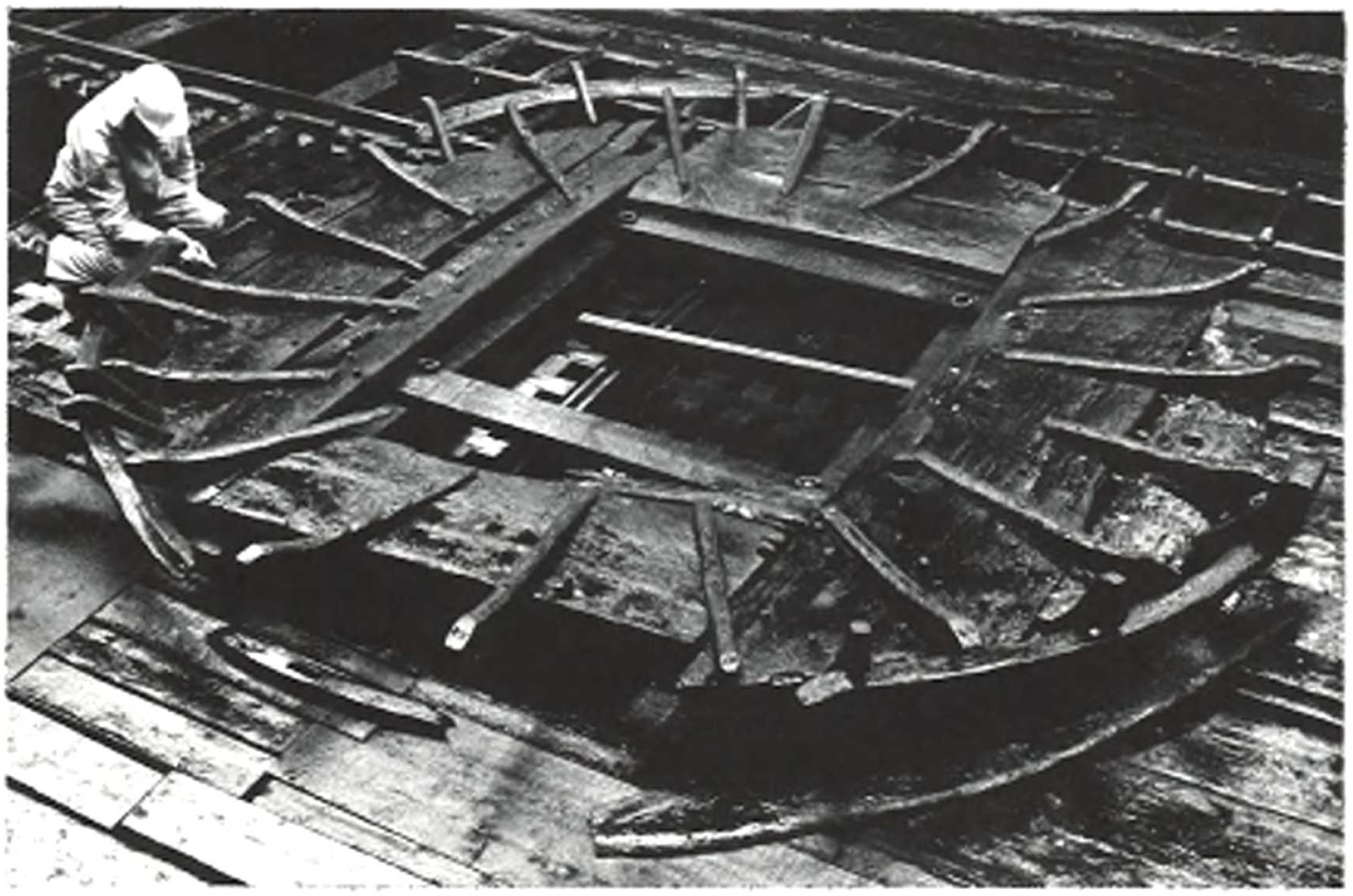


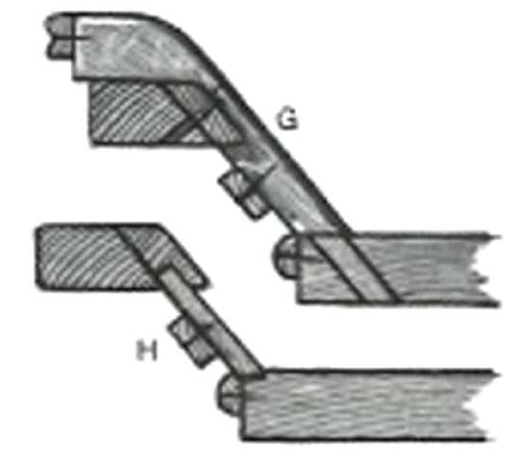
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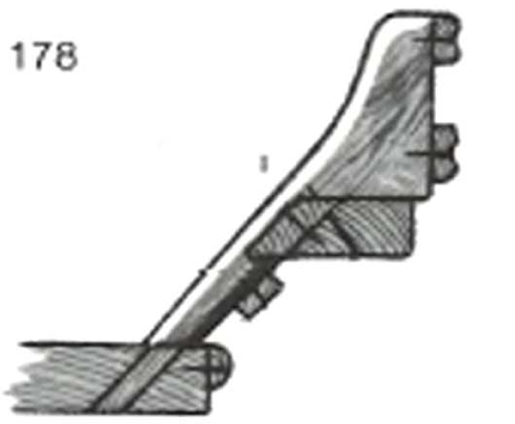
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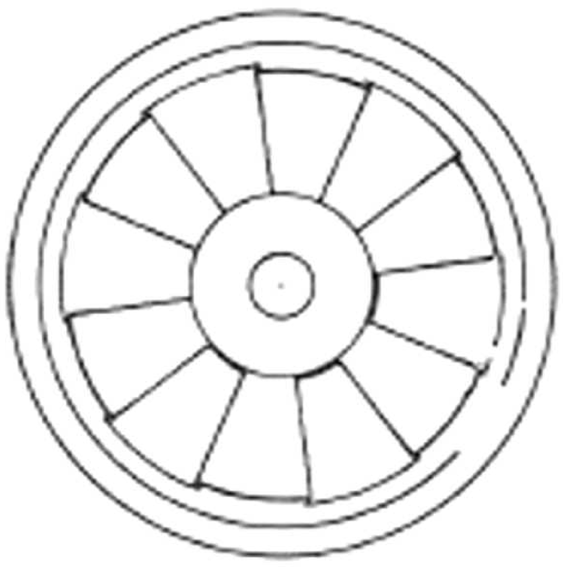






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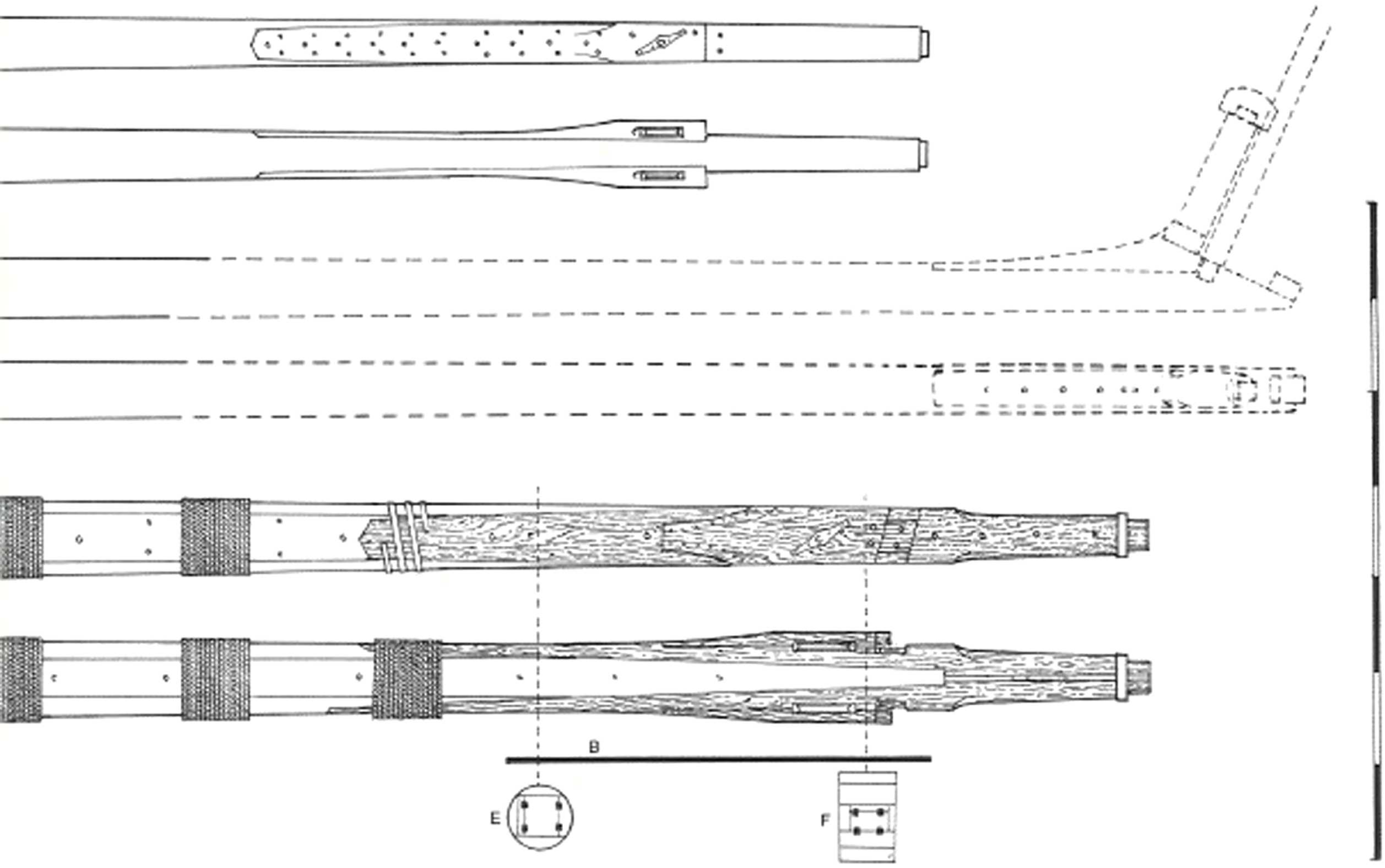




179



180



two masts; the size of the mizzen-top can be deduced from that of the recovered main-top, while the rake of the mizzen-top should be the same as that of the main-top.

The foremast and mainmast are practically complete, even if they were broken, with the loss of unimportant pieces at the point of break.

The foremast is a single length of pine (illustration 175) and, like the mainmast, is strengthened with oak cheeks into which fit two sheaves (either iron or bronze on the foremast; bronze on the mainmast) and the trestle-trees that support the tops.

Only a ten-metre length of the inboard end of the bowsprit (176) was recovered. The bowsprit's missing parts are indicated with a broken line, and are copied from the Amaranth model from the 1650s, which is in the National Maritime Museum, Stockholm.

The mainmast, by contrast, is surprisingly thick (90 cm in diameter at the upper deck) and built of a square or rectangular core of pine (inverted, so that the direction of growth is downwards) with lengths of pine around it, held by mast-fishes, so as to produce a circular cross section (*C, D, E, F*).

The most surprising detail of the masts and spars is the use of iron strengthening pieces built into the mainmast in the sections where it passed through the decks (illustration 177 *B, E, F* and *A, C*) and carried the main-top. I know of no other example of this, but then—excepting *Vasa*—we know nothing of the details of early seventeenth-century ships.

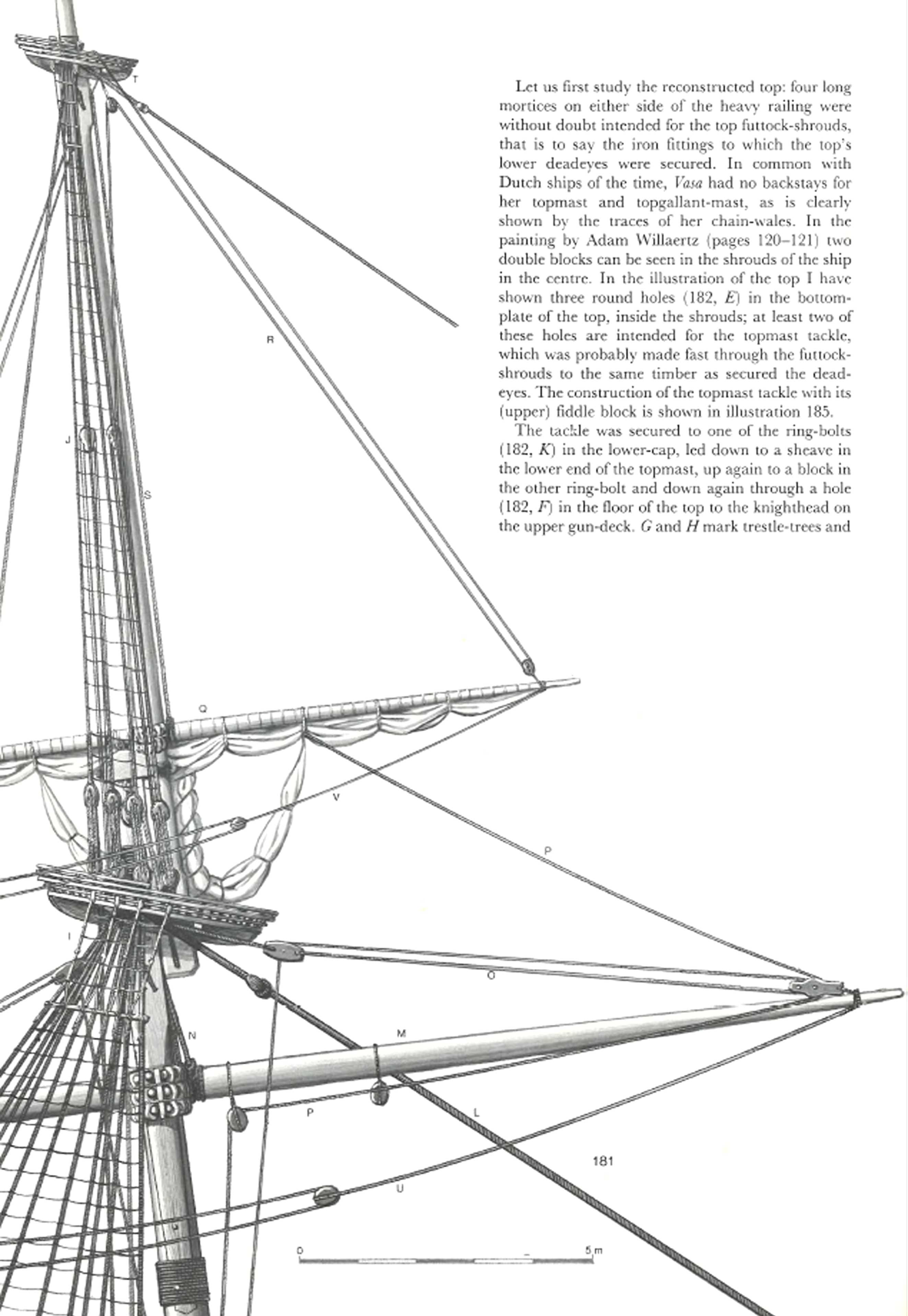
The railing around the main-top (illustration 178) was supported by three different types of knee (*G, I* and *J*); a fourth type (*H*) can be deduced from mortices in the bottom plate of the top. The knees have nail-holes and other traces from the narrow battens that would have fitted round the top.

A large (44 cm diameter) bronze sheave has been found, one of two in the mainmast (179). Among the finds was also a double block for the main topsail sheet and the mainmast lift (illustration 180). Its form is previously unknown, being something between the fiddle-block from the Danish *Tre Kroner* and the Dutch pear-shaped blocks that came into general use in the middle of the century. It is 66 cm long (cf., illustrations 17 and 186).

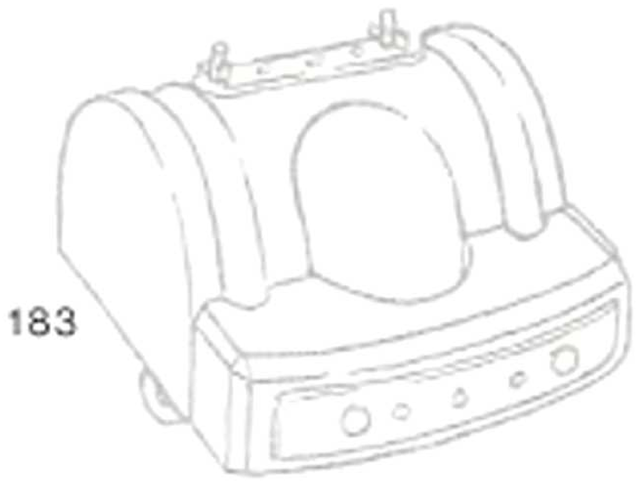
From extant reports it is known that *Vasa* carried only a foresail with bonnet, fore-topsail, main-topsail, and mizzen without bonnet on her only voyage. It is remarkable that no other sail was bent, and as the fore-topgallant mast-cap was found on board, one may presume that the fore-topgallant mast was struck. All the other sails were found neatly folded in their locker, and thanks to them it has been possible to reconstruct the masts and spars as need be.

Let us first study the reconstructed top: four long mortices on either side of the heavy railing were without doubt intended for the top futtock-shrouds, that is to say the iron fittings to which the top's lower deadeyes were secured. In common with Dutch ships of the time, *Vasa* had no backstays for her topmast and topgallant-mast, as is clearly shown by the traces of her chain-wales. In the painting by Adam Willaertz (pages 120–121) two double blocks can be seen in the shrouds of the ship in the centre. In the illustration of the top I have shown three round holes (182, *E*) in the bottom-plate of the top, inside the shrouds; at least two of these holes are intended for the topmast tackle, which was probably made fast through the futtock-shrouds to the same timber as secured the dead-eyes. The construction of the topmast tackle with its (upper) fiddle block is shown in illustration 185.

