Introducción a la Arquitectura Naval II

Especialización en Patrimonio Cultural Sumergido
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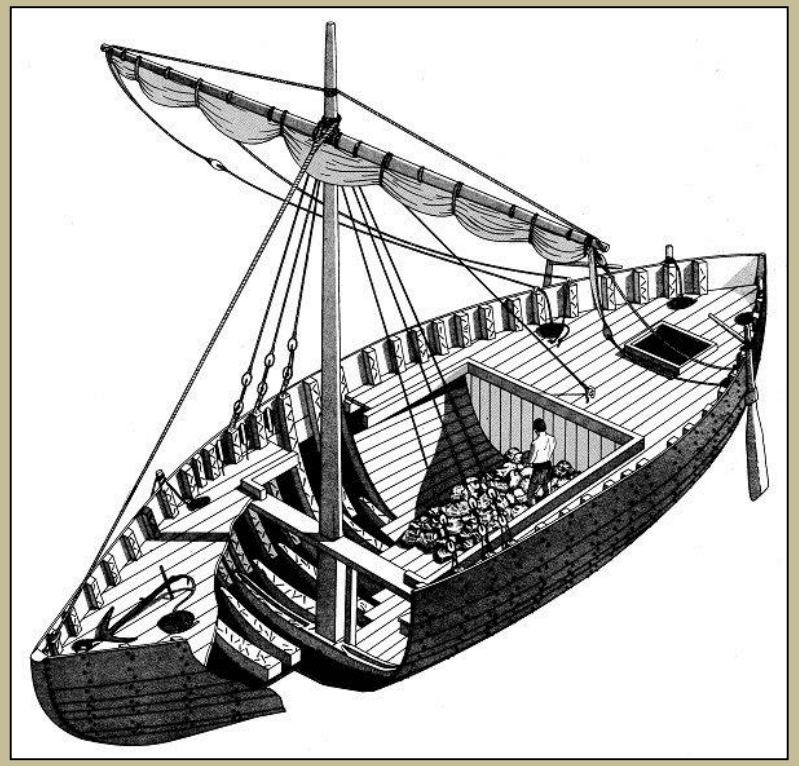
Part 2

J. Richard Steffy Ship Reconstruction Laboratory
ShipLAB
TEXAS A&M UNIVERSITY

Filipe Castro

“Celtic” Construction

Archaeological finds suggest the existence of a shipbuilding tradition different from the Mediterranean and Scandinavian ones, which appears in the territories invaded by the Celtic peoples in the first millennium BC.



“Celtic” Tradition

Such ships are described by Julius Cesar in his chronicle of the Gallic Wars (De Bello Gallico) and seem to be different from the ships that we think Scandinavians built at the time, represented by the Nydam ship of the 4th century AD.

"Celtic" Tradition

Julius Cesar was impressed with the nautical qualities of the ships of the Veneti, a tribe from Brittany (Armorique) with whom his ships clashed in the 1st century BC.

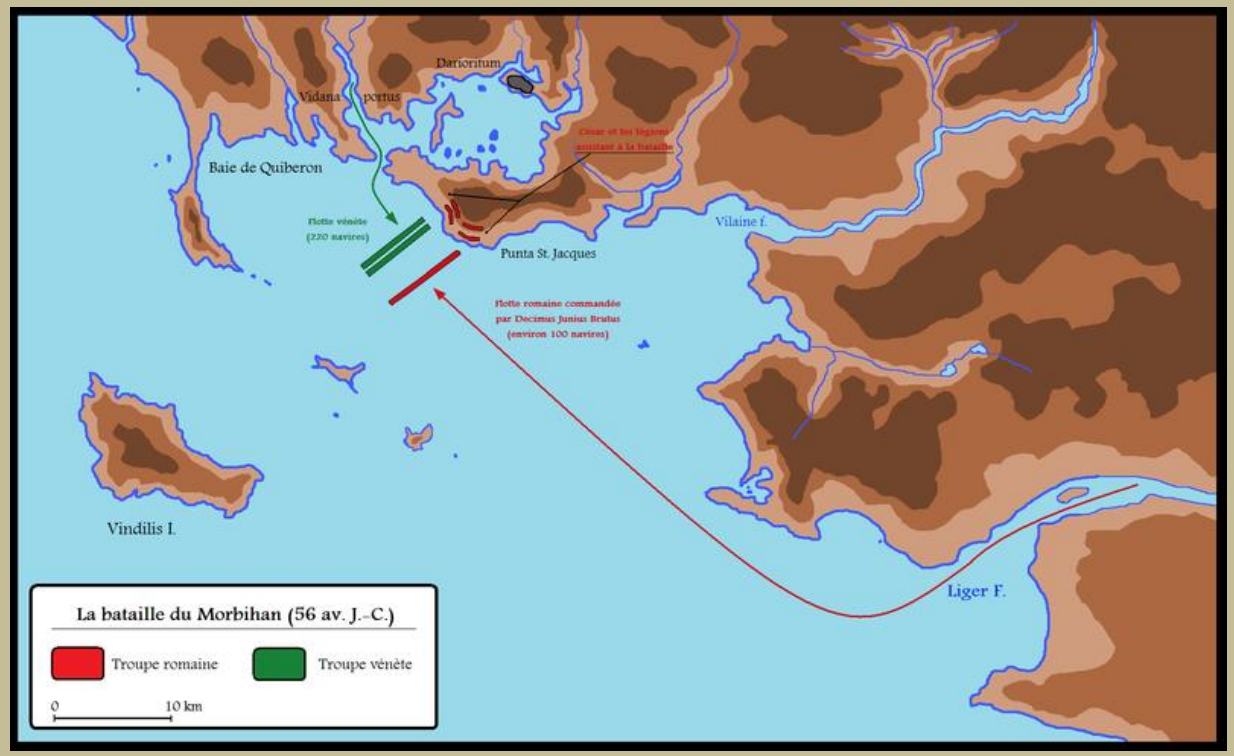
Veneti

"For their ships were built and equipped after this manner. The keels were somewhat flatter than those of our ships, whereby they could more easily encounter the shallows and the ebbing of the tide: the prows were raised very high, and, in like manner the sterns were adapted to the force of the waves and storms [which they were formed to sustain]. The ships were built wholly of oak, and designed to endure any force and violence whatever; the benches which were made of planks a foot in breadth, were fastened by iron spikes of the thickness of a man's thumb; the anchors were secured fast by iron chains instead of cables, and for sails they used skins and thin dressed leather.

Veneti Coins, 5th to 1st Century BC

“Celtic” Tradition

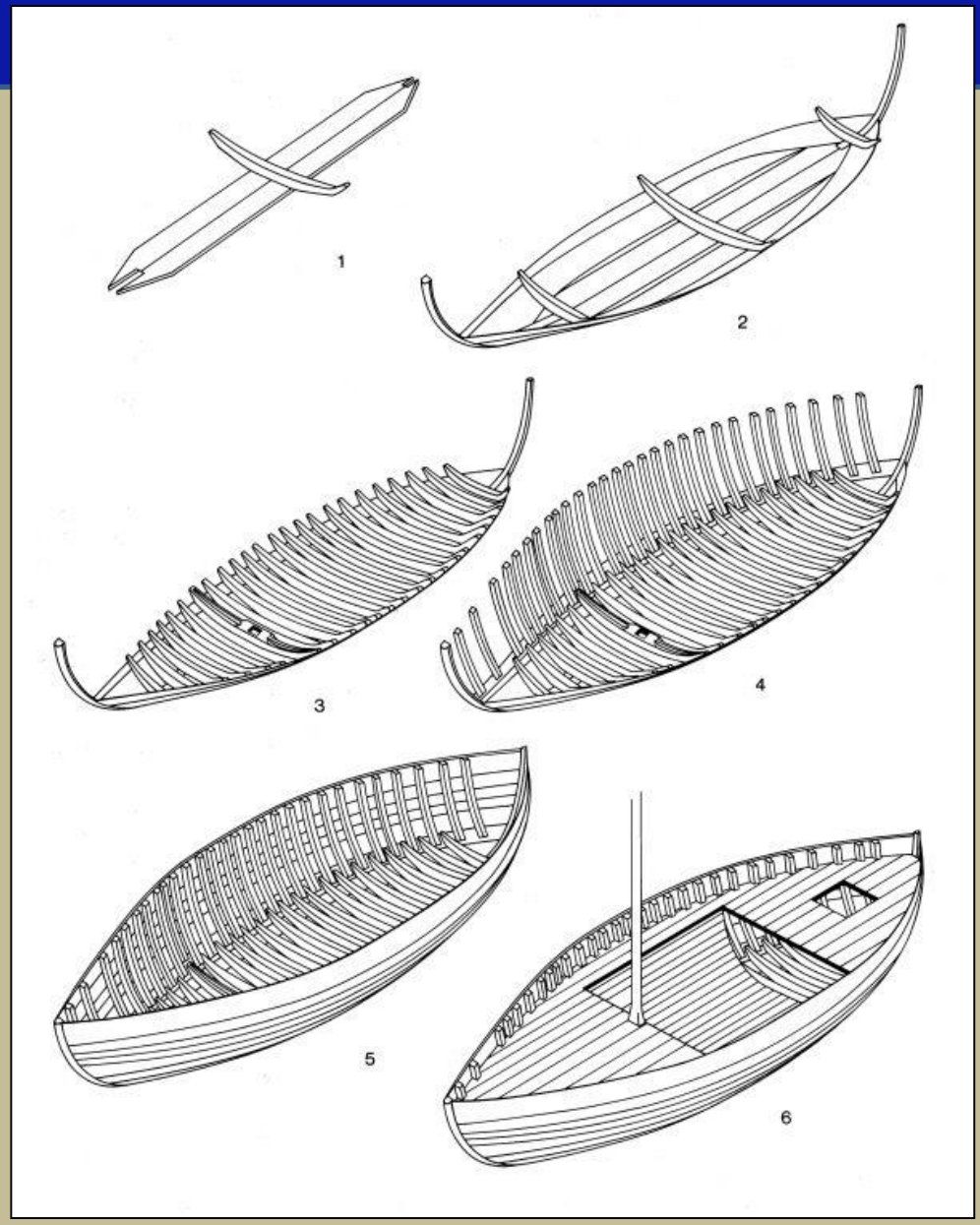
These [were used] either through their want of canvas and their ignorance of its application, or for this reason, which is more probable, that they thought that such storms of the ocean, and such violent gales of wind could not be resisted by sails, nor ships of such great burden be conveniently enough managed by them. The encounter of our fleet with these ships' was of such a nature that our fleet excelled in speed alone, and the plying of the oars; other things, considering the nature of the place [and] the violence of the storms, were more suitable and better adapted on their side; for neither could our ships injure theirs with their beaks (so great was their strength), nor on account of their height was a weapon easily cast up to them; and for the same reason they were less readily locked in by rocks.



“Celtic” Tradition

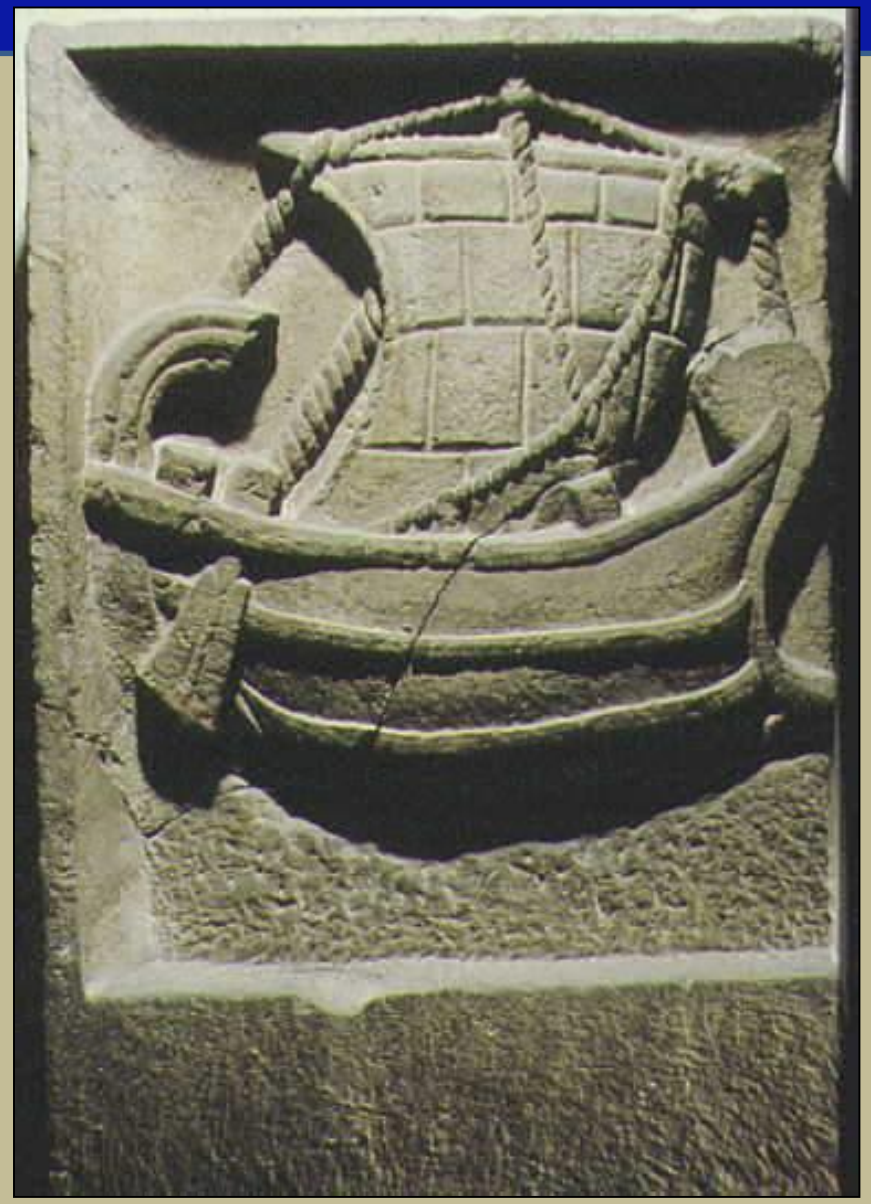
To this was added, that whenever a storm began to rage and they ran before the wind, they both could weather the storm more easily and heave to securely in the shallows, and when left by the tide feared nothing from rocks and shelves: the risk of all which things was much to be dreaded by our ships.”

De Bello Gallico



“Celtic” Tradition

Romans had a variety of river craft for transport within the empire. We have iconography – mostly from tomb reliefs – and archaeological remains.



“Celtic” Tradition

Flat bottom

Flush laid planks

Non edge joined

Double clenched nails driven through treenails;

Small plugged holes suggesting temporary fastenings;

Free futtocks;

Mast step is a mortise on an enlarged floor timber;

Caulking of hazel twigs;

“Crude” construction.

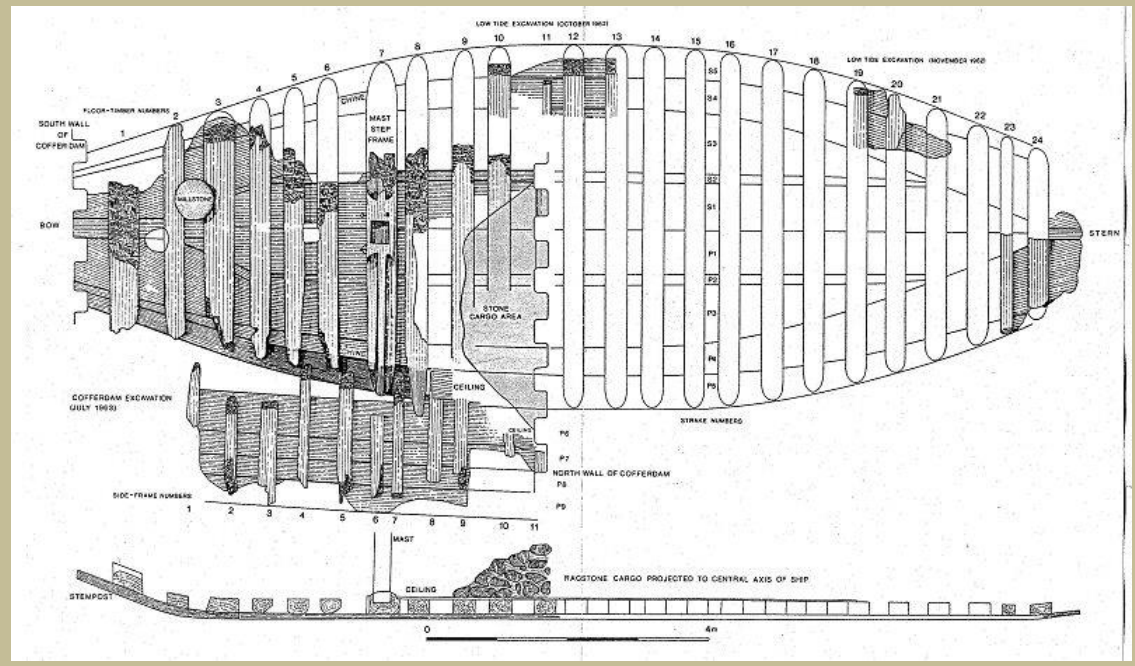
Typology

1. Blackfriars type (Hocker and Marsden type 1);
2. New Guy’s House type (Marsden type 2; Hocker 1);
3. Zwammerdam type (Marsden 3; Hocker 2);
4. Swiss boats type (Hocker and Marsden type 3);
5. Utrecht boat type (Marsden type 4);
6. Mainz patrol boats type (Hocker type 4).

1. The Blackfriars type has at least two parallels:

Bruges vessel (found in 1899 and published by Peter Marsden in 1976).

Guernsey ship (found in the 1980s).



“Celtic” Tradition

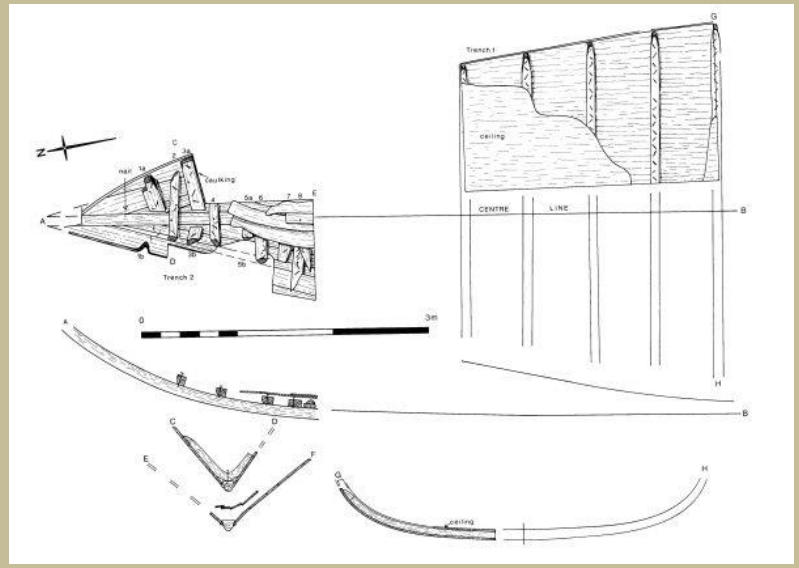
2. The New Guy’s House type has no parallels.

It is probably a river barge.

Found in 1958 and dated to the end of the 2nd century AD.

The total length of the vessel was probably at least 16 m, and it had a beam of about 4.25 m.

Lanceolate shape.



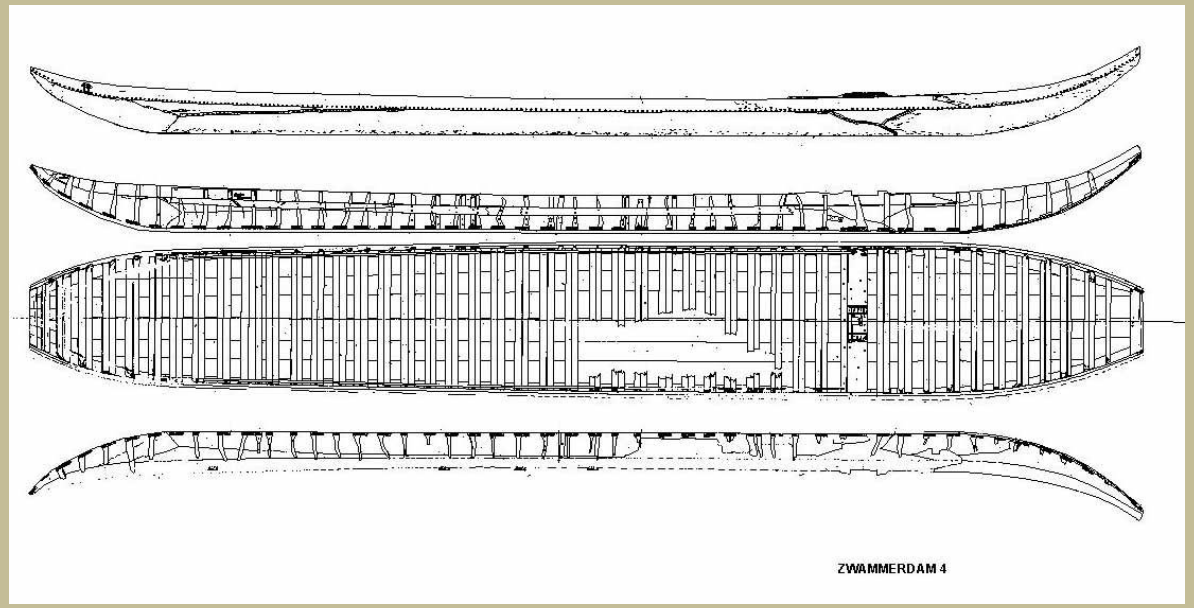
3. The Zwammerdam type has many parallels:

Flat bottom;

Vertical sides;

L-shaped bilge strakes (sometimes called chine girders);

Blunt of square ends.



“Celtic” Tradition

4. The Swiss lakes’ type has two examples:

The Bevaix boat

The Yverdon boat

"Celtic" Tradition

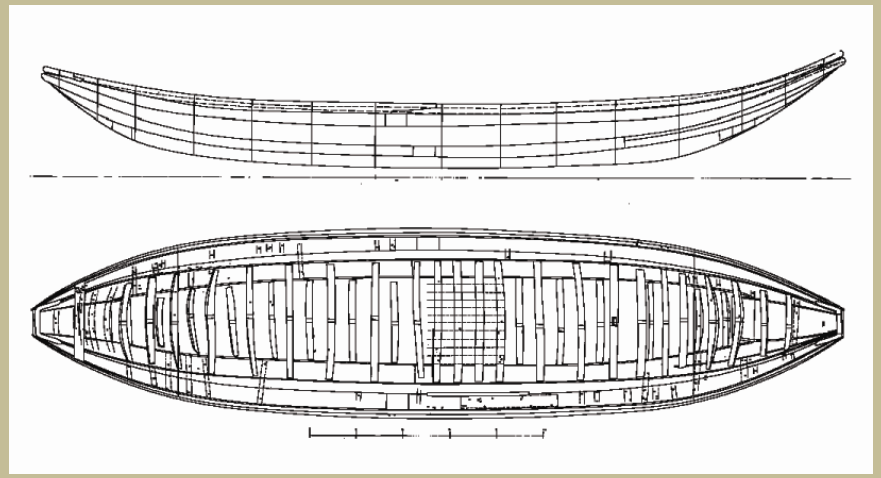
5. The Utrecht boat type has parallels:

Utrecht 2, Utrecht 5 and Velsen 1 boats, all from the 12th century.

Utrecht 1 was found in 1960 and dated to the 10th century AD.

Rounded bottom dugout with treenailed lapstrake sides.

Inland water cargo vessel.



6. The Mainz boats’ type have no other parallels.

Found in the Winter of 1981/82 all boats were built between the 3rd and 4th century, and abandoned in the late 4th century.

Boats Mainz 1, 2, 4 and 5 belong to a particular type of river patrol boat known as “Type Mainz A”.

Boat 3 was also built for military purposes and is known as “Type Mainz B”.

Boats 1, 2, 3, 4 and 5 were all built with mortise and tenon joints.

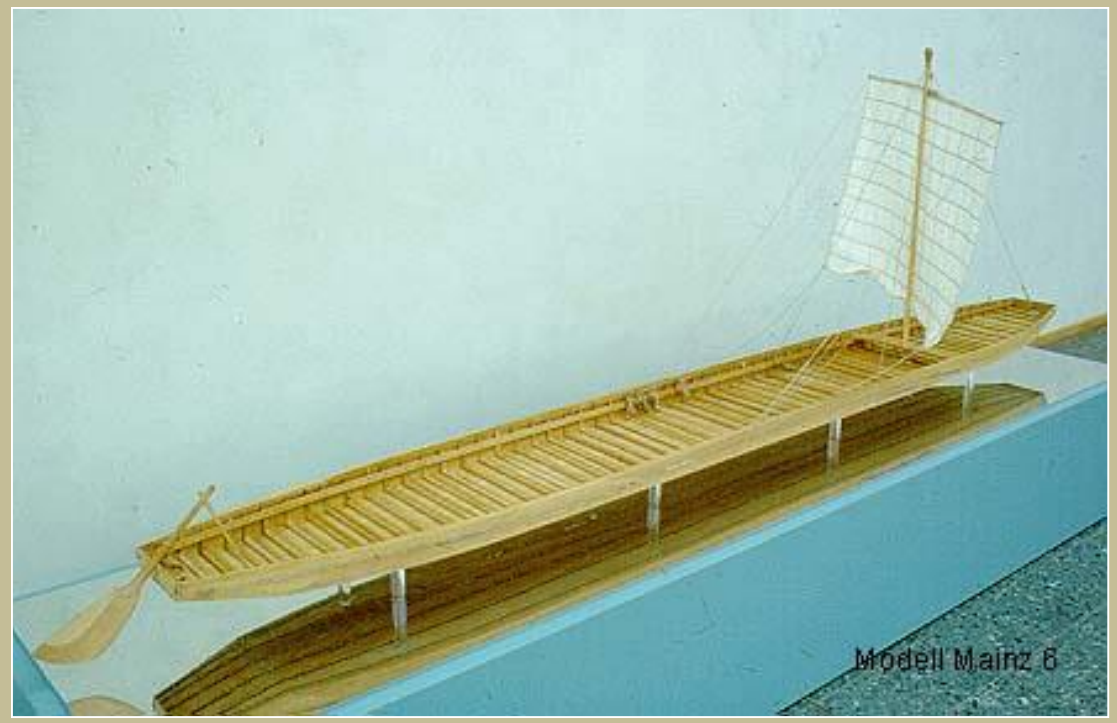
“Celtic” Tradition

The Mainz 6 boat was found 500m from the remaining vessels, together with the remains of a similar boat that was not recovered.

