

Ships of the 13th-century Catalan Navy

Lawrence V. Mott

Nautical Archaeology Program, Department of Anthropology, Texas A&M University,
College Station, Texas 77843, USA

For the Crown of Aragon the 13th century ushered in a period of expansion and the acquisition of overseas possessions. During this period the Aragonese came to control, either directly or by proxy, all of the western Mediterranean islands, and expanded their commercial interests to every corner of the Levant. The spearhead of this rise in naval power was the Catalan navy, whose ships varied considerably in both size and style of construction. This variety is expressed in the plethora of ship names that have come down to us in various documents and chronicles. Unfortunately, to date very little headway has been made in defining the differences between the types of vessels used by 13th-century navies beyond generalizations about size and use. The problem is compounded by the evolution of ship design during this period and by a complete change in the method of rowing at the end of the century.

However, the problem is not completely insoluble. By using previously documented iconographic material and new ship representations that have come to light, we can start to attach names to the different ship types. This paper will first analyse the different construction styles used during the 13th century and then compare this analysis with the written descriptions of the various vessels and with the iconographic data. Two Catalan chronicles provide the most detailed information concerning the types of vessels in use and their various functions. The first, entitled *El Rei En Pere*, was written by Bernat Desclot between 1283 and 1285, and covers the period 1276–1285. The other chronicle is entitled *Crònica* and was started in 1325 by Ramon Muntaner. The chronicle relates various events from 1209–1328, but most of the chronicle concerns the period starting c. 1265, as this was the period in which the author lived. During this

latter period Muntaner participated in many of the naval and land battles mentioned in the chronicle.

The distinctions made by medieval writers between the different ship types did not entirely depend on either the number of oars or the rowing system employed. This is clearly implied by Muntaner when he speaks of adding a *tarsol*, or third oar, to a light galley (Muntaner, 1860: 218). From the passage it is evident that a galley could change the number and arrangement of its oars and that the distinctions made between vessels was based as much on hull types and their use, as on the system of rowing.

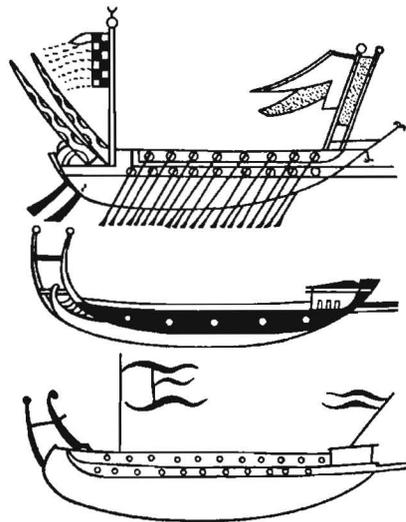


Figure 1. French galleys on a document dated between 1154–1235. The centre galley has a fan-stern which may be the source of the term *com a ventall* or like a fan. (Landstrom, 1961: 85. Reprinted by permission of Doubleday Publishing).

Using existing iconography, the hull designs of 13th-century galleys can be divided into three groups based on the design of the stern: fan-, flat-, and full- or round-sterns, all of which can be traced to the start of the 13th century, if not before. While initially this may appear to be an arbitrary classification, at least one class of galley, the *uixer*, was distinguished by the design of its stern and they are often listed as *galees obertes per popa* [galleys open at the stern] (Muntaner, 1860: 204).

The fan-stern was formed by extending one of the waterline wales on each side straight aft

and then curving it vertically to form the 'wing' characteristic of 13th-century warships. This created a gap between the upturned wale and the stern post which was filled by horizontal cross-planks that formed a flat area between the 'wing' and the stern post. The term 'fan-stern' is used here due to the absence of an already existing term or phrase to identify this style of construction. It can be clearly seen in a French manuscript dated between 1154 and 1235 (Fig. 1), and in a Catalan mural dated to 1200 (Fig. 2). This type of construction may have survived until the start of the 14th century since it seems to appear