The tackle was secured to one of the ring-bolts (182, *K*) in the lower-cap, led down to a sheave in the lower end of the topmast, up again to a block in the other ring-bolt and down again through a hole (182, *F*) in the floor of the top to the knighthead on the upper gun-deck. *G* and *H* mark trestle-trees and

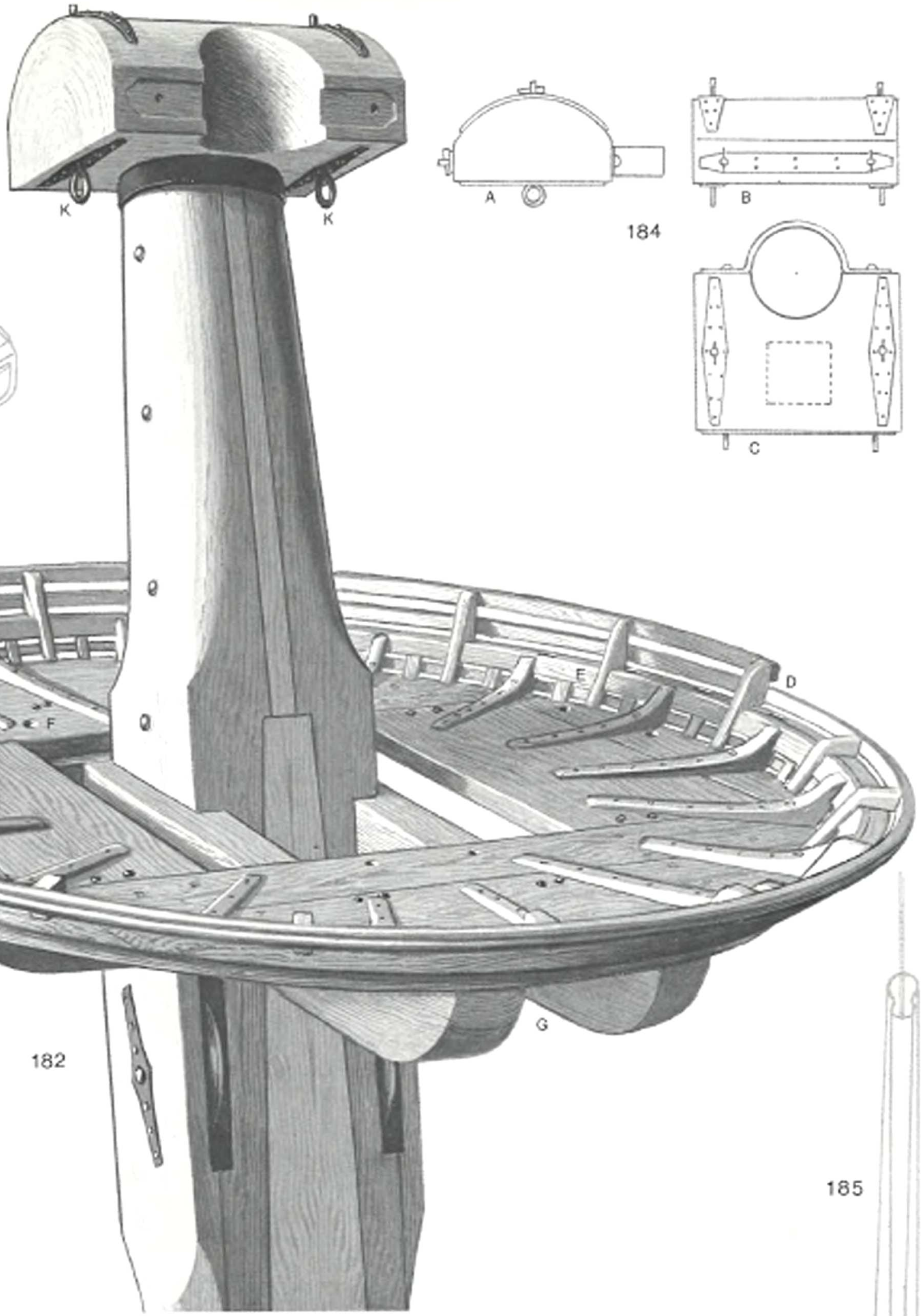


181



183

184



182

185

cross-trees respectively of the top. Three projections of the ship's lower-cap (illustration 184) show how the iron fittings could be reconstructed with the help of the marks they had left in the uneroded oak.

The large sheaves immediately below *Vasa*'s main-top were used for the ties that hoisted the main-yard; in Dutch ships it had been usual before the 1620s to lead the ties over the lower-cap. A mast-cap from the Amaranth model (illustration 183) shows the grooves in its 'shoulders' for its ties. As the model of *Norske Løve* (see page 87) shows the same arrangement as the *Vasa*, we may guess that British shipwrights and naval officers had recommended this system.

The letters in illustration 181 stand for: *I* futtock-shrouds *J* topmast-shrouds *L* mainstay *M* main-yard *N* tie *O* a main-lift *P* topsail sheet *Q* topsail yard carrying the furled topsail. *R* a topsail lift *S* topsail yard tie *T* gallant trestle-trees and top *U* mainbrace and *V* topsail brace.

This is a detail of a grisaille by Willem van de Velde the elder, called "Three Rotterdam Admirals' ships with a squadron from the Netherlands," in which only Admiral Jacob Wassenaer van Obdam's ship *Eendracht* is visible; she was built in 1653. As this artist's grisailles have in practice the documentary value of a photograph, this one is worth looking at carefully; the original is in the Prince Hendrick Maritime Museum, Rotterdam.

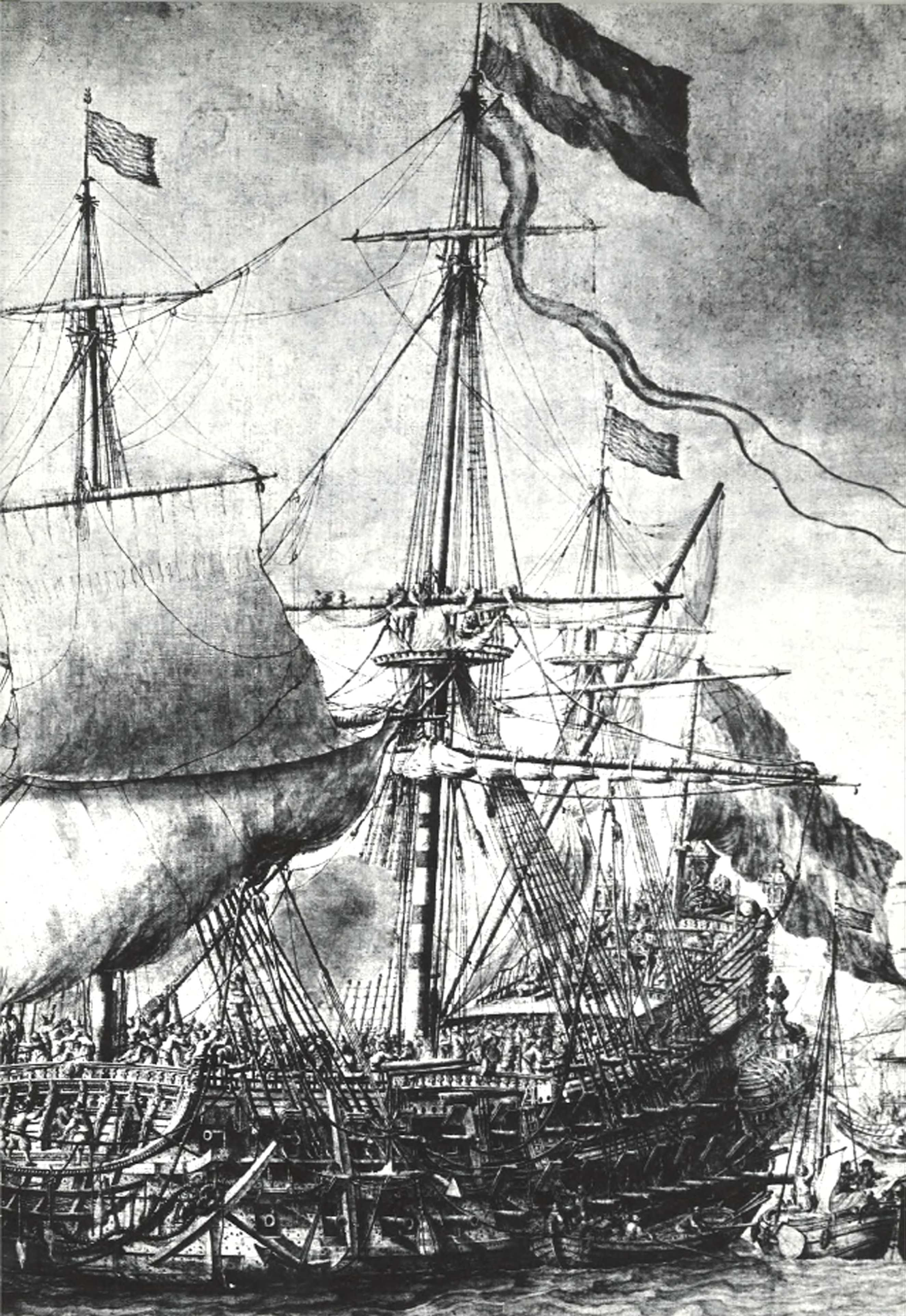
The *Eendracht* is very obviously deeply loaded, so much so that her waterline is within the depth of a gun-port of her lower ports. The upper beakhead railing is egg-moulded, and some swabs hang from it. A similar swab can be seen hanging from the anchor at the chains of the *Vrijheid* (page 116). These swabs would have been used to clean the anchor and cable and, naturally enough, the heads too. The cathead can be seen projecting out from the ship's side aft of the beakhead. An anchor is secured at the chains, and a pear-shaped anchor buoy, painted in contrasting stripes, hangs down from it; the buoy would probably have been cut out of a single tree stem, as was then usual in Holland.

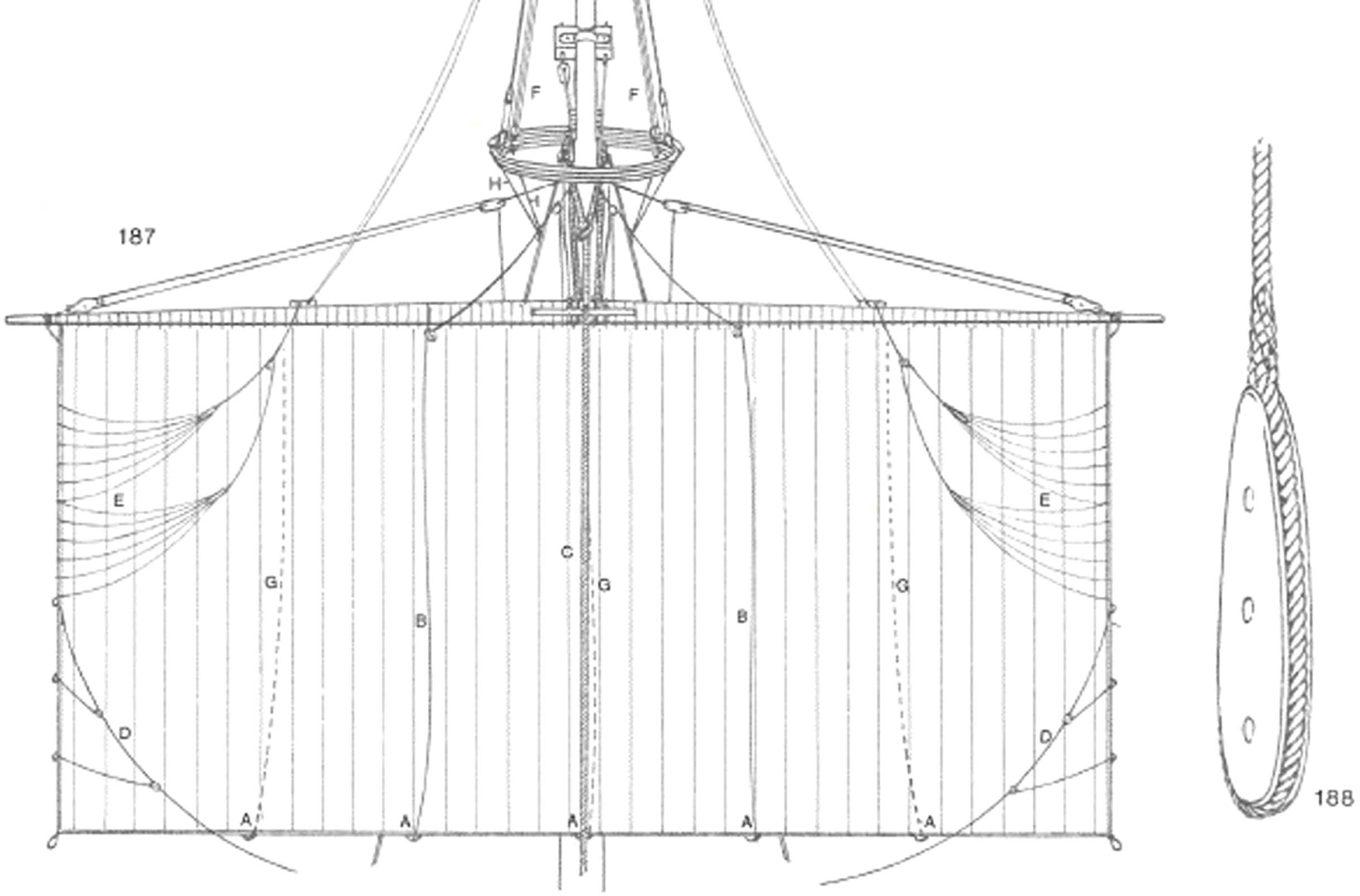
Eendracht's dimensions according to Vreugdenhil (page 15) were length overall 150′, greatest beam 38′, draught 15′, *Vasa*'s dimensions being, by contrast, 167′9″, 39′2″ and 16′3″ respectively, making her a relatively large ship. In the action in the Sound in 1658 she carried 3 thirty-six-pounders (storm-pieces perhaps), 22 twenty-four-pounders, 14 eighteen-pounders, 12 twelve-pounders, and 22 six-pounders, all in bronze. *Vasa*'s armament is given on pages 132 and 133.

The rigging of *Eendracht*'s foresail is not too easy to make out, but it seems to comprise two leach-lines and two bunt-lines, but these are not taut, and the sail seems to have been hoisted behind three other lines. The leech-lines for both the foresail and the fore-topsail may be seen to run through cringles for bowlines; this would add to their gathering effect.

This grisaille was done about 1665, when reefing-points on topsails were a novelty. It was in this year that *Eendracht* exploded and sank off Lowestoft, on the east coast of England, having been hit in the magazine. She was twelve years old: it was said at the time that Dutch ships were built to last for seven years, while English ones were built for seventy.

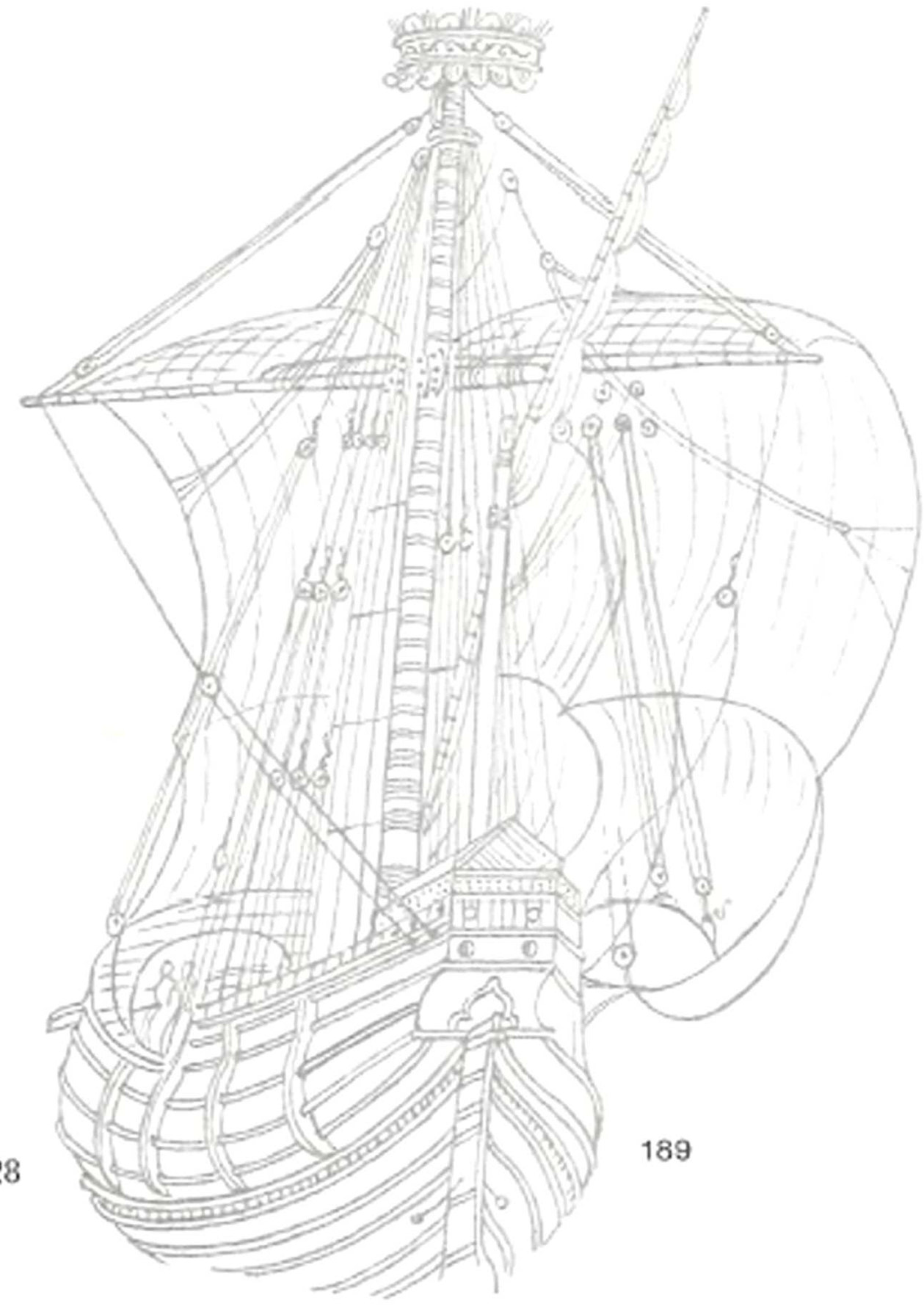
This is something of a caricature: *Sovereign of the Seas* was built in 1637 and survived until 1696, the *Rainbow* was built in 1617 and sank sixty-three years later in 1690, and careful study of, for example, R. C. Anderson's book *English Ships 1649–1702* might reveal an English ship of the time that survived for even longer. Nevertheless I know of none





187

188



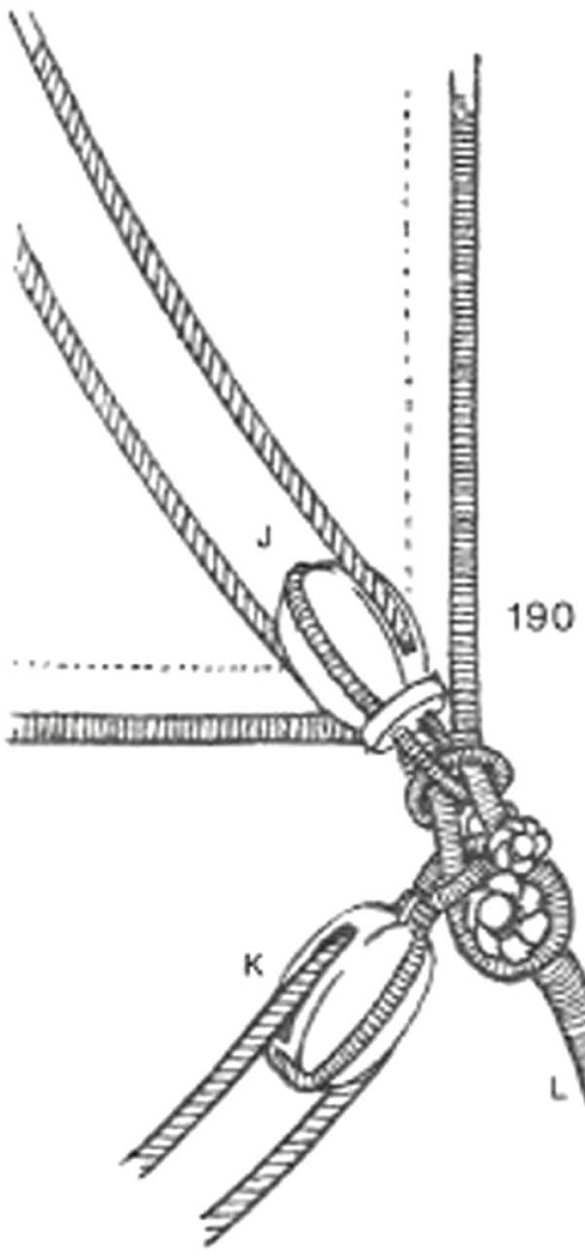
189

that was built with such heavy timbers as those that we can see on the *Vasa*.

