## FURTHER IDENTIFICATION OF FUNCTIONAL PARTS OF THERA FRESCO'S SHIPS

The archaeological work being supervised and directed by S. Marinatos near Akrotiri at Santorini during the season of 1972 uncovered the now well-known fresco that illustrated, for the first time, watercraft of the Minoan era. The fresco, when discovered, was extensively fragmented, due mostly to the volcanic eruption blast with accompanying earthquakes and the final covering of volcanic ash. This was based on geological investigation and research that the eruption of Thera approximately at 1510 BC.

So we are looking at a fresco with ships, presumably 3500 years old, plus or minus a factor of 100 years to account for variations of carbon dating and the painting's age before Thera was destroyed. This fresco is an illuminated picture for us in time, surrounded by centuries of dark and unknown nautical experience and activity. We must make of it what we can by logical reasoning, using parallel situations, knowledge of nautical science, and speculation based on archaeological knowledge. There is no way of knowing with certainty that the ships depicted, or for that matter the painting, is contemporary with the cataclysm of Thera.

Since the discovery of this important art work, there have been many and innumerable interpretations. This fresco is in the form of a frieze (originally), of which less than half has been recovered. Our major interest in the painting lies in the flotilla of ships, of which there are seven larger vessels proceeding from left to right, and of these there is only one which is nearly intact in its detail. The others, however, are with various amounts missing, fragments and in various locations on the ships. It is possible to see that the major ships are all very similar, and the missing parts of some are present in others, and vice versa, and that all together they match closely with the intact ship. Their sizes are also variable, but not excessively different. At any rate, our attention will largely be concentrated for obvious reasons on the intact vessel, the second from the left in the procession beginning with the very interesting island village scene.

It is not the intention to describe the entire fresco here. It is assumed that the majority of readers and audience are familiar with this remarkable and most valuable ancient art. It is necessary to begin this short discussion , however, by referring to Fig. 1, a reproduction of the portion of concentration on this famous

fresco. It shows the vessel referred to above, the most intact ship. Its actual length in the fresco is 75 cm. from end to end, but eliminating the long, stem-like extension on its forward end, the basic vessel is but 62 cm. Quoting Professor Marinatos, this projection, which he refers to as a bowsprit " is an additional, thin wooden[2] spar, attached to the prow when necessary ..... apparently a device for the ship's festive decoration." The archaeological drawing taken from the fresco of this ship is shown in Figure 2 and this decorated extension can be easily identified.

Referring to the related paper presented at the first Symposium, "Ship Construction in Antiquity", Athens, 1985, "Theories on Ship Configuration in the Bronze Age Aegean,"[1] this same ship as above was identified and discussed. It was determined by reconstruction that it was a vessel whose dimensions were:

Overall length = 24 meters
Waterline length = 16.2 meters
Draft of water = 1.0 meters
Beam (extreme) = 5.0 meters
Displacement = 24 tons
Sail area = 61.5 square meters

Fig. 3 is the profile drawing, and Fig. 4 is the lines drawing (three view configuration) as reconstructed. These illustrations are repeated with the kind permission of the Symposium Administration merely to provide a basis for further discussion.[2] The validity of the reconstruction has been reasonably argued and for purposes of this paper it must be considered the basic ship.

Perhaps the most controversial focus in the ships of this fresco has been the appendage on the stern of the larger ships. It appears on each one except the vessel under sail. Let us concentrate on this feature. It appears to be as it was first described in the first official report,[2] Excavations at Thera VI, (1972 Season) ..."attached to the stern and well over the sea's surface ... it is clear that the object is composed of a bifurcated wooden shaft and of a massive piece also of wood fastened vertically to it". This writer would agree that this is a good description of the object from which to proceed. It would be proper to add that the vertical "massive" piece is shaped like a wooden knee historically used in ships of wood for stiffening and strengthening. The bifurcated shaft is quite probably in two parts, being lashed or fastened at the after extremity of the vertical knee with a single common junction from which each extends forward one side to port and the other to starboard to fasten just below the rail's edge. This is visable, Fig. 5, in each of the major ships showing the stern appendage. In the profile views of the fresco

ships in which they all are proceeding from left to right, we are looking only at the starboard side, unless there was an identical part on the port side lying in exactly the same place. As it is described, it is an assembly making a three-point attachment, port, starboard, and center on stern. (Fig. 5A).

In order to demonstrate the practicability as well as the basic function of the stern appendage, it has been assembled as described and attached as shown in Fig. 6 on the scale model first introduced in reference[1].

This assembly has been constructed to scale and configuration according to Fig. 2 as was the model. Fig. 7 is an extension of the lines drawing (Fig. 4) showing the profile with the stern appendage located as attached. The three attachment points on the model were as described above, and the actual attachment was accomplished with very simple touches of rubber cement. The solidity of this three point suspension was surprising. The assembly is convincing as one which is removable and re-attachable with a feature of stowability. When it is removed, it folds into a flat package that could very easily be hoisted inboard for stowage in the ship at some suitable place in the hold. This latter feature has been discussed elsewhere and assists in the explanation of temporary usage as a landing platform or gangway astern.

