THE RIGGING OF A 17TH-CENTURY FRIGATE AT MOMBASA, KENYA

A Thesis

by

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ABSTRACT

The Rigging of a 17th-century Frigate at
Mombasa, Kenya. (May 1988)
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Between 1977 and 1982 the Institute of Nautical Archaeology (INA), under the auspices of the National Museums of Kenya, conducted the excavation and analysis of a frigate that wrecked off the coast of Mombasa, Kenya. Interpretations of the remains and reviews of the historic record disclose, with some certainty, that the wreck is that of the Portuguese frigate Santo Antonio da Tanna (Piercy, 1979:308), which played a key role in the historical siege of Fort Jesus in the late 17th century (Kirkman, 1974:215).

Of the more than 6,000 artifacts recovered from the wrecksite, 237 pertain directly or indirectly to the ship's rig. Deck and hull fittings, standing rigging, running rigging, and sails are represented. This thesis represents the analysis of rigging components recovered from the Mombasa Harbor wreck and proposes reconstructions of rigging features, where possible. Hopefully, the study provides answers to important questions about the differences and similarities between the 17th-century Portuguese rigging techniques and the better known European methods.

An introductory chapter will familiarize the reader with the characteristics of the Mombasa Harbor wrecksite and the archaeological investigations completed to date. Artifactual proof for the age and origin of the ship is discussed next. Finally, since the evidence strongly suggests that this is indeed the Portuguese frigate Santo Antonio da Tanna, a brief history of this ship and its loss is provided.

Chapter II presents the major contemporaneous and modern sources available for ship construction and rigging practices during the 17th century, and a review of the archaeological parallels for the period. Chapter III includes a brief explanation of the sinking and offers a theoretical reconstruction of the ship's hull profile and sheer shape.

The artifacts are categorized by function (deck and hull fittings, standing rigging, running rigging, and sail) and are discussed in separate chapters (Chapter IV thru VII). With evidence provided by the hull and rigging remains, major rigging features are reconstructed within the appropriate chapters. A summary chapter compares the resulting rigging techniques to known European rigging methods of the 17th Century.

DEDICATION

"Do not go gentle into that good night...
Rage, rage against the dying of the light."

- Dylan Thomas

To the memory of my father
Lee O. Thompson

ACKNOWLEDGEMENTS

This thesis would not have been possible without the generous assistance of many people and institutions. First and foremost, I must thank the Institute of Nautical Archaeology and in particular Dr. George F. Bass who made it possible for me to go to Kenya in 1982.

Special thanks must also go to Robin C. Piercy, director of the Mombasa Harbor Project, for providing me with the opportunity to study the rigging artifacts from the Mombasa Harbor Wreck.

Dr. Richard E. Leaky, of the National Museums of Kenya, graciously acted in the interest of my studies by sending to Sweden a cover letter concerning the conservation of sail material found on the wrecksite. I must also mention Walter Zacharchuk, of Parks Canada, who early in my search for clues provided me with several leads.

I would also like to thank the staff of Fort Jesus Museum and Ali Abubaker, curator of the museum, for all the help afforded me during my stay in Kenya. Wazwa Mwademi, the museum conservator, spent many hours helping me record artifacts and gather reference materials.

Several illustrations used in this thesis are the artistic work of Netia Piercy, Myra Stanbury, and Caroline Sassoon. Manuela Lloyd and Allison Withy, INA volunteers, spent many hours recording the rope samples and other

rigging artifacts. Hamo Sassoon and Allison Darroch provided me with information and measurements when I most needed them.

Warm regards must go to Mr. Morris Taffe, retired vice-president of East African Kodak, whose photographic talents were indispensable. Thanks also to Dr. James Kirkman for his assistance at the University of Nairobi Library, and to Jean Yves Blot who provided me with archival information over the years.

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CHAPTER I

INTRODUCTION

Site Description

Mombasa, often called "the Impregnable" or "Mvita" which means war in kiswahili (Brady, 1950:60), is a small island port town located at 39°54'E, 4°18'S and is surrounded north, south, and west by mainland Kenya (Fig. 1). On the eastern end of the island, which faces the Indian Ocean, the Portuguese placed a defensive outpost named Fort Jesus. Built during the period when Portugal was a possession of the Spanish Crown (1580-1640), the fort was designed by Giovanni Battista Cairati and constructed by Mateus Mendes de Vasconcelos between 1593 and 1596 (Kirkman, 1974:6).

The majority of the island's perimeter consists of coral cliffs cut by occassional gullies that support small sand beaches during low tides. Two sand reefs narrow the Indian Ocean entrance to the deep channel, which cuts in and close to the island. Vessels traveling along the channel have to pass very close to the fort, well within point-blank range of its guns. From the 16th to the 19th century an Arab trading town was located west of the protected passage. Today the area is only occasionally visited by Arab dhows, the traditional trade vessels of the Western Indian Ocean.

The International Journal of Nautical Archaeology provides the format for this thesis.

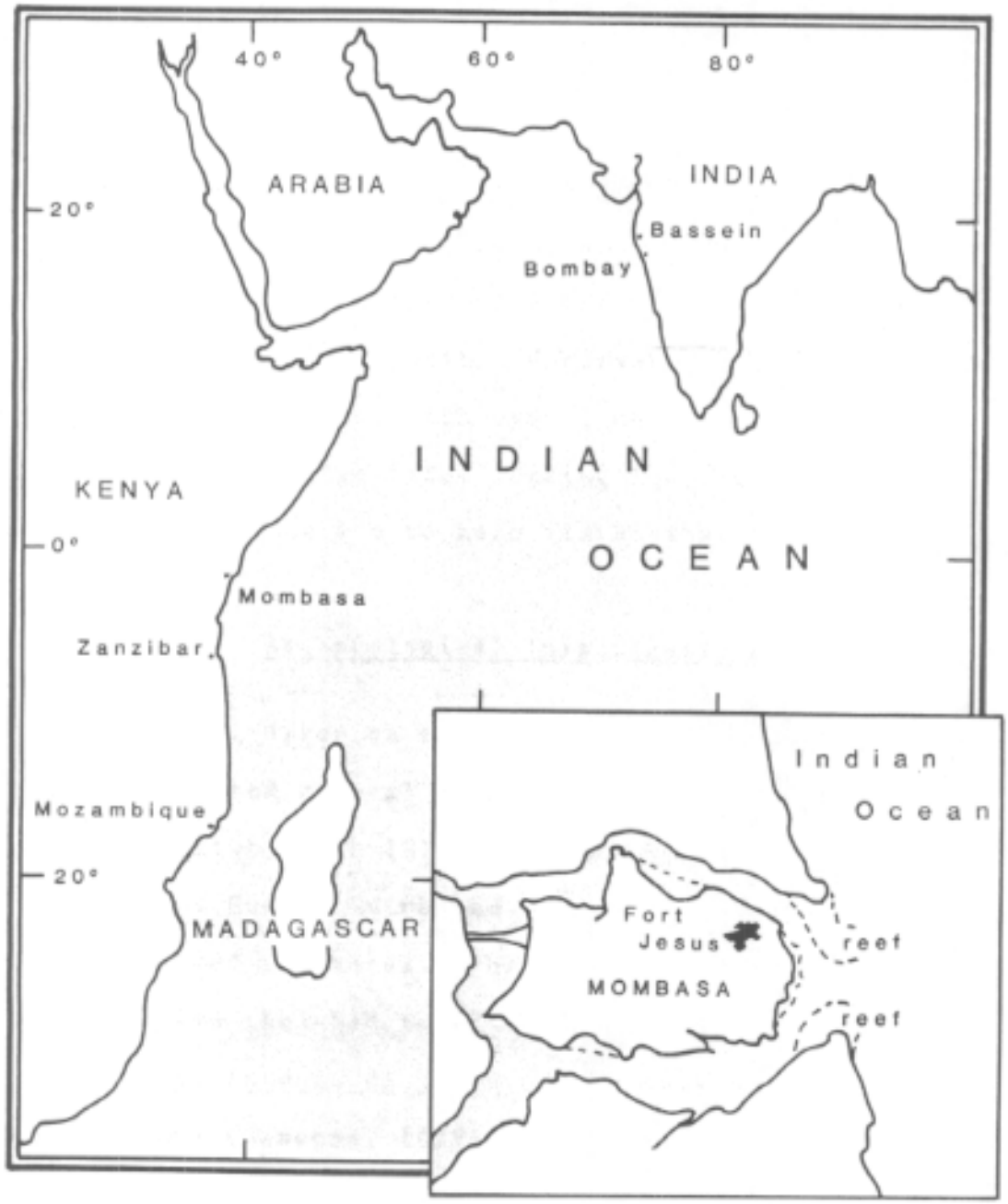


Figure 1: Location of Mombasa, Kenya. B.F. Thompson.

In 1963 Conway Plough and Peter Phillips, two local sport divers, discovered the wreck of a late 17th-century Portuguese warship below the fort and about 150 m from its outworks. The shipwreck lies diagonally across a 30 degree slope, at a depth of 13 to 16 m, with the bow pointed down and out toward the channel entrance.

A mixture of fine silt, sand, and broken coral covers the site to a maximum depth of 2 meters. Modern debris lies over the top of this deposit. Underwater conditions vary according to the tides, with over 1 knot current and 10 m visibility during high tide. During low tide there is minimal current and 1 m to zero visibility.

Archaeological Investigations

Occassional dives on the wreck site by Plough and Phillips produced several artifacts that were dated to the late 17th Century. In 1970 Dr. James Kirkman, then curator of Fort Jesus Museum, directed limited underwater excavation on the site and recovered more artifacts. The results led him to believe they had found the wreck of the Portuguese frigate Santo Antonio da Tanna, which sank below the fort walls in 1697 (Sassoon, 1978:33).

In 1976 Don Frey and Robin Piercy, from the American Institute of Nautical Archaeology (AINA), examined the wreck. They conducted a magnetometer survey over the site and estimated its dimensions to be 32 m long and 8 m wide.

In addition, several anomalies appeared downslope from the wrecksite (Piercy, 1976:3). At the end of their reconnaissance, they laid plans for a controlled excavation to begin the following year.

In 1977 a 27 meter-long lighter, a vessel without means of self-propulsion, was moored over the wrecksite and excavation began in earnest (Fig. 2). Grids (2 m x 2 m) were laid over the central portion of the wreck. A trench excavated across the wreck revealed the main mast step, deck supports and two well preserved pumps. Further work uncovered the majority of the ship's stern section and port-side framing (Piercy, 1977:331-347). Large deck knees, found on the port side, indicated the location of the lower gundeck, which is estimated to be 3.2 m above the keelson.

Artifacts raised during this field season included cannon shot, a sword hilt, wooden ink wells, compass boxes, rigging gear, and pottery. Several collapsed barrels, found in the stern, were sandwiched between fallen ship's structure and ballast. Compasses, sailmakers palms, a wooden plate, boxes of nails and bolts, a wooden bucket, cannon quoins, and large quantities of rope discovered in the same area suggested a boatswain's store.

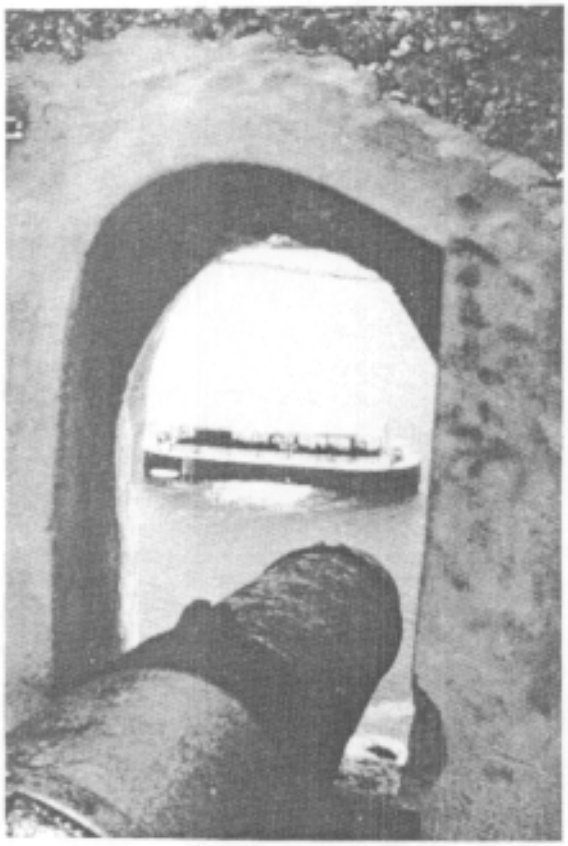


Figure 2. Excavation lighter over site. R.C.M. Piercy.

Excavation during the 1978 season exposed the remainder of the ship's stern section as well as an area 8 m forward of the mast-step (Fig. 3) (Piercy, 1978:301-319). A large mound of sail and rope was found hidden behind a longitudinal wooden partition located on the stern port side of the wreck. The discovery of caulking tools and unused caulking added further support to the presence of a boatswain's store.

The season also produced Chinese porcelain, lathe-turned hardwood furniture, reed matting, and a brass powder horn. Two large concreted boxes, adhering to several metal rigging elements, were loosed from the hull by means of a small

explosive charge. Elsewhere on the wreck, the divers found a horn comb, shell lantern lights, and leather.

Besides expending 987 diving hours on the site, progress was made on other fronts as well. Jeremy Green of the Western Australian Museum produced several hull profiles and Wendy Turner of the Museum of Wales started iron and ceramic conservation. In addition, stereo-photogrametry produced excellent hull records of the cleared stern area.

The hull remains were completely exposed during the 1979 field season. Excavators accomplished a trilateration of the exposed timbers in an attempt to accurately determine known points on the wreck. This would later be used to develop a plan made from stereo pairs of photographs (Piercy, 1979:302).



Figure 3. Underwater photograph of the mainmast area. R.C.M. Piercy.

The bow contained a complete stoneware Martaban olive jar with stamped neck, Portuguese faience, unglazed Indian flasks and more than 400 cannon shot. Among the small finds were musket balls, brass buckles, and Chinese porcelain.

Divers spent more than 1,300 hours underwater during the 1980 season, the last season of excavation, revealing more than 3,500 objects downslope from the hull remains. So many artifacts were encountered that the divers did not have time to complete the excavation of the downslope area. The result is that only the area between amidships and stern was excavated and recorded. Further work is necessary to uncover the area from amidships to bow.

Excavators uncovered evidence pertaining to the captain's life onboard the vessel by the recovery of a brass table bell, two identical pewter juglets, a silver-plated candlestick, a bowl and several porcelain plates (Piercy, 1980:110). Other finds excavated from this area include a wood-carved Portuguese coat of arms, a carved wooden figure and a bronze swivel gun, dated 1677.

Not enough can be said for the remarkable amount of work accomplished over four years of excavation (Fig. 4). Although financial and logistical problems constantly plagued the project, high archaeological standards were maintained. Because of logistics and conservation costs, no thought has been given to raising and conserving the ships' hull.

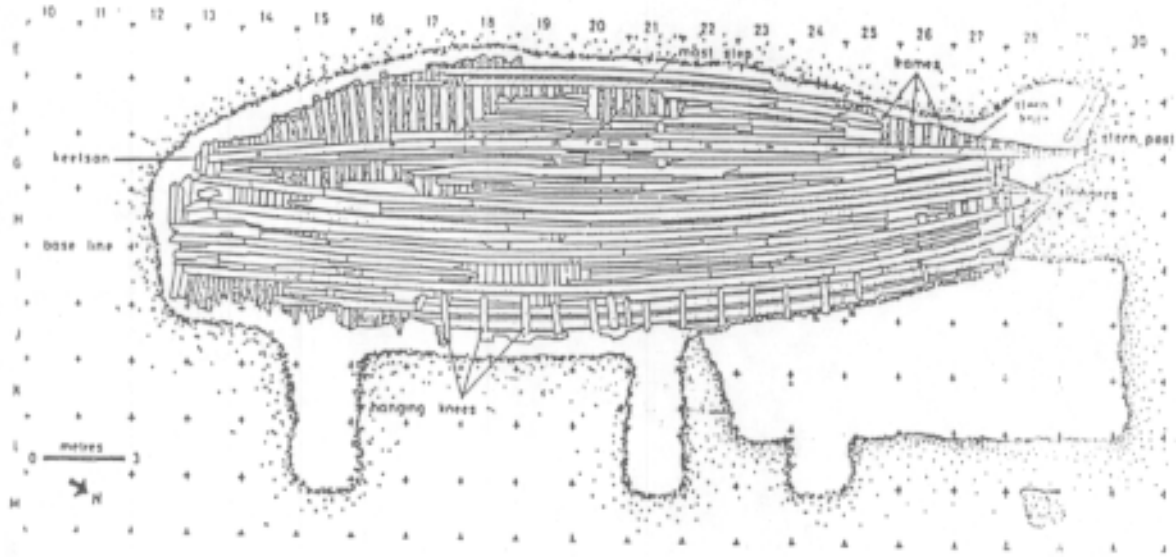


Figure 4. Plan showing the area excavated to date. Adapted from original lines by R.C.M. Piercy.

1981 and 1982 were study seasons. Artifacts were recorded, drawn, and catalogued before being conserved at the Fort Jesus Conservation Laboratory. Considerable time was spent casting hundreds of concretions containing the iron objects that had completely degraded, leaving only a mold of the former objects. Each concretion was cleaned of residual corrosion products and cast with special epoxies. Several of the iron rigging elements were measured through this technique of artifact recovery.

Over 6,000 artifacts have been recovered from the four years of excavation and documented in the two study seasons on the Mombasa Harbor wreck. To date only the compasses, ship's pumps, ceramics and armaments have been analyzed and

reported (Davis, 1979; Shuey, 1981; Sassoon, 1983; and Darroch, 1986).

Age and Origin of the Wreck

This shipwreck can be dated, with some certainty, to the later part of the 17th Century. In the absence of historical records relating the saga of the Santo Antonio da Tanna the ship could be identified, by careful analysis of the recovered material, as being a 17th-century vessel of Portuguese origin that had traveled to exotic ports throughout the Indian Ocean.

The age of the ship is substantiated by two discoveries of dated artifacts. In 1970, Dr. Kirkman's excavators uncovered a bronze swivel gun which bore the date of 1678 (Venter, 1973:72, and Sassoon, 1978:33). A second discovery, made during the last season of INA's excavations in 1980, was a small bronze breech-loading swivel gun with an inscribed date of 1677 (Piercy, 1980:109).

Additional evidence for the vessel's origin comes from the many Portuguese artifacts recovered over the years. Portuguese glazed bowls brought to light in 1977 have parallels found in excavations at Fort Jesus. Other objects that point to an Iberian origin are Portuguese blue and white glazed earthenware, a religious medallion with Roma in exergue, and a carved wooden Portuguese coat of arms.

The vessel's ports of call are hinted at by the

remarkable variety of ceramics found on the site. The following is a list of the various items encountered: a coarse unglazed earthenware bowl from Mozambique; large, crude wooden bowls indicative of local African craft found even today in Mombasa; Persian Gulf glazed storage jars (Fig. 5); thin-walled unglazed flasks from India; Chinese



Figure 5: Glazed storage jar. R.C.M. Piercy.

blue and white porcelain bowls attributed to the K'ang Hsi's reign (1662-1722); and a Siamese black-glazed jar.

The age and origin of the Mombasa Harbor Wreck, as indicated by its contents, further supports Dr. Kirkman's earlier assumptions. A review of the history of Santo

Antonio da Tanna further illustrates the parallels between the Mombasa Harbor Wreck and this ship.

History of Santo Antonio da Tanna (1681-1696)

Santo Antonio da Tanna, a 42-gun Portuguese warship, was loosed from its cradle at a shipyard on Thana creek, near Bassein, India in 1681 (Boxer, 1984:34). Thana is situated in what was then a great timber-producing district (Mookerji, 1962:18) and Bassein was the headquarters of the 'Portuguese General of the North' in the later half of the 17th century, the largest habitation of the Portuguese, and was second in importance only to Goa (Apte, 1972:16). Built of teak by Portuguese architects and Indian laborers, the sturdy frigate served Portugal in the Indian Ocean for 16 years.

Her whereabouts between 1681 and 1694 have yet to be traced. It is likely she saw duty along the coast of India and may have participated in the supplying of forts along that coast as well as those of East Africa.

An important source for determining Portuguese ship traffic in the Indian Ocean during the 17th Century is "Da Navegacao Portuguesa no Indico no Seculo XVII," published by Alberto Iria, director of the Ultramarino Archives in Lisbon (Iria, 1963). The work contains original letters, requests and permissions made by authorities of the State of India and of Portugal.

From these records we can determine some of Santo Antonio da Tanna's movements before she sank at Mombasa Harbor. We know she completed one round-trip voyage in the Carreira da India (Fig. 6) and was in Lisbon between the end of 1694 and the end of 1695 (Sassoon, 1983:17). Documents of the Ultramarine Counsel state that the capitana Nossa Senhora da Gloria and another ship, Santo Antonio da Tanna , were sent south in February of 1696 with aid for the India State (Iria, 1963:222). Nothing is stated concerning the countries they visited nor the length of time they spent at sea.

The fate of Santo Antonio da Tanna and the fall of Fort Jesus, in the last decade of the 17th Century, will forever remain symbols of the collapse of Portuguese power on the East African coast. Primary sources for these events include the anonymous Historia da Mombaca Museu de Marinha, Lisbon and Bibliotheca Nacional Fundo Geral 584 Lisbon and de Castro de Mello, the Planta da Ilha de Mombaca e discricao de principio do seu cerco ate o fim delle... (Biblioteca Nacional, Rio de Janeiro 1-25, 28.2, no. 5). Translations of these records have been the basis for modern histories of the events, such as Axelson (1960), Boxer and Azevedo (1960), Kirkman (1964, 1974) and Strandes (1961).

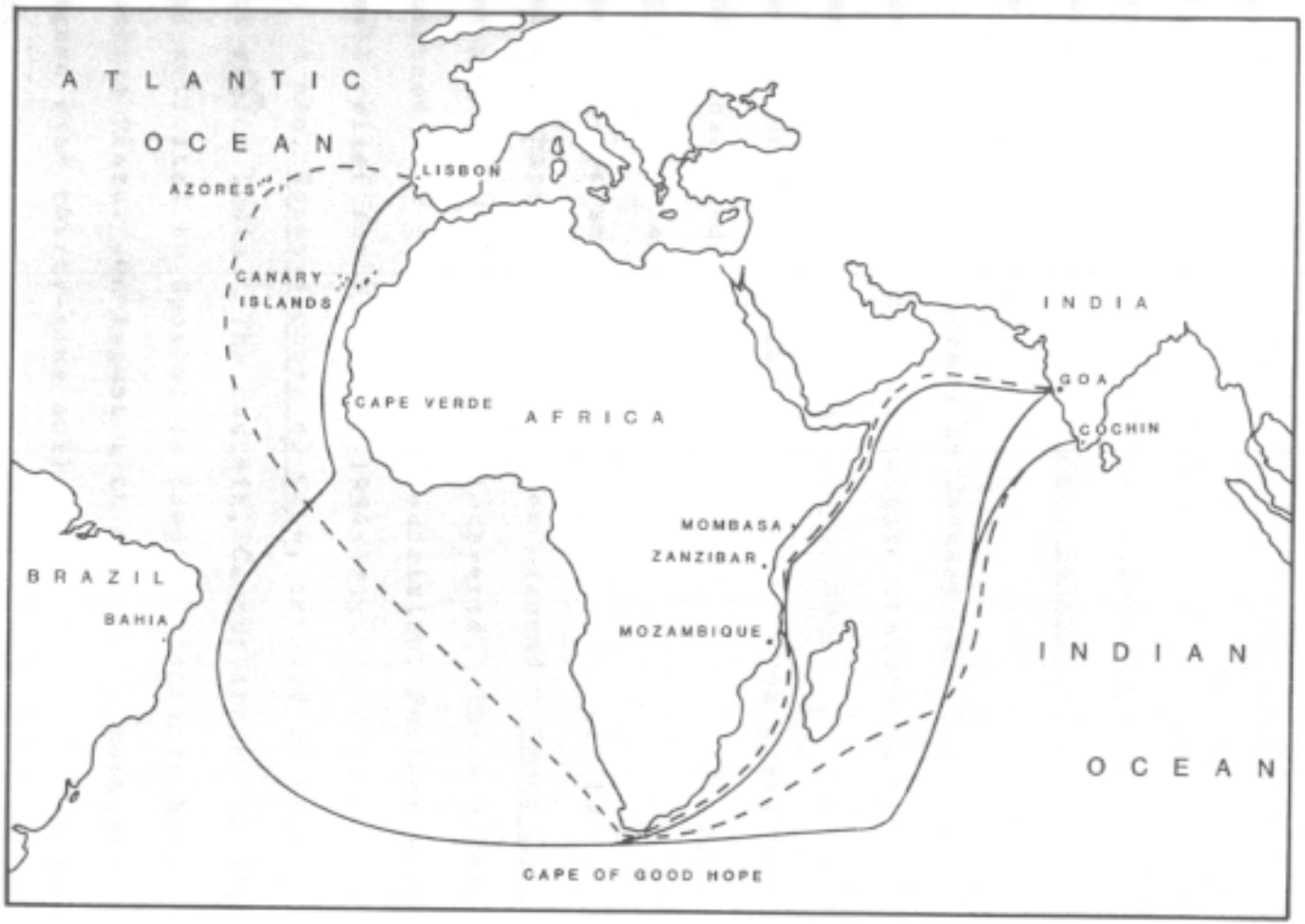


Figure 6: The route of the Carreira da India during the 17th century (solid lines represent the outward voyage and dashed lines the homeward voyages. Adapted by author from original lines by C.R. Boxer.

We again hear of Santo Antonio da Tanna on November 25, 1696, now upgraded to carry 50 guns (Axelson, 1960:163). She sailed as the flagship of the relief force under the command of General Luis de Mello de Sampio, sent to relieve the fortress of Mombasa which was beseiged by the Omani Arabs. Together with another frigate Nossa Senhora do Valle two galliots and 400 men, Santo Antonio arrived in Mombasa on December 28, 1696.

Moved from anchorage on January 14, 1697, due to the loss of some anchors, the frigate cruised to and fro, landing supplies in small boats. On January 25, the Santo Antonio sailed for Mozambique and arrived there February 5, 1697 (Boxer and Azevedo, 1960:63). Meanwhile, Nossa Senhora do Valle was left to cruise off the Mombasa coast. During April of the same year Mozambique was struck by a hurricane and all ships in the harbor ran aground. Santo Antonio lost her rudder, which was later recovered. These problems, combined with disease and malnutrition, further weakened the small relief force (Boxer, 1984:57).

A nao, Nossa Senhora do Cabo, arrived in Mozambique on its way to India. The captain, Gaspar Aranha de Alancastre, was solicited by General de Sampio to provide help to rescue Mombasa Plaza. On August 17th of 1697 Captain Alancastre signed over thirty-nine sailors and eleven cabin boys (Iria, 1963:227).

Santo Antonio then sailed to Zanzibar and anchored there

September 8th. A near mutiny by crewmen wishing to return to Goa added further difficulties to the Captain's efforts to return to Mombasa, but on September 15th the vessel arrived off Mombasa (Axelson, 1960:168). This time General de Sampio sailed into Mombasa Harbor and anchored near Fort Jesus. He stretched three cables and a warping line at the poop while under fire by three enemy batteries (two on the island and one on the mainland).

The frigate, now anchored fore and aft near the fort outwork so as not to swing with the tides, came under heavy attack by the batteries. According to the Historia de Mombaca, Santo Antonio da Tanna was so closely engaged that "...not only did every shot strike her hull, but even the wadding from the besiegers guns inflicted casualties among the men on the frigate's deck" (Boxer, 1984:41). The strength of her hull kept her afloat throughout this barrage, but it is highly likely that her masts, yards and upper-structures suffered greatly from the ordeal.

To further add to the ship's plight it was set on fire by a chance explosion of a barrel of grenades, but the fire was extinguished by the crew. On September 18 an attempt to change the moorings was unsuccessful because the anchors held fast in the rocks. On October 20 the cables broke and the ship, with 150 men, was carried to a reef northeast of the island where it lost its rudder for a second time (Strandes, 1961:229).

When the tide rose, Santo Antonio cleared itself and was swept near an enemy battery. A party of 28 men from the fort succeeded in taking the battery and towing the frigate close to the fortress. Shortly after this incident the frigate sank but not before many of the stores had been removed and taken to the fort.

Fort Jesus was eventually overtaken by the Omani forces and many of the guns onboard Santo Antonio da Tanna were removed a year later by the conquering troops. In 1727 three Portuguese frigates were assigned to reconquer the fort but their attempt failed.

Both the location of the Mombasa Harbor Wreck and the artifacts found on her substantiate the belief that we have uncovered the remains of the Portuguese frigate lost during Fort Jesus's historic siege. As will be seen in the chapters that follow, further parallels between the Mombasa Harbor Wreck and Santo Antonio da Tanna can be drawn by a study of the rigging artifacts.

CHAPTER II

LITERATURE REVIEW

Rigging components from actual 17th-century European ships are rare, and rigging components from 17th-century Portuguese ships rarer still. For this reason I have had to depend heavily on contemporaneous and modern writers for clear descriptions and examples of rigging components. Even with this, published material concerning Portuguese ships' rigging is as scarce as the number of excavated parallels.

The earliest contemporary source for 17th-century rigging elements comes from John Smith's A Sea Grammar (1627), which covers the entire spectrum of ship-building from the construction dock to the launching event. Sir Henry Manwayring wrote a maritime lexicon called The Sea-man's Dictionary (1644) that is referred to as one of the earliest English dictionaries dealing with the vocabulary of a particular art or science. Sir Edward Haywards, writing in 1666, included in his text the proportions of bos'n's stores and carpenter supplies.

Sir Anthony Deane, a shipwright for the Royal English Navy, published his Doctrine of Naval Architecture in 1670 (Lavery, 1981). It was, in its time, the most influential book about the art of ship architecture. His ships' designs guided shipbuilders from neighboring France to distant Russia.

Two excellent 18th-century works are from the Scottish sailor and poet William Falconer, who produced An Universal Dictionary of the Marine (1768) and the English writer David Steel, who wrote The Elements and Practice of Rigging and Seamanship (1794). This latter publication was improved upon by Captain George Biddlecombe in 1848 and republished in 1969.

Books illustrating shipbuilding techniques for Dutch, French and English ships are plentiful. A 1700 publication by Nicolaes Witsen Architectura Navalis et Regimen Nauticum presents a history of seafaring which includes graphic information about Dutch shipbuilding. French shipbuilding is described and illustrated in a 1758 text, Architec Navale authored by M. Duhamel du Monceau.

Our closest hull profile parallel comes from the rudiments and rules of English shipbuilding as presented in M. Stalkartt's Naval Architecture (1787). A similar English source dealing with the rules of shipbuilding during the 17th century is The History of Marine Architecture by John Charnock (1801).

The best modern publications for 17th-century rigging are by R.C. Anderson, Seventeenth-Century Rigging - A Handbook for Modelmakers and The Rigging of Ships - In the Days of the Spritsail Topmast 1600-1720 (1974 and 1982), who writes for the model-maker using original sources as the basis for his study. Both of these works were originally

published as one book in 1927. Also founded on contemporary sources is James Lee's The Masting and Rigging of English Ships of War 1625-1860 (1979), which tends to list the proportional scales of rigging components rather than describe them.

Jean Boudriot's three volume description of a French Seventy-Four Gun Ship (1975) is a monumental attempt at archaeologically detailing the construction of an 18th-century ship. Two of these volumes have recently been translated into English by David H. Roberts (Boudriot, 1986). Boudriot's most recent publication is called "John Paul Jones and the Bonhomme Richard" (1987). The text lists the reconstruction measurements of the French ship Duc de Duras and offers detailed descriptions of timberheads and other deck fittings common to the period.

Frank Howard's, Sailing Ships of War, 1400-1860 (1979) has long been a good review of major differences between period warships. Two recent publications about sailing ships of war are Peter Goodwin's Sailing Man of War (1987) and John Harlands Seamanship in the Age of Sail (1984), which is a beautifully illustrated text which describes seamanship on board a man of war.

Historians have recorded the loss of hundreds of 17th-century Portuguese ships. Some of these wrecks have even been relocated and partially salvaged, for example the Santo Alberto , the Santo Joao Baptista (Kennedy, 1955), and

the Bassein, India built Sacramento (Allen and Allen, 1978; and Guilmartin, 1981). To date only one Portuguese shipwreck has been archaeologically excavated, the Mombasa Harbor Wreck.

The search for archaeologically recorded parallels is rewarded when one looks to 17th-century Dutch shipwrecks, of which there are more excavated examples than from any other European nation. Among the better reported Dutch wrecks are the flute Lastdrager, wrecked in 1653 (Stenuit, 1974), Vergulde Draeck, wrecked off Australia in 1656 (Green, 1973), Kennemerland, lost in 1664 (Price and Muckleroy, 1974), Meresteyn, built in 1693 and lost in 1702 (Marsden, 1975), and Amsterdam, which sank under less than noble conditions in 1749 (Marsden, 1972).

The English frigate Dartmouth sank within the Sound of Mull in 1690. She was a fifth rate carrying 28 to 32 guns on her two full decks and single quarter deck (Holman, 1975). The two best preserved 17th-century vessels are the Swedish Wasa, wrecked during her maiden voyage in 1628 (Stenuit, 1974; and Franzen, 1961) and the Jutholmen Wreck, whose origin and date of wrecking have yet to be ascertained (Cederlund and Ingelman-Sundberg, 1973; and Cederlund 1982). This latter vessel has tentatively been dated, using artistic analysis of carved ship's structure found on the wreck, to between 1650 and 1700.

This review does not contain every source available on

17th-century European shipbuilding and rigging practices, but it does represent a broad overview of those sources used in determing major similarities and differences between our wreck and the common practice of the day.

CHAPTER III

THE HULL

> "Naval architecture is not an exact science, it begins with exact science and then averages... The difference between good reconstruction and bad reconstruction is knowing where to place the curves."
>
> - J. Richard Steffy 1981

The reconstruction process, from wreck remains to ships' lines, begins during the excavation. Control and discipline are necessary throughout the process and to this end the archaeologist lists the major features and measurements of all timbers. Following the original construction process in reverse he attempts to collect information about the architecture, technology, nationality and people involved in the ship's original construction. In order to reconstruct ancillary yet vital components of a hull, ie. a ship's rigging, it is necessary to have a basic understanding of the hull shape and its association to rigging artifacts.

This chapter is included in an effort to propose basic hull features as they exist for the Mombasa Harbor Wreck. A brief discussion of the wreck remains is presented first. Length-to-beam ratio, tons burden, frame size, mast size, deck beam size and gunport location are the criteria from which I have chosen a particular sheer plan and hull profile. By proposing a hull shape for the Mombasa Harbour

Wreck, we can better predict the riggers intent to follow the "curve" between the hull and the ship's rig.

Extant Hull Remains

Should this vessel represent the remains of Santo Antonio da Tanna, certain things can be stated about her condition before she settled upon the seabed of Mombasa Harbor. Although the hull held up under constant battering by Arab cannon shot, she must have suffered some damage to her superstructure and rigging. After all, we know that sailors were being wounded by the wadding from the enemy's cannon. There is also historical evidence for a fire onboard, although the extent of damage is unsubstantiated and only a few burnt artifacts have come to light. Several of the Santo Antonio's cannon were salvaged soon after the seige, possibly causing further damage to the rigging. Beyond this, we do not know the extent of salvage activities over the years that followed.

Nearly three hundred years of submergance under the waters of Mombasa Harbor caused deterioration and loss of perishable materials as well as substantial weakening of major constructional features. The current swept away many loosely attached items such as running rigging components, sail material and loose rope. Perhaps the most detrimental ingredient in the ship's wrecking process was its dispersion down a 30 degree slope.

According to Muckleroy, who wrote an evaluation of twenty shipwreck sites in British waters, a site with the extent of hull remains such as ours would normally fall into a Class 1 wreck category (Muckleroy, 1978:164). Class 1 wrecks have extensive structural remains, many organic remains, many other objects and coherent artifact distribution. Environmental attributes for a class 1 wreck compare favorably to our wreck with the exception of one, namely slope average over whole site. Our wreck remains lay over a 5.2 degree slope, which would normally be a class 4 attribute, rather than the expected minimal slope.

Upon sinking the Mombasa Harbor ship settled upon an upper ledge, where it began the slow deterioration process. In time it slid off the ledge and down to its present location (Piercy, 1982:personal communication). Regardless of the ship's initially "gentle" deposit on the upper shelf, once the hull slid off and down a 30 degree slope, cannon movements on the deck or decks, masts tearing from their steps, and rigging holding tight at their anchor points must have caused some calamic changes to the hull. Surviving chainplates were found to be twisted at the bow and stern and bent over at amidships (Fig. 7).

The attached lower rigging remains, and the wood which held them, broke from the hull and eventually were covered by sediment along a line approximately 4 m outside the bulk of the hull remains. The masts appear to have been

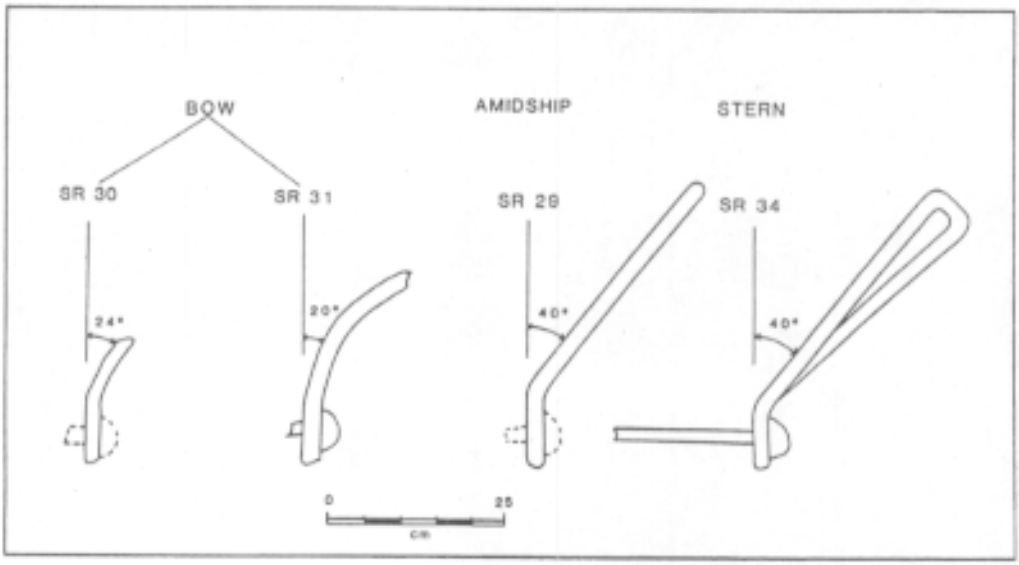


Figure 7: Chainplate angles for bow, amidships and stern. B.F. Thompson.

separated from the ship together with major deck structures. Standing rigging remains verify much of this hypothesis since only those parts connected to the hull have been located. Their attachment to the hull kept them from being taking away with the masts.