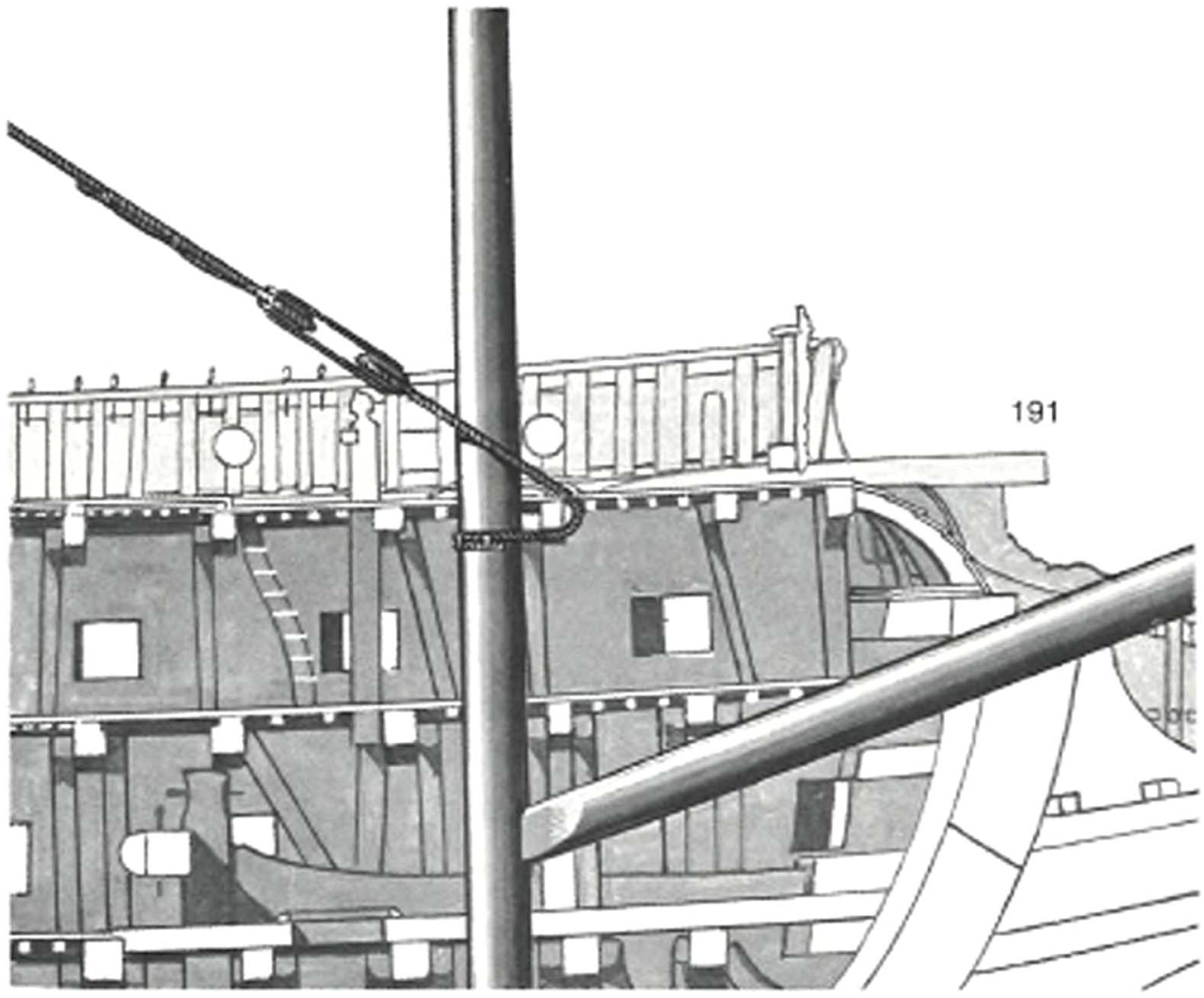
Vasa's mainsail is about 22 m broad and 10.7 m in height, and it can be compared for size with the other sails in the illustration on pages 130–131. Five cringles are spliced into its foot rope (see illustration 187 *A*). The copperplate engraving of *Le Grand Saint Louis* shows only two leech-lines on the forward side of the foresail, as does the grisaille of the *Eendracht*, but in both the mainsail is furled: *Vasa*'s mainsail had no bonnet but otherwise it would in principle have had the same fittings and attachments for handling as the foresail.

I assume only two bunt-lines were on the forward side of the sail (187 *B*), while three bunt-lines were rigged on its after side (187 *G*). The other letters of illustration 187 stand for *C* mainstay *D* bowlines *E* martnets *F* main-topmast tackle *G* three bunt-lines on the after side of the sail. *H* top futtock-shrouds *I* top-tackle futtocks. The topmast tackle was used to stay the topmast laterally before it was secured with the top-shrouds' deadeyes and lanyards.

Illustration 189 shows a fifteenth-century ship; it is copied from a Venetian engraving and shows a ship with two cringles in the sail to starboard, from which lanyards run up to the yard. Bunt-lines on the after side of the sail were no novelty then. The standing rigging to port hides any details there, but other ship-portraits from the same source show four cringles and four lanyards. The ship has martnets



190



191

but neither this ship nor any of the others in the same source have bunt-lines on the forward side of the sail. From a Venetian engraving from the end of the fifteenth century (see *MM* 3, pages 238ff).

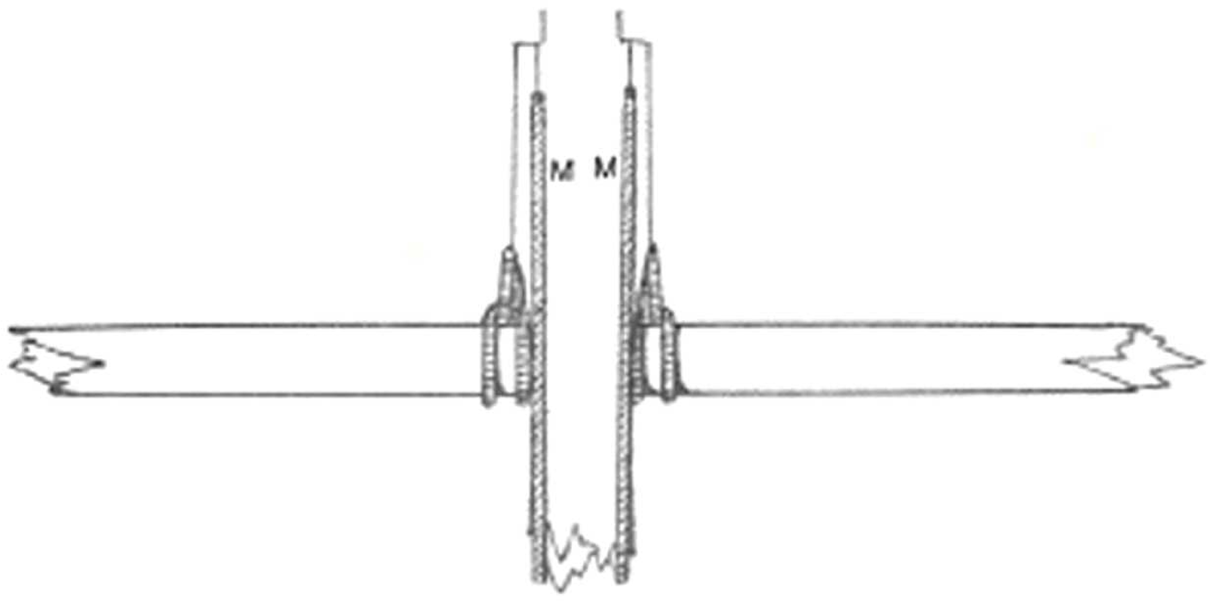
I should like to suggest that leech-lines on the back of sails was the first step in their development, something which can have gone back and forth like the tides, but over long periods of time.

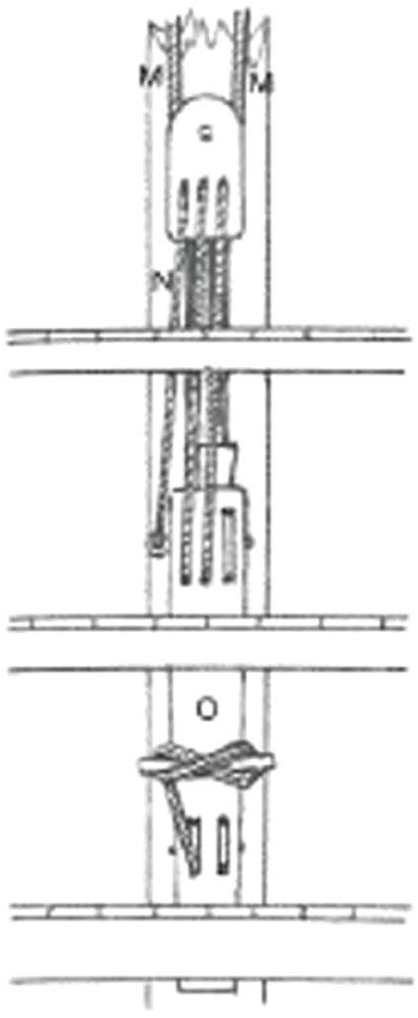
For Dutch riggers, the tide would have turned around 1660. What is known as the Hohenzoller model (from about 1660; it was destroyed in the Second World War) lacked leech-lines on the back of her sails. Even so, this line of argument does not answer the question about *Vasa*'s bunt-lines.

For the method of attachment of sheets and tacks in the clews of the sails we must rely on a detail from the Amaranth model, which is shown in illustration 190: *J* clewlines *K* sheet-block with two strops each passing through the loop at the clew and terminating in a double wall-knot. *L* tack with a double wall-knot also passing through the clew-loop.

The question as to how the mainstay was made fast in the hull has caused lively discussions. Its strop would certainly have passed through two holes in the deck forward of the foremast (cf., illustration 105) in a manner that seems to have been usual on Dutch ships of the time (see illustrations 33 and 35), but there is no point of attachment in the hull for the strop; my solution has been to lead the strop aft round the foremast and to fill the space between the mast and the beam immediately forward of it with a short timber, so that the strop cannot shift the mast forward. This arrangement which is shown in illustration 191 would in any event work well.

Below I show how main-yard ties *M* lead down to a large block and the jeers *N*, thence to one of the knightheads *O*.

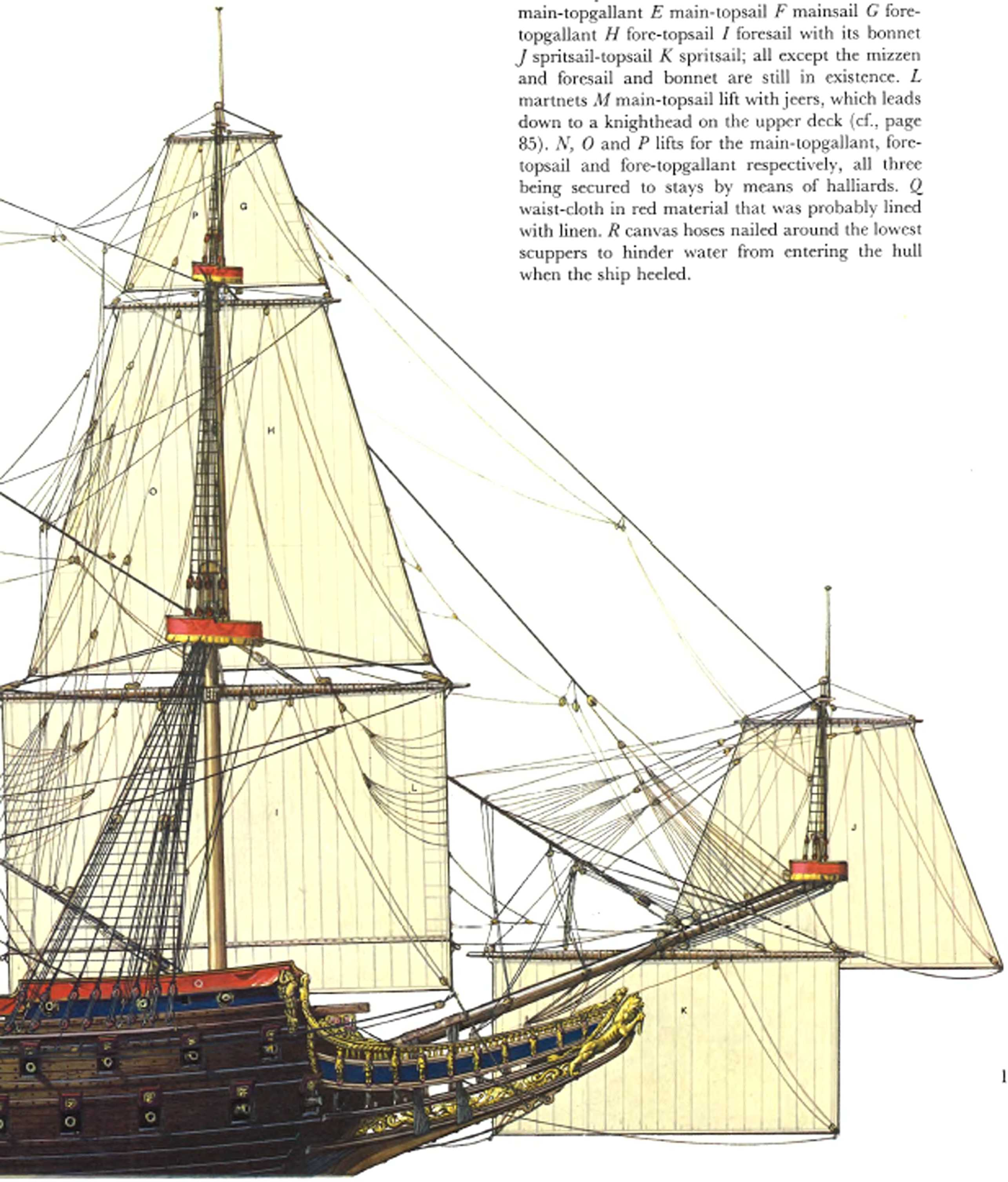


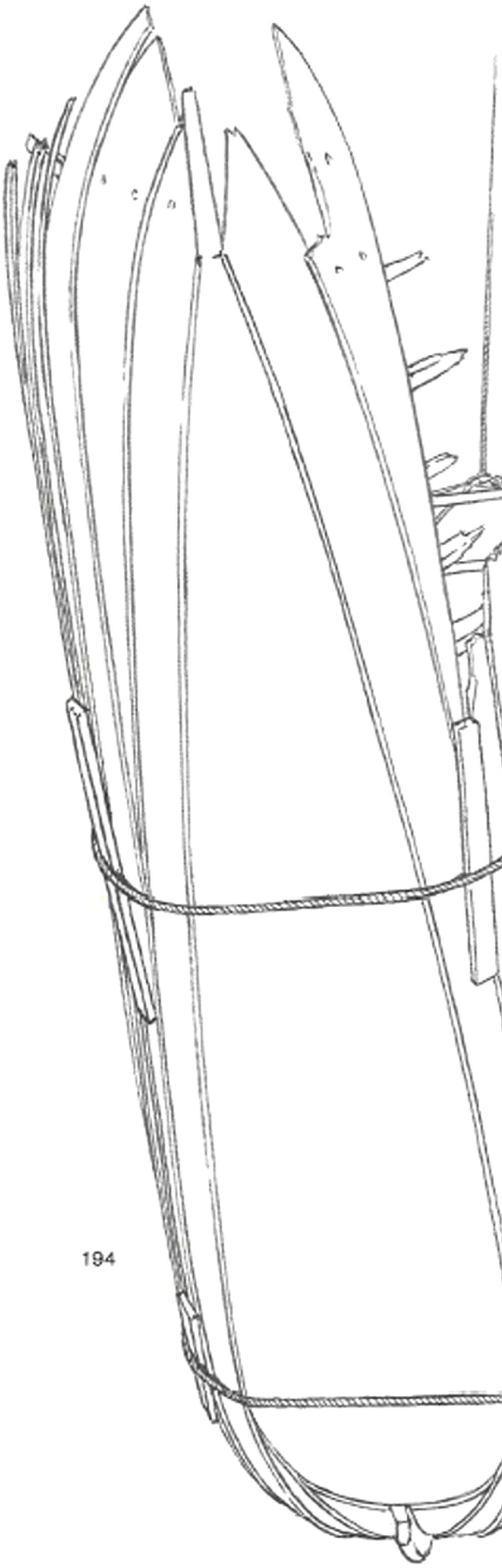


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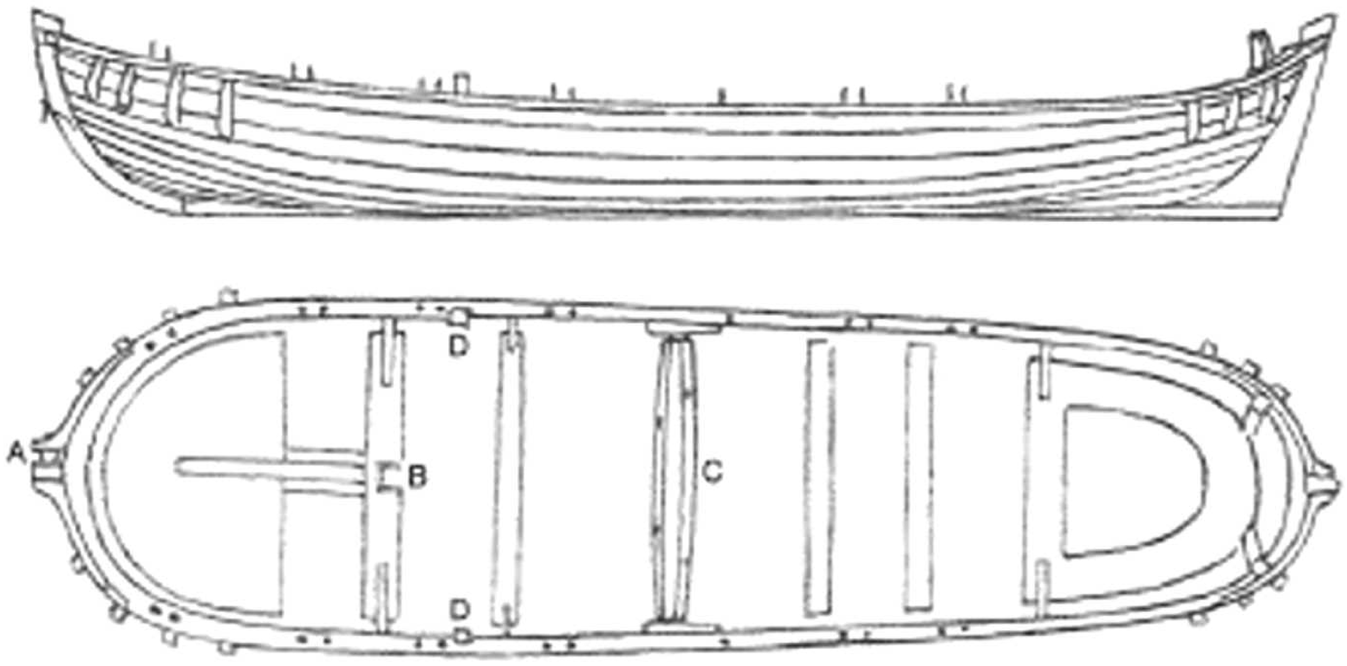

0
5
10 m
A
B
C
D
E
F
R
R
R

In the foregoing I have touched on only those parts of *Vasa*'s rigging that have survived and those that can throw some new light on rigging from the early seventeenth century. Here is shown a reconstruction of the sail-plan with its elementary parts. *A* mizzen-topsail *B* mizzen *C* bonnet to the mizzen *D* main-topgallant *E* main-topsail *F* mainsail *G* fore-topgallant *H* fore-topsail *I* foresail with its bonnet *J* spritsail-topsail *K* spritsail; all except the mizzen and foresail and bonnet are still in existence. *L* martnets *M* main-topsail lift with jeers, which leads down to a knighthead on the upper deck (cf., page 85). *N*, *O* and *P* lifts for the main-topgallant, fore-topsail and fore-topgallant respectively, all three being secured to stays by means of halliards. *Q* waist-cloth in red material that was probably lined with linen. *R* canvas hoses nailed around the lowest scuppers to hinder water from entering the hull when the ship heeled.





