

MARY ROSE: YOUR NOBLEST SHIPPE

Anatomy of a Tudor Warship

edited by Peter Marsden

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with contributions from

Douglas McElvogue, Richard Barker, Martin Bridge, Christopher Dobbs,
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Cover illustration: detail from a painting by Geoff Hunt PPRSMA *The Mary Rose: Henry VIII's flagship, 1545.*

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Foreword

Barry Cunliffe

Margaret Rule OBE

This year the Trust publishes the two final volumes in the series of monographs detailing the remarkable excavation of the *Mary Rose*. As a Trustee director these last twelve years and as Chairman of the Editorial Committee I would like to take this opportunity to acknowledge the extraordinary contribution that Margaret Rule has made to the *Mary Rose* venture – and to maritime archaeology in its widest sense. There can be no more appropriate place to do this than in the volume dedicated to the *Noblest Shippe*.

Put simply, without Margaret the ship would not now be ashore and there would be no publication such as this. Our present understanding of the *Mary Rose* – her materials, her construction and her sailing characteristics – is dependent on our ability to have studied her thoroughly and over time. Increasingly sophisticated methods of measuring, checking and rechecking, have allowed today's archaeologist to get the fullest insight into this unique sixteenth century vessel to add to our intimate knowledge of her spectacular contents published in Volumes 3 and 4 of this series.

Margaret was recruited by Alexander McKee to give archaeological advice at the outset of the search for the *Mary Rose* which started in 1965. At the time she was working with me excavating Fishbourne Roman Palace but I could see her becoming increasingly fascinated by the rival venture which was soon to set entirely new standards in maritime archaeology. Two years later the

Mary Rose Committee was formed, but it was not until 1971 that the ship was discovered. Margaret was not content to be Director of Archaeology from the comforts of the surface, so she learnt to dive in that year to be able to see for herself the huge task in hand and to direct it more closely. Such an action was typical of this lady of enormous strength of character.

What followed is described in Volume 1 of the publication, *Sealed by Time*. The foresight of that Committee and the dedication of all those who worked tirelessly over the next eleven years to the moment of lifting created a story that is now legendary in the annals of maritime archaeology. Margaret's role was paramount; her enormous drive and her determination to achieve success – often against great odds – combined to ensure the dreams of those early pioneers could become a reality.

The five volumes of this publication display something of the enormous wealth of knowledge that has been forthcoming from the excavation. We have learnt much that is new and unexpected about Tudor life from this time capsule, but there can be no doubt there is a great deal more yet to be discovered from both the ship and her artefacts. Archaeologists in the generations ahead will be studying the *Mary Rose* and unravelling her secrets, but all of us will remember the archaeologist who began the process all those years ago. Margaret is owed a huge debt of gratitude.

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Abstract

The Preface stresses that this volume is an interim statement of what was found of the English warship *Mary Rose*. She was sunk in battle against the French navy on 19 July 1545, and was raised by archaeologists and engineers in 1982.

Chapter 1, The Mary Rose and fighting ships by David Loades, places the *Mary Rose* in the context of the history of warships from Greek and Roman times to the sixteenth century. Of special importance is the significant amount of historical documentation about the ship that has been found, and the fact that the ship reflects the increasing use of heavy guns. She was built under the orders of King Henry VIII at Portsmouth in 1509–1511 and soon took part in naval battles against the French in 1512 and 1513. Thereafter she was hardly used but was kept under repair between 1524 and 1530. She was originally designed for medieval hand to hand fighting, but during the 1530s she was modernised to carry a heavier armament.

Chapter 2, Salvage, saving and surveying the Mary Rose by Peter Marsden, discusses the efforts to salvage the ship between 1545 and 1549. At first the Admiralty hoped to raise the ship, but found that this was not possible and only managed to raise some of her guns. Much of the salvage was undertaken by a Venetian who employed a diving team led by a west African diver. The wreck was rediscovered in 1836 and continued to be salvaged by one of the Deane brothers until 1840. More guns were found and were stored by the Admiralty at Woolwich, but other items were sold at Portsmouth. In 1965 a search for the wreck was started by Alexander McKee, and in 1970 his team located a gun and a loose plank. Next year Percy Ackland found the side of the ship exposed in the sea-bed, after which the full excavation commenced. The *Mary Rose* Trust was formed, and in 1982 the ship was raised for preservation in a new museum in Portsmouth Dockyard. It was here that the ship began to be recorded, though this had to fit in with the conservation process. After 2000 the *Mary Rose* Trust received grants to complete and publish five volumes describing the ship and her contents, and also her conservation. Facilitating this was the laser scan of the ship in 2002, with the detailed recording of parts of the ship by Douglas McElvogue that have enabled reconstructions of the vessel to be made.

Chapter 3, Understanding the Mary Rose by Peter Marsden, sets out the principles by which the ship has been studied, leading to conclusions on how she was built, used, repaired and modified. Distortions to the hull were identified, and obvious missing timbers reconstructed. Crucial to reconstructing the ship was identifying her ‘plane of symmetry’ whereby the missing port side was the mirror image of the surviving starboard side. This enabled the Hold and decks to be re-

constructed and furnished. Although the bow is missing the discovery of the collapsed stempost has enabled a fairly accurate reconstruction of the bow to be completed.