The way in which she eventually settled to the bottom of Mombasa harbor and the protection afforded by artifacts and sediment covering the hull seems to account for the abundance of the ship's lower remains (Fig. 8). Digging beneath the hull proved to be both difficult and dangerous and for this reason we have no measurements of the timbers

of the outer hull. A review of the major statistics for this vessel includes those inner hull timber measurements most useful for a hull study (Table 1).

The estimated tonnage for this ship was determined by a 17th-century formula for burden (Fox, 1980:174):

$$\frac{\text{beam x beam x keel length}}{188}$$

It is not the traditional tonnage formula that was used between the 13th and 17th centuries (Steffy, 1981:personal communication), which is:

$$\frac{\text{keel length x max. breadth x keel length}}{100}$$

Fox's formula has been used here since much of our comparative data for proposed hull shapes comes from his ships lists.

Table 1: Extant timber dimensions and major statistics.

Keel length (est.)	> 30.0 m (98.43 ft)
Keelson length	26.5 m (86.94 ft)
Main-mast step	4.0 m x 6.0 m
Main-mast step mortice	48 cm x 21 cm
Frames	20 cm x 20 cm
Ceiling planks est. thickness	2.0 cm
Stringers	7 port; 2 starboard
Knees (15 extant)	min. length 70 cm; max. length 1.75 m; min. width 20 cm; max. width 30 cm
Deck stanchions (5 extant)	max. length 2.8 m
Pump sumps	32 cm x 37 cm
Tons burden (est.)	526.1 tons
Beam (maximum)	9 m 65 cm (31.7 ft)
Depth in hold	3.2 m (10.5 ft)
Beam-to-length ratio	1:3.1

Figure 8: Wreck Plan I (Hull Remains). Adapted from a drawing by R.C.M. Piercy.

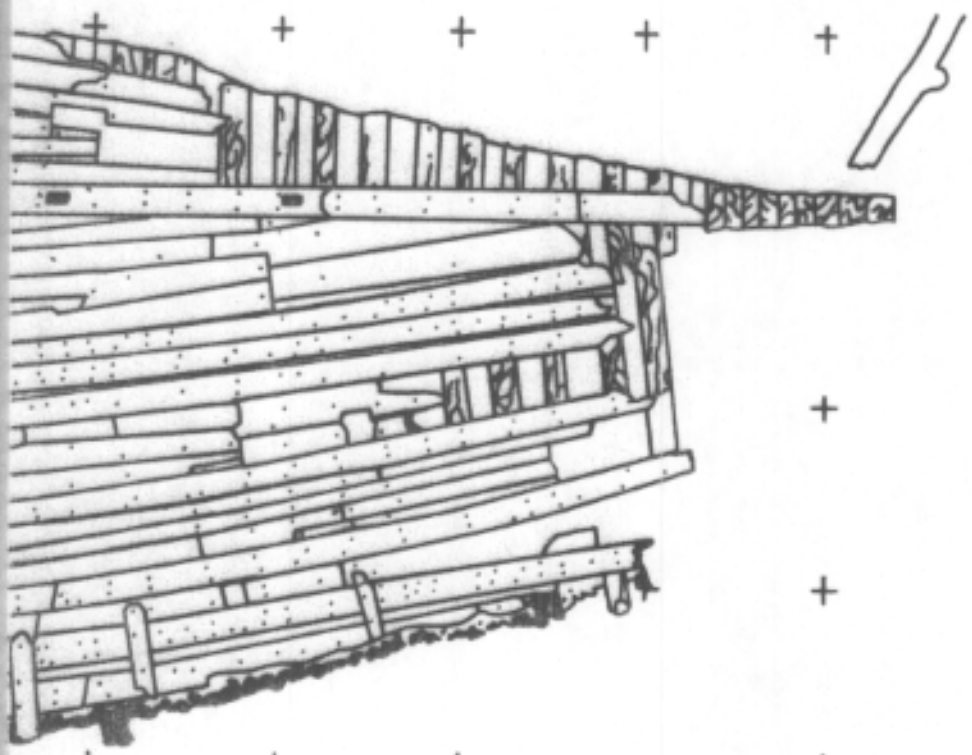
By comparing our hull measurements to contemporary sources, excavated 17th-century shipwrecks, and depictions of period vessels I have been able to produce a possible gunport plan for the Mombasa Harbor Wreck. When the resulting upper hull shape is compared to the best surviving chainplate and chains, found downslope from the mainmast, the major similarities become apparent and a hull profile can be deduced.

Proposed Hull Shapes

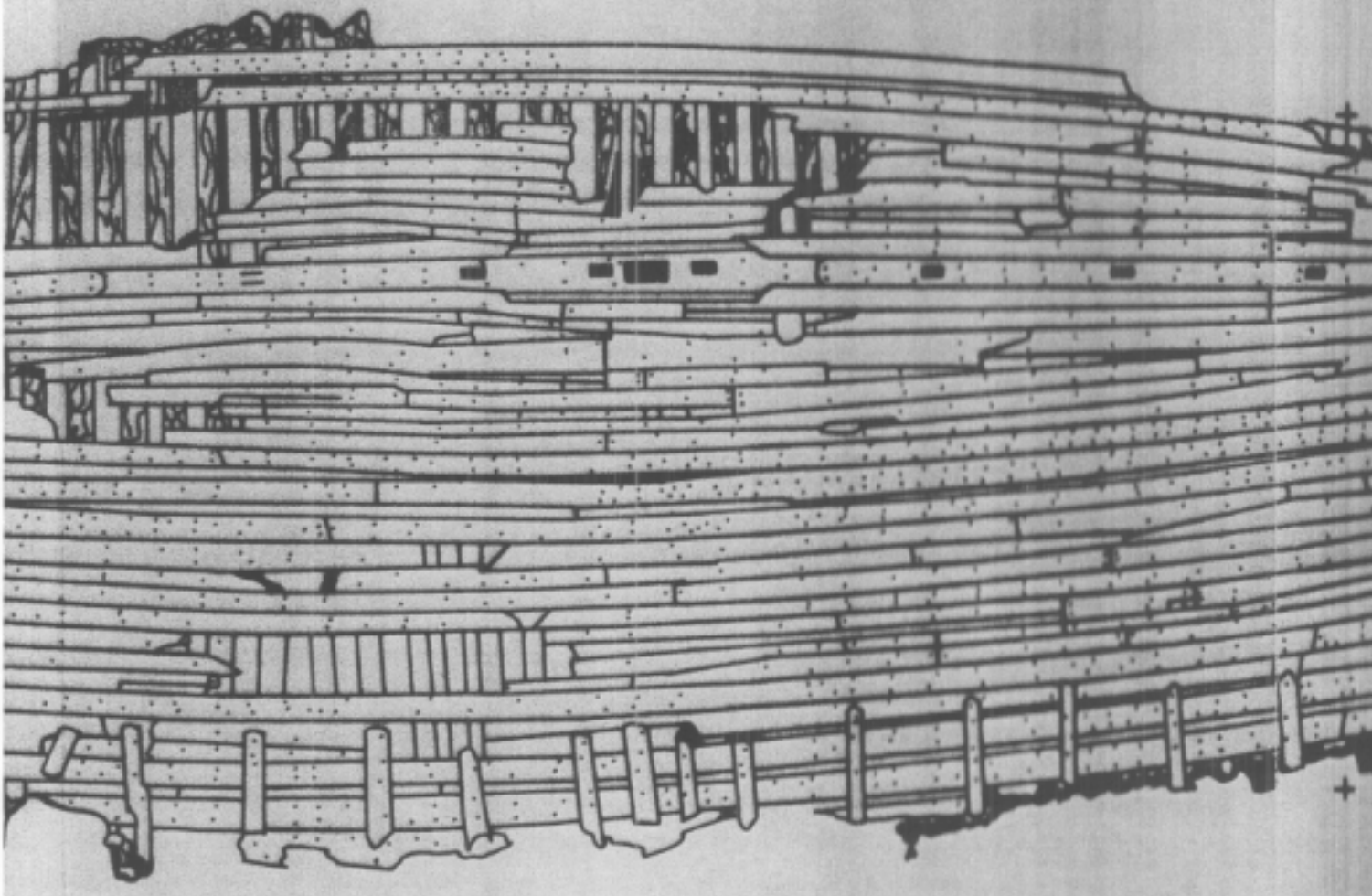
The following reconstruction efforts are by no means meant to be definitive. Their inclusion here is to set the basis for understanding rigging features as they may be reconstructed for the Mombasa Harbor ship. The basic criteria chosen in developing these hull shapes includes length of keel, deck beam size, depth-in-hold, tons burden, and gunport locations. Since excavations under the hull were never completed we can only estimate the length of keel.

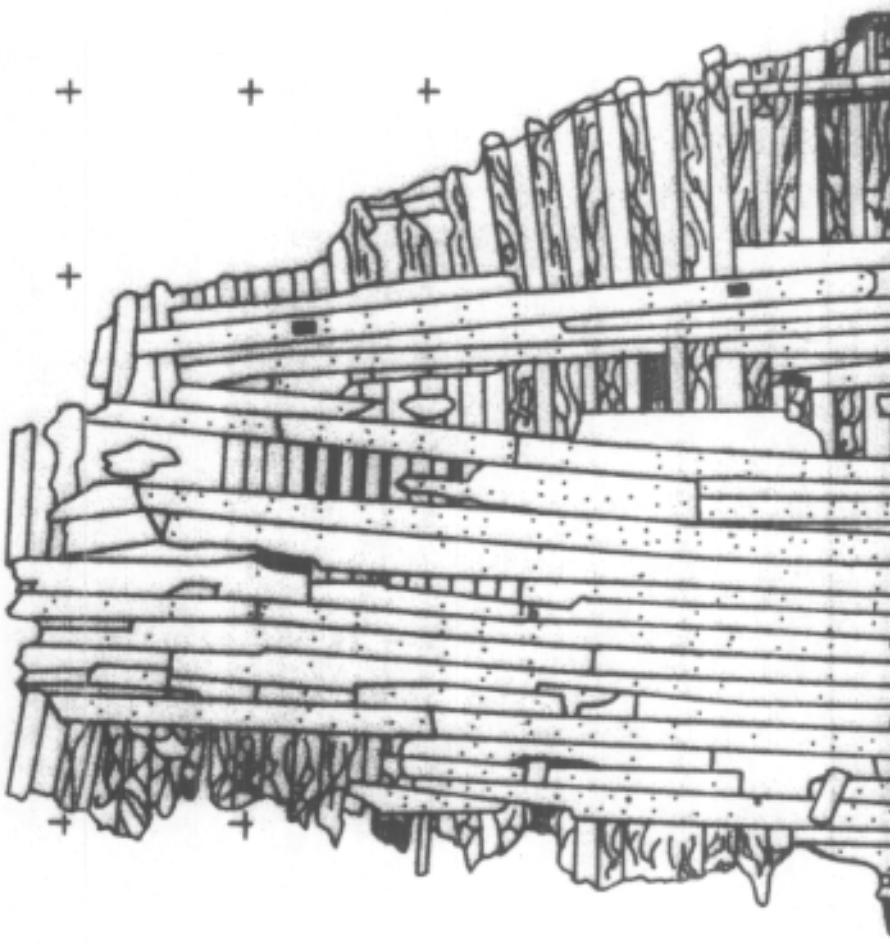
As stated above this vessel has a keel length of 98.43 ft, a beam of 31.7 ft, a depth of 10.5 ft in the hold, a tonnage of 526.1 tons and was originally built to carry 42 guns (capable of upgrading to 50 guns). When these statistics are compared to comparable lists of English fourth-rate warships and prizes recorded during the middle

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to late 17th century, it becomes apparent that our vessel could be described as a fourth-rate warship (Table 2).

Probably the most important clue to the basic hull form is the size and location of fifteen deck knees uncovered on the port side of the vessel. According to Deane, deck beams connected to the knees were placed in such a fashion that every other deck beam supported a cannon (Lavery, 1981:60). This provided space for the gunners to do their job and at the same time allowed proper clearance for the lower gunports and standing rigging chains. This practice is further verified by most cut-away views on ships' plans for 17th-century warships.

Finding 17th-century Portuguese ships' plans or even major ships' measurements has proven to be most difficult. The only Portuguese hull measurements I could find were for the Convertine, a fourth-rate warship captured by the Dutch in 1666 (Fox, 1980:179). Although somewhat larger, the Convertine might have been a good parallel for our vessel had we the actual ships' plans.

By comparing the Mombasa wreck remains with known hull shapes of Swedish, Dutch, English and Danish ships we can better hypothesize possible gunport locations for our vessel. When the hull remains were overlain by one example in particular, the Danish Delmanhoest recorded in 1707, a pattern of gunport locations emerged. In 1987 Robin Piercy aquired photographs of the Delmanhoest plans

Table 2: Fourth-rate warships of the 17th Century (adapted from Fox, 1980:176-180).

from	built	name	keel	beam	dep.	ton	guns
Port.	1681	Santo Antonio	98.4	31.7	10.5	526	42
from	**built**	**name**	**keel**	**beam**	**dep.**	**ton**	**guns**
English	1681	Mordaunt	101.9	32.4	13.0	567	46
English	1650	Advice	100.0	31.2	12.3	516	48
English	1683	Bonaventure	102.6	32.2	12.4	564	48
English	1681	Tiger	104.0	32.8	13.8	590	48
from	**taken**	**name**	**keel**	**beam**	**dep.**	**ton**	**guns**
Royalist	1651	Marmaduke	87.0	31.5	15.2	457	42
Dutch	1673	Arms of Terver	96.0	32.0	11.9	523	52
Dutch	1665	Golden Lion	101.4	28.6	13.0	438	42
Dutch	1665	Unity	95.0	24.6	9.2	303	42
Algerines	1681	Golden Horse	101.0	36.8	14.1	722	46
Algerines	1682	Two Lions	92.6	33.6	13.6	552	44
Port.	1650	Convertine	103.0	30.0	13.6	493	42

from the Rigsarkivet Museum in Denmark. These photographs were used as the basis for our gunport locations.

The Delmenhoest carried 50 guns and had two gun decks and a quarter deck. She had a keel length of 122 feet, a beam of 37 feet and a depth of hold of 16 feet. This vessel was somewhat larger than ours, so that the total number of gunport locations had to be reduced for the illustration. Although it cannot be established that the Santo Antonio would have had exactly the same sheer lines throughout, the gunport placement follows our deck knee pattern very closely.

The Santo Antonio da Tanna was a 42-gun warship upgraded to a 50-gun warship at the time of her last departure from

India. The fact that she could accomodate so many extra guns may have been partly due to extra deck space and to a greater extent to the use of smaller guns. Whatever the case her suggested hull shape more closely resembles that of the Delmenhoest than any other whose are known to survive (Fig. 9).

Having decided on a basic gunport placement, the next step was to develop a hull profile shape which corresponded closely to the gun position plan. In this case, the hull profile measurements taken by the INA divers in 1978 compared remarkably well to our chosen hull plan, especially when the extant port-side profiles were "mirrored" for the missing starboard-side of the Mombasa Harbor Wreck (Fig. 10). Dotted lines in the figure represent projected hull shapes and hull components, while solid lines represent extant hull features. Profile A was taken along a line just abaft the main mast-step across the pump wells, Profile C was taken 3.2 m further astern, and Profile B was taken 6.5 m further aft of Profile C (see Fig. 9 for exact profile locations).

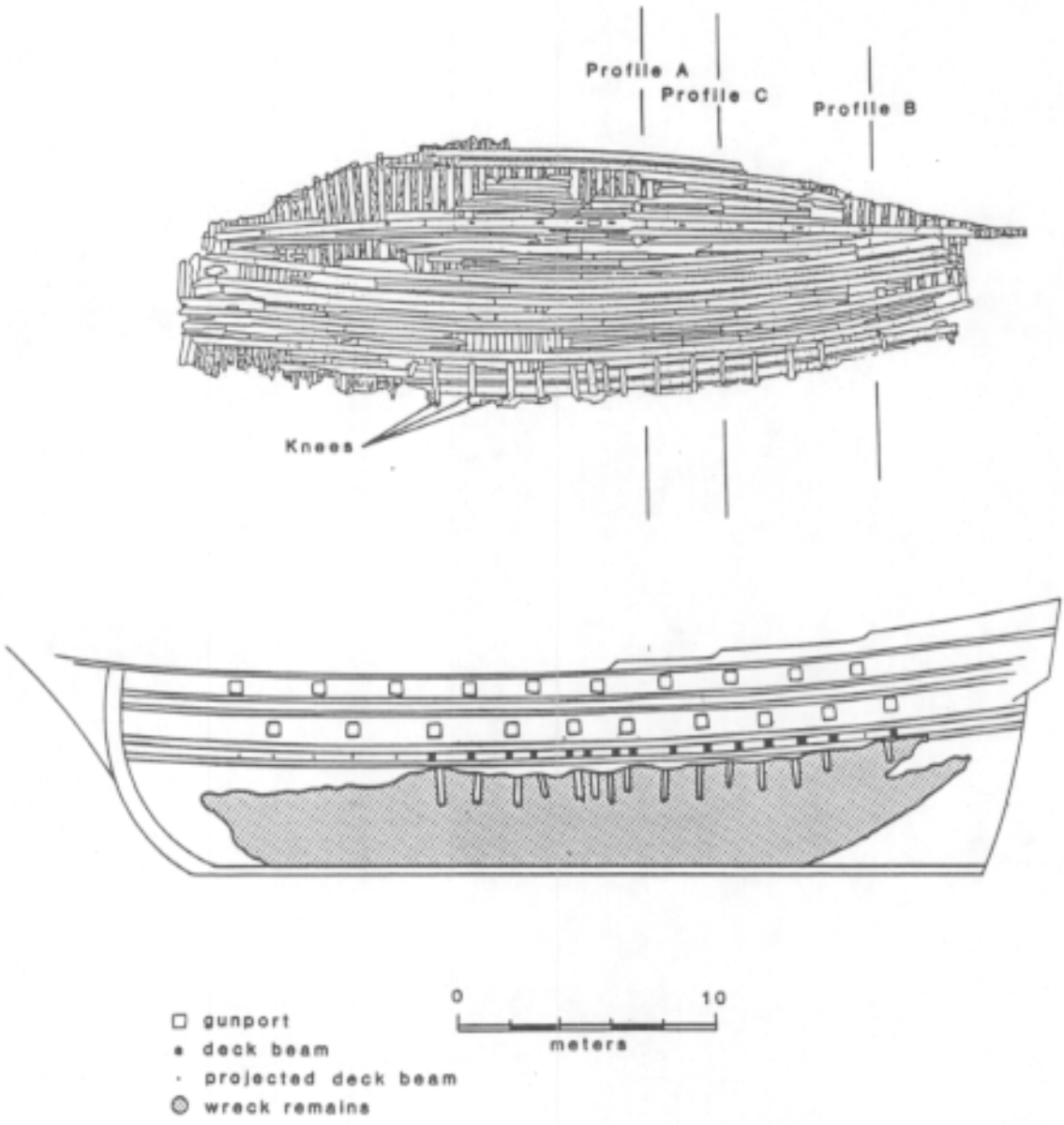


Figure 9: Deck beam and gunport projections. B.F. Thompson.

The location of the first deck could be established when the hanging knees were placed at a level which allowed for a 3.2 m depth of hold, the estimated height of the first deck above the keelson (Piercy, 1977:339). At this point it was necessary to match the midship chains to the preliminary hull profile in order to estimate the distance between the first deck and the gunwale. Once this was accomplished it became obvious that the vessel might have had a second gun deck amidships, as illustrated in Figure 11.

The closest parallel to the resulting hull profile comes from Stalkartt's depiction of a mid-17th century English frigate (Stalkartt, 1787:49). The location of its first gundeck is exactly 3.2 m above the limberboards and the lower hull shape matches ours with the same degree of accuracy. The un-named vessel had two gun decks and carried 54 guns.

These proposed hull shapes will be used in Chapter V to illustrate the standing rigging of the Mombasa Harbor hull. A more detailed reconstruction is being developed and will be published by R.C.M. Piercy and Jeremy Greene.

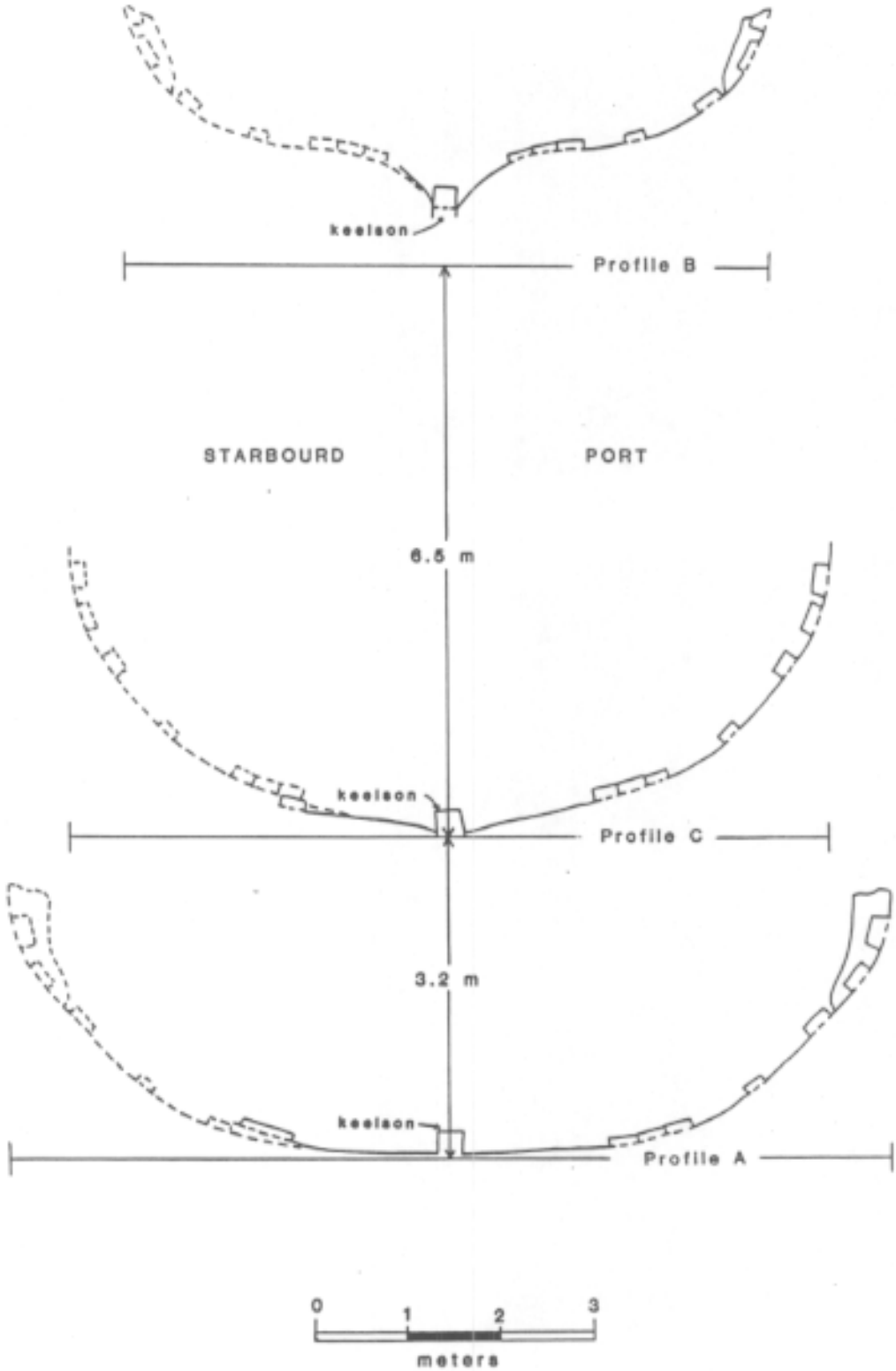


Figure 10: Interior hull profiles (missing starboard side has been mirrored using extant port side). B.F. Thompson.

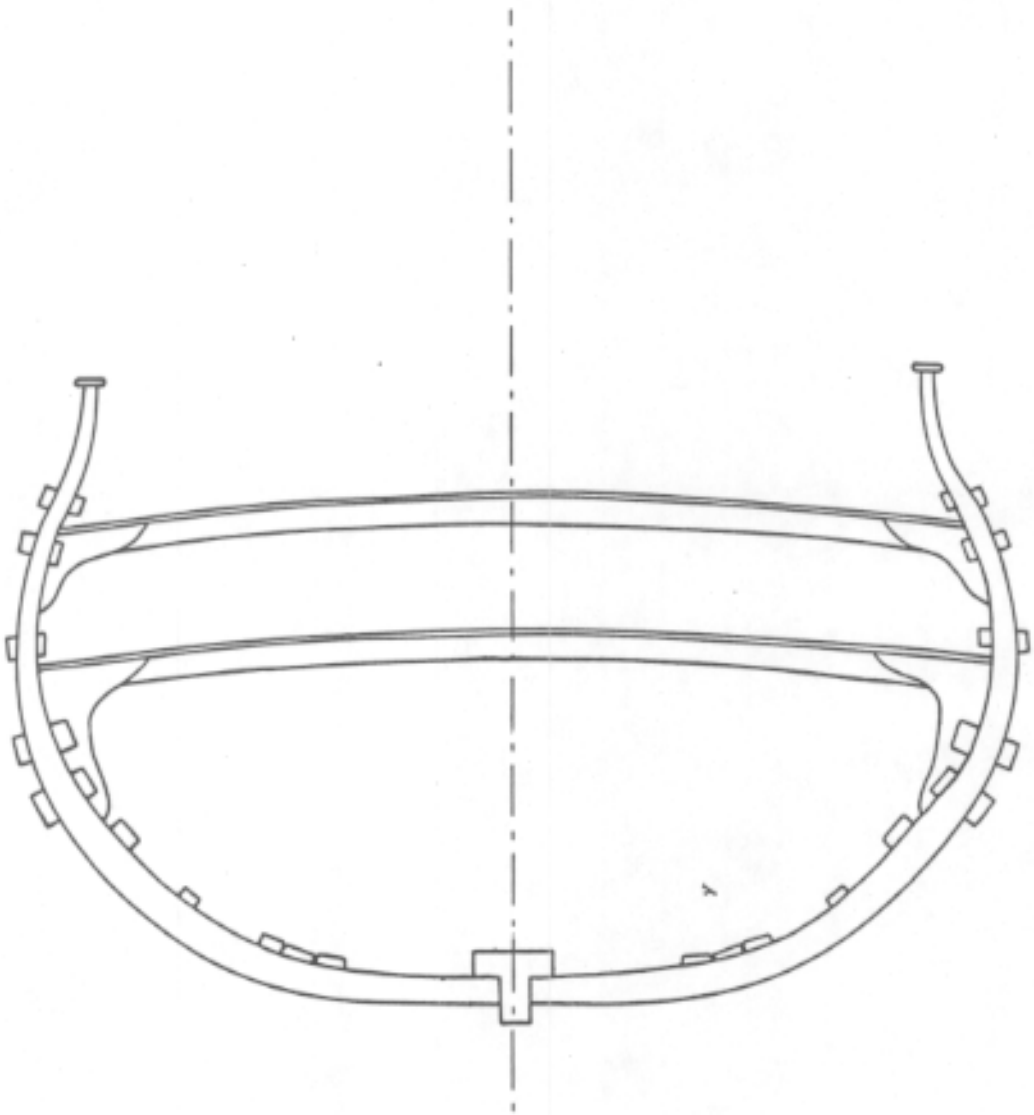


Figure 11: Projected midship profile (scale: 15 mm = 1 m).
B.F. Thompson.

CHAPTER IV

DECK AND HULL FITTINGS

Introduction

The 237 artifacts identified as rigging components have been categorized according to function. They fall into four basic groups and are presented in this and the following three chapters of this thesis. Chapter IV is a review of those objects, made of wood or iron, which would have been fitted to the deck or hull to assist in the ship's rigging. Artifacts that pertain to the vessel's standing rigging are discussed in Chapter V, and those that are associated with running rigging are listed in Chapter VI. A sail bundle, parcelled rope, and four sailmakers palms comprise Chapter VII. Wreck plans illustrating the distribution of each artifact category are provided at the end of each chapter. The catalog form is adapted from Yassi Ada, A Seventh-Century Byzantine Shipwreck (Bass and van Doorninck, 1982). For the most part, standard measurement abbreviations have been used in the artifact record form. Where it was necessary to shorten certain artifact part names, the simplest abbreviation was used, eg. sheave, sh.. The following abbreviations will be used throughout the catalog (Table 3).

Table 3. Legend of abbreviations.

MH	Mombasa Harbor	d	Depth
HF	Hull fittings	ht	Height
SR	Standing rigging	thk	Thickness
RR	Running rigging	w	Width
SA	Sail Artifacts	gr	Groove
Prov	Provenance	sc	Score
sp	Spoil	sh	Sheave
l	Length	sw	Swallow
o l	Overall length	p	Pin
dia	Diameter	prts	Parts
i d	Inner diameter	str	Strands
o d	Outer diameter	yn	Yarn
x-sec	Cross-section	ap	Aperture of a hook

The metric system was used for all artifact dimensions appearing in the catalog.

Deck and Hull Fittings

Deck and hull fittings include those wood and iron objects that were originally fastened either to the deck or hull and utilized in the ship's rigging. On 17th-century ships, deck fittings would have included such things as knightheads, bitts, timberheads, masts, mast partners, and capstans; hull fittings included such items as ring-bolts, preventer bolts, chain-bolts, hookbolts, channels, clevels, cleats, fairleads, and belaying-pins.

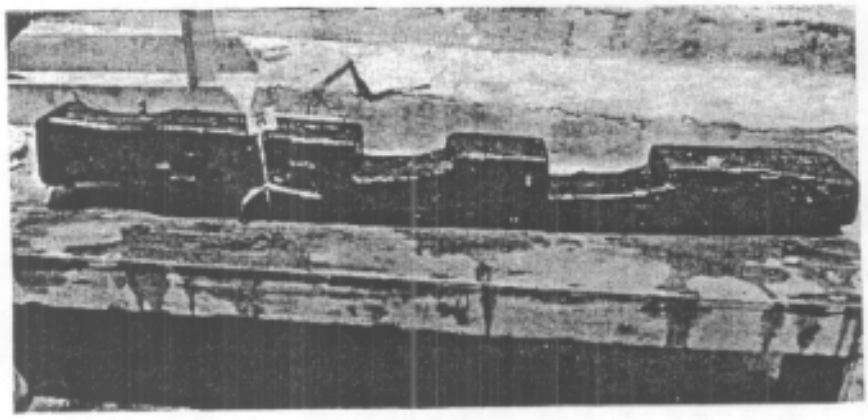
Thus far, the only artifact recovered from the Mombasa Harbor Wreck that has been identified as a deck fitting is a 1.32 m long bitt. It has been included under the heading of hull fittings for the purpose of expediency only. Better represented for our vessel are the hull fittings which include 30 ringbolts, 1 ringplate, 2 hookbolts, 2 fairleads, and 1 cleat.

Bitt

All sources agree about the basic definition of a bitt. It was a frame composed of two upright pillars, sometimes referred to as pins, with a crosspiece fixed to them and with its lower lengths bolted to deck beams. Smaller bitts were fitted in square-rigged sailing vessels for securing other parts of the running rigging, such as topsail-sheet bitts, paul-bitts, carrick-bitts, windlass-bitts, gallows-bitts, and jeer-bitts (Kemp, 1976:86).

They all served the same purpose, providing a convenient means of taking a securing turn with the fall of whatever piece of rigging was involved. There were also what the Dutch called 'small knights' which were upright timbers with sheaves in them fixed in various places to the inside of the bulwarks (Anderson, 1974:43). The arrangement of smaller bitts placed along the rail is exemplified by a plate of a mid 17th-century English frigate in Stalkartt's Naval Architecture (1787:213).

The use of timberheads, knightheads, small knights and bitts dictated their location on the deck or decks. The Mombasa Harbor Wreck a bitt, HF 01 (Fig. 12), was found downslope of the hull remains and in line with a point just aft of the main mast-step. The purpose of this bitt is suggested by its size and location on the wrecksite. The size of HF 01 suggests a topsail sheet-bitt which would



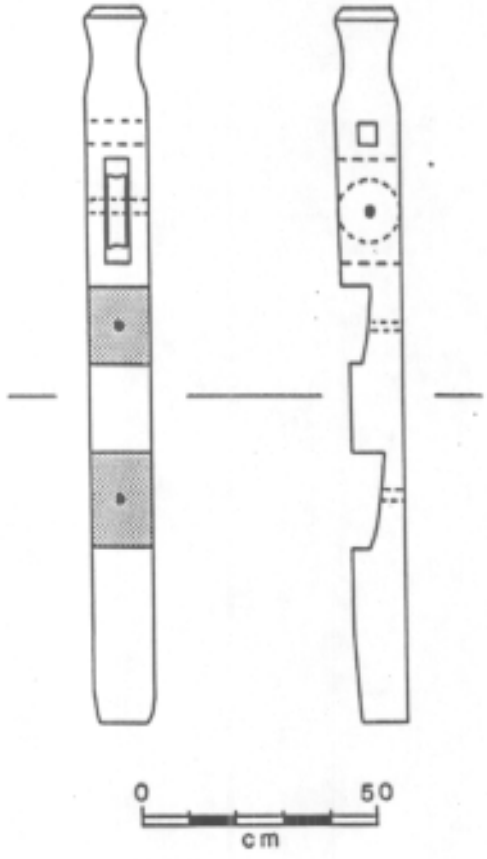


Figure 12: Photograph and drawing of bitt, HF 01. Photo by A. Darroch and drawing by B.F. Thompson.

have been located just in front of the main or mizzen mast. A sheet-bitt was used to make fast the topsail sheets while the larger jeer-bitts, just abaft the mast, were used to make fast the lower haliards and other top ropes (Anderson, 1982:78).

HF 01. Bitt. Inv. No. MH 0440
Figs. 12, 13, 14 ; Wreck Plan II

o. l. 1.520; max. w. 0.135; min. w. 0.095; square hole 0.040 x 0.045; sh. slot l. 0.220; sh. slot w. 0.050; sh. dia. 0.130; sh. thk. 0.043; sh. pin dia. 0.030; cross-piece slot l. 0.160; cross-piece slot w. 0.130; cross-piece slot max. dep. 0.060; cross-piece slot min. dep. 0.030; bolt hole dia. 0.020; deck beam slot l. 0.210; deck beam slot w. 0.130; deck beam slot max. dep. 0.065; deck beam slot min. dep. 0.040; bolt hole dia. 0.020.

Bitt is square in cross-section for most of its length, with one beveled surface at lower end. The timber is made of teak and has survived remarkably well for its time upon the seabed. As of this writing it has yet to go through any conservation process and has been kept in a Dowicide storage solution. Sheave and pin are also made of teak and were found in-situ.

Prov. 21K

Preliminary Bitt Reconstruction

The bitt's location on the site, downslope of the hull remains, suggests that its original location had been amidships, possibly just aft of the main mast. The upper notch is cut to allow a crosspiece which was connected by means of forelock bolts. The lower notch probably fit into a deck beam or ledge and was fastened by a forelock

bolt (Fig. 13). The beveled lower portion of the bitt may have been set into a chamfered fitting that would have been attached to another beam or was set into a step. One anomaly is a small, purposely-cut gouge located just below the lower deck notch (Fig. 13).

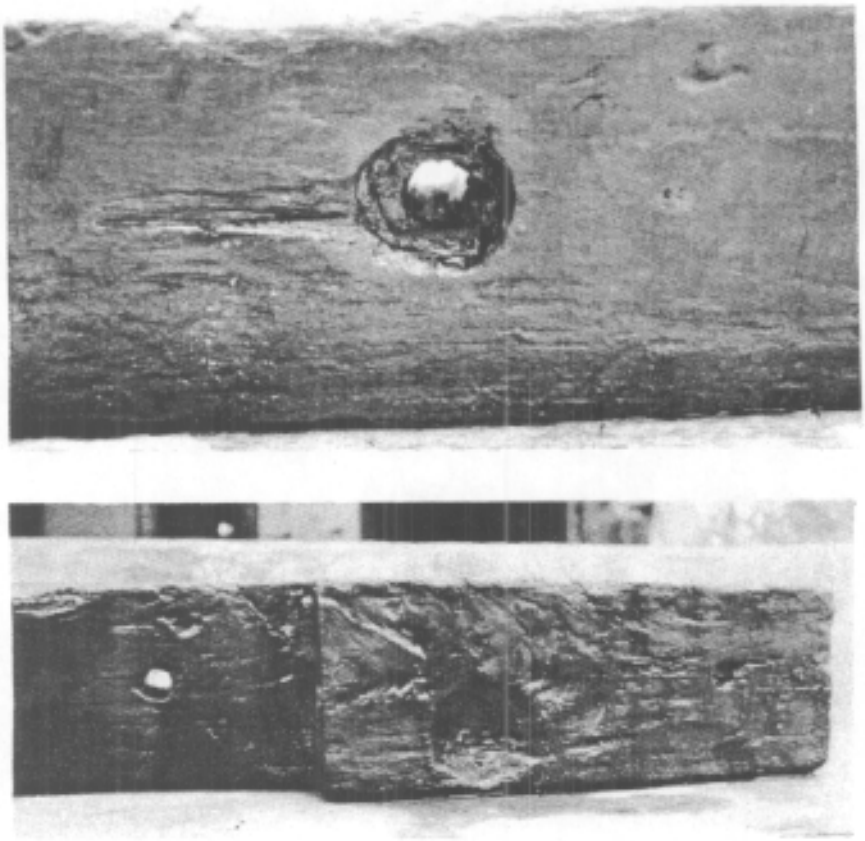


Figure 13: Details of bitt, HF 01 (upper photo shows bolt hole with recess for washer; lower photo illustrates an anomolous gouge). A. Darroch.

Most bitts were fitted so that the lower end would either be attached to another deck beam or be stepped onto a lower deck floor. Neither seems to be the case with the

Mombasa Harbor bitt. The reason for this is that it is too short to project beyond its first deck connection and on to a lower deck. There are indications for a single deck beam attachment only. The bitt's upper notch measurements are small enough to allow for a crosspiece but too small to attach to a deck beam. For these reasons I have projected only the obvious attachment possibilities (Fig. 14). The square beveled head style is similar to what Laughton calls a Dutch timberhead (1925:256), but he admits that the English used a similarly shaped timberhead toward the end of the 17th century.

The deck location of HF 01 is only one hypothesis; there is a possiblity that it could have been set below the second gundeck rather than on it. According to Anderson, who quotes Van Yk, a Dutch author who wrote about shipbuilding in 1697, knights were often set to the lower gun deck of a two-decked warship (Anderson, 1982:76). For the Mombasa Harbor bitt to have been fitted to the lower gundeck, a second lower beam would still be required; thus far there is no evidence for this. Future excavations may reveal other bitts and timberheads which will further add to our knowledge of deck fittings onboard Portuguese ships.