194



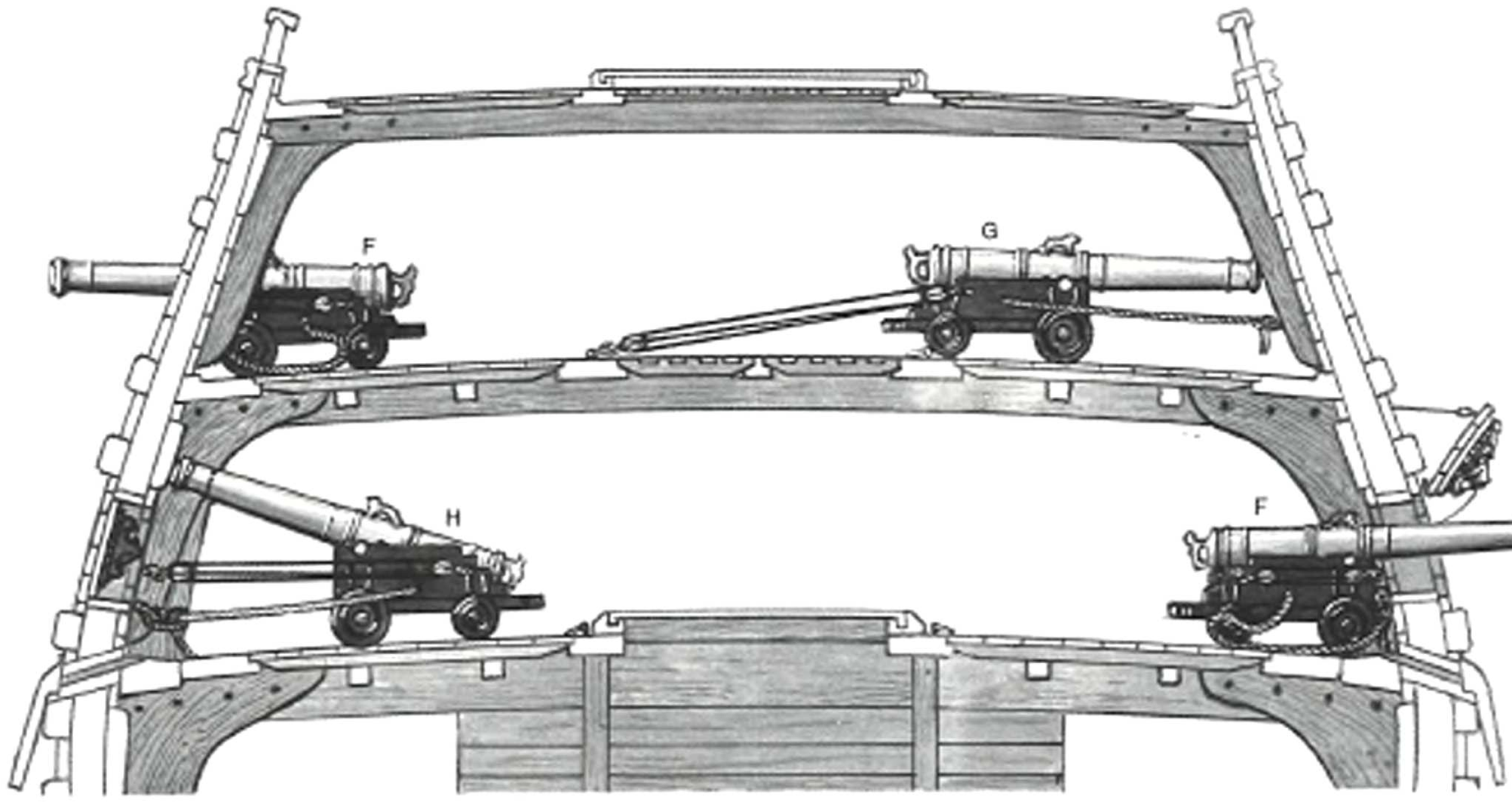
195

Close to the hull of the *Vasa* a large ship's boat, broken at the stern, was found on the seabed (illustration 194), and today it is wholly reconstructed with the original pieces which were also recovered. It is flat-bottomed with clinker-built sides and to begin with noone risked claiming that it belonged to the *Vasa*; later on, however, a windlass was found in the hull that exactly fitted this boat (illustration 195, *C*) and so it could be determined that the boat was *Vasa*'s sloop.

The sloop is 11.8 m long and has a maximum beam of 3.15 m. The accompanying illustration (illustration 195) is a sketch, and its details are: *A* sheave for the anchor line *B* mast support *C* windlass for raising the anchor and sails *D* timber-heads for securing lee-boards *E* lee-board, one of two that were recovered. Bits of two other boats were also recovered, one of them a Dutch type, the other probably Swedish. Two lee-boards from the sloop were recovered, together with two other smaller lee-boards.

I have already claimed (page 48) that *Vasa* was originally intended to carry 32 twenty-four-pounders on a single gun-deck. The oldest known documentation of her armament is from 1627 (see "Tidskrift i Sjöväsendet", 1964, page 850); it mentions 36 twenty-four-pounders and 24 twelve-pounders, 8 forty-eight-pounder storm pieces and 10 breech-loading swivel-guns for the tops.

The four round gun-ports in the aftermost cabin (cf., page 115) must have been made in accordance with this plan. According to the same source, another plan for the armament was drawn up in 1628, this time for 30 twenty-four-pounders and 30 twelve-pounders together with smaller pieces. When *Vasa* sailed, she carried 48 twenty-four-pounders, 8 three-pounders, 2 one-pounders and 6 storm pieces.

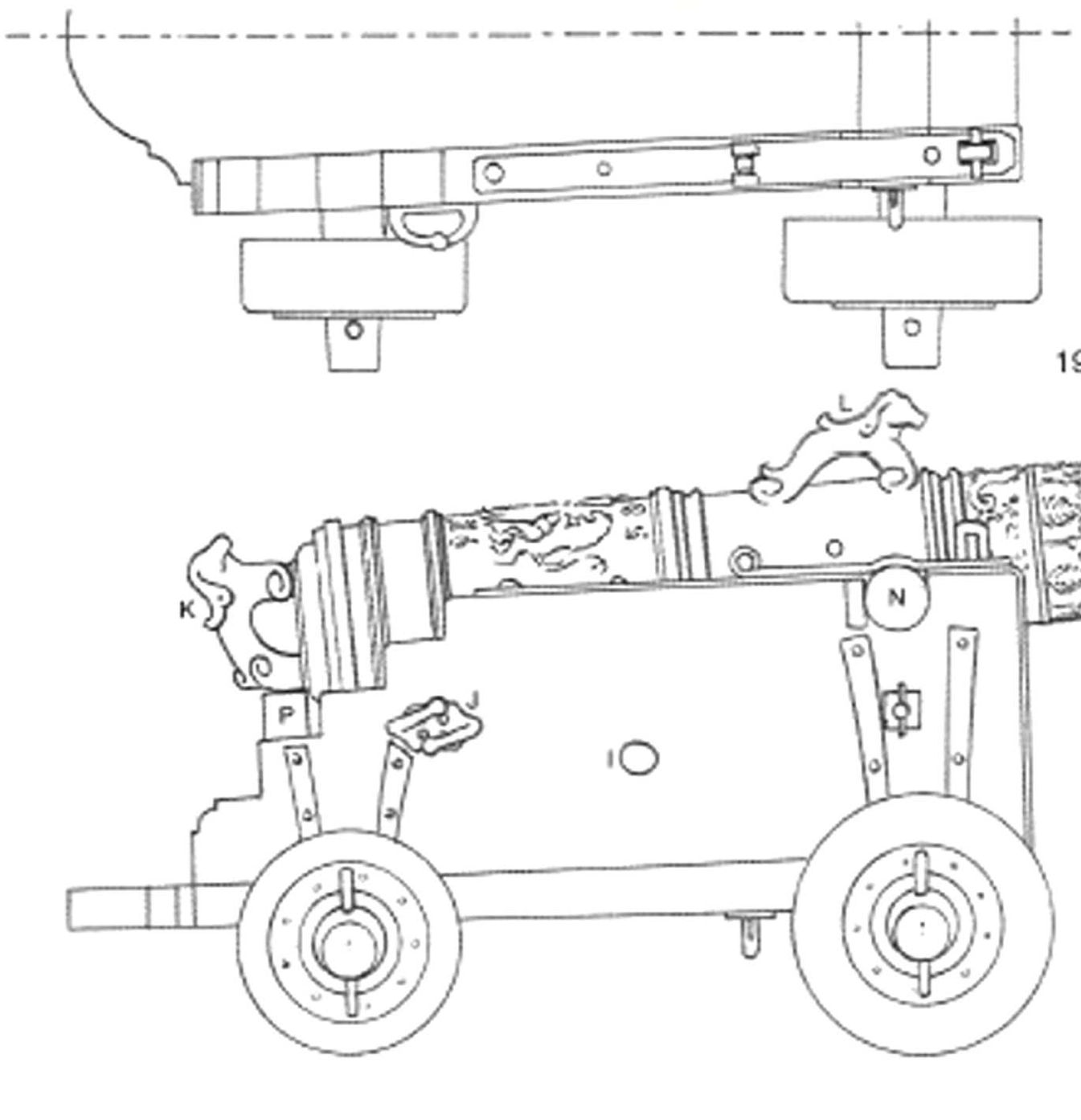


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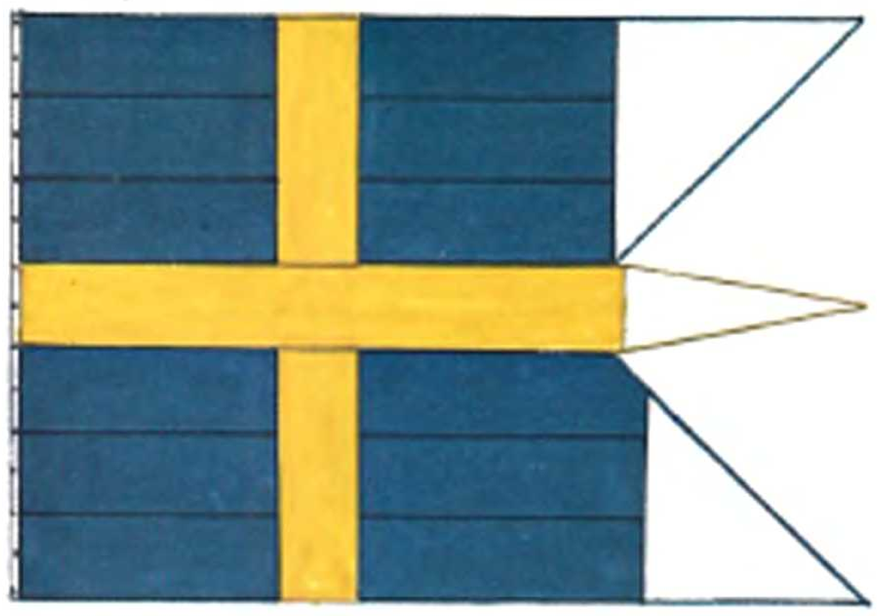
Behind the gun-ports at the stern and inside the first and third ports of the lower gun-deck were only empty carriages standing. Only three guns were recovered together with the ship. All three were twenty-four-pounders, and one of them, with its carriage, is shown in illustration 197: *I* hole for breeching, a thick four-part rope secured to the lower ring-bolt by the gun-port. *J* fitting with two hooks for the gun-tackles. *K* cascabel in the form of a dog, with the touch-hole between its forepaws. *L* dolphin—formed as a dog!—placed at the point of balance of the gun by which it could be lifted. *M* muzzle of a type preceding those with a conical appearance. *N* trunnions *O* fittings that secured the gun to its carriage. *P* quoin which could roughly fix the gun's elevation.

Illustration 196 above shows two guns (*F*) run out ready for firing, and one gun (*G*) being run in with the help of tackle secured to a ring-bolt in the opposite binding strake, so it can be sponged out and re-loaded with the gun-port closed. The sponge, rammer and powder shovel would have had shafts of hardened rope. One gun (*H*) is secured with its muzzle hard up against a beam stringer.

Storm pieces were relatively short, light wide-calibre guns used at short range to discharge grape-shot or scraps of metal.



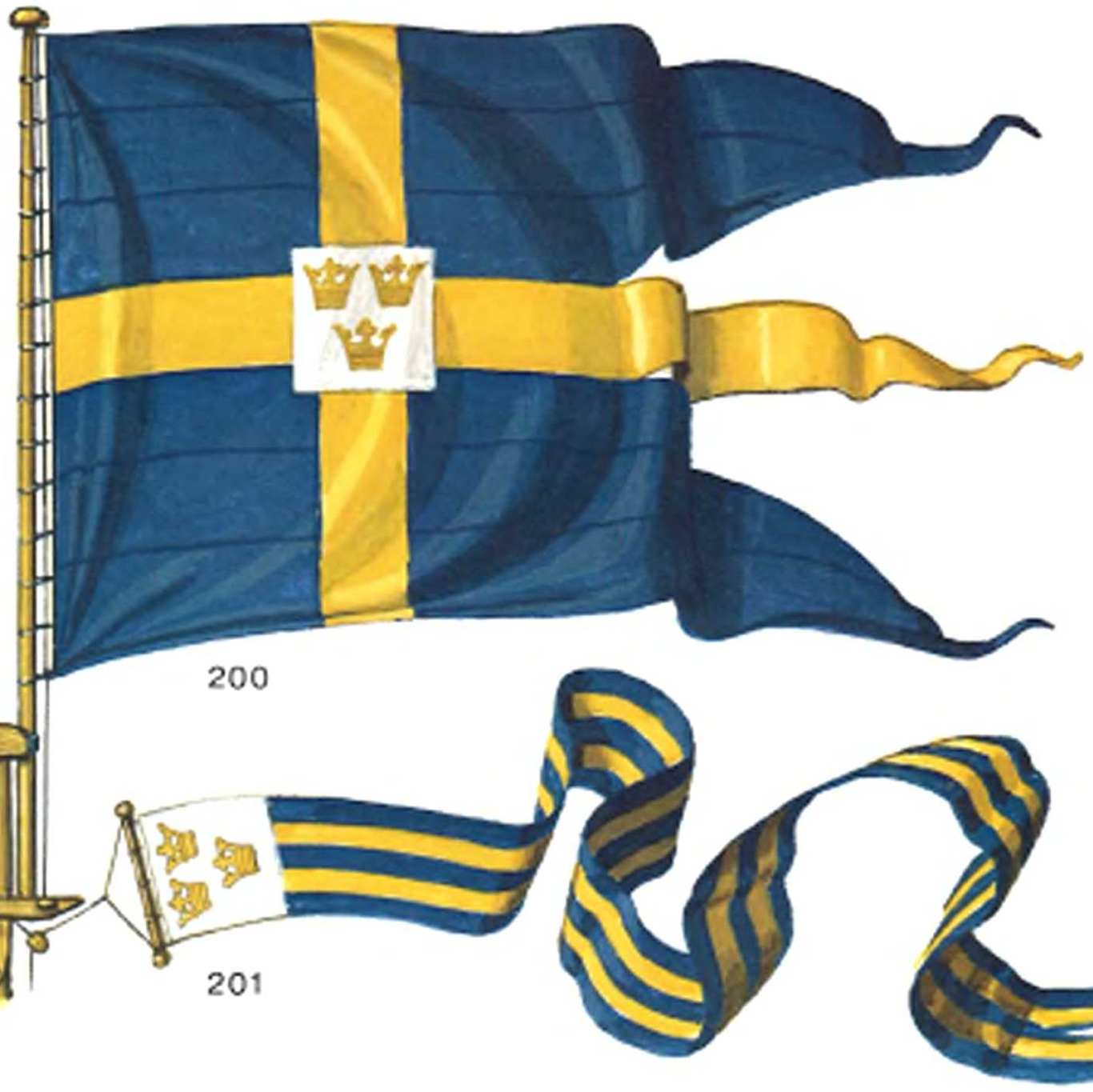
197



198



199



200

201

In 1626 Gustav Adolf's army and fleet took Pillau in Polish Prussia without a struggle. A painting in watercolour, made that year or perhaps the next, shows the harbour of Pillau and parts of the Swedish fleet under sail and at anchor. A couple of the vessels fly a three-tongued flag, with a yellow cross on a blue ground, from their mainmast tops, three are to be seen carrying a straight-cut striped blue-and-yellow flag, and the others a straight-cut blue and yellow cross flag. All carry small blue flags at their foremast and mizzenmast tops. We have thus dared to assume that *Vasa* carried at least one three-tongued rectangular flag with the yellow cross on a blue ground.

The oldest preserved three-tongued Swedish flag is to be seen today in the Rijksmuseum in Amsterdam, a trophy from the action in the Sound in 1658 (illustration 198); enough of the flag has survived to reveal its proportions.

A grisaille by Willem van de Velde the elder, made from sketches he made during the action, shows the Swedish ships carrying at their sterns three-tongued flags with a square, probably white, field with three crowns in it in the middle of the cross (illustration 200); at least one of the ships can be seen flying such a flag at her main. Pendants (illustration 201) are decorated with either three crowns in a field or a gold cross in a similar blue field.

Two large pencil-and-wash drawings depicting the action at Femerbält in 1644 have earlier been ascribed to Willem van de Velde the elder, but the drawings are unsigned and seem to me to be altogether too stereotyped to be by this artist. They are kept at Skokloster, the large country-house near Stockholm, and in them the Swedish admirals' ships each fly a flag aft with the national coat-of-arms (illustration 203), while their pendants bear three crowns in a field (illustration 201).

The same action appears in a painting by an unknown artist, and in it the Swedish ships are shown carrying a red battle flag with three crowns (illustration 202) on the windlass on the cabin. A painting by Peter van de Velde (no relation to the other van de Veldes; se *Maritieme*, page 331) depicts the action in the Sound with the Swedish ships carrying blue standards with three crowns and blue-and-gold striped standards at their mains and foremasts.

With some hesitation I can believe that *Vasa* would have carried at her stern a flag with only the symbols of the national coat-of-arms, but Gustav Adolf's order of sailing, probably from 1621, provides otherwise; it stated that the king's own ship should carry flags and pendants "from the bowsprit to the stern on the cabin and at the yard-arms", that the ship of the king's brother Duke Karl Filip should do so too but without a pendant at the mizzen; that the Admiral of the Realm should fly only a pendant at the mizzen but without flags and pendants at the yard-arms, and the other admirals nothing at all at the mizzen or quarter-deck. From this it seems that the royal standard was not to be carried on the quarter-deck.