Further shown in the model illustration, Figure 6, there is the clearance question when the vessel is moored stern-to on a beach. There is a common phenomenon on sandy and gravel beaches of the world's seas that involves the gradual slope of the beach to the water and to an extent beyond. This slope is at an angle that remains within narrow limits at approximately 60. This is something, of course, related to the constant force of gravity rearranging the washed sand or aggregate of gravel inside the surf line as the waves surge onto the beach in continual reversal of flow.

Referring to the model of the photograph in Figure 8, it has been set up in a position with its stern to a beach angle of 6° and the model on a horizontal plane at the waterline, a situation that would exist when such a vessel as the Thera ship places her bow at an anchor to seaward and allows the stern to touch lightly the slope of the beach below the waterline. It will be observed that the stern appendage just clears the beach slope as it reaches aft toward solid, dry land. From the end of this projection, when diagrammed on the scale drawing (Fig. 7), there measures a step down in this position of 25 cm (9.8 in). Such measurement closely approximates the height of one riser used by carpenters in making a standard stair step.

Actually, it is believed that the mode of attachment of stern appendage is such to make it removable and available when and as needed. It is held by two strap arrangements that pass through the stern knee piece and up to the hull's after deck, where they most probably are tightened up and secured inboard. This would allow adjustment to a higher position on the stern when needed for a stern landing at a stone-built embarkation(Fig. 9).

This mode for embarkation and disembarkation very naturally adapts to the classic usage in the Mediterranean in antiquity. There are abudant illustrations of Mycenaean ships and later Attic paintings showing vessels carrying ladders on the stern or actually with some in place and boarding, illustration.[3]

The stern-to beaching or landing custom seems to have extended into the Minoan culture, which may even have established it as the common standard. It truly is for the experienced sailor, a natural and simple way of going ashore. The boat may be hauled up lines ashore or merely touching the bottom with anchor to seaward and lines ashore from port and starboard quarters. It is for either a friendly of hostile shore the most simple; the quickest and safest way of getting to sea. It can be done gracefully and graciously in departing from a friendly host. From a pursuing host, the well-organized crew can take to a ship presenting the minimum target, cast off, and haul to a seaward anchor while underway with oars, sail, and/or other propulsion.

Tying up to a quay or slip, it is still considered best seamanship to have the stern to shore and bow to seaward. Only for cargo vessels and large commercial ships in protected harbors or rivers is it considered more practical to load and discharge cargo and passengers from the side. The stern-to bow-out system has been practiced universally for centuries. It had its beginnings in the Mediterranean - no doubt with the Eastern civilizations, it has been known among maritime people for this indefinite time as the "Mediterranean moor". It is for these reasons together with the natural adaptability in model experiments as indicated that the stern appendage of the Thera ship is most believably an embarkation platform.

As far as a trimming device[4] is of alternative possibility, it must be pointed out from the fresco that the few additional people in the stern will not cause a significant change in trim. The vessel was determined to be 16.2 m (53.2 ft) waterline length and approximately 5.0 m (16.4 ft) beam. This means that it would have a trimming moment which would allow five men to be in the stern, where we see them in the fresco, without changing the trim on the waterline at the stern more than 5 cm (2 in). This result is computed as a function of the vessel's length

and waterline area, and involves a common parameter in examining and predicating performance in ship design. It indicates that for every 5 cm (2 in) change of trim, it is required to move 349 kg (770 lbs), 8 m (26.25 ft) aft from amidship.

Leaving the stern appendage, it is of further interest to examine the function of the objects shown on the forward ends of each of the large vessels on the rails. It is very clear on the rail of the intact subject ship, Figs 1&2, that this attachment is similar to the modern-day chock or fairlead for a rigging line or rope of some kind. It will be noted in the illustrations that the opening or hole in this rail-mounted "fairlead" type object falls almost directly below the end of the sail's yard arms, which are supported in the fore and aft positions by crutches or in modern terminology, "gallows".

The type of sail used on these vessels is apparent on the vessel under sail, and by the accumulation of furled sail and yards on the above-named gallows, to be a square sail with upper and lower yards. Such a sail is raised and lowered by a multiple halyard system, which is visible in some detail. The mast heads fitted with sheaves for these separate halyards are visible on mast head as eye-like sheaves lashed in vertical arrangement to each side of the mast. This system is identical to that used on Egyptian ships of the same and earlier periods.

These nearly identical mast head halyard sheaves in the Egyptian vessels we know to be essentially of wood, with rope lashings. This is an unquestionable thing, as well as their use, essentially because there are many more contemporary Egyptian illustrations of ships as well as funerary models of their ships. It is quite reasonable, with no evidence to the contrary, to judge that the mast head halyard sheaves are also of smooth polished wood on these Bronze Age Aegean ships which parallel the 18th Egyptian Dynasty of the New Kingdom. They also would appear much like the today's similar object of rigging which is used in Aegean fishing vessels as well as in other contemporary working rigs of Europe. They are called "bull's eyes" in English and serve well the need for changing the direction of a rigging line under a pulling force without the complexity and expense of adding a rotating sheave to a block of wood. Their multiple use in this case lightens the strain on each as the yard is raised. This function today would be accomplished through a three or four part tackle in one block with as many rotating sheaves.