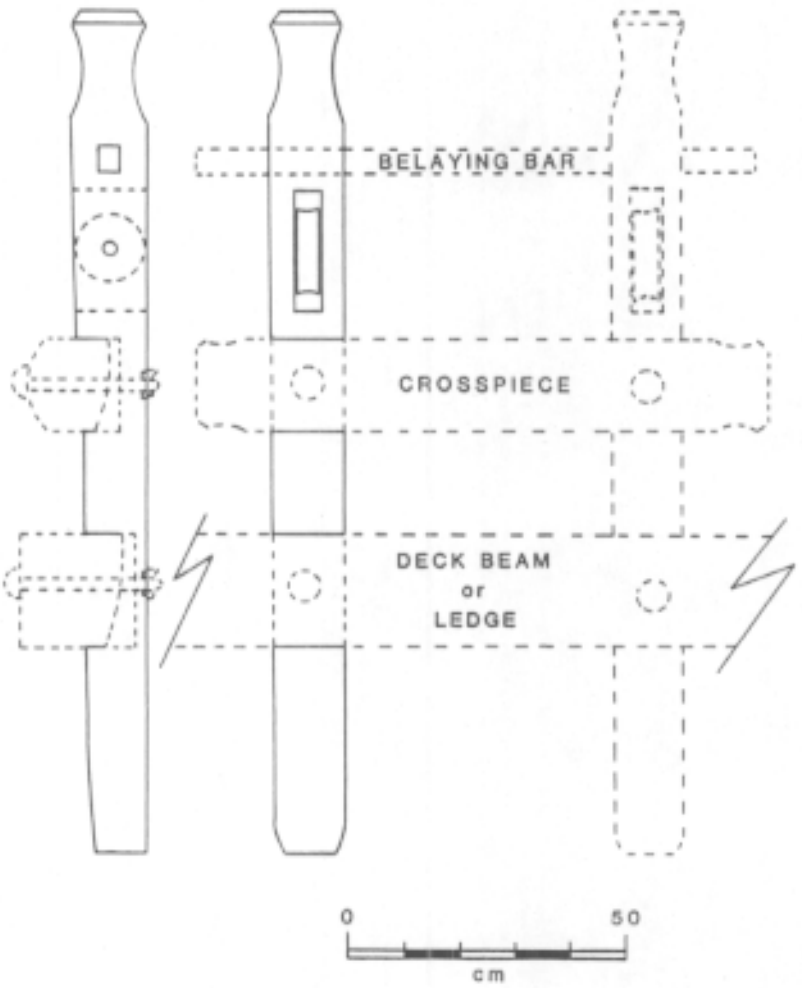


Figure 14: Bitt reconstruction. B.F. Thompson.

Ringbolts

Both Manwayring and Smith describe ringbolts as necessary fasteners for the combining of planks and wales to the ship, as well as purchase points for the tackles and breechings of the "great ordnance" (Manwayring, 1644:11 and Smith, 1627:5). These were not the only functions of

ringbolts onboard a ship. Placed upon the channels they served as fastening points for the four-part tackle or "swifters", simple tackles, and runners. According to Anderson a foreign ship, ie. other than English, would have two ring-bolts in each of the fore and main channels, and their placement would depend to some extent on the location of the ports above and below the channels (Anderson, 1974:38).

The Mombasa Harbor Wreck excavators uncovered twenty-six ringbolts, five rings and one ringplate. Understandably, not all of these rings were used for rigging. The guns required rings for lifts and siezings. Five rings were discovered without eyebolts, HF 07, HF 08, HF 09, HF 11 and HF 32. Three of these had been sprung, possibly during the wrecking event, and two had maintained their original closed state. These artifacts represent the smallest rings found and their proveniences, along a line outside the hull remains, indicate that they could have come from gunport lids. Small diameter rings were used on gunport lids for the securing and lifting of the gunports (Goodwin, 1987: 188).

Twenty of the larger ringbolts were also distributed along the downslope area of the site and six more rings were discovered within the area of the extant hull remains. The downslope ringbolts were probably fitted to the outer hull and some may have been fitted onto the channels. It seems

reasonable to assume that only those rings and ringbolts which were long-shafted and forelocked could have been used on the hull. Those that were short-shafted and clinched can only have been fitted through a single plank or board.

By listing the outer ring diameters (see Table 4) I have been able to estimate the three major size categories represented. The type A category (smallest outer diameter) has 6 examples ranging in sizes between 8 cm and 12 cm, the type B category has 13 examples ranging is sizes between 14 cm and 16 cm, while the type C category (largest outer dia.) has 11 examples ranging in sizes between 17 cm and 21 cm. Four ring examples are illustrated, one from each type category and one with the most complete forelock (HF 05).

HF 02. Ringbolt. Inv. No. MH 6521
Fig. 15 ; Wreck Plan II

Ring: o.d. 0.116; i.d. 0.084; dia. 0.014. Eyebolt: o.l. 0.218; o.d. 0.052; i.d. 0.026; w. 0.018.

Iron ring and eyebolt are both square in cross-section with the eyebolt shaft clenched for 0.058 of its length. It is the only clenched example recovered thus far.

Prov. sp

HF 03. Ringbolt. Inv. No. MH 0982
Fig. 16 ; Wreck Plan II

Ring: o.d. 0.148; i.d. 0.104; dia. 0.022. Eyebolt: o.l. 0.155; o.d. 0.073; i.d. 0.035; dia. 0.024.

Iron ring and eyebolt are both round in cross-section. This is a Type B ringbolt.

Prov. 21K

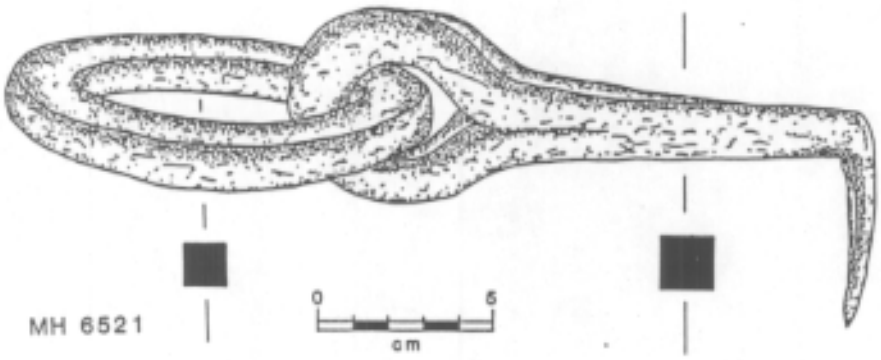


Figure 15: Clenched ringbolt, HF 02. B.F. Thompson.

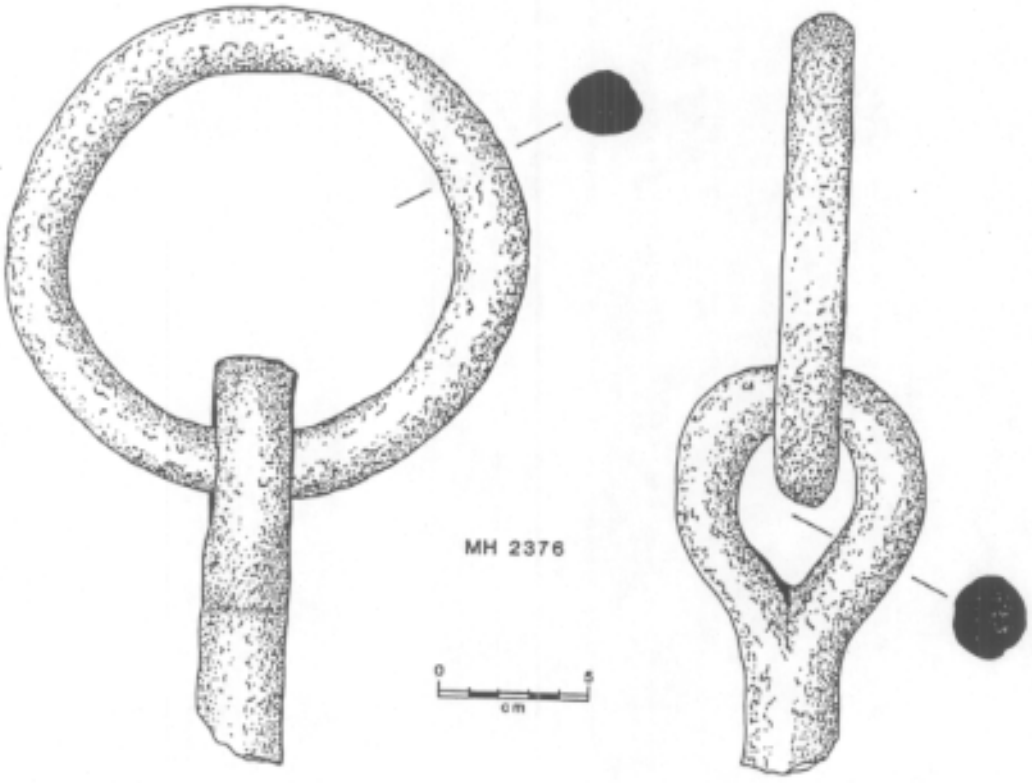


Figure 16. Ringbolt, HF 03. N. Piercy.

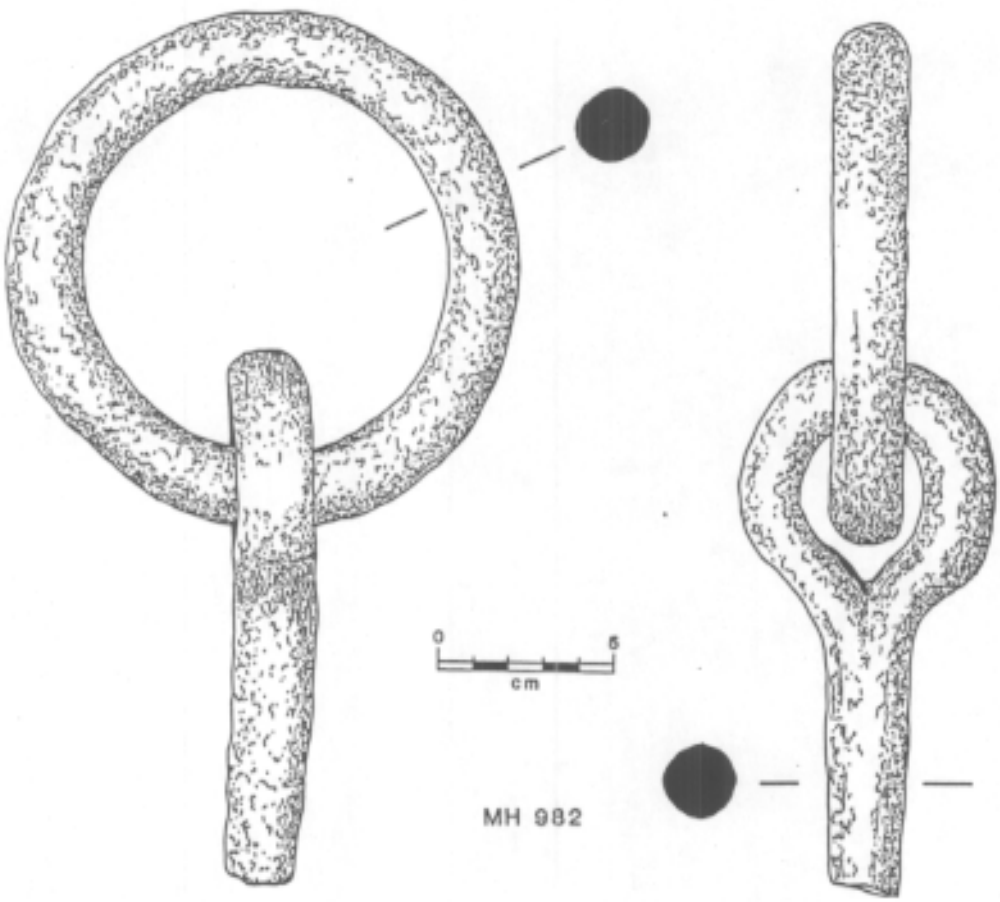


Figure 17. Ringbolt, HF 04. N. Piercy.

HF 04. Ringbolt. Inv. No. MH 2376
Fig. 17 ; Wreck Plan II

Ring: o.d. 0.170; i.d. 0.123; dia. 0.024. Eyebolt: o.l. 0.135; o.d. 0.083; i.d. 0.039; dia. 0.029.

Both ring and eyebolt are round in cross-section. The ring is representive of the Type A category.

Prov. 24L

HF 05. Ringbolt. Inv. No. MH 4969
Fig. 18 ; Wreck Plan II

Ring: o.d. 0.150; i.d. 0.105; dia. 0.023. Eyebolt: o.l 0.438; o.d. 0.025; i.d. 0.069; dia. 0.030. Forelock slot: 0.019 x 0.005.

Iron ring and eyebolt are both round in cross-section This is the only complete forelocked ringbolt recovered from the site.

Prov. 25J

Table 4: Rings and ringbolts from the Mombasa Harbor Wreck (all measurements in centimeters - for distribution see Wreck plan II).

ARTIFACT			RING			EYEBOLT			
HF	MH	Prov	o d	i d	x-sect	o l	o d	i d	x-sect
06	4890	27J	10.0	7.0	1.5	6.3	5.0	2.5	1.7
07	5788	sp	8.6	6.8	1.0	----	---	---	---
08	0257	21J	8.3	5.6	1.2	----	---	---	---
09	2324	15K	8.0	6.0	1.1	----	---	---	---
10	0864	21H	9.3	7.2	1.1	11.5	3.9	1.5	1.2
11	4349	23K	11.6	8.5	1.9	----	---	---	---
12	0976	26H	15.2	10.2	2.5	12.3	9.8	4.4	3.0
13	3333	24J	15.0	10.5	2.3	14.0	8.0	3.2	2.6
14	0433	26G	15.2	10.2	2.5	12.4	9.7	4.3	2.5
15	0897	26G	15.1	10.3	2.5	12.4	9.6	4.2	2.5
16	5652	28I	16.5	10.3	2.8	11.2	9.2	3.5	2.9
17	0144	sp	15.2	10.2	2.5	12.3	9.8	4.3	5.1
18	0896	26G	16.0	10.8	2.7	9.6	8.5	3.5	2.5
19	6517	sp	16.2	11.0	2.6	12.0	9.1	3.5	3.0
20	0128	sp	16.0	16.5	2.8	9.0	7.4	3.0	2.0
21	4790	26J	19.4	14.2	2.6	10.5	7.7	3.3	2.9
22	6499	sp	19.0	14.8	2.6	44.0	8.2	3.8	3.0
23	0967	26H	17.3	12.5	2.6	11.0	7.5	3.1	2.5
24	0139	sp	17.3	12.6	2.6	10.7	7.3	3.2	2.6
25	4970	25J	17.0	12.3	2.5	11.5	7.6	3.1	2.5
26	4031	26K	17.3	12.5	2.6	11.2	7.5	3.1	2.5
27	4140	27I	17.6	12.4	2.0	10.3	9.5	4.1	2.8
28	3097	22J	17.3	12.5	2.6	11.0	7.5	3.1	2.5
29	2402	24J	18.5	12.6	2.8	9.2	8.7	3.9	2.9
30	2403	24J	17.5	12.5	2.6	8.7	8.6	3.8	2.9
31	4356	23K	14.1	9.5	2.3	12.6	7.6	3.6	2.7
32	6613	sp	21.0	17.0	3.0	----	---	---	---

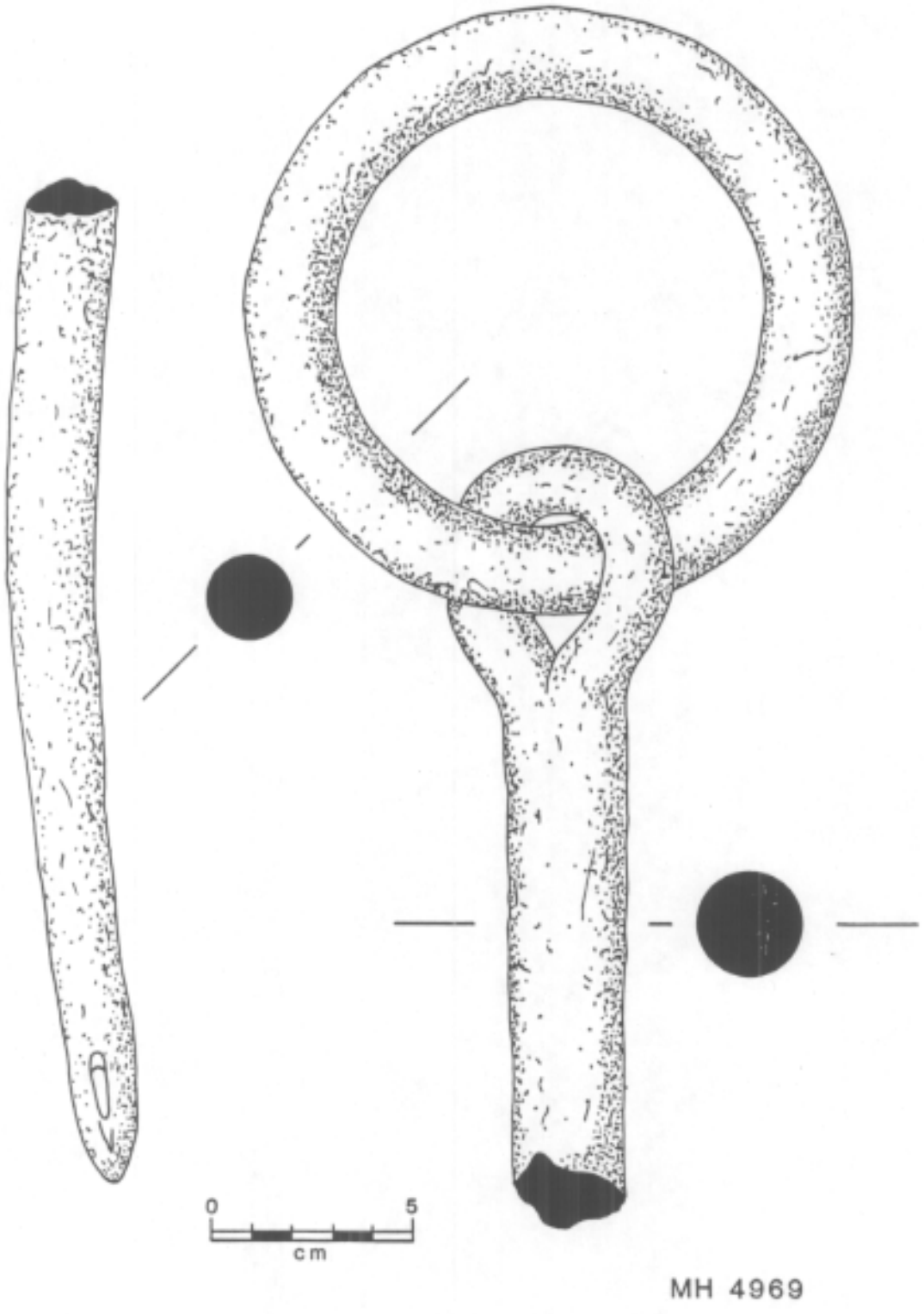


Figure 18: Complete forelocked ringbolt, HF 05. B.F. Thompson.

Ringplate

There is no mention in the literature, neither ancient nor modern, of the function and location of ringplates onboard 17th-century ships. It is possible that this type of fitting was used on gun carriages, but as yet a good parallel has not been found. Only one example of a ringplate has been uncovered from the Mombasa Harbor Wreck, its condition fragmentary and its provenience in doubt (Figure 19). It is presented here in hopes that future parallels may be found.

HF 33. Ring-plate. Inv. No. MH 1257
Fig. 19 ; Wreck Plan II

Ring partial: o.d. 0.200; i.d. 0.151; dia.0.023.
Eyeplate: o.l. 0.122; eye o.d. 0.082; eye i.d. 0.032; thk. 0.016; w.d. 0.064.

The iron ring is only 1/4 of its original size and the plate appears to be only a fraction of its original size. No fastener holes are indicated.

Prov. sp

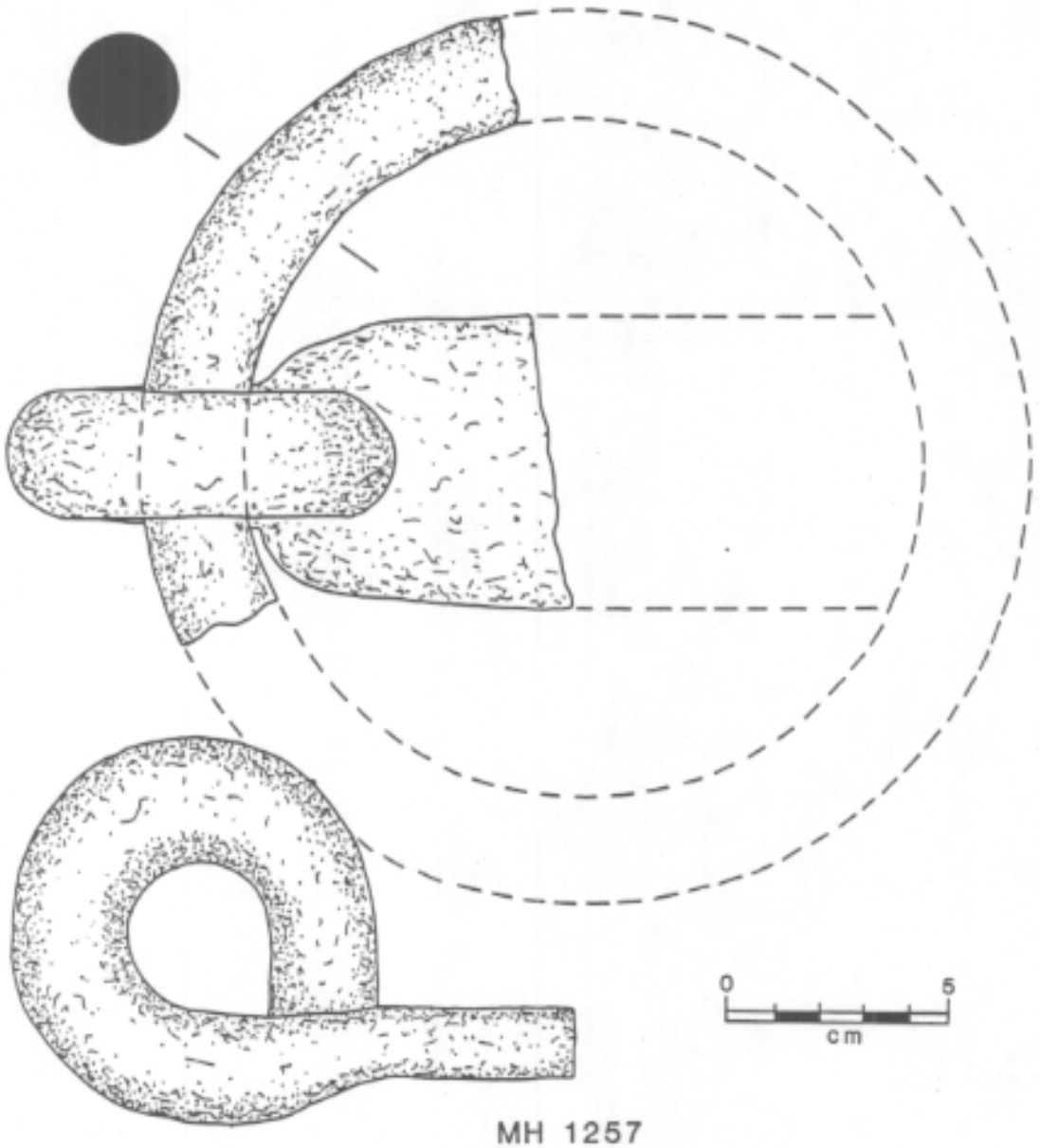


Figure 19: Ring-plate, HF 33. B.F. Thompson.

Hookbolts

Hookbolts are round-shanked bolts with one end made into a hook while the other end is made fast to the hull, probably by means of a wedge and washer. They were used in conjunction with the tackle suspended from the small boat davits and purchase points for running rigging and guns (Boudriot, 1986: 163). Two examples were uncovered from the wrecksite. Found in the area of the main mast one of the examples HF 34 (Figure 19) was most likely attached to the deck before the sinking. The second, more complete hookbolt HF 35 (Figure 20), was found downslope in the stern area with a running hook and thimble concreted to its hooked end. This last example may have been attached to the castle structure, since its provenience is within the area where stern castle artifacts were found, eg. lantern shell lights, carved wood figures, etc..

HF 34. Hook & Washer. Inv. No. MH 0365
Fig. 20 ; Wreck Plan II

Hook: o.l. 0.155; max. w. 0.114; aperture 0.080; dia. 0.030. Washer: o.d. 0.056; i.d. 0.028; thk. 0.023.

Iron hook has an iron deck washer attached to it, just below the hook aperture.

Prov. 21G

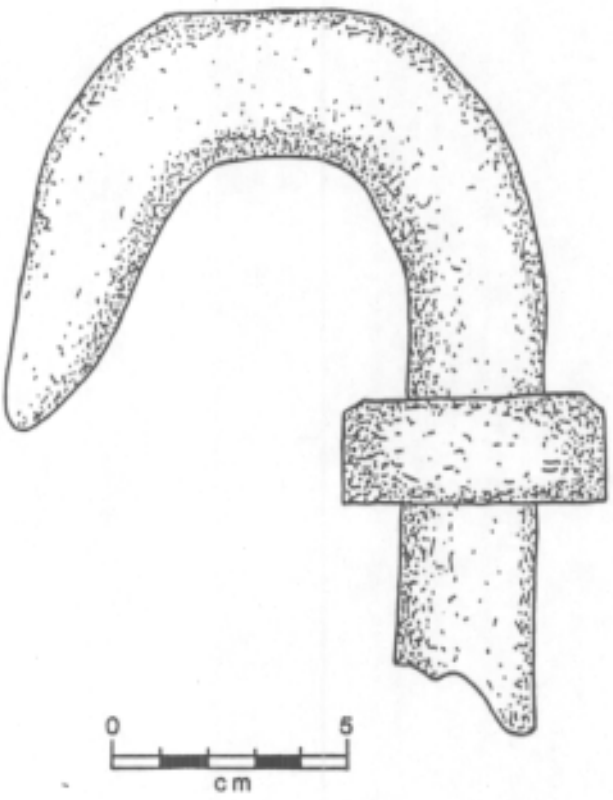


Figure 20: Hook with washer, HF 34. B.F. Thompson.

HF 35. Hook-bolt w. single hook & thimble. Inv. No. MH 3334
Fig. 21 ; Wreck Plan II

Hook bolt: o.l. 0.355; max. w. 0.080; aperture 0.080; dia. 0.030. Hook: 0.160; max. w.0.085; aperture 0.061; dia. 0.020. Thimble: o.d. 0.070; i.d. 0.038; thk. 0.004.

The thimble had s-twist, 3-strand rope adhering to the surface. The hookbolt was obviously in use during the wrecking event since the small hook remained hooked to it long enough to become concreted in place.

Prov. 26J

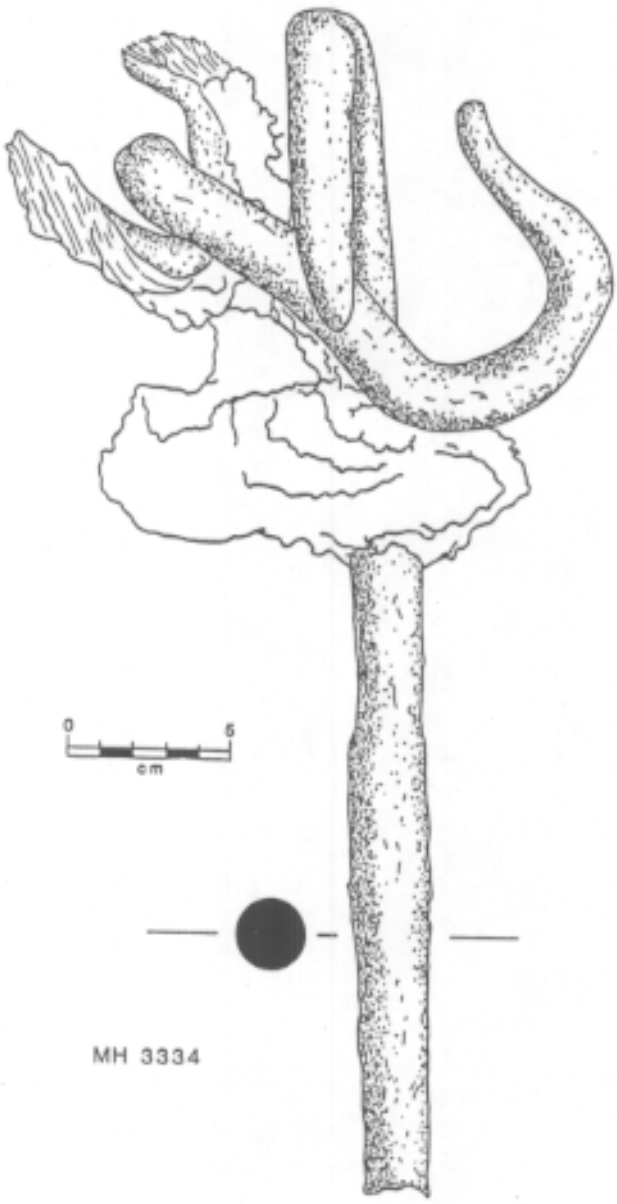


Figure 21: Hook-bolt and hook with thimble, HF 35. B.F. Thompson.

Fairleads

Fairleads are fixtures used to lead a rope in a desired direction. Lines run through them can be easily removed, since they act like open rings. In earlier ships, boards with holes, through which various parts of the running rigging were rove, were used to provide fairleads (Kemp, 1976: 294). The two iron fairleads excavated from the Mombasa Harbor Wreck, HF 36 and HF 37, are similar to each other in style. The better preserved of two, HF 36, was found outside of the hull remains in the area where stern associated artifacts were collected.

HF 36. Fairlead. Inv. No. MH 6376
Fig. 22 ; Wreck Plan II

o.l. 0.220; ht. 0.080; w. 0.080; fastener holes dia. 0.010; aperture 0.060; dia. 0.015.

Iron fairlead fashioned from a single piece of iron flattened in the center for four fasteners and two prongs rounded to points, which have been bent in opposing directions.

Prov. 29J

HF 37. Fairlead. Inv. No. MH 2404
Wreck Plan II

o.l. 0.170; ht. 0.059; w. 0.045; thk. 0.008; aperture approx. 0.060; dia. 0.015.

Iron fairlead made in similar fashion as HF 38. The iron prongs and base deteriorated.

Prov. 24J



Figure 22: Fairlead, HF 36. B.F. Thompson.

Cleat

Cleats are single pieces of wood or metal, shaped like two horns and nailed or bolted to flat surfaces such as the inside of the bulwarks. The literature mentions two types: the belaying cleat, which is used to belay ropes and the sling cleat, which is used for gammoning the bowsprit and as stops to stay collars (Falconer; 1768: 54). According to Anderson, there were also cleats on the mast which were occasionally lashed to the collar of the main-stay or even to the shrouds (Anderson, 1974: 43).

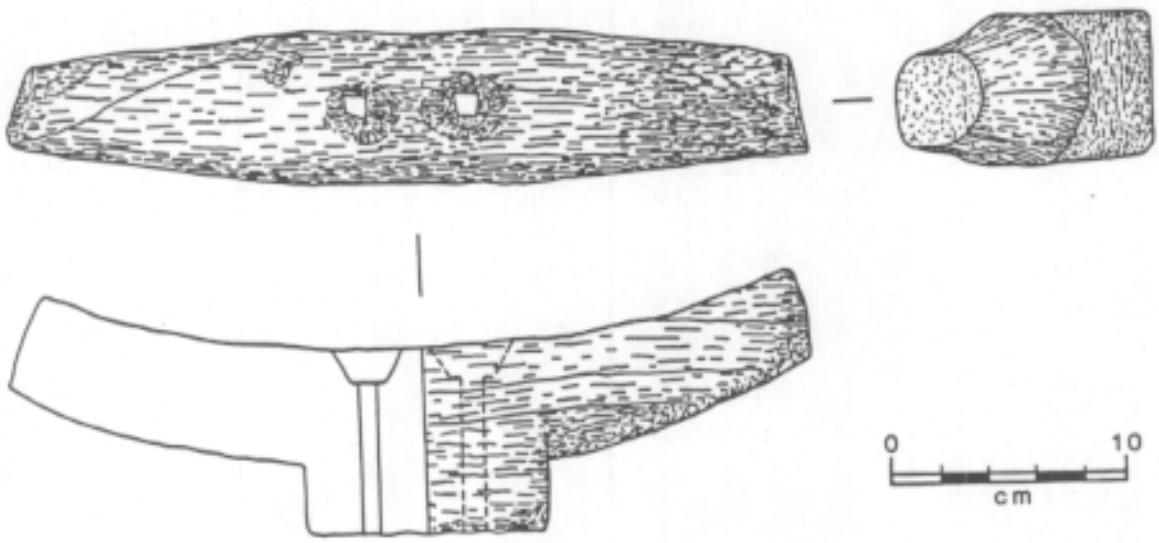


Figure 23: Cleat, HF 38. M. Stanbury.

Only one example of a cleat has been identified thus far for our vessel. The location of HF 38 suggests that it might have fallen into the area of the mast-step or was torn free of the mast as that large timber was wrenched from the ship (Figure 24). Its size and concave bottom shape further suggests attachment to the mast.

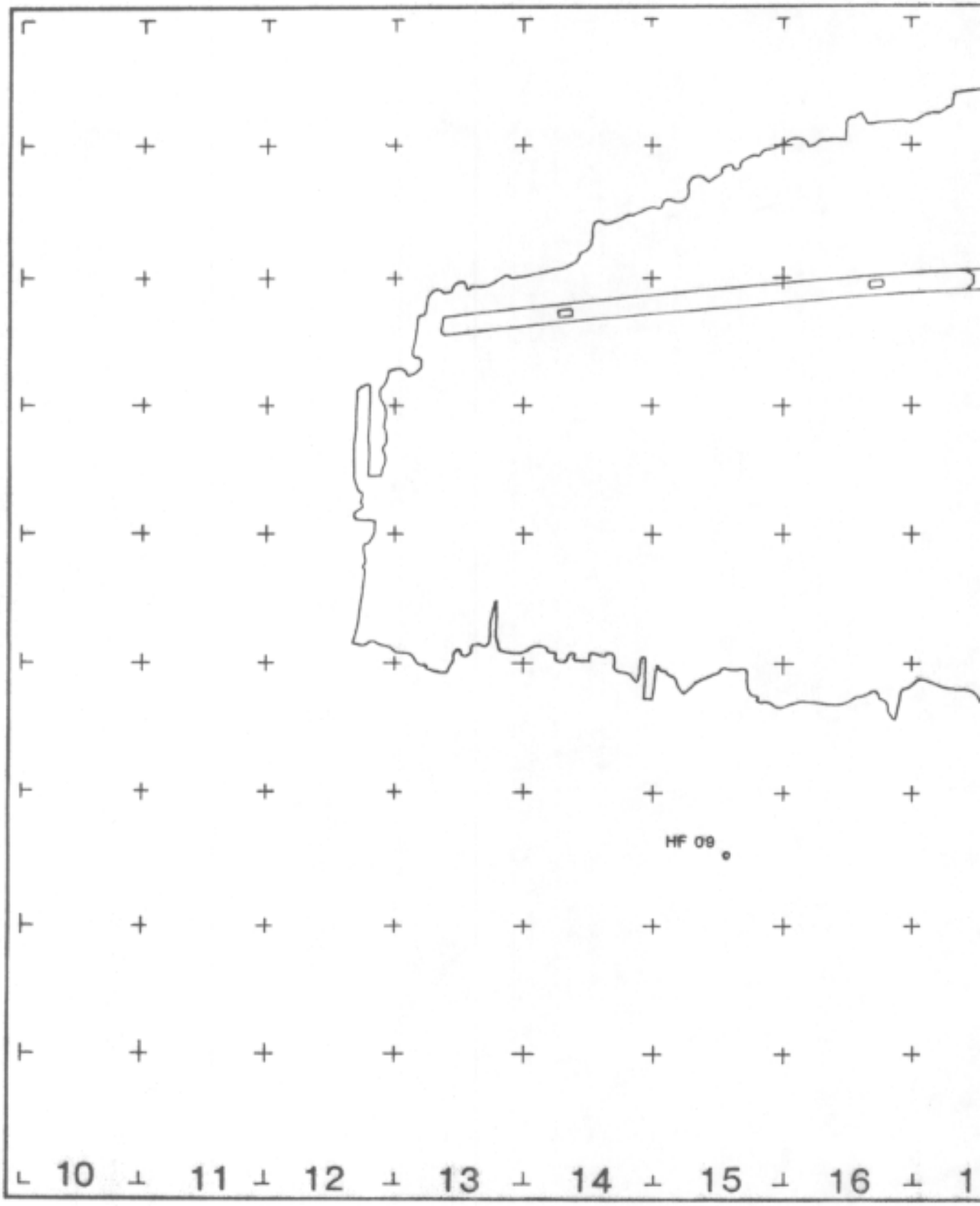
HF 38. Wood Cleat. Inv. No. MH 1495
Fig. 23 ; Wreck Plan II

l. 0.340; ht. 0.080; w. 0.063; base 0.100 x 0.060; tangs max. dia. 0.050; tangs min. dia. 0.040; fastener holes 0.010 x 0.010; fastener head w. 0.030.