202



203

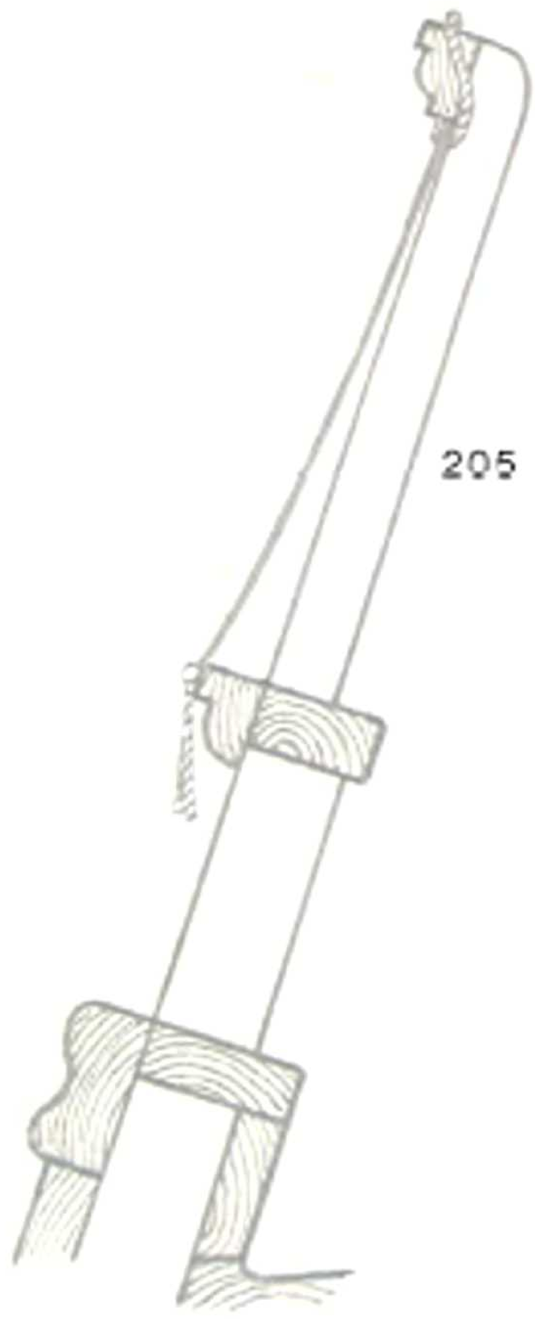
The order of sailing further provides that each vice admiral should carry his flag on the bowsprit and "his pennant of admiralty be carried by an ensign aft on the poop." Other vessels, both warships and merchantmen in the service of the Crown, were to "fly the pennants of the country's places, which they have aft on the quarter deck."

Should this be interpreted to mean that Field Marshall Erik Jönsson Kremer, who was appointed admiral over the small fleet that was to sail to Germany, carried his colours on *Vasa*'s flagstaff aft? It can hardly be a matter of an ensign who stood and let a banner fly in the wind, for we know *Vasa* had a flagstaff. The watercolour with the motif from Pillau shows no flags flying aft. Is it possible that the order of sailing had been changed between 1621 and 1628? It is not easy to find a solution to this problem.

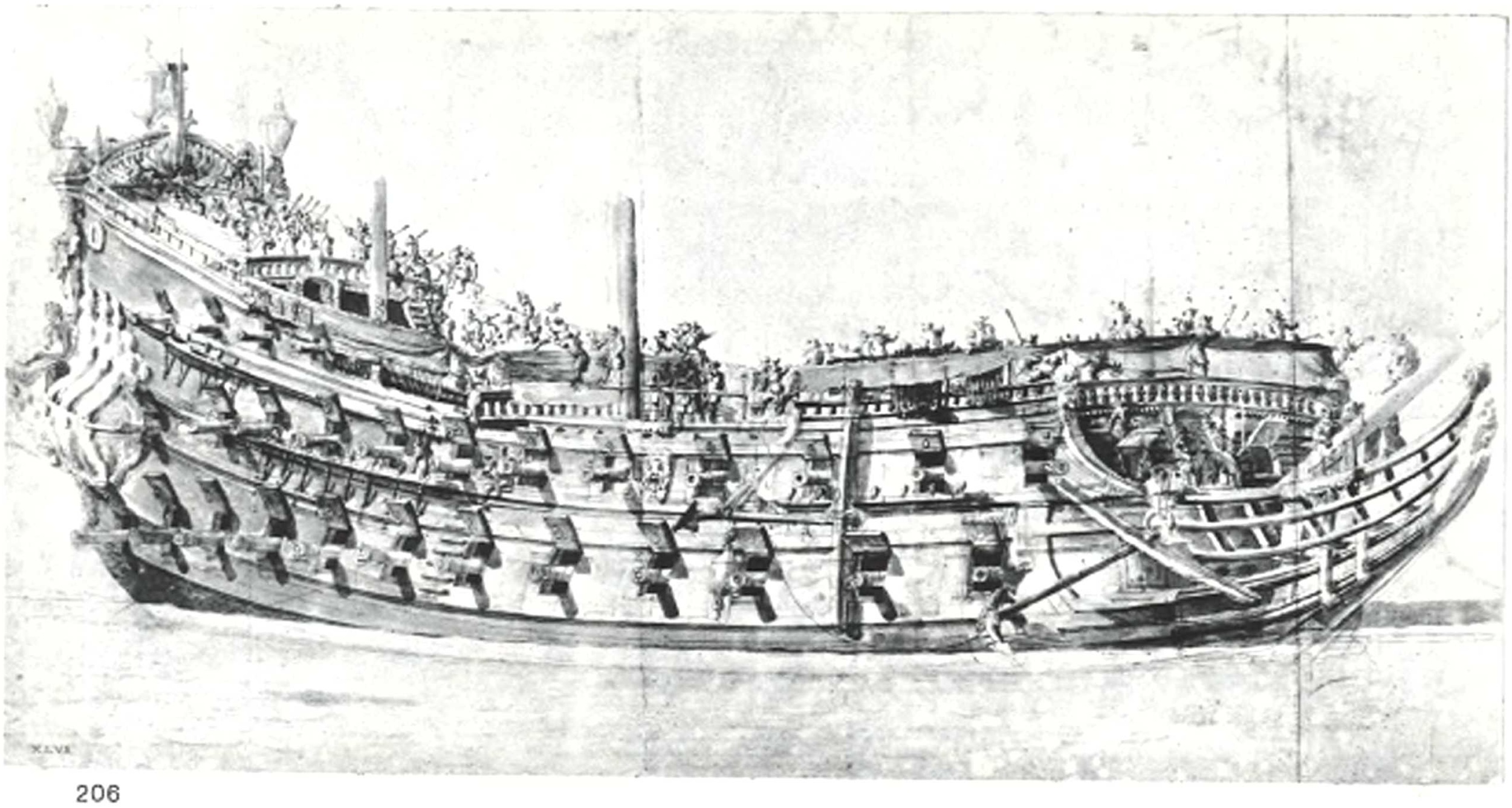
In the dockyard accounts, preserved in the archives of the National Maritime Museum, Stockholm, there are frequent entries for purchases of red material to be used for waistcloths, and there is a single mention of red cloth and linen. Gold thread was also imported, perhaps for fringes or an edging of the lower side of the waistcloth. We do know that painters were sometimes instructed to paint waistcloths and flags, and so my illustrations of the waistcloth shows it (204) with painted crowns and (205) how it was attached.



204



205

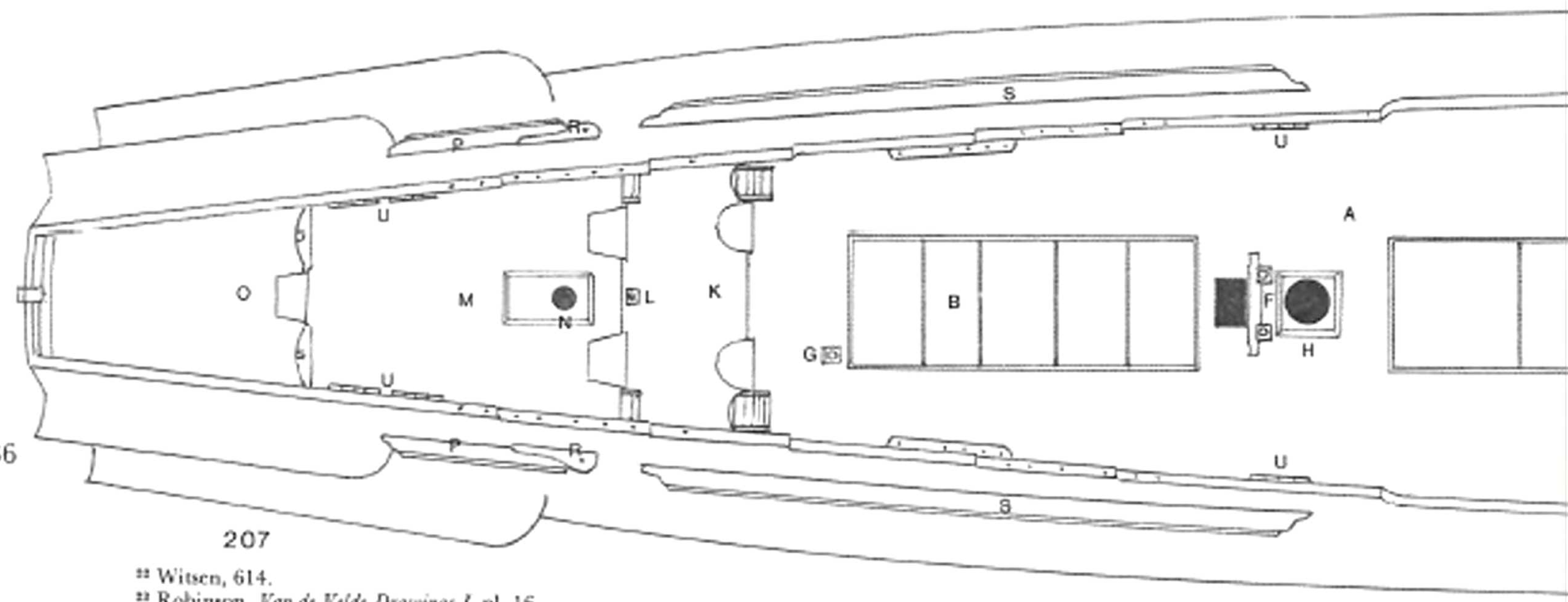


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Willem van de Velde the elder shows in some of his drawings lengths of what Witsen (page 614) calls servings under the waistcloth; they were made of bits of old rope woven or bound together, and were thick enough, it was said, to resist a musket-ball. They were hung round a ship when it was sailing into action.

On looking again at the illustration of the English ship *Antelope* (illustration 147)—the drawing is from about 1648—she seems to have something of the sort hanging under her waistcloth on the quarter-deck and coach-deck; otherwise it is most often Dutch ships that are shown with servings: *Brederode* and *Eendracht* (1658), *Zeelandia* (1659), and the Danish ship *Tre Løver* (1665), all appearing in M. S. Robinson's book on the van de Velde drawings (plate 16). For Witsen, servings were probably something rather old fashioned, for, in about 1670, he refers to what other people have to say about their strength.

Had *Vasa* actually sailed into action against an enemy fleet I would not have hesitated to depict her with servings, but the start of her first voyage was intended to be a piece of propaganda, and I cannot believe that she would have carried such inappropriate equipment in the middle of the harbour at Stockholm.



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[22] Witsen, 614.
[23] Robinson, *Van de Velde Drawings I*, pl. 16, 17.

The decks

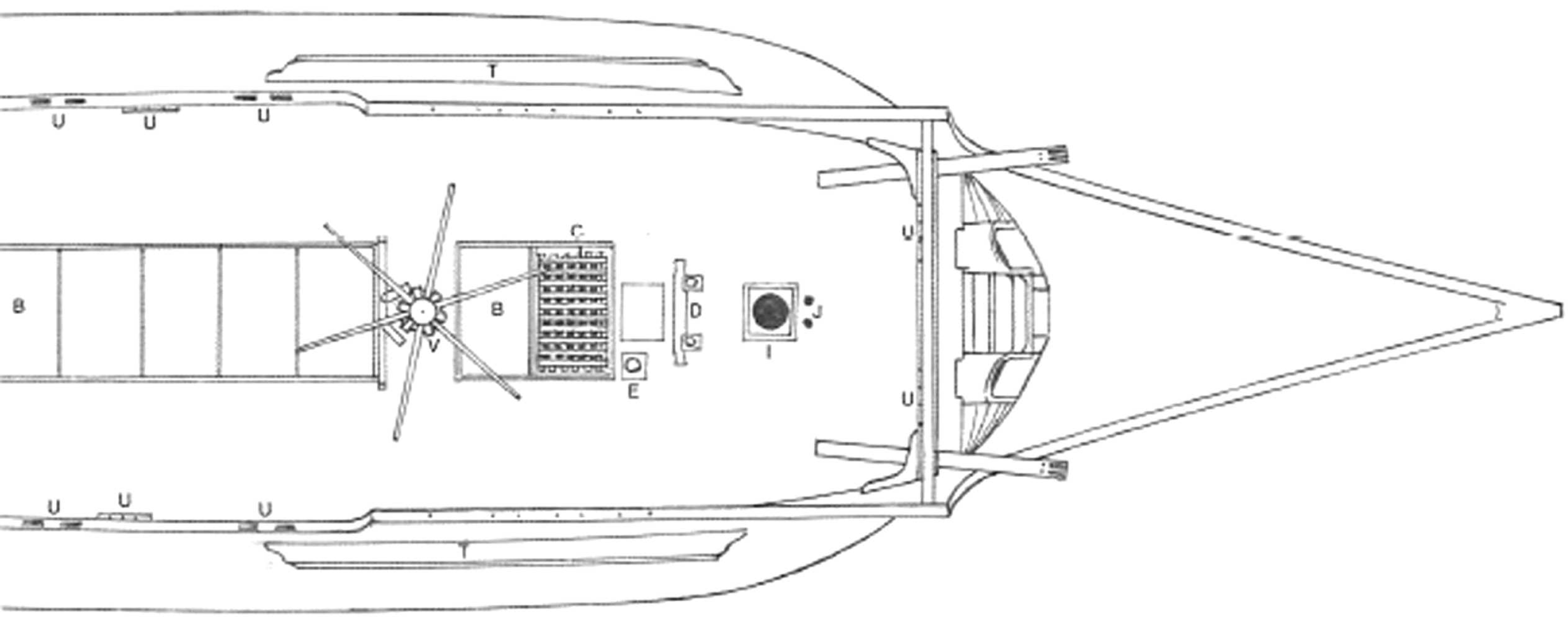
To show the ship's proportions I have made a schematic illustration (207) of the upper deck and the decks at the stern: *A* upper deck. *B* hatches over the gratings, channeled to allow water to run off them. *C* a grating with its hatch removed. One feature here does not appear on any seventeenth-century model or illustration that I know of, namely the hatches *B* over the gratings in the upperdeck: the hatches could be removed in fine weather but would otherwise afford the crew some shelter from rain and cold.

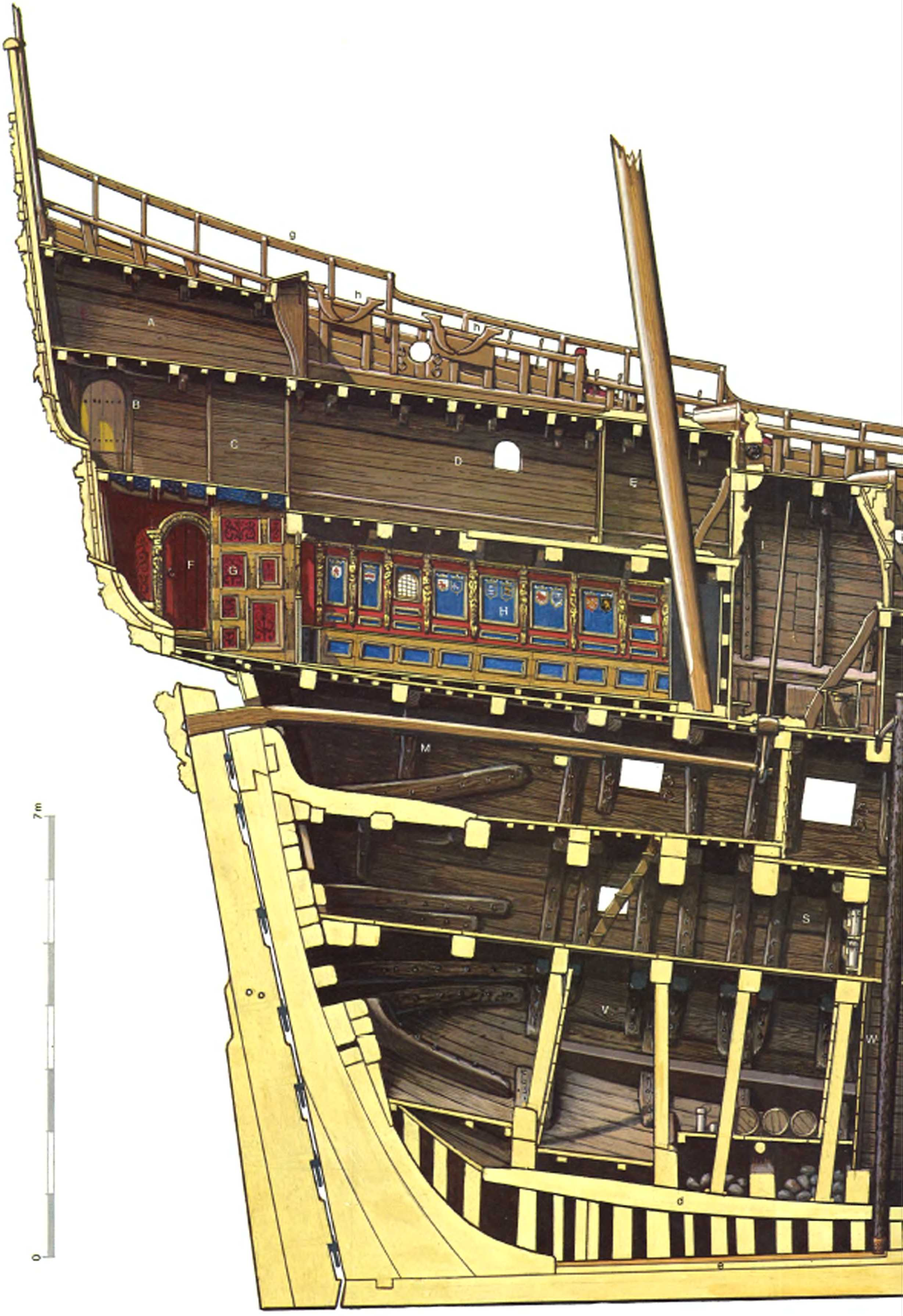
D is the twin knightheads joined by a transverse beam; the knightheads secured the fore topsail sheets, the beam probably the topsail lifts and the topgallant sheet. *E* foresail knighthead with three sheaves for the foresail halliard and one for the top-rope. *F* knightheads for the maintopsail sheets, with a transverse beam for topsail lifts and topgallant sheets; the dark rectangle aft of the knightheads is the opening in the deck leading down to the large knighthead for the main halliard and top-rope. *G* knighthead for the maintopsail halliard, a previously unknown detail. *H* hole for the mainmast. *I* hole for the foremast. *J* the two holes for the mainstay strop. *K* deck over the steerage. *L* knighthead for the mizzen halliard. *M* deck over the cabin. *N* hole for the mizzenmast. *O* deck over the poop-royal cabin. *P* mizzen-chains that had holes for the chain-plates and one in the middle for the tackle for the mizzen; other holes were for the mizzen-shrouds. *R* mainsheet block. *S* main chains that had holes for nine shrouds and three sets of tackle for the mainsail. *T* fore-chains with holes for eight shrouds and three sets of tackle for the foresail that were used primarily to set the rigging but also for general purposes such as hoisting the anchor to the chains. *U* transverse beam for securing sheets, halliards and cat-tackle. *V* capstan for hoisting the foresail and foretopsail, and for other work. Dots along the railings indicate belaying-pins to which were secured relatively lighter ropes.