The arrangement of upper suspension points distributed on the yard allow for canting it down forward at a leading angle to the horizontal wind force, which improves the sail's aerodynamics. These conclusions have been arrived at by sailors over the millennia without the advise of ship designers technology[1].

The ends of the lower yard as the sail is braced around to beam wind or somewhat forward of the beam as is the condition of the model, Fig. 5, would be most effective when the leading (forward) edge of this square sail is stretched taught. This sort of hardening down can be accomplished by hauling hard in on the two forward lower boom braces, which are shown rove through the rail-attached fairleads described above. (Fig.10). At the same time, the after end of the upper boom must be hardened down by that brace. This sail can thus be set very effectively, aerodynamically, in this manner, athough in today's world of fore and aft rigged vessel, the term must be relatively applied. We can at least see that the single square sail rig as is most clearly illustrated in this famous fresco of Thera, is a flexible, workable rig of the age in which it was used.

This ship, under sail, is rather an enigma. There is no question that it is sailing, believably so; there is no after landing gear rigged, the helmsmen (here there are two) are standing, both well braced with legs apart, indicating they are maintaining the head-up to wind in a stiff breeze. Because of the extensive fragmentation, we depend on the restoration with some misgivings. It is for this reason that the rigging is very sparse. There is evidence of taught halyards to the left on the upper yard and a pair to starboard on the lower yard as well as a portion of two braces coming off the yards. There also appears to be halyards coming down on the aft side of the sail forward of the mast. All of this is correct, but the whole forward end of the ship is missing from the original fresco, as is the stern.

It is difficult to tell whether the *ikrion* was rigged, although the restoration seems noncommittal on this, having inventively been painted in a shapeless lump at this location. It is felt in this analysis that there should be this aft structure shown even under sail. The *ikria* apparently were of considerable importance to the owners and/or captains of these Thera ships. In the house where the ship's fresco was found these command stations are exhibited particularly as wall frescos, each one individualized and painted apparently at some scale between half and full size.

Each exhibits different decorations, which indicate something of the reverence or elevated rank associated with them. According to Professor Marinatos, the owner of the house was the commander or "Admiral" of the flotilla[2] portrayed in the fresco. It suggests itself as a possibility that his murals of various *ikria* may be those from his past commands. Their placement on the ships indicate the location of command as in the later profiles of trireme[5] and/or war vessels which exhibit very prominent throne-like chairs.[3]

In further examination of the fresco ship #2 of the procession, we observe ın it, and at least on one other ship, an object rising from a forward location just ıeyond the rail sheaves that appears to be a two-pronged fork or cradle. It is very listinctly delineated, and seems to be standing approximately 0.75 m (2 1/2 ft) ıigher than the rail or forward deck, if there were such. At first sight, this would ıppear to be the top of a crutch, and with considerable further examination and :omparative considerations, one still returns to this conclusion. There is strong ıvidence - archaeological evidence as well as practical requirements - that lead ɔ the identity that this crutch is an installation to receive the end of the mast when : is being lowered and stowed in its horizontal position as shown in five of the ;even ships. The mast, when not in use, would, for practical reasons, be stored ı an overhead arrangment where tall post-like gallows can support it. These mast ;towing structures are seen in the fresco on the ships where the masts are not ;tepped. There are in the abundant Egyptian iconography, largely in Middle Kingdom and earlier, detailed paintings and reliefs of ships in the process of ɔwering and raising masts.[5] Many of these examples show a crutch forward vhere the mast's lower end is apparently being braced or held temporarily when he upper portion is held up by a taller post-like crutch amidships.[5]

The detailed procedure in unstepping the mast is not entirely clear. It must ɔe lifted vertically, however, from its support (mast step) in the bottom of the ship ɔy means of a rope sling or slings. A mast of the dimensions shown in the fresco ;hip #2, approximately 8.8 m (28.9 ft) in overall length and with an average diameter mid diameter) of 16.5 cm (6 1/2 in) would weigh approximately 267 kg (588.6 ɔs). (This is assuming the mast was of some appropriate wood native to the Aegean area such as pine or cedar). It is obvious from this weight that such a mast vould be handled by a crew of sailors, approximately 6 to 10 men. Lifting it between wo parallel crutches with a rope slings would bring it up to a position where its ıpper portion must rest on one of the taller post-like crutches. The lower end, or ıeel of the mast, could then be carried forward to the lower forward crutch, where t would rest safely for an indefinite time. It could at least be secured, until the nidship crutches are in place, the sails made up between their yard arms, and ɔther items stowed and ready for landing. At this time, it would no doubt be raised ıt its upper end , which now points aft, and lifted and moved to the upper stowage evel on the supports. These supports can be seen on Fig. 2, where there are four n place supporting the furled sail and sail yard as well as an assortment of poles ɔelow them.