Chapter 4, Hull design of the Mary Rose by Richard Barker, Brad Loewen and Christopher Dobbs, considers the ship as the oldest English ‘document’ on sixteenth century hull design and enables it to be compared with fifteenth century Italian texts on the subject. According to Renaissance methods, all frames were shaped according to a system of arcs with identical radii, and this influenced timber supply and frame style. The authors found that the frames of the *Mary Rose* followed a system of arcs, but they concluded that it was unlikely that the Italians influenced the ship’s builders. The authors believed that although there was no meaningful pattern of framing elements in the ship, the frames do fall into three groups: at the bottom of the ship, at the turn of the bilge, and at the sides. They conclude that the ship reflects a mature design process, but a youthful carvel shipbuilding industry that was less than 50 or so years old when the *Mary Rose* was built. It had superseded the clinker shipbuilding tradition that had existed in northern Europe for about 1000 years. The shipwright responsible for building the *Mary Rose* had mastered the proportional conception of the hull’s overall dimensions, conceived its master frame according to tangent arcs, and had control of the complex geometry of design. The sophisticated design methods invite questions as to their origin. Was it already in use in England during the fifteenth century, or did it come from abroad?

Chapter 5, Woodworking aspects of the Mary Rose by Damian Goodburn, describes the species of timber used, mostly oak, but with some elm used in parts of the keel and on the Orlop deck. There is also a little pine, spruce and poplar used in repairs. The sizes of trees and the weights of some timbers are discussed. The construction methods of selected parts of the ship are described, including the weatherboarding in the Sterncastle, the keelson and mast-step, the deck beams, outer hull planking, knees, frames, riders, half-beams and pillars. Toolmarks and the tools that they represent are described, as well as carpenters’ marks, scarfs and joints, and treenails and iron fastenings.

Chapter 6, The hull by Douglas McElvogue, is a description of the timbers that make up the ship’s hull. They include the keel (of three timbers, elm at the ends and oak in the middle), keelson, stempost assemblage, sternpost, ‘deadwood’ (strictly not deadwood, but vertical frame ends), transom stern, frames, ceiling, stringers, gunwale, riders, brace timbers, outer hull planking, wales, caulking, seam battens, possible traces of ‘white stuff’ (a protective coating over the hull below

the waterline), standards at the ship's waist, traces of the forecastle, the channel (the rigging shelf) and the 'rigging rail'.

Chapter 7, The Hold by Peter Marsden, describes the discovered structure of the Hold, the keelson, stringers, ceiling planks, Orlop deck clamp timbers, riders and the lower ends of the side brace timbers. The plan of the Hold is reconstructed after the forward distortion has been corrected and the plane of symmetry identified. Missing structure, indicated by fixings, is reconstructed, including some stanchions, partitions, the main mast and its likely diameter, the two bilge pumps indicated by two pump wells, and the absence of fixed companionways.

Chapter 8, The ballast by Christopher Dobbs, was gravel that contained some sea shells and so was most likely quarried from a beach in the Portsmouth area. The ballast, originally at the bottom of the Hold, had been displaced to starboard in the sinking. Its volume, roughly indicated by its occurrence in the excavated sections across the ship, and density gives it a weight of approximately 102 metric tonnes.

Chapter 9, The galley by Christopher Dobbs, describes the construction and use of the two brick ovens or 'furnaces' in the Hold, of which only part of the starboard one had survived. Each had a copper alloy cauldron over its firebox, that on the starboard side held a maximum of 600 litres and that on the port side held about 300 litres. The brick furnaces were surrounded on three sides by timber cladding, and there were traces of a lead lip to the brickwork. Associated cooking utensils were found, including a copper alloy kettle and cooking pot. The furnaces were heated by fuel logs, of which 776 were found in the ship. A reconstruction of one of the furnaces shows that starting at 20° C it took 5 hours to heat 400 litres of contents, and also that the oven was more efficient without side flues from the firebox. Forward of the furnaces was a working area for the cooks.

Chapter 10, The Orlop deck by Peter Marsden, is supported on main beams spaced at roughly 3m intervals. These are held by rising knees some of which are inscribed with the numbers II, III, IV, VII and VIII. By chance these are the same as the beam numbers given by the excavators and show that only one is missing from the bow. Other elements of the Orlop deck are described, including half-beams and their shelves, carlings, deck planks, central hatches and their covers (but no trace in the ship of hatch gratings), partitions, stanchions and a curious large forked timber. There were no companionway hatches, so access to the Hold was by ladder through the central hatches, such a ladder being found in position at the galley. The Orlop deck was reconstructed after the distortion at its forward end was corrected. The partitions and stanchions showed that the deck had ten compartments whose contents show that they were used to store gun equipment, rigging including a spare sail, fuel logs for the galley furnaces, a coil of anchor cable, and archery and lighting equipment.