In the illustration (208) on the following page of the cross-section of the after part of the ship there are a number of details that should be mentioned. In the poop-royal cabin *A* nothing is shown of the four fixed bunks—two-a-side—that are evidenced by tracers in the deck. The door *B* carried a small trace of its original gold paint, and a few decorative details of arches, possibly from a panel, survive from the companion-way *C*. A bunk combined with a chest that also doubled as a bench is the only reconstructed detail in the cabin *D*; it was made of pine. The bulkhead between this cabin and the one aft of it was furnished with a window.

E is the forward part of the cabin with a companion-way between it and the deck over the steerage. *F* is the aft part of the main cabin with a door to the lower quarter-gallery and a companion-way to the cabin above. In front of the companion-way is a panelled bulkhead with doors to two cupboards. *H* is the main cabin. I is the helmsman's place with its whipstaff, bunks, binnacle and companion-way to the upper deck.

J is the upper gun-deck. Alongside all the gun-ports are sets of ring-bolts. *K* is the knighthead for the main halliard, with sheaves of iron. *L* is a pump made of a bored-out elm trunk (see page 83). *M* is the after part of the lower gun-deck, with the tiller resting on a horse. The opening in the stern for the tiller would, on smaller ships, be closed with a conically formed canvas cover secured around the




A
B
C
D
E
F
G
H
I
M
S
h
h
o
o
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tiller at its narrow end; its function was to stop water entering the hull at this point, but I do not know if such a fitting would have been thought necessary on such a large ship as the *Vasa*.

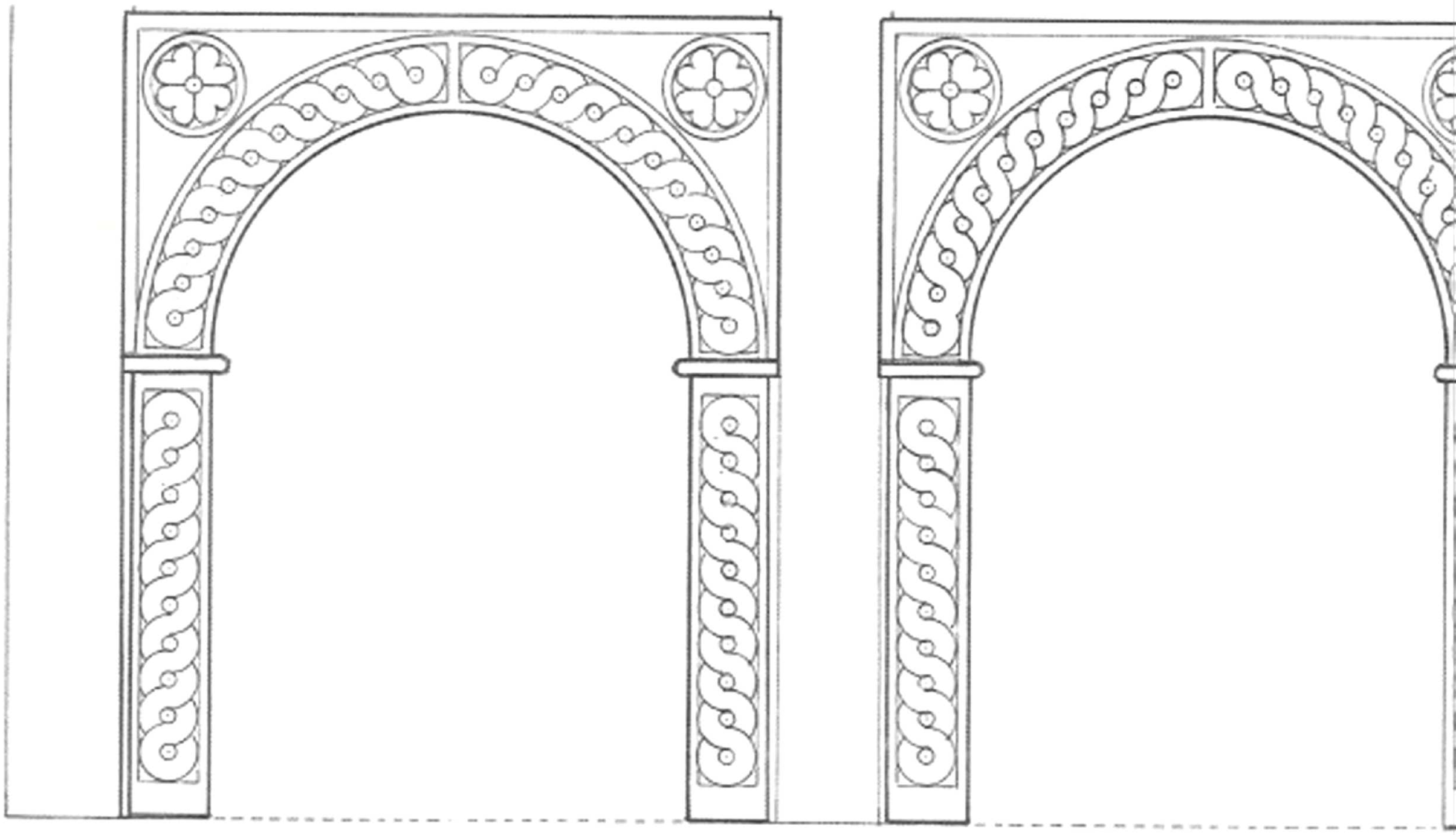
N is the lower gun-deck. *O* the large capstan for raising the anchor and the mainyard. *P* is the lower sheave of the large knighthead. *R* is a pump comprised of a lead pipe sheaved in wood, bifurcated at its upper end to discharge water through two pipes on the upper gun-deck between the mainmast and the knighthead; the pump handle has not survived.

S is the gun-room with conjectural shelves for powder kegs along the bulkhead to the orlop-deck. Behind that shelf is a door leading to the sail locker where so many of the *Vasa*'s sails were found. The aft part of the orlop-deck was the place where the wounded in action would be carried to the waiting barber-surgeon.

Z is a lead pump, like the other protected with wooden battens, to port; another exists to starboard at this point.

The space below the orlop-deck was the hold, and some part of it was evidently not used: the space between the powder magazine *V* and the stern could be reached through a hatch in the deck above, but it was nailed fast. The magazine itself was lit by a lantern that shone through a window in its forward bulkhead, and a companion-way led from it up to the gun-room. Six barrels of powder, each weighing 134.4 kilos, were on board when the ship sailed.





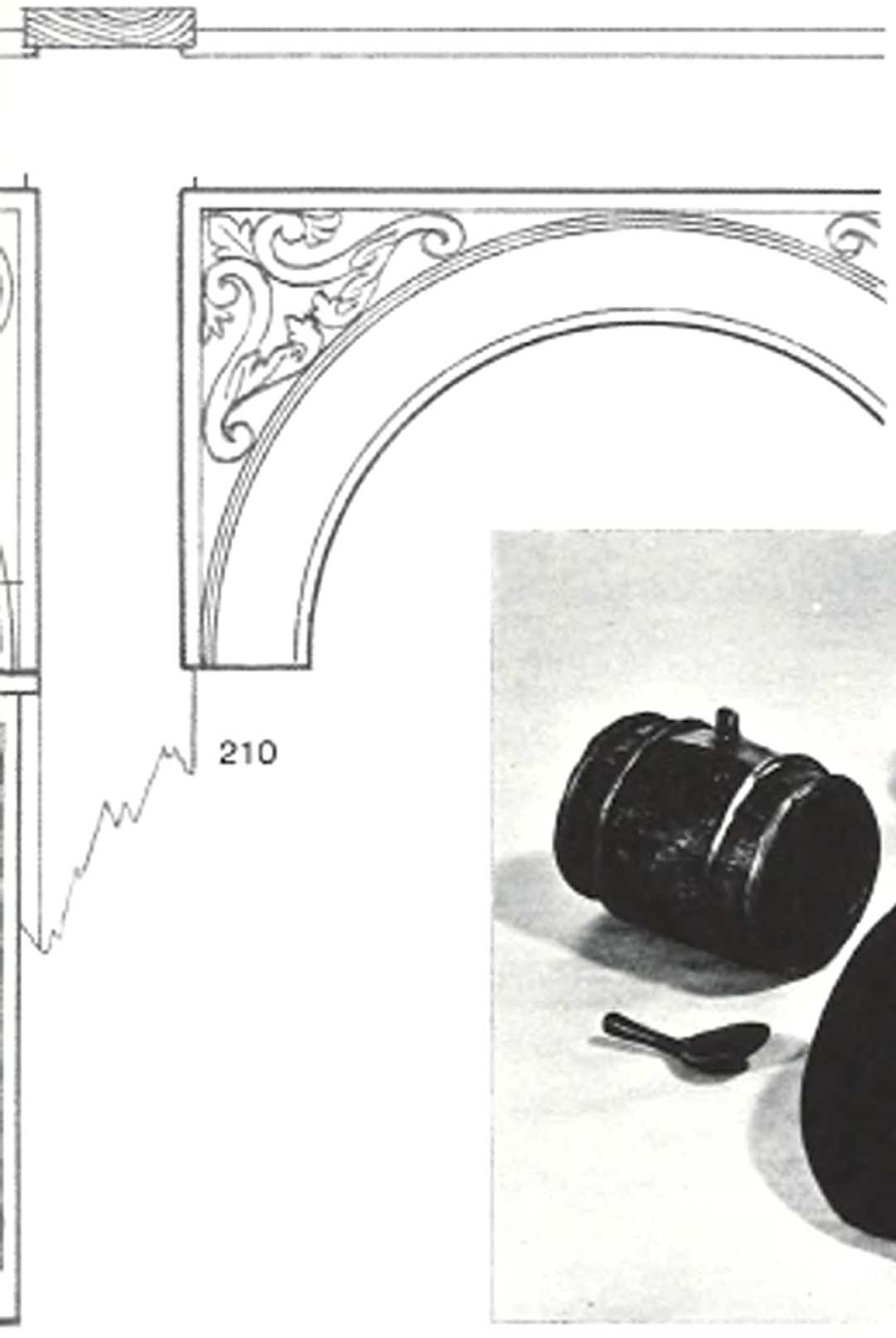
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Ship's boys would work in the magazine sewing cartridges on a form and then filling them with powder before finally sewing up their covers. The completed cartridges were kept in powder kegs stored in the gun-room and, in action, the ship's boys—powder-monkeys, as they were called—would carry the kegs at a run between the gun-room and the guns, where the cartridges would only then be extracted for use.

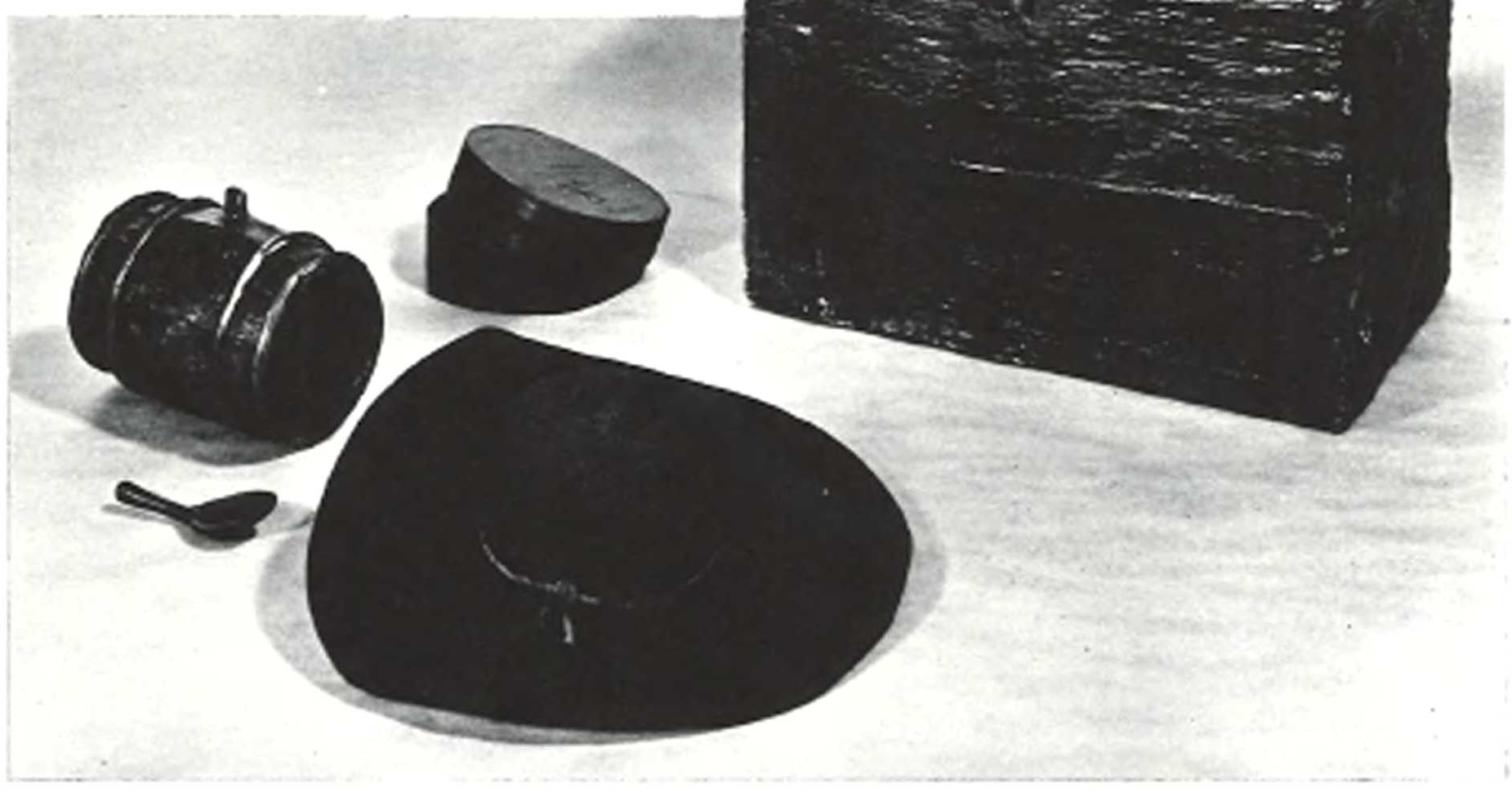
W is a protective covering of battens around the after pump. *X* is the purser's store. The provisions on board would have been salt fish, salt meat and large quantities of sour bread. It seems as if Swedish ships often had hardly any fresh water on board. Crews had earlier fallen ill from drinking the brackish Baltic water, and the king had commanded that beer should be taken on board instead, but nothing suggests that any large quantity would have been carried on *Vasa*'s first voyage. *Y* is the gallery, brick-built and resting on a bed of sand and probably clad with sheet-iron, as may be deduced from the shipyard archives from the time preceding the *Vasa*'s construction. What has survived from the galley, however, is the—or at least a single—large iron cooking pot.

A large part of the hold that was otherwise filled with the stone ballast *a* was taken up by the long and massive floor-riders *b*, which are closer to one another on the *Vasa* than on any other known ship. Herman Fleming's observations on the country's fleet, which he wrote in 1649, mention (page 5) that "in the hold shall be laid a good floor-rider under every other beam 15″ in breadth and of a depth as each timber shall require." On the *Vasa* there is a rider under every beam.

The mainmast stands between two floor riders *b* and the mainmast step *c*. The scarfs in the keelson are conjectural as nothing is visible under the floor riders. The remaining letters stand for *e* upper false keel which is bolted to *f* the keel; a false keel was required when insufficiently heavy keel timbers were available; *g* railings for the waist-cloth attached to



211



their supports; holes for lacings were bored obliquely inboard from the tops of the railings (cf., page 135); *h* kevels; *i* hole in the hull through which the mainsheet was led from the block fastened at the mizzen chains to be made fast at the beam visible aft of the mainmast; *j* three sets of lead-blocks used when the mast-tackle was hauled taut; *k* block with three sheaves: one for the foresail sheet, one for the spritsail, but the third?

Illustrations 209 and 210 show respectively two arches from the after part of the junior officers' cabin and a part of an arch that might belong to the after part of the same cabin.

In addition to pieces of several chests, a complete chest was found on board (illustration 211); it must certainly have belonged to one of the senior officers. The chests were probably used as seats and the framed lid of the one illustrated would have been more comfortable had it had a cushion. Among other things it contained a housewife [pronounced *hussife*] holding sewing things and a comb; the keg would almost certainly have contained spirits, and the wooden spoon is evidence of some degree of table-manners on board. The hat was probably an import from Holland.