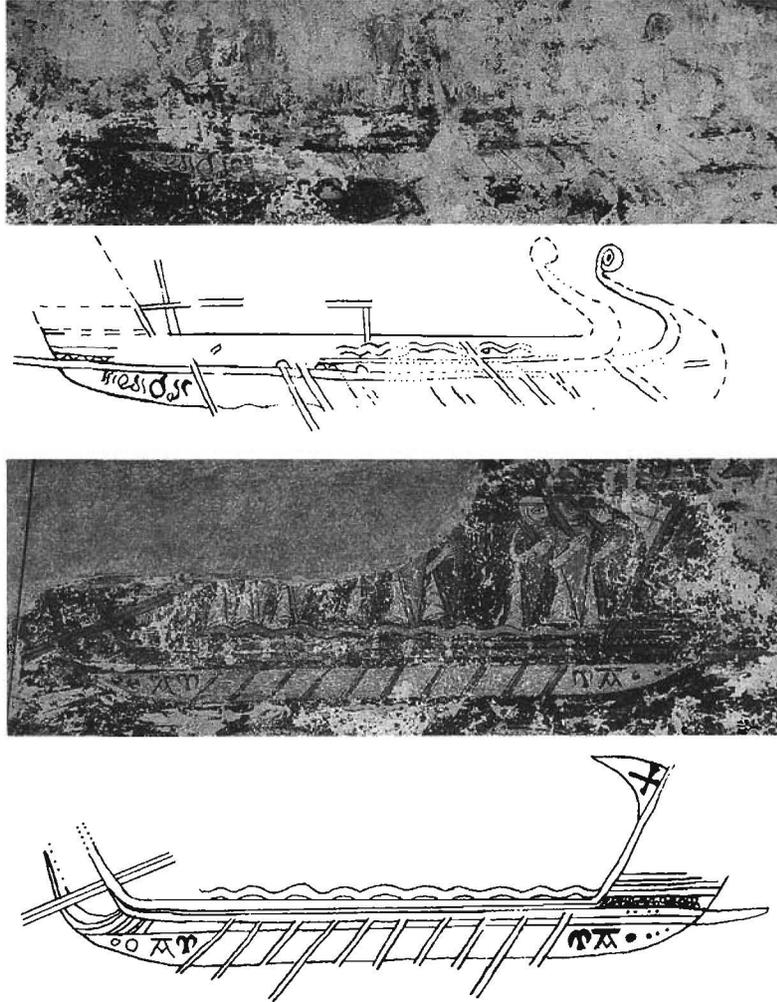


Figure 2. Galleys on a mural from Lerida in the Museo de Arte de Catalunya, c. 1200. Two distinct classes of vessel are depicted, the upper a type of *galea* and the lower a *galea lleugera* (light galley). Both appear to have fan-sterns.



Figure 3. A miniature dating to 1260 from the *Cantigas de Santa Maria* (NS T.I. 1, fol. 164 v.) depicting a *uixer*. The flat-stern can be seen between the two upturned 'wings'. (Reproduced with permission of the Patrimonio Nacional, Spain).

on one of the *tablitas* from the ceiling of the Palau Nadal dated to around 1300, but there are no representations of the hull type after this date (Fig. 11). By the second half of the 13th century the type appears to have been limited to lighter vessels, although this is speculation based on the small number of representations available. The previously mentioned examples of vessels with fan-sterns appear to have a single row of oars, although it could be argued that the French representation could mount oars on the caprail, as was done on the galleys in the *Cantigas de Santa Maria* (Fig. 3). In the mural (Fig. 2) the lower galley is obviously quite small as the helmsman is standing on an open quarterdeck using a simple steering oar laid between the 'wing' and stern post, while the upper vessel appears to be a larger vessel with two rows of oars set at different levels.

The term *ventall* may have originated from this style of construction (Muntaner, 1860: 517).

The word translates literally as 'fan', which would be an apt description of a view of the stern. The cross-planking between the stern post and 'wings' becomes wider towards the top of the cross-planking, which would give the upturned stern post and 'wings' the appearance of the ribs in an opened fan. When Muntaner advises the king to build light galleys *com a ventall*, he may have been simply suggesting they be built with fan-sterns.