Chapter 11, The Main deck by Peter Marsden, has a similar structure to the Orlop deck, with a timber deck clamp, beams, half-beams, rising and lodging knees, half-beam shelves, carlings and deck planks. Along the centreline were hatches with parts of hatch covers, but no indication of gratings. In the starboard side are scuppers, gunports with their lids and iron fittings for gun tackle. An horizontal timber, P18, has certain fittings and lies beside a round hole through the hull suggesting that it was a pin rail for the rigging or an anchor cable. The entire deck was reconstructed by drawing the plane of symmetry, which allowed the guns and their carriages to be drawn in position. How the gunports were opened and closed is discussed, and it is concluded that they were opened by men lifting ropes outboard from the Upper deck of the waist. Such a method is shown on a carrack by the sixteenth century artist Stradanus.

Chapter 12, The Upper deck by Peter Marsden, describes the two distinctly different areas of deck construction: in the waist and below the Sterncastle. There is a step down of 270mm from one to the other, at the base of which was a timber drainage 'dale' to discharge water from the deck over the side. The structure of the deck is described, that in the waist having heavier timbering of clamp, beams and half-beams, hanging knees, carlings and deck planks. There are also four small hatches in the Upper deck above the guns on the Main deck, possibly for communication, and an access hatch beside the Sterncastle. The side of the ship in the waist was found almost complete and stands about 2.2m high. In it are semicircular gunports, and above that 'blinds' or removable shields. Outboard are upright 'standards' to support the structure. One iron gun was found at its gunport. The 'top rail' of the side had rebates presumably for the roof joists that supported a protective cover over the waist. This crucial timber is missing at present, and needs to be recorded. Inboard was found a T-shaped timber structure, probably to support the inboard end of the cover. Fragments of anti-boarding netting were found scattered over the waist. Beneath the Sterncastle the deck is of much lighter construction, with beams supported by a deck clamp and hanging knees. There is also a timber drainage dale, and loose pieces of a staircase. Part of the forward face of the Sterncastle has survived, with overlapping planks beneath two windows. Also, there is an upright post or 'bitt' worn by rope. It is not clear how access was gained from the waist to the deck beneath the Sterncastle. Two square gunports are in the ship's side beneath the Sterncastle, with one gun found in position.

Chapter 13, The Sterncastle by Peter Marsden, describes the overlapping weatherboarding, timber rails with swivel gun positions, and the outboard upright standards of the starboard side. Slots for decorative panels were recorded. Only the starboard edge of the Sterncastle deck remains, though more has yet to be recorded. A few ends of deck beams survive in the deck clamp on the starboard side, which, together with other

rebates in the deck clamp reflect the positions of more beams. This enables the forward part of the deck to be reconstructed. Also, there are parts of several hanging knees to support the beams. A small portion of deck planking remains with a forward facing gun in position.

Chapter 14, Propulsion by Peter Marsden and Richard Endor, describes the considerable evidence for the ship's propulsion to be derived from the 1514 inventory of the ship, from the image of the ship on the *Anthony Roll* of 1546, and from the archaeological remains. The ship had four upright masts, the fore mast, main mast, mizzen mast and bonaventure mast, and a bowsprit. The step of the main mast was found, and at the side of the ship were deadeyes for the shrouds that formerly supported that mast. Smaller deadeyes for the shrouds of the mizzen mast were also found and show where that mast was situated. No trace of the other two masts or of the bowsprit was found. Other than that there was found a mast top, a sail and a windlass. The standing and running rigging is reconstructed, with clues from pulley blocks, a parrel and other deadeyes, as well as from contemporary sources. Much more work is required on this subject.

Chapter 15, Steering, mooring, anchoring and the ship's boats by Douglas McElvogue, discusses the limited evidence for these aspects of the ship. The incomplete ship's rudder is described, but there was no evidence to show how the ship was steered, though a tiller was found. Several iron anchors and their wooden stocks are described, and also the coils of mooring cables found in various parts of the ship. Wooden fenders or mooring buoys were also found. The ship's boats are referred to based on the documentary records, but their only trace was one oar.

Chapter 16, Removing water by Douglas McElvogue, describes the important evidence for removing water. The main pump-well lay beside the step for the main mast, and a second well appears to have existed further aft at an early stage in the history of the ship. A spare pump tube 8.22m long was found with its valve fittings. Two drainage dales existed on the Upper deck. The scuppers were found on the Main deck amidships, with leather sleeves that were used as valves.

Chapter 17, The fighting ship by Alexzandra Hildred, describes the considerable evidence for the *Mary Rose* as a warship. Inventories of her weapons from 1514 to 1546 are important, and link up with the discovered remains of guns, bows and arrows, and pikes and bills. There is clear evidence that when first built she mainly had anti-personnel guns, but by 1545 she had more and heavier guns. Battle tactics at sea are discussed, and the likely movement of ships in the final battle. Explanations of why the ship sank, either by rashness or negligence, are considered, and it seems that various difficulties combined to bring about the disaster of 1545 (Chap. 21). A comparison is made between the ship's guns listed in 1545–6, and those actually found and where they were positioned, as well as the handguns, gunpowder and shot. The role of the hand weapons is

discussed, as is the purpose of the grapnel hanging from the bowsprit.