It suggests itself when comparing all the ships in the fresco, notable in the areas of the painting where there was no restoration necessary, that these upright post-crutches or gallows are fashioned to receive the masts and sail-yards separately. The upper ends have a "T" bar shaped as in a shallow, side by side double cradle, seen on close examination, Fig. 2. This can be seen on vessels numbers 1, 2, 3, 4, and 7. Inasmuch as can be seen in unrestored portions of vessel number 5, which is under sail, there are no such vertical supporting posts, and it is reasonable to conlude that these, like other non-sailing or seagoing gear like the stern appendage, must be removable and stowable.

Examination of ship number 5 must be necessarily restricted because of the extensive fragmentation and missing portions. It may be seen in this vessel #5 that there is a portion of the original fresco in it that clearly shows just forward of the second helmsman's legs a corner of an object that must be the after portion of a weather cloth or wind screen. This is broken off by a missing fragment, but continues again to include the lower portion of the mast above its edge and including several heads and arms of crew or passengers above it until it ends at a forward stanchion. These weather cloths are shown in many ancient paintings and reliefs of ships from the late Egyptian dynasties. Greek paintings on pottery of the 7th and 8th century and down through the centuries to our own time, not only on Aegean fishing craft, but on modern yachts that go to sea. Any watercraft with low freeboard will find that these fabric shields along their sides are a usefull adjunct to their low rails in keeping their decks dry and crew more protected from flying spray.

The various details as noted in this paper are all of them a part of maritime culture that utilizes functional equipment that is recognizable still after 3500 years. It is of satisfaction to see that there is such constancy in facing the forces of the sea, but it is not surprising. It is, on the other hand, surprising to this writer that some of these recognizable things in the beautiful fresco from Thera are so often contested. It has been pointed out in past writings and interpretations of the fresco that I have accepted this painting too literally, that I have lifted the ship's profile line by line to be the basis for a blueprint. It is said with truth that before accepting ancient iconography, it must be submitted to a deep critical analysis. This has certainly been done, and because of the many realities in the fresco beyond the ships; the very identifiable species of dolphins, as well as other animals and flora, it is most believable. What else must we find to doubt?

One most credible critic says we must see the entire fresco as fantasy because it contains one rampant griffen. True enough, there is among the other fauna, lions, stags, fowl chased by spotted cat, a panel from the east wall (the ship panel

was on the south wall) , a single rampant griffen. It is drawn in much by outline and not filled in with color as are the other animals, as though perhaps the artist knew and appreciated that he is illustrating a supernatural beast. This strange beast is all there, just as our modern dictionary defines a griffen; lion's body, eagle's head and wings. It certainly, rather than stamping the whole fresco as a figment of some overcharged artist's imagination, does for this analyst, give the painting a mark of authenticity. The griffen is most accurately drawn.

To paraphrase and apologize to the poet Gelett Burgess, it is not resistable to conclude with the following:

I never saw an ancient Griffen,
I never hope to see one;
But I can tell you here and now,
That this one is a real one.

It is not in the details of this fresco that any major and very few minor details should cause doubt. Perhaps we are misreading some of them or putting some unrelated interpretation on others. This is not where the trouble may lie. It is an extensive and major archaeological milestone with considerable importance.We can easily see the portrayal of ships and people , towns and hillside of animals and saltwater with dolphins. We can count the paddlers on the ships and thus judge their dimensions with reasonable accuracy; we can even, from their profile and mast and sail extent, judge their third dimension and reconstruct their shape. The greatest question in this beautiful fresco has not been answered nor has it even been asked, perhaps indirectly once by Professor Casson, and that question is; how old are these ships and when did they sail? It may be, as has been assumed, that they are contemporary with or shortly before the destruction of Thera, which has been dated both geologically and by carbon dating. The age of the fresco and/or the scene of the fresco may be presumptuous.

There is evidence that may be quite supportive of this in the similarity of the masts as well as the profiles and other features of Egyptian ships in the reign of Sesostris III from the Twelfth Dynasty or Middle Kingdom of Egypt. This would date them only as late as 1780 BC or older, if the similarity could be substantiated with their time. The very visible stripes, on the masts both parallel and spiral, could be the woldings to hold together composite wood assembled masts or the stripes may be decorative. There is no evidence that Egyptian masts were composite assemblies and this question's answer is irrelevant in either case. The masts appear the same in the Egyptian tomb painting ship procession and the ship's

profiles, as do the Thera ships. The low mast crutch on the forward deck as well as the higher supporting crutches are also the same. These similarities seem more than coincidental.

In closing, I beg forbearance and ask the kind consideration of all the Scholars, classicists, archaeologists, and others here assembled for this form of direct examination and analysis taken by an old sailor, teacher, and successful practitioner of ship design for many years.

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U.S. Naval Academy (Ret.)

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4. Casson , L. The Thera Ship, *IJNA*, Vol. 4, 9 (1975)
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## ILLUSTRATIONS

Fig. 1 Original Fresco Showing Ship #2, Least Restored Portion of Fresco's Ships. Dr. S. Marinatos, Athens, 1973.

Fig. 2 Archaeological Construction of Ship #2. Dr. S. Marinatos, Athens, 1972.

Fig. 3 Profile of Thera Ships #2 With Dimension. T. Gillmer. 1st Symposium of Ship Construction in Antiquity.