It was 11 m long, 2×60 m wide and 92 cm high.

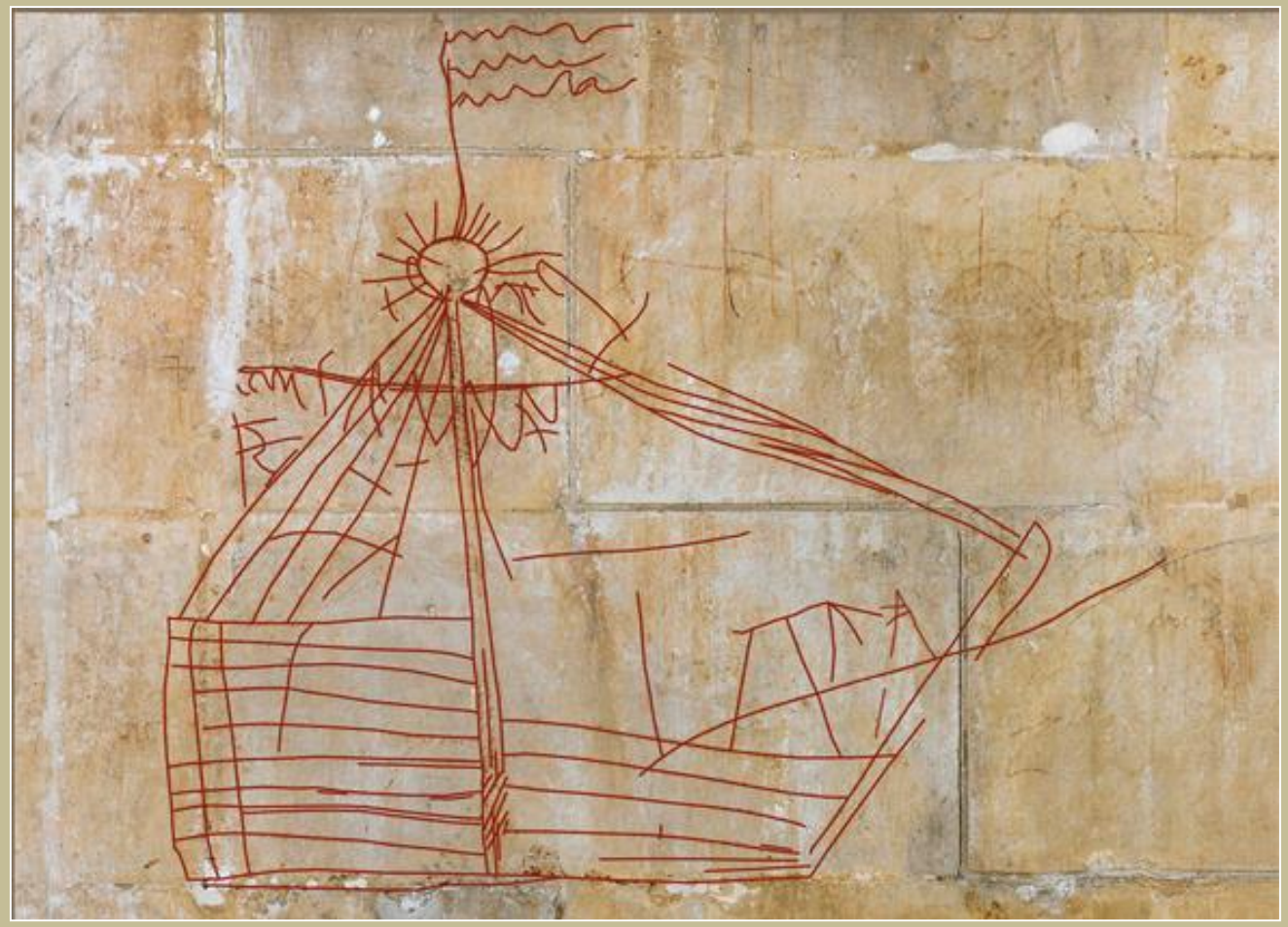
It was dated to AD 81.

It belongs to the Zwammerdam type.



“Celtic” Tradition

This Celtic, or Galo-Roman, bottom-based tradition is believed to be the base of the cog construction of the mid-12th century.

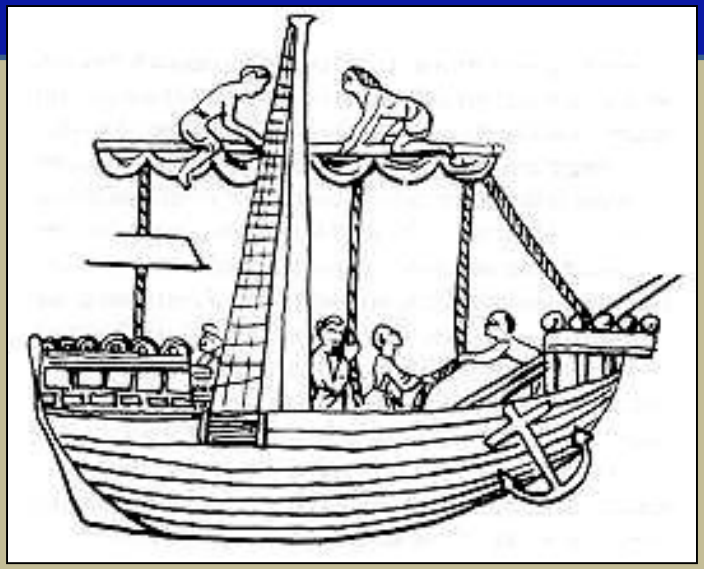


Cog scratched on the walls of Mosteiro da Batalha, Portugal, c. 1450.

“Celtic” Tradition

The working horses of the Baltic Sea trade in the late Medieval period are known to us as “cogs.”

These vessels are closely related with the activity of the Hanse League, a political (and military) organization that regulated commerce in the Baltic and the North Atlantic from the 10th to the 14th centuries.



“Celtic” Tradition

Cogs appear in the literature and iconography of the 12th through 15th centuries, mostly in the seals of cities.

“Celtic” Tradition

According to Paul Heinsius, a historian who analyzed town seals, cogs were characterized by:

1. A single mast;
2. A straight keel line;
3. Straight stem and sternposts;
4. High sides.

“Celtic” Tradition

Cogs are thought to have evolved from Frisian coastal craft sometime between the 8th or 9th centuries (according to Fred Hocker) and the 12th century (according to Ole Crumlin-Pedersen).

“Celtic” Tradition

According to Ole Crumlin-Pedersen cogs are thought to have evolved from the Nordic cargo vessels, such as the Skuldelev 1 (1040) or the Bergen ship (1188).

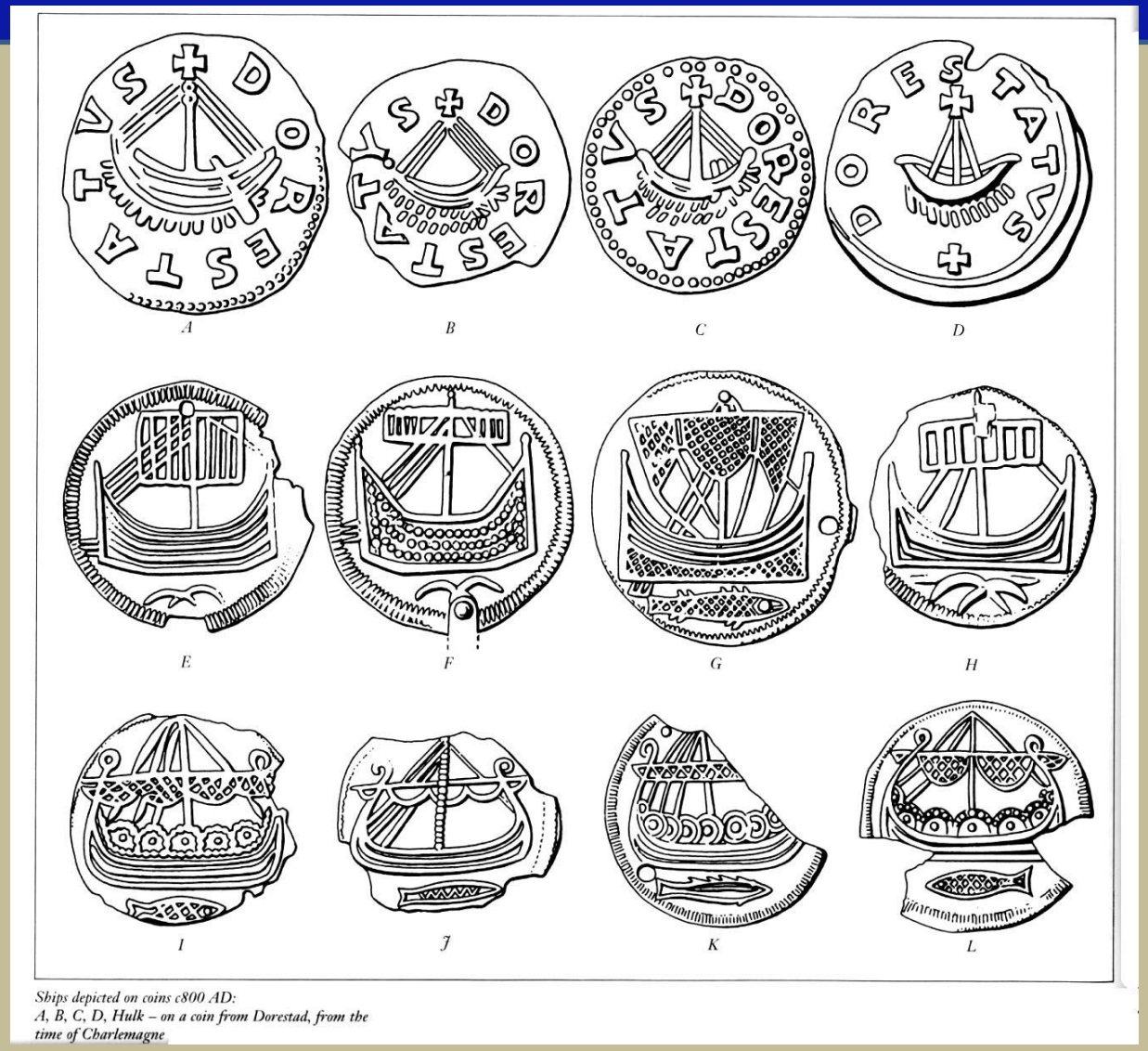
Skuldelev 1

Nordic Cargo Ships

No.	Date: Constructed/lost	Date: Dendro	Site	Country	Origin	Size L × B m	Year Found/excavated
1	*c.* 1025/	x	Hedeby 3	D	W Baltic	*c.* 22 × 6·3	1980/
2	*c.* 1040/1065	x	Skuldelev 1	DK	W Norway	16·0 × 4·8	1957/1962
3	1110/	x	Roskilde 4	DK		*c.* 20·5 × 6·5	1997/1997
4	1140	x	Eltang	DK	W Baltic	17·5 × 3·8	1943/1947
5	*c.* 1140/	x	Lynæs 1	DK	Kattegat reg.	*c.* 24 × 6	1975/1975
6	*c.* 1150/	x	Skanör Knösen	S		*c.* 20 × ?	1982/1991–92
7	*c.* 1180	x	Erritsø	DK		*c.* 20 × 4·2+	1929–30
8	1185	x	Roskilde 2	DK	Kattegat reg.	*c.* 16·5 × 4·5	1996/1997
9	1188/	x	Bergen	N	W Norway	*c.* 30 × 9·5	1955/1962

“Celtic” Tradition

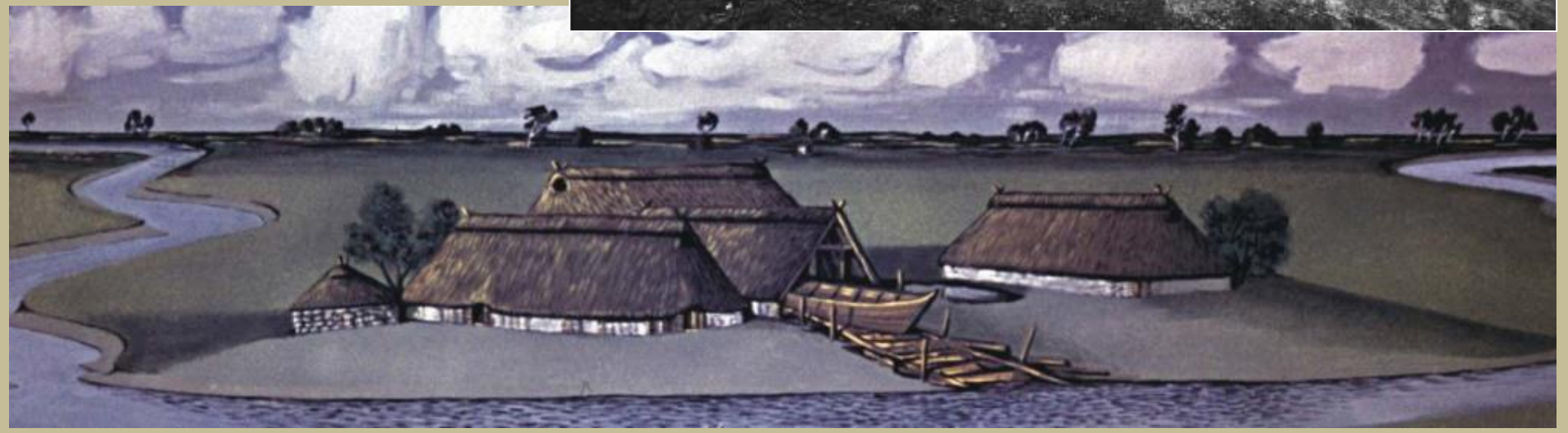
Some scholars trace the oldest references to cogs to before the 9th century.



Ships depicted on coins c800 AD:
A, B, C, D, Hulk – on a coin from Dorestad, from the time of Charlemagne

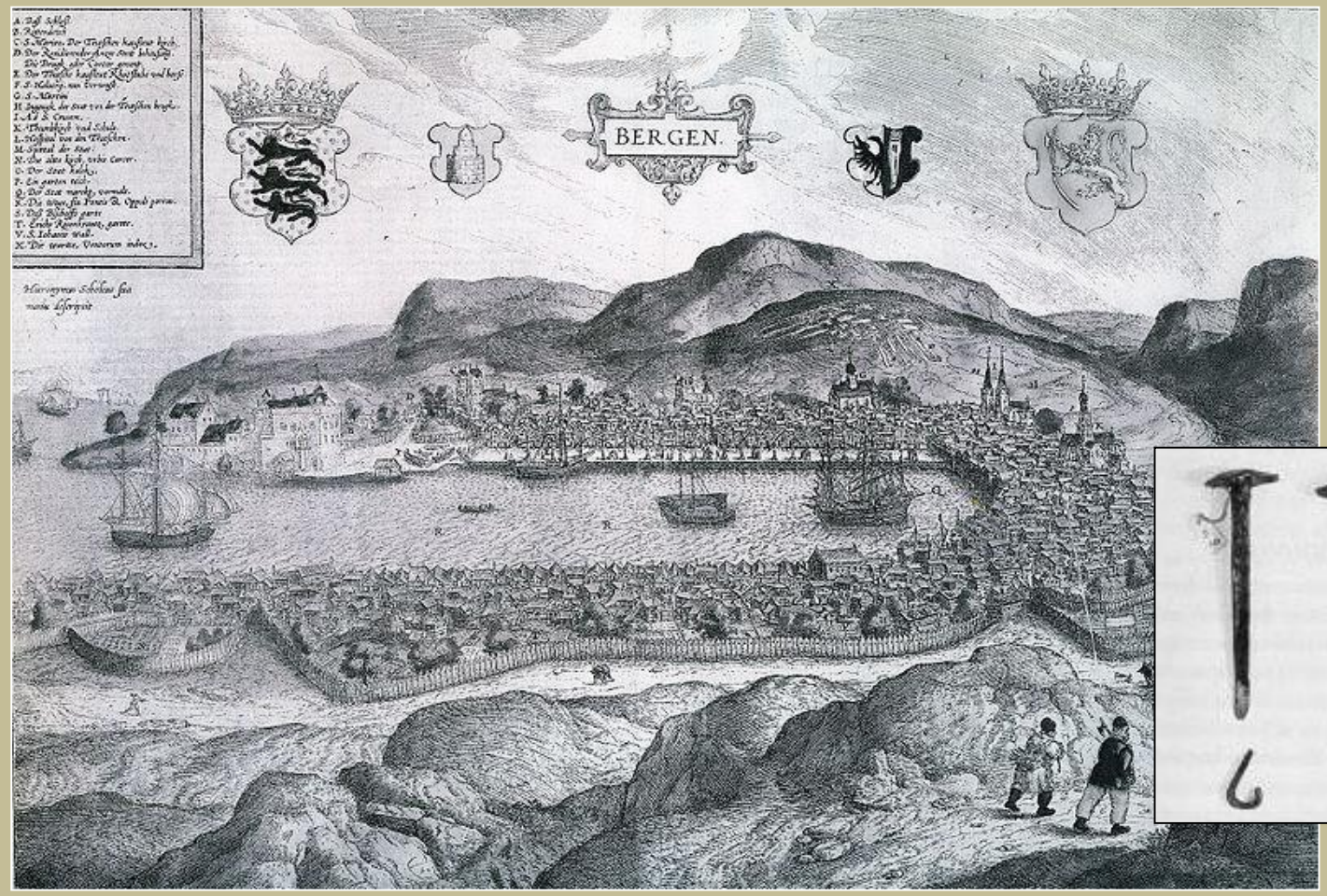
“Celtic” Tradition

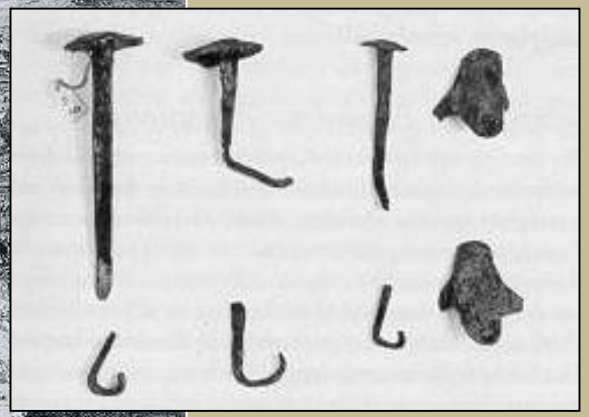
7th century farm at Wurt Hessens, where archaeologists found a steering oar and a slipway for a boat with a 2 m wide bottom. The oar is of a *firrer*-type: has a t-shaped handle and a blade shaped like a spade.



“Celtic” Tradition

Cog nails found at Bergen, near Stockholm, dating to the 10th century.





From the Bremen Cog

"Celtic" Tradition

However, there is no solid evidence for cogs before the middle 12th century, and then they are much smaller than the Nordic cargo ships.

These first cogs were probably built in Northern Frisia, Jutland, where Frisians, Saxons, and Danes joined in trading relationships.

Cogs had a formative period in the 12th and early 13th centuries.

“Celtic” Tradition

Frisian coasts are characterized by flat beaches and high tidal cycles and this may have determined the shape of their bottoms.

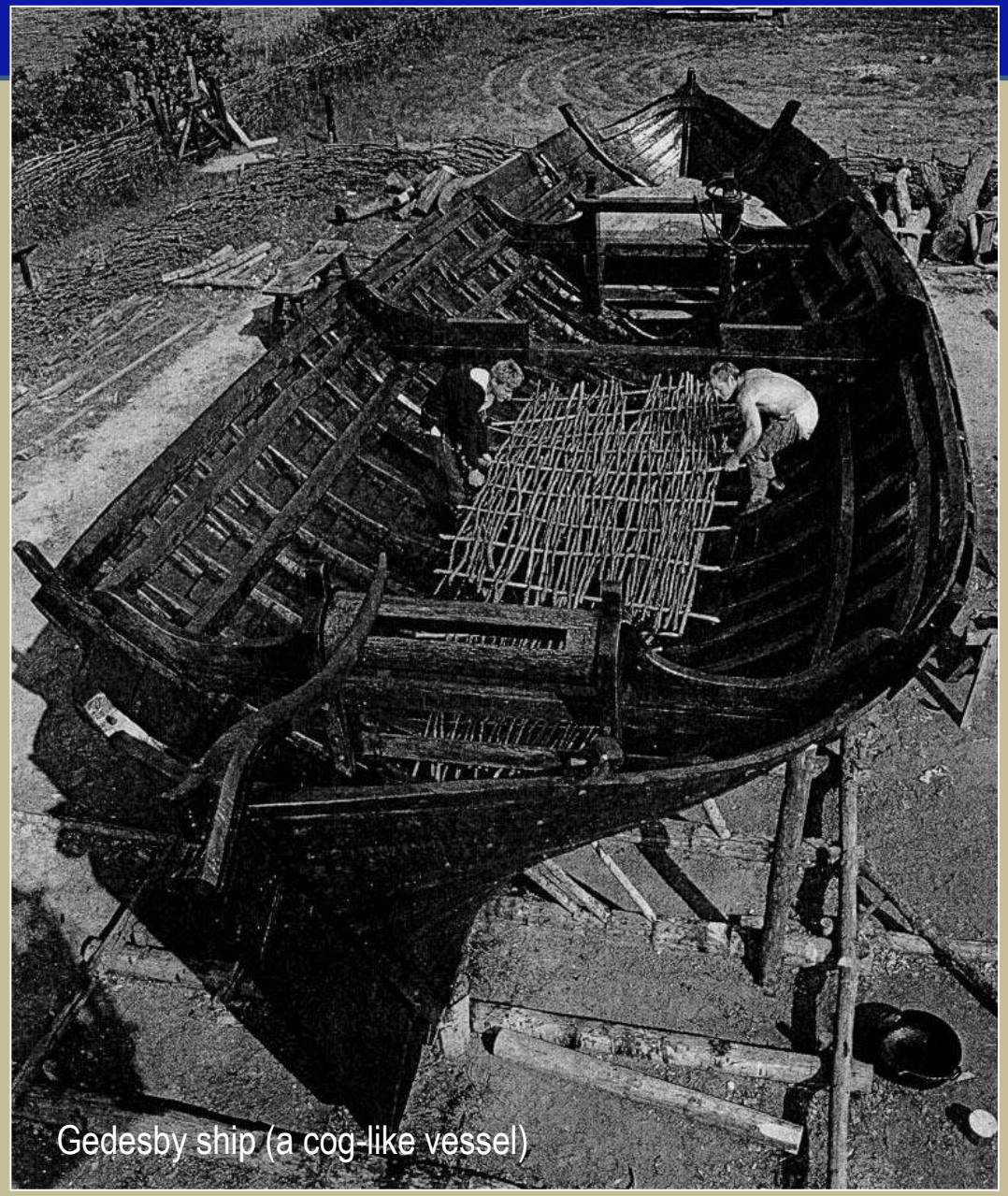
“Celtic” Tradition

Cogs dominated seafaring in the Baltic and the North Sea until the early 15th century. Transition to hulks in the 15th century may have been slow: sometimes ships were called cogs in one port and *hulks* or *bardzes* in the next.

Functions

Cogs were mostly used in the transport of bulk goods such as grain, timber, and salt.

Other types of vessels display cog-like features, such as straight posts or heavy knees, but are built according to the Nordic tradition.


Gedesby ship (a cog-like vessel)

"Celtic" Tradition

The earliest cogs were smaller than their clinker equivalent cargo ships. Archaeological remains of a cog were found at Kollerup. The Kollerup cog (built with trees felled in the Winter of 1150).

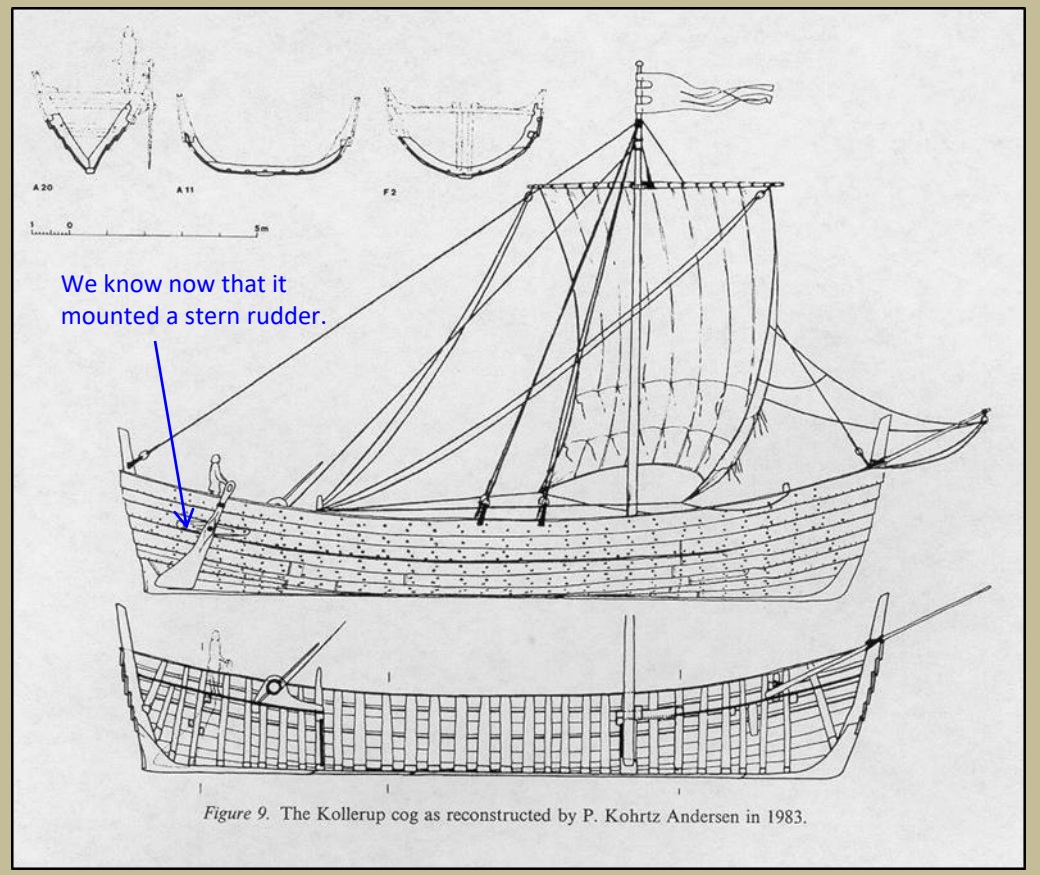


Figure 9. The Kollerup cog as reconstructed by P. Kohrtz Andersen in 1983.