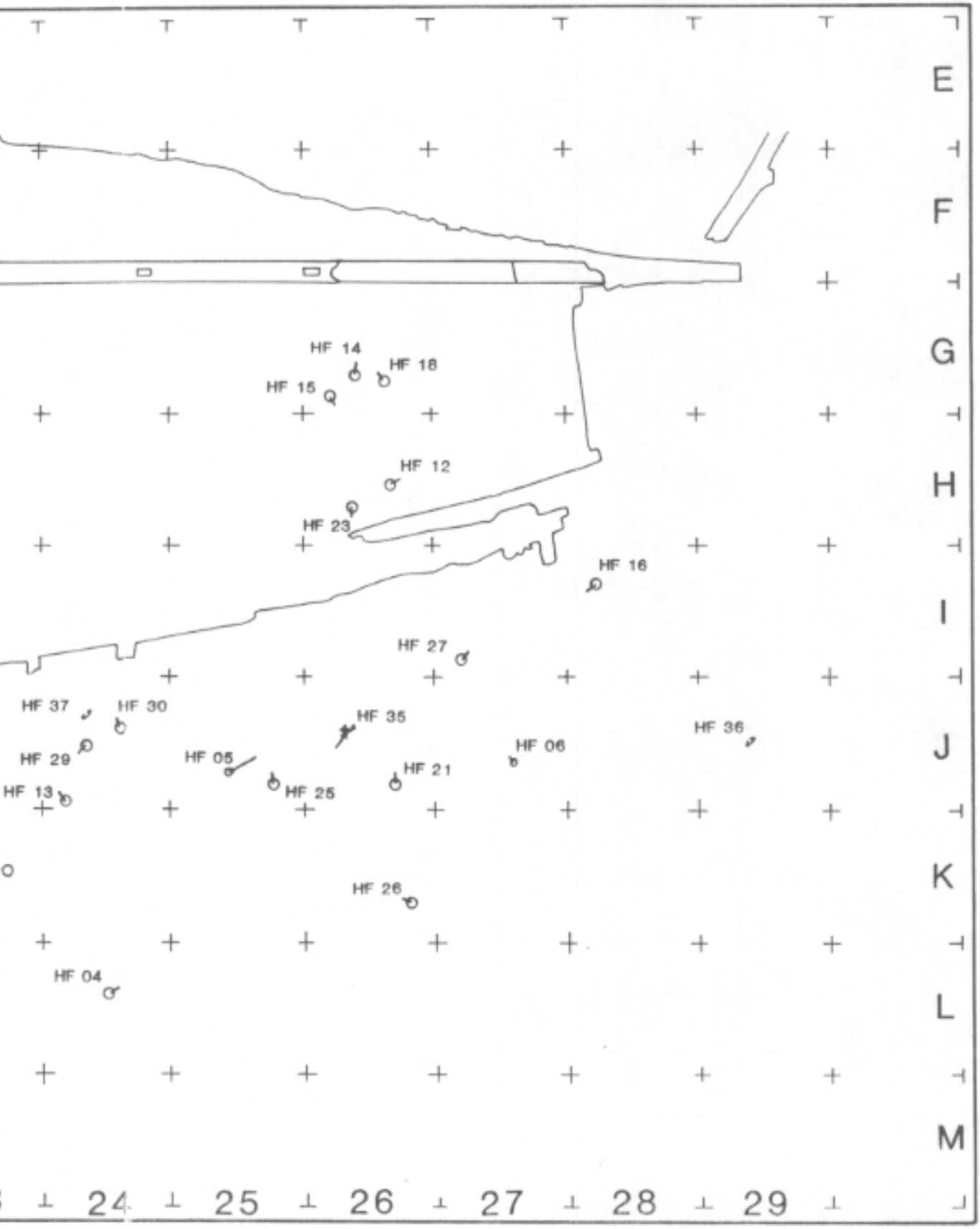
PEG-treated teak cleat has two round shaped horns, two fastener holes and concave lower surface.

Prov. 20H

Figure 24: Wreck Plan II (Distribution of Hull Fittings). B.F. Thompson.


HF 09
10
11
12
13
14
15
16

HF 34
HF 38
HF 10
HF 37
HF 08
HF 28
HF 29
HF 13
HF 11
HF 01
HF 03
HF 31
16
17
18
19
20
21
22
23


E
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HF 14
HF 18
HF 15
HF 12
HF 23
HF 16
HF 27
HF 37
HF 30
HF 35
HF 36
HF 29
HF 05
HF 06
HF 21
HF 13
HF 25
HF 26
HF 04
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CHAPTER V

STANDING RIGGING

One would expect the literature to be clear on the definition of standing rigging, but the difference between standing and running rigging remains a debated point. Most authorities agree that anything directly connected with masts, shrouds and stays may properly be called standing rigging. The disagreement arises with those tackles which have a share in supporting the masts but can be moved and utilized in the running rigging (Anderson, 1974:40).

Manwayring (1644:100) and Biddlecombe (1969:31) regard standing rigging as those ropes that are not used to be removed or turned in blocks, but are only set taut and slack as the occasion demands. For our purposes I have chosen the broader term for standing rigging as defined by Kemp (1976:707). All rigging used in support of the masts, yards and bowsprit when fitted is known as standing rigging.

The Mombasa Harbor Wreck excavations did not produce masts, yards or bowsprits, but they did produce 16 deadeyes, 12 pieces of standing chain, 7 chainplates, 7.08 m of shroud-laid rope and 8.34 m of hawser-laid rope. These are some of the components which, when joined together, support the masts laterally and longitudinally. An illustration of the nomenclature used in the catalog follows (Fig. 25).

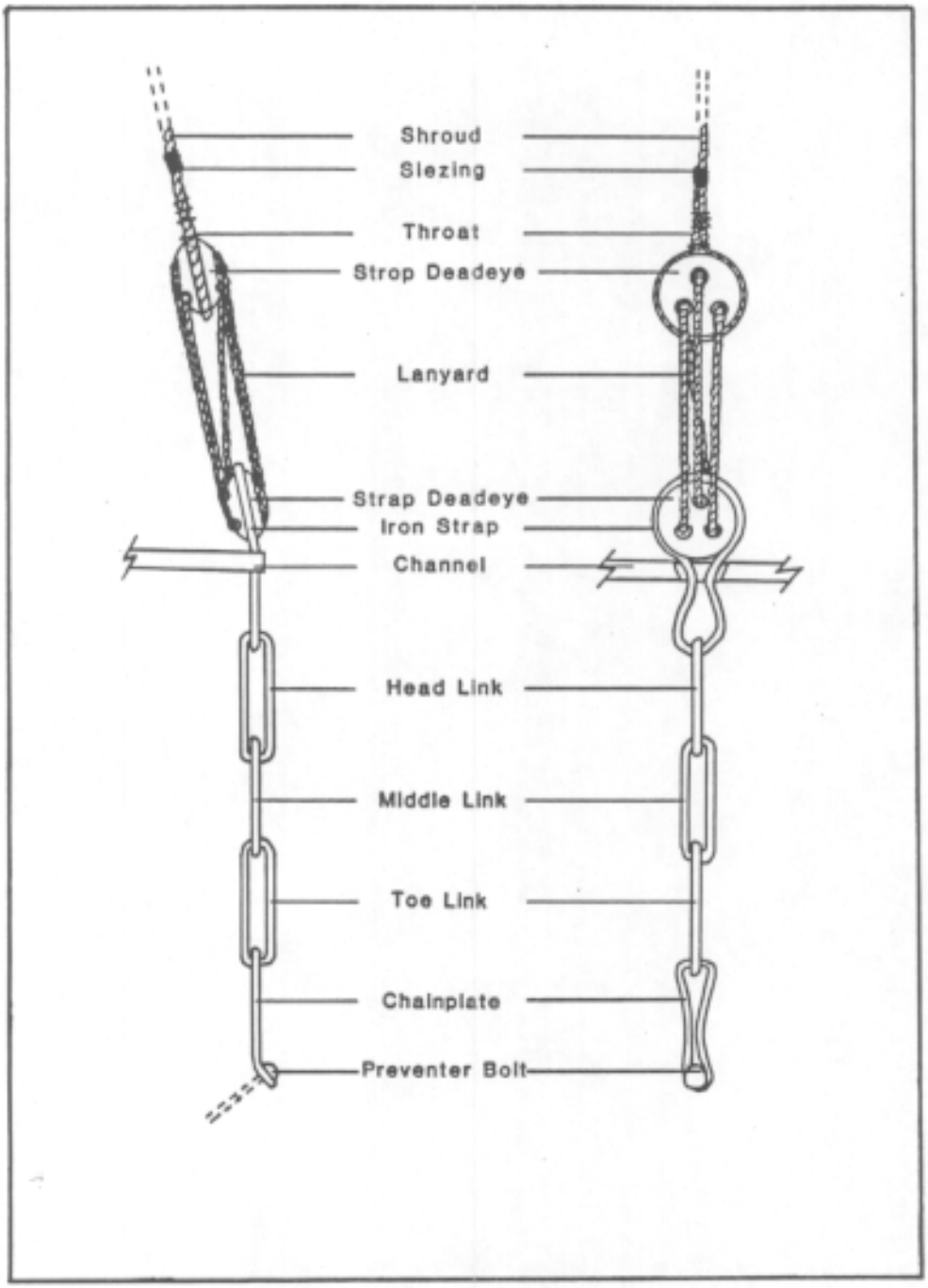


Figure 25. Nomenclature for standing rigging shroud chains. B.F. Thompson.

Deadeyes

The original term dead-mens-eyes probably came from the similitarity of these three-holed blocks to the human skull (Kemp, 1976:234). More practically however, the term 'dead' was used because, although deadeyes perform the function of triple blocks, they have no revolving sheaves. Deadeyes are generally circular wooden blocks with three holes through which the lanyards are rove. In the circumference of the deadeye is a groove which, in an upper deadeye, takes the end of the shroud or backstay, and in a lower deadeye the iron by which it is secured to the ship's side (Moore, 1970: 247).

The power gained by the deadeyes is directly related to the number of lanyard parts rove through them and, as such, are much stronger than blocks with sheaves since the strain is not lying on a single pin (Biddlecombe, 1969:11). Manwayring states that crows-feet, a 17th century-rigging feature, were also rove through dead-men-eyes (1644: 33).

Ten strop-deadeyes and five strap-deadeyes were found on the Mombasa Harbor Wreck (Table 5). The outer diameter measurements for the strop-deadeyes range between 8.7 cm and 36.8 cm and for the strap-deadeyes between 17.2 cm and 20 cm. The majority of these artifacts were found downslope of the hull remains from amidships to the stern. The location

and function of these artifacts, in relation to other standing rigging components, will be discussed at the end of this chapter under the heading of standing rigging reconstruction.

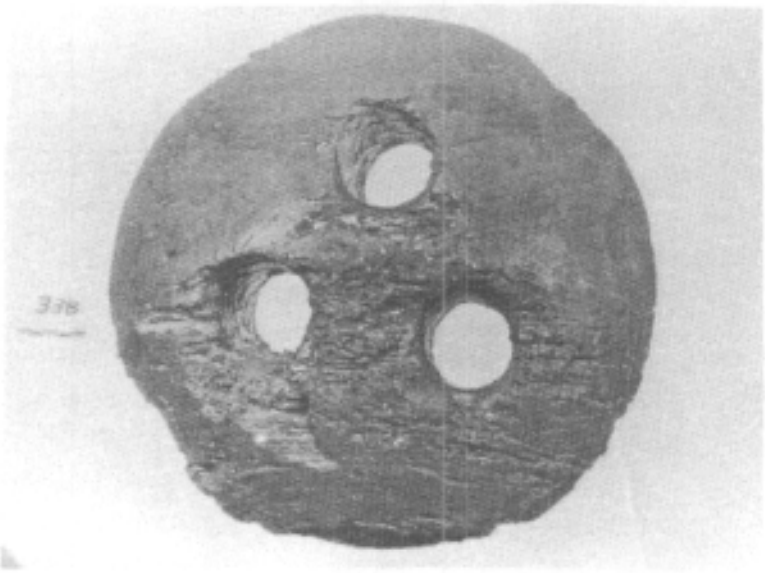


Figure 26: Photograph of strop deadeye, SR 01. M. Taffe.

SR 01. Strop Deadeye. Inv. No. MH 0338
Fig. 26 ; Wreck Plan III

o.d. 0.340; w. 0.160; eye dia. 0.060; gr. d. 0.028; gr. w. 0.056.

Teak deadeye shows some damage to the inboard face, but for the most part in excellant condition. Drill marks evident in eye hollows.

Prov. 21L

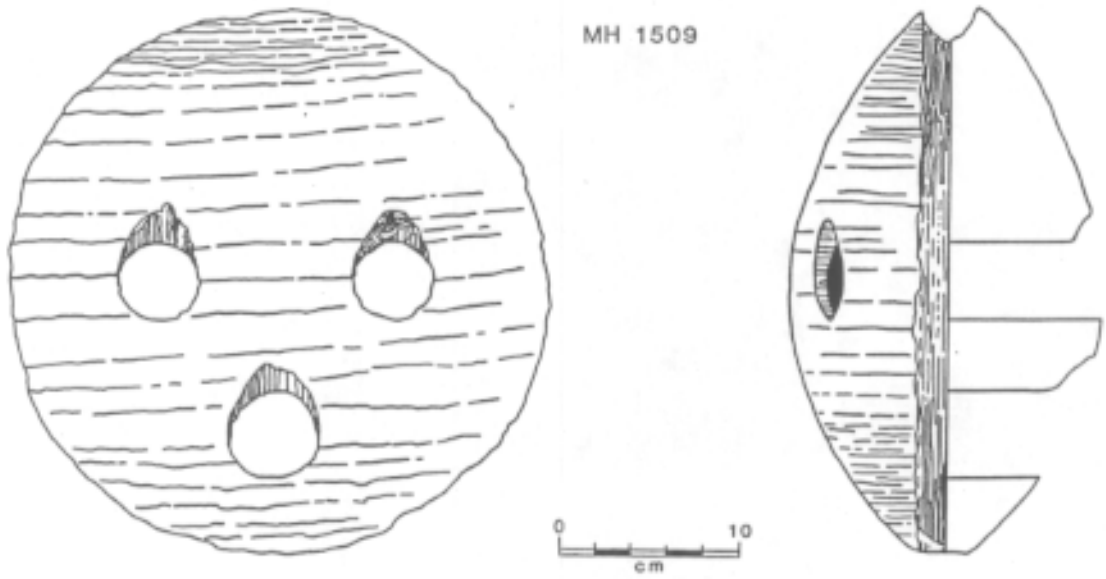


Figure 27: Strop deadeye, SR 02. B.F. Thompson.

SR 02. Strop Deadeye. Inv. No. MH 1509
Fig. 27 ; Wreck Plan III

o.d. 0.304; w. 0.178; eye dia. 0.046; gr. d. 0.018; gr. w. 0.028.

Same condition as SR 01 but with more extensive damage to inboard face.

Prov. 27H

SR 03. Strap Deadeye. Inv. No MH 1508
Fig. 28 ; Wreck Plan III

Deadeye: o.d. 0.200; w. 0.105; eye dia. 0.026; gr. d. 0.017; gr. w. 0.030. Strap: x-sec. 0.017 x 0.017.

Teak deadeye with wide strap groove, square in cross-section. Slight damage to outboard face and more extensive damage to inboard face.

Prov. 27H

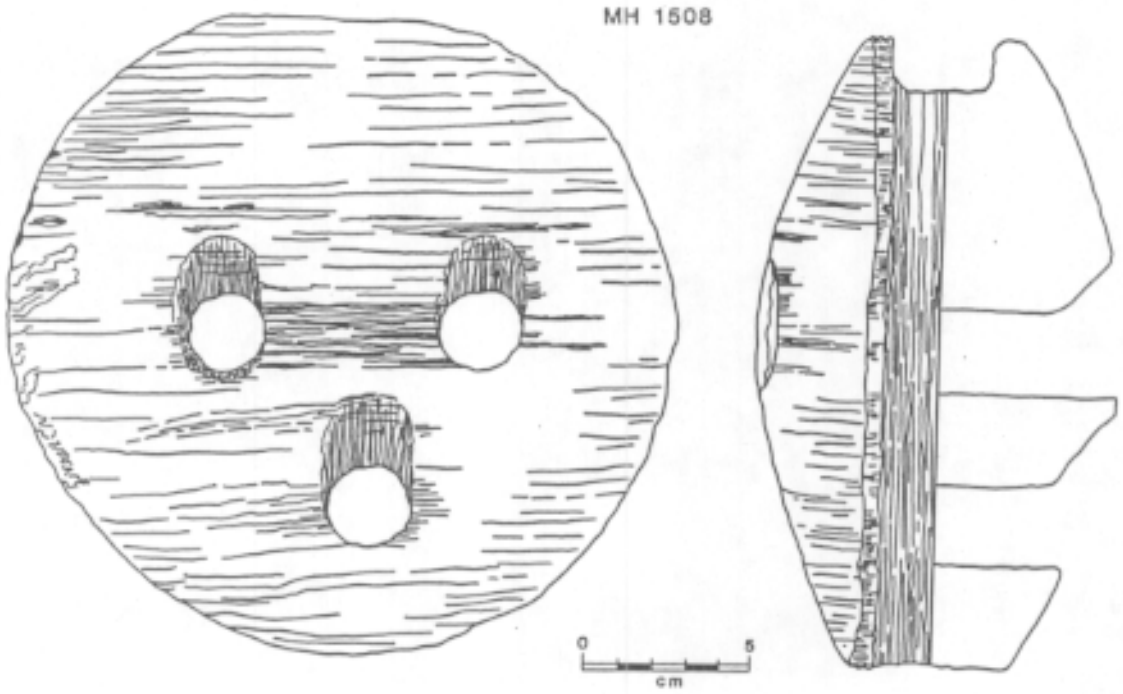


Figure 28: Strap Deadeye, SR 03. C. Sassoon.

SR 04. Strop Deadeye. Inv. No. MH 5235
Fig. 29 ; Wreck Plan III

o.d. 0.120; w. 0.051; eye dia. 0.023; gr. d. 0.009; gr. w. 0.021.

Concretion adhering to eyes but otherwise exposed.

Prov. 27K

Table 5: Strop deadeyes (all measurements in centimeters - for distribution see Wreck Plan III).

SR	MH	Prov	o.d.	w.	eye dia.	gr.d.	gr.w.
05	1507	27H	36.8	19.6	4.6	2.4	4.2
06	0469	21K	33.0	----	6.8	---	---
07	4551	23J	31.0	----	4.6	---	2.7
08	4646	24K	30.0	17.5	4.6	2.0	2.7
09	1520/1	27H	27.5	14.0	---	2.2	3.4
10	5176	24J	17.0	6.0	2.4	2.0	2.2
11	5859	28J	13.0	4.9	2.2	1.1	2.1

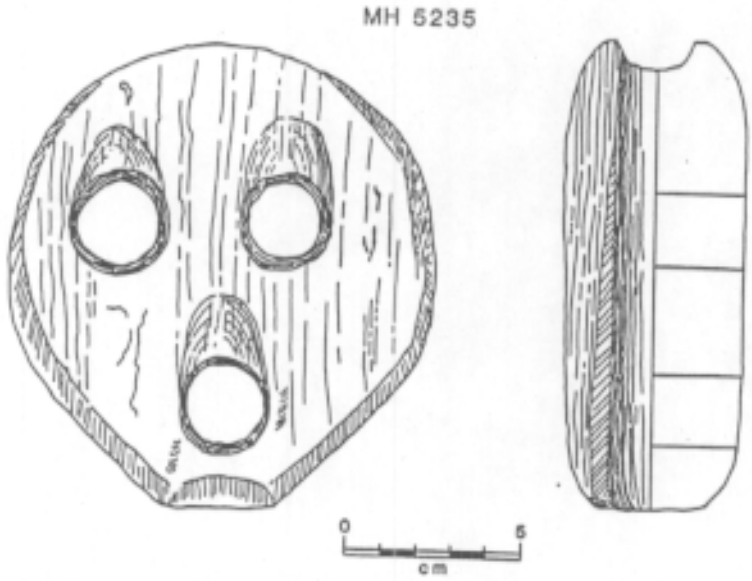


Figure 29: Strop Deadeye, SR 04. C. Sassoon.

SR 12. Strop Deadeye. Inv. No. MH 5236
Fig. 30 ; Wreck Plan III

o.d. 0.087; w. 0.040; eye dia. 0.019; gr. d. 0.011; gr. w. 0.017.

Small teak deadeye treated in PEG. Damage longitudinally due to shrinkage.

Prov. 27K

SR 13. Deadeye & strap. Inv. No. MH 1520/2
Fig. 31 ; Wreck Plan III

Deadeye: o.d. 0.172; w. 0.090; eye dia. 0.027; gr. d. 0.015; gr. w. 0.027. Strap x-sect. around deadeye 0.014 x 0.027; strap x-sect. below deadeye 0.016 x 0.016.

Iron strap and wood deadeye missing one-half of the upper deadeye and strap. The strap is rectangular in cross-section where it fits into the deadeye, but becomes square at lower end. Heavily concreted.

Prov. 27H

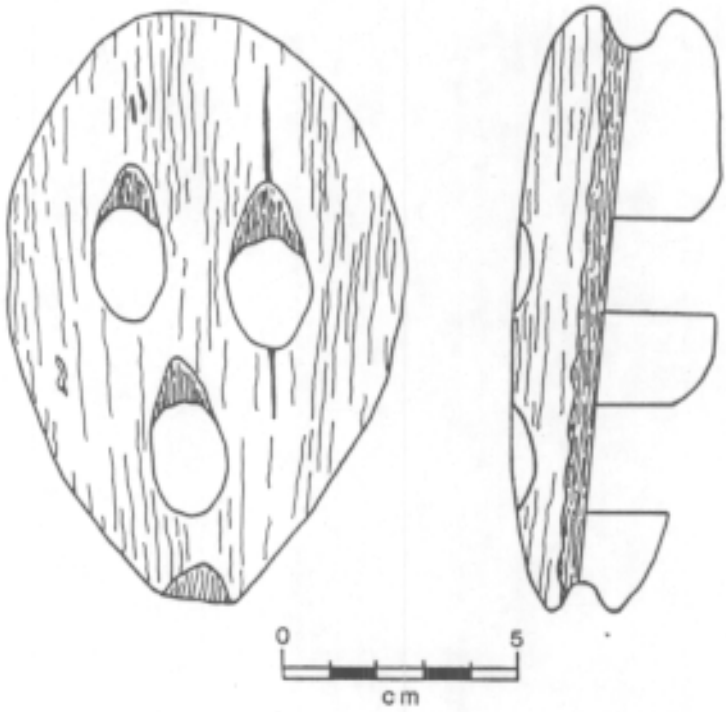


Figure 30: Strop deadeye, SR 12. B.F. Thompson.

SR 14. Deadeye & Strap Inv. No. MH 6502
Wreck Plan III

Deadeye: w. 0.067; eye dia. 0.023; gr. d. 0.009; gr. w. 0.022. Strap: 0.007 x 0.022.

Although similar to SR 13 the iron strap has smaller rectangular dimensions and very fragmented wood deadeye remains. Iron strap completely oxidized but good concretion cavity with sound surface to concretion interface.

Prov. tool box area (stern).

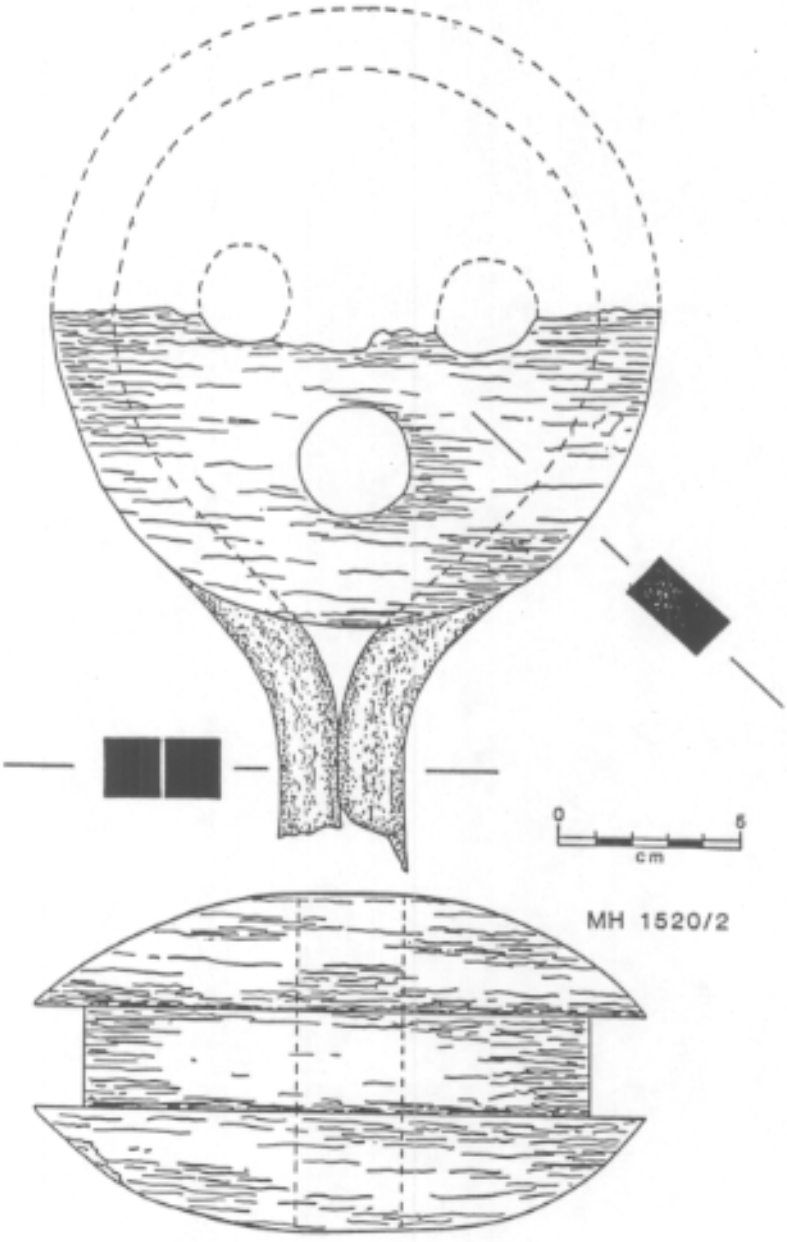


Figure 31: Deadeye and strap, SR 13. B.F. Thompson.

SR 15. Deadeye & Strap. Inv. No. MH 1505
Wreck Plan III

o.d. 0.180; w. 0.060; eye dia. 0.027.

Concreted deadeye & strap. Damage to back surface but otherwise in good condition. No measurements for iron strap. Similar in size and shape to SR 13.

Prov. 27H

SR 16. Deadeye & Strap. Inv. No. MH 1506
Wreck Plan III

Deadeye: o.d. 0.172; w. 0.062; eye dia 0.027; gr.d. 0.070; gr. w. 0.016. Strap: 0.010 x 0.016.

Wood deadeye badly damaged along diametric line and iron strap concreted for entire circumference. Large unidentified strap concretion adhering to outer surface of deadeye strap concretion. Strap measurements taken from deadeye strap cavity since the original object is completely oxidized.

Prov. 27H

Chains

The chains of a ship are those iron fittings to which the shrouds are made safe to the ship's sides, as well as those that belong to the top-mast shrouds (Manwayring, 1644:23). According to Anderson, Dutch ships had longer chain loops on their deadeyes, forming links lying parallel with the hull (Anderson, 1974:37). This is proven out when one reviews depictions of the period, such as Elder's 1667 drawings of the Dolphijn, Olifant and de Hollantse Leeu (Fox, 1980:118).

Mombasa Harbor Wreck chains are here treated independent of the chainplates, which are the chain links that were

bolted to the hull. On our wreck none of the chainplate were found connected to links. Eight deadeye straps and fifteen partial or complete links are presented in this section, the most complete set of which is SR 17. All but two deadeye straps, three complete links and seven partial links were discovered along the portside and downslope of the hull remains.

SR 17. Deadeye Strap. Inv. No. MH 0227
Fig. 32 ; Wreck Plan III

Complete deadeye strap: o.l. 0.650; o.d. 0.356; i.d. 0.290; dia. 0.033. Complete head link: o.l. 0.400; dia. 0.033; w. 0.13. Complete middle link: o.l. 0.400; dia. 0.033; w. 0.13. Complete toe link: o.l. 0.400; dia. 0.033; w. 0.13. Total length 1.630.

Angle of deadeye strap loop 173 degrees. The entire set of chains has been electrolytically cleaned and conserved. Good condition with some loss of diameter resulting in less than true x-section measurements in some places. The toe link appears to be associated with chainplate SR 29 (MH 0280).

Prov. 21L

SR 18. Deadeye Strap & Links. Inv. No. MH 0140
Wreck Plan III

Partial deadeye strap: o.l. 0.465; o.d. 0.355; i.d. 0.295; dia. 0.030. Complete head link: o.l. 0.400; dia. 0.033; w. 0.120. Partial middle link: o.l. 0.100; dia. 0.033; w. 0.120. Total length 0.960.

Lower part of iron deadeye strap is pinched. Iron head link and partial middle link open throughout their lengths.

Prov. 20H

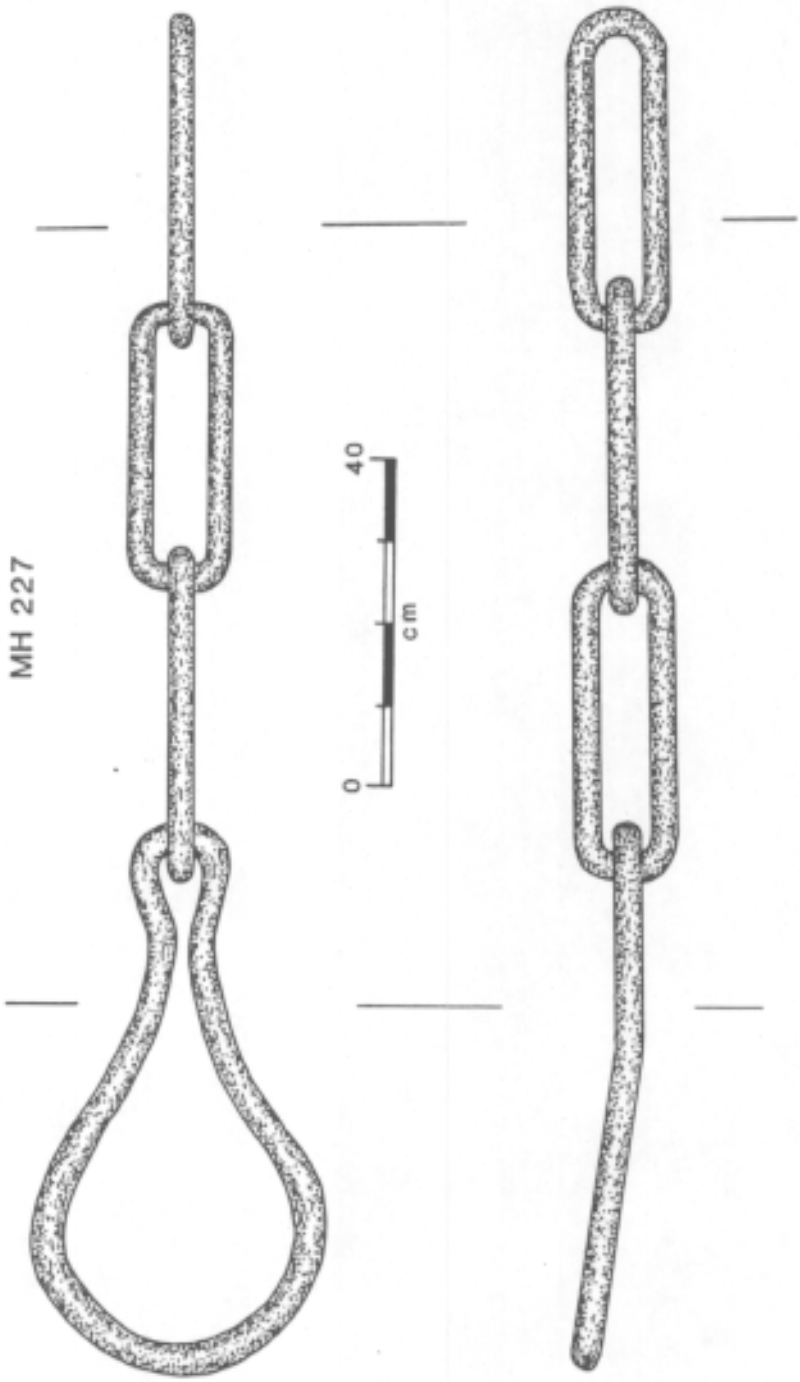


Figure 32: The most complete set of chains, SR 17. B.F. Thompson.

SR 19. Deadeye Strap. Inv. No. MH 2395
Wreck Plan III

Partial deadeye strap: o.l. 0.450; o.d. 0.310; i.d. 0.250; dia. 0.030.

Iron deadeye strap in concreted form at time of recording.

Prov. 15L

SR 20. Deadeye Strap. Inv. No. MH 4351
Wreck Plan III

Partial deadeye strap: o.l. 0.550; o.d. 0.310; i.d. 0.250; dia. 0.030.

Lower portion of iron deadeye strap is pinched.

Prov. 23K

SR 21. Deadeye Strap. Inv. No. MH 5225
Wreck Plan III

Complete deadeye strap: o.l. 0.660; o.d. 0.360; i.d. 0.295; dia. 0.030. Partial head link: o.l. 0.150; dia. 0.030. Partial middle link: o.l. 0.400; dia. 0.030.

Deadeye strap pinched and the two partial links open.

Prov. 23K

SR 22. Deadeye Strap. Inv. No. MH 0122
Wreck Plan III

Partial deadeye strap: o.l. 0.685; o.d. 0.360; i.d. 0.295; dia. 0.033.

Iron deadeye strap pinched at lower end.

Prov. 21H

SR 23. Deadeye Strap. Inv. No. MH 4693
Fig. 33 ; Wreck Plan III

Partial deadeye strap: o.l. 0.460; o.d. 0.238; i.d. 0.190; dia. 0.024.

Prov. 26K

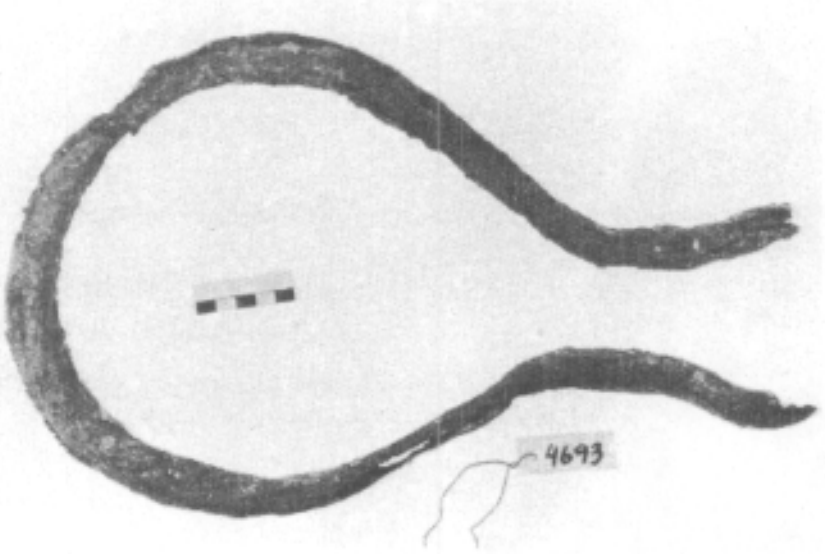


Figure 33: Photograph of a medium-size deadeye strap, SR 23. M. Taffe.

SR 24. Deadeye Strap. Inv. No. MH 3934
Wreck Plan III

Partial deadeye strap: o.l. 0.420; o.d. 0.236; i.d. 0.190; dia. 0.023.

Iron deadeye strap open throughout its length.

Prov. 26K

SR 25. Chain Link. Inv. No. MH 0999
Wreck Plan III

Partial link: o.l. 0.235; dia. 0.033; w. 0.109.
Partial link; o.l. 0.160; dia. 0.033; w. 0.069.

First partial link is open and second partial link is pinched.

Prov. 20G

SR 26. Chain Link. Inv. No. MH 1308
Wreck Plan III

Complete head link: o.l. 0.448; dia. 0.030; w. 0.120. Partial middle link: o.l. 0.160; dia. 0.030; w. 0.110. Partial toe link: o.l. 0.160; dia. 0.030; w. 0.110.

All three iron links are open throughout their lengths..

Prov. 18H

SR 27. Chain Link. Inv. No. MH 0989
Wreck Plan III

Complete chain link: o.l. 0.500; dia. 0.035; w. 0.120. Partial chain link: o.l. 0.250; dia. 0.035; w. 0.110.

Both links open.

Prov. 21K

SR 28. Chain Link. Inv. No. MH 2327
Wreck Plan III

Partial chain link: o.l. 0.215; dia. 0.033; w. 0.110.

Link open.

Prov. 15K

Chainplates

Chainplates are thick iron plates or pinched links bolted to the ship's sides, to which the chains and dead-eyes, that support the mast by the shrouds, are connected (Biddlecombe, 1969: 7). According to Kemp, in the older sailing ships these deadeyes were attached to short lengths of chain secured to the ship's side, and the name remained when chains were superseded by a plate (1976:150).

Only six chainplates are recorded for our wrecksite, three from the bow area, two from amidships and one from the stern area. What may be a backing link, SR 35, was discovered in the bow area and downslope of the hull remains. Backing links were short links going from the bolts in the wales to other bolts in the planking just below (Anderson, 1982:69). Ours differs from the conventional type in that, rather than overlapping a chainplate link, it has a partial chain link running through it (Fig. 35). This would indicate that this device held one link which in turn held a deadeye strap link, in other words a shortened set of chains.

SR 29. Chainplate. Inv. No. MH 0280
Figs. 7, 34 ; Wreck Plan III

Complete chainplate: o.l. 0.460; o.d. 0.105; i.d. 0.040; dia. 0.030; w. 0.060.

Chainplate angle is 39 degrees and is pinched.

Prov. 21L

SR 30. Chainplate. Inv. No. MH 2330
Fig. 7 ; Wreck Plan III

Chainplate: o.l. 0.230; o.d. 0.130; i.d. 0.130; dia. 0.025; w. 0.060.

Chainplate angle is 24 degrees and is pinched.

Prov.15K

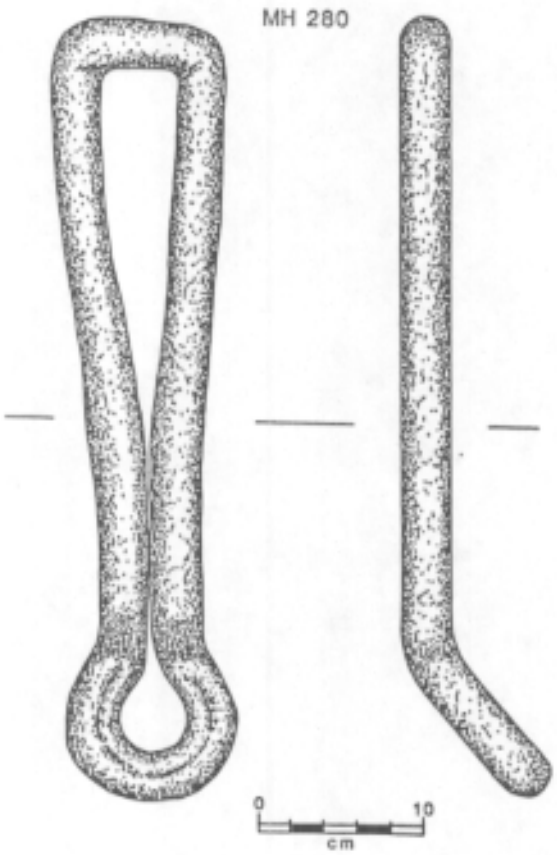


Figure 34: Chainplate, SR 29. B.F. Thompson.

SR 31. Chainplate. Inv. No. MH 2329
Fig. 7 ; Wreck Plan III

Partial chainplate link: o.l. 0.280; dia.0.025; w. 0.080. Partial preventer bolt: o.l. 0.070; dia. 0.030; head w. 0.075; head ht. 0.038.

Chainplate angle is 20 degrees. Associated with SR 32.

Prov. 15K

SR 32. Chainplate. Inv. No. MH 2328
Wreck Plan III

Partial chainplate link: o.l. 0.350; dia. 0.030; w. 0.092. Partial toe link: o.l. 0.090; dia. 0.030.