Fig. 4 Lines Configuration of Thera Ship #2, Three Views. T. Gillmer.

Fig. 5 Unrestored Fresco Fragments Showing Stern Appendage of Ship #4.

Fig. 5A Detail of Stern Appendage Attached.

Fig. 6 Model With Stern Appendage Attached.

Fig. 7 Drawing of Stern Appendage In Place on the Lines Configuration.

Fig. 8 Model With Stern to Beach Showing Slope.

Fig. 9 Illustration Showing Landing and Embarkation From a Stone Mole.

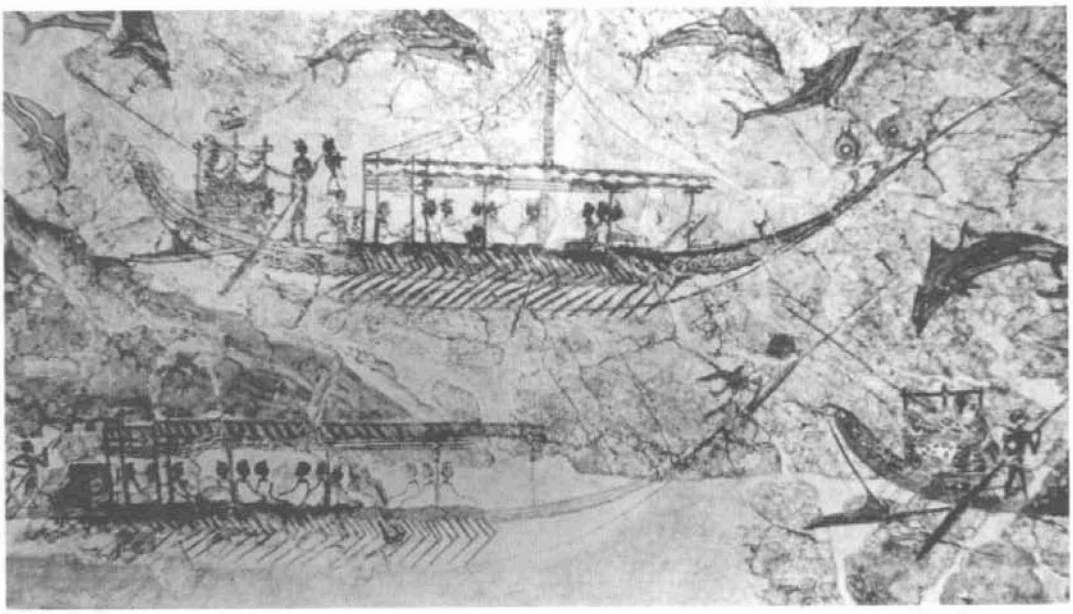
Fig.10 Square Sail Leads for Bracing Up Sail for Windward Sailing.

**Editor's note**

Since Professor Gillmer presented his communication the chronology of the Thera eruption has been much debated. Ice-core dating is giving a date of around 1645 BC, while tree-ring chronology a date around 1628 BC.

At the Third International Congress on Thera and the Aegean World, held in Santorini, Greece between the 3rd-9th September 1989 no less than 28 papers, dealing with the chronology, were presented. At his closing address Professor Colin Renfrew among other said, "When we turn to the historical dates, the archaeological chronology is still a matter of debate: whether it should be the traditional date of around 1500 or 1520 BC or much earlier in the middle of the 17th century ..."

The Proceedings were published in 1990 in *Thera and the Aegean World*, Editors D.A. Hardy with A.C. Renfrew, The Thera Foundation, London, 1990. Volume III deals with the chronology and it was thought appropriate to provide the reader with the above reference.



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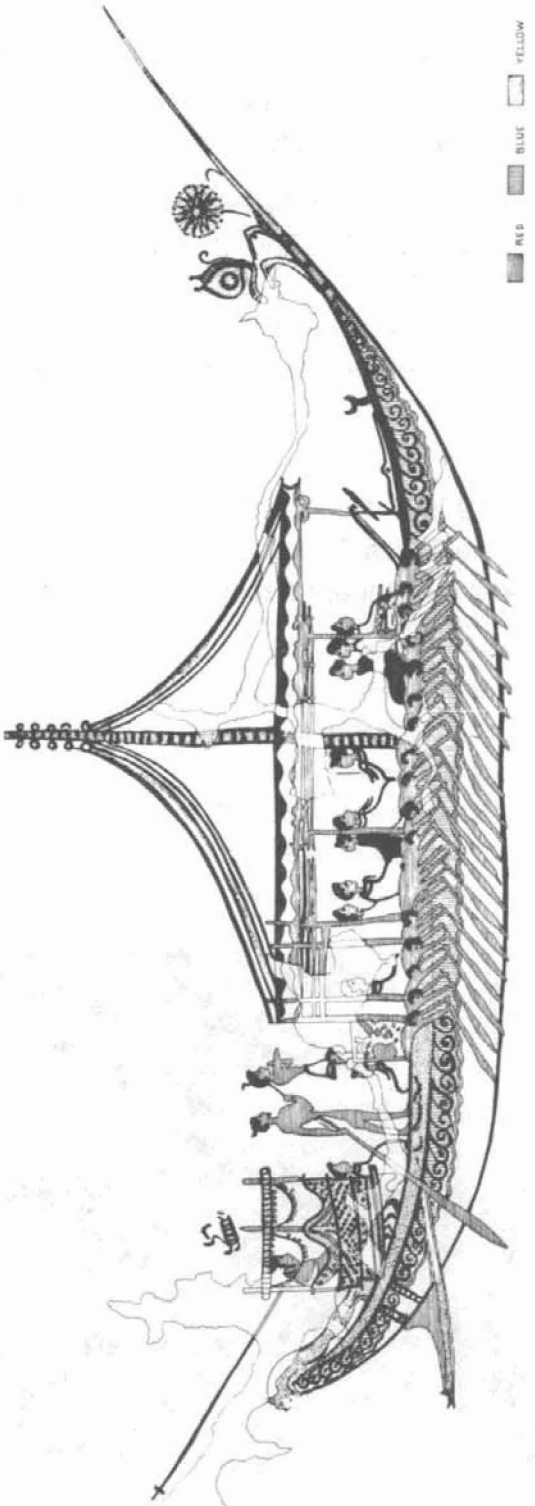