Chapter 18, Navigating the Mary Rose by Robert D. Hicks, considers the voyage in which she was sunk and the place of the navigational equipment found in her. The compasses, sandglasses, sounding leads, dividers, log reel, probable chart storage items, and a slate protractor form the earliest dated assemblage of navigational tools found in Europe. Whereas some reflect coastal voyaging, others reflect navigation based upon mathematics and an understanding of astronomy and cartography. The *Mary Rose* was lost at a pivotable time in the development of navigation.

Chapter 19, Construction and refits: tree-ring dating the Mary Rose by Christopher Dobbs and Martin Bridge, describes the tree-ring dating of some of the ship's oak timbers. 108 timbers were sampled, of which 41 gave dates. These showed that many timbers, such as some riders and diagonal braces, and the stern transom knees, had been added after the ship was built, and that the vessel had been rebuilt, probably in the 1530s. Other timbers were from the ship's original construction, including three of the main deck beams, and possibly some of the overlapping planks in the Sterncastle. One frame at the waterline shows that the ship was being repaired as late as the 1540s. The tree-rings suggest that the original timbers may have been from central southern England, and that the repair timbers were perhaps from the Medway region in Kent.

Chapter 20, Reconstruction of the Mary Rose: her design and use by Peter Marsden, brings together the evidence for what the ship was like in 1545 and what she may have been like when launched in 1511. The only contemporary picture of the ship is of her in 1545, in the *Anthony Roll*, which shows that she was a carrack. Images of other carracks around 1500 indicate that *Mary Rose* probably had a sharp stern below the waterline, and that later she was rebuilt with a flat transom stern. This view is also suggested by the tree-ring dates of the knee timbers that support the transom. When originally built she had four masts and a bowsprit, and appears to have had the same decks as existed in 1545, though they did not have fixed names. In an inventory of the ship in 1514 she had 78 guns, most of which were anti-personnel weapons for close combat. When she was rebuilt, probably around 1535–6, heavy guns were placed on her Main deck with new gunports cut in her sides. The gunport lids were probably opened by men manipulating ropes from the Upper deck. By 1545 she had about 65 anti-personnel guns and 26 anti-ship guns. This extra weight of guns, and the proximity of the Main deck gunports to the waterline was a dangerous situation. Access around the ship is poorly understood, for although there were some fixed companionways, most access was apparently by movable ladders through the central hatches of the decks. When she sank there were clusters of men, represented by 'fairly complete skeletons', in the galley, in the main storage area of the Hold, in the archery store on the

Orlop deck, around a gun on the Main deck, and on the Upper deck beneath the Sterncastle. These possibly represented cooks, seamen, archers, a gun crew and soldiers and archers, a view also suggested by differences in their clothing.

Chapter 21, The loss of the Mary Rose 1545 by Peter Marsden, describes the loss of the ship soon after being in action against an enemy vessel, and whilst she was turning to re-engage the enemy. Her main guns were found loaded, so the sinking took place after reloading. One gun, a port-piece on the Upper deck in the waist, was still being loaded when she sank for the shot was in the barrel but the cartridge chamber was not in position. Possibly with a range of roughly 430m, the gun suggests how close the *Mary Rose* was to the enemy. Judging from the location of fairly complete skeletons, the archers and soldiers were ready for action on the Upper deck beneath the Sterncastle, whilst others were collecting archery equipment from a store on the Orlop deck. It was the rebuild of the ship in the 1530s that caused the vessel to be unstable, with the insertion of new gunports on the Main deck close to the waterline and the extra weight of new guns and additional ship's structure. Added to this was the slow response to closing the gunport lids which, judging from the teeth studies that showed that many of the crew were foreigners, suggests that they may not have understood orders. All of this apparently contributed to the disaster. Much later, Sir Walter Raleigh is reported as saying that he believed that the waterline was only sixteen inches below the gunports. The sinking of *Mary Rose*, therefore, was mainly due to her having been modified too far, and the anti-boarding netting compounded the problems by stopping most of the crew from swimming to safety. Only 40 of her crew survived. Following her loss, the old fashioned carrack was phased out and replaced by the galleon, a sleeker warship designed around guns and without high castles.

Chapter 22, Future research by Peter Marsden, urges the need for a research plan driven by questions so as to reconstruct what the ship was like both in 1545 and when she was first built. An essential element is to compile a complete transcript of all known historical documents concerning the *Mary Rose* and related warships, especially her sister ship the *Peter Pomegranate*. All of the excavation records and the underwater archaeological survey by the Direct Survey Method need

to be processed so as to compile drawings of the ship as found, with all objects in her plotted out. Other matters include sorting out irregularities in the plane of symmetry, and undertaking more tree-ring dating to determine how the ship was modified. All of this would make it possible to carry out a stability assessment of the ship. Many details of the structure of the *Mary Rose* need further study, such as her changing keel sections, her varied caulking, the possible traces of 'white stuff' coating on her underwater body, and the drawing and reconstruction of the partitions that define her compartments. Doorways in partitions may be identified, and the positions of companionways determined. The corroded iron fittings on the gunport lids require investigation and recording so as to show how they were opened and closed, and iron fittings for gun tackle on the Main and Upper decks need recording. Also, the cabins on the Main deck need recording, particularly the Barber-surgeon's cabin and the Pilot's cabin. More information on the propulsion of the ship may be derived from the positioning of the possible 'mast partners', and the rigging can be much better reconstructed from the rope sizes as reflected by the wooden fittings, and by the edging of the surviving but mostly decayed sail. Constructing a working model of the entire means of propulsion, the rigging, masts, yards and sails, would help define how they were used. Finally, the remaining timbers of the collapsed bow need excavation, lifting and recording.