The Kolding (built with trees felled in the Winter of 1189).

"Celtic" Tradition

It seems that by the 14th century cogs were much larger, and became the ubiquitous working horse of the Hanseatic League.

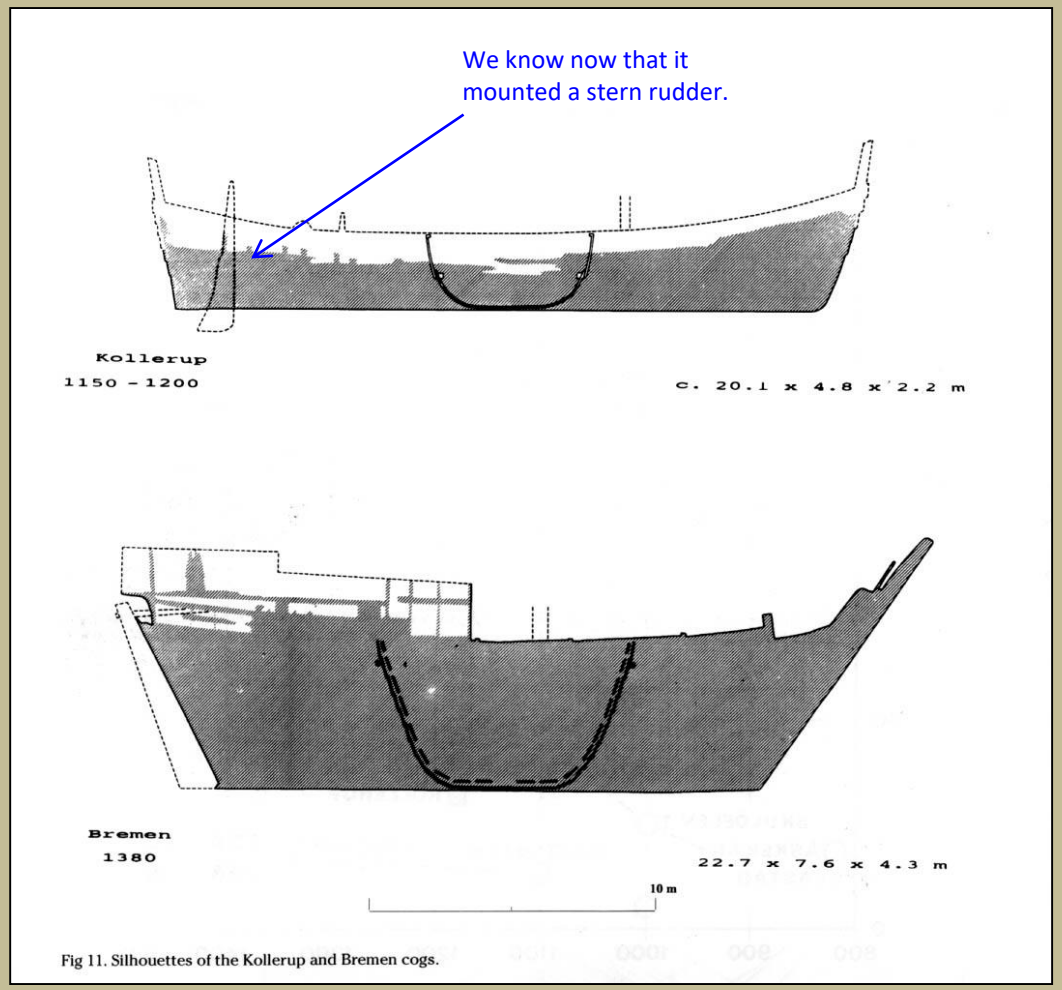
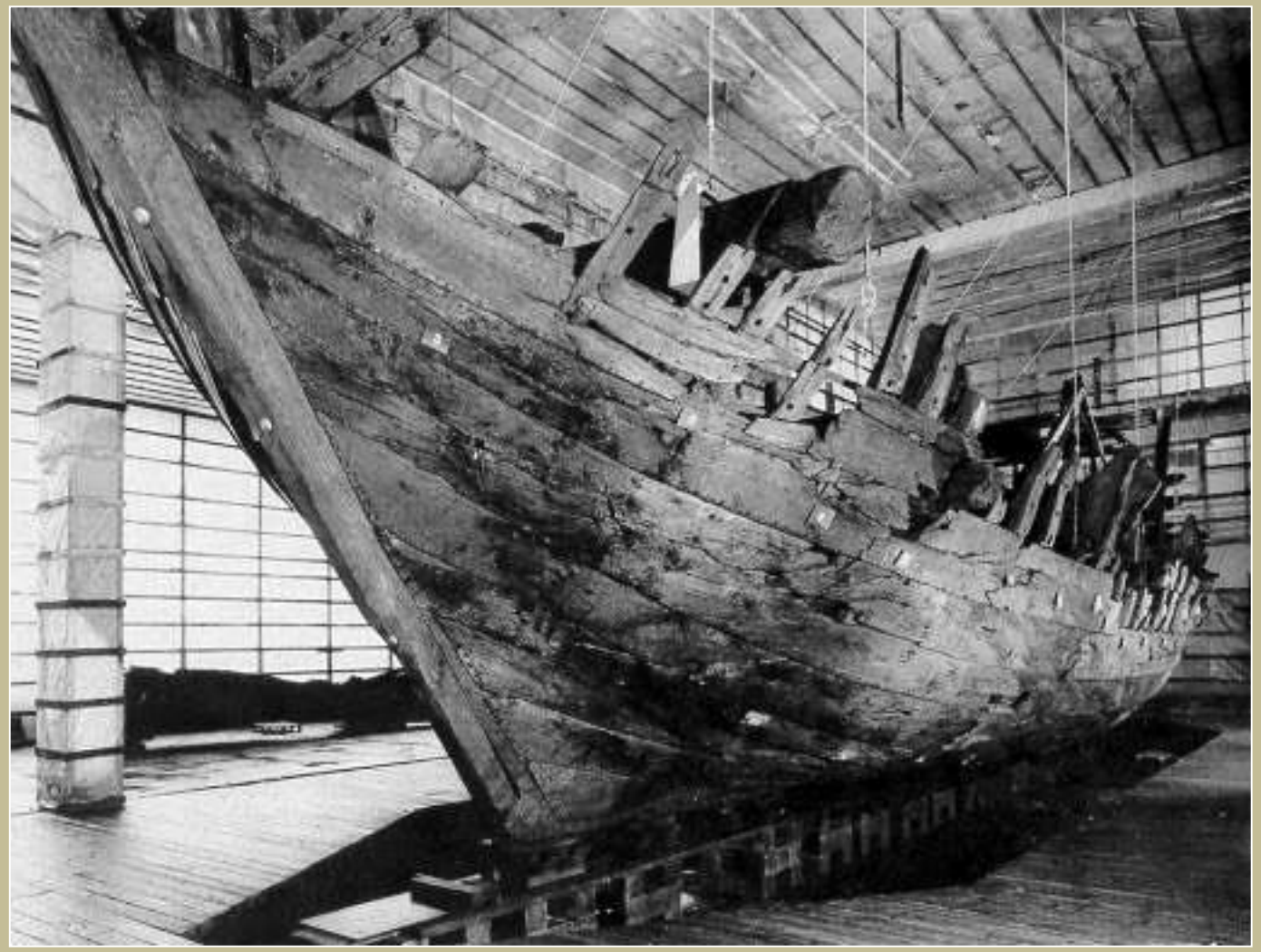


Fig 11. Silhouettes of the Kollerup and Bremen cogs.

“Celtic” Tradition

Cog-built ships gradually grew in size, from the second half of the 13th century onwards.



“Celtic” Tradition

Cogs evolved from the low and narrow river vessels with flush laid bottoms, perhaps inspired on the clinker Scandinavian cargo vessels.

Ole Crumlin-Pederson

“Celtic” Tradition

Cog built ships were built in a simple and rough manner, and did not require the same high quality of timber (and craftsmanship) of the clinker cargo vessels.

“Celtic” Tradition

It was possible to use sawn planks for cog built ships from the 14th century onwards.

“Celtic” Tradition

Scandinavian ships required special, odd-shaped, timbers for the frames and large high-quality logs that could be split for planks.

“Celtic” Tradition

Population growth from the 11th century onwards created a tendency towards scarcity of high quality tress. This led to the recycling of timbers (Skuldelev 5 and Fotevik 1 ships, for example).

“Celtic” Tradition

In the 13th and 14th centuries, the growth of harbor cities boosted the development of maritime commerce and cogs seem to have been the working horses of this trade.

"Celtic" Tradition

According to Ole Crumlin-Pederson:

1. Flat keel with large transition pieces (hooks);
2. Straight stem and sternposts;
3. Flat external floor of flush-laid planking gradually shifting to overlapped planks;
4. Sharp fore and aft sections of the underwater body;
5. Floor timbers covering the bottom and part of the side, alternating between port and starboard;
6. Hooked nails with chisel-like tips;
7. Caulking: moss forced into the seams, thin laths over the seams, and sintels or small nails;
8. Strong through beams;
9. Large vertical knees on top of the beams.

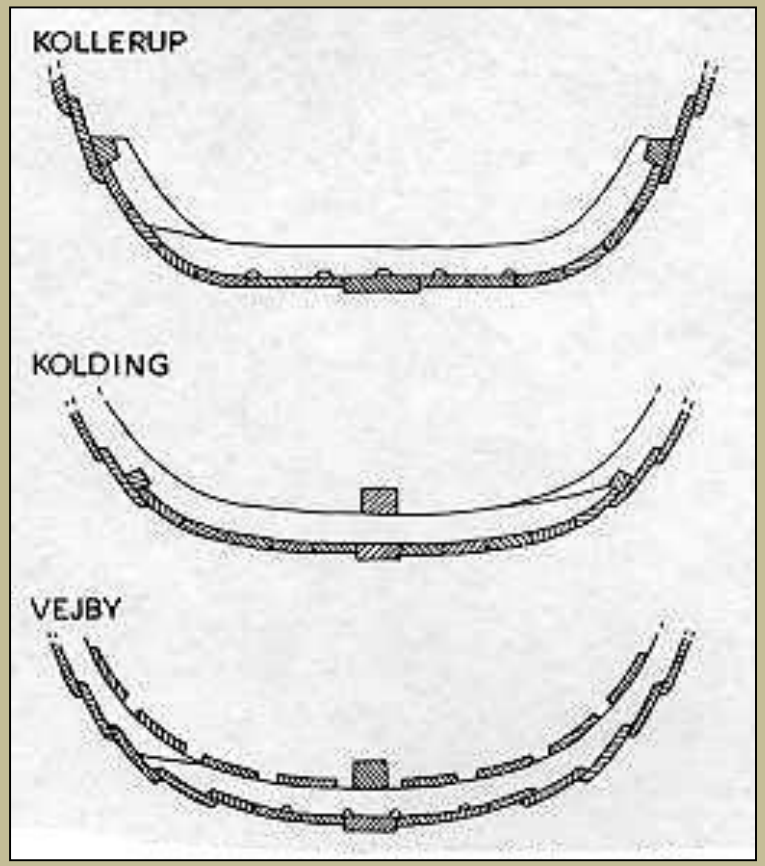
“Celtic” Tradition

According to Fred Hocker:

1. Plank keel (generally less than twice the thickness of the adjacent garboards);
2. Straight stem and sternpost connected to the keel plank by hooks;
3. Bottom planking flush-laid in the middle of the hull, but overlapped near the ends;
4. Full overlapping planking on the sides;
5. Lapstrake planking fastened by double clenched iron nails;
6. Lower plank hooding ending seated in rabbets in the hooks and posts, and upper hooding ending scabbed or nailed to the exterior faces at the posts;
7. Caulking in the plank seams with tarred moss covered with light wooden laths and held in place by sintels;
8. Rudder on the sternpost.

What varies:

1. Dimensions:
   Bremen cog - 20 m; 80 tons;
   NZ43 IJsselmeer - 11.8 m; 9 tons.
2. Shape:
   Bremen cog - flat bottom;
   NZ43 IJsselmeer - round bottom.
3. Through beams are not universal;
4. Mast-step arrangements almost as numerous as cogs found;
5. The number of flush-laid timbers decrease over the centuries;
6. False posts are added in the late cog-like vessels.



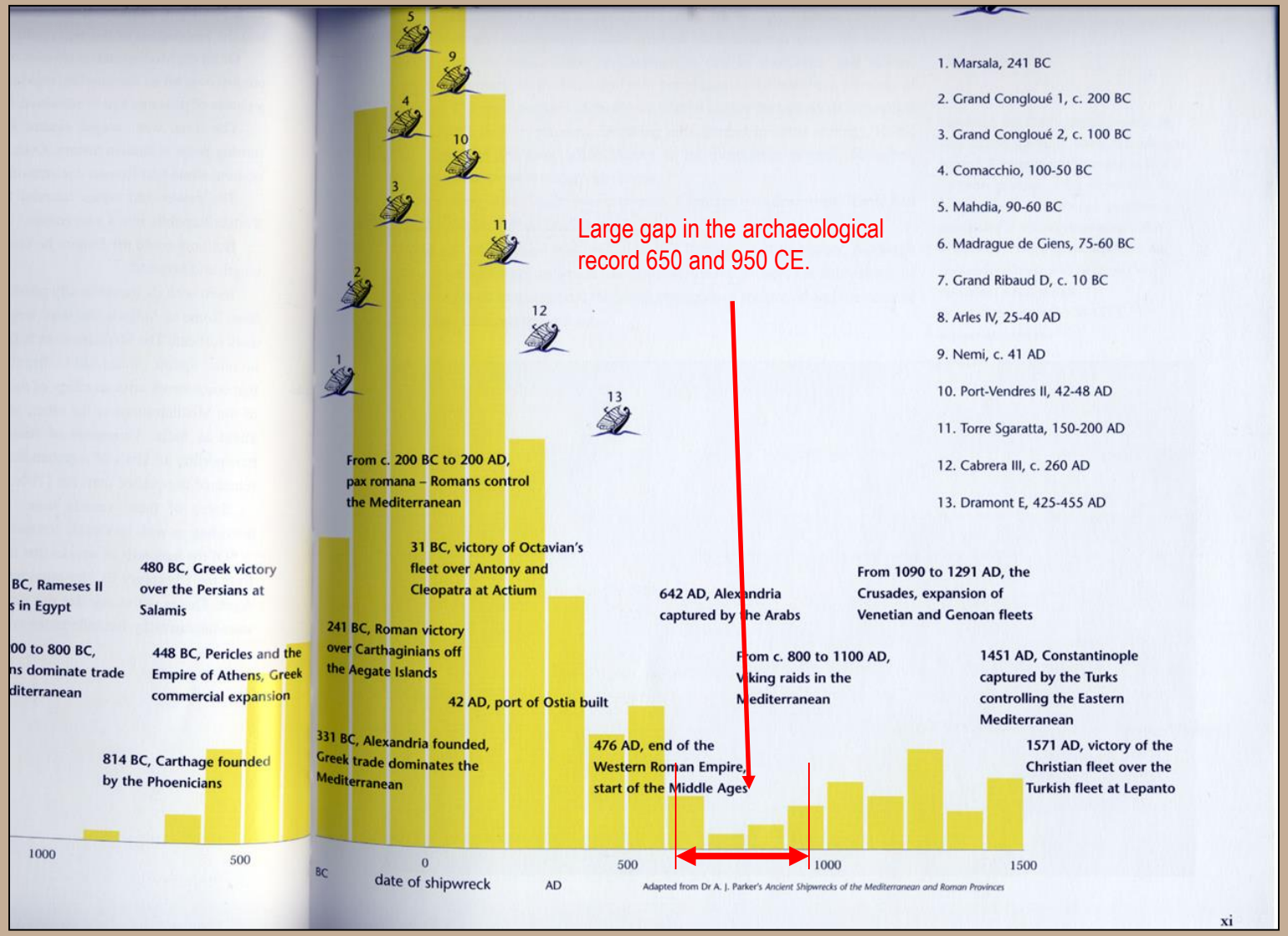
"Celtic" Tradition

No.	Date Constructed/lost	Dendro	Site	Country	Origin	Size Keel length	Year Found/excavated
1	1150/	x	Kollerup	DK	S Jutland	18·6 m	1978/78
2	1200/	x	Skagen	DK	W Denmark	*c.* 15 m?	1962/
3	*c.* 1250		Kolding	DK		*c.* 16 m	1943/
4	1242/*c.* 1272	x	Bossholmen	S	W Baltic	12·5 m	1985–88
5	1275–1300		Flevol. OZ43	NL		13·2 m	1981/
6	1275–1300		NOP A57 Rutten	NL		15·9 m	1985
7	*c.* 1300		Flevol. NZ 43	NL		9·0 m	1979
8	1300–25		NOP Q75	NL		8·5 m	1949
9	1330/	x	Helgeandsholm 2	S		*c.* 14 m?	1978
10	1325–50		Flevol. N5	NL		12·5 m	1976
11	1336/*c.* 1375	x	Flevol. OZ36	NL	Holland	11·0 m	1983
12	1360	x	Ll. Kregme	DK	SE Baltic	*c.* 14 m?	1986/
13	1372/*c.* 1375	x	Vejby	DK	SE Baltic	*c.* 12 m?	1976/77
14	1380/1380	x	Bremen	D	Bremen	15·6 m	1962–65
15	1350–1400		Flevol. NZ42	NL		13·5 m	1979
16	1375–1400		NOP M107	NL		12·6 m	1944
17	1396	x	Skanör	S	W Baltic	18·7+ m	1993/
18	1410/1430		Flevol. Almere	NL		12·7 m	1986

“Celtic” Tradition

Frisian sea captains accounted for the overwhelming majority of the ships plowing the Baltic commercial routes (eg. beer or salted fish), and this may have been a good asset when the Dutch Republic developed as a political player, in the late 16th century.

Mediterranean World



Transition from shell to frame-based construction

The centuries 650-950 CE are precisely the period during which the edge-joined, mortise-and-tenon hulls were replaced by frame-first ships.

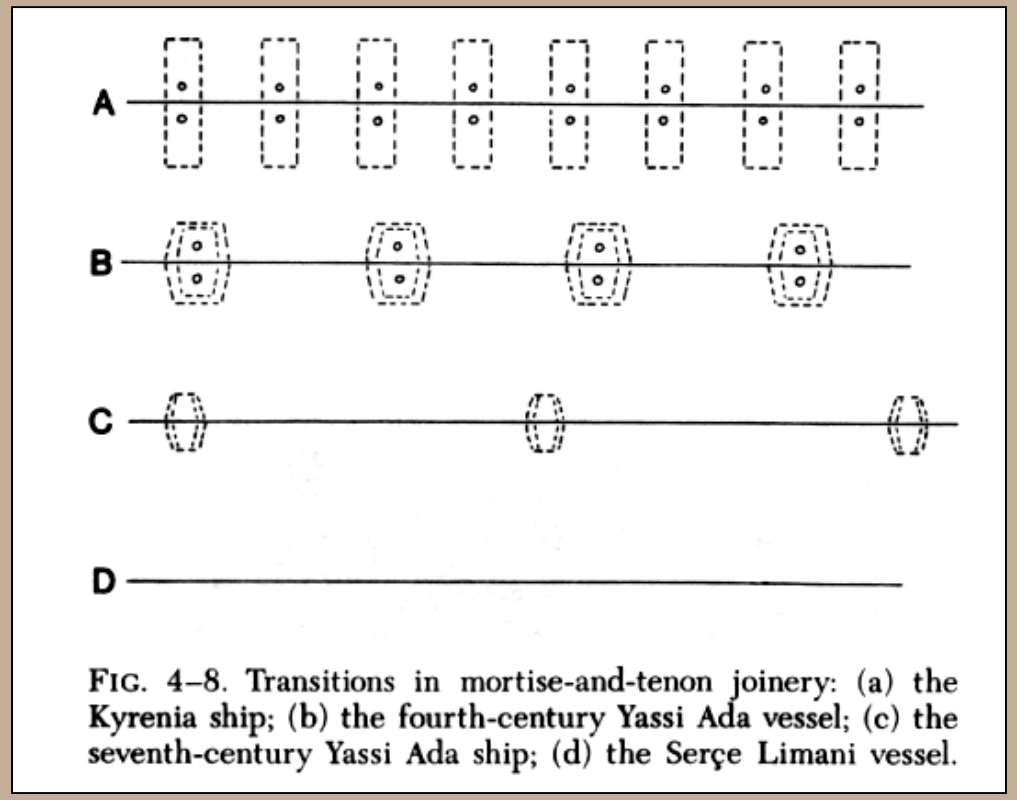


FIG. 4–8. Transitions in mortise-and-tenon joinery: (a) the Kyrenia ship; (b) the fourth-century Yassi Ada vessel; (c) the seventh-century Yassi Ada ship; (d) the Serçe Limani vessel.

Kyrenia

Yassiada 4th century

Yassiada 7th century

Serçe Limanı

…and the period during which amphorae were replaced by barrels.
(Barrels were much more expensive and required much skilled labor to make, but were much lighter: in a shipment of wine amphorae the wine was about 60% of the weight; in barrels the same shipment could have 90% of its weight in wine).

The evidence we have comes from a small number of shipwrecks and a small number of written sources.

For instance, the use of a frame-based type of construction is suggested in a 7th century manuscript, the *Aphrodito papyri*, which mentioned the purchase of large quantities of iron nails for the Cairo shipyards.

Mediterranean World

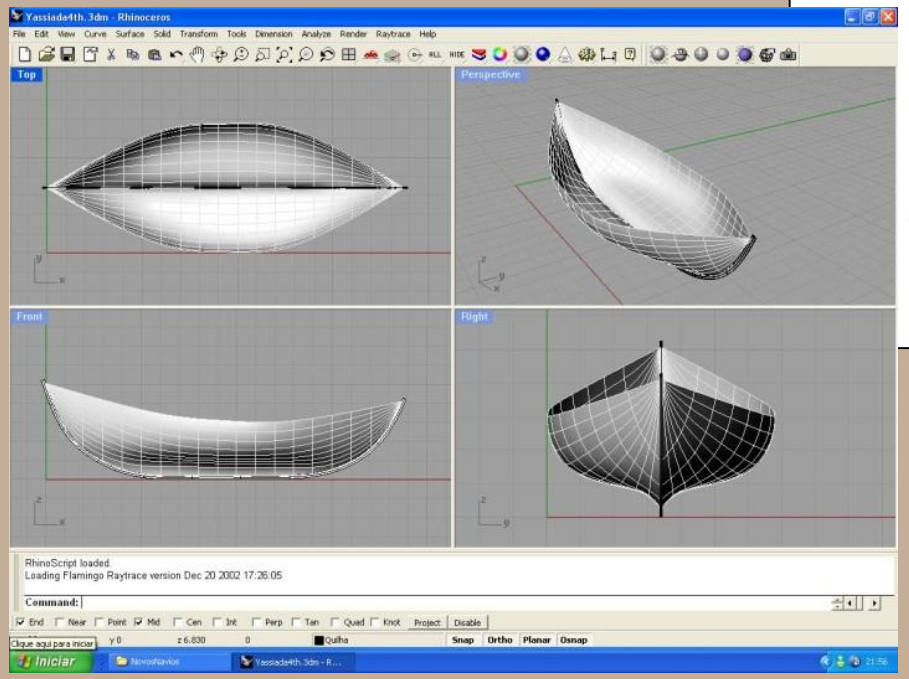
The evidence we have comes from a small number of shipwrecks and a small body of documents. Four shipwrecks have yielded the main evidence that lead to the theory about the transition from shell to frame-based construction we teach today:

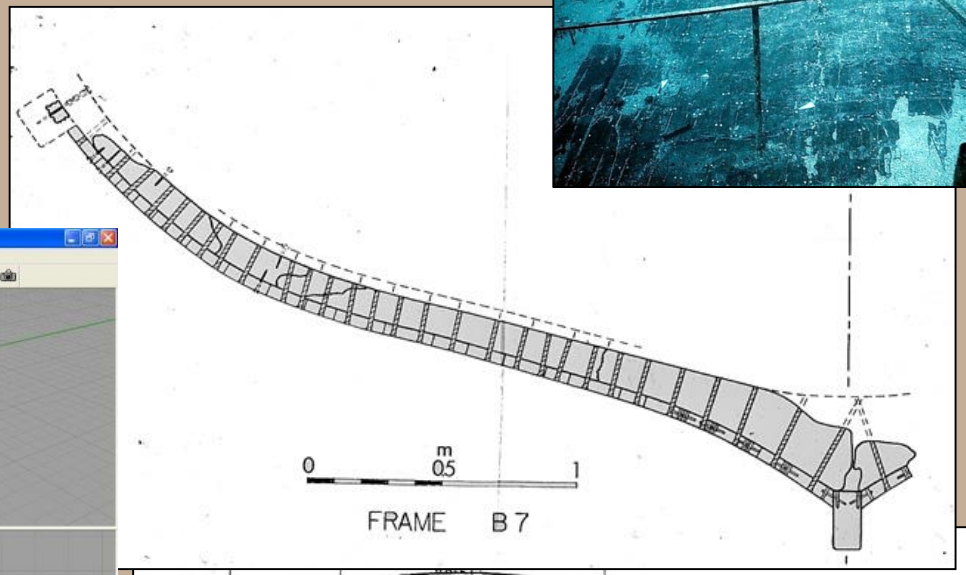
1. Yassiada II (4th Century)
2. Yassiada I (7th Century)
3. Bozburun (9th Century)
4. Serçe Limanı Ship (11th Century)

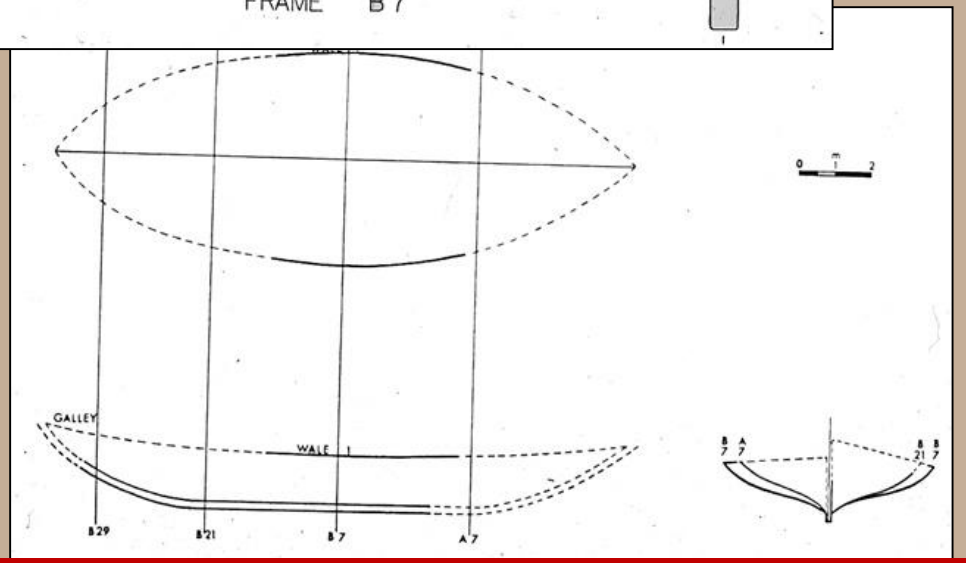
The INA @ A&M is probably the only institution in the world that advocates the full excavation of each shipwreck site, but a growing sample of shipwrecks with similar characteristics is being assessed and published, helping us form an idea of the evolutionary process.