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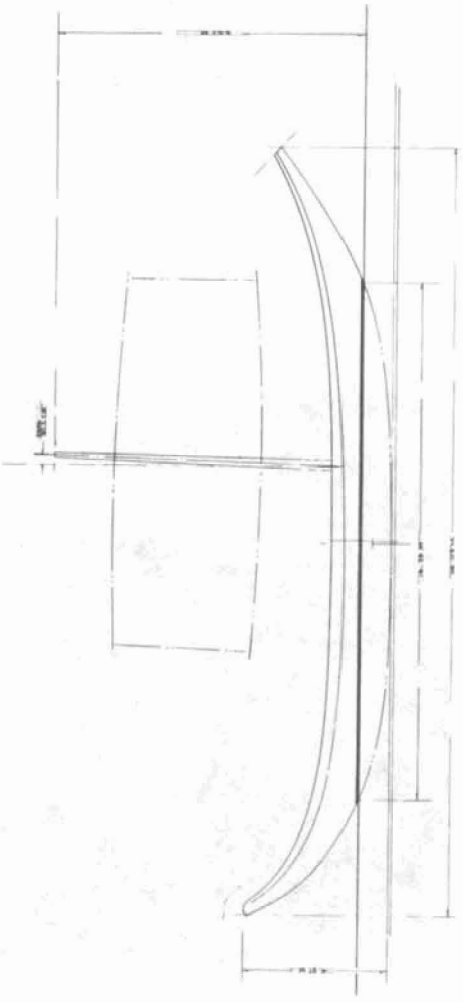

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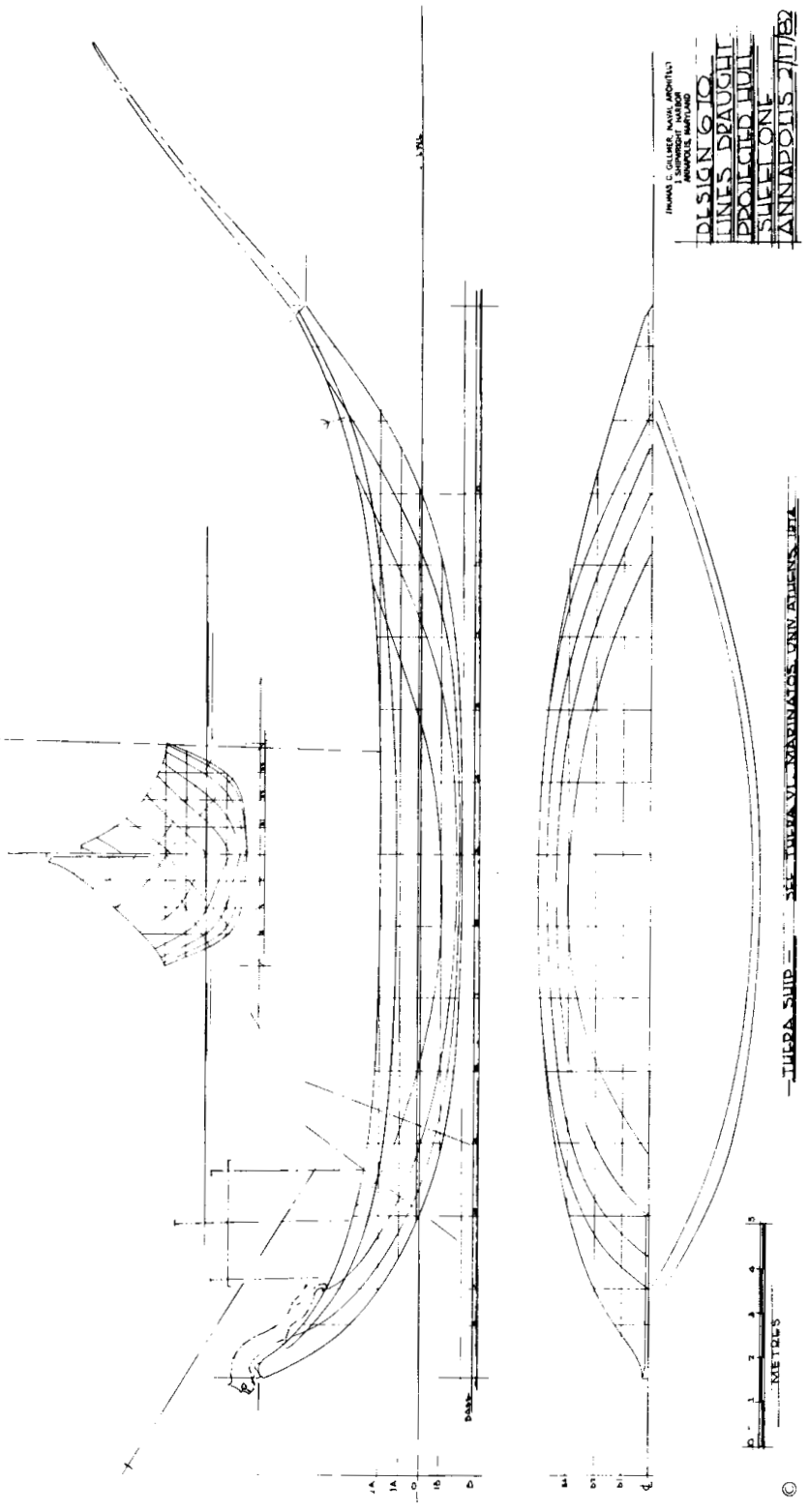
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Fig. 4