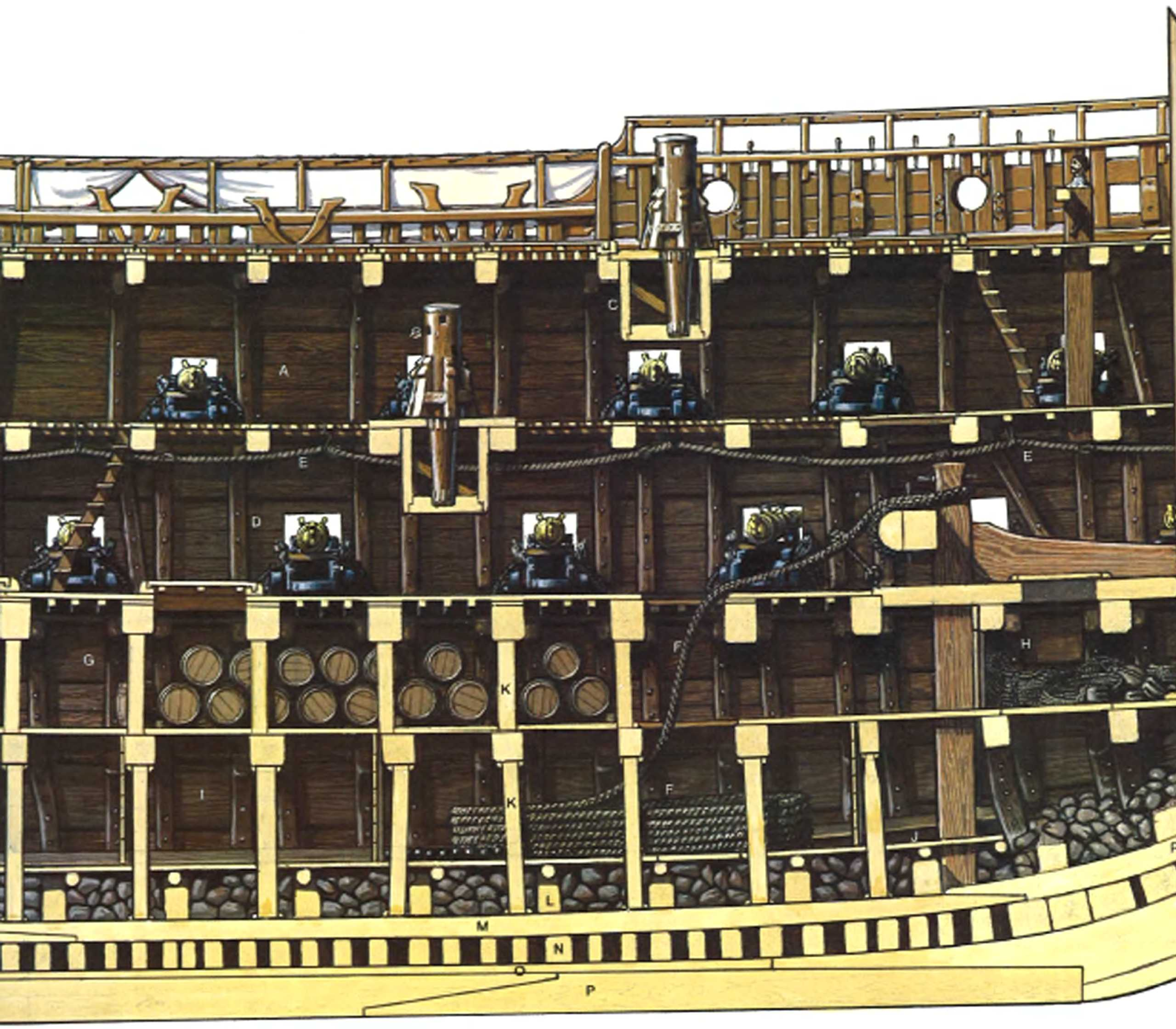
The officers would have lived and messed on board in what we would now call spartan conditions, while the lower-deck were even worse off, living on the edge of starvation and sleeping either between the guns or in the orlop, and in any case on the bare deck. If they were also afflicted by smoke from the galley, this would have been hardly worse than conditions in their homes on shore.

According to their contract with the king, the dockyard lessees were to provision the fleet "with required victuals and all necessities to keep as many good shipwrights as may be needed according to the size of every ship." Shipwrights' tools and a good supply of victuals were found in the gun-room; pieces of a carpenter's bench were found on the upper gun-deck and have been reassembled by Johan Blomman.

Here we have the fore part of the *Vasa*, with twenty-four-pounders in place on both gun-decks; she also carried eight three-pounders and two one-pounders on her upper deck, together with six storm pieces of three different calibres: "Three scrap pieces to shoot 35 pounds in iron, 10½ calibre long, are Polish, cast in 1564, are of good metal with conical chambers, one radziwills scrap piece, shoots 16 pounds in iron, 14 calibre long, is of good metal with a conical chamber . . . 2 scrap pieces, Swedish, shoot 62 pounds in iron, 6¾ calibre long, cast in pure copper." (See "Tidskrift i Sjöväsendet", 1964, page 765.)

It is evident that the chambers—or first reinforce as seen externally—were conical and that the cartridges used would have been so formed. Storm pieces were light guns that could be drawn into position as required by foot-soldiers on board in preparation for boarding an enemy ship: they were definitely used for combat at close quarters, even against boarders from an enemy vessel, but as no such piece can be identified in a contemporary illustration I have not tried to depict one here; one may assume, even so, that they were lightly cast and short.

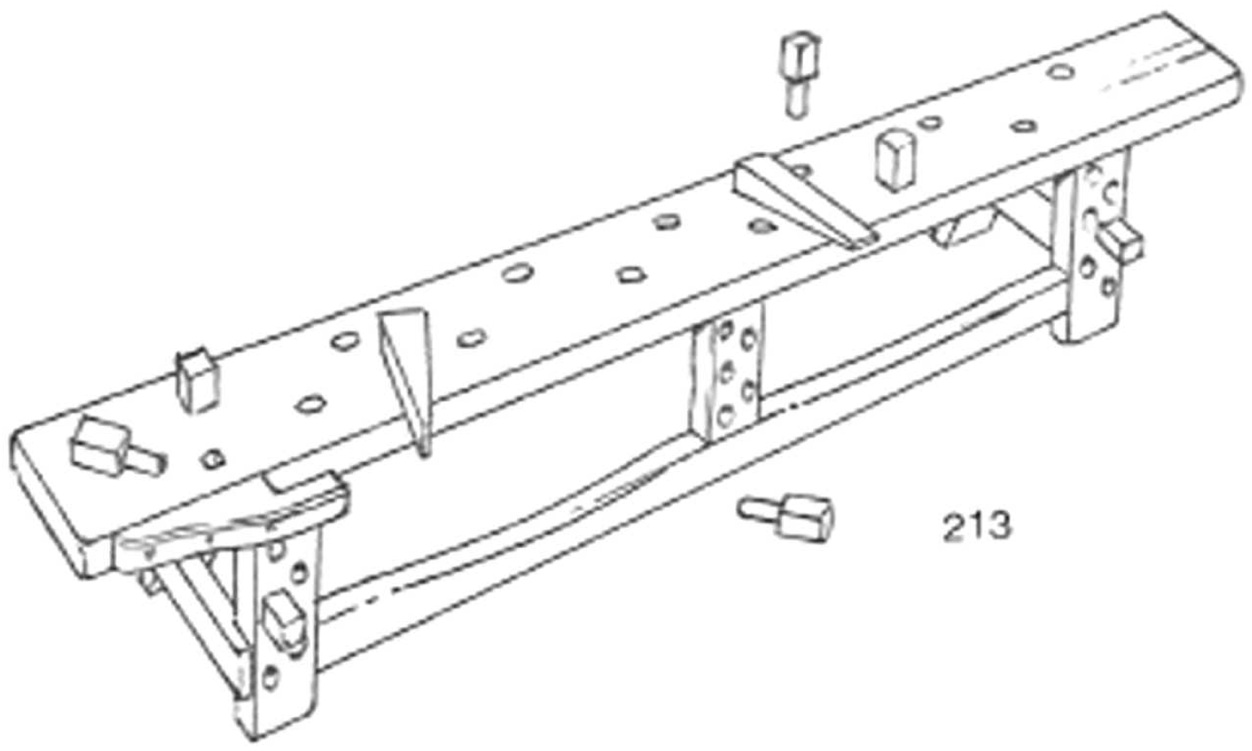
A is the upper gun-deck that terminated forward with a breast-hook and a clinker-built bulkhead. *B* is a capstan and *C* a support for the capstan, shown in part, with two diagonally-crossing supports not shown. *D* is the lower gun-deck where no cannon is

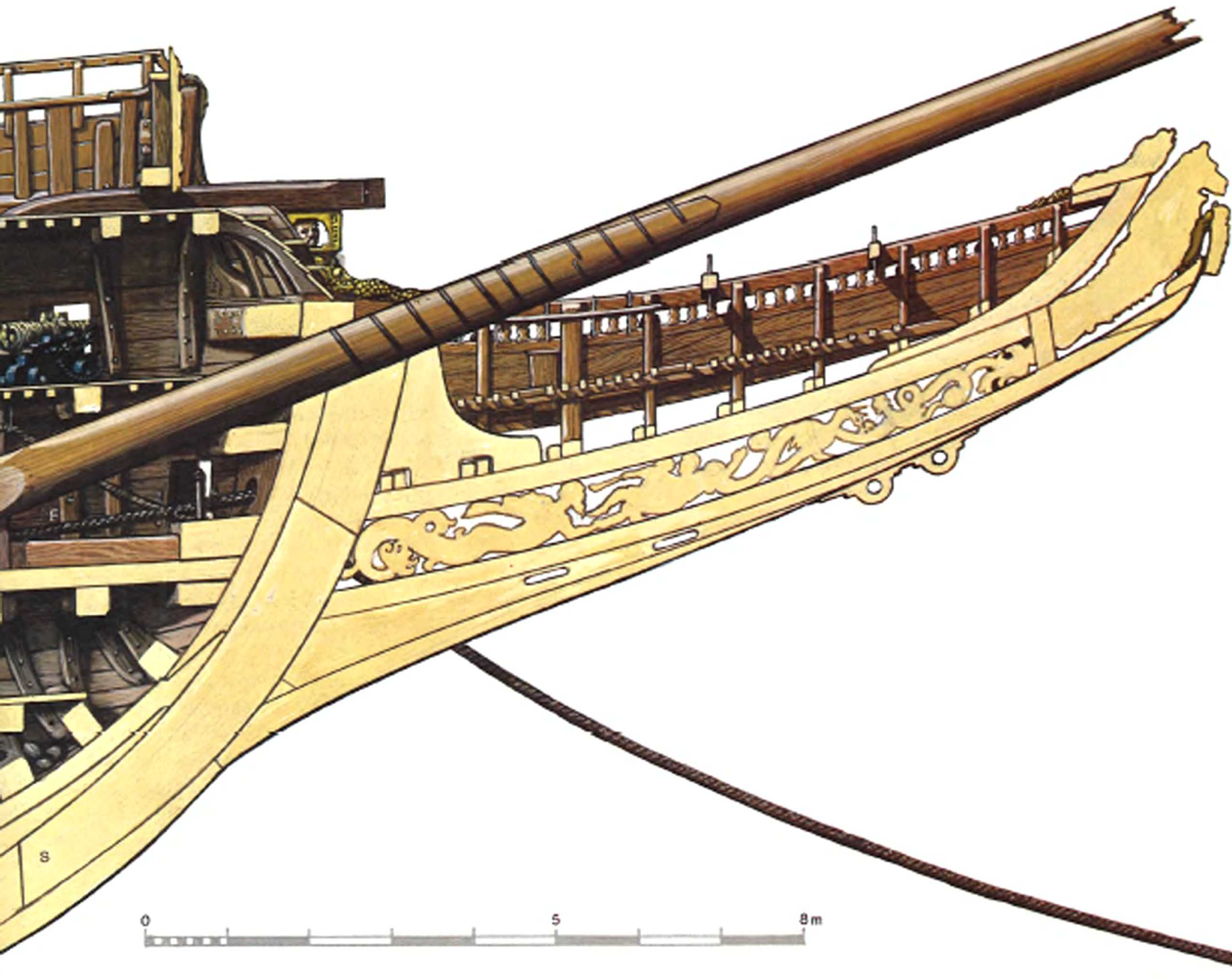


shown at the foremost and third gun-ports. *E* is the cable messenger hung up in strops when not in use. *F* is the anchor cable coiled down in the hold. *G* is the orlop-deck with space for provisions. *H* is the storeroom, for spare rope, blocks, deadeyes, parrels and so on. *I* is the hold and *J* another storeroom.

The ballast was stowed along the entire length of the ship and a good deal was carried far forward, just aft of the foremast; altogether the ballast weighed only 120 tons; *Vasa*'s guns, by comparison, weighed about 63.7 tons.

K are deck stanchions, *L* floor-riders and *M* the keelson. *N* is the floor-timbers, *O* the false keel, *P* the keel, *R* the apron and *S* the stem.





The catastrophe

We have already mentioned that the commander of the ordnance (today's Inspector of Artillery), Erik Jönsson Kremer, had been appointed admiral of the fleet which was to sail to Älvsnabben to take on troops, powder and shot, food and perhaps other supplies.

This Kremer was from Westphalia and is said to have been of aristocratic descent. He entered Swedish service in 1610 as a major, became ordnance officer in 1613 and commander of the ordnance in 1621. According to the Swedish writer Gustaf Elgenstierna (Vol. II, page 54), it is not known what became of him after 1628.

The *Vasa*'s captain was the former captain of the dockyard, Söfring Hansson Jute, who was promoted to major's rank in 1634. At the time, according to Axel Zettersten (pages 67 ff), the captain of a ship was responsible for the ship's welfare, while earlier he had been responsible only for the fighting men on board.

The master on the *Vasa* was Jöran Matsson, a fearless man who is the source of much decisive information about the warship. The chief boatswain was Peer Bertilsson and the gunner Joen Larsson. The complete strength of the crew when the ship sailed seems to have been about 130 men; one can assume that about 300 soldiers were to embark at Älvsnabben.

The main strength of the Swedish fleet lay, as was usual in summer, blockading Danzig and other harbours. From the start it had been intended that five of the fleet's largest vessels should later sail to the theatre of war; as early as May, however, the warship *Riksnyckeln* was ordered to join the fleet on patrol, and *Riksäpplet* was still undergoing repairs in the dockyard when the fleet sailed. The fleet thus came to comprise only *Vasa, Kronan, Gamla Svärdet,* and probably some smaller vessels.

During the morning of 10th August 1628 *Vasa* had begun to be hauled (or warped or towed?) from her berth below the palace to Tranbodarna, where Stadsgården now lies. The wives and children of many of the members of the crew were on board and were to disembark at Vaxholm.

The first preserved record of what happened next is to be found in Abraham Brahe's *Tidebok*. Both Abraham Brahe (1569–1630) and his son Per (1602–1680) kept diaries that are important sources of information about seventeenth-century Sweden. On this occasion Abraham wrote: "10 afternoon between 4 and 5 of the clock the great new ship turned over and sank with 80 cannons in the channel hard by Dannewicken so that nothing was more up above the water than the uppermost top of the mainmast."

It is not known how many were saved when the catastrophe occurred. Some must have been drowned when they were thrown into the water. Eighteen skeletons were found on board the ship, and contemporary reports say that "many boats came out there almost at once but nothing could be done to help." (See "Tidskrift i Sjöväsendet", 1957, pages 404 and 413.)

Erik Jönsson Kremer, it was reported, "got a lot of water in him and was badly knocked about by the hatches," and for the next few days he was on the point of death. A letter from Gabriel Oxenstierna to his brother, the Chancellor of the Realm, says that the old captain Hans Jonsson had drowned and that in addition "some 30 persons including bos'uns, wives and children who were to remain on board until Vaxholm" had lost their lives. The Danish ambassador, Erik Krabbe, wrote in a report that over a "half hundred" people, including women and children, were reckoned to have drowned.

Captain Söfring Hansson had been under water for a long time, but he was rescued and then confined under arrest in the palace, where he was first interrogated and then released on bail a couple of days later.

Erik Krabbe gives surprisingly exact details of how the ship was lying: the depth was 16 fathoms at her rudder, 14 fathoms at her mainmast, 18 fathoms at her beakhead, and gives the depth of water over the ship as 7 fathoms. The upper top on the mainmast was 8 ells over the water.

There are two sets of minutes from the examination by the Council of State of Söfring Hansson on 11th August. The first reads: "The year 1628 the 11 August were in the Council Chamber... [incomplete in original] ... Captain Söfringh having been brought in he was asked in what way the accident happened. He replied: 'When he was under Söderlandet the ropes were let go and the topsails were thus loosed—And she would at first not go about nor had she done so before, but instead heeled... All guns were made fast, and were any gun not made fast, they might cut him up into a thousand pieces. And when they had come under Tegelviken there came a gust of wind; all the crew were up [on deck?]. That he never in all his days had had some time... [incomplete in original] The ballast [was] so much that the scuppers were a span from the water. What was the right cause? Her great crankness.'"

The second set of minutes is somewhat fuller. "Söfringh: the warp [kedge?] on Söderlandet hung

out a cable's length, she was down by the head [or heeling] [She] did not want to go about or answer the helm at first, then she went ahead somewhat and when a little puff of wind came she heeled and came upright again several times; and when they came a little better out at Tegellvijken, he sent each man to his station and [he said to the court of enquiry] he immediately gave the order to loose the topsail sheet and it was loose before any water came in through the gun-ports. And as she stood, she went over very soon afterwards.—He swore that the entire crew were sober.—The fault none other than crankness and the ship down in her bottom had no more than 3 planks in her floor.—There was as much ballast as could be and 100 lasts more than Admiral Flemingh wanted to have; and the ship was so crank that she could not carry her masts. They were sailing with slack sheets.—The shipwright has said that she could also well run out with ballast.—The topsail, he says, was for that matter hoisted, because he was afraid of Kalkholmen."

On one point this evidence is false: as captain of the dockyard Sōfring Hansson would have been well able to follow the building of the *Vasa*, and he would have known—as we know—that the ship's flat comprised nine planks a side. He says, however, that "down in her bottom" there were only three planks, and would presumably mean that either side of the flat comprised only three planks.

The other information he gave I wish to combine with the information from a court of enquiry held in the palace on 5th September. The chairman of the court was Admiral of the Realm Karl Karlsson Gyllenhielm, and the other members were probably all the members of the Council of State who were then in Stockholm. A fragmentary copy of the minutes has survived; it is in the National Archives (*Flottans handlingar* A:1, vol. G 1).

"...to this Erich Jōnsson [Kremer] replied that he knew that no gun was loose but that all were made fast, for when the ship began to heel he ran straightway down to the guns, then water was coming in throught the gun-ports, then he called out down there that they should let fly the sheets but they were already loosed. And before he could come up the water was already so high in the ship that the stairway came loose so that he could scarcely get up, and meant to try to recover [by supporting himself?] on the railing when he had got up. And says that he had not known about the ship's situation. Also [he] believed firmly that had she not been under sail, it would have happened anyway, because of the heaviness, with the upper works, since she was heavier over than under.

"[He] said that he had not had anything to eat that day, but had drunk twice, and then he was alone in the cabin with his cabin boy where he took a little bit of meat and bread, and that was all he had consumed that day.

"[He] also said that when they lay at Tranbodarna before they cast off and sailed, she heeled a little, he ran down to the guns to see if there was any fault [but] there was not, but then the ship righted herself again.

"Then Carl Carlsson [Gyllenhielm] said that he [Kremer] was after all vice admiral and should have zealously informed himself whether the ship was correctly ballasted as it should be.

"Erich Jönsson he replied that he was neither captain nor vice admiral, nor did he behave as such but as a commander of ordnance, so the captain and the master understood about the ballast better than he did.

"Then the prosecutor put it to him that the shipwright was reported to have said that if he [the shipwright] had got to know that the ship was crank and if he had been so instructed, he would certainly have made sure that they would have had the ship more deeply loaded by a foot. Then Erich Jönsson replied [that] how would he have been able to ballast any more when the gun-ports were not more than 3½ foot from the water, whereupon he was instructed to leave."

Observe that Erik Jönsson makes here what is perhaps an unconsciously false statement. The height of the gun-ports above the water was in reality 4'8" (Swedish measure) or 4'10" (Amsterdam measure). The next witness was more exact.

"Then Petter Gierdsson, the lieutenant on the *Vasa*, was called in. He had rigged the ship and was on board when they were to set sail, and [he] was accused by the prosecutor of not having made known that the ship was so crank to which he replied he knew nothing of that but he had been concerned only with the rigging and had not seen either what ballast there had been in the ship.

"But the guns, he said, were all made well fast, and the ship lies as he says, 14 feet deep forward and 16 feet deep aft and 15 feet in the hold." This evidence seems to be wholly reliable. *Vasa* has draft marks cut into her stem and stern posts that show her draft in feet. The witness had had a good chance of reading off her draft.

"The gun-ports, he says, were about 4 or 4½ feet from the water. He was asked if he had not seen that she was crank before they set sail, he answered that when she lay at Tranbodarna and some people went together to one side she heeled over to that side.