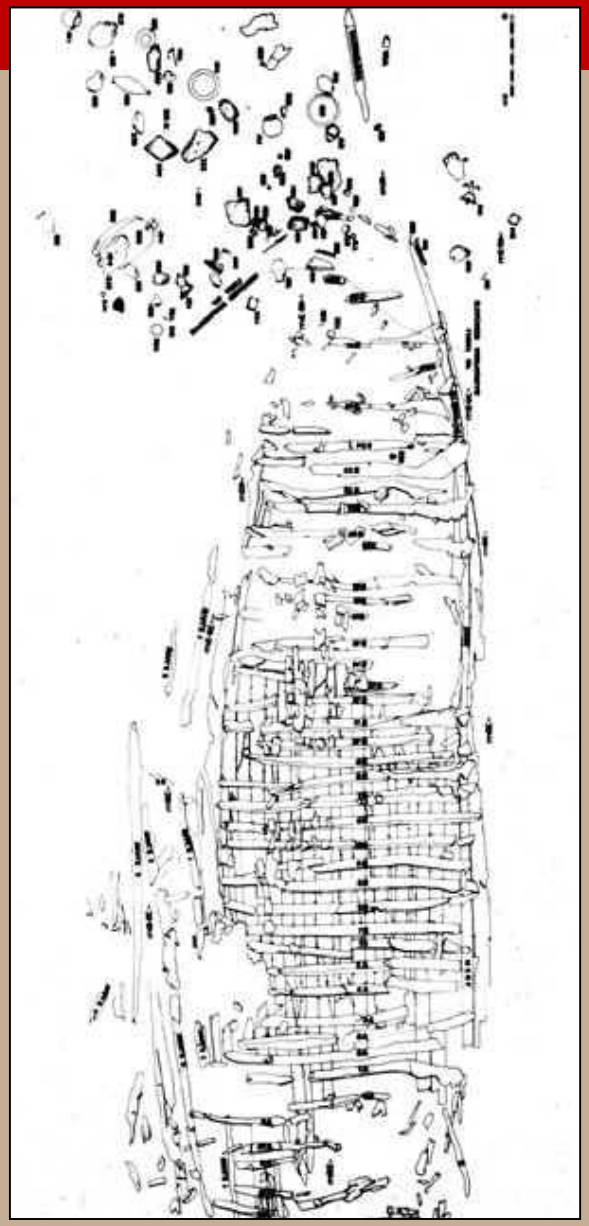
Mediterranean World

1. Yassiada II (4th century):

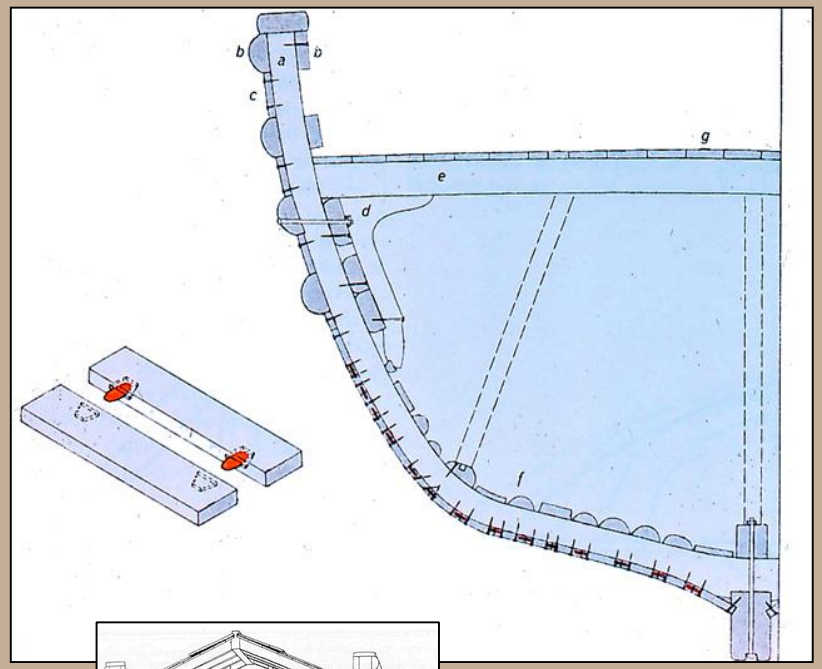


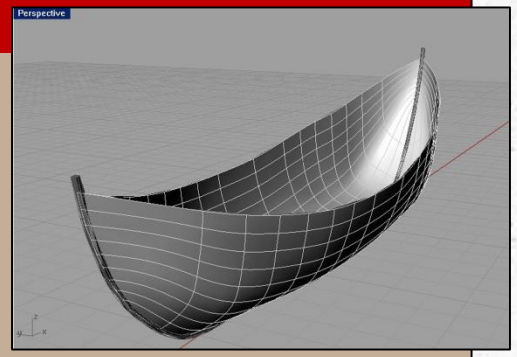


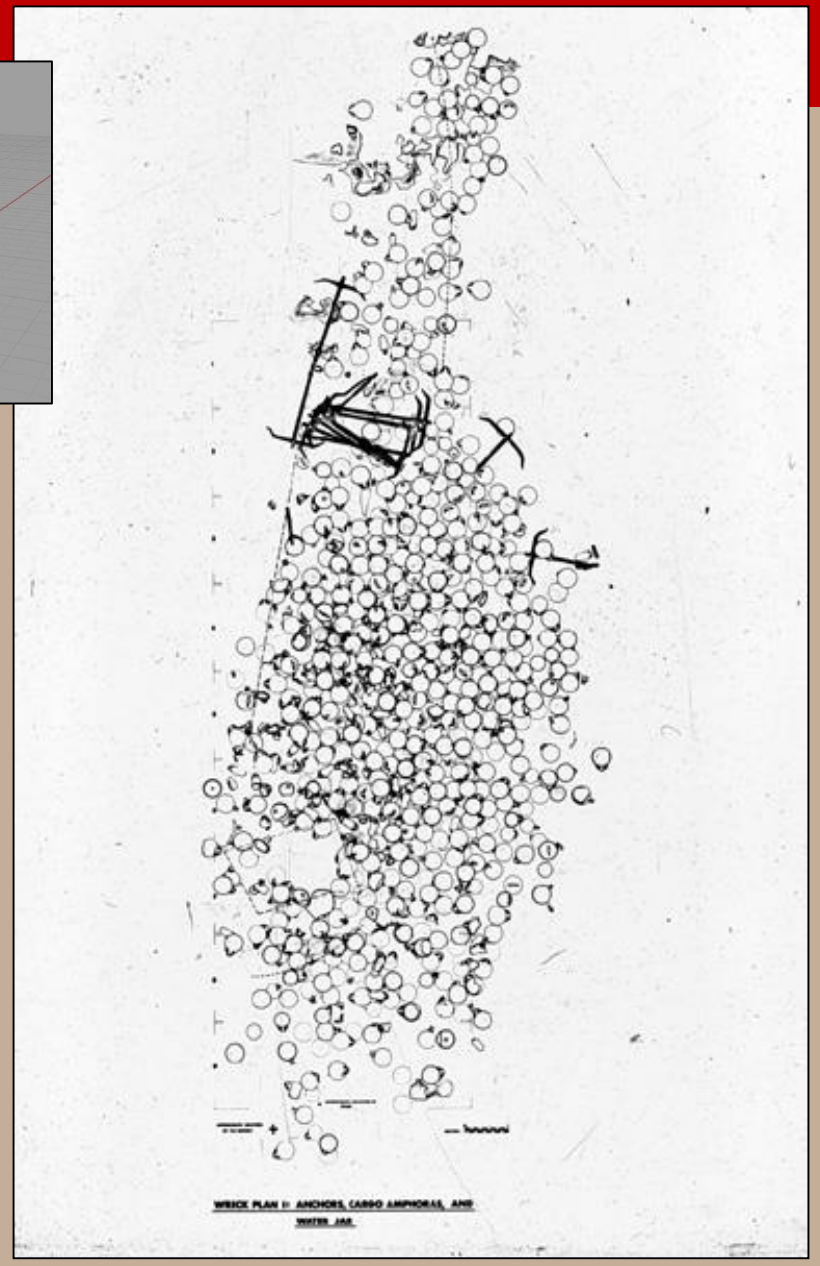


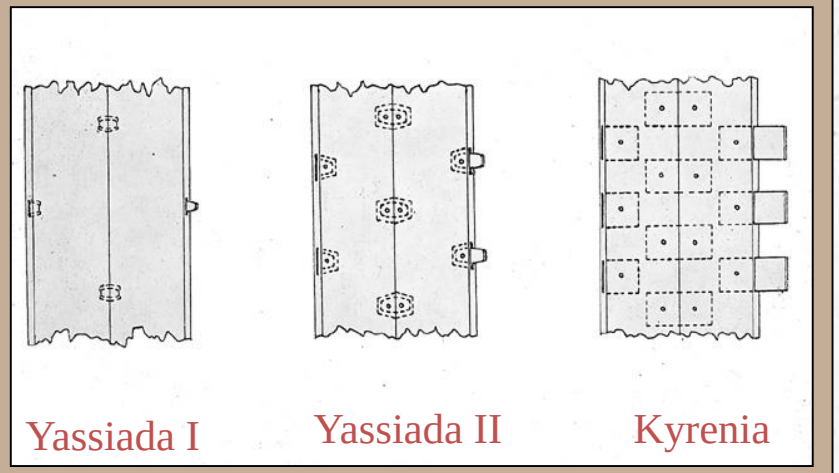


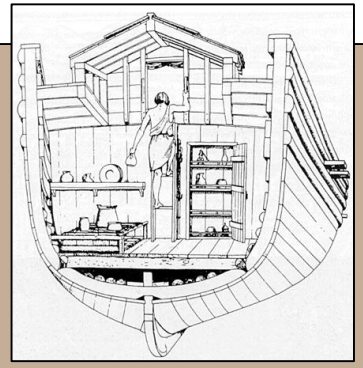
2. Yassiada I (7th century):



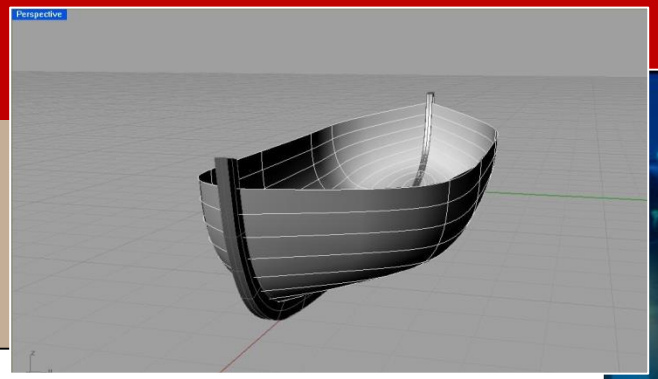


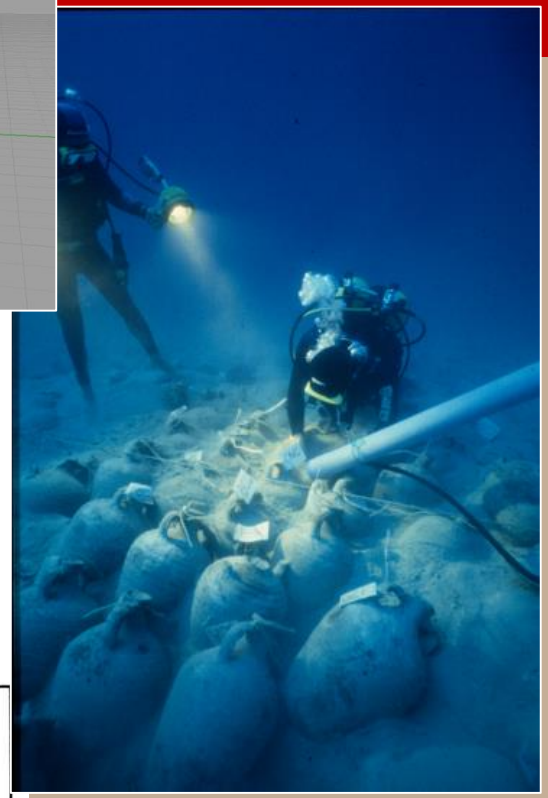


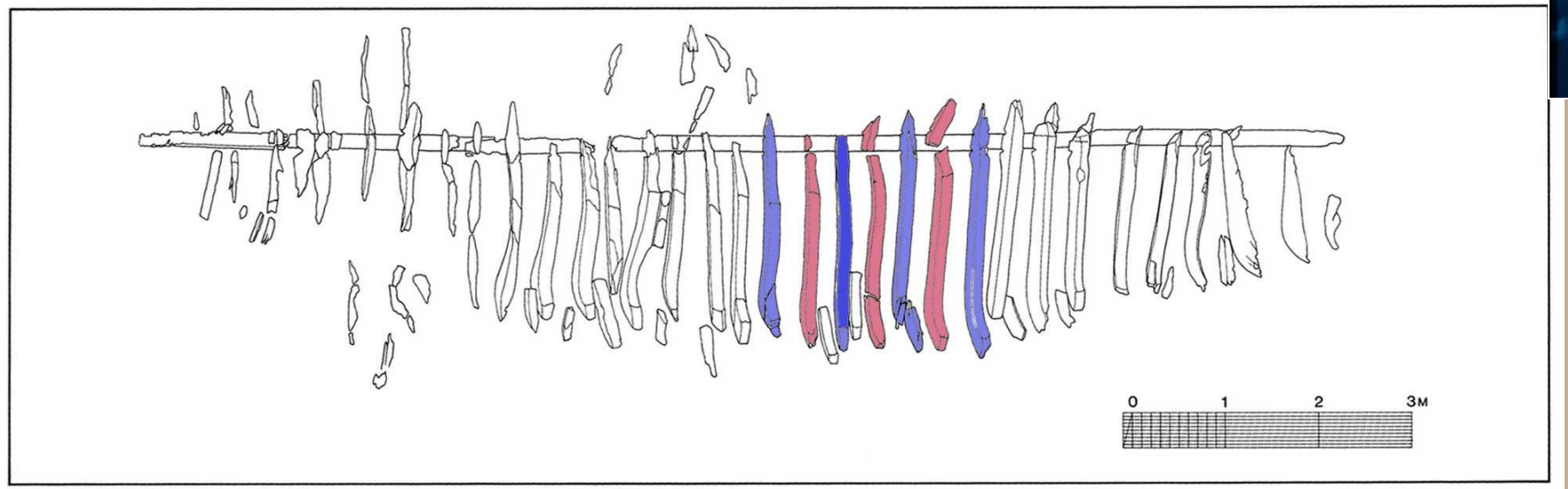




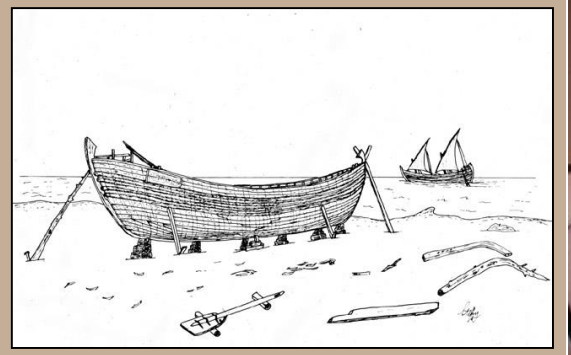
3. Bozburun (9th century):