Both iron chainplate links are twisted.

Prov. 15K

SR 33. Chainplate. Inv. No. MH 0130
Wreck Plan III

Partial chainplate link: o.l. 0.325; o.d. 0.099; i.d. 0.044; dia. 0.027; w. 0.050. Partial preventer bolt: o.l. 0.080; dia. 0.030; head w. 0.077; head ht. 0.040.

Iron chainplate link is pinched at bolt end.

Prov. 21K

SR 34. Chainplate. Inv. No. MH 5516
Fig. 7 ; Wreck Plan III

Complete chainplate link: o.l. 0.427; o.d. 0.094; i.d. 0.043; dia. 0.028; w. min. 0.050, w. 0.110. Partial preventer bolt: o.l. 0.259; dia. 0.030; head w. 0.070; head ht. 0.035.

Angle of iron chainplate is 40 degrees.

Prov. 27I

SR 35. Backing Link. Inv. No. MH 2289
Fig. 35 ; Wreck Plan III

Complete backing link: o.l. 0.380; o.d. 0.120; i.d. 0.050; dia. 0.030d; w. 0.065. Partial toe link: o.l. 0.185; dia. 0.030.

Link is pinched with a bolt-head impression visible on each end of the link.

Prov. 15K



Figure 35: Backing link, SR 35. B. F. Thompson.

Shrouds

The shrouds are "great ropes" which go up either side of all masts (Smith, 1627:20). The mizzen, main and fore mast shrouds have, at their lower ends, deadeyes seated into them, and are set up taut by lanyards to the chains. The top masts shrouds are also fastened with lanyards and deadeyes. Run in pairs, these "great ropes" were the lateral support for the masts.

Shroud-laid four-strand rope was commonly used for the shrouds onboard 17th-century ships (Fig. 36 and Table 6). It was laid right-handed with a center core or heart, termed a 'goke', and was used for standing rigging before the days of wire rope (Ashley, 1944:23). The total length of

shroud-laid four-strand rope recovered from our wrecksite is 7.1 m, with an average diameter of between 5.3 cm and 6.1 cm.

Table 6: Shroud-laid four-part rope (all measurements in centimeters - for distribution see Wreck Plan III).

SR	MH	Prov	Lay	Prts	Str	Yn	l.	dia.
36	0334	21L	rt.	4	3	10	23.0	5.6
37	0335	21L	rt.	4	3	20	10.0	5.7
38	0178	21L	rt.	4	3	13	10.0	6.1
39	0443	21K	rt.	4	3	13	114.0	5.9
40	0454	21K	rt.	4	3	09	30.0	5.4
41	0485	21L	rt.	4	3	10	14.0	5.4
42	0452	21L	rt.	4	3	13	56.0	5.9
43	0453	21L	rt.	4	3	13	52.0	5.9
44	6199	23K	rt.	4	3	13	103.0	5.9
45	0455	21K	rt.	4	3	13	78.0	5.9
46	5932	28I	rt.	4	-	42	32.0	5.3
47	4964	23K	rt.	4	-	27	49.0	6.1
48	6042	28I	rt.	4	-	42	97.0	5.3
49	6386	28F	rt.	4	3	--	20.0	5.9

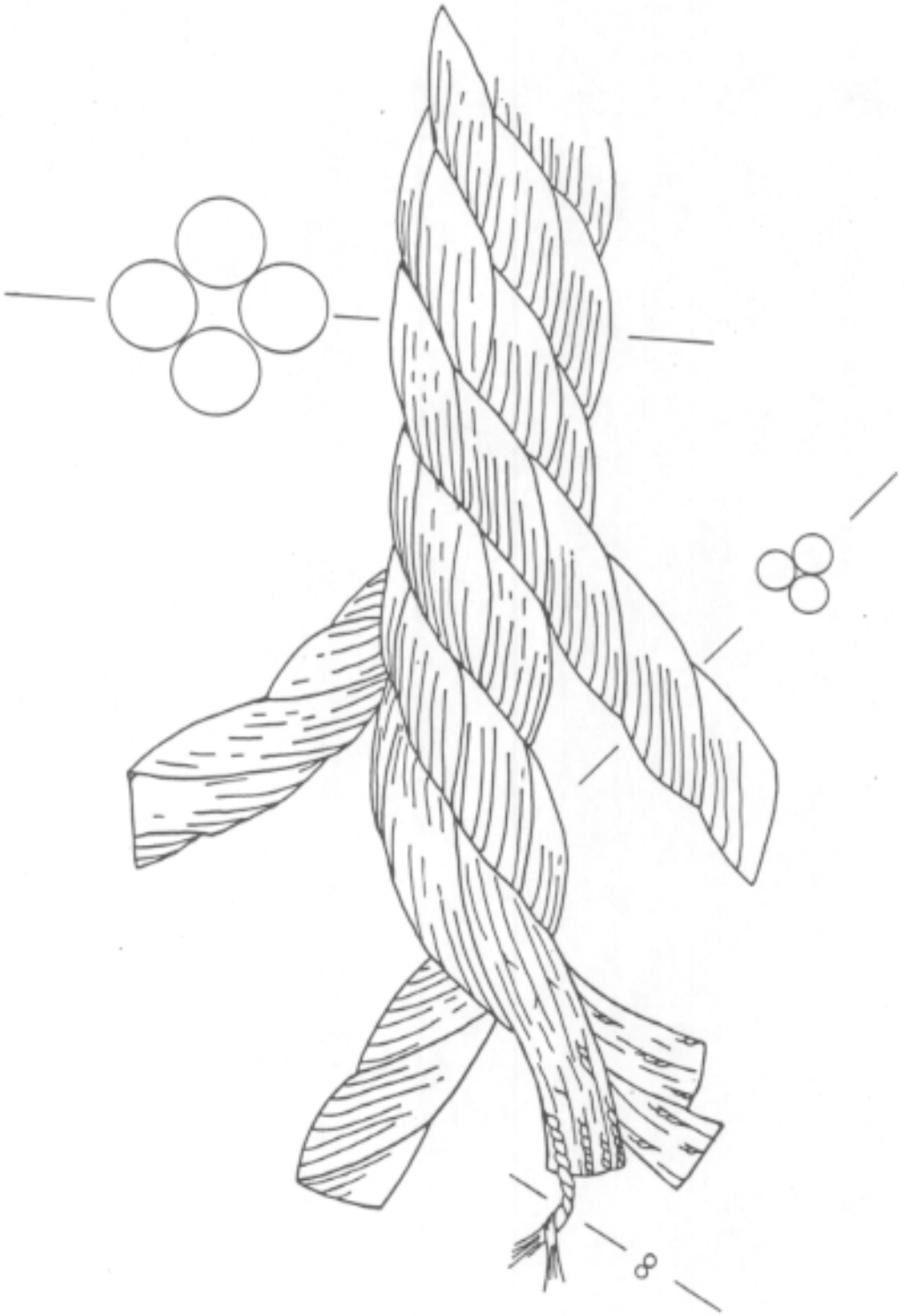


Figure 36: Shroud-laid four-part, z-twist three-strand rope (scale 1 cm = 1.5 cm). B.F. Thompson.

Stays

All the masts, top-masts and flag-staves were supported longitudinally by stays (Manwayring, 1644:101). Manwayring does not describe the rope or its make-up, but Lees states that it was usually made of cable-laid rope and wormed (1979:40). According to Ashley, four-strand cable was often used for the stays (1944:23). He goes on to say that they were usually cable-laid or hawser-laid ropes laid up together left-handed and were sometimes called water-laid, because it was presumed to be less pervious to moisture than plain-laid rope (1944:23).

These descriptions, together with the distribution on the wrecksite of 8.34 m of hawser-laid four-part rope, leads me to believe that we have uncovered remnants of the aft main-mast or forward mizzen-mast stay. The rope fragments, having an average diameter of between 2.1 cm and 6.1 cm, were found along the downslope area from amidships to the stern (Fig. 39). Two examples had tar adhering to their surfaces (Table 7).

Table 7: Hawser-laid four-part rope (all measurements in centimeters - for distribution see Wreck Plan III).

SR	MH	Prov	Lay	Prts	Str	Yn	l.	dia.
50	0180	21K	lt.	4	3	16	12.0	2.5
51	5723	sp	lt.	4	3	16	18.0	3.5 Tar
52	4361	24K	lt.	4	3	16	60.0	3.5 Tar
53	5021	23K	lt.	4	3	16	34.0	3.5
54	4456	24K	lt.	4	3	09	12.0	2.1
55	4974	25K	lt.	4	3	13	42.0	4.1
56	4257	23J	lt.	4	3	18	47.0	4.0
57	4503	sp	lt.	4	3	23	26.0	4.1
58	4807	23K	lt.	4	3	23	27.0	4.1
59	4263	23K	lt.	4	3	23	38.0	6.1
60	2411	24K	lt.	4	3	16	23.0	3.7
61	3674	sp	lt.	4	3	18	33.0	2.7
62	5558	29I	lt.	4	3	05	7.5	2.4
63	4229	26J	--	4	3	09	9.0	2.7
64	5790	26J	lt.	4	3	16	2.6	5.9
65	4271	26J	lt.	4	3	11	14.0	3.2
66	4554	sp	lt.	4	3	11	19.0	3.2
67	3486	23J	lt.	4	3	11	14.0	3.2
68	4125	25J	lt.	4	3	16	21.0	2.9
69	5770	25K	lt.	4	3	13	23.0	5.7
70	3666	24J	lt.	4	3	13	3.7	4.5
71	4677	sp	lt.	4	3	16	21.0	3.5
72	6409	26J	lt.	4	3	23	187.0	4.1
73	3790	23K	lt.	4	3	23	67.0	3.8

Standing Rigging Preliminary Reconstruction

A complete reconstruction of the Mombasa wreck standing rigging is not possible until all of the downslope area has been excavated. However, the distribution of artifacts and their proximity to the hull remains does allow some interpretive information from which a partial reconstruction can be proposed. The only starboard-side evidence for standing rigging are deadeye straps and chains, SR 18, SR 22, SR 25 and SR 26. Their location on the site suggests that sometime during its submergance the starboard hull

remains fell down and was deposited upon the midship section of the hull. It is highly likely that SR 18 and SR 22 represent starboard-side main-mast chains.

There is far more evidence for the port-side standing rigging. A test trench in the bow area revealed three chainplates, three chain links and a single deadeye strap. The careful excavation of the area from amidships to stern exposed a considerable number of standing rigging artifacts for the port-side mainmast and mizzenmast area of the ship (Fig. 37).

Mainmast standing rigging was easier to reconstruct since several artifacts were discovered next to adjoining components. Deadeye sizes and equivalent size deadeye straps fell into place when laid against the proposed broadside plan. Where strap and strop deadeyes were available for the mizzen area outer diameter measurements were used to match-up the appropriate pairs. It is difficult to interpret the exact configuration for the stern of this ship since several of the deadeyes for that area were discovered under structural remains. I have only projected those artifacts which have been excavated from above those fallen structural remains.

The number of shrouds varied with the size of the ship. Anderson feels that a lesser number of shrouds were used at the end of the 17th century than at the beginning (Anderson, 1974:36). His evidence for this argument comes from the

variation in the number of shrouds used on ships of equal firepower built during different quarters of the 17th century. Following this assumption then, a vessel of 42 guns might have had as few as 6 to 8 shrouds per side for the mainmast, 4 to 6 shrouds for the foremast and 2 to 3 shrouds for mizzenmast. More likely the mizzenmast would have required at least 4 shrouds, regardless of the apparently smaller size of the ship.

Our vessel appears to have had at least six shrouds on each side of the main-mast and four shrouds on each side of the mizzen-mast. Moreover, each main-mast channel must have had a small deadeye and two or three ringbolts for use with the runners, swifters or pendants. When the best preserved set of chains is place against a proposed hull profile for this vessel and the angle of the shrouds, lanyards and chains is adjusted for an 87.4 foot main-mast (according to Lees formula for masts of post-1670, L+B+D/1.66), the shrouds will transect a point on the mast 61 feet from floor (Lees, 1979:183; and Fig. 38).

It is difficult to ascertain whether or not the hawser-laid four-part rope represents remains of stays, since none of the samples looked as though they had been wormed, a feature described by Lees as standard for the 17th century (1979:185). Should they represent stays, however, a more detailed study of their location and condition will be necessary before making further assumptions (Fig. 39).

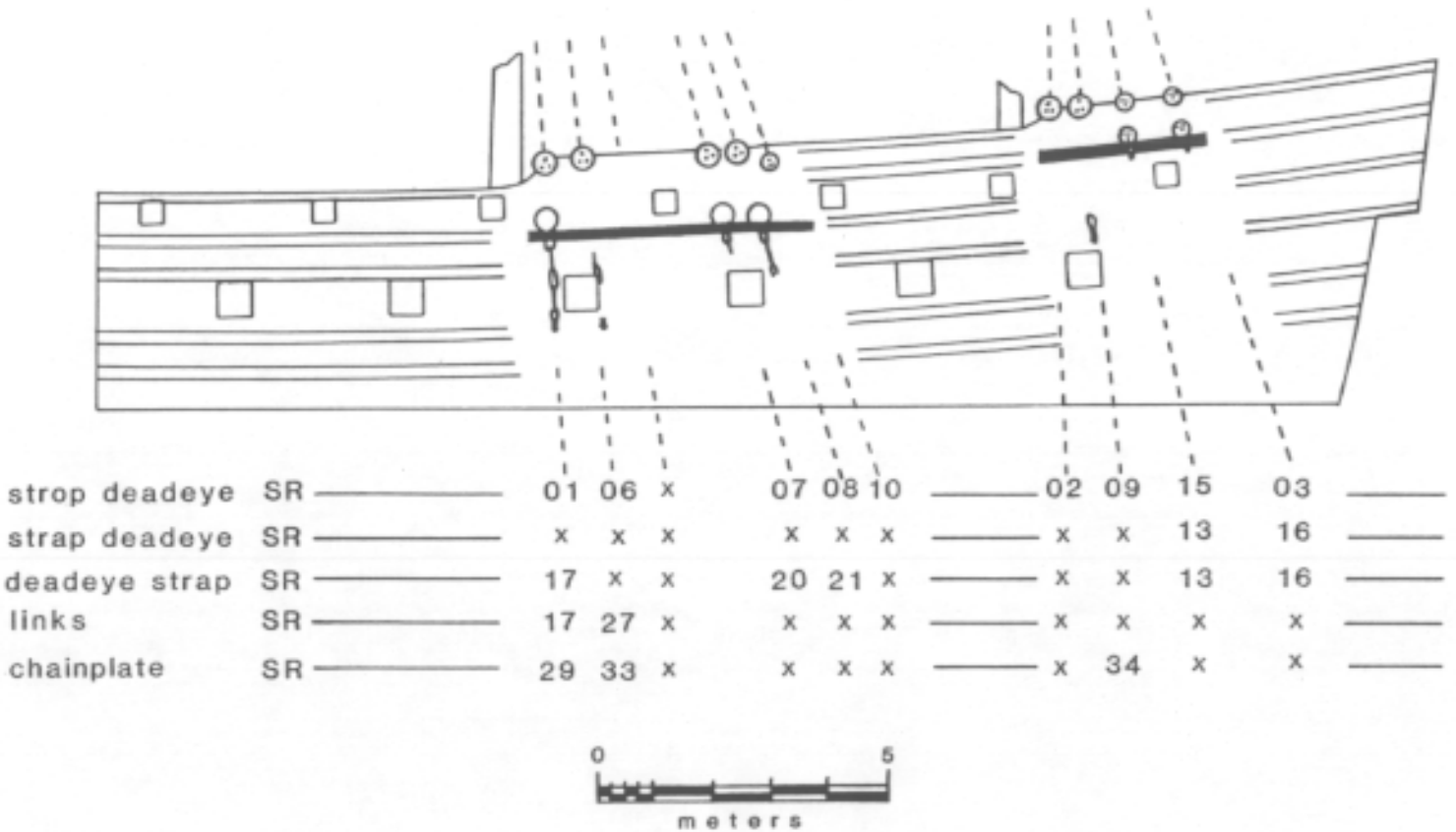


Figure 37: Standing rigging artifacts distribution against proposed broadside plan. B.F. Thompson.

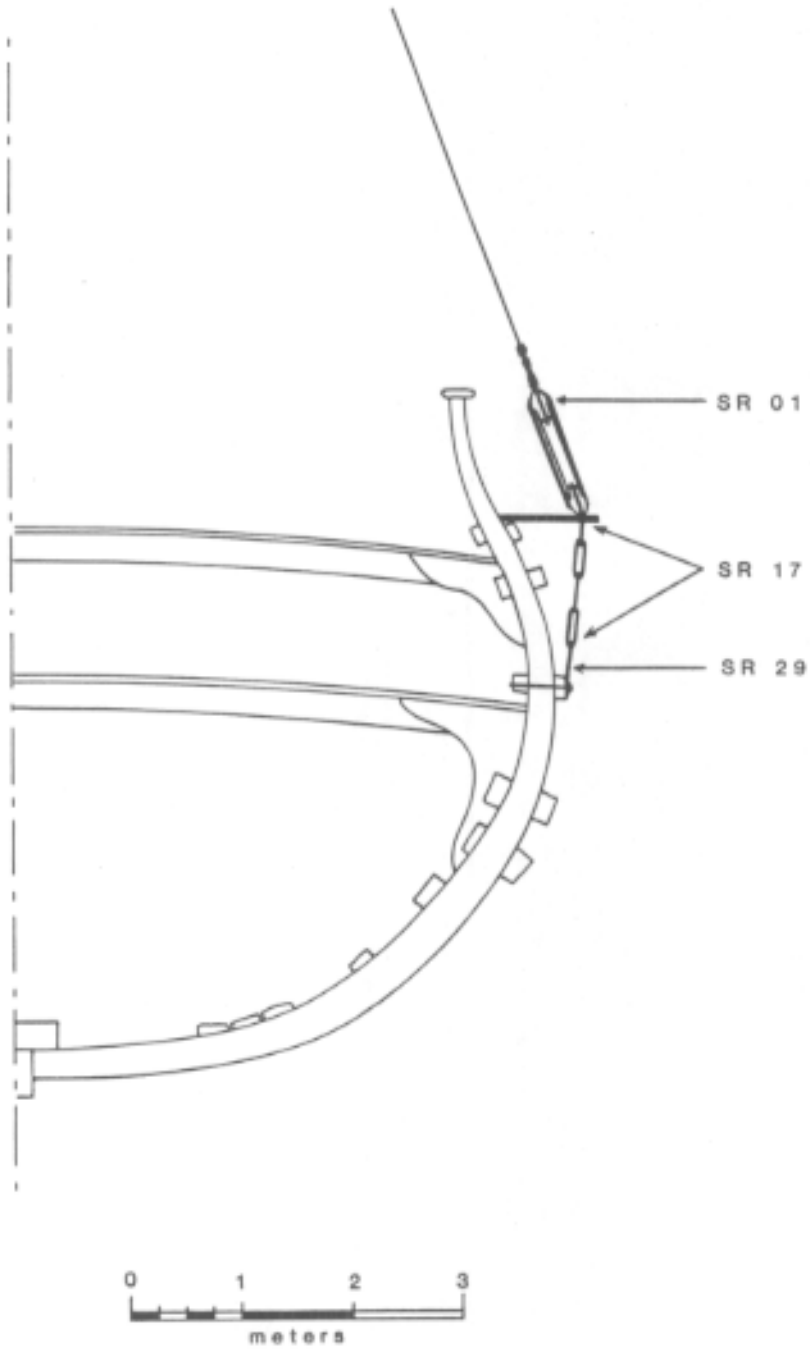
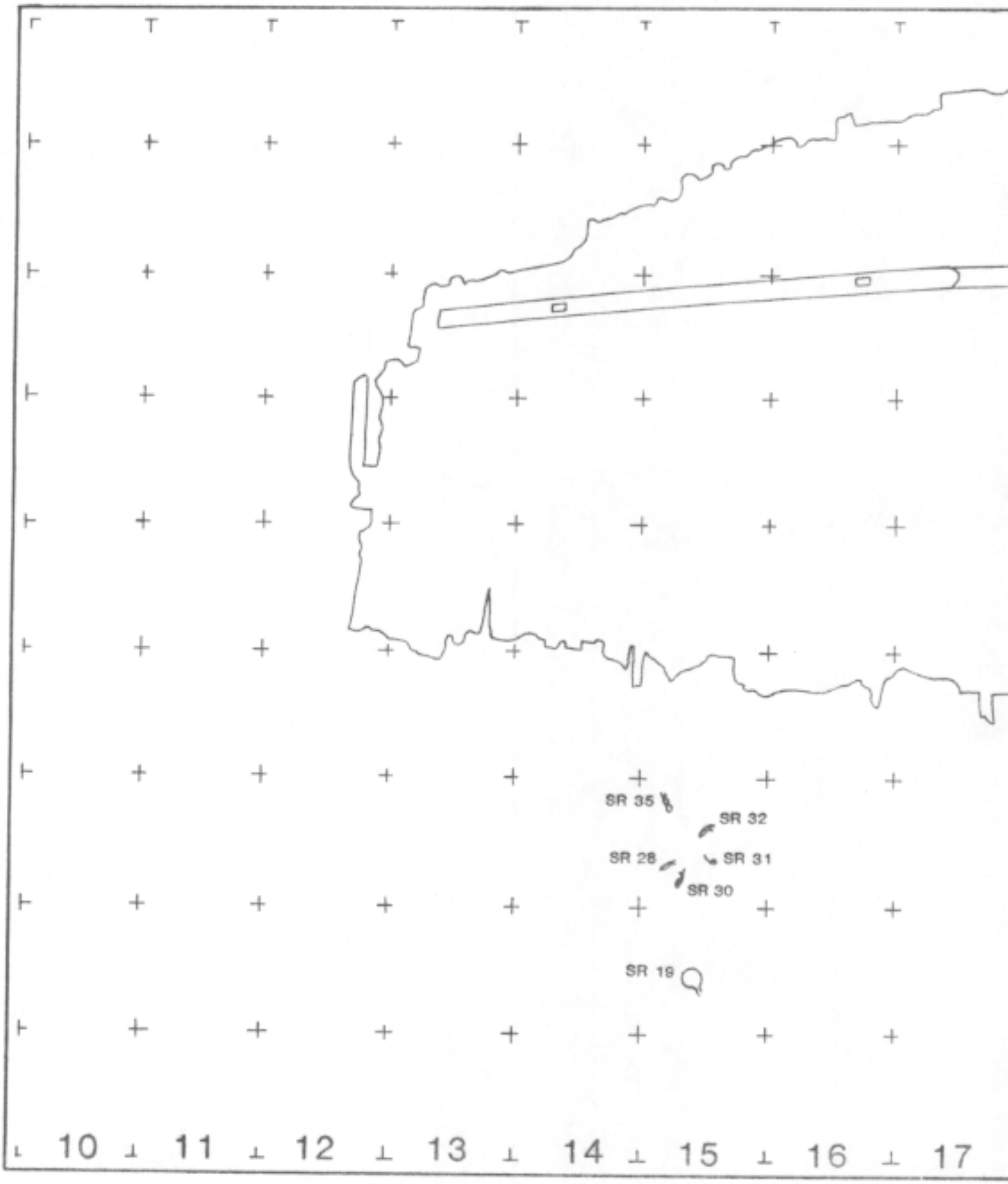
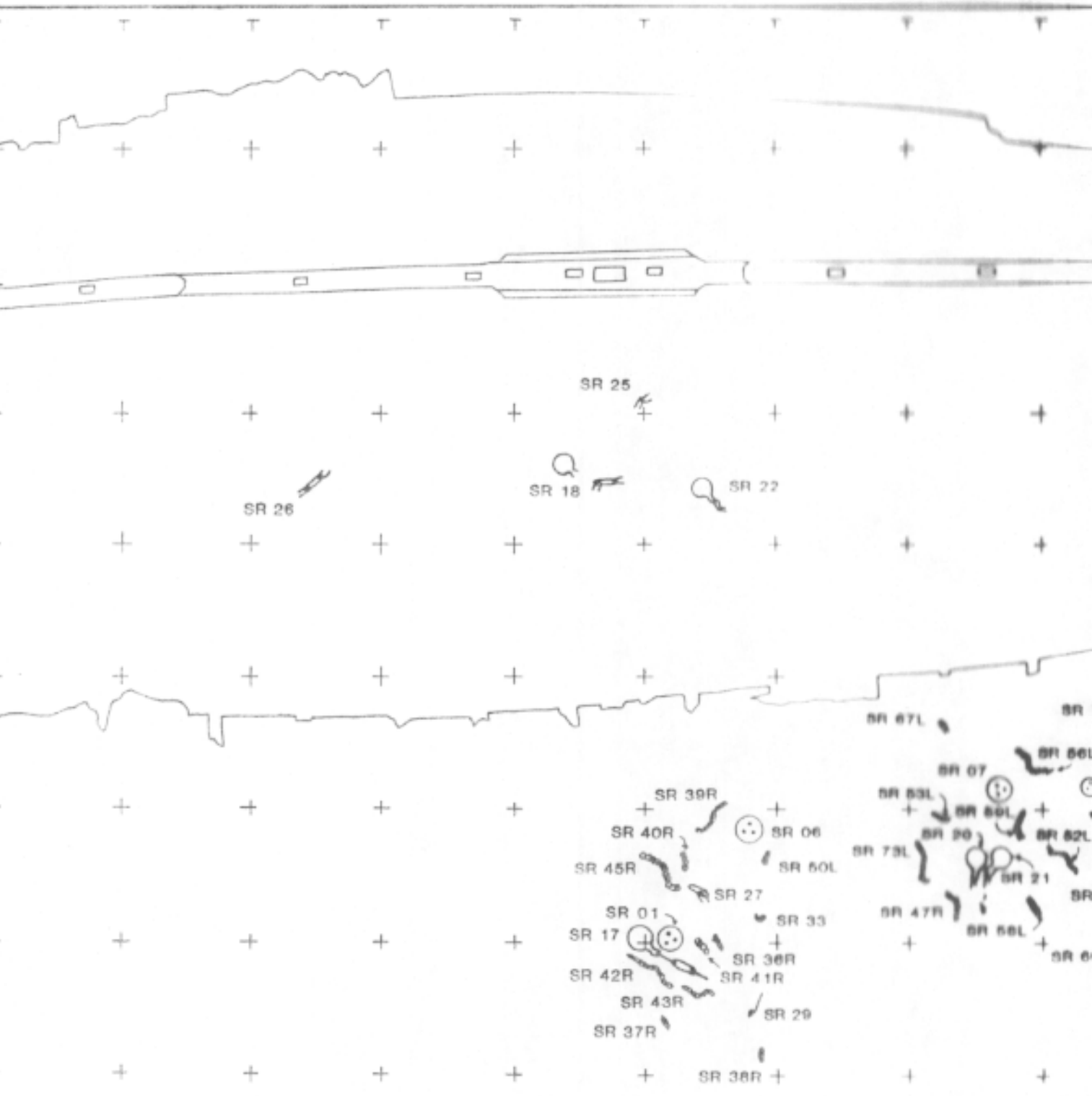


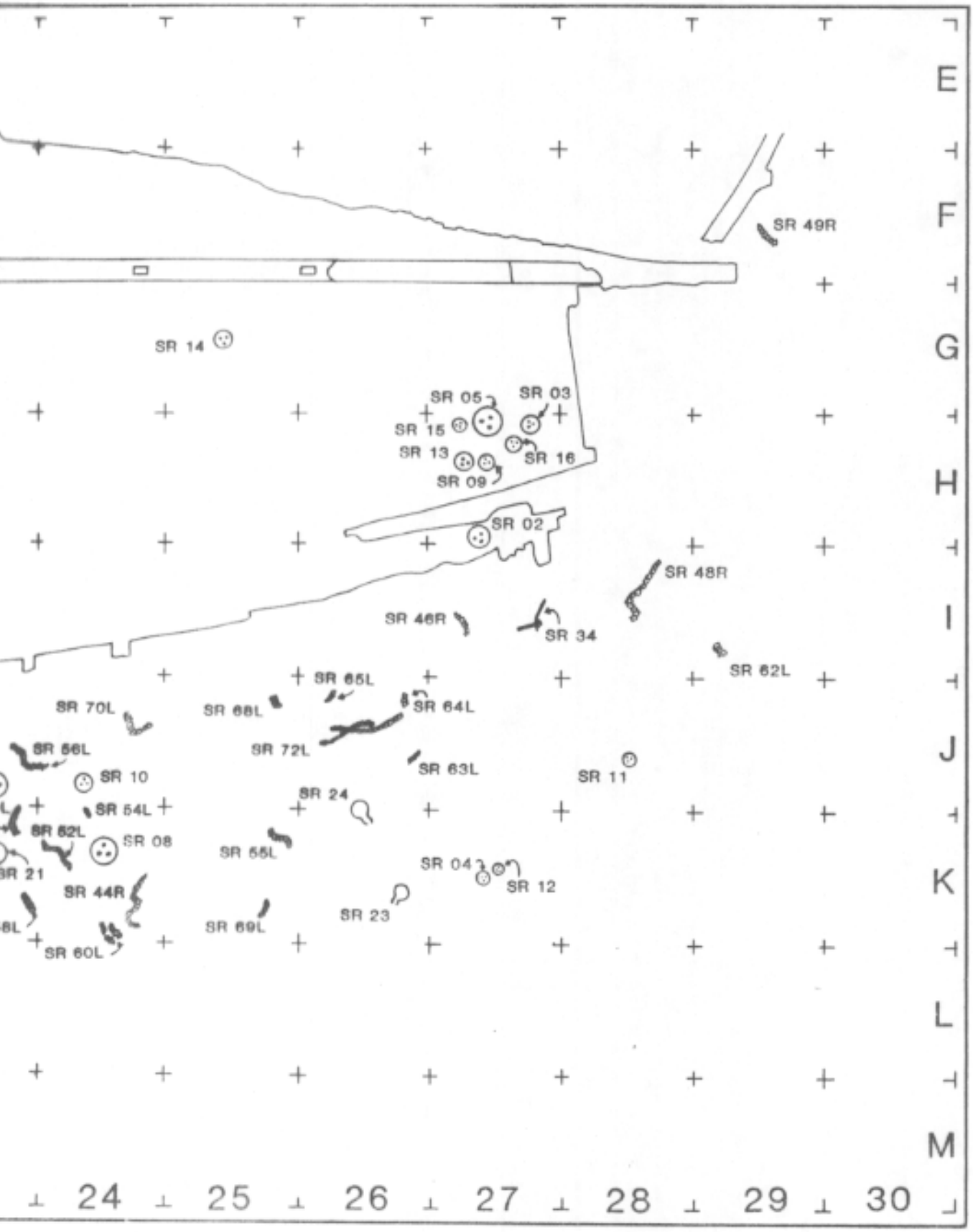
Figure 38: Example of Mombasa Harbor Wreck standing rigging artifacts against projected midship hull profile. B.F. Thompson.

Figure 39: Wreck Plan III (Distribution of Standing Rigging Artifacts). B.F. Thompson.


SR 35
SR 32
SR 28
SR 31
SR 30
SR 19
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17



16 ⊥ 17 ⊥ 18 ⊥ 19 ⊥ 20 ⊥ 21 ⊥ 22 ⊥ 23 ⊥


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SR 49R
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SR 03
SR 15
SR 13
SR 16
SR 09
SR 02
SR 48R
SR 46R
SR 34
SR 62L
SR 65L
SR 70L
SR 68L
SR 64L
SR 56L
SR 72L
SR 63L
SR 11
SR 10
SR 24
SR 54L
SR 52L
SR 08
SR 55L
SR 04
SR 12
SR 21
SR 44R
SR 23
SR 69L
SR 60L

CHAPTER VI

RUNNING RIGGING

Running rigging encompasses those objects which were fitted for the purpose of arranging the sails by passing through various blocks in different places about the masts, yards, and shrouds (Biddlecombe, 1969:26). A more descriptive definition comes from Anderson (1974:70), who describes the running rigging belonging to a square sail as being of two classes: there are the ropes which control the yard and are only indirectly concerned with the sail; and there are those which are actually connected to the sail itself.

In the first class are the ties, halliards and jeers for hoisting or lowering the yard, the parrel for holding it to the mast, the lifts for keeping it horizontal or for raising it at either end, and finally the braces for moving one end or the other forward or aft. There may also be foot-ropes beneath the yard and yard-tackles for hoisting the boats in or out. In the second class are the tacks, sheets and bowlines for setting the sail, and the clew-garnets (or clewlines), buntlines and leechlines or martinets for hauling it up to the yard when it is to be stowed (Anderson, 1974:70).

It is impossible to illustrate the exact running rigging arrangement for the Mombasa Harbor Wreck. What we can do

is list and describe each category of artifacts recovered from the site and suggest the possible uses for those objects. Basic information about the types of running rigging is revealed through this study. The Mombasa Harbor Wreck remains includes a large single-sheave common block, a shoe block, a double block, 2 fiddle blocks or viol-blocks, 17 single-sheave common blocks, 9 miscellaneous block cheeks, 9 sheaves, 2 parrel trucks, 8 hooks (7 with thimbles attached), 4 thimbles, and 5.43 m of cable-laid three-strand rope.

Large Single-Sheave Block

Singularly different from any other block found on the Mombasa Harbor Wreck, this block is presented independently of the other categories of block types. No direct parallel has been discovered so far. It size and component make-up, a sheave perpendicular to a "hawser" hole, would give it the same function as a shoe block. Its location on the wrecksite suggests it may possibly have been used as a stay block, but depictions of 17th-century warships in Frank Fox's "Great Ships" suggest it could also have been used as a yard block (1980:165).

RR 01. Large Single-Sheave Block. Inv. No. MH 1212
Figs. 40, 41 ; Wreck Plan IV

o.l. 0.795; max. w. 0.220; max. thk. 0.197; slot l. 0.385; slot w. 0.100; sh. pin hole dia. 0.060; hawser hole dia. 0.110.

One-third of block is missing and the remaining portion badly degraded. Sheave appears to be teak, the block itself seems very soft and open grained. A 9 cm "hawser hole" lies perpendicular to the plane of the sheave.

Prov. 18H

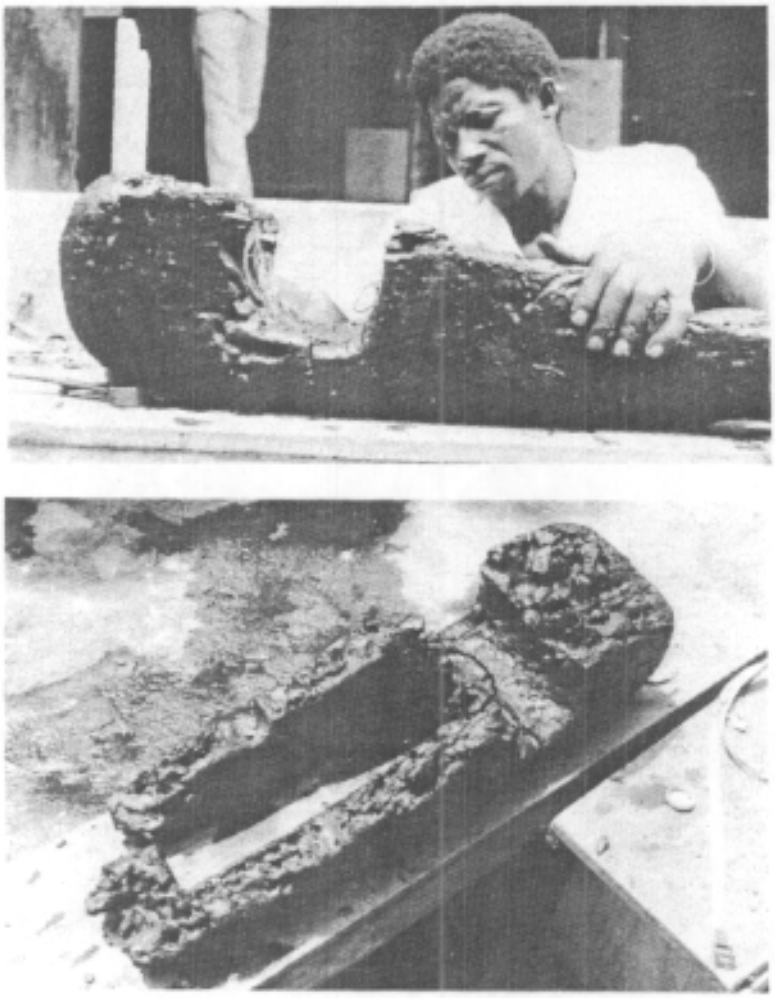


Figure 40: Photographs of large single-sheave block, RR 01. A. Darroch.

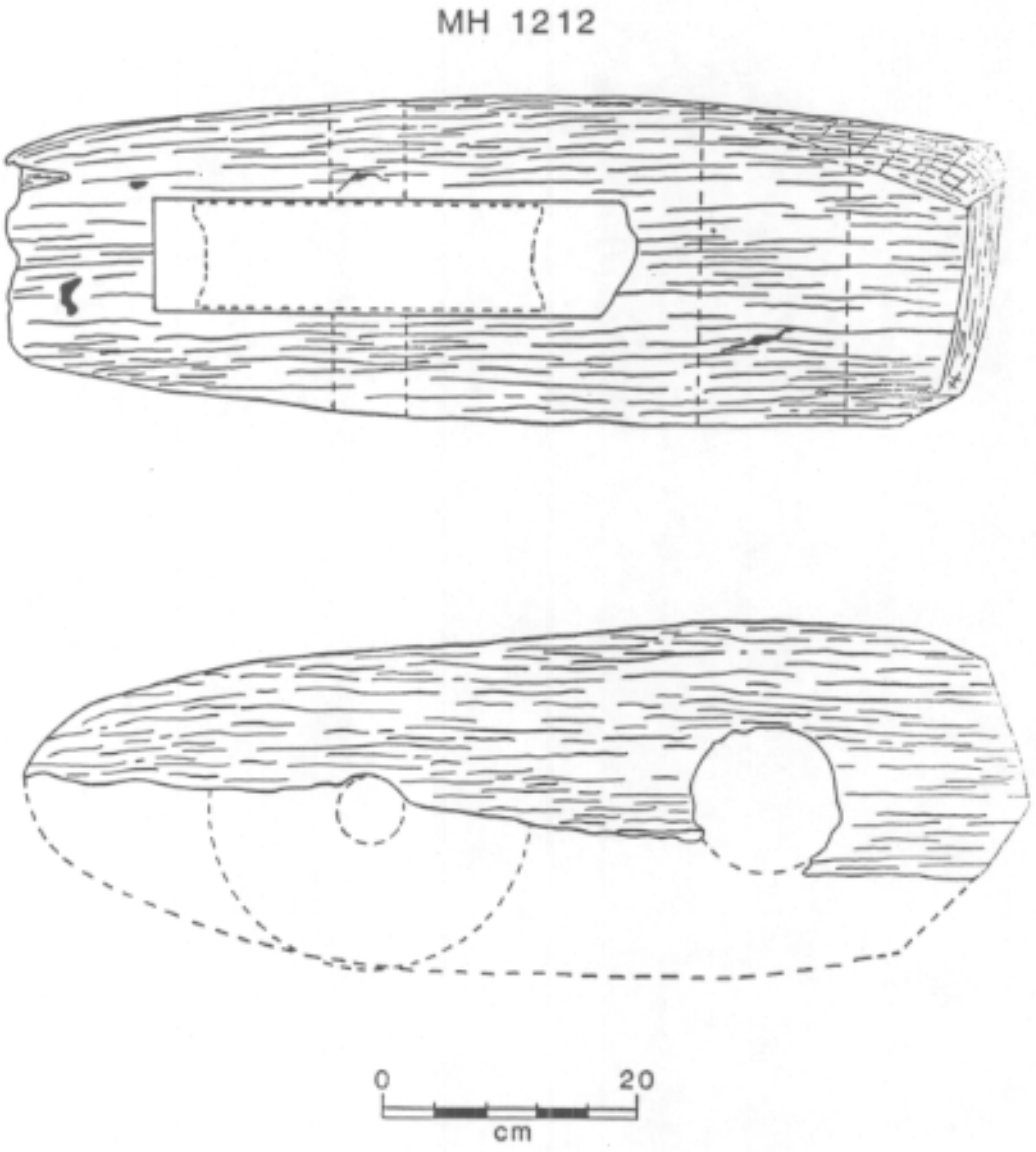


Figure 41: Large single-sheave block, RR 01. B.F. Thompson.