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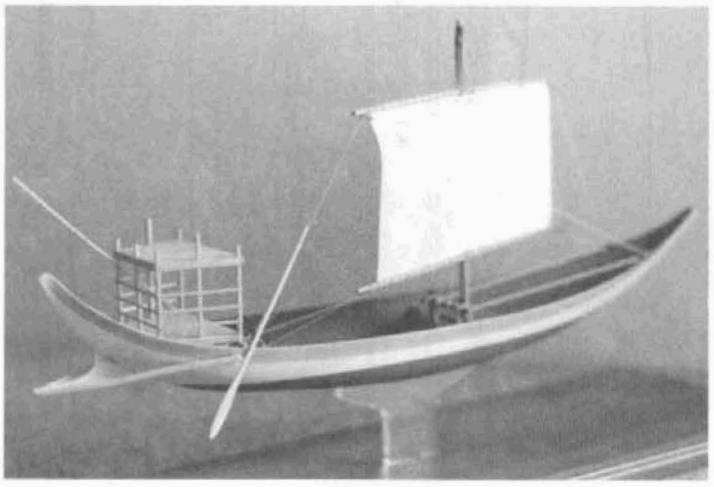

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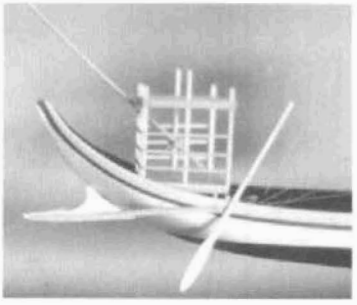

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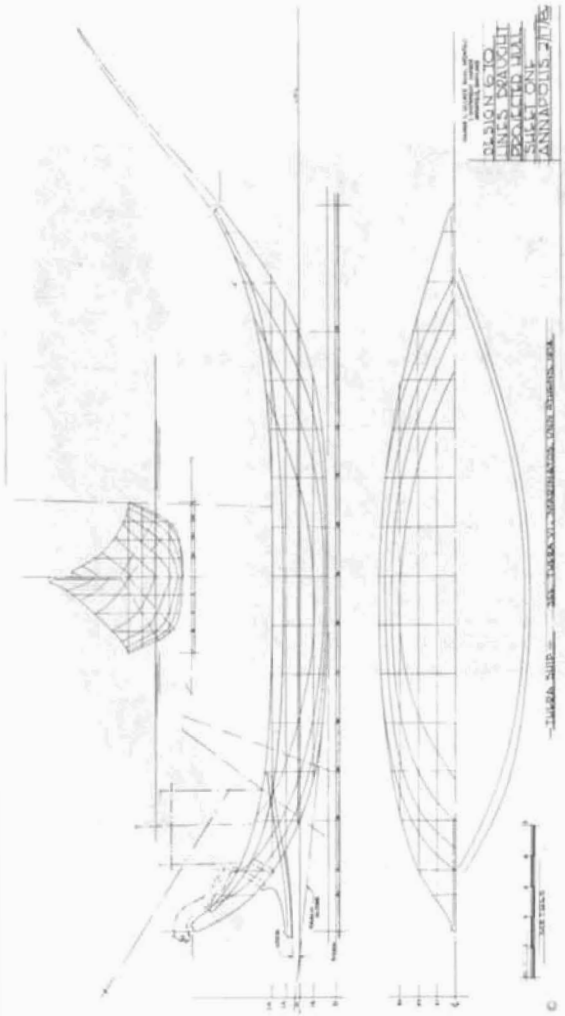
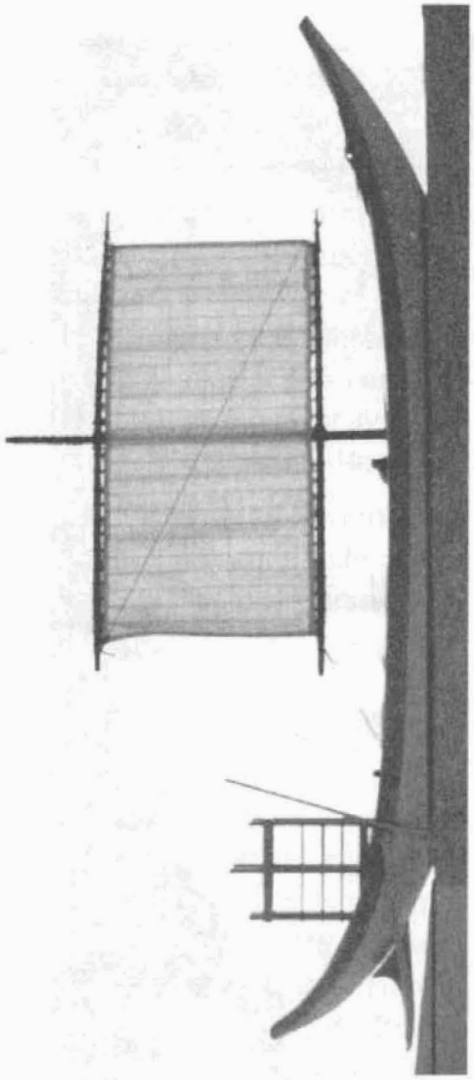