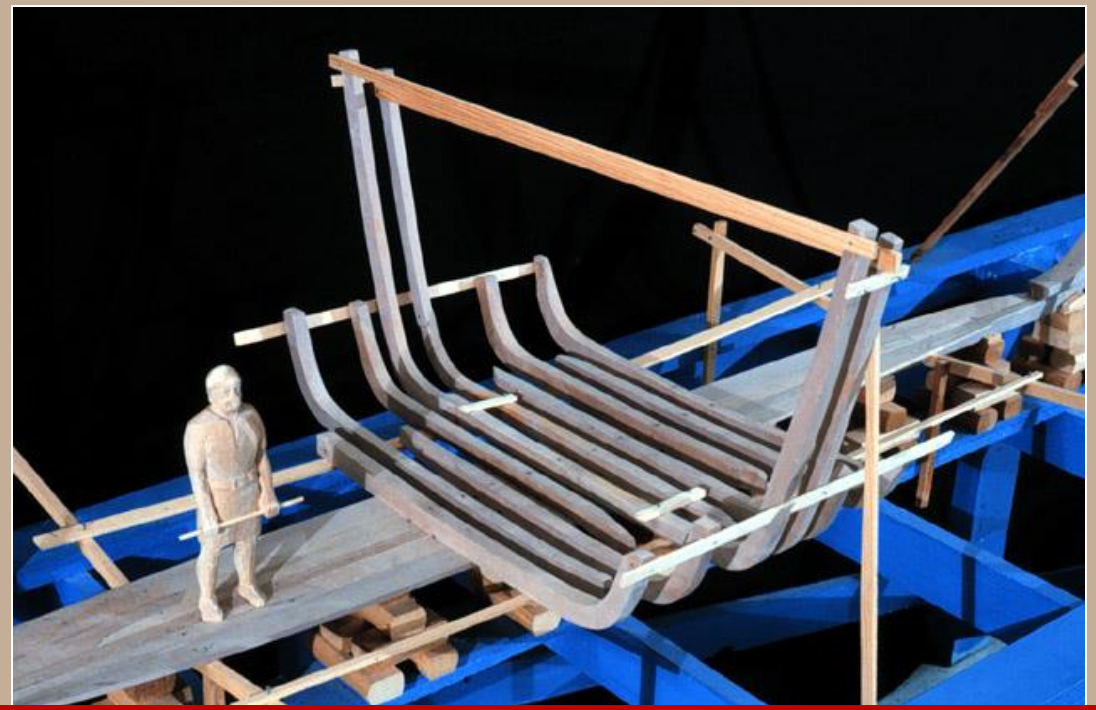


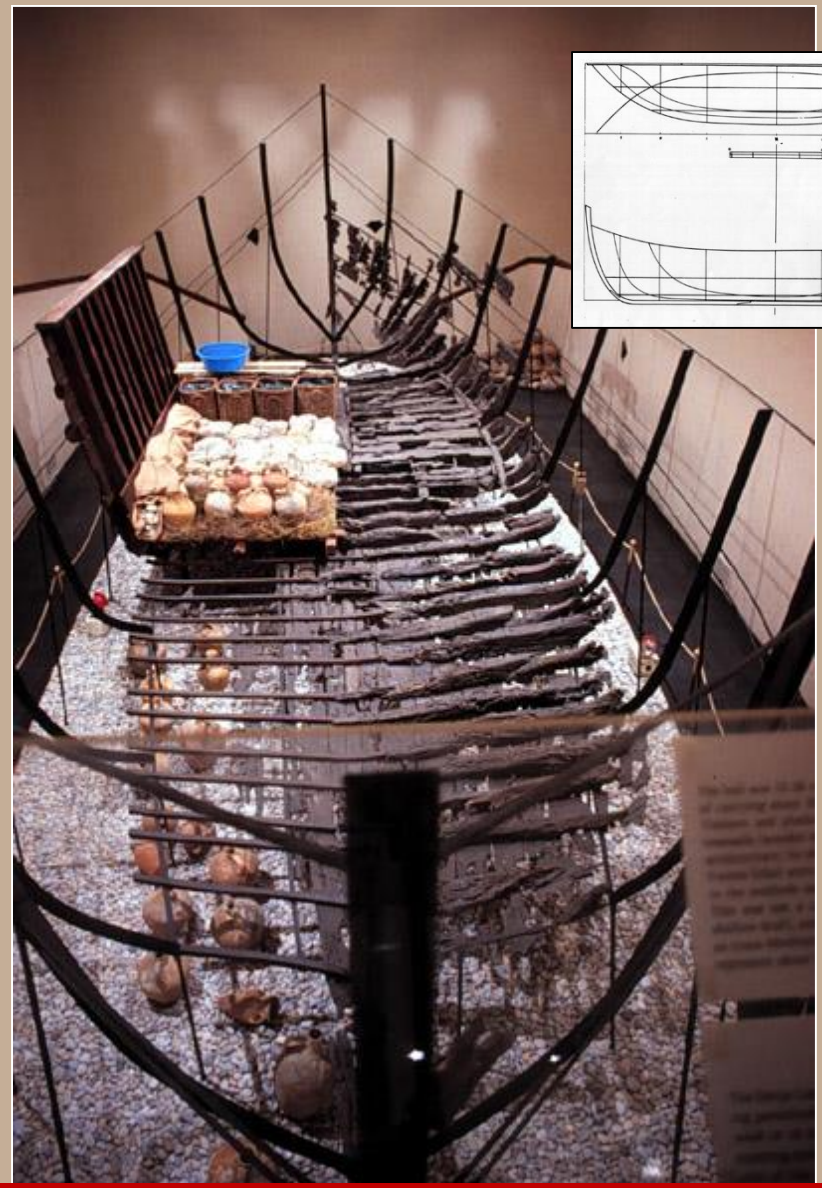


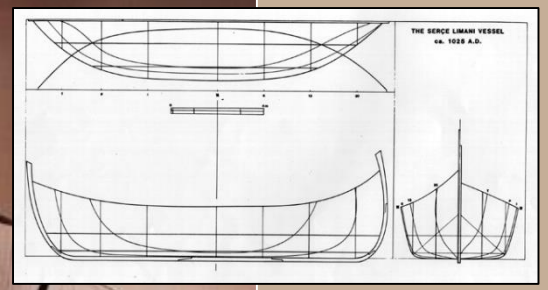


4. Serçe Limanı Ship (11th century):



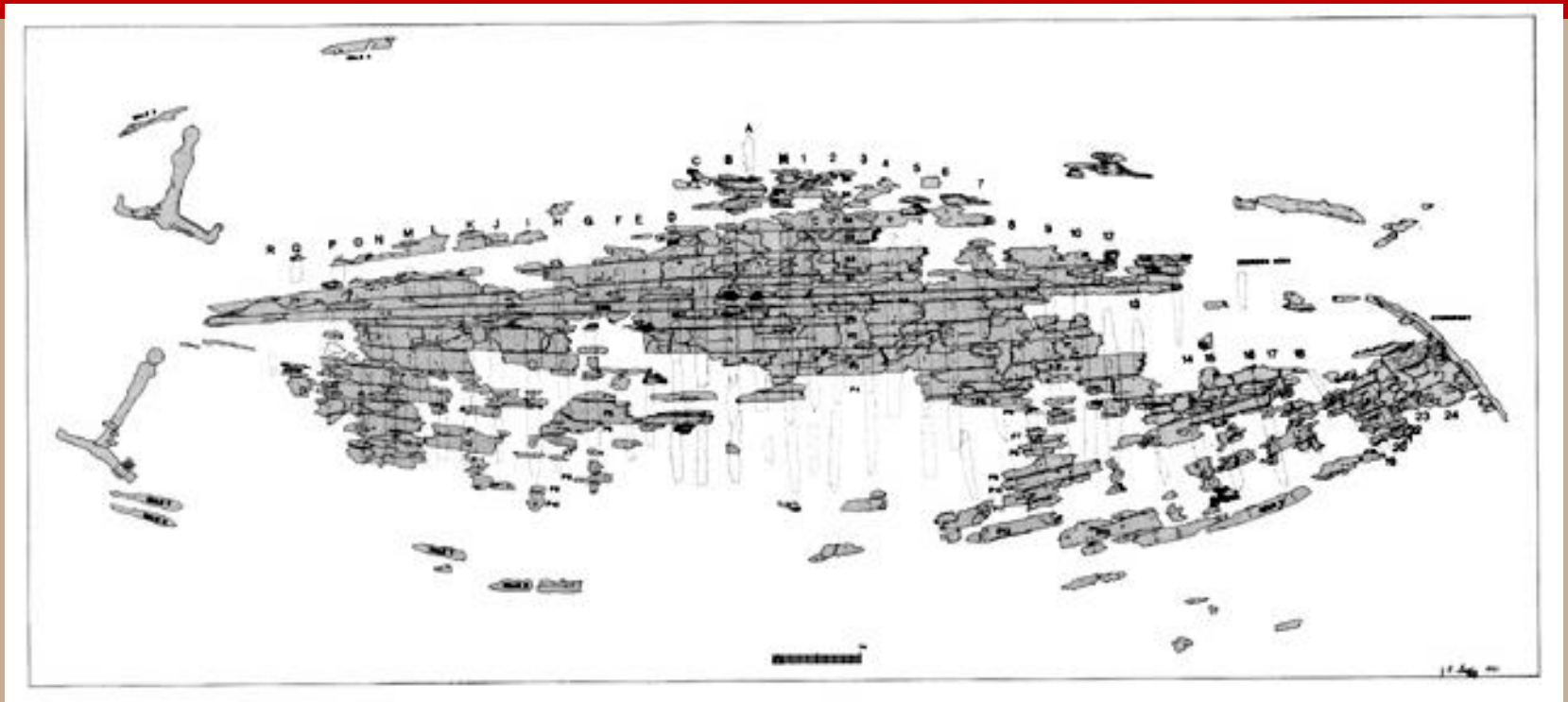






Serçe's Hull Reconstruction

Mediterranean World



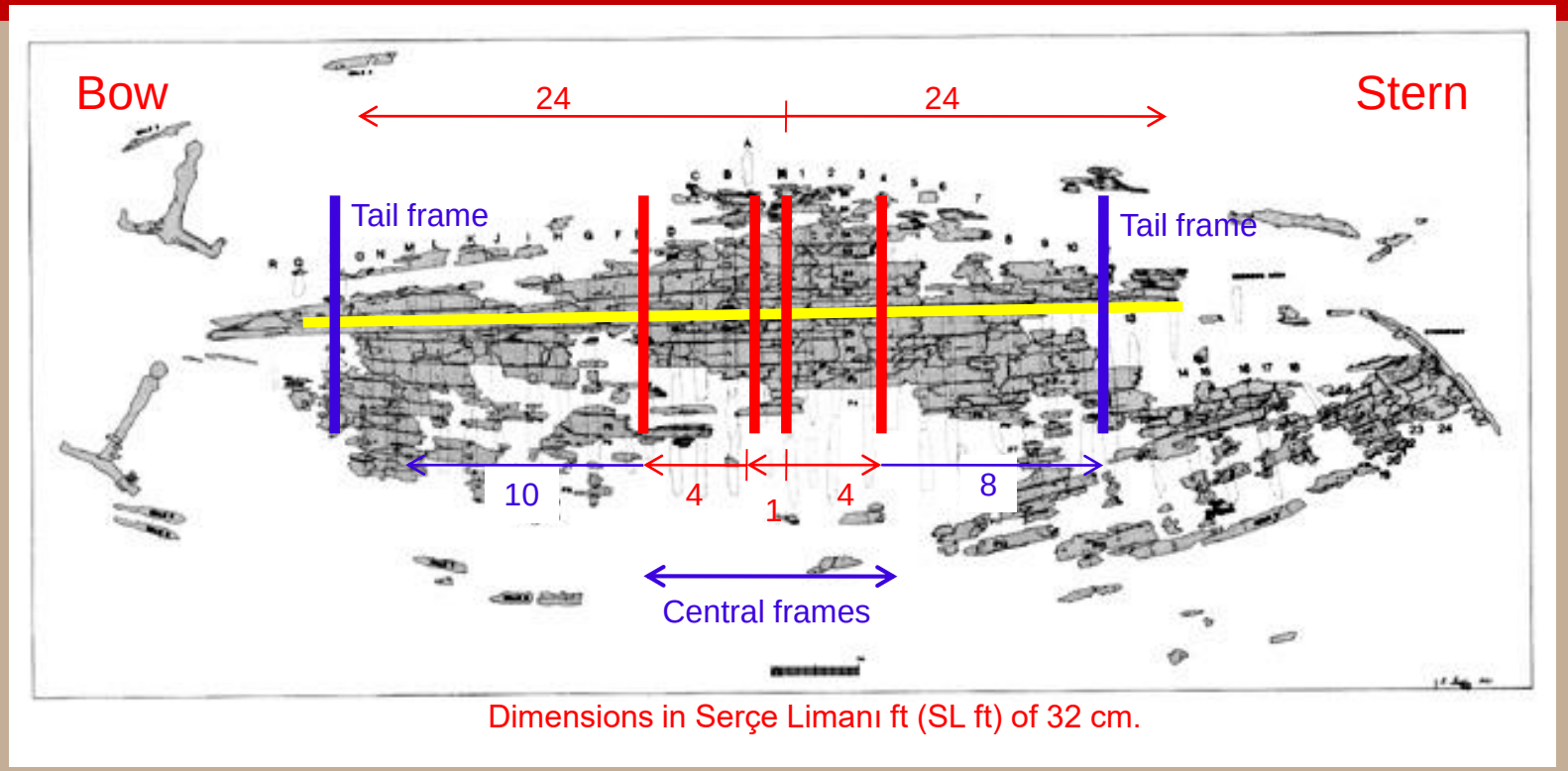
The ship's hull remains were particularly interesting:

Its dimensions were established based on a unit of 15.8 cm, which was rounded to 16 cm. J. Richard Steffy found that the planking was 4 cm thick (1/4) and the keel was a multiple of 64 cm (4 x). He called this unit 'quart'.

This means that it was not built by eye!

Furthermore, 15.8 x 2 = 31.60 cm, a value very close to the Byzantine foot (31.23 cm).

Mediterranean World



Dimensions in Serçe Limanı ft (SL ft) of 32 cm.

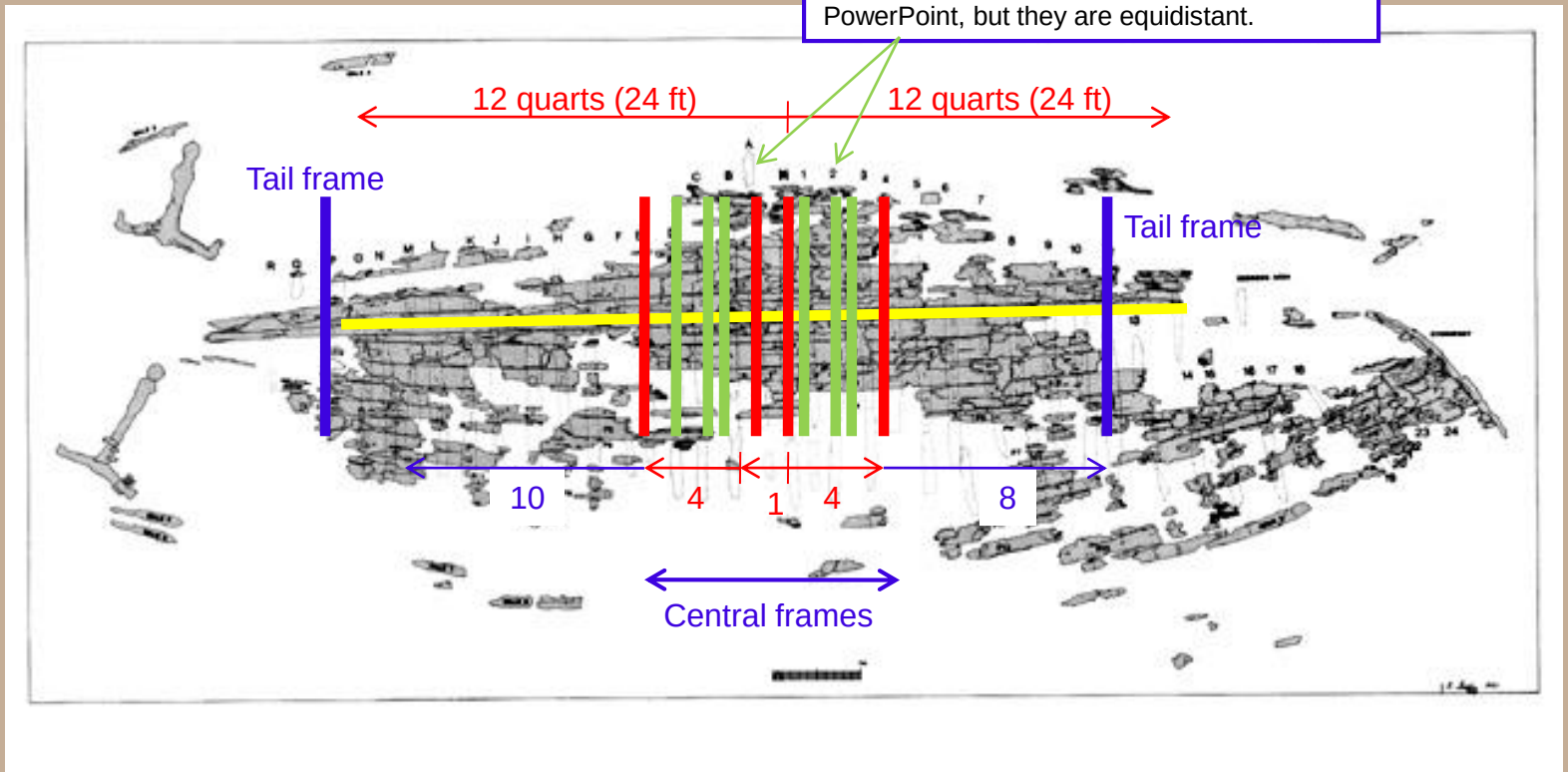
Be it as it may, a value of 32 cm was adopted in the study and reconstruction of this hull. It was called the Serçe Limanı foot. The keel was exactly 48 SL ft long. The master frame was placed exactly on the middle of the keel.

One similar frame (A) was placed 1 quart forward of the master frame; Two floor timbers, slightly raised and narrowed, were placed 4 quarts before and abaft the two master frames (E and 4). Tail frames P and 12 were probably also erected before the planking was laid.

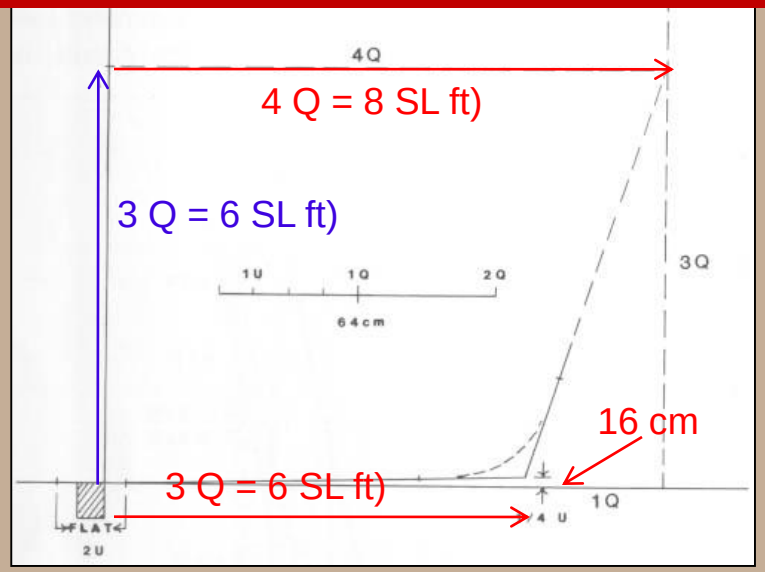
Mediterranean World

The space between frames E and 4 was filled with floor timbers.

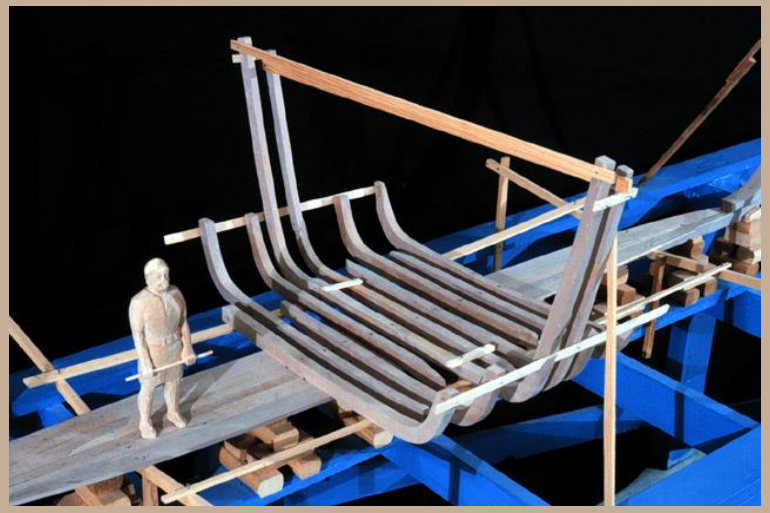
Only then was the ship planked.

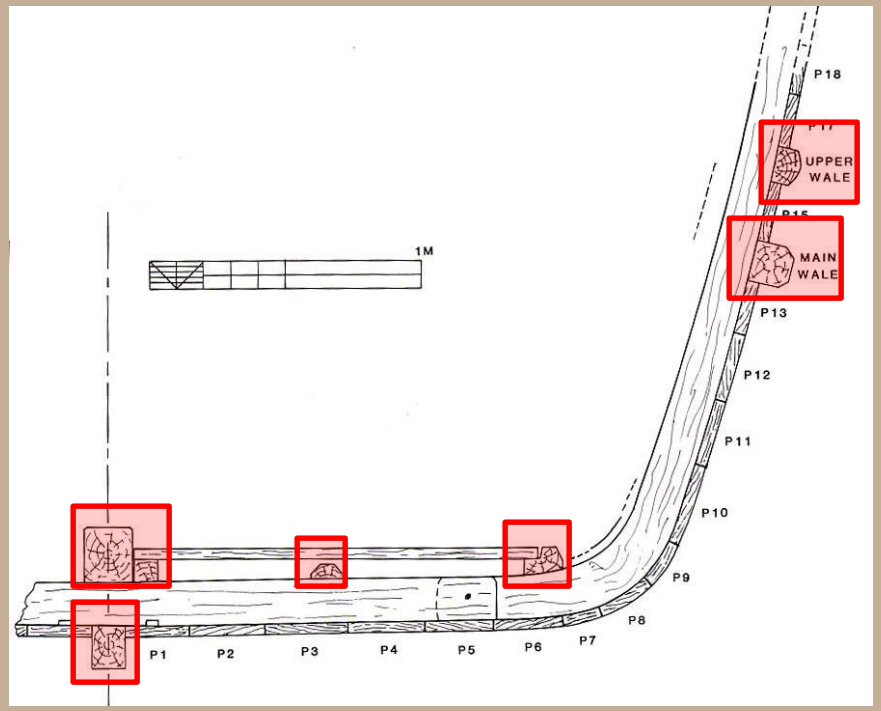


Mediterranean World



The frames' main dimensions were also multiples of the SL foot.

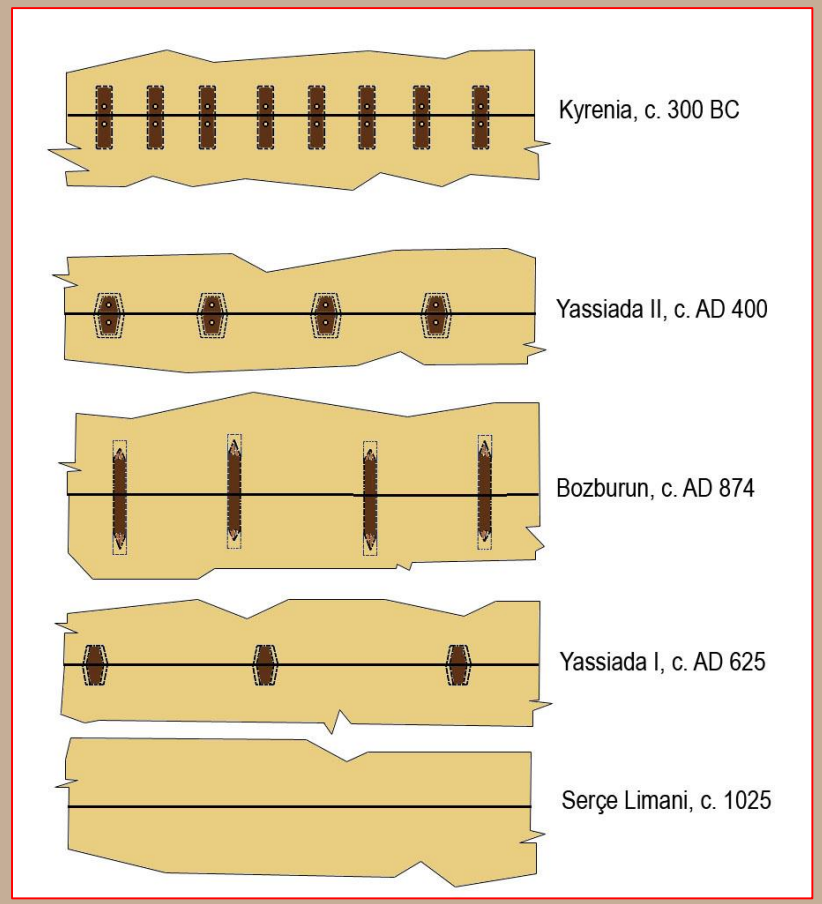




Keel, keelson, stringers and wales conferred the ship all the resistance needed.

Mediterranean World

This evolution from shell to skeleton is not unilineal, and seems to have started in the Middle East, around the 6th century, as a number of shipwrecks found at Tantura Lagoon, today's Israel, seem to suggest:



Tantura A (5th/6th century)

Dor D (6th century)

Dor 2001/01 (6th century)

Anse St. Gervais II Ship (7th century);

Tantura B (9th century);

Tantura F (9th century);

Agay A and B (9th/10th Century);

Bateguier (9th/10th century);

Ile Plane 3 (9th/10th century)…

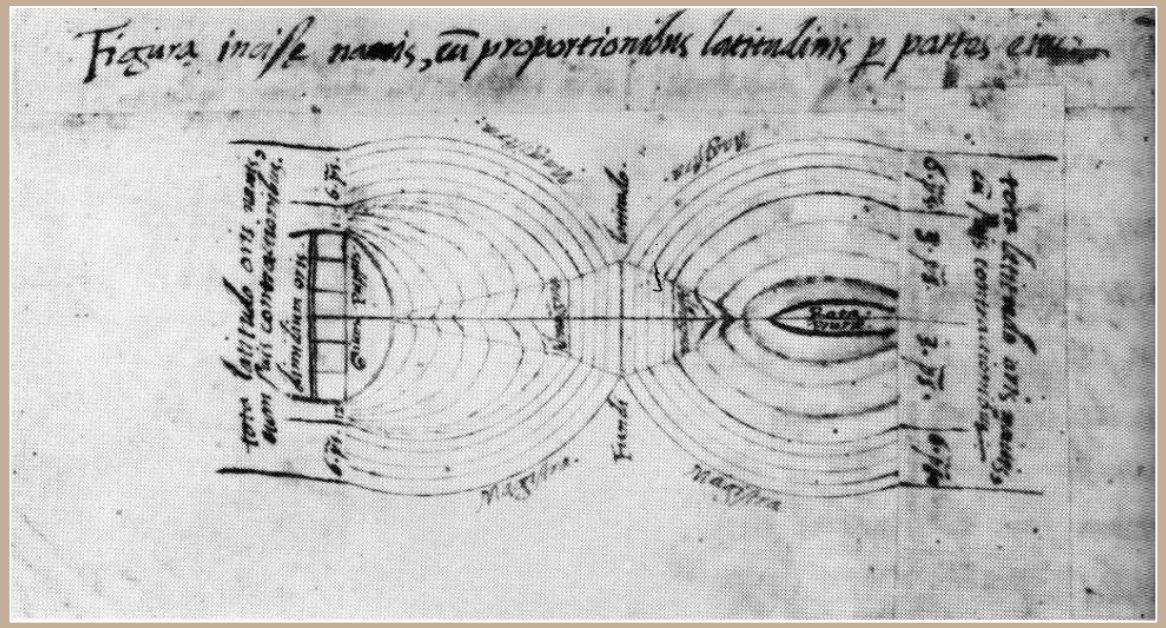
Little is known about Arab shipbuilding.

There is evidence suggesting the use of frame-based vessels in the Arab world since the 8th century:

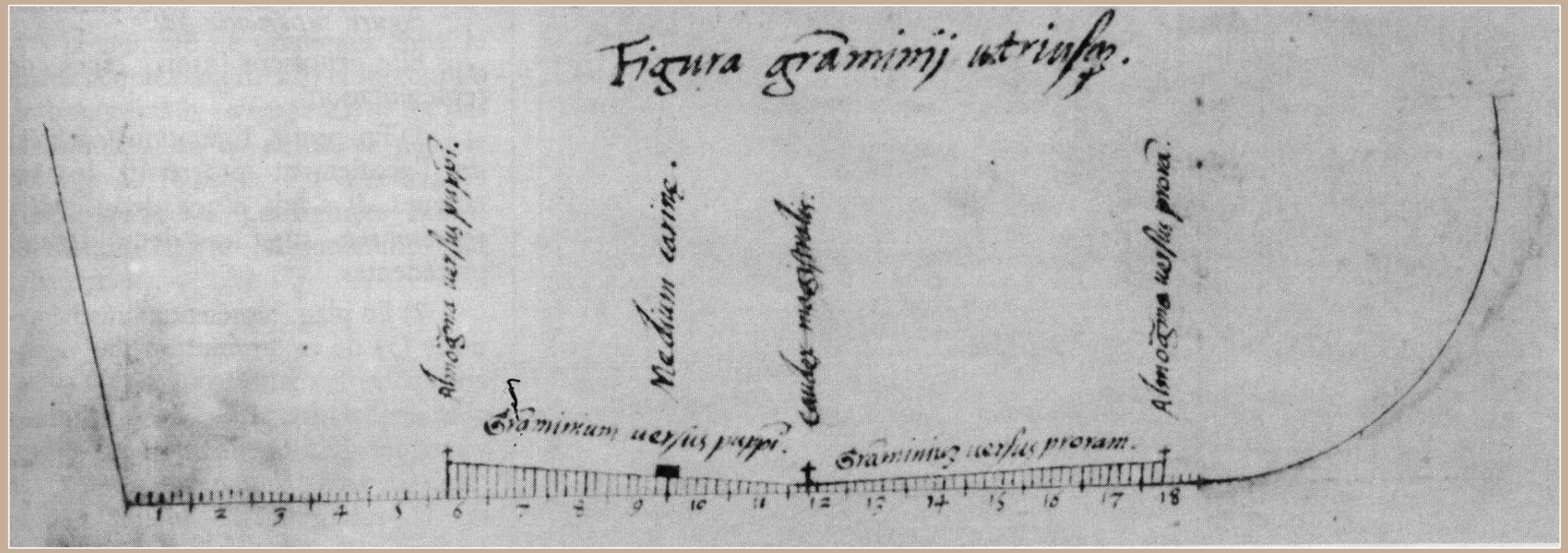
- The author of the *Book of the Animals*, Gahiz (b.776), mentions an Umayyad governor of Iraq named al-Haggag, who died in AD 714, and is reputed to have built the first vessels "nailed and caulked."
- Other Arab references from the 10th century mention the construction of vessels built with planks nailed to the frames as opposed to the Indian Ocean and Red Sea vessels, in which the planks were sown together. [1]

[1] Darmoul, Ali, “Les épaves sarrasines” in M. Galley and L. Ladjini Sebai eds. *L’homme mediterranéan et la mer*, Tunis, 1985 :157-158.

It is regrettable that one of the best Portuguese sources on shipbuilding, Father Fernando Oliveira, did not give any details of his visits to Moroccan shipyards, in spite of finding them worth mentioning in his memoirs. Father Oliveira considered that his visits to North African shipyards in the 1550s increased his expertise and experience, and he certainly did not express any criticism of them in spite of his well-known candor.



It is worth mentioning here that the Portuguese word for tail-frame is *almogama*, the Arab word for "meeting point." We can only suppose that Arab shipbuilding was as good and sophisticated as any other of its time.



In Sum

"By at least the fourth century AD shipwrights began to move toward the frames-first technique (Yassıada 4th century wreck). By 1000 AD the transition had been completed (Serçe Limanı wreck) and from then on frames-first was to be the standard throughout the western world."