Shoe Block

Shoe blocks were similar to two single common blocks, placed together head to head, with the sheaves running in a contrawise direction. Both sheaves were the same size, the shell was cut out of one piece of wood, and no strap was required. The proportions of shoe blocks were the same as two single common blocks (Lees, 1979:165).

The Mombasa Wreck shoe block was found downslope of the hull remains and amidships, in a line about 4 m from the mast-step. Three pieces of hawser-laid four-strand rope, possibly parts of a stay, were found in the same area. This would indicate that the block may have been used as a stay-block rather than a yardarm block. Its size would also point to its being stay-block.

RR 02. Shoe block. Figs. 42, 43 — Inv. Nos. MH 5936 & MH 5899 ; Wreck Plan IV

o.l. 0.780; w. 0.390; est. thk. 0.210; lg. sh. dia. 0.270; sh. thk. 0.068; pin dia. 0.070; pin l. 0.210; swallow 0.050; sm. sh. dia. 0.200; sh. thk. 0.058; pin dia. 0.038; pin l. 0.210; swallow 0.060.

Teak block with two sheaves at perpendicular planes to each other. Shell deteriorated and partially missing over larger sheave. "Tip" of block near small sheave is also missing.

Prov. 23K

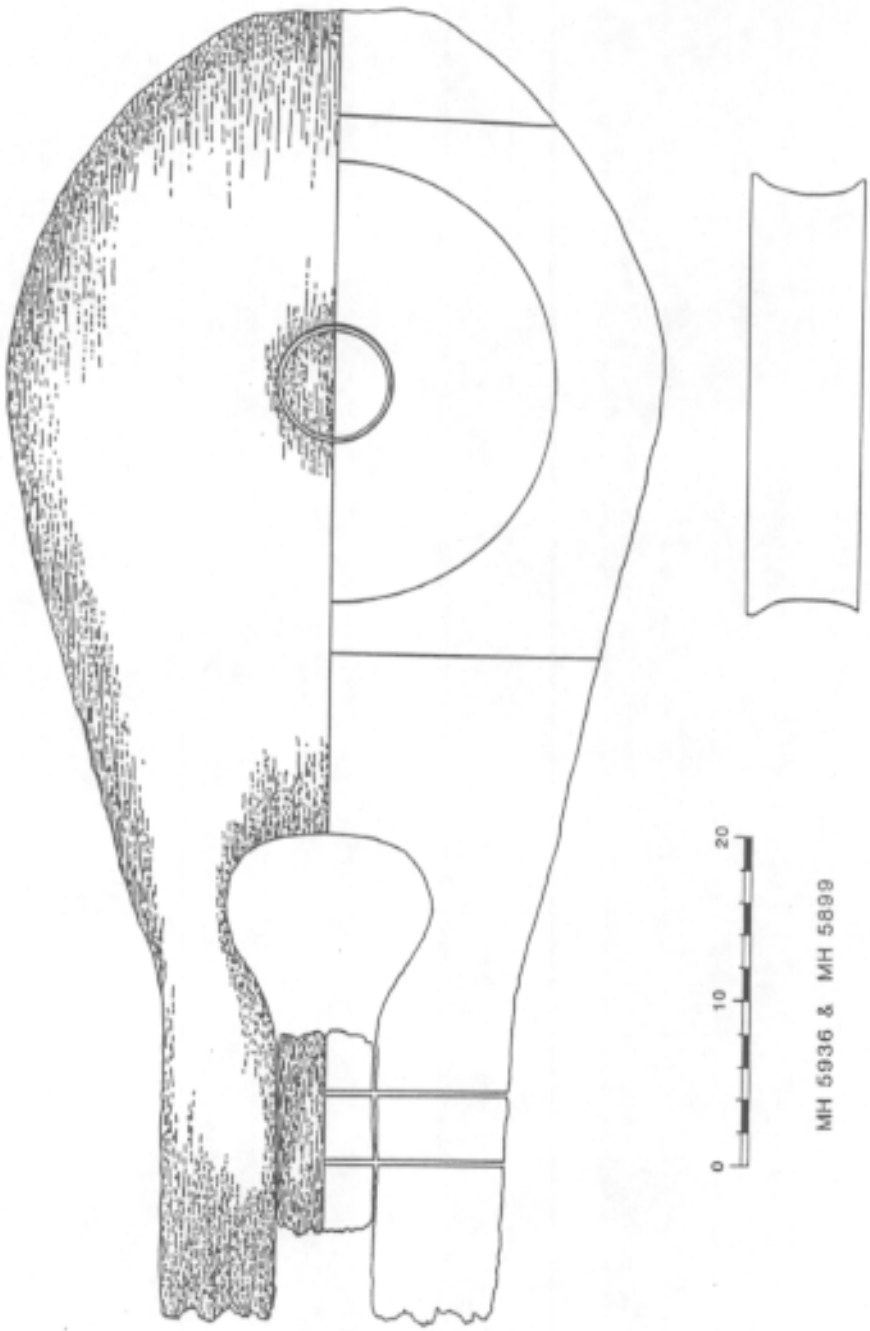


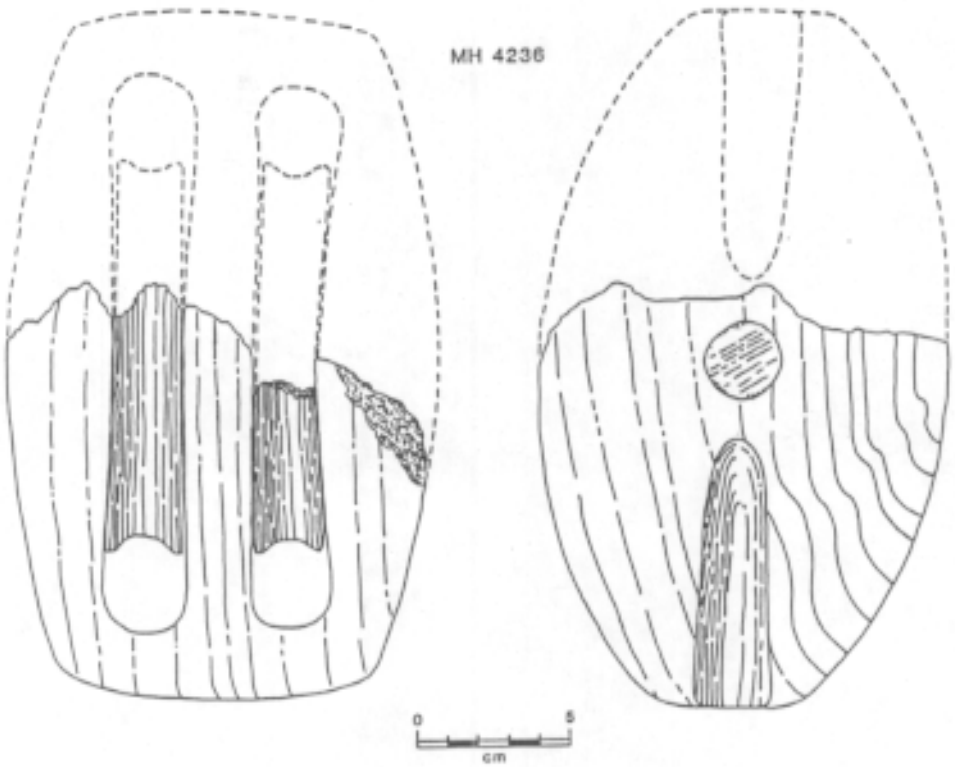
Figure 42: Shoe block, RR 02. C. Sassoon.



Figure 43: Photograph of shoe block, RR 02. A. Darroch.

Double Block

Common blocks (double and treble) were made to the same proportions as the single blocks except in the width of the shell. This was increased by the separating piece or pieces between the sheaves which were five-sixths the width of the sheaves. The common block, as the name suggests, was the most popular type of block and was used for all purposes except where specific types of blocks were called for (Lees, 1979: 164). Only one double block is recorded for the Mombasa Wreck, its provenience downslope of the stern area. It is surprising that more double blocks were not found in other areas of the ship. It is likely that they were swept away along with the mast and other rigging lines.



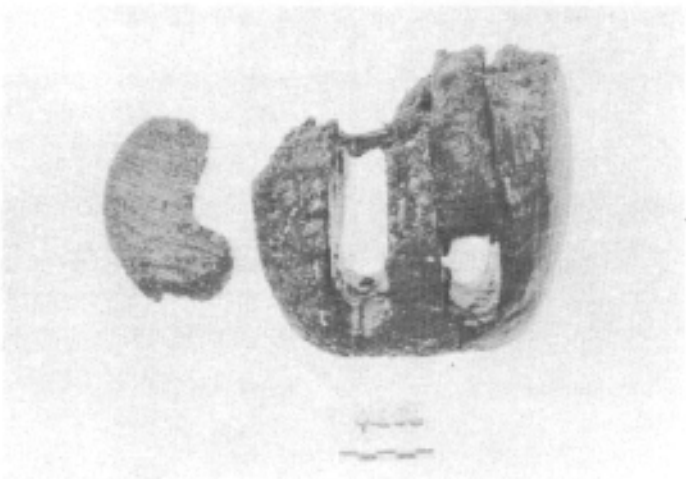


Figure 44: Double block, RR 03. Drawing by B.F. Thompson and photograph by M. Taffe.

RR 03. Double Block. Inv. No. MH 4236
Fig. 44 ; Wreck Plan IV

est. o.l. 0.420; max. w. 0.149; max. th. 0.139; crown sc. l. 0.089; max. crown sc. w. 0.024; crown sc. d. 0.009; pin dia. 0.022; pin hole dia. 0.020; pres. sh. dia. (approximate) 0.127; sh. dia. (approximate) 0.127; both sh. w. 0.024; max. sh. gr. d. 0.005; sw. dia. 0.030.

Fragmentary teak double block, both wheels and pin partially preserved. More than one-third of shell is missing.

Prov. 26J

Fiddle Blocks

Two fiddle blocks were found in the downslope area, the smaller RR 04 in the amidship area and the larger RR 05 in the stern area. Fiddle blocks were a preferred block for use on masts or near yards, since their flat shapes lay flatter than a double block (Ashley, 1944:524). Lees formulas for the dimensions of fiddle blocks fits perfectly the examples found on our wreck. For instance, the length of the shell overall was fourteen times the width of the sheaves (Lees, 1979:166). Our large fiddle block is 44.8 cm long with a sheave width of 3.2 cm. Long-tackle or fiddle blocks had a width of sheave that was one tenth more than the diameter of the rope, our width of sheave is 3.2 cm and our groove width, which would indicate the size of rope, is 2.8 cm.

The size and location of the blocks may hint at their

uses. The large block from the stern area is large enough to have been used on a stay and the smaller block would have been the right size for a yard-block.

RR 04. Fiddle block. Inv. No's. MH 6014 & MH 5754 Wreck Plan IV

o. l. 0.220; max. w. 0.150; th. 0.100; arse sc. l. 0.074; arse sc. w. 0.028; lg. sh. dia. 0.125; sh. thk. 0.016; pin dia. 0.030; pin l. 0.100; sm. sh. dia. 0.100; sh. thk. 0.016; pin dia. 0.026; pin l. 0.100.

Fiddle block with degraded shell of alternating open and closed grain wood. The block is worm-eaten and very deteriorated for most of its surface.

Prov. 26K

RR 05. Fiddleblock. Inv. No. MH 0086
Fig. 45 ; Wreck Plan IV

o. l. 0.448; max. w. 0.243; max. th. 0.134; arse max. w. 0.162; arse max. th. 0.116; crown sc. l. 0.112; crown sc. w. 0.043; arse sc. l. 0.090; arse sc. w. 0.022; lg. sh. dia. 0.160; sh. thk. 0.032; sw. dia. 0.027; pin dia. 0.042; pin l. 0.134.

Very deteriorated cheeks and sheave with smaller sheave missing completely. Wooden pin and most of one cheek very deteriorated. Wood grain on cheeks alternates open & closed.

Prov. 21L

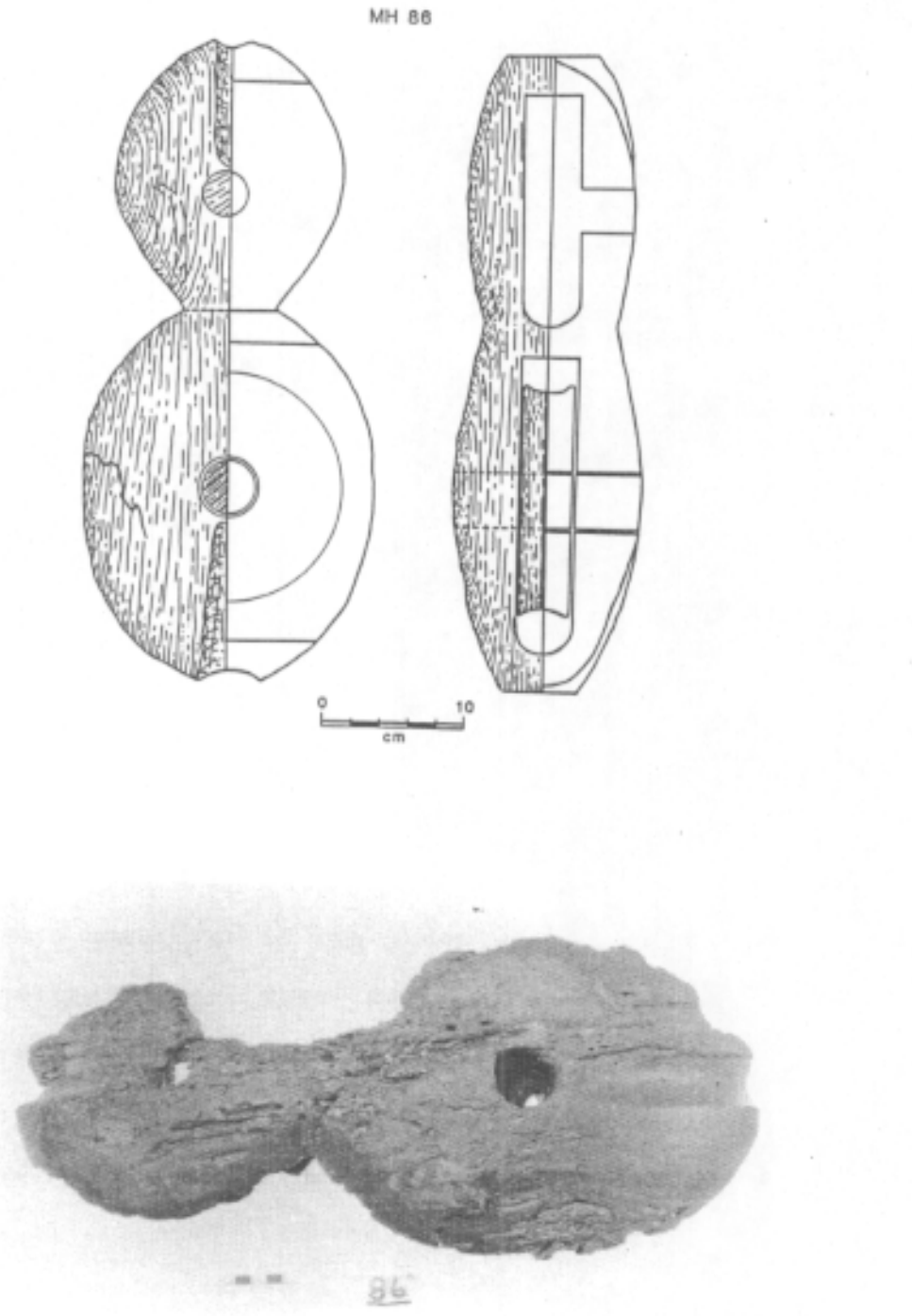


Figure 45: Fiddle block, RR 05. Drawing by B.F. Thompson and photograph by M. Taffe.

Single Blocks

Concerning the single block, Manwayrings says "But you must note also, that though double-blocks purchase with more ease, single blocks do purchase faster" (1644:11). All of our single blocks were "made" blocks, which means they were chiseled out of a single piece of wood (Ashley, 1944:523). Single blocks consisted of a shell, a revolving sheave and a pin. The shell had grooves scored on both ends and sides of the block around which the strop was seized. The measurements for these artifacts have been taken according to the nomenclature most commonly used (Fig. 46).

The common single block had a sheave diameter four times the width of the sheave and a shell width two fifths the length of the shell (Lees, 1979:164). Seventeen complete single blocks were discovered on the wrecksite, the majority of which were uncovered in the stern area. Using length as a determinating factor, three major size groups are evident: 8 blocks ranging between 12 cm and 15 cm, 7 blocks ranging between 16.3 cm and 21.8 cm and 2 large single blocks 22.2 cm and 24.2 cm. Four of the more representative type single blocks are illustrated; the remainder are listed in Table 8.

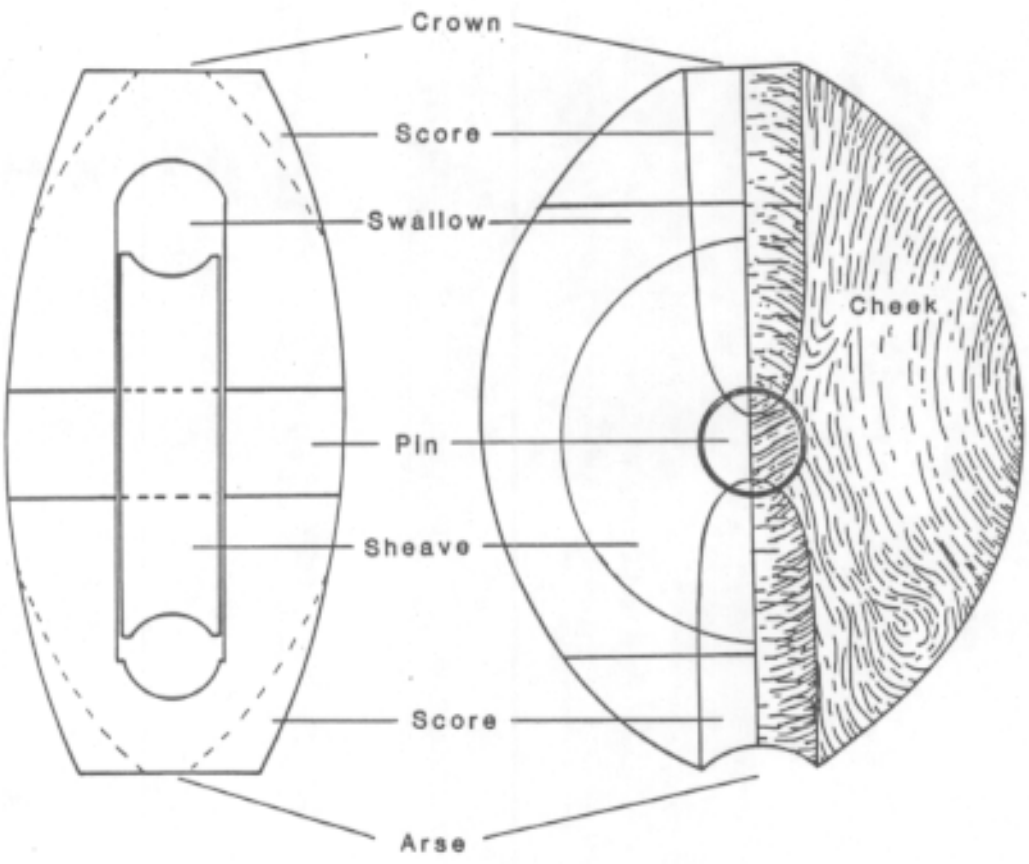


Figure 46: Single block nomenclature, RR 07. B.F. Thompson.

RR 06. Single Block. Inv. No. MH 0702
Fig. 47 ; Wreck Plan IV

o.l. 0.145; w. 0.094; thk. 0.070; sc. d. 0.010; sc. w. 0.020; sw. dia. 0.020; sh. dia. 0.070; sh. thk. 0.021; pin l. 0.070; pin dia. 0.021.

Small teak common block in excellent condition with sheave and pin in-situ. PEG treated.

Prov. 25H

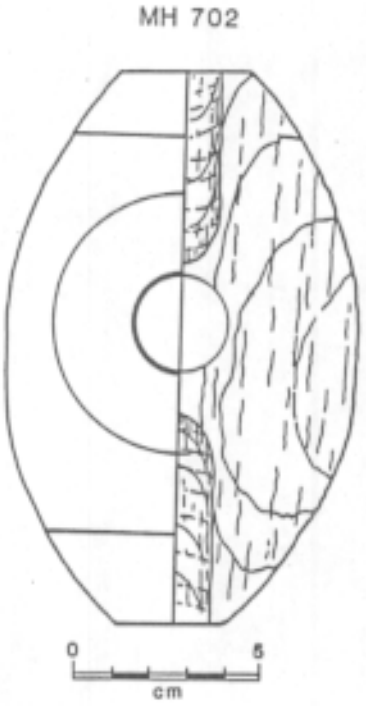


Figure 47: Single Block, RR 06. N. Piercy.

RR 07. Single Block. Inv. No. MH 5466
Fig. 48 ; Wreck Plan IV

o.l. 0.150; w. 0.115; thk. 0.073; sc. d. 0.008; sc. w. 0.025; sw. dia. 0.025; sh. dia. 0.080; sh. thk. 0.020; pin. l. 0.073; pin dia. 0.021.

One side of softwood block is crushed and areas of deterioration at crown. Sheave and pin in good condition.

Prov. 26I

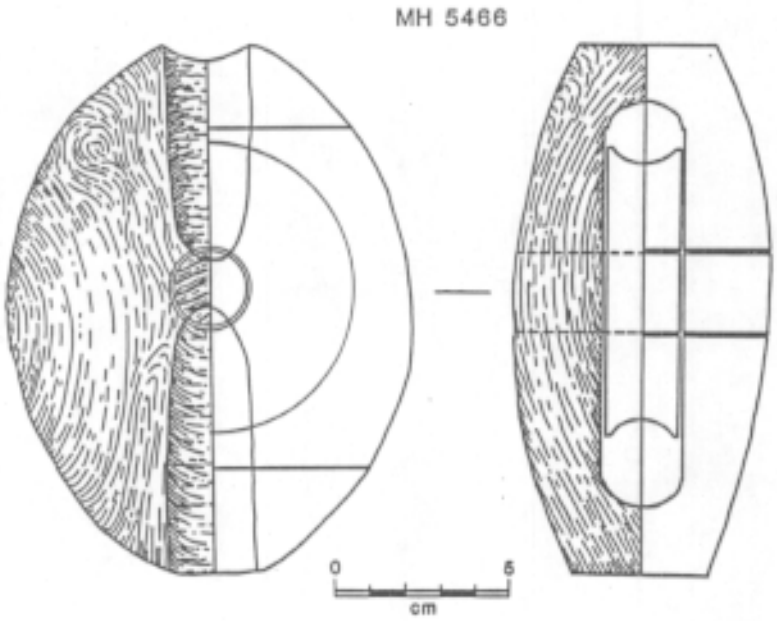


Figure 48: Single Block, RR 07. B. F. Thompson.

RR 08. Single Block. Inv. No. MH 0360
Fig. 49 ; Wreck Plan IV

o.l. 0.163; w. 0.110; thk. 0.062; sc. d. 0.010; sc. w. 0.029; sw. dia 0.022; sh. dia. 0.095; sh. thk. 0.021; pin l. 0.062; pin dia. 0.014.

Complete block is in excellent condition, apparently teak.

Prov. 20G

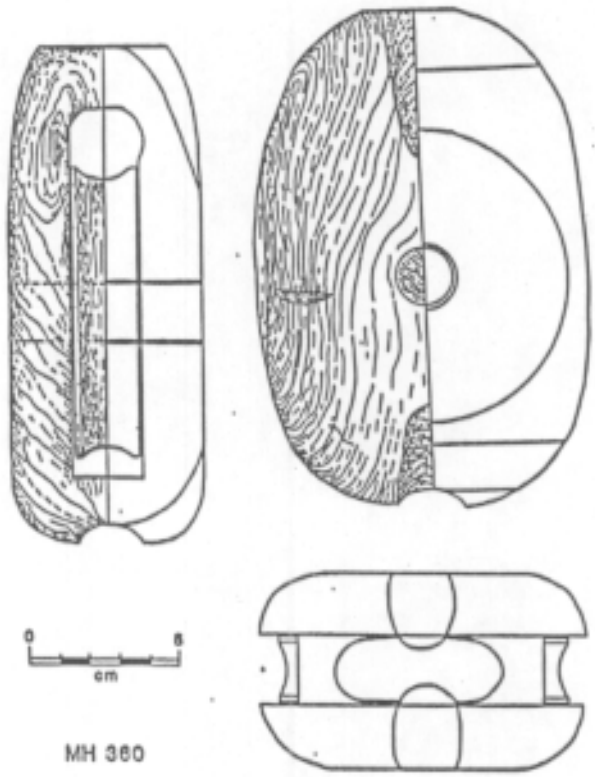


Figure 49: Single block, RR 08. B.F. Thompson.

RR 09. Single Block. Inv. No. MH 4398
Fig. 50 ; Wreck Plan IV

o.l. 0.218; w. 0.140; thk. 0.092; sc. d. 0.012; sc. w. 0.030; sw. dia. 0.022; sh. dia. 0.120; sh. thk. 0.028; pin l. 0.092; pin dia. 0.028.

Flat pulley block, teak, in badly deteriorated condition. Pin appears to have been "wrenched" at the time the cheeks separated. Sheave in good condition and impression of sheave can be seen on backsides of cheeks.

Prov. 26J

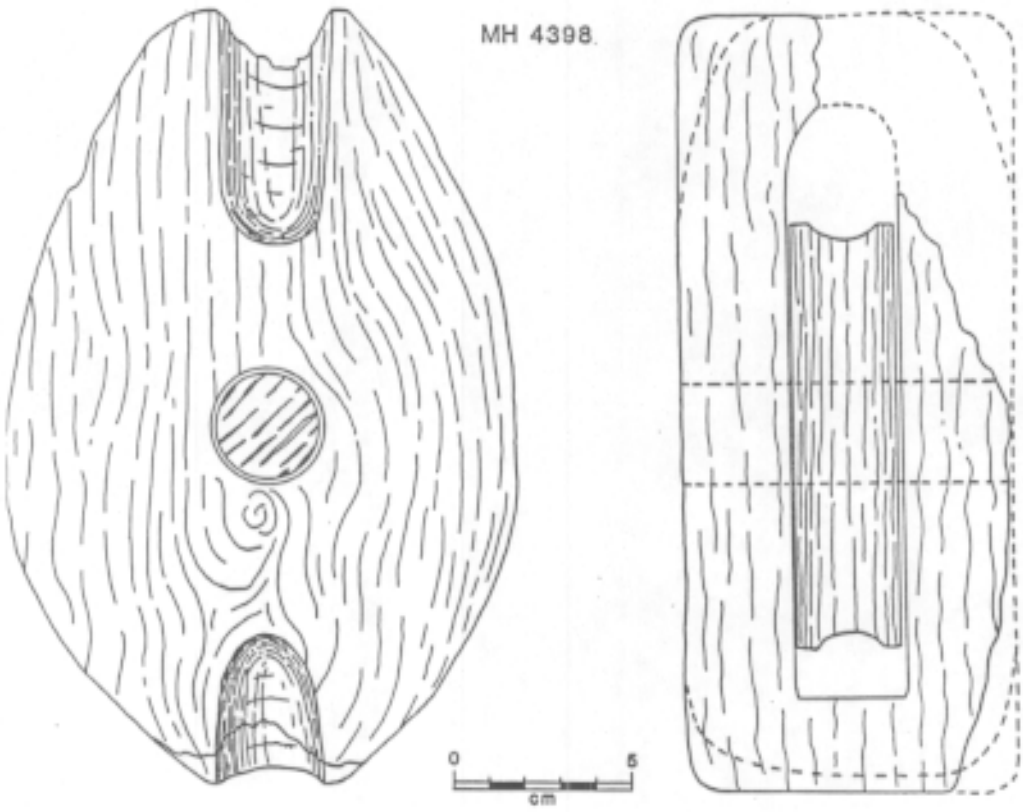


Figure 50: Single Block, RR 09. B.F. Thompson.

Table 8: Single-sheave common blocks (all measurements in centimeters - for distribution see Wreck Plan IV).

RR	MH	Prov	o l	w	thk	sh dia	sh thk	sw dia
10	0892	23G	12.0	9.2	6.2	6.5	2.0	2.0
11	2189	15G	12.0	10.0	6.2	6.6	2.0	2.0
12	1730	18H	14.9	13.5	8.3	8.0	2.0	2.1
13	0744	24G	14.5	10.0	6.2	7.2	2.0	2.0
14	4306	26J	18.0	13.5	---	8.0	---	---
15	4900	25J	15.0	11.8	7.0	8.2	1.9	---
16	5716	sp	14.8	10.5	6.9	8.2	2.3	2.1
17	0701	25H	18.0	15.0	8.2	9.0	3.0	2.3
18	4397	26J	16.8	13.9	1.0	10.5	2.7	2.0
19	4221	26J	17.0	14.2	9.0	10.8	2.9	2.9
20	4205	sp	24.4	8.3	---	13.0	---	---
21	0116	21L	22.2	15.4	3.7	13.1	3.1	3.0
22	5610	28K	21.1	15.0	3.5	14.0	3.0	2.6

Miscellaneous Block Cheeks

Miscellaneous block cheeks includes those block shells which were deteriorated to the point that complete measurements were not possible. They are included here as reference for base measurements only (Table 9). In most cases only one shell is extant and no sheaves or pins were found with the artifacts. Pin diameters are eastimated from pin holes rather than the wooden pin itself.

Table 9: Miscellaneous block cheeks (all measurements in centimeters - for distribution see Wreck Plan IV).

RR	MH	Prov	o.l.	w.	thk.	p. dia.	comments
23	6545	sp	13.0	9.5	2.8	2.3	1 cheek
24	5719+ 5715	25K	21.0	11.0	9.0	2.3	2 cheeks
25	6248	28J	20.0	11.0	5.2	3.1	1 cheek
26	5720	sp	8.0	11.0	5.2	---	partial
27	4569	23J	30.0	18.0	9.7	4.2	1 part of fiddle block
28	0146	221L	29.9	14.0	6.9	2.4	2 partial cheeks
29	5720	sp	10.0	9.0	9.0	2.3	2 partial cheeks
30	5696	27J	11.0	11.0	6.0	2.4	1 partial cheek

Sheaves

There is no way to determine if the sheaves here listed represent parts of blocks in use or rather spare sheaves to be used as replacements (Fig. 51). Locations of these finds suggests that they were in use during the sinking, but had been separated from their original blocks (Table 10).

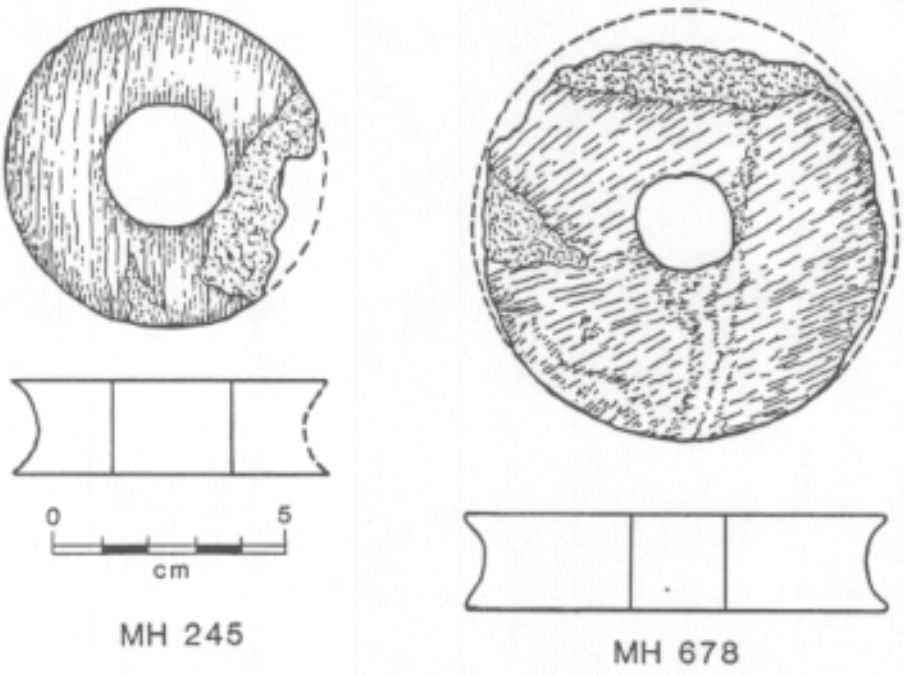


Figure 51: Pulley sheaves, RR 31 and RR 36. M. Stanbury.

Table 10: Miscellaneous pulley sheaves (all measurements in centimeters - for distribution see Wreck Plan IV).

RR	MH	Prov	sh. dia.	sh.thk.	pin dia.	gr. d.
31	0245	21L	6.4	1.8	2.4	0.3
32	0133	21L	7.0	2.3	2.0	0.4
33	6546	sp	7.5	1.5	2.0	---
34	0210	21L	8.0	---	---	---
35	4314	sp	8.2	1.6	2.3	0.4
36	0678	sp	9.0	2.0	2.0	0.4
37	3555	25J	12.0	3.2	3.5	---
38	2130	16G	12.5	2.3	3.0	0.5
39	0592	26H	12.7	3.3	4.0	0.1

Parrel Trucks

The parrels for the yards are comprised of ribs and trucks; those on the lower yards are made up of three rows

of trucks, and the other parrels made up to two. The length of the trucks was one and a quarter times their diameter and holes were bored through the trucks to take the parrel rope. The trucks were positioned so that 1/2 inch of truck protuded beyond the back of the rib, with a slight cavity in the ribs in the way of the trucks (Lees, 1979: 168).

Only two trucks were found on the wrecksite, one of which SR 41 does not wholey fit Lees description of a parrel truck. Its dimensions are somewhat longer, being three times the size of the hole diameter (Fig. 52). This artifact may be a shroud rigging truck, but there are none of the typical running rigging grooves that one would expect to find (Lees, 1979:168).

RR 40. Parrel Truck. Inv. No. MH 1174
Fig. 52 ; Wreck Plan IV

l. 0.070; thk. 0.058; hole dia. 0.030.

Wooden truck with enscribed line about its middle. Partially squashed but otherwise in good condition.

Prov. 19H



Figure 52: Photograph of parrel truck, RR 40. M. Taffe.

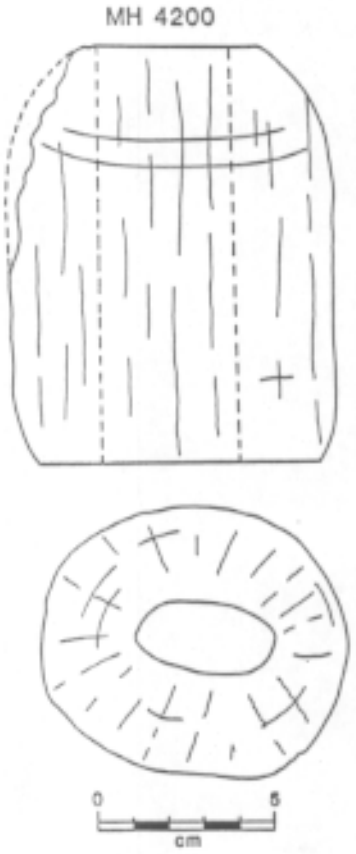


Figure 53: Truck, RR 41. B.F. Thompson.

RR 41. Parrel Truck. Inv. No. MH 4200
Fig. 53 ; Wreck Plan IV

l. 0.093; thk. 0.117; hole dia. 0.030.

Softwood truck with normal open grain. Badly degraded on one side and squashed. Incised line about its middle.

Prov. sp.

Common Hooks

As useful and plentiful as hooks are onboard both ancient and modern vessels, there are few references as to their description or use. The best definition of a hook comes from Biddlecombe, who describes it as "a crooked piece of iron, of which there are several kinds, of different shapes, used at sea; as, boat-hooks, can-hooks, cat-hooks, chain hooks,&c" (1969:16). Another type of hook is named a fish-hook, which was about one and a half times the diameter of a cat block hook and had an eye in the top running through a thimble, which was to take the fish pendant (Lees, 1979:168).

It is difficult to determine which functions the Mombasa Harbor Wreck hooks were put to since they could have been used for everything from the gun tackles to pendant tackles. Of the eight hooks recorded to date, all but one had thimbles attached to their eyes. Their sizes, as reflected by length, range between 13 cm and 17.8 cm. The majority of the hooks were located in the stern area.

RR 42. Hook. Inv. No. MH 4657
Fig. 54 ; Wreck Plan IV

o.l. 0.145; eye o.d. 0.072; eye i.d. 0.037; max. w. at ap. 0.085; ap. 0.055; x-sec. 0.023.

Iron hook with large eye and wide aperture, still in concretion.