Appendix 1, Some background considerations in the construction and geometry of the hull by Richard Barker, examines various issues concerning the quality of the evidence from the survival of the ship. These involve the present form of the hull, the plane of symmetry, distortion, and exactly where the sections recorded in 1982–5 were situated and whether or not they were at right angles to the plane of symmetry. He considers evidence for the position of the master frame that defined the shape of the hull amidships, and considers evidence for how the ship was launched and rebuilt.

Appendix 2, Caulking materials used in the Mary Rose by Penelope Walton Rogers and Allan Hall, shows that a range of caulking materials was used in the ship, including cattle and goat hair, and flax, with possibly lime, was used to make oakum. There was also some caulking of mixed plant and wool, and some wood tar.

Preface

The English warship *Mary Rose* was sunk in the Solent, between Portsmouth and the Isle of Wight, during a naval battle against a French fleet on 19 July 1545. Over 400 men died in her. Her wreck was discovered in 1971 by a team of divers led by Alexander McKee, and was subsequently excavated as an archaeological site by a team led by Margaret Rule. A major part of the ship's starboard side and parts of four decks had survived buried in the sea-bed, together with a considerable amount of the ship's contents, including the remains of many of her crew. The ship's structure was raised in 1982, and subsequently underwent preservation in Portsmouth Dockyard where a *Mary Rose* museum was created.

Since then the *Mary Rose* Trust has carried out a huge amount of archaeological recording and research to find out what the ship was like and how she was used. Much more study is needed, but the interim results are being published in four volumes of which this is Volume 2, with a fifth dedicated to describing the conservation processes. Volume 1 describes the sixteenth century history of the ship, the discovery of the wreck in the nineteenth century, its rediscovery in 1971, and its subsequent excavation and recovery (*Sealed by Time: the loss and recovery of the Mary Rose*). Volume 2 describes the ship; Volume 3 describes the weapons (*Weapons of Warre: the armaments of the Mary Rose*); and Volume 4 describes the rest of the objects that were found, including artefacts, human remains, animal bones, and environmental samples (*Before the Mast: life and death aboard the Mary Rose*). Throughout the text that follows these volumes are referred to in a simplified manner by the abbreviation *AMR* (eg, *AMR* Vol. 1, xx–xx).

The precise aim of this second volume is to describe as much of the remains of the ship as possible, and to use this as the basis for reconstructing the vessel as she was in 1545. Fortunately, there are also valuable clues to suggest what the ship may have been like when first built in 1511.

When this interim programme of publication was planned the 'brief' from the *Mary Rose* Trust and the Heritage Lottery Fund, that financed the work, was to publish only existing research. However, it soon emerged that not enough archaeological work had been completed to make this possible because the *Mary Rose* Trust had, rightly, made as its priority the cataloguing and conservation of the ship's structure and the finds. Most important was that there were no overall drawings of the entire ship as found or as she was in the museum. Consequently, it was necessary to undertake much more research, to continue the excellent work on the ship that had already been carried out under the leadership of Andrew Fielding to a point when publication was possible. The Trust's archive is ideally constructed for curatorial purposes, but its ordering and indexing for

archaeological research is limited, so finding data occupied a significant amount of time. The research upon which parts of this volume are based is, therefore, often incomplete. Difficult decisions had to be made as to what aspects should be studied, and what left out. This was far from ideal, but the result reflects what could be achieved with the limited time and funding.

In spite of these restrictions those involved have all taken their restricted 'brief' far beyond what was agreed, and the patience and support of both the *Mary Rose* Trust and the Heritage Lottery Fund has been much appreciated. Many aspects could not be started, such as, for example, it was not possible within the constraints of time and funding to construct a plan of the ship 'as found' on the sea-bed. The main method of survey underwater was the Direct Survey Method of three-dimensional recording of structures and objects, but this had not been processed by computer. This would be a huge task, first computerising and then dealing with thousands of measurements to prepare sets of drawings of the ship and her contents as found. Fortunately, other excavation records define what lay in each sector of the ship, and it is upon these that reliance has been given. This back-up system reflects the excellent quality of the archaeological work by the team that was led by Margaret Rule, for it worked to standards and systems that were far ahead of what was normal on underwater sites in the 1970s and 1980s.

Although a great deal of the ship has now been recorded, there is a considerable amount of structure that still lies in tanks of water and awaits study. Consequently, the conclusions given here will no doubt be modified in the future. Amongst the unrecorded structures are the forward end of the surviving hull and decks and most of the internal partitions and cabins. Moreover, some broken ship's structure, particularly parts of the Forecastle, still lie buried in the sea-bed, though the stempost was recovered in a recent excavation (during the preparation of this volume) and has enabled the shape of the bow to be estimated.