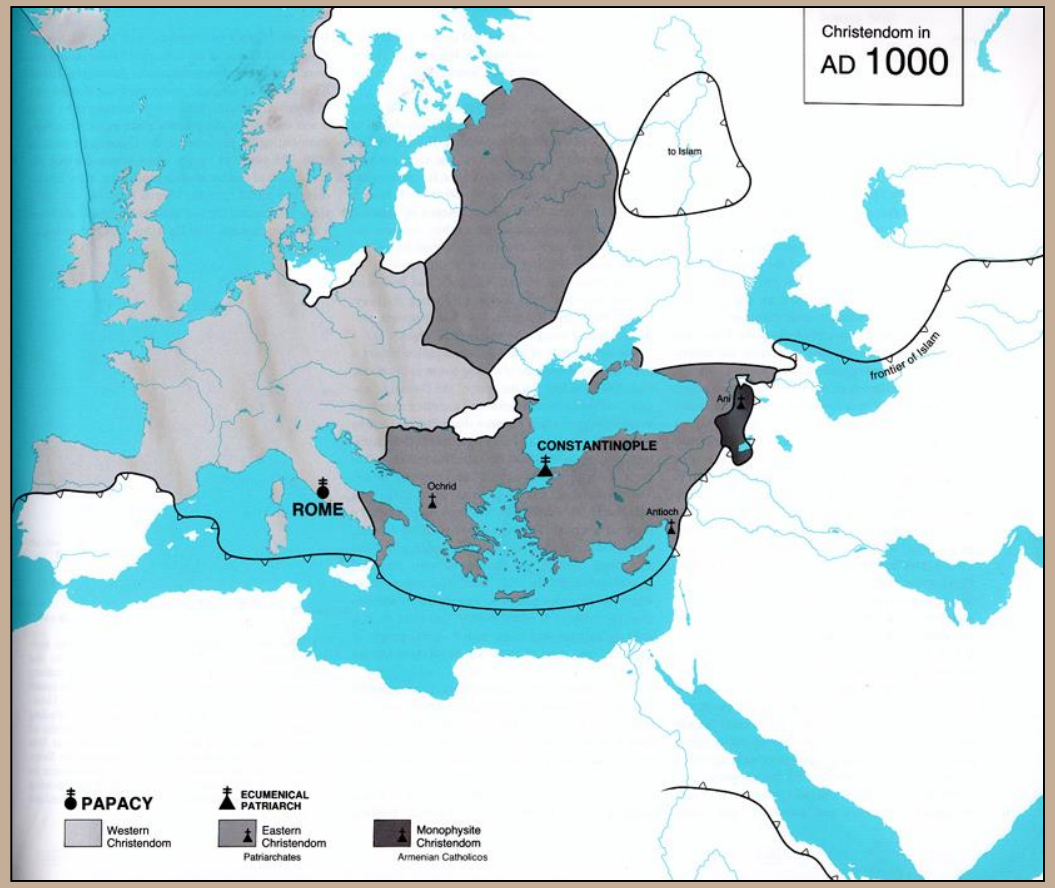
Lionel Casson

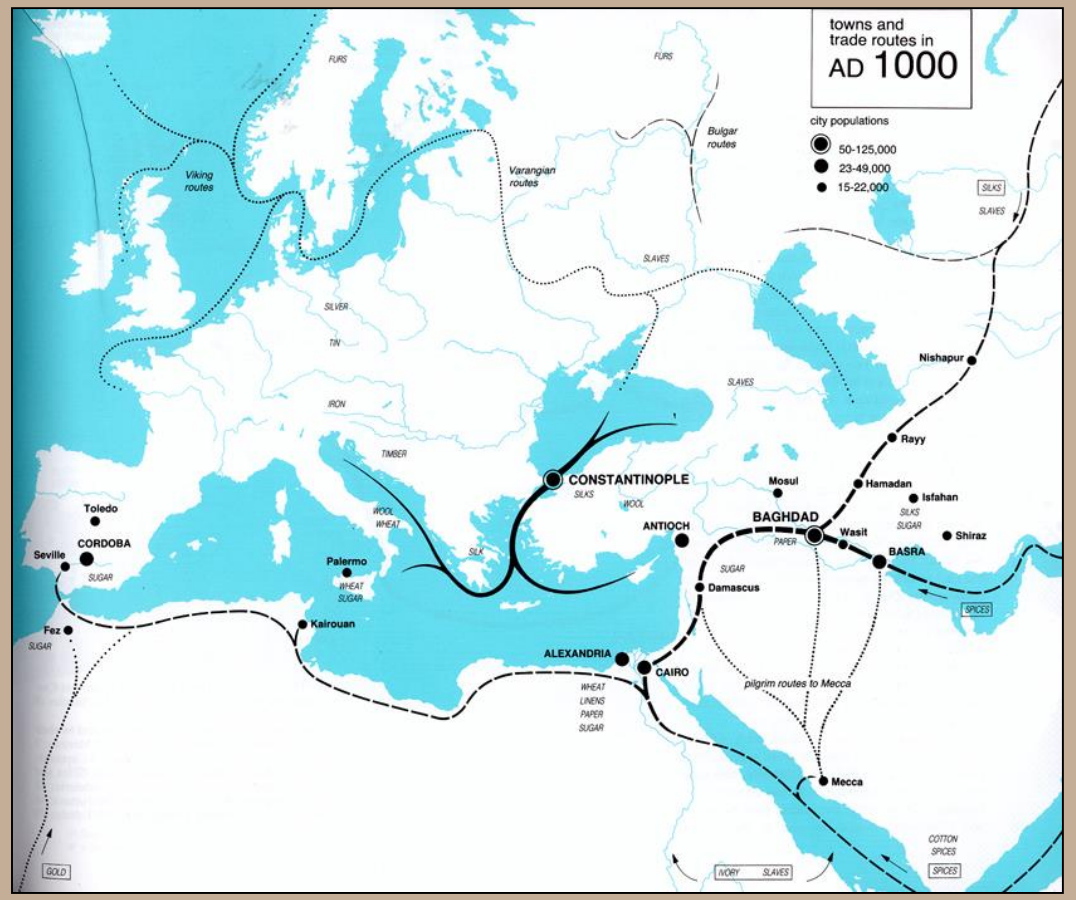
Mediterranean World

"The frames-first technique (…) was used [in Northern Europe] in ancient times not only for river boats and barges but also seagoing vessels; there are indicators that the Celts may have been its originators."

Lionel Casson

Scholars are cautious about the motives that triggered these changes. As usual is was probably a series of different factors, instead of just one main reason.





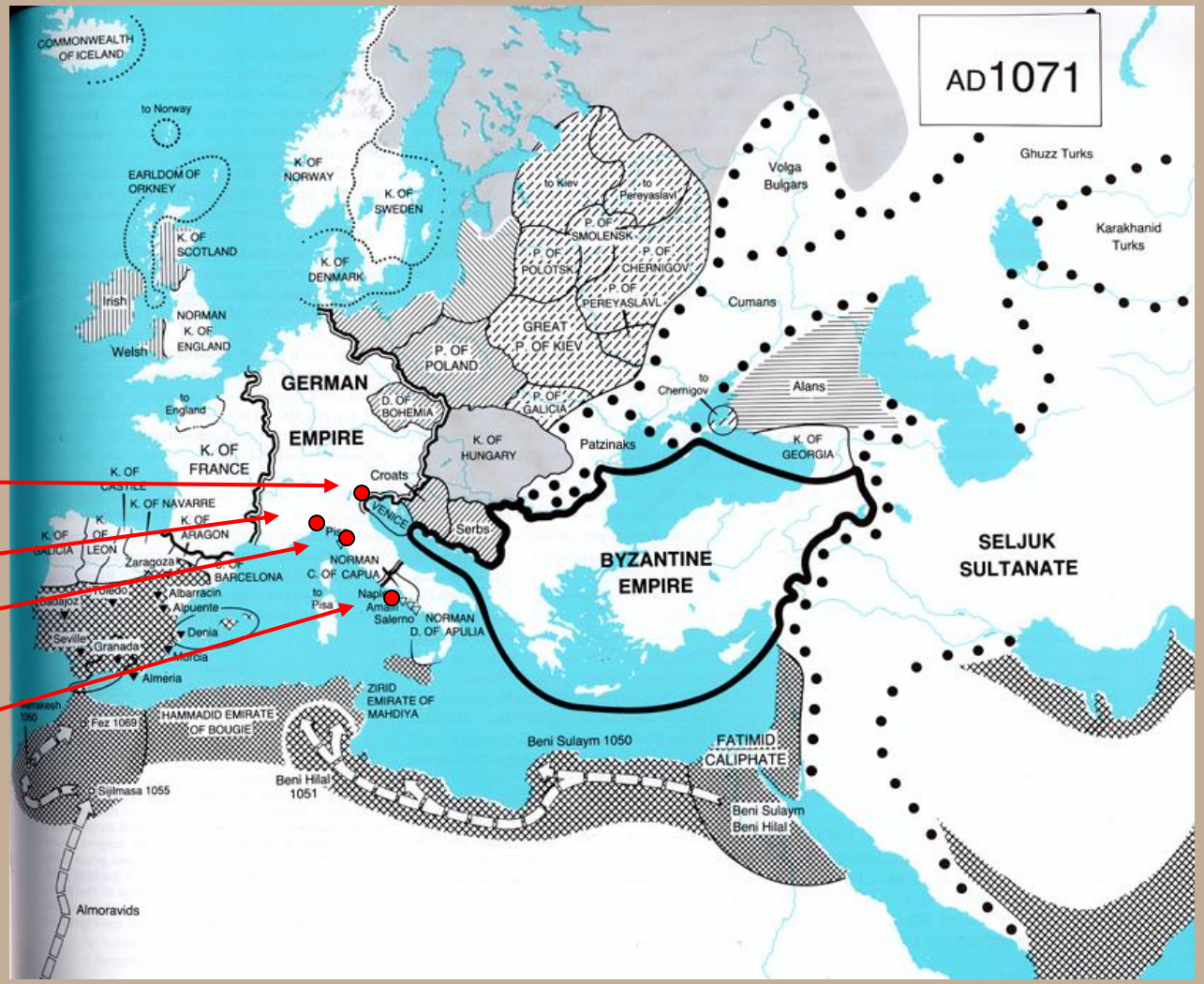
The upsurge in maritime activity that took place in the Italian ports of Amalfi, Pisa, Genoa, and Venice during the tenth century may have favored this transition by increasing the demand for ships.

Venice

Genoa

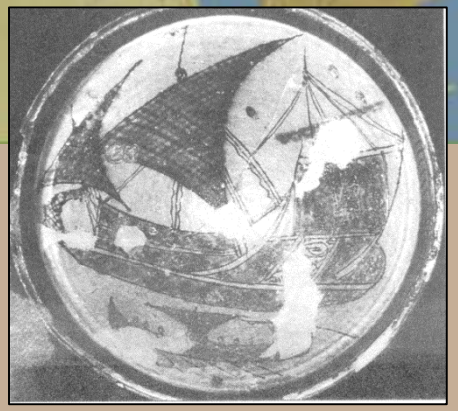
Pisa

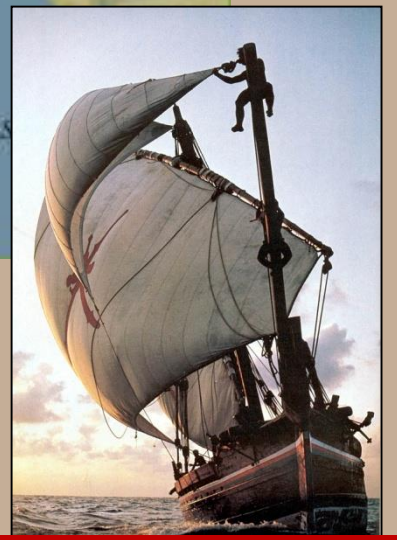
Amalfi



Mediterranean World

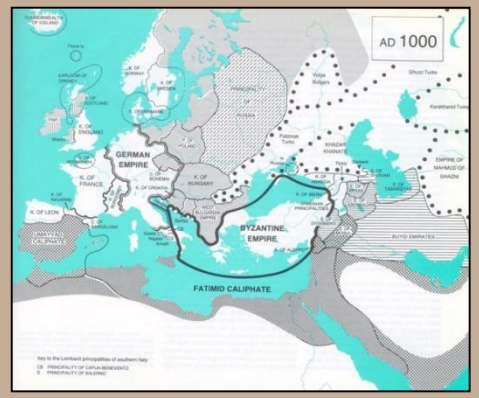
Arabs may have been in part responsible for the switch, having to build entire fleets from scratch.



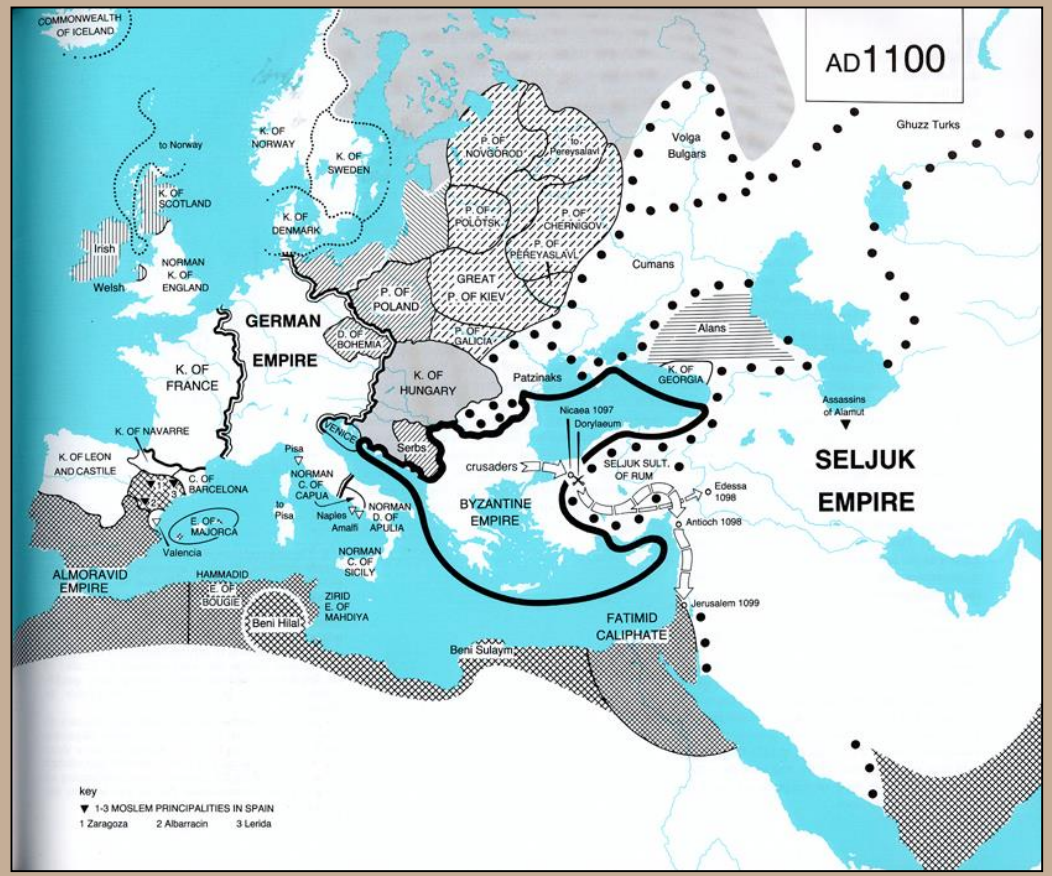


Shrinking of commerce in the centuries after 700 CE may have induced the adoption of a cheaper method to build frames.

Mediterranean World



The rapid expansion of commerce after the second half of the 10th century may have also helped to generalize the adoption of this faster way to build ships.



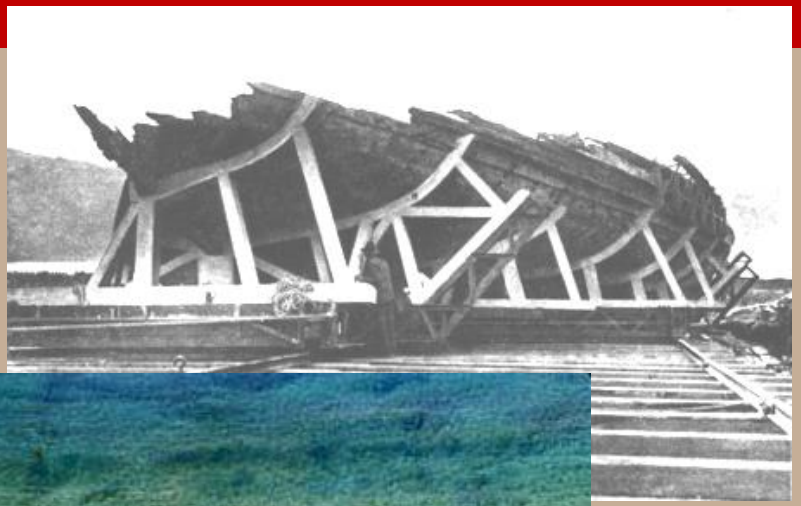
With this adoption shipwrights were forced to change the way in which they conceived ships and boats:

Shell-first ships are conceived longitudinally, its building blocks being strakes and wales;

Frames-first ships are conceived longitudinally but built transversely, their building blocks being the frames.

(This transition entailed the use of longitudinal aids to control of the shape – that is why it is sometimes called "master frames an ribbands").

Shell-first ships are conceived longitudinally, its building blocks being strakes and wales;



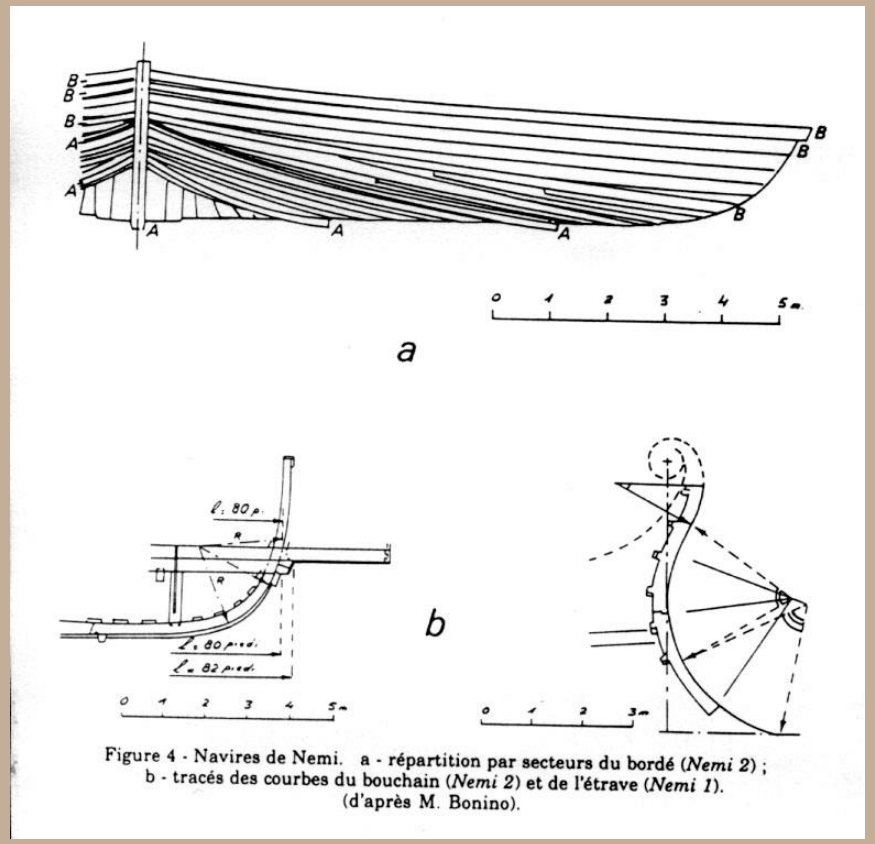
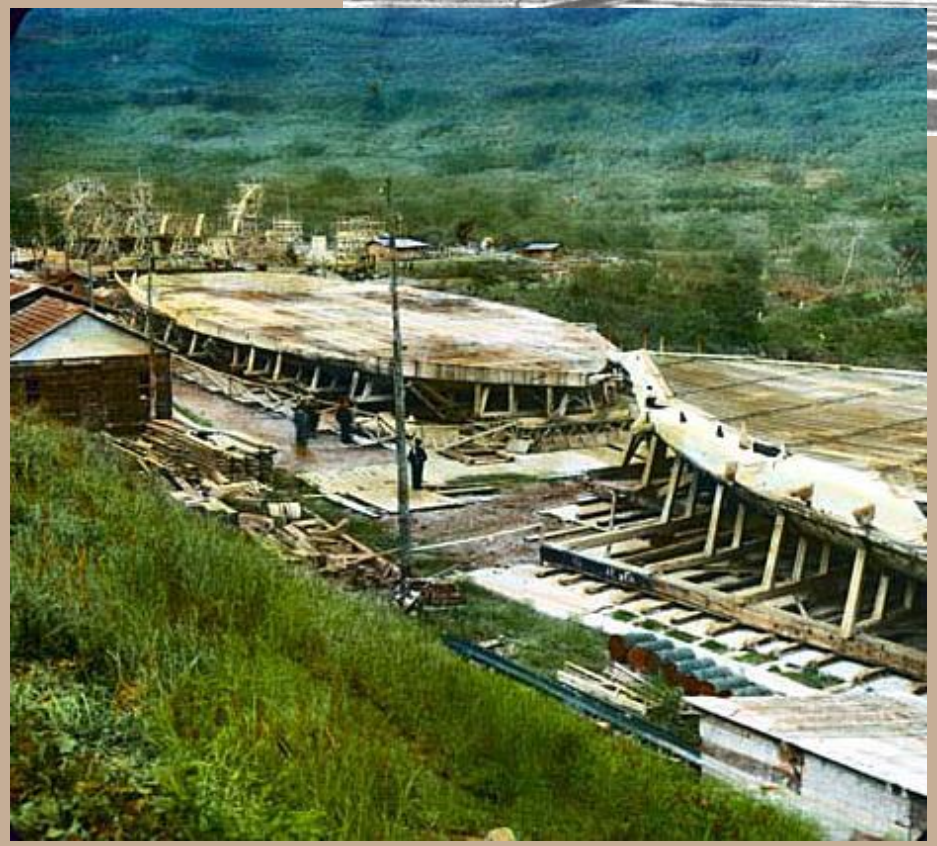
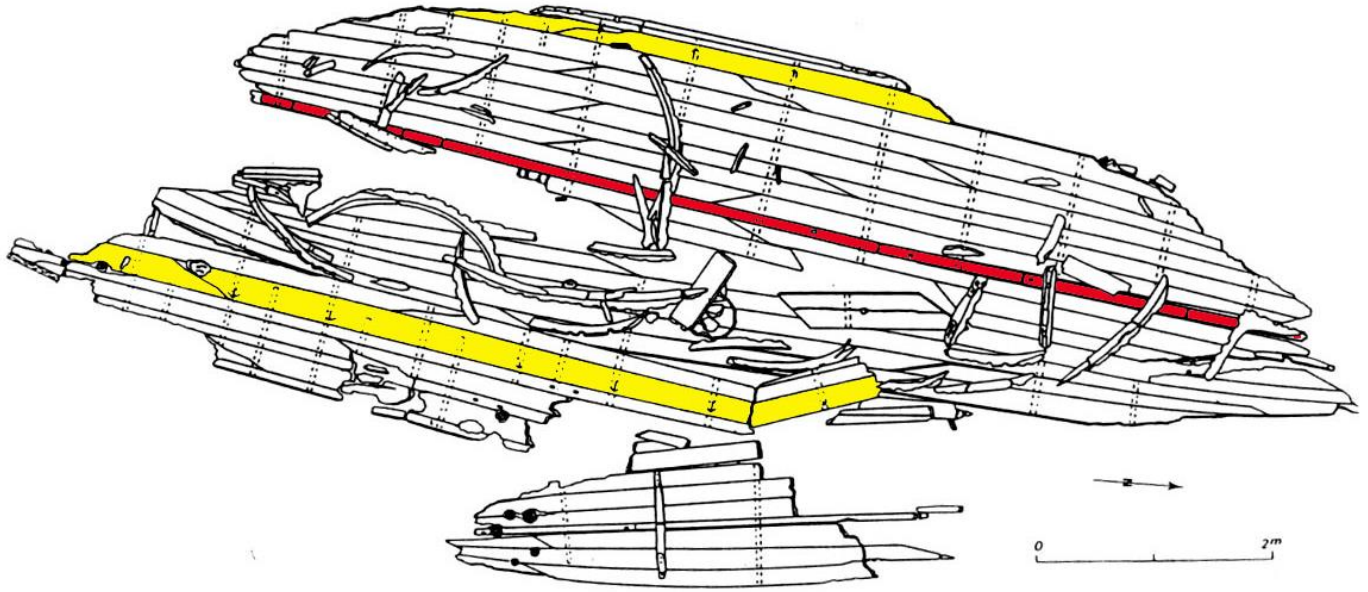


Figure 4 - Navires de Nemi. a - répartition par secteurs du bordé (*Nemi 2*) ; b - tracés des courbes du bouchain (*Nemi 2*) et de l'étrave (*Nemi 1*). (d'après M. Bonino).





La grande épave grecque de Marseille, *Jules-Verne 7*, apporte à ce sujet des précisions inédites. Alors que la plus grande asymétrie règne pour les sept premières virures, celle-ci est totalement rectifiée à la huitième (fig. 8). C'est manifestement au niveau de cette virure, plus large que les autres et située vers la fin de la courbure des fonds, juste avant la première préceinte basse, qu'avait lieu le contrôle et la rectification des formes des fonds. Elle jouait en somme un rôle de *"virure de réglage"*.

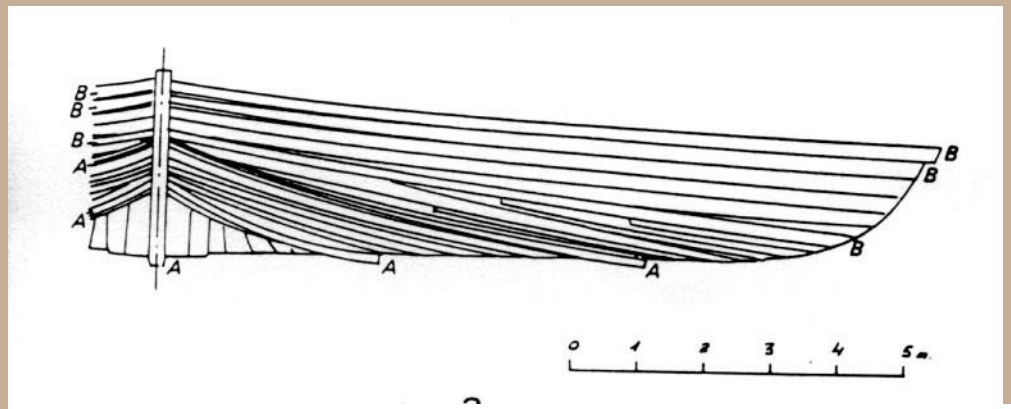
Patrice Pomey

Mediterranean World

L'importance de cette huitième virure est encore soulignée par les marques incisées à la pointe sèche en forme de flèche qu'elle porte à l'emplacement de l'extrémité des varangues. En rapprochant ces marques des encoches situées sur le dos de la quille à l'aplomb du pied des varangues, on en déduit que la phase suivante de la construction consistait à mettre en place les varangues selon l'alignement de ces marques de repère (Pomey, 1995 : 478). Ainsi, après l'assemblage des huit premières virures, on procédait à la consolidation du fond de carène par les varangues avant de poursuivre le montage du bordé par la pose de la première préceinte et des virures suivantes. Les murailles étaient ensuite, à leur tour, consolidées par la mise en place des allonges et des couples de revers.