Prov. 27I

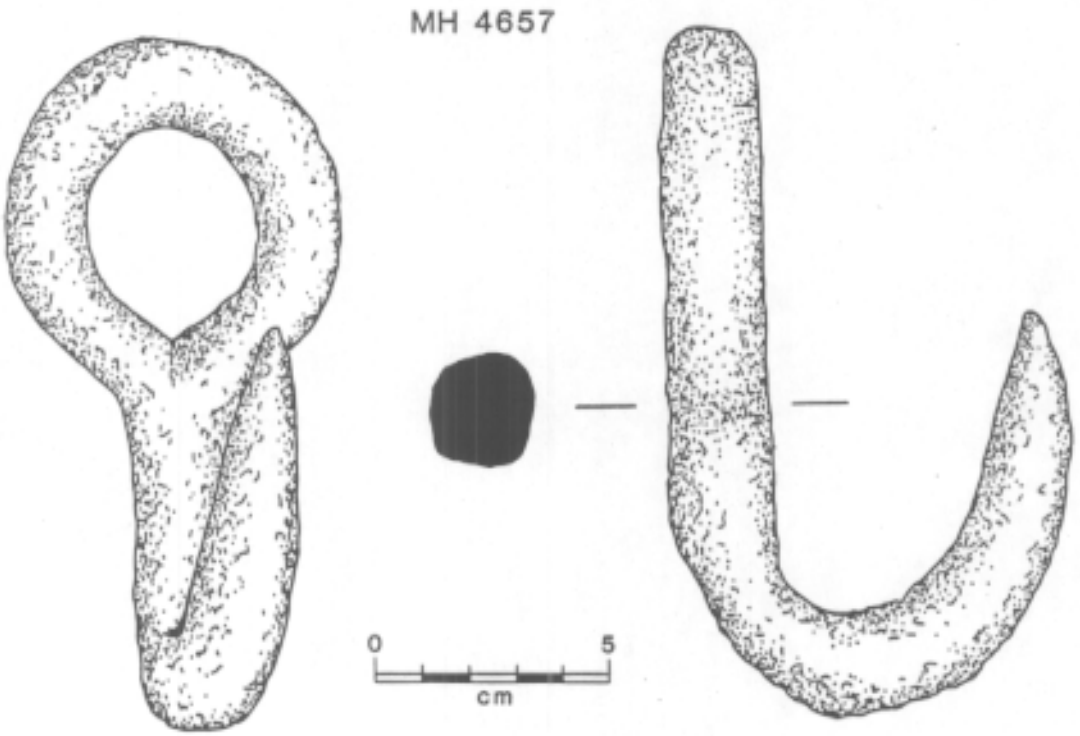


Figure 54. Common hook, RR 42. N. Piercy.

RR 43. Hook & Round Thimble. Inv. No. MH 4097
Wreck Plan IV

Hook: o.l. 0.150; eye o.d 0.073; eye i.d. 0.030; max. w. at ap. 0.084; ap. 0.055; x-sec. 0.021. Thimble: o.d. 0.074; i.d. 0.030; thk. 0.003.

Iron hook and thimble with three-strand rope in-situ within thimble groove.

Prov. sp

RR 44. Hook & Round Thimble. Inv. No. MH 4566
Wreck Plan IV

Hook: o.l 0.150; eye o.d. 0.070; eye i.d. 0.037; max. w. at ap. 0.080; ap. 0.051; x-sec. 0.021. Thimble: o.d. 0.074; i.d. 0.030; thk. 0.003.

Iron hook and thimble with three-strand rope adhering to thimble (rope dia. 2.2 cm).

Prov. 23J

RR 45. Hook & Thimble. Inv. No. MH 6384
Wreck Plan IV

Hook: o.l. 0.150; eye o.d. 0.080; eye i.d. 0.035; max. w. at ap. 0.100; ap. 0.065; x-sec. 0.026.

Iron hook and thimble still in concreted state but appears that rope is in-situ within thimble groove. No measurements possible for the thimble or rope.

Prov. 25J

RR 46. Hook & Round Thimble. Inv. No. MH 4657
Wreck Plan IV

Hook: o.l. 0.145; eye o.d. 0.070; eye i.d. 0.035; max. w. at ap. 0.085; ap. 0.055; x-sec. 0.021.

Iron hook in good condition but thimble still in concreted state. No measurements possible for the thimble but it appears to be round.

Prov. 27I

RR 47. Hook & Round Thimble. Inv. No. MH 5687
Fig. 55 ; Wreck Plan IV

Hook: o.l. 0.178; eye o.d. 0.045; eye i.d. 0.025; max. w. at ap. 0.085; ap. 0.062; x-sec. 0.020. Thimble: o.d. 0.062; i.d. 0.035; thk. 0.003.

Iron hook and thimble with three-strand rope adhering to thimble surface. Hook mechanically cleaned but thimble still in concretion.

Prov. sp.

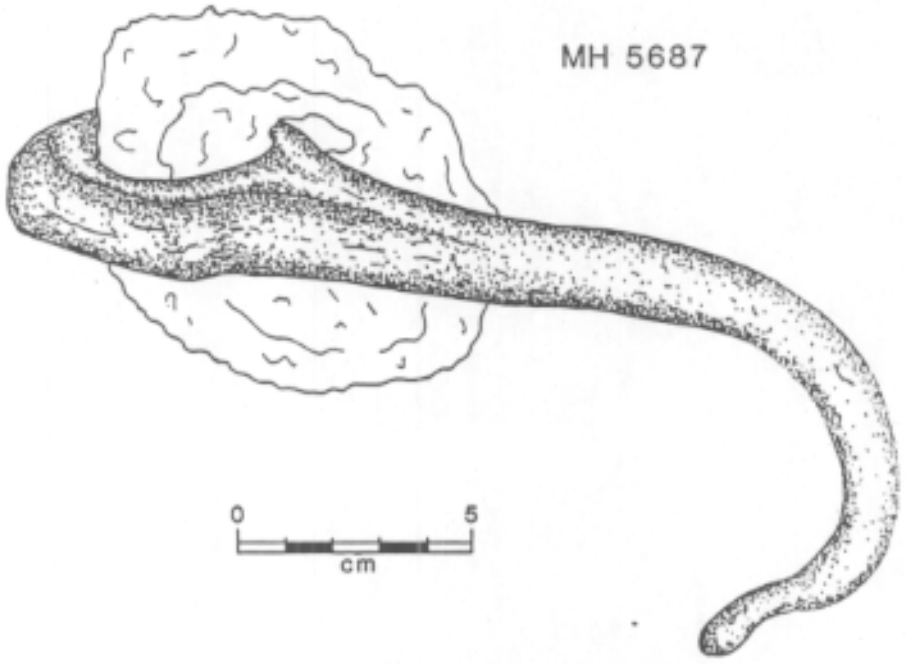


Figure 55: Hook and thimble, RR 47. B.F. Thompson.

RR 48. Hook & Thimble. Inv. No. MH 4799
Fig. 56 ; Wreck Plan IV

Hook: o.l. 0.130; eye o.d. 0.064; eye i.d. 0.032; max. w. at ap. 0.080; ap. 0.052; x-sec. 0.020.
Thimble: o.d. 0.060; i.d. 0.030; thk. 0.003.

Iron hook complete and thimble partial. Some rope of indeterminable strand adhering to thimble groove.

Prov. 26J

RR 49. Hook & Thimble. Inv. No. MH 2381
Wreck Plan IV

Hook: o.l. 0.145; eye o.d. 0.070; eye i.d. 0.040;
max. w. at ap. 0.085; ap. 0.050; x-sec. 0.020.
Thimble: o.d. 0.020; i.d. 0.040; w. 0.025.

Iron eyehook and thimble poorly cast.

Prov. 24K

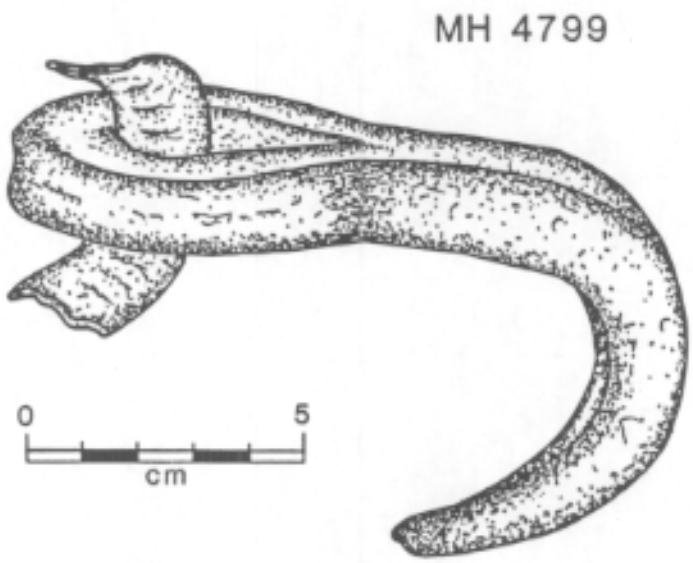


Figure 56: Hook & thimble, RR 48. B.F. Thompson.

Thimbles

Thimbles are metal rings with a concave outer edged round which a rope can be spliced. They are usually made to take a hook or to guide another rope. Ashley describes two types of thimbles, round and oval (1944:534). Round thimbles are said to be the oldest type and were used with fiber rope, while the oval thimbles were used mainly with wire. Of the seven thimbles associated with hooks and the four individual examples listed here, only one example is oval in shape.

RR 50. Oval Thimble. Inv. No. MH 3950
Fig. 57 ; Wreck Plan IV

Thimble: o.l. 0.063; o.d. 0.050; i.d. 0.031; thk. 0.003; w. 0.025.

Prov. 26J

RR 51. Round Thimble. Inv. No. MH 2366
Fig. 58 ; Wreck Plan IV

Thimble: o.d. 0.065; i.d. 0.036; thk. 0.003; w. 0.038.

Prov. 24K.

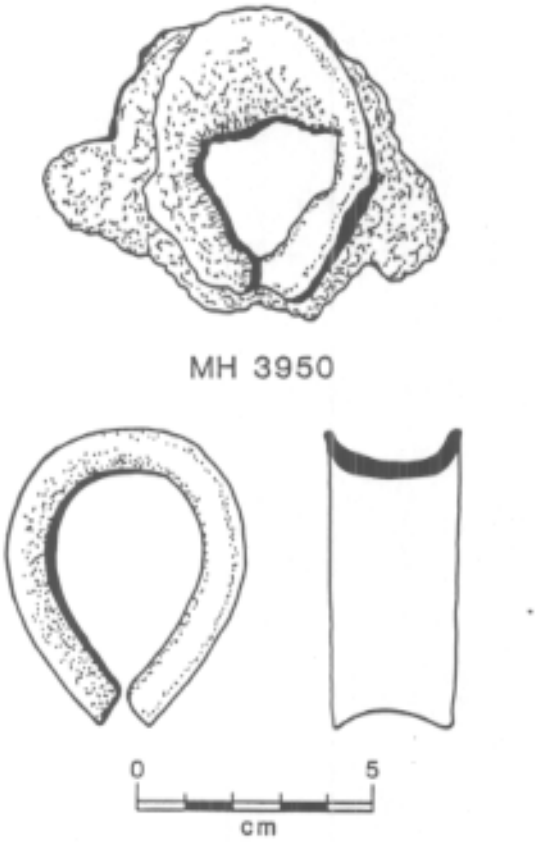


Figure 57: Oval thimble, RR 50. N. Piercy.

RR 52. Round Thimble. Inv. No. MH 3422
Wreck Plan IV

Thimble: o.d. 0.062; i.d. 0.035; thk. 0.002; w. 0.025

Thimble fragmented, w. frags of three-strand rope. Cast.

Prov. 25J

MH 2366

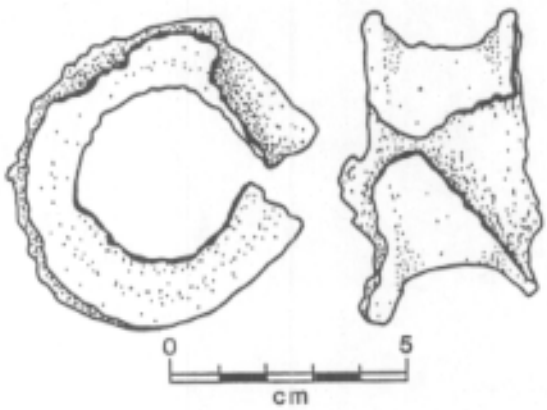


Figure 58: Round thimble, RR 51. B.F. Thompson.

RR 53. Round Thimble. Inv. No. MH 6605
Wreck Plan IV

Thimble: dia. 0.035; th. 0.034; cringle track 0.008

Fragmentary iron round thimble.

Prov. sp.

Three-Part Rope

Three-part rope consists of three plain- or hawser-laid ropes laid up together left-handed. According to Biddlecombe, "every hemp cable, of whatever thickness it may be, is generally formed of three ropes, twisted together, which are then called strands, all containing a certain number of ropeyarns, the number being, more or less, in proportion to the size of cable needed" (1969:6).

NAUTICAL ARCHAEOLOGY

The smaller diameter cables or cablets served several purposes onboard a sailing ship, such as purchase tackles. I have entered this type of rope under the heading of running rigging, since most of the thimbles recorded for this wreck had small fragments of three-strand left-laid rope adhering to their grooved surfaces. The distribution of this rope type parallels the distribution of single blocks. There is a total of 5.43 m of cable-laid three-part rope along the downslope area of the wrecksite, which indicates that the samples were in use when the vessel sank (Table 11).

Table 11: Cable-laid three-part rope (all measurements in centimeters - for distribution see Wreck Plan IV).

Ro	MH	Prov	Lay	Pts.	Str.	l.	dia.	
54	0292	21L	lt.	3	10	24.5	2.2	
55	0114	21L	lt.	3	10	21.0	2.7	
56	0781	25H	lt.	3	14	22.0	2.7	
57	5744	25K	lt.	3	16	29.0	4.9	
58	4967	25K	lt.	3	23	14.5	4.8	
59	5118	22J	lt.	3	14	61.0	2.7	
60	4972	25J	lt.	3	23	42.0	4.8	Tar
61	3626	25J	lt.	3	13	21.0	4.5	
62	2411	24K	lt.	3	10	32.0	2.7	
63	4486	25J	lt.	3	16	16.0	4.8	Jute
64	4903	25K	lt.	3	11	11.0	2.2	
65	4821	25J	--	3	09	----	---	
66	4301	26J	--	3	09	----	---	
67	5565	26J	lt.	3	10	9.0	1.6	
68	1467	25G	lt.	3	02	12.0	0.8	
69	5120	23J	lt.	3	16	13.5	3.2	
70	0252	21L	lt.	3	13	96.0	2.2	
71	3888	25K	lt.	3	23	13.0	4.8	Tar
72	0256	21L	lt.	3	09	17.0	2.5	
73	0108	21K	lt.	3	--	16.3	---	
74	1560	25H	lt.	3	--	13.6	2.2	
75	3624	25J	lt.	3	--	21.0	3.5	
76	3160	26I	lt.	3	--	26.5	1.9	
77	5988	29I	lt.	3	--	12.0	1.9	

Cable Eye

Originally this artifact was described as a serving mallet (Piercy, 1977:343) and it may possibly be, however I was unable to find a parrallel example (Fig. 59). The groove on the bottom of the object is only 3.3 cm wide and as such would be a poor candidate for a serving mallet. I offer a second possibility though the name may be a misnomer. It appears that the wooden arms have been worn possibly due to having been tied to something, perhaps a stay or running line. The eye would act as a fairlead, guiding a line toward a desired direction.

RR 78. Serving Mallet or Cable Eye. Inv. No. MH 0566
Figs. 59 ; Wreck Plan IV

l. 0.223; w. 0.040; max. ht. 0.073; min. ht. 0.032; eye dia. 0.021; tang ht. 0.040; groove w. 0.033.

Wooden block with two arms, the ends of which flare upwards, and an eye located in the center. Considerable wear on surface of arms. The outer surface of the eye is beveled on all four sides.

Prov. 25G

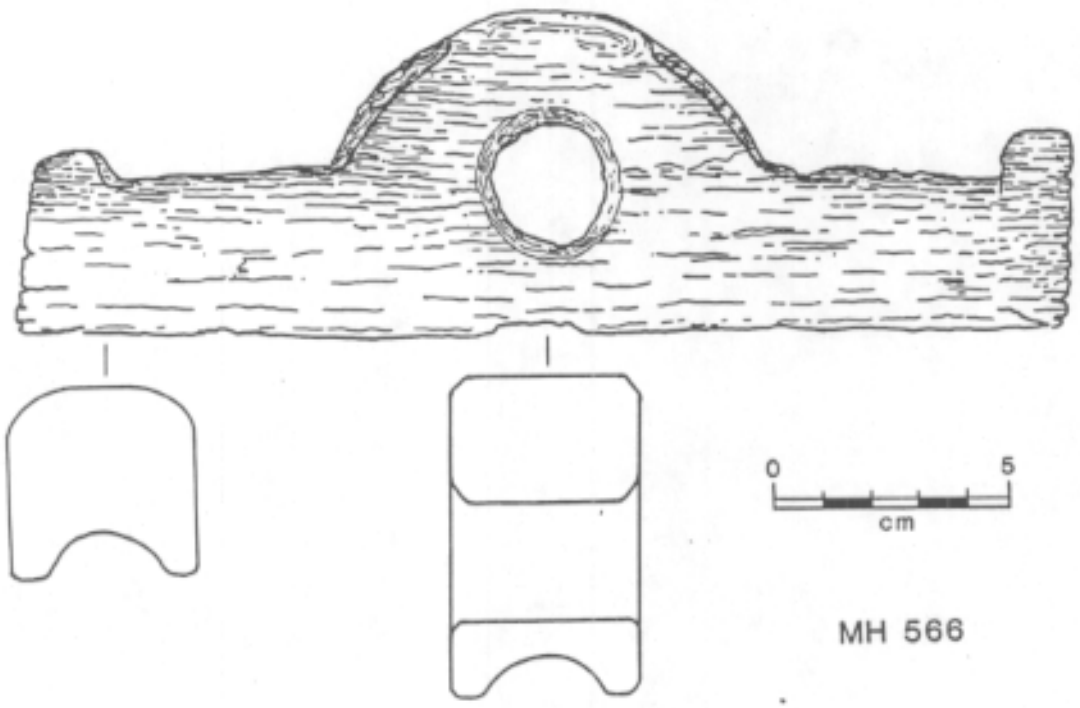
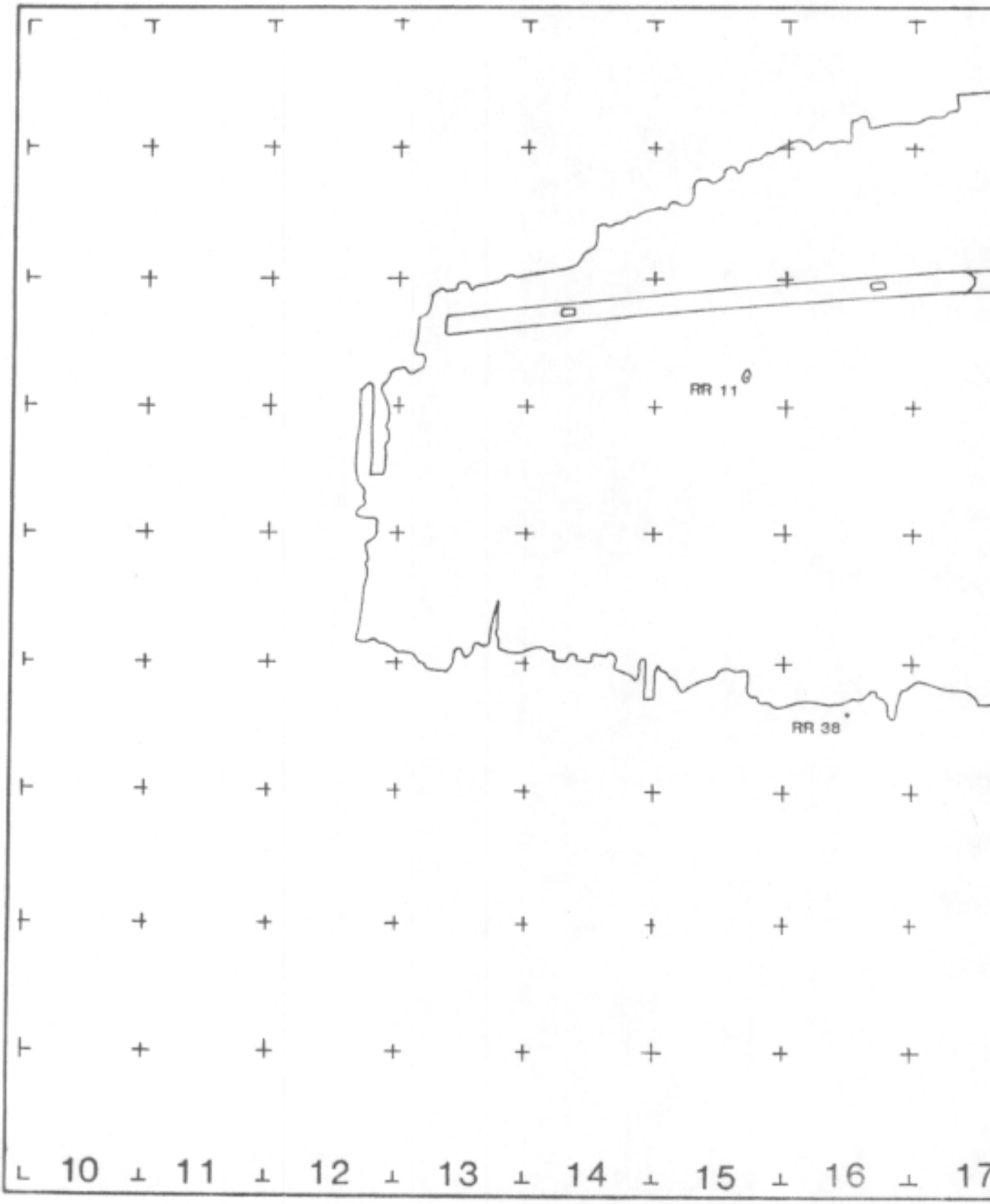


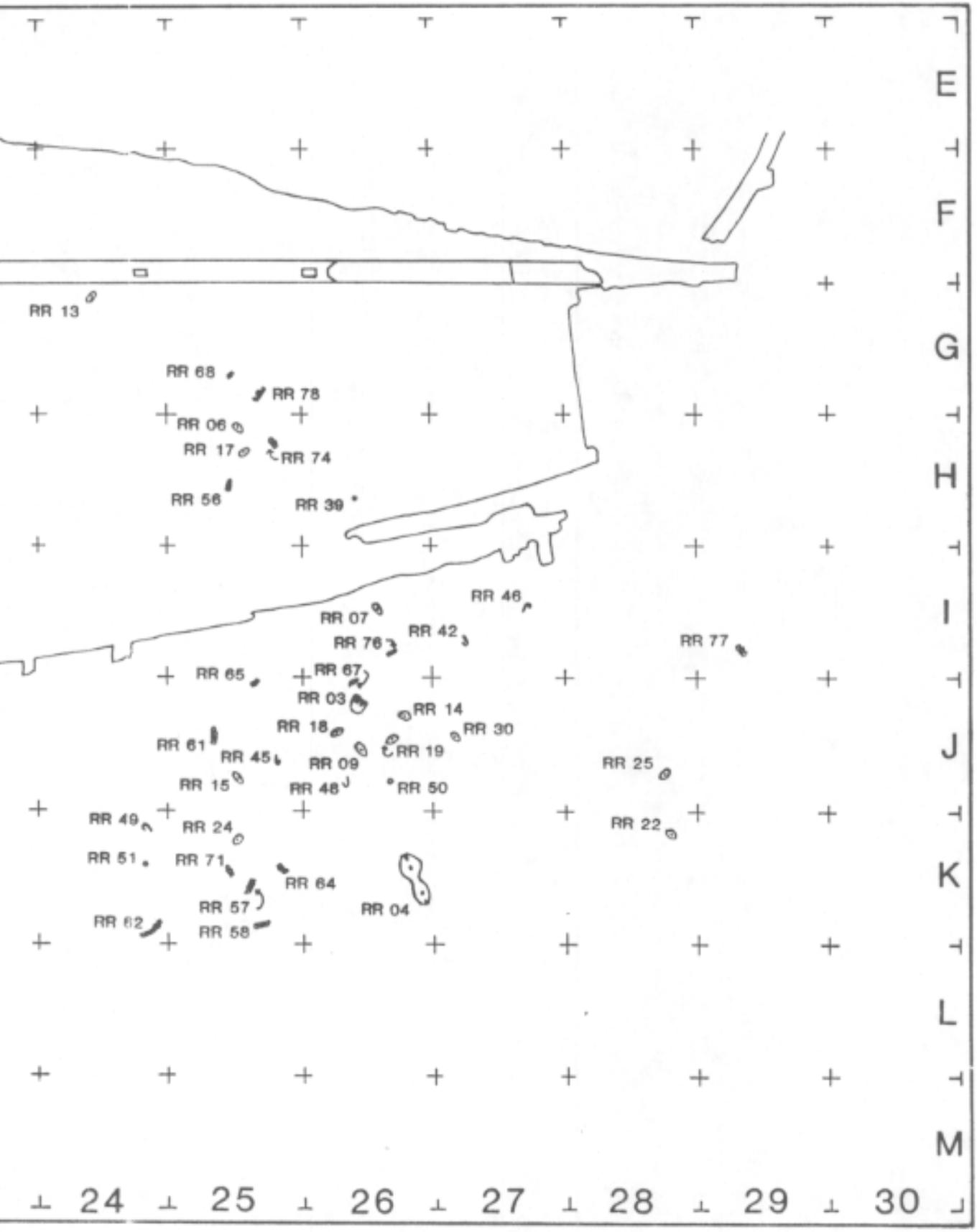
Figure 59: Serving mallet or cable-eye RR 78. B.F.Thompson.

The distribution of running rigging artifacts on the site illustrates substantial mizzen-mast and stern rigging remains for this wreck (Fig. 60). For the main-mast area these same artifacts are less evident and for the bow area they are non-existent. This latter pattern can be explained by the limited excavations in the bow downslope area. Most of the main-mast running rigging was probably taken away along with the mast as it separated from the wreck or was removed during salvage operations carried on in the past.

Figure 61: Wreck Plan IV (Distribution of Running Rigging Artifacts).


RR 11
RR 38
10
11
12
13
14
15
16
17

RR 08
RR 13
RR 12
RR 01
RR 40
RR 44
RR 27
RR 49
RR 51
RR 62
RR 73
RR 31
RR 34
RR 32
RR 64
RR 72
RR 55
RR 05
RR 28
RR 70
RR 21
17 18 19 20 21 22 23 24


E
F
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24
25
26
27
28
29
30
RR 13
RR 68
RR 78
RR 06
RR 17
RR 74
RR 56
RR 39
RR 46
RR 07
RR 42
RR 76
RR 77
RR 65
RR 67
RR 03
RR 14
RR 18
RR 30
RR 61
RR 45
RR 09
RR 19
RR 25
RR 15
RR 48
RR 50
RR 49
RR 24
RR 22
RR 51
RR 71
RR 64
RR 57
RR 04
RR 62
RR 58

CHAPTER VI

SAIL AND ASSOCIATED ARTIFACTS

Sails of any kind are rarely found on submerged shipwrecks of an any age. Seventeenth-century sails are rare finds indeed, having been reported on only two period wrecks to date, Wasa and Santo Antonio da Tanna. The following sail study includes a description of the sail bundle and the artifacts found within the folds, a discussion of major sail features (sailcloth, tabling, roping, cringles, splices and seizing), a catalog of served and or parcelled rope and a description of sailmakers palms found on the wrecksite.

Sail Bundle

A sail bundle (Fig. 61), approximately 1m x 50cm x 68 cm, was found just behind a longitudinal partition on the port side of the vessel (Piercy, 1978:307). A laboratory accident caused the bundle to dry out beyond apparent recognition. The canvas had decayed to a black crust and rope portions of the sail had nearly lost all integrity. It was decided that some information could still be gained from the bundle, so it was placed into warm Lippasol for two months, then gently unfolded. Descernable details were then recorded, photographed and drawn.

Due to the sail's provenience on the wrecksite and three artifacts found within the folds of the bundle, it is likely that the sail was in repair and below decks at the time of the vessel's sinking. A badly oxidized iron needle (just near the needle was a repair stich or re-enforcing stitch sewn over a double seam), a banana peel, and a bamboo mess tag were found in close proximity to each other (Fig. 62). The bamboo stick was identified as a mess tag on the basis of an article by David Switzer which included several similarly shaped wooden pieces recovered from the American brig-of-war Defense (1982:73,74).

Sa 01. Sail Bundle. Inv. No. MH 7033
Figs. 61 thru 72 ; Wreck Plan V

overall dimensions 100 cm x 50 cm x 68 cm.

Small mound of parcelled and unparcelled rope folded among encrusted black canvas remains. Some knots and other ropework features descernable, but with very little consistent integrity throughout bundle.

Prov. 26H

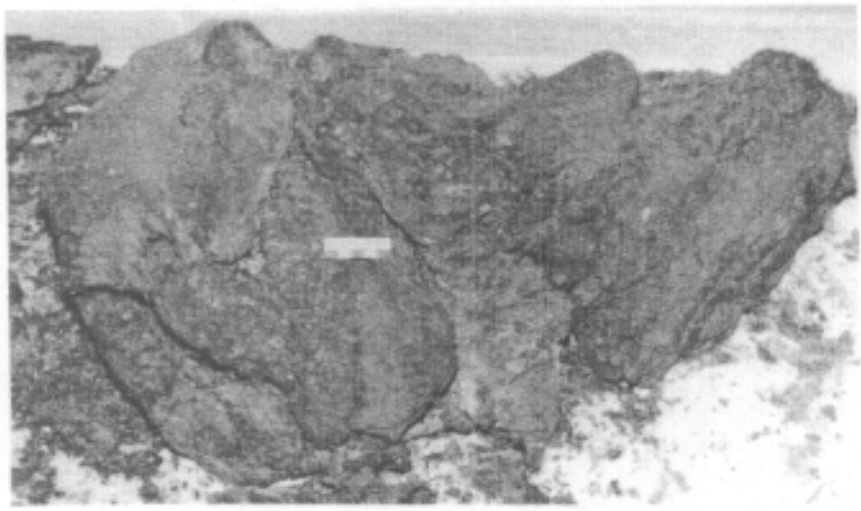


Figure 61: Sail bundle, Sa 01. B.F. Thompson.

Sa 02. Needle. Inv. No. MH 7028
Wreck Plan V

l. 0.040; dia. 0.002.

Badly oxidized, with a portion of the eye at one end. It was found next to what appears to be either a repair stitch or a re-enforcing seam.

Prov. 26H

Sa 03. Banana Peel. Inv. No. MH 7029
Fig. 62 ; Wreck Plan V

l. 0.103; w. 0.032; thk. 0.005.

Sinewy banana peel, dried and cracking, was found within the sail bundle Sa 01 in close proximity to Sa 04.

Prov. 26H

Sa 04. Bamboo Mess Tag. Inv. No. MH 7030
Fig. 62 ; Wreck Plan V

l. 0.0578, max. w. 0.017; min. w. 0.005; thk. 0.006.

Bamboo stick with two notches on widest end. No other markings found.

Prov. 26H



Figure 62: Photograph of banana peel and bamboo mess tag. A. Darroch.

Sailcloth

The condition of the canvas within the bundle was so badly degraded that the weave pattern was discernable for only a very small patch, 10 cm x 12 cm (Fig. 63). The resulting 12 warp and 8 weft for a 1 cm sq area, indicate a canvas similar to those found on the Wasa (Bengtsson, 1973:33). Our sample might be termed intermediate between the coarse and light weight canvas of the Wasa, whose light canvas has 12 warp and 10 weft while their heavy canvas has 10 warp and 7 weft. During the mid to late 18th century, an intermediate canvas was used for the upper sails, topsails of small vessels, or as lining for the courses and topsails of ships-of-the-line (Boudriot, 1975:66).

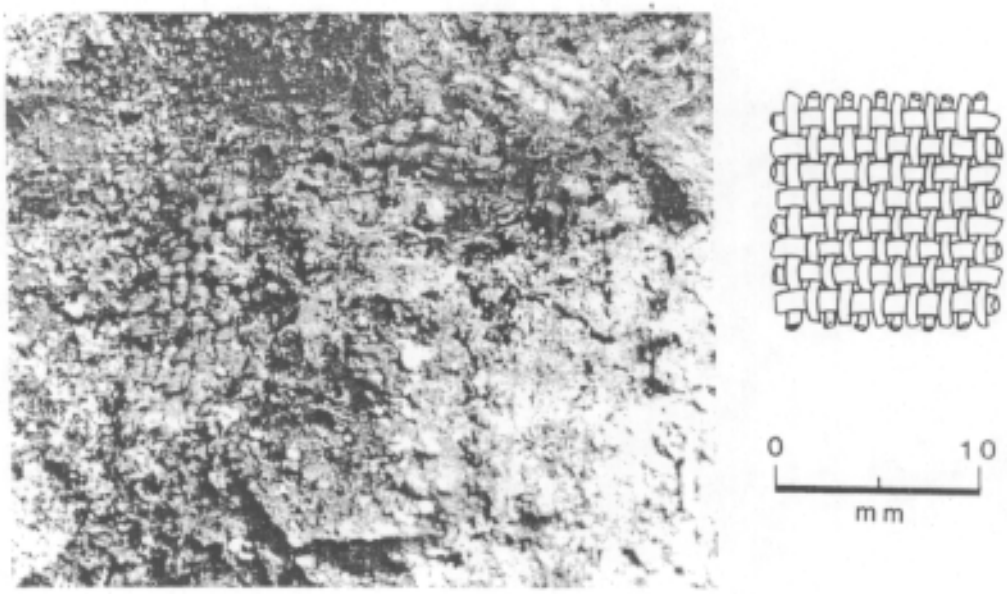


Figure 63: Weave pattern of sail, Sa 01. B.F. Thompson.

Tabling

A 5.7 cm x 3.8 cm patch of stitching was found about 30 cm from a clew (Fig. 64). Horsely describes something similar as a customary middle seam or "sticking" which was added to a flat seam or "tabling" to give it extra strength. A badly oxidized needle, Sa 02, was found just centimeters away from the stitching.

Roping

Due to the state of disintigration of the rope within the sail bundle, very little can be said about the extent of

boltrope around the sail. Boltrope is the heavy roping used to re-enforce the outer edges of a sail. The amount of served and partially parcelled rope does, however, offer the possibility that the sail had a continuous boltrope around the perimeter of the sail. Nearly all of the boltrope which

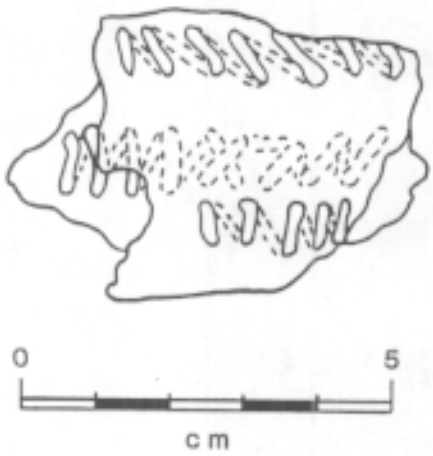


Figure 64: Re-enforcing stitch. B.F. Thompson

could be studied had three-strand cable served by 7 mm double-twist line, which was parcelled on the outside of the serving. A narrow canvas strip, 2.3 cm wide, lay under a lace line 9 mm wide, which ran lengthwise to the bundle and was seized by marline hitching (Fig. 65). The triangular cross-section of these boltropes was a mystery until it was discovered that their cable had no worming and no inner parcelling, which was commonly used to fill cable.

As yet unidentified is a section of parcelled boltrope

with canvas strip and laceline seized by 1 mm twine (Fig. 66). What makes it peculiar is the fact that a three-strand, unparcelled and unserved cable appears to be both spliced and seized to the bundle. A small eyesplice with its eye seized is spliced into the three-strand cable and further seized by 1 mm twine to the cable and boltrope bundle. A lace line also runs over a canvas strip for the length of the cable.

Three 15 cm wide and 15 cm long clews were found, two of which were served and one unserved, which had remnants of 2 mm seizing about the throat of the splice (Fig. 67). The two served clews are served by 5 mm two-strand line. Their placement within the bundles did not reveal their association with other major sail features.

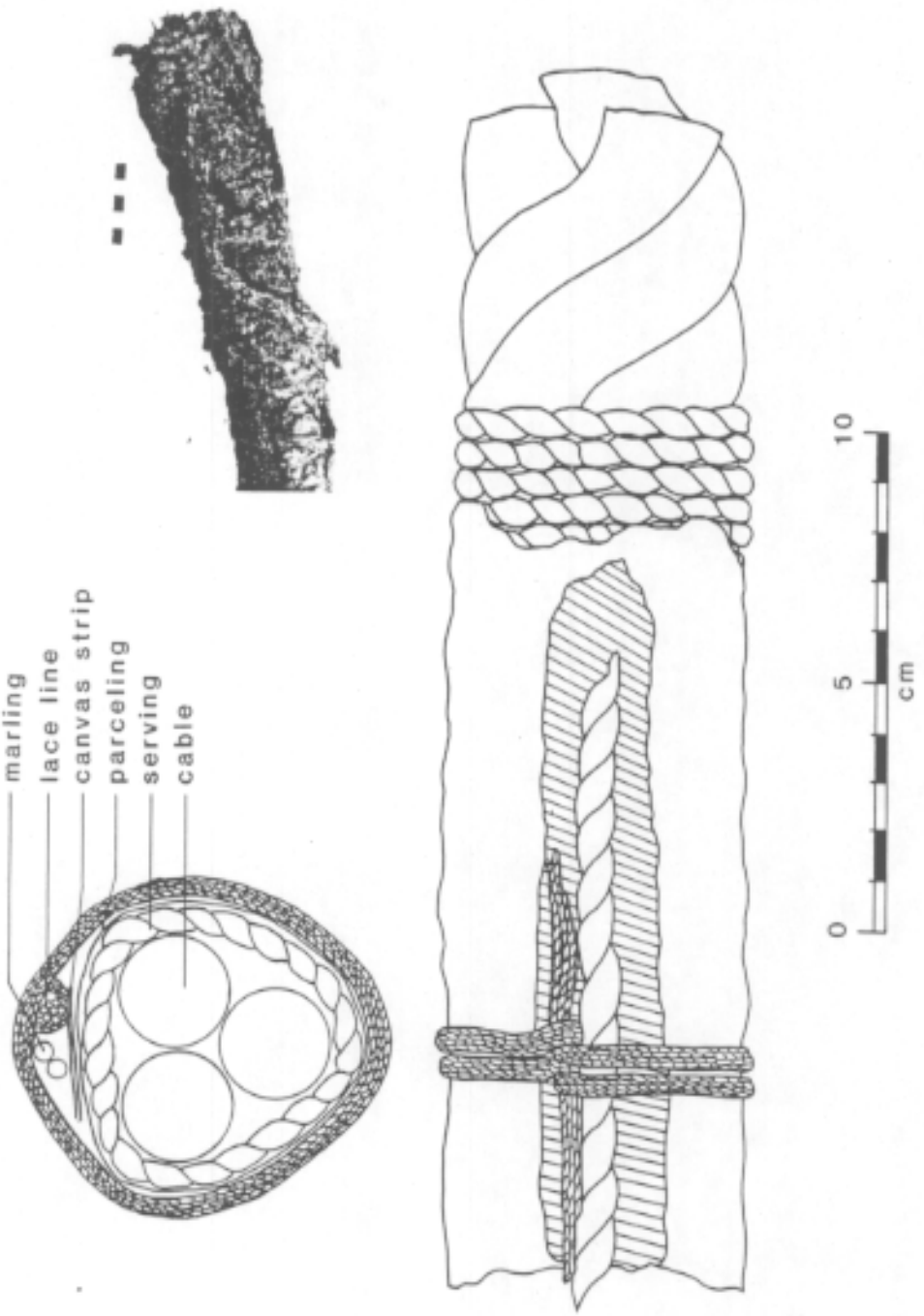


Figure 65: Parcelled rope nomenclature. B.F. Thompson.