There are also some other partly recorded structural elements that require much closer study. These include the 'blinds' from the ship's waist, which need to be checked before they are conserved as they might retain traces of decorative painting; and also the 'top rail' that formed the uppermost part of the ship's side in the waist. Other fittings of the ship that require study include a folded sail found in a store, ropes and rigging fittings, and the 'decorative panels' that also might still have traces of decorative paint.

After the ship was raised, a huge effort was made to record her in the museum though this was incomplete. It is a credit to Andrew Fielding and his colleagues that so much was drawn, and that a remarkable photographic record of the ship was made under the direction of

Christopher Dobbs. Andrew Fielding compiled plans of the surviving structure of decks, and drew a series of profiles across the hull, as well as organised the drawing of significant timbers, including the keel which was then partly accessible. Stuart Vine wrote valuable descriptions of parts of the ship, and Debbie Fulford drew isometric views of the remains of the ship that magnificently reflect its structure.

In spite of all of this effort, no set of master drawings of the entire remains of the vessel in the museum were prepared upon which it was possible to base a reconstruction. The reason was largely because access to the ship for recording was restricted by the conservation process which had to take priority. Access was limited to short periods each day when the sprays of PEG (polyethylene-glycol) solution could be turned off, but even then the environment in which the archaeological team took measurements and prepared drawings was very cold and wet, since the liquid sprayed onto the hull was chilled. Moreover, the ship was poorly illuminated because of the need to restrict biological growth, and the wet and black timbers made it necessary to use torches to see construction detail, whilst iron fittings had to be interpreted although partly obscured by the concretion that mostly still remains.

Fortunately new technologies for recording became available after the 1980s and in 2000 Julie Gardiner (Series Editor) arranged with Leica UK, as a test-run for new laser survey equipment, for the vessel to be 3-dimensionally scanned by laser onto a computer. Instead of weeks of work, the scan occurred on just one day, and from this it was possible to print out many vertical and horizontal views of the ship's structure to any scale and in very fine detail. Douglas McElvogue, at the Mary Rose Trust, then used these large-scale printed plans and sections as the basis for an accurate series of construction drawings of the remains of the ship in plans, sections and elevations. It required numerous visits to the ship by him to check structural details, and, again, these visits had the same restrictions as were encountered before, and had to be fitted into only an hour or so between sprayings of water and chemicals. The result, a detailed drawn record of the ship as she is in the museum, is not quite of the vessel as she was in the sea-bed, since some original timbers had not yet been replaced and others that were found dislodged after her sinking had been repositioned. It was well worth the effort, though it took a long time and required much patience. But once completed it was possible to embark on the process of preparing a written description of the remains of the ship, and of developing reconstruction drawings of what she probably looked like, even though there were still many parts of the ship's structure to be recorded. Where there are omissions in this volume, therefore, the reader should interpret it that the work has yet to be carried out or completed.

The basic layout of the ship is as shown in the Figure below, and in order to locate parts of the ship during the excavation, the interior of the vessel is divided into

Sectors, roughly cubic blocks of volume between the riders in the hold and between the major deck beams. The horizontal distance between the beams is about 3m. For example, Sector M6 is the area between deck beams M6 and M7 above the Main deck.