Patrice Pomey

Mediterranean World



Les mêmes phases de construction se retrouvent sur l'épave de Kyrénia où la pose des varangues intervient vraisemblablement après le montage des neuf premières virures (Steffy, 1985 ; 1994 : 42-59). La forme de la carène était, en outre, ajustée à l'herminette selon une pratique souvent observée sur les épaves antiques (Rival, 1991 : 225). C'est sans doute à diverses phases du contrôle du montage que correspondent les zones du bordé de l'épave de la Bourse de Marseille que l'on peut distinguer par la répartition des différentes essences utilisées (Rival, 1991 : 254). De même, le montage par secteurs du bordé des navires de Nemi, où l'on note le rôle déterminant d'une virure de bouchain qui a pu servir de virure de réglage, renvoie directement à ce processus de construction, tout comme le montage par étapes de la *Syracusia*.

Patrice Pomey

Mediterranean World


Marsala, 3rd Century BC.

Le cas de l'épave de Marsala mérite une attention particulière en raison de l'abondance des marques qui nous éclairent sur les procédés de construction. L'étude de H. Frost (1976 ; 1993) montre clairement que le navire a été construit selon les mêmes méthodes de construction comportant, notamment, la mise en place des varangues après l'assemblage des onze premières virures. Pl

Patrice Pomey

Shell-first ships are conceived longitudinally, its building blocks being strakes and wales;

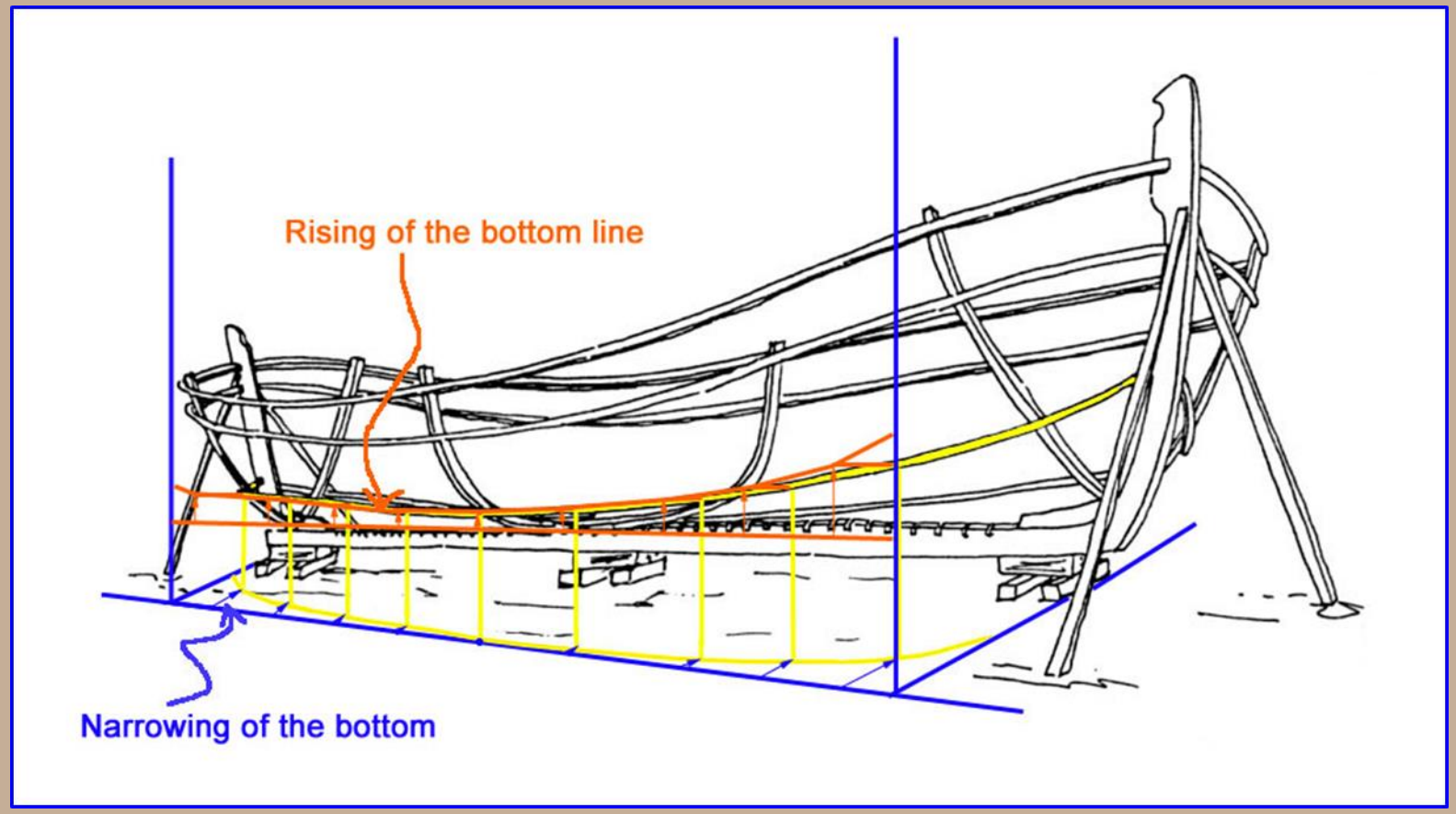
Figure 4. Plank at bow, showing bending and twisting (N. Sheizaf)

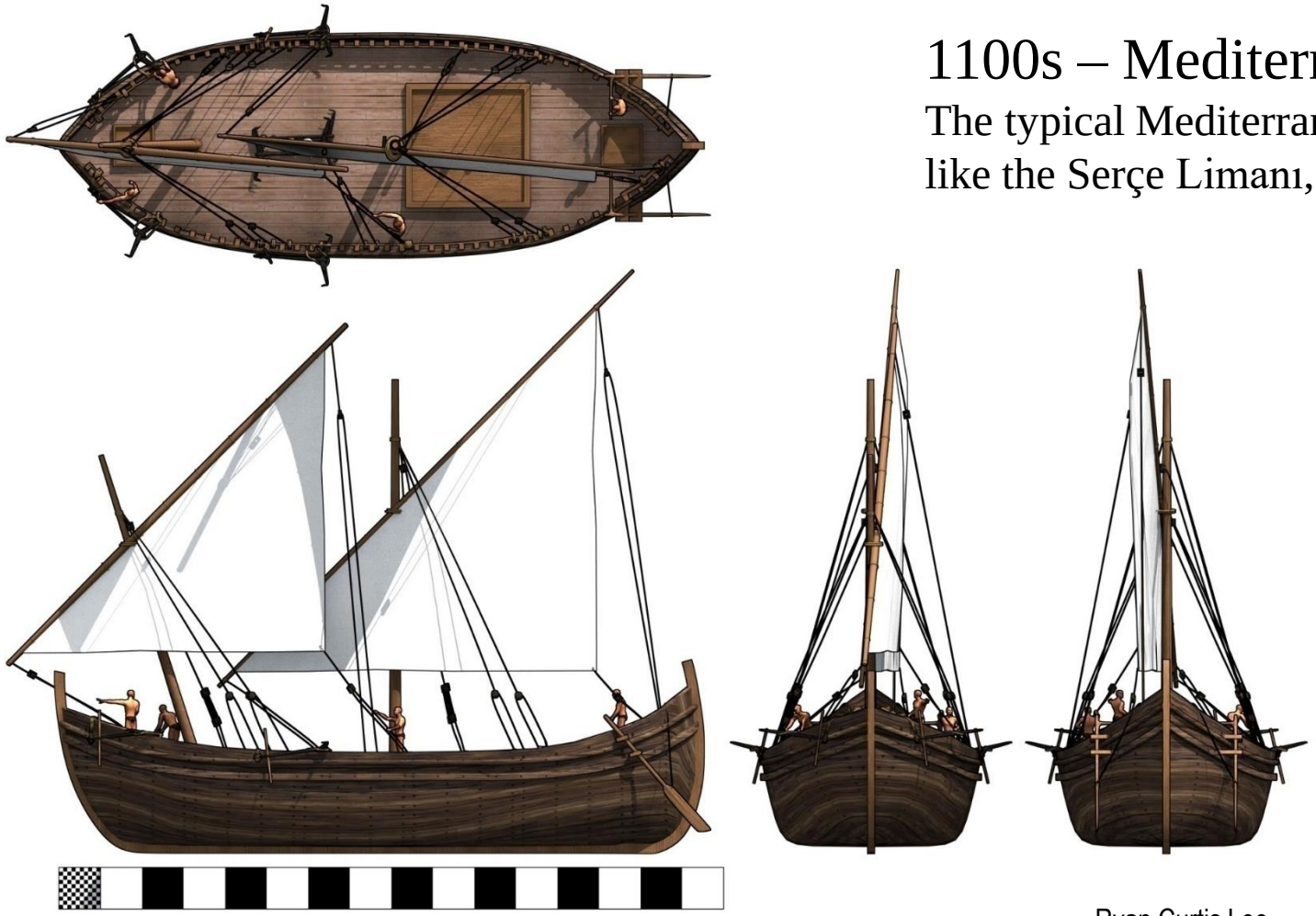
Frames-first ships are conceived longitudinally but built transversely, its building blocks being the frames.

Mediterranean World

Most early frame-first ships were built as a central box of pre-designed frames and the ends' shapes taken from ribband fair runs.

Master Frames an Ribbands:





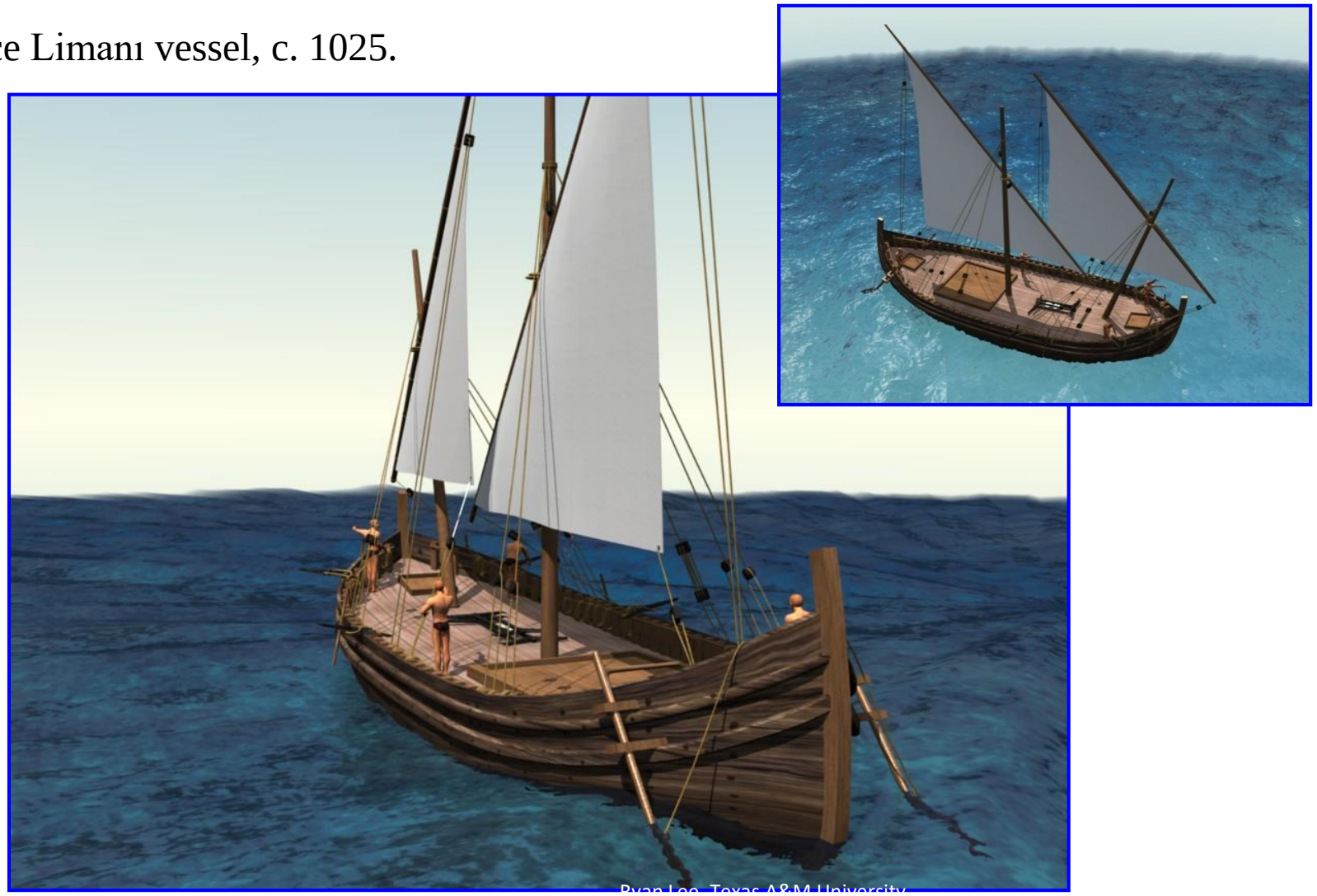
1100s – Mediterranean Sea

The typical Mediterranean ship was a one- or two-masted lateener, like the Serçe Limanı, c. 1025.

Ryan Curtis Lee

1100s – Mediterranean Sea

Ryan Lee: reconstruction of the Serçe Limanı vessel, c. 1025.



1200s – Mediterranean Sea

The typical Mediterranean ship was a one- or two-masted lateener, although there may have been larger vessels.

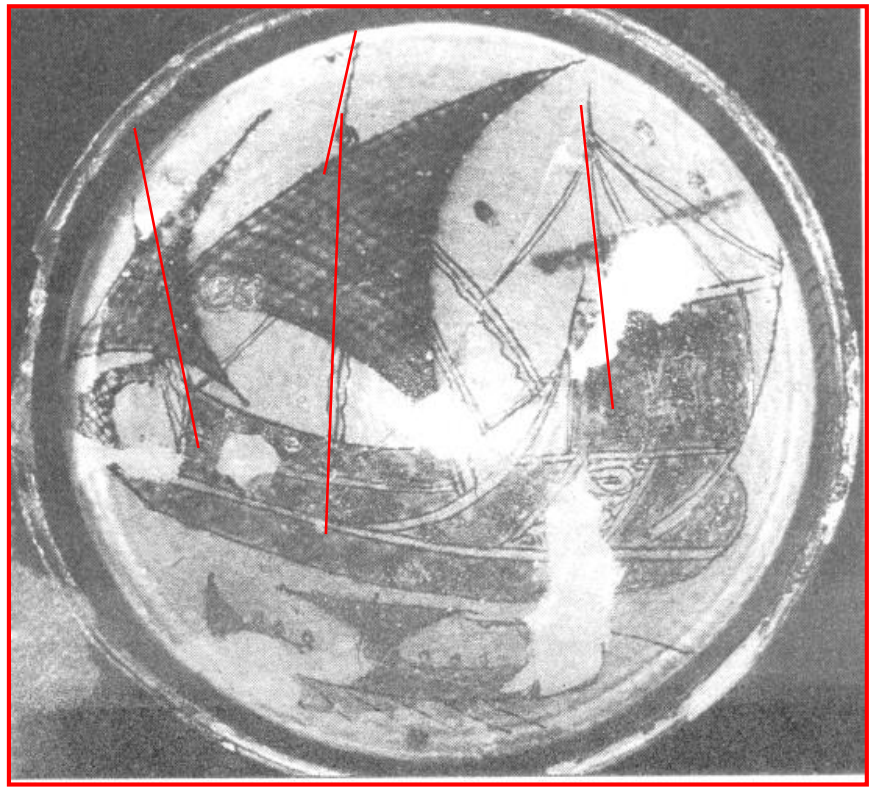


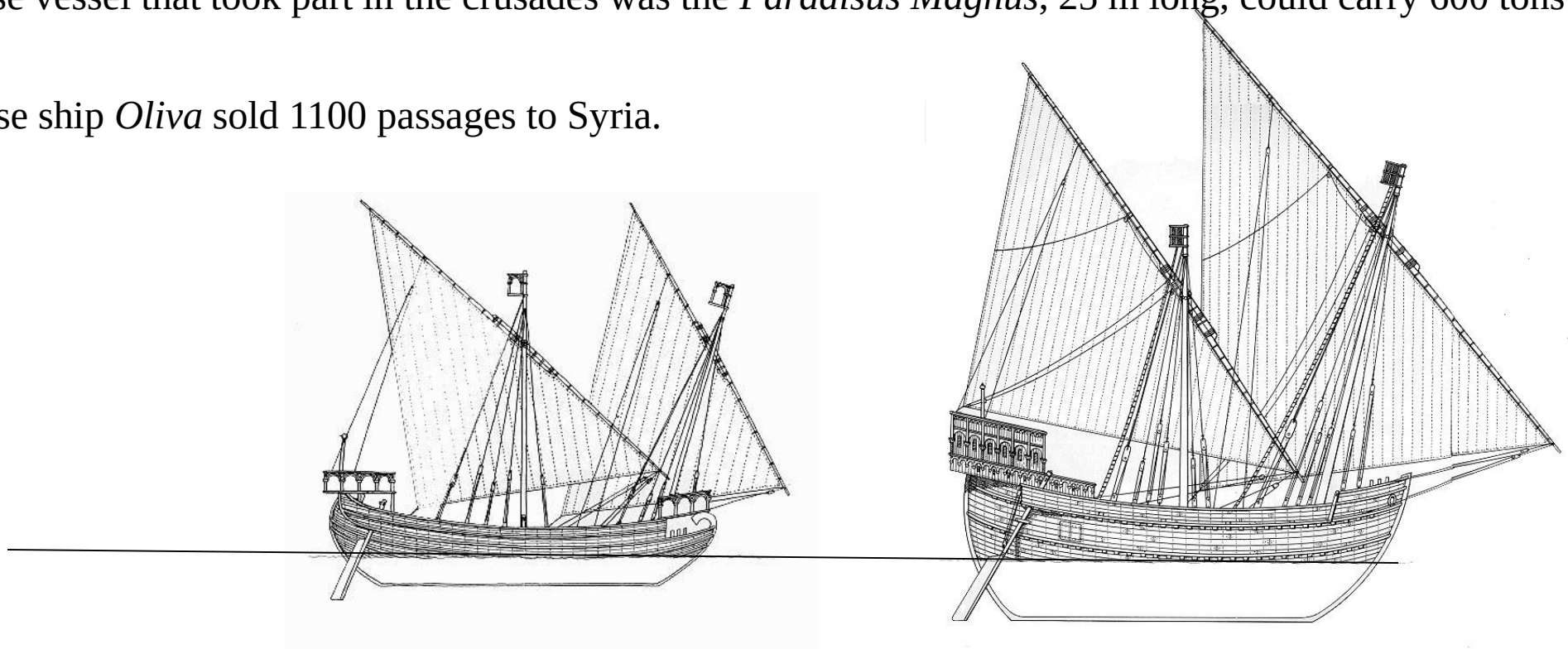
Image of a three-masted ship from an 11th century (?) Islamic plate.

1200s – Mediterranean Sea

Sizes varied. Although most ships were relatively small, in 1268 the venetians offered Louis IX of France a large ship (a *nave* or *buss*) to take part in his crusade to Tunis: the *Roccaforte* which was 500 tonner and mounted two or three masts with lateen sails. This was exceptionally large for its time. Other large Venetian ships – around 190 tons – took part in the crusade.

The largest Genoese vessel that took part in the crusades was the *Paradisus Magnus*, 25 m long, could carry 600 tons and had a crew of 100.

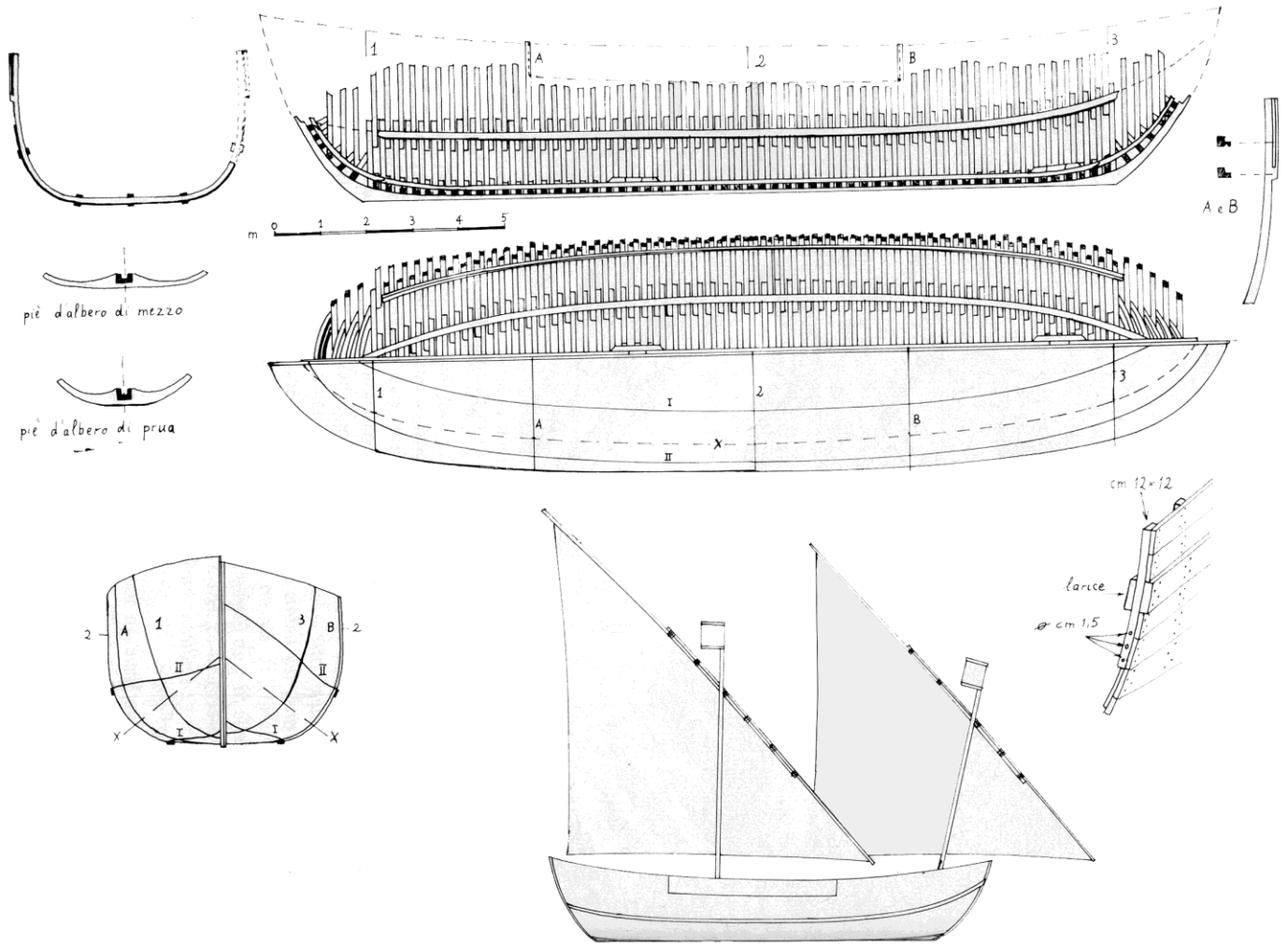
In 1248 the Genoese ship *Oliva* sold 1100 passages to Syria.



The *navi* are replaced in certain routes by *cocche* with one mast, one square sail, and fore and stern castles. Mediterranean *cocche* grew substantially in size in the first half of the 14th century.

Contarina 1, c. 1300?

Found in 1898 at Contarina, near Rovigo, north-east Italy. As reconstructed it measured 20.98 m overall, had a beam of 5.20 m and a depth of hold of 2.46 m, making it similar but slightly smaller than the vessel described in the Venetian manuscript known as *Libro di marineria*, or *Fabrica di galere*, whose original (the Michael of Rhodes manuscript) dates to 1436.

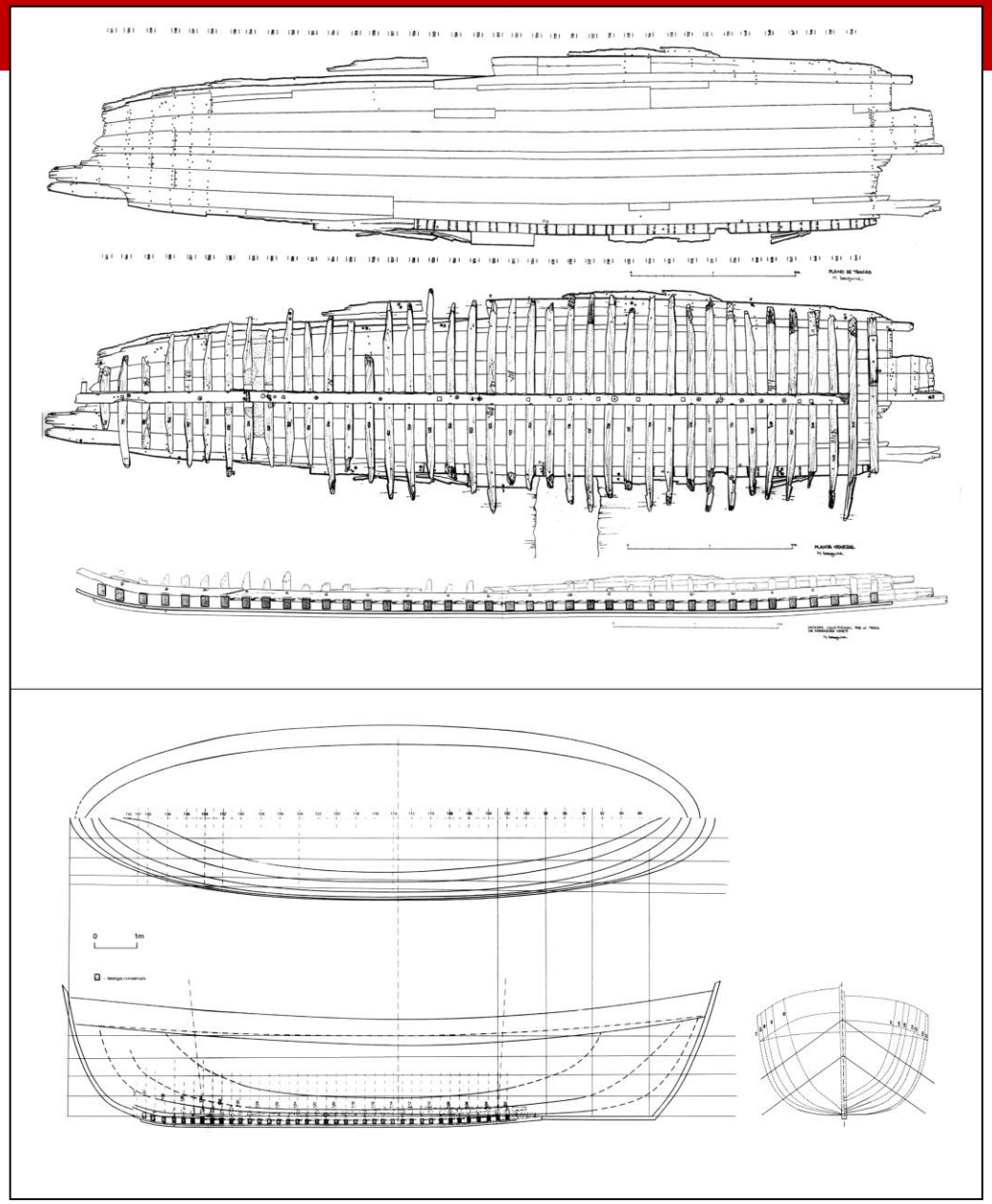


Culip 6, c. 1300

Found in 1987 at Cala Culip, Catalonia. Excavated by the Centre d'Arqueologia Subaquàtica de Catalunya (CASC) between 1988 and 1990, under the direction of Xavier Nieto Prieto.