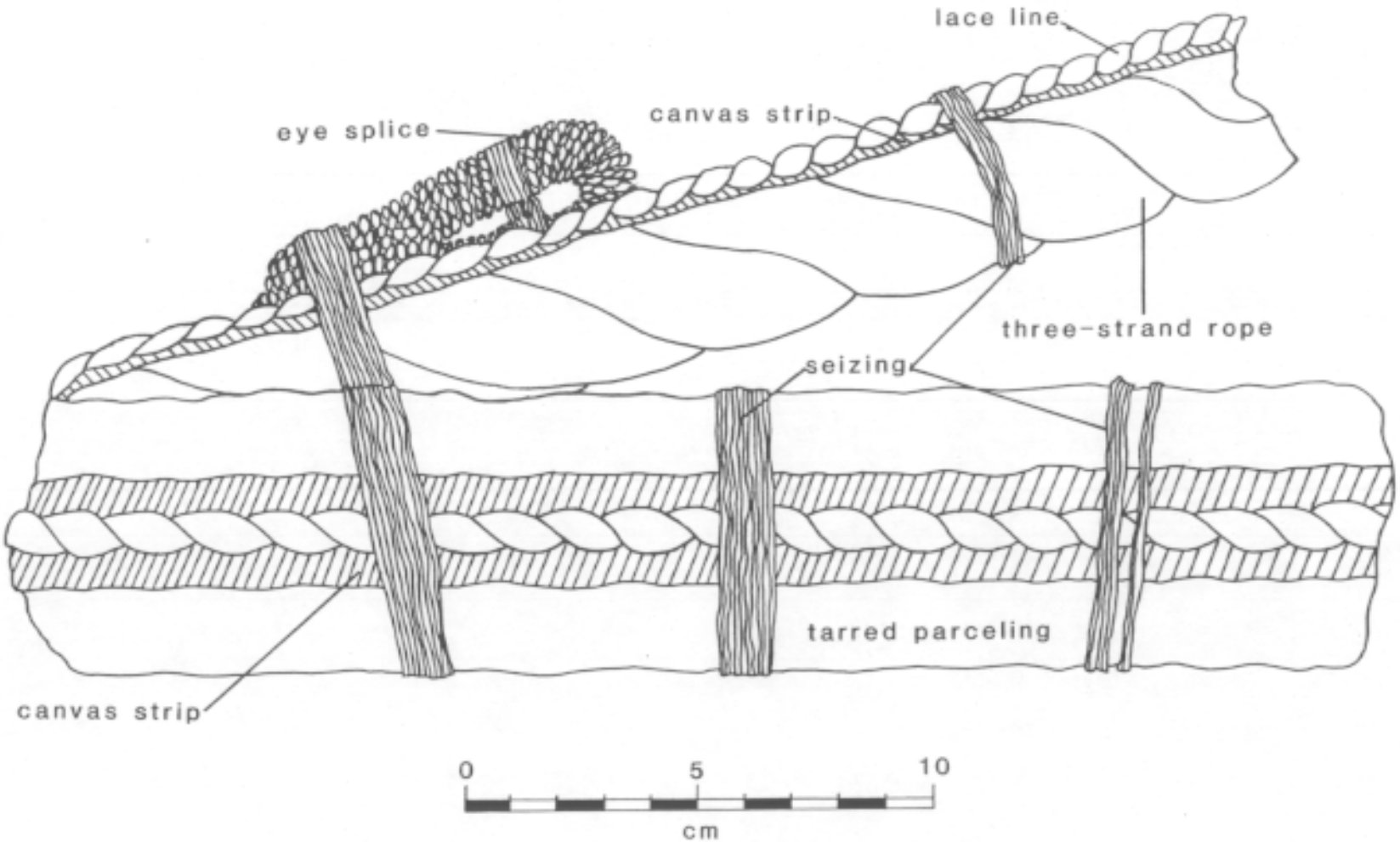


Figure 66: Three-strand rope splice to boltrope. B.F. Thompson.

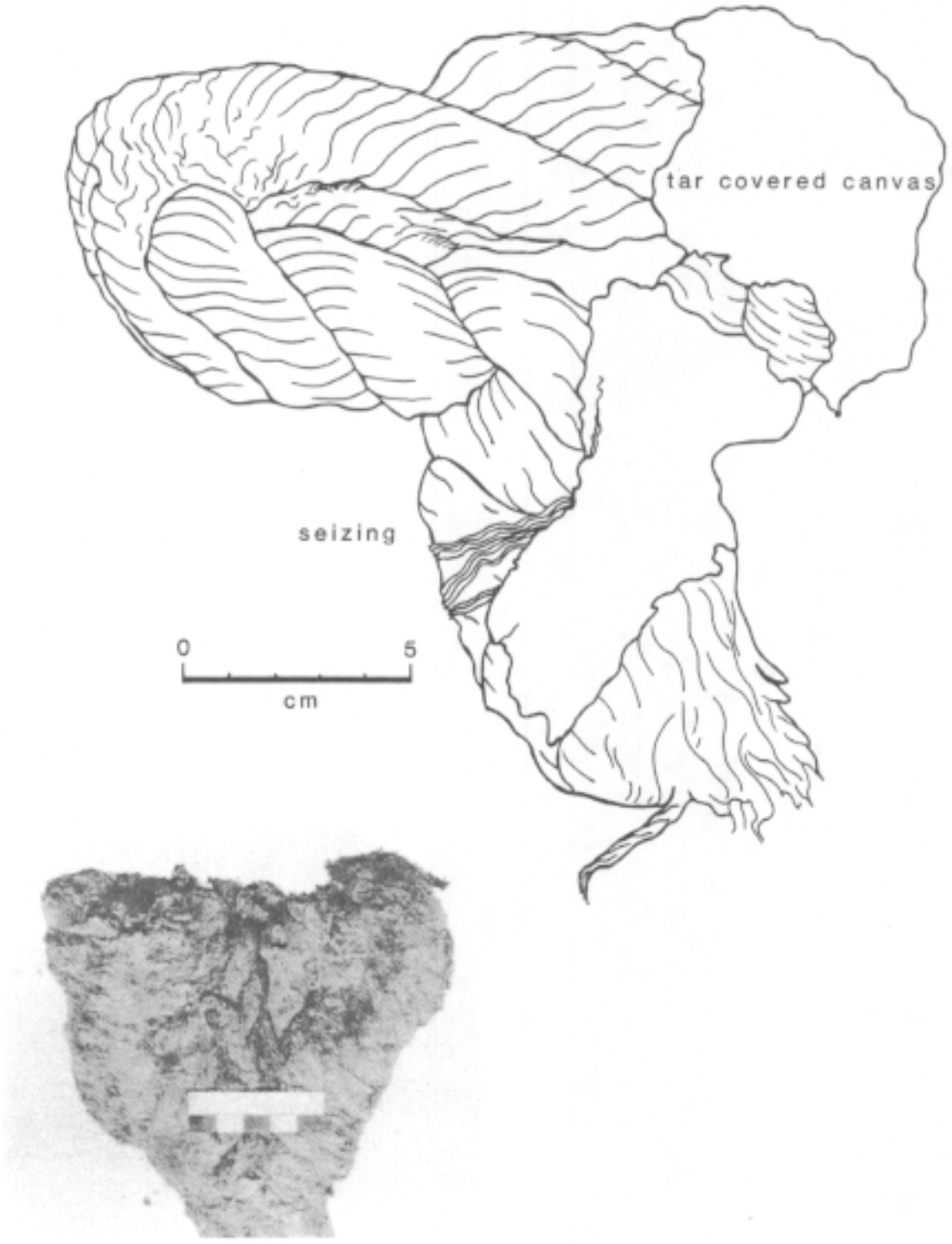


Figure 67: Photograph of a served clew and drawing of an unserved clew. B.F. Thompson.

Cringles, Splices and Seizing

Cringles were rope splices attached to bowlines, leechlines, slab lines and buntlines to extend the leech of a sail. Three cringles with identical missing halves were found within the sail bundle (Fig. 68). Ashley's closest parallel is called a sinnet cringle (1944:457), which would not have been as strong as boltrope cringles, such as those found on the Wasa (Bengtsson, 1973:34). Another

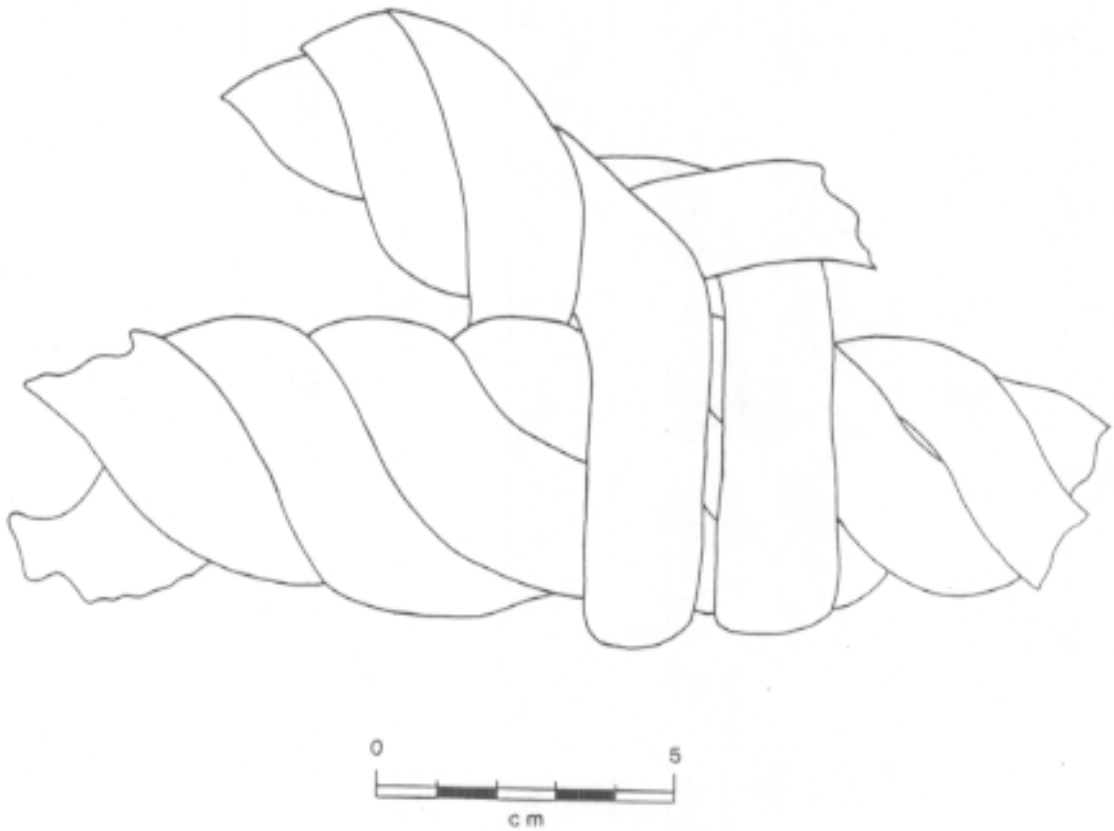


Figure 68: Cringle. B.F. Thompson.

possibility is that it represents what is called an English cringle, which was sometimes used with thimbles but more often used directly onto a boltrope (Ashley, 1944:457).

Five examples of eyesplices, tied in much the same fashion (Fig. 69), were found in close proximity to each other. They appear to be similar to a riggers eye called the Flemish Eye (Ashley, 1944:447). They were made-up of

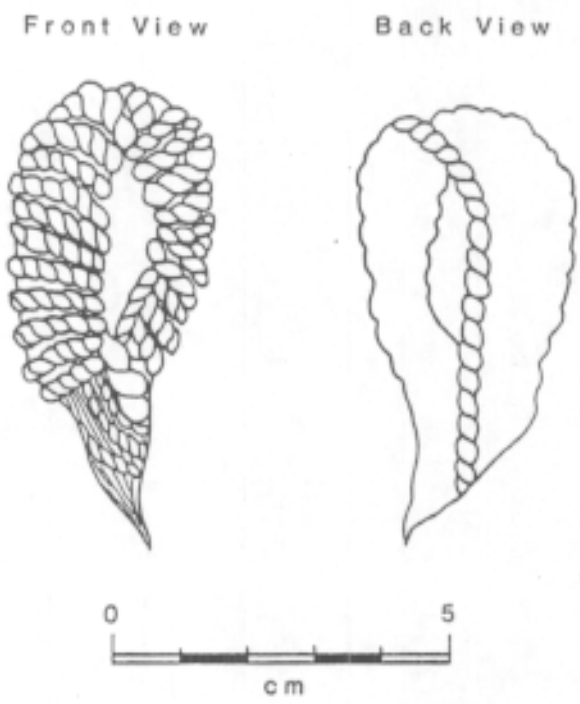


Figure 69: Eyesplice. B.F. Thompson.

multi-stranded line served over with one strand laid out and around the eye in a contrary direction.

Several pieces of three-strand seized rope may indicate leechlines for the sail (Fig. 70). Most of these rope

lengths were seized by a method called Portuguese whipping, which is the quickest method to sieze a rope since it is merely reef knotted together (Ashley, 1944:548).

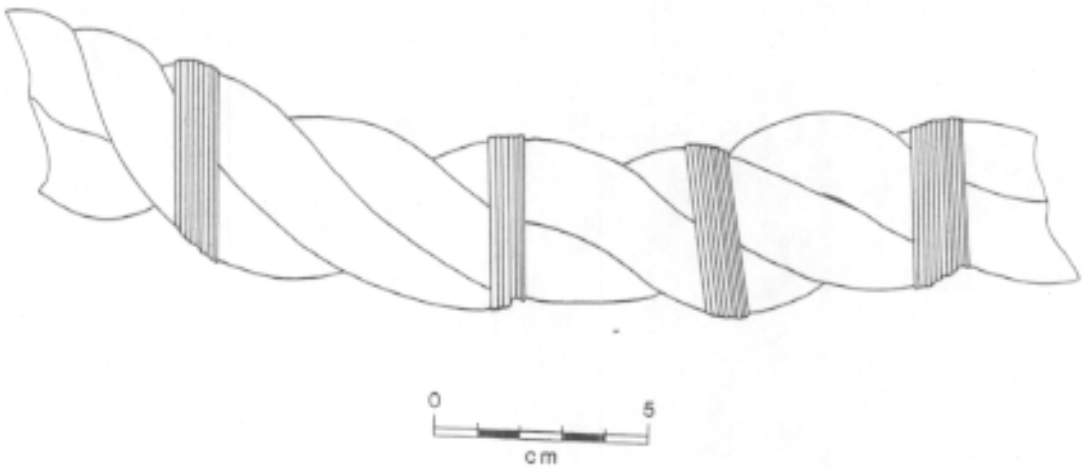


Figure 70: Seizing. B.F. Thompson.

Parcelled and or Served Rope

All but three examples of parcelled rope were uncovered in the area of the sail bundle (Fig. 72). This suggests that they were either extensions of the sail bundle which had floated away from the original sail bundle, or representative samples of a second sail, which had lost the canvas to deteriorated.

Sa 05. Served Rope. Inv. No. MH 0775
Wreck Plan V

lt. lay; 4 parts; 15 strand; l. 0.460; dia. 0.043.

Six pieces of four-part rope served with twine. Very squashed, two pieces discarded.

Prov. 25H

Sa 06. Served Rope. Inv. No. MH 0780
Wreck Plan V

lt. lay; 3 parts; 12 strand;; combined l. 0.650; dia. 0.041.

Rope served by very stout twine, doused in tar and loosely twisted.

Prov. 25H

Sa 07. Parcelled and Served Rope. Inv. No. MH 0732
Wreck Plan V

approx. l. 0.200; dia. 0.051.

Rope served by twine with indications tarred of parcelling on small area of outer surface. Too solid for analysis at this time.

Prov. 25H

Sa 08. Parcelled and Served Rope. Inv. No. MH 0781
Wreck Plan V

lt.lay; 3 parts; 14 strand; combined l. 0.450; dia. 0.045.

Two pieces: (A) Served three-part rope with either matting or canvas adhering to the surface, spots of tar on one edge. Too solid for detailed description. (B) Fragments of three-part rope.

Prov. 25H

Sa 09. Served Rope. Inv. No. MH 0456
Wreck Plan V

lt. lay; 2 part; 54 strand; combined l. 0.460; dia. 0.050; double twist.

Three pieces of degraded served rope with tar adhering to surface, served with double-twist line.

Prov. 21L

Sa 10. Parcelled and Served Rope. Inv. No. MH 0770
Wreck Plan V

3 parts, 16 strands, combined l. 0.20; dia. 0.051; lt. lay.

Two pieces of served rope, a lot of canvas (?) adhering to surface, pieces stuck together with canvas or sail (?) between them, sample of canvas taken, either tar or pitch over much of the surfaces. Stout double-twist line used for serving.

Prov. 26H

Sa 11. Parcelled and Served Rope. Inv. No. MH 0634
Wreck Plan V

3 parts, approx. combined length 0.041; dia. 0.0076

Three pieces of served rope with canvas on surface. Two solid for analysis at this time. A patch, 7 cm x 7 cm, of canvas between pieces consisting of several folds 1 cm thick. A deep V-shaped furrow, 2 cm wide x 1 cm deep runs along one edge of these samples.

Prov. 25H

Sa 12. Parcelled Rope. Inv. No. MH 3547
Wreck Plan V

6x4; 5x2; 5cm

Tight knot with canvas; (?) parcelled rope.

Prov. 26J

Sa 13. Served Rope. Inv. No. MH 5985
Wreck Plan V

3 parts; 12 strands, length 0.260; dia. 0.041; lt lay.

One piece of served rope same as Sa 06.

Prov. 25K

Sa 14. Parcelled and Served Rope. Inv. No. MH 0788
Wreck Plan V

3 pieces max l. 0.900; dia. 0.040

Three pieces of parcelled rope, appears to be with canvas, double-twist line, same as Sa 13; too solid for analysis at this time.

Prov. 24O

Sa 15. Served and Parcelled Rope. Inv. No. MH 0789
Wreck Plan V

1 piece, max l. 0.360; w. 0.135; thk. 0.080.

Large served and parcelled rope, tar and other rope pieces adhering to surface. Too solid for further study.

Prov. 25H

Sa 16. Served and Parcelled Rope. Inv. No. MH 3128
Wreck Plan V

1 piece, 3 parts, strand (?), lt. lay, max. l. 0.100, dia. 0.038.

Parcelled rope, some canvas adhering to surface - also tar - same as #780.

Prov. 26I

Sa 17. Parcelled Rope. Inv. NO. MH 1560
Wreck Plan V

(A) 1 piece, l. 0.035; dia. 0.019; lt. lay;

Parcelled rope wrapped in canvas and single twine tarred rope L (two turns) Prob. 3 parts with multiple strands.

(B) 4 pieces; l. 0.125. 0.085, 0.210; dia. 0.061

Canvas parcelled rope.

(C) 5 pieces; combined l. 0.360

Parcelled rope completely dried out - sample discarded.

Prov. 25H

Sa 18. Parcelled and Served Rope. Inv. No. MH 0709
Wreck Plan V

2 pieces, 3 parts, 21 strands, lt lay, l. 0.285 dia. 0.040

Parcelled rope tar adhering to surface, parcelled by strong fibrous twine, double twisted.

Prov. 25H

Sa 19. Parcelled and Served Rope. Inv. No. MH 0790
Wreck Plan V

3 pieces, 3 parts - small piece, 13 strands small piece lt. lay, l. 0.320, dia. 0.089, 0.027 (small)

Parcelled rope wrapped in tarred canvas, several varieties of rope interspersed around and throiugh canvas on sailcloth, too solid for analysis at present. Small piece 3 part rope.

Prov 250

Sa 20. Parcelled and Served Rope. Inv. No. MH 0114
Wreck Plan V

(A) 4 parts; 3 strand; 10 yarn; max l. 0.250; dia. 0.062; rt. lay; yard dbl. twisted.

Six pieces of rope which combined to make four strand rope. Each strand dia. 0.027. Circum-

ference lt. lay 3 parts - each substrand double twist x 10 rt lay.

(B) 3 pieces; 3 parts; 10 strand; combined 1. 0.220; rt. lay; ;dia.0.027

See 114 - A Frags of possible 4 part rope.

Prov. 21L

Sailmakers Palms

Iron and brass sailmaker's palms were found at three locations over the wrecksite. These are the circular or elliptical shape metal plates used by the rigger when sewing, of which there are two types, a seaming palm and a roping palm. The seaming palm has a series of close-set indentations to prevent the needle from slipping and is set into a thick pad of leather which is, in turn, mounted on a leather strap (Horsely, 1978:172). The eye sits on the heel of the palm of the sailmaker's hand, where it can support and protect the hand. According to Horsely a roping palm, which was similar to the seaming palm except for the much heavier identations in the eye and a thicker moulded leather guard to the thumb hole, was necessary for the heavier needles and twine used when roping (1978:172).

One would assume that a brass palm would have been better used as a roping palm, but of the four examples recovered from the wreck there were one iron and one brass palm of 28 dimples and one iron and one brass palm of 33 dimples (Fig. 71).

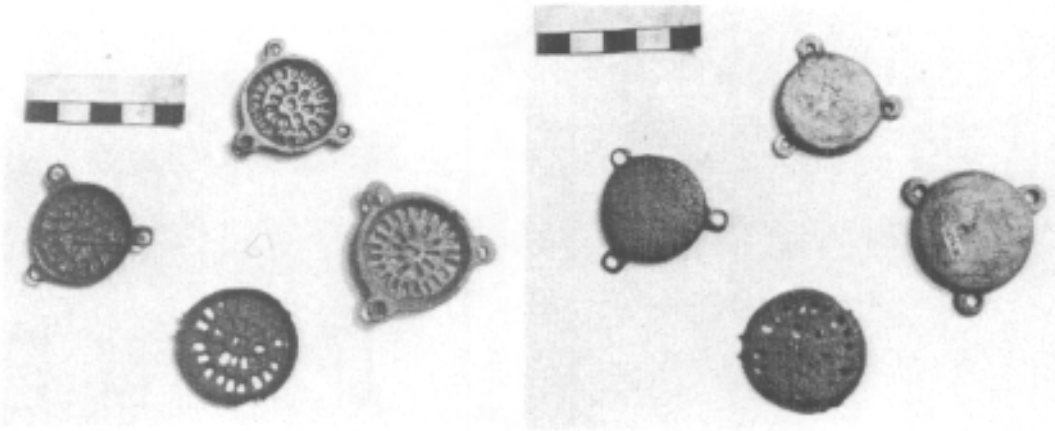


Figure 71: Photograph of palms, top Sa 21, right Sa 23, bottom Sa 24, and left Sa 22. A. Darroch.

Sa 21. Sailmakers Palm. Inv. No. MH 2346
Fig. 71 ; Wreck Plan V

o.d. 0.038; depth 0.005.

Iron sailmakers palm has 33 dimples, several of which have oxidized through. Sewing eyes completely oxidized away.

Prov. 15 J

Sa 22. Sailmakers Palm. Inv. No. MH 3657
Fig. 71 ; Wreck Plan V

o.d. 0.037; i.d. 0.033; depth 0.007; attachment eyes avg. i.d. 0.003.

Brass sailmakers palm has 32 dimples and is in excellent condition.

Prov. 24 J

Sa 23. Sailmakers Palm. Inv. No. MH 0579
Fig. 71 ; Wreck Plan V

o.d. 0.034; i.d. 0.031; depth 0.005; attachment eyes avg. i.d. 0.004.

Iron sailmakers palm has 28 dimples. Artifact is in fair condition attachment eyes partially oxidized.

Prov. 26 H

Sa 24. Sailmakers Palm. Inv. No. MH 6236
Fig. 71 ; Wreck Plan V

o.d. 0.034; i.d. 0.030; depth 0.005; attachment eyes avg. i.d. 0.003.

Brass sailmakers palm has 28 dimples and is complete.

Prov. sp

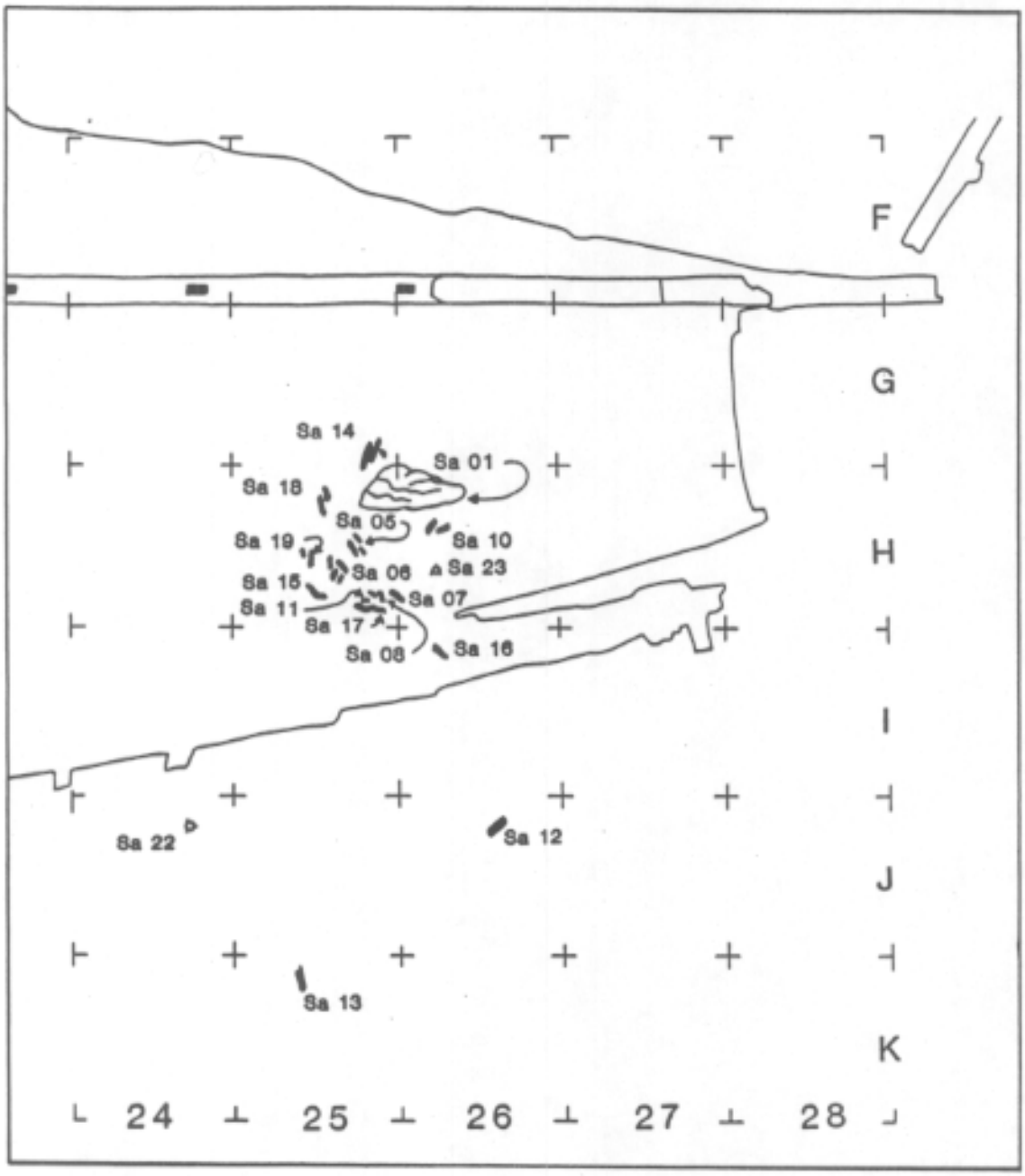


Figure 72: Wreck Plan V (Distribution of Sail Artifacts).

CHAPTER VII

SUMMARY AND CONCLUSIONS

It is ironic that Portugal, credited as the provocateur of the great "Age of Discovery", should have left us with so little information about its shipbuilding techniques. Not only do we know nothing of the early caravels which took Da Gama around the Cape of Good Hope in 1499, but we also know nothing of the later empire ships that sustained trade throughout three centuries in the Indian Ocean and in the Orient.

The site of the Mombasa Harbour Wreck coincides with the historical location of the sunken Portuguese frigate Santo Antonio da Tanna, lost in 1697. Artifacts recovered from her, over four years of archaeologically controlled excavation, further support the parallel between these two. A study of the hull and rigging artifacts offers a picture of the technological similarities and differences between India-built Portuguese warships and their European counterparts.

Several conclusions can be drawn about the hull and its rigging components. The preliminary hull study indicates that she had two decks and possibly a third, two gundecks and a quarter deck. It appears that her stern structure and starboard hull remains had collapsed on top of the lower hull remains (below the first deck). The locations of

several standing rigging artifacts supports this hypothesis. Her stern structure appears to have been well supplied with rigging purchase points, as indicated by the abundance of ringbolts in the stern area.

There is no evidence for the use of square-sectioned chainplate onboard European warships, so this feature must represent a Portuguese innovation. All of her main mast chains were round in cross-section. The Mombasa Harbor Wreck appears to have had 6 shrouds for the main mast and 4 shrouds for the mizzen mast, which would be normal for most smaller fourth-rate warships of the late 17th century. There is also evidence for the topmast shrouds in the form of four artifacts found downslope of the stern area, SR 04, SR 12, SR 23 and SR 24. A Dutch influence is the use of long shroud-chains on this vessel, consisting of a deadeye strap, three links and a chainplate. These are identical to depictions of ships built in Amsterdam during the late 17th century. Bitt HF 01 is also a Dutch attribute, with its chamfered head.

A large single-sheave block, RR 01, appears to be another Portuguese feature since a parallel for this artifact has yet to be found. Its location suggests that it was used either as a stay block or as a yard block for a large yard. Perhaps it carried the lateen mizzen sail, which was a common feature for ships of this period. Further proof for substantial stern structure remains comes

from the large number of running rigging artifacts noted for that area.

Sail material found on the wreck verifies historical references as to the scarcity of roping and canvas materials during this period. The boltrope was under-parcelled for use on anything other than a tarp. However, other sail features, ie. cringles, clews, eyesplices and leechlines, indicate that the sail bundle nust have been a major sail for the ship. Laceline found on several pieces of boltrope within the sail bundle offers the possibility that the sail was either a bonnet sail or the lower part of a topsail which would have accepted a bonnet. Whatever the case, it is obvious from the evidence found within the bundle that it was under repair before the sinking.

The differences between Portuguese ship technology and that of the Europeans appears to lie in the quality of the ship's structure and rigging components, ie. the availability and use of teak versus the scarcity of textile materials, by the Portuguese. The blocks and other wooden fittings appear to have been well fashioned from quality wood while the textile materials appear to have been constructed from poor quality materials and creatively put together.

The greatest European influence on the Mombasa Harbour ship seems to have come from the Dutch. This would be an obvious assumption when one looks at the history of rivalry

between these two empire builders. The taking of prizes during running battles has been noted throughout the history of the 17th century. Further, Dutch shipwrights were producing ship's plans extensively throughout the 17th-century while there is little evidence for Portuguese shipwright's efforts. This would seem to indicate that Portuguese shipwrights in India depended more heavily on "rule-of-thumb" construction techniques than their European contacts.

MR 04. Double Twist Line. Inv. No. MH 5381

3 parts; l. 0.180; lt. lay; dia. 0.054; 1 piece.

Same as 3626. Squashed and fragmentary.

Prov. sp

MR 05. Double Twist Line. Inv. No. MH 3964

8 strands; l. 0.075; rt. lay; dia. 0.008; 1 Piece.

Very tightly woven; double twisted, possibly part of other larger rope.

Prov. 26K

MR 06. Double Twist Line. Inv. No. MH 3268

4 strands; l. 0.070; rt. lay; dia. 0.011; 1 piece.

Double strand, very tightly woven.

Prov. sp

MR 07. Double Twist Line. Inv. No. MH 3661

9 strands; l. 0.070; rt. lay; dia. 0.019; 1 piece.

Double twisted, possibly part of larger four strand rope.

Prov. 24K

MR 08. Double Twist Line. Inv. No MH 6068

3 part; 7 strand; l. 0.011; lt. lay; dia. 0.014; 1 piece.

Small squashed piece.

Prov. 29I

MR 09. Double Twist Line. Inv. No. MH 4387

Double twist line with crusty material on surface (sail?) sample taken.

Prov. 27I

Knots

MR 10. Knot. Inv. No. MH 4963

overall dimensions 19 m x 10 m x 4.5 cm.

Possibly a figure eight knot - too solid for analysis.

Prov. 24J

MR 11. Knot. Inv. No. MH 3987

3 parts; l. 0.120; 1 piece.

Tight knot - sample too squashed to determine number of strands.

Prov. 24J

MR 12. Knot. Inv. No. MH 5613

8 parts; 7 strands; l. 0.080; rt. lay; dia. 0.029; 1 piece.

Small knot consisting of eight parts, unable to determine type - too little remains - each part consists of seven double twist strands.

Prov. 29I

Rope Coils

MR 13. Four Rope Coils. Inv. No. MH 1500
Fig. 73

3 strand; (l. x w. x dia.) 0.148 x 0.100 x 0.040; lt. lay; dia. 0.022; 4 coils.

Well preserved coils of thin three strand rope. PEG treated.

Prov. 24H

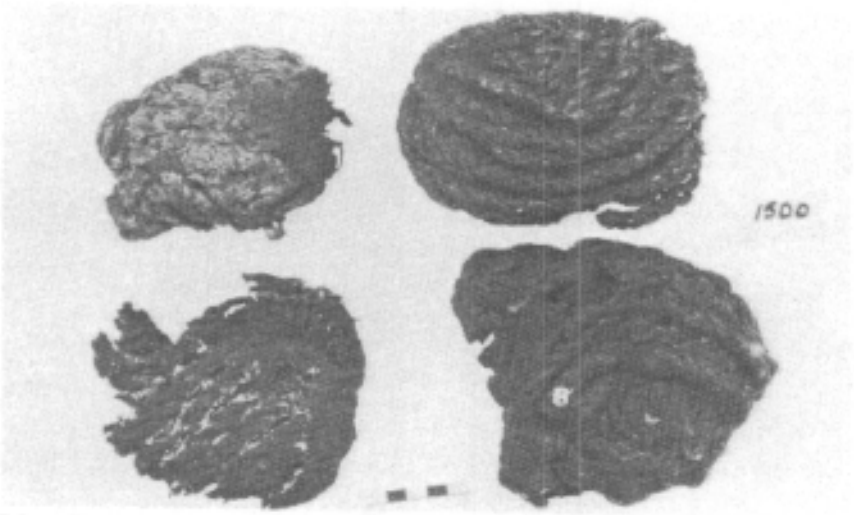


Figure 73: Rope coils, MR 13. M. Taffe.

MR 14. Rope Coil. Inv. No. MH 4962

3 parts; 3 strands; 49 yarn; l. 0.240; rt. lay; dia. 0.096; 1 piece.

Very large loosely coiled rope, very fragile.

Prov. 24J

MR 15. Rope Coil. Inv. No. MW 2255

6 parts; 13 strand; l. 0.210; lt. lay; dia. 0.035; 1 piece.

Very Loosely coiled line, double twist.

Prov. 15K

MR 16. Rope Coil. Inv. No. MW 4677

4 parts; 16 strand; l. 0.210; lt. lay; 1 piece; dia. 0.035.

Very loosely coiled line, double twist.

Prov. 15F

MR 17. Rope Coil. Inv. No. MW 6042

4 parts; 42 strands; l. 0.070; rt. lay; dia. 0.053; 1 piece.

Large solid loose coiled rope, double twisted.

Prov. 28I

MR 18. Rope Coil. Inv. No. MH 1466

3 part; 2 strand; lt. lay; dia. 0.010.

Loosely wrapped coil of line - 15 x 13 x 6 cm., double twist.

Prov. 25O

Rope Bundles

MR 19. Rope Bundle. Inv. No. MW 1252

3 strand; lt. lay; approx. 30 pieces; dia. 0.006.

Small bundle of three part rope; each double twisted - 11 x 7 x 3 cm.

Prov. 25H

MR 20. Rope Bundle. Inv. No. MW 683

2 strands; rt. lay; dia. 0.005; 20 pieces.

Large bundle double twist line, no order to bundle and indication of larer ropes having been twisted from this.

Prov. 22H

MR 21. Rope Bundle. Inv. No MH 1456

3 parts; 2 strands; l. 0.200, 0.500; lt. lay; dia. 0.08; 4 pieces.

Bundle of thin twisted rope, preserved in PEG, some bits seperated from bundle.

Prov. 20H

MR 22. Rope Bundle. Inv. No. MH 1428

3 strand; (l. x w. x th.) 9 x 6.5 x 5; lt. lay; dia. 0.008; 1 piece.

Small bundle of PEG treated double twist three-strand rope.

Prov. sp

Plaited Line

MR 23. Plaited line. Inv. No. MW 1544

l. 0.060; dia. 0.019.

Braided rope same as #1533, squashed.

Prov. sp

MR 24. Plaited Line. Inv. No. MW 1533

3 part; l. 0.017 and 0.060; dia. 0.018; 2 pieces.

Plaited rope appears to be 3 braids of hairlike fiber.

Prov. 20H

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Field Experience

1978 Crowell Reservoir Project - Crowell, Texas.
1979 5th Green Site - Canyon, Texas.
1979 Little Wolf Creek Site - Canadian River, Texas.
1979 Tierra Blanca Site - Umbarger, Texas.
1980 Pipeline Survey - Borger, Texas to Kansas City, Kansas.
1980 Ozier Site - Canadian River, Texas.
1981 Port Royal Site - Port Royal, Jamaica.
1981 Pedro Banks Survey - Pedro Banks, Jamaica.
1981 Sevilla La Nueva Survey - St. Ann's Bay, Jamaica.
1981 Freeport Harbour Survey - Freeport, Texas.
1982 Mombasa Wreck Project - Kenya, Africa.
1982 Ottoman Wreck Project - Yassi Ada, Turkey.
1983 Highborn Cay Wreck - Highborn Cay, Bahamas.
1983 Bahia de Isabela Project - Isabela, Dominican Republic.
1983 Molasses Reef Wreck Project - Turks and Caicos.
1983 Little Inagua Recon. - Little Inagua, Bahamas.
1987 Belen Survey - Belen, Panama.

Laboratory Experience

1978-79 Killgore Research Center - Canyon, Tex.
1980 Cultural Research Lab. - TAMU C.S., Tex.
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