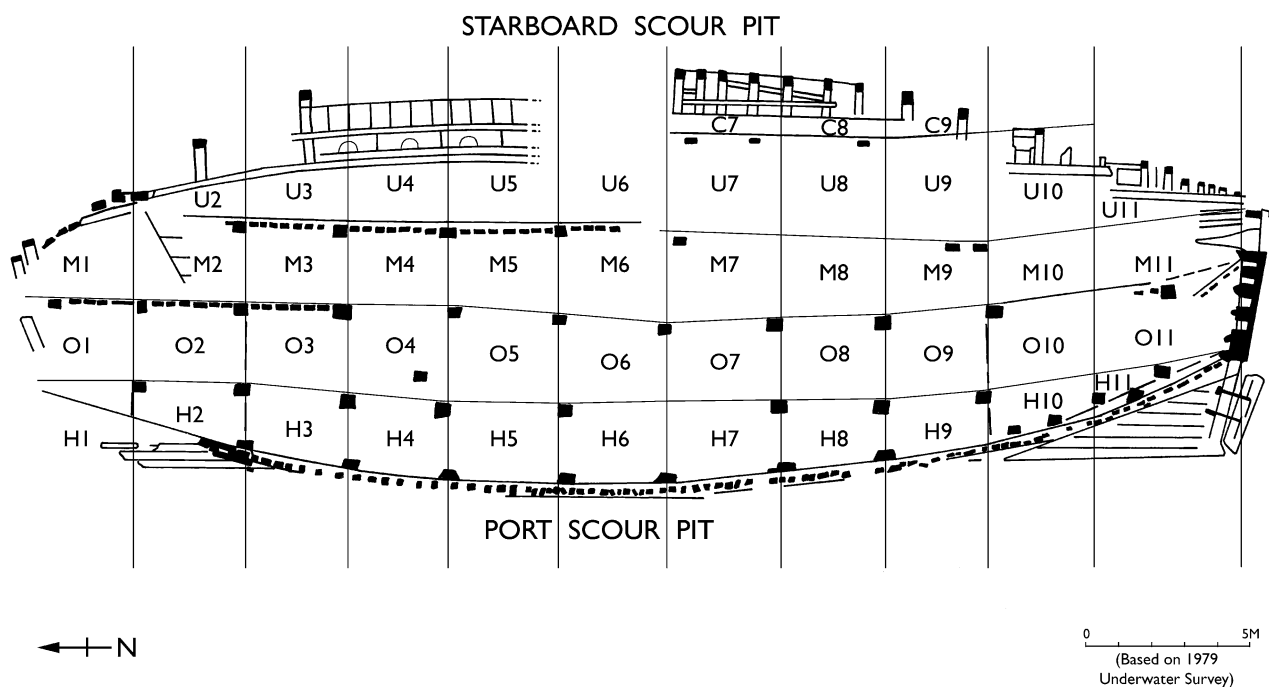
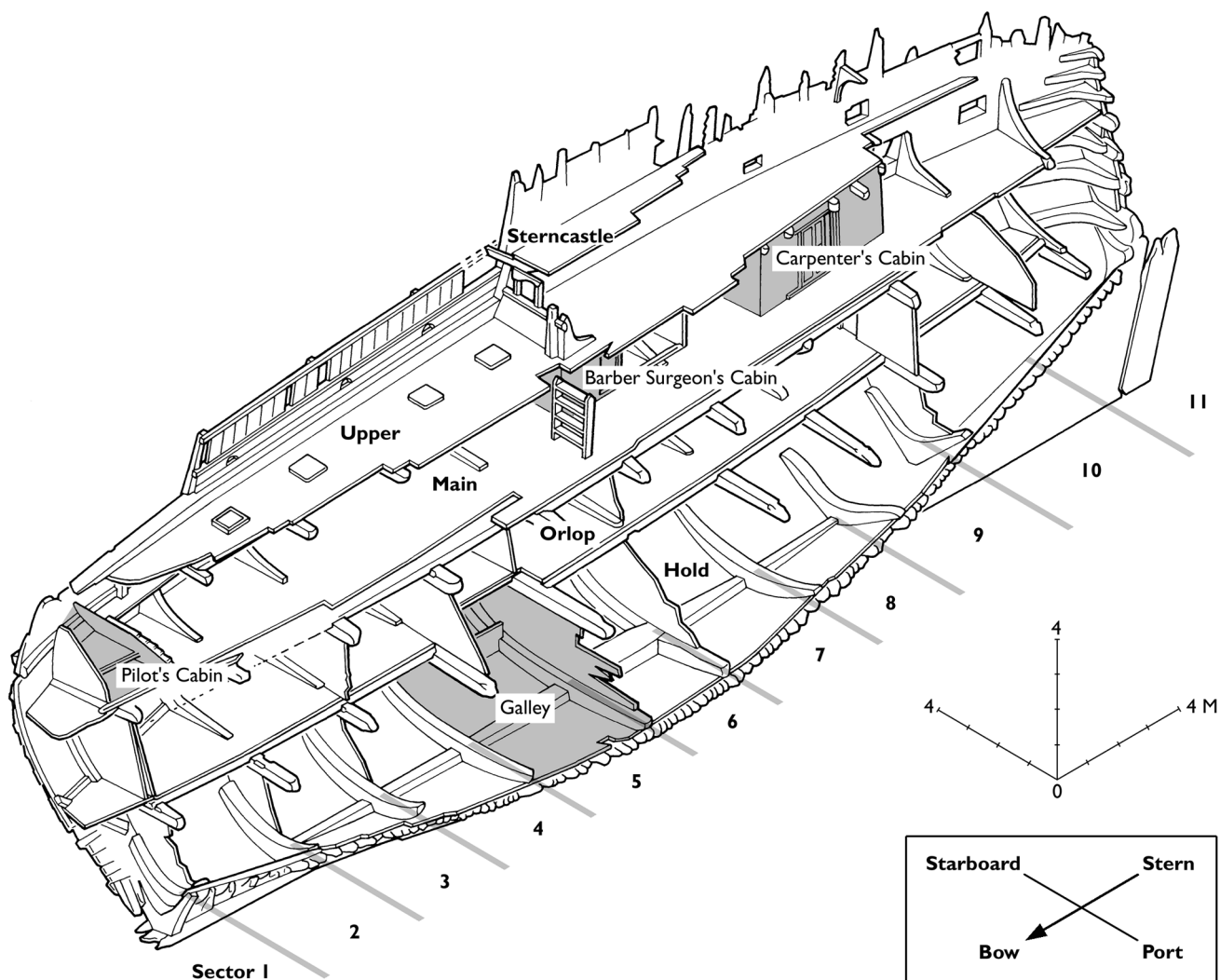
The deck beams are similarly named, with the beam lying at the forward end of its sector. For example, deck beam O6 on the Orlop deck lies at the forward end of sector O6. This might, at first, seem confusing, but it is a modified version of the system used in the Mary Rose Trust's archives and so retaining it will facilitate access to the archives. To avoid confusion in this volume each number is preceded by the words 'Sector' or 'Deck beam'. It is interesting to find, after the ship was raised, that the same numbers were used in Tudor times for they had been carved into some of the deck supports.