The hull was reconstructed by Eric Rieth as a small short-sea trader of 16.35 m length overall, a beam of 4.11 m and a depth of hold on 2.06 m.

The hull weight was estimated at *c*.16 tons, and the cargo capacity at *c*.40 tons. When fully loaded it displaced 56 tons.



1320s – Mediterranean Sea

A second mast appears abaft this mast with a lateen sail. This new rigging arrangement – *quadra-latina* – spreads quickly.

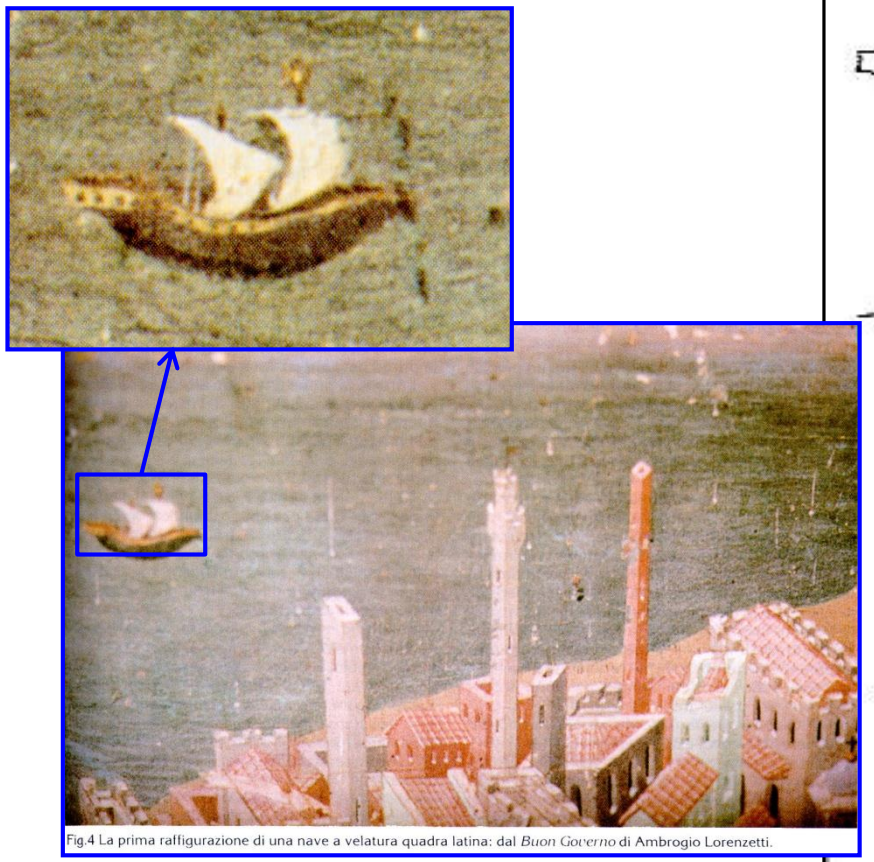
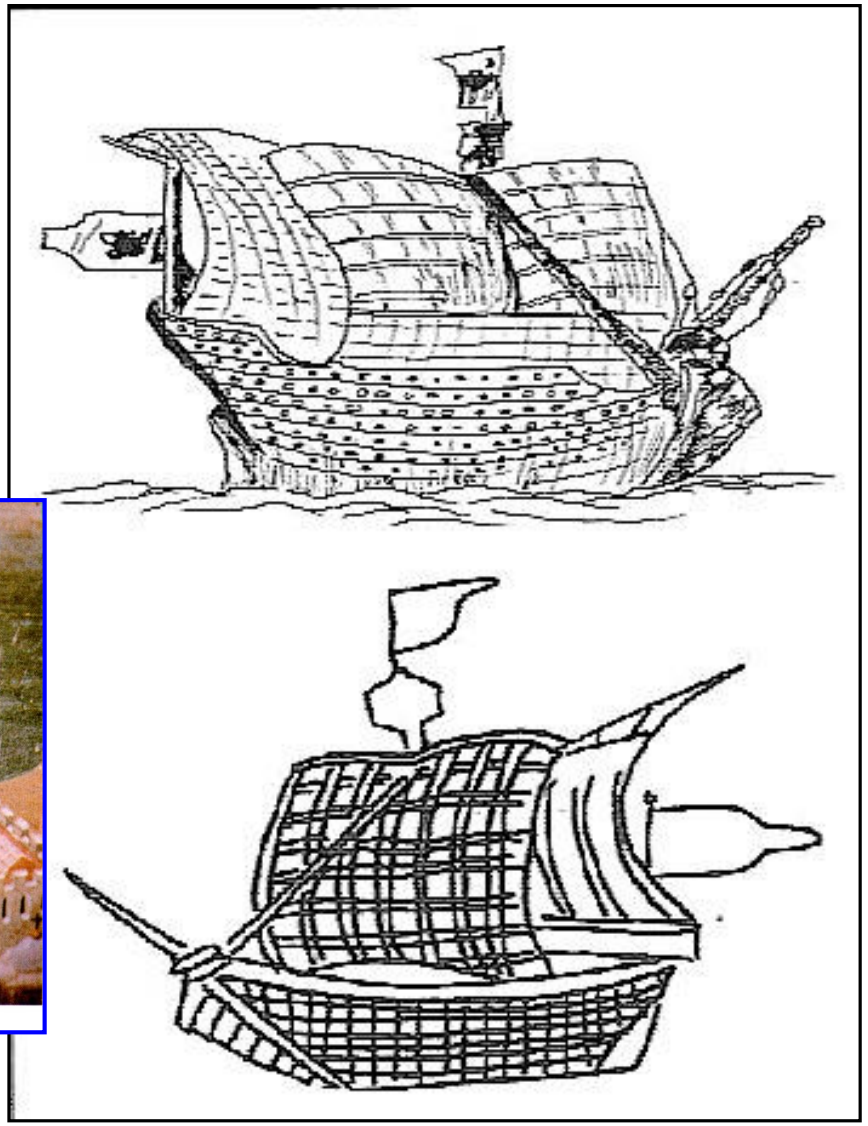


Fig.4 La prima raffigurazione di una nave a velatura quadra latina: dal *Buon Governo* di Ambrogio Lorenzetti.

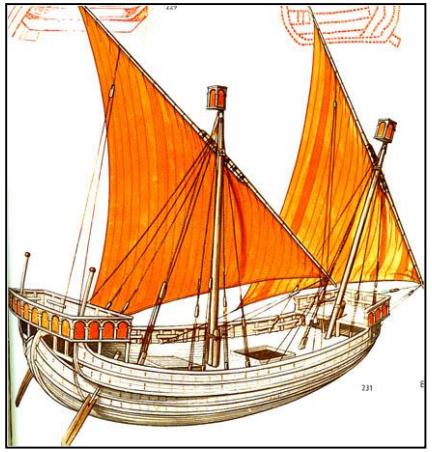


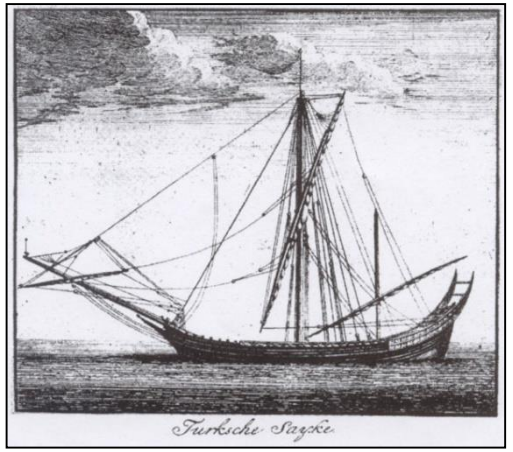
1320s Mediterranean Sea

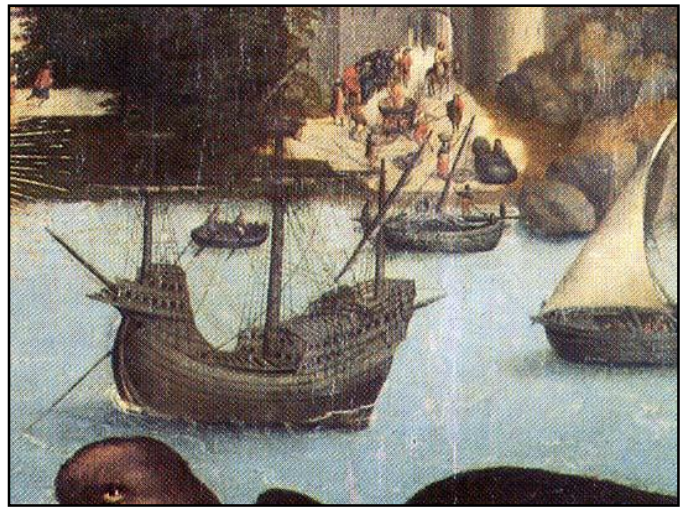
A nave with a *quadra-latina* rigging arrangement in a French, 14th century manuscript.

1400s – Mediterranean Sea

The three-masted, full-rigged ship appeared, matured and replaced part of the merchant craft.







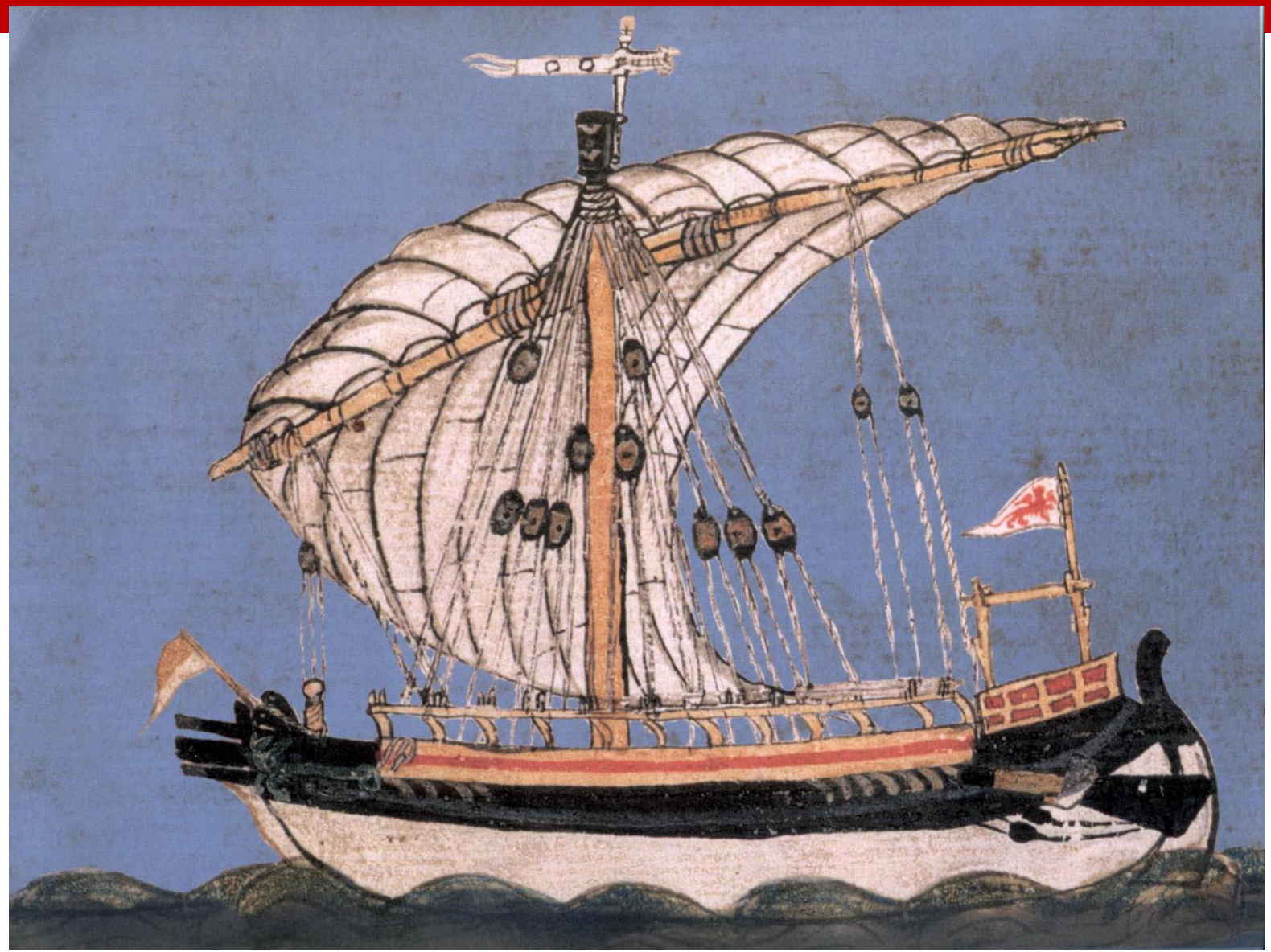
1400s – Mediterranean Sea

Galleys

Around 1300 venetian galleys carried about 140 tons of merchandise bellow deck;

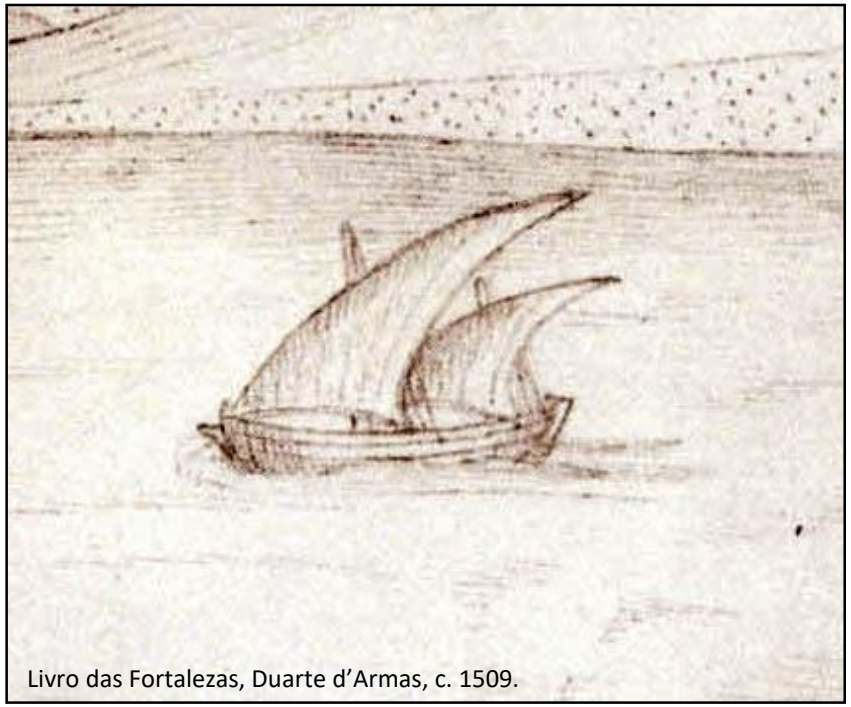
A century later the galleys of Flanders could carry 200 tons bellow deck;

Around 1450 the galleys of Flanders could carry 250 tons bellow deck.

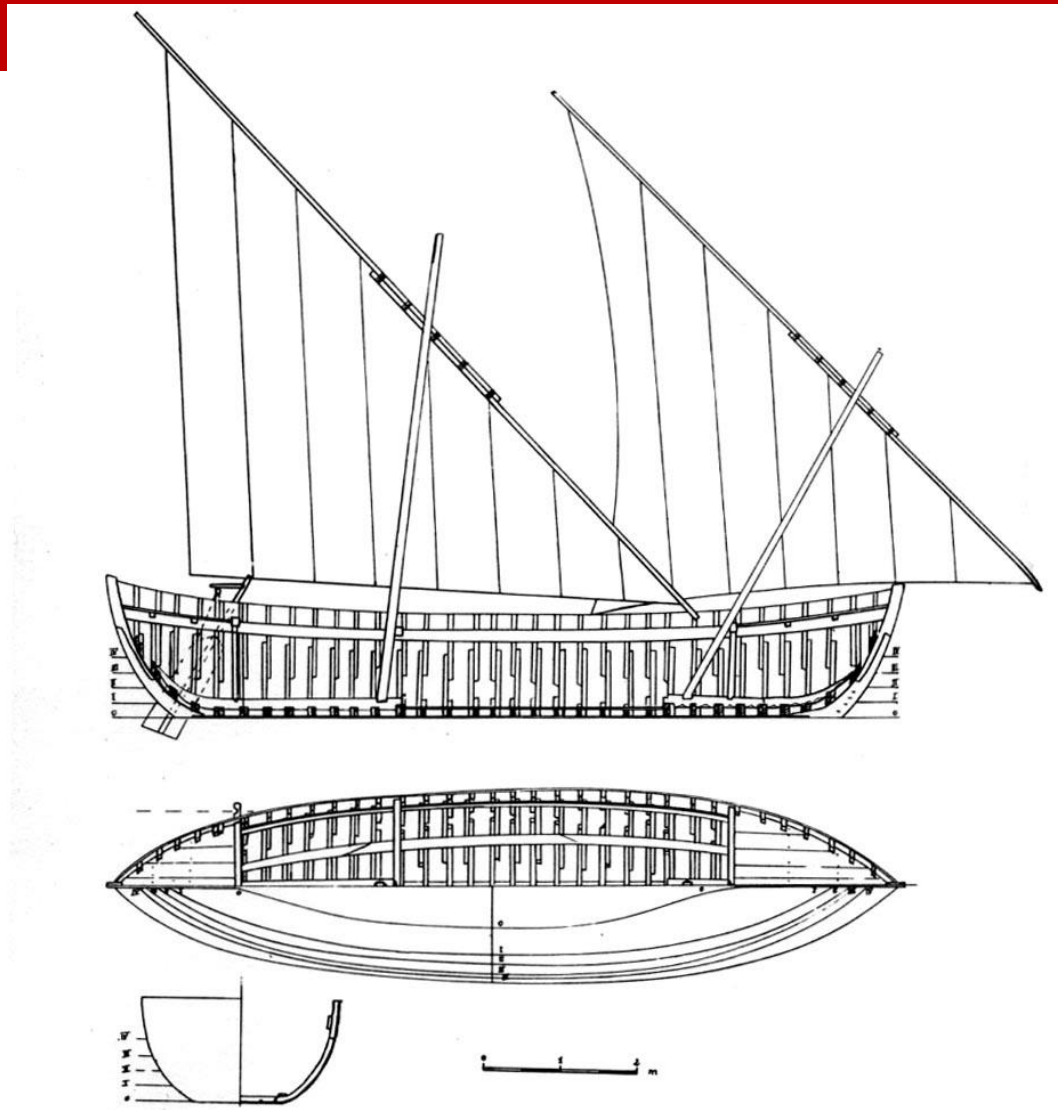


Logonovo, c. 1400

A small two masted lateener probably engaged in short sea commerce.



Livro das Fortalezas, Duarte d'Armas, c. 1509.



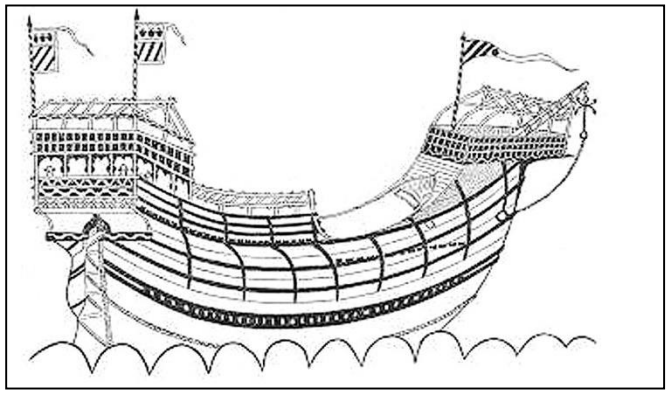
1400s – Mediterranean Sea

Venice

1400 – Larger merchantmen were about 300 to 400 tons.

1450 – References to at least six 600 ton merchantmen on the wine trade route between Crete and England.

1500 – At least one ship built with 1000 tons burden.



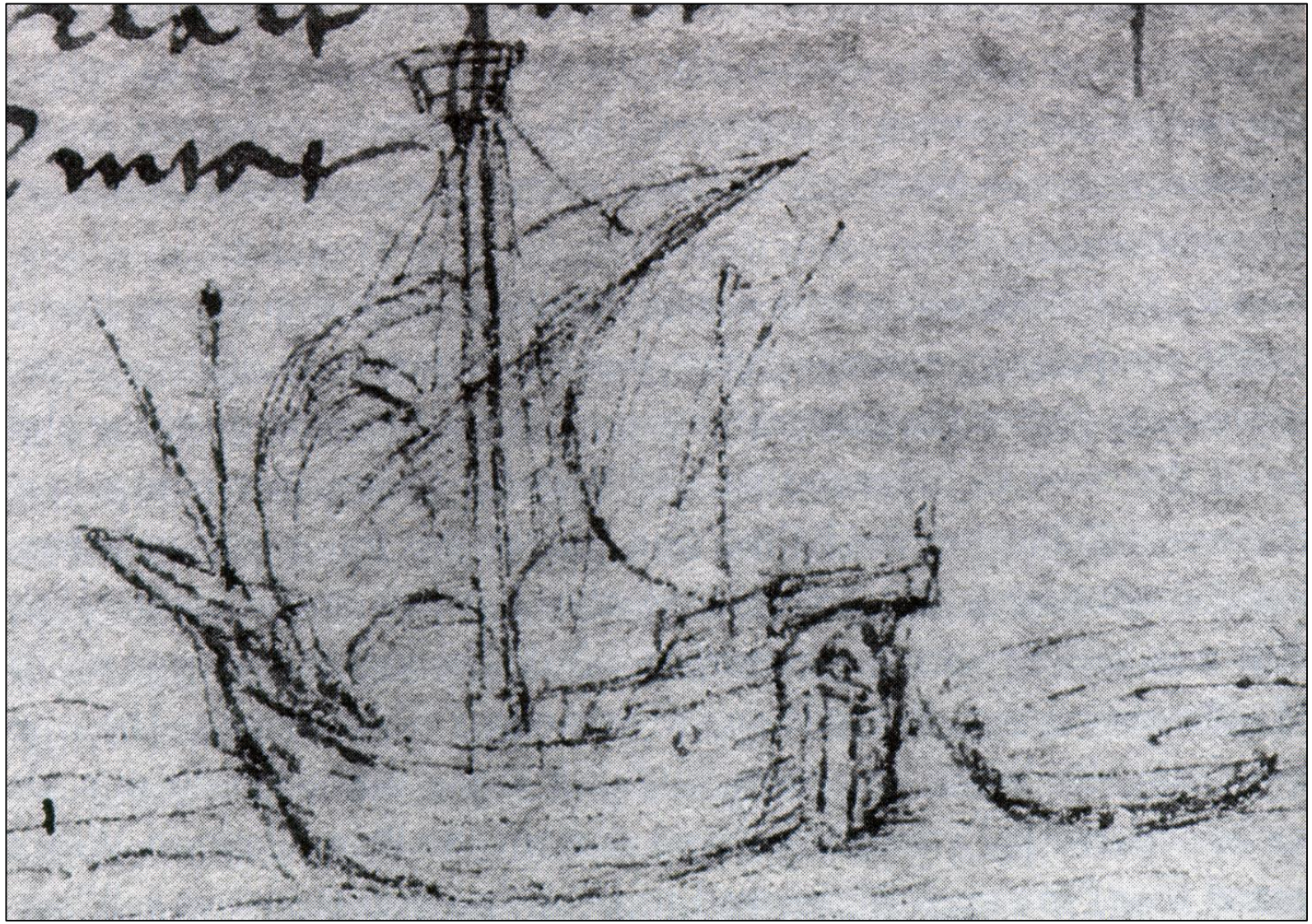
Trombetta, 600 tons.

Large ships “Passages Outre Mer” ms., late 15th century.

1400s – Mediterranean Sea

Catalonia

1409 – Libro del Consulat del Mar: the earliest known representation of a three-masted vessel in modern Europe.



1400s – Mediterranean Sea

Catalonia

1460s – Ex-voto from the Mataró church, was originally two-masted and had a third, crudely shaped mast added at some point.

1400s – Mediterranean Sea

Turkey

1486, Konrad von Grunenberg represented a Turkish ship that resembles all the Italian models.

Questions?