Fig. 7



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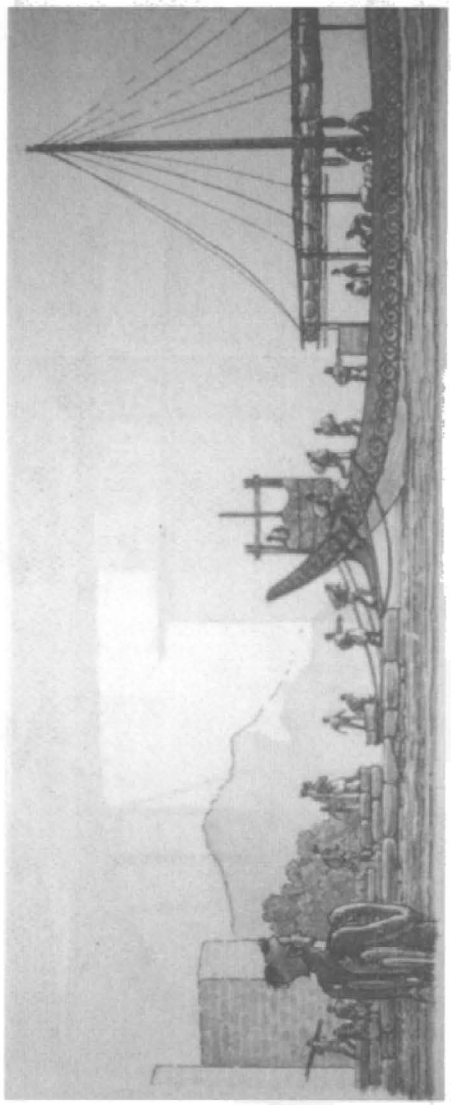

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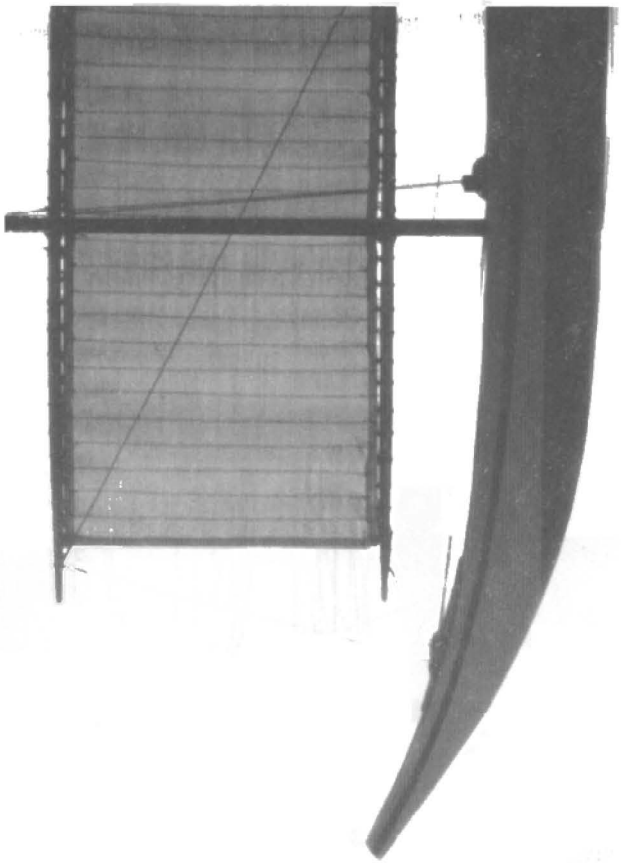

Fig. 10