Next spread: Vasa immediately after her departure from Tranbodarna. She is firing a salute of two guns. The flags she is flying are taken from Gustav Adolf's Order of Sailing from 1621. The smaller vessel is a yacht of Dutch type, and behind her can be seen the island now called Kastelholmen.





"And when they proceeded under sail they had nothing more set than both topsails, the foresail and the mizzen, and when the ship began to heel a little they loosed all the sheets but the wind was not strong enough to cause the sheets to run out although they were thoroughly greased so they were forced to ease the sheets out, and one man alone held the sheet and [Gierdsson] had never believed that a ship would have turned over in such light weather. He was asked what he thought was the reason that she so easily turned over, if she had been poorly built or [if there was too] little ballast in her. He replied that he did not know for he did not understand shipbuilding, nor had he seen what ballast there was. He was ordered to step down.

"Then the master Jöran Matsson was called in and was also accused by the prosecutor that he had not faithfully discharged the duties of his office nor had given such attention to the ballast and other things as his duties had required and directed with the result that HM's ship had suffered an accident.

"To which the master replied that he had put in as much ballast as could be placed, also he did not believe that the dockyard workers would do it as well as he wanted, so he went down with a light and arranged it as evenly, and put in as much, as he could, so that he could only think that he must have done his best.

"[He was] asked if he had been able to notice that the ship was crank [and he] replied that when they proceeded under sail she heeled a little and then came upright again at once, and when they had come abreast of Tegelwiken and she began to heel, some were ordered to run in the guns but before they could run in a gun the ship went over.

"[He] also said that Sōfringh had told Admiral Flemingh that the ship was crank and said in that connection that when she lay at the crane here by the palace, with her ballast [on board?], they had in the presence of Admiral Fleming caused 30 men to run the ship over, the first time she put one plank under, the second time two planks and the third time three planks, then Admiral Fleming told them to stop [for if] they had run more times she would have turned over, and when this occurred, he [Fleming] said: 'Would that HM the king were still here.'

"I was asked of him if [the ship] was then fully ballasted, he replied except for a sloop load the ballast was on board, and he said that if by the grace of God they were to get the ship up again, and were to load her over the gun-ports, she would even so go over. It was asked of him what the reason would be [and] he replied that the ship is narrow in her floor nor has any belly above. Says that he had also told Admiral Fleming of this fault and when he was putting the ballast on board Fleming had said 'you are putting in too much ballast [so] that the gun-ports will come too close to the water,' then he had replied 'God grant that she will anyway float upright on her keel,' then the Admiral answered him that the shipwright had certainly built ships before [and that] he should not trouble himself about it.

"Said also that all guns were made well fast except for one gun of twenty pounds which was lying unsecured because it had no carriage [but] which could not have had much effect.

"Said also that when the ship could not carry the sails [that were set] in such still weather as it had been, how would she have behaved when the top-gallant sail with all the others were up in heavy weather. He was also ordered to leave."

This testimony by the master, Jöran Matsson, is the most important of them all, and thanks to this man who was uncowed in the presence of those set in authority over him we have such lively details of what all the others kept quiet about. It seems as if someone had forgotten to give him his instructions before he was examined.

"After this the chief boatswain, Peer Bertilsson, was called in and was charged by the prosecutor that he had not zealously discharged his duties of looking after the sails, ropes and materials as he ought but had perhaps been drunk, he and others, by which cause the ship had gone down. He replied that he was not drunk, but had that day taken the holy communion.

"The ballast, he said, they had on board as much as could be carried, and [he] could not either perceive that the ship might have been crank when she lay in Strömmen, but meant that all things would be well. But when the ship was under sail she soon began to heel, and then they cast loose all the sheets but the ship could not come upright again. And he was likewise ordered to leave.

"Then the shipwright, Hein Jacobsson, was called in and was interrogated and asked why he had built the ship so narrow and badly so that it had no belly so that it could lie upright and thus had gone over.

"To this he answered that he had built it according to the specification he had been given by Master Hindrick and on HM's command. [And he] said he had even so built her one foot and 5 inches broader than was given [in the specification], and all people say that she was well built.

"And then Arendt Degrot was asked why the ship in her construction was so poorly equipped [and] he answered that he had done it according to the specification that he states he has contracted with HM according to what he had shown HM [*efter det wis som han hadhe wist HKM*] of a Frenchman that he saw built in Holland for the Duke de Guise, [he] asserts the fault not to be in the building but as the shipwright means she shall be equipped with ballast.

"He was answered by the prosecutor that the shipwright had earlier said to Söfringh that this ship was certainly as stiff as Saint Peter's ship and must thus sail without ballast [but] the shipwright denied that he had said this. And [the shipwright? Degrot?] said that if she had been more ballasted the ship would not have been in any danger.

"To this Söfringh replied that if more ballast had been put into the ship the scuppers would have come under water and the [gun] ports [would have been] caulked, which could not be done if one otherwise would have wanted to use the guns.

"And Söfringh said this: [it] is feared lest it go [as badly] with the ship he is now building, because she is also being built in the same way, [and] the shipwright answered that he must build [her] according to the specification he has received, [and] the prosecutor answered that he should first question other competent men about the matter.

"Arendt Degrot said that if they were to have all the shipwrights look at it they would say that it is built so that it is impeccable. Then [he] was answered by the prosecutor that if it had been impeccably built what has the reason been that it went over.

"They replied that they did not know, God must know it, [and] Arendt Degrot said that he has told HM how long and broad it was, and HM deigned to be pleased and wished it to be so. They were answered by the prosecutor [that] although HM had wished to have it thus, they who understood the matter better should have told HM what it could have entailed.

"The shipwright was asked if he thought that he had a good conscience after building such a ship [and] he replied that it is as well built as any ship can be whereupon he was answered by the prosecutor that the ship is quite well built but not rightly proportioned as she should be.

"The prosecutor said to Arendt Degrot that as HM has contracted with him he should have sought the advice of the shipwright how [the ship] should have been equipped, so that the ship might well have been built so that HM had been able to use and get the benefit of it.

"Arendt Degrot answered that just as he has contracted with HM he means that he has fully done what he had contracted most properly according to his utmost conscience [and then] they were ordered to stand down.

"And then M: Johan Isbrandsson was called in and the prosecutor put it to him that as he is HM's servant why had he not also paid more attention to seeing that the ship must have been built in such a way that it could stand up to some sea or weather, but instead the upper works are heavier than the under [and] why he has not made this known in good time. He answered that insofar as he can understand the art [of shipbuilding] he cannot see any fault but that she is rightly built, that she should be well able to go to sea with her complete complement of sails.

"[He] said also that she should be as broad as *Cronan* and according to the knowledge of his art and the specification so much he has learned, she seems to be stiffer than *Cronan* and according to his art aforementioned does not know, but she is a good ship. It was asked of him what the reason was that the ship has gone over, and he said he did not know and thought it was impossible that such a ship should turn over.

"[He] was also asked how far the gun-ports are from the water on *Cronan*, [and] he said about 4 foot, [and] then Captain Frans was sent there to find out."

Here it is evident that the sailors were trying to make out that it was the shipwright's fault, while he, assisted by Arent de Groote and his colleague Johan Isbrandsson, explained that the ship was proven to be well built and that she could have carried more ballast. It is remarkable that the prosecutor, Admiral of the Realm Gyllenhielm, did not ask why Hein Jacobszoon had made the ship one foot five inches broader than was given in the specification. In my opinion this can be indirect evidence that the Admiral, and perhaps the whole Council of State, knew that the king had made a new decision about the ship's armament—a new gun-deck—while work was under way. This decision had certainly led to protests from the leading men at the dockyard, which had probably been passed on to the king by Admiral Fleming.

To try to sort out the truth about events that took place 350 years ago, and which were at the time fairly thoroughly covered up by the authorities, is undeniably a difficult business. Many may perhaps regard my attempt to marshall the evidence as insufficiently well founded. During my three years at the Vasa Museum I have become aware that the truth always wants to evade one's grasp.

The court of enquiry at the palace in Stockholm also heard evidence from some expert witnesses who were called, and their testimony is included in the minutes already cited:

"1. Hugo says, the fault is that the ship does not have a sufficient breadth so that the keel can carry the weight above the water therefore [she] ought to have had more weight under [water].

Next spread: Vasa *beginning her ultimate heel: her main topsail has been loosed and the other sheets eased off in the gust off Tegelviken, where the cliffs drop abruptly down towards the east.*





"2. The other his fellow relates that the ship is heavier above with masts and yards, sails and guns, than under, also the ship has not yet taken up water. [He] related that he has seen ships in Venice that carried 100 guns and drew 24 foot under water, therefore it seems to be too heavy over the water [so] that the ballast could not keep it upright.

"3. Captain Clerk says that concerning masts, sails, yards and other things, it was not extraordinarily high or broad, but the ship did not have a big enough hold, and the hold ought to have been 2 feet deeper [so] that more ballast could have been put into it, and then the ship would have stayed upright.

"4. Lasse Bubz' opinion was also that as the ship was so [heavily] ballasted, that if any more had been put in, it [the waterline] would have gone over the scuppers, therefore the hold was too small, and for that matter the fault was in the building, the upper parts were heavier than the lower, the ship was too narrowly drawn together. [Lasse Bubb was later an admiral, and was ennobled, taking the name Roderskiöld.]

"5. Master Wellam [the landowner Willem de Besche, of Finspång] said that if he were to give his opinion, a shipwright ought to be able to calculate and know how high it ought to be above the water, so the fault seems to him to be the slight hold, for the ballast lies too high on the floor riders and the large beams lying there take away space for the ballast and the tumble-home is altogether too heavy, and [he] meant that [another] ship would have been built with the same material, for [the *Vasa*] is heavier above than below. He said it was like a man who puts a pound of lead in one of a pair of scales and a pound of feathers in the other and then drew down the scale with the lead in it and let the other go up, and then allowed the feathers to go back again, and said that it is also like that with the present business, that the ballast in the bottom of the ship was too light.

"6. Hans Förrådz [a Scots captain, ennobled 1650, called Hans Forath] was of the opinion also that the hold was too small [so that] it could not take as much ballast as was needed, the ship was too sharply built underwater [with the result that] it could not carry its upper works.

"7. Erich Larsson [treasurer] was also of this opinion that the hold was too small and that the lowest deck should have been laid higher, for if it had been the ship could have been loaded 2 feet deeper, because the tumblehome was too high and too heavy, with the result that the ballast could not balance it.

"8. This opinion was shared also by the mayor, Hans Nielson."

What these expert witnesses had to say was sometimes too difficult for the secretary who wrote the minutes, but we can make out a general area of agreement. The ship's hold was too small, so not enough ballast could be taken on board. Two of the experts say that she was too narrow, too sharp in her underwater body, and one considers that her tumblehome—the inward-sloping upper extension of the hull—was too lofty and too heavy.

Willem de Besche had evidently seen the ship under construction, for he could testify on the large beams—the floor riders—that occupied space that could have been filled with ballast. Lars Bubb relied too greatly on Erik Jönsson Kremer's statement that the gun-ports lay no more than 3½ feet above the water; together with the master, Jöran Matsson, he considered the ship to be too narrow in her bottom.

When the master claims that he evened out the ballast and put in as much as he could, there is no reason to doubt his testimony, but it is a fact that only 75 percent of the available space under the storage deck was made use of. He had worked from openings in the centre of the deck and so had not been able to get at the narrow spaces between the deck and the ceiling (inside planking).

His account of Admiral Fleming's test of the ship's crankness is revealing. It should be understood that Captain Sōfring Hansson took the initiative in making this test, and it is probable that, in his capacity of the Crown Inspector of the dockyard, he had been informed of the shipwright's misgivings about the impossibly delayed order for an additional gun-deck.

Fleming had been sent to Stockholm by the king to hurry up work on the *Vasa*, and despite his own misgivings he felt himself obliged to approve the ship and then return to the fleet. But the master had heard him say: "If only His Majesty were still here!" It is surprising that Klas Fleming considered that the ship was adequately ballasted and the gun-ports already too close to the water, but we may assume that he had never sailed in a ship with two gun-decks. The picture of *Eendracht* (pp. 126–127) shows that good Dutch ships could be loaded so deeply that their gun-ports were no higher above the water than a distance equal to their own height. Had *Vasa* been so deeply loaded, her gun-ports would have been 86 cm, or 2′9″ Amsterdam measure, above the water. Observe that *Eendracht* is not unique in this respect.

Had *Vasa* been loaded down a further two feet, as two of the expert witnesses proposed, after the event, things would have been even worse than they were, for then her level of greatest breadth would have been below her waterline.

Both Hans Clerck and Erik Larsson would have

liked to see the hold two feet deeper, while those who thought the ship was too narrow below the waterline would have given her a broader flat. These remedies would have been the right medicine, but they were prescribed when the ship lay at the bottom of the harbour in Stockholm.

Once again, then, we shall try to put ourselves in the master shipwright's shoes, once the keel and uprights, the fashion timbers of the stern and the beams are in place, and the flat is laid: all of a sudden this order for a new gun-deck!

Had he alone been allowed to decide, he could have torn out the flat and taken down the stern, before rebuilding the latter broader, which would have allowed him to build a wider flat: the drawing on page 59 illustrates what would have been his starting point.

When one compares the stern of the *Vasa* with illustrations of other contemporary ships it is clear that it is unusually high in relation to its width, and this height is the consequence of the additional gun-deck. We may also note that the stern-post was lengthened upwards by 90 cm (cf., page 138). The stem is also extended upwards exactly as much as the new deck was to require (cf., page 143), and so I am prepared to state, rather than suggest or guess, that Hein Jacobszoon really was caught in the troublesome reality I have described.

Quite probably he was simply told to carry on without causing any delay, so he chose as a way out to give the ship a slightly greater beam and a fuller sweep up to her level of greatest beam (cf., page 48). In this way the ship's floor came to seem too narrow in the eyes of those who saw her under construction, with the result that Söfring Hansson, in the agitation after the accident, said that the floor was composed of only three planks.

The observation by the Dutchman, de Besche, that the large beams took up space that could have been used for ballast is very valuable. Hein Jacobszoon had evidently been ordered to build a strong ship, and we should not forget that the fleet's largest vessel, the unsuccessful and probably scrimped *Riksäpplet*, had been in the shipyard since 1625, waiting to be rebuilt.

So far as may be known, there were at the time no comparative tables that could guide a master shipwright towards solutions of new problems. Experience later in the century laid the ground for such tables, which were compiled by formally educated, practising shipwrights. The attempts to make mathematical and geometrical trials were scarcely of greater value than Willem de Besche's parable of the lead and the feathers.

No one was then able to work out a displacement. No one was able to work out with any accuracy the carrying capacity and stiffness of a ship from her main section. It was sound practice to build according to old proven specifications: one could guard oneself by telling a story about the Duke de Guise and his ship that had been built in Amsterdam. It could be said that *Vasa* was not narrower than *Kronan*, that *Vasa* was in fact stiffer than *Kronan*—according to the art and the specifications by which these ships were judged. Shipbuilding was truly no science, but it was an art.

On 12th August the Council of State sent off a report about the accident to the king, and it reached him on 27th August. He quickly formulated his understanding and replied that the catastrophe occurred "without doubt through the lack of judgement and the carelessness of those who should have governed the matter." Despite this, the king maintained his trust in Söfring Hansson, for when he commented on the arrangements that were planned for raising the ship, he recommended him, not doubting that he, as well as any other, could get the ship up.

None of those who were examined by the court on 5th September were found guilty, and as far as is known only one man was imprisoned on account of the catastrophe. In November 1628 Arent de Groote left the country in secret and this has been interpreted so as to make him responsible for the catastrophe. On 23rd November Klas Fleming asked the Council of State if de Groote's clerk should not be arrested, so that the shipyard's accounts could be got hold of, and the Council was unanimously agreed that this should be done.

The clerk was arrested, and the accounts for 1627 and 1628 were confiscated: they have never been found, and nothing is known of what happened to the clerk.

Today marine designers and shipbuilders can demonstrate that *Vasa* was an unsuccessful experiment, but despite this all of us who have worked on the ship, and all who have read about her or made long journeys to see her, must agree that this experiment had a sucessful conclusion. Thanks to her strongly built hull—and to the instability that sank her only a few cables' lengths from the quay she sailed from—we can now read her like an open if somewhat dog-eared book.

At the start, it was my intention to conclude the present work with a technical article on the reasons why *Vasa* turned over, and for this purpose I made contact with Marine Director Curt Borgenstam, at the time an instructor in warship design at the Technical College in Stockholm, who asked some of his students to make the study.

Circumstances outside my control led to the results being published elsewhere, so that only the final conclusion is given here; it is known to all at the Vasa Museum. It was calculated that *Vasa* could

not have heeled more than 10°, and could not have carried the sails she had hoisted in a wind exceeding 4 metres/second (Beaufort Scale 3), without turning over!

This calculation may be compared with Jöran Matsson's—the master's—testimony about the test he and Söfring Hansson performed by the palace: "the first time she put one plank under, the second time two planks, the third time three planks, and then Admiral Fleming told them to stop: had the men run across the deck some times more she would have turned over."

If we accept this reliable man's word and look at the drawings and lay off a heel of three planks' depth, we find that this is exactly 10°!

We know that almost all the guns from the *Vasa* were got up later in the century but no one succeeded in getting up the ship, which was soon forgotten, together with the exact location of where she had sunk.

On 29th August 1929, Professor Nils Ahnlund published an article in *Svenska Dagbladet*, a leading Stockholm daily, that was furnished with sensational headlines: "A Memorial of the Age of Greatness in Stockholm Harbour. Fighting Seamen from 1628 at the Bottom of the Stream, *Vasen*, one of Gustav Adolf's proudest Warships, packed with guns, still rests 18 fathoms down in The Stream between Tegelviken and Beckholmen."

In August 1956 Anders Franzén believed he had located the ship with a plumb line and the naval dockyard's divers could soon confirm that it was indeed the wreck of the *Vasa*. In the spring of 1957 the demanding work of raising her began, and on 24th April 1961 she once again saw the light of day.

But all that is easily documented history.

Vasa's dimensions

Length	
Hull	61.0 m–200 ft
between perpendiculars	47.5 m–156 ft
keel	38.3 m–126 ft
Beam (at the main frame)	
within the planking	11.1 m–36 ft
outside the planking	11.3 m–37 ft
Height	
keel to mainmast truck	52.2 m–171 ft
of transom, keel to top of centrepost	20.2 m–66 ft
Depth	
upper surface of keelson to underside of deck beams	6.6 m–22 ft
Draft	
at forward end of keel	4.0 m–13 ft
at after end of keel	4.8 m–16 ft
Capacity (17th-century measure)	400 lasts
Displacement	1,200 tons
Ballast (stones)	130 tons
Armaments (weight)	63.7 tons
Sail area	
maximum theoretical	c. 1,300 sq.mc. 14,000 sq.ft
10th August 1628	c. 653 sq.mc. 7,030 sq.ft

Author's acknowledgements

What I have written and depicted here is for the most part the fruit of a long period, beginning in 1951, of working together with museums and libraries, and with individuals, in various parts of Europe. For more than three years I have enjoyed the advantage of having been able to work at the National Maritime Museum, Vasavarvet, Stockholm, where all the results of the research on the *Vasa* have been generously put at my disposal, and where I have been further helped in my work, and for this I should like to express my warmest thanks. In addition it is a pleasure for me to be able to express my thanks to the following institutions for their help in gathering information for the present book.

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Vasavarvet, Stockholm
April 1980 *Björn Landström*

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