This interim publication seeks to identify the 'big picture' of what the *Mary Rose* was like and how she was used. Although much detail has been described, much more has been left for future research by others, and towards that end the Mary Rose Trust welcomes expert help in studying the ship. That need for help also extends to specialists who will complete the pioneering work of David Loades and Charles Knighton to transcribe and publish all historical records that relate to the *Mary Rose* and to her sister ship the *Peter Pomegranate*, since that is where the ship's story mostly lies.

That story is of a warship, launched in 1511, that was designed for anti-personnel fighting at sea with small guns, bows and arrows, pikes and other hand weapons. Subsequently, in the 1530s, she was drastically modified and updated to house more guns, some of which were heavy anti-ship weapons. Mistakes were made, and therein lay a cause of her loss in the battle of 1545, her first engagement since being 'modernised'.

Even when she was first built in 1509–11 the *Mary Rose* was a 'modern' warship for that earlier time, and she incorporated important advances in naval architecture. Her hull shape was precisely defined, suggesting that she may have been designed on a drawing board. Her means of propulsion, many sails on four masts, was still a fairly new concept that required considerable steering expertise. And her outboard planking was carvel laid edge-to-edge, whereas only twenty years earlier it was normal for large ships to be clinker built with overlapping planks.

These developments in naval architecture were presumably partly a response to the recent discoveries during pioneering ocean voyages that had revealed the sea route to Asia and discovered the American continent. Until 1500 Europe was 'the world' to most local people, and most ships sailed in coastal waters where the traditional method of navigation was to recognise environmental clues. But now a new and larger class of ship was needed for long ocean voyages, so that they could carry large quantities of provisions and heavy armaments. But to do so required the use of more advanced navigation instruments to fix the position of ships far from the coast. The *Mary Rose* was



Above: the basic layout of the ship, with decks and cabins named, and sectors indicated
 Below: Trench plan and nomenclature adopted in 1979

not used for such distant voyages, but she was required to be as modern and well equipped as possible so as to confront the new generation of warships with their more up-to-date firepower, and, of course, to reflect the status and power of King Henry VIII.

This volume has 22 chapters, with 2 Appendices, a Glossary of terms, and a Bibliography. They are written so as to trace the story of the ship in a logical fashion, commencing with a discussion of the place of the *Mary Rose* in the development of warships (Chapter 1). The next chapter (Chapter 2) describes the recovery and recording of the ship. Then the method by which the ship has been reconstructed is described (Chapter 3). Next, the evidence for how the ship seems to have been designed and built is discussed (Chapter 4). There then follows a study of how the timbers were fashioned (Chapter 5).

The next eight chapters (Chaps 6–13) describe parts of the ship as she was in 1545, and show how each part has been reconstructed. And the following five chapters (Chaps 14–18) describe how the ship was used, the greater length of Chapter 17 being due to the importance of the vessel's primary function as a warship.

The final four chapters (Chaps 19–22) examine the evidence for how the ship was altered during her use, and how she might be reconstructed as a whole, and suggests why she sank. They also point out areas of future research that would contribute to a greater understanding of the vessel.

There are two Appendices that include details that are best separated from the main theme of the book, but are equally important. Appendix 1 develops themes relating to the design of the ship found in Chapter 4. Appendix 2 analyses the caulking.

Finally, there are a Glossary and a Bibliography, the former containing many of the technical terms used, as often standardised in the Mary Rose Trust archives, some of which might not be quite logical (eg. 'Fore-castle' and 'Stern-castle'). During the sixteenth century the names of the decks were different from those used

today, but throughout the volume the names that were used during the excavation and subsequently have been retained (ie. Hold, and Orlop, Main, Upper and Lower and Upper Stern-castle and Fore-castle decks). The masts, in contrast, mostly have the names that were used during the sixteenth century (ie. from bow to stern: bowsprit, fore mast, main mast, mizzen mast, bonaventure mast).

Although the priority of this publication has been to describe as much as possible of what was found of the ship, contributors have stressed varying interpretations of how the ship was built and should be reconstructed. They were first aired at two seminars held by the Mary Rose Trust. One seminar was on reconstructing the ship and the other was on her use in battle. Rather than present a consensus view, this volume Editor decided that, as so many uncertainties exist, these varying views should be allowed to stand so as to reflect the importance of debate, and to help give direction to any future research programme.

It is important not to view this volume as anything other than an interim statement about the *Mary Rose*. It shows the state of knowledge now, and does not replace a more final publication in the future that would follow on from a comprehensive new survey of the vessel once the conservation process is completed and all parts of the ship have been recorded.

That comprehensive study has been made possible because the principle of research used on much smaller vessels, that it is necessary to raise the entire boat for recording and study, has been applied to this large ship. Because she was raised and preserved the *Mary Rose* has given scholars an unprecedented opportunity to carry forward research into a crucial stage of the development of ships that would otherwise have not been possible had she been recorded only on the seabed. It is thanks to the vision of Alexander McKee and Margaret Rule, and the extraordinary efforts of numerous others, that this goal was achieved.