The flat-stern was similar to the above construction in that two lower wales were curved upward. The difference between the fan-stern and a flat-stern was that the latter vessel lacked even a rudimentary stern post and the gap between the two wings was cross-planked to form a low-angle, flat-stern. This is different from a transom stern which, by definition, requires a stern post to which the transom pieces are attached creating a nearly vertical stern. An

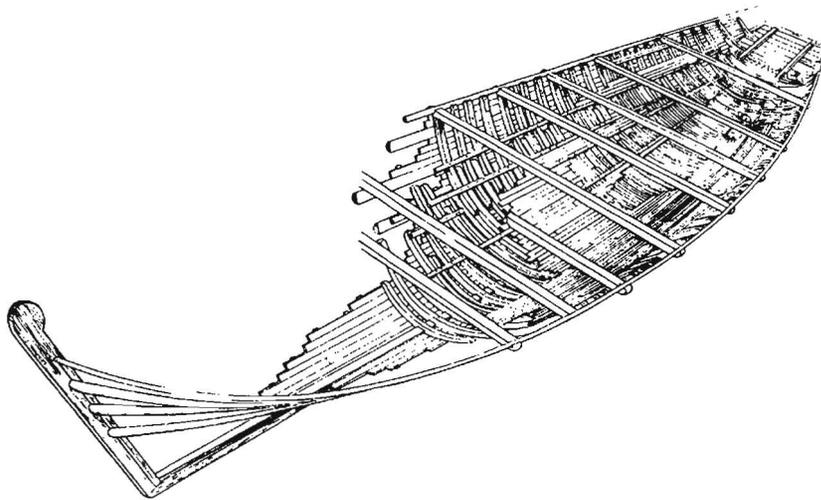


Figure 4. Reconstruction of the early Byzantine ship excavated at Pantano Longarini, Sicily. The ship was approximately 39.5 m long and had a flat-stern. The ship type known as a *uixer* or *galea oberte per popa* probably evolved from this type of construction (Throckmorton, 1988: 95).

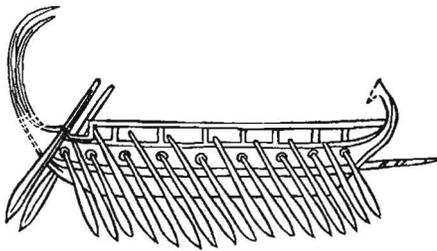


Figure 5. A depiction of a large *galea* from *Liber ad Honorem Augusti* dated to 1195. Besides having two rows of oars at different levels, this galley was probably a *uixer*. The quarter-rudders are mounted outboard of the 'wings' indicating that the space between the two was flat and crossplanked to form a flat-stern (After R. C. Anderson, 1962).

actual archaeological example exists in the early Byzantine ship excavated at Pantano Longarini (Throckmorton, 1988: 95) which was sufficiently preserved to enable a reconstruction of the ship (Fig. 4). The best iconographic example comes from the *Cantigas de Santa Maria* dated to 1260 in which the straight cross-piece and the flat-stern between the 'wings' can clearly be seen. It is also probable that the galleys in Figs 5 and 9 have flat-sterns as the quarter-rudders are mounted outboard. All of the representations of vessels which clearly have fan-sterns have the

quarter-rudder mounted in the gap between the stern post and the outer 'wing' with the aft horizontal end of the 'wing' forming a housing for the rudder. Based on the available iconography the flat-stern appears to have been used primarily on larger vessels, although it has been found on a small galley (Fig. 9).

The term *uixer* or *galea oberta per popa* probably refers to this style of construction, for the galley was literally 'open at the stern'. These warships carried up to 120 oars and were approximately the size of a galley. They were generally heavier than the large galleys and so were usually placed at the centre of the battle line (Bofarull, 1898: 11). But their use was more varied than that of a *galea*, for besides carrying soldiers, *uixers* often carried horses for use by raiding parties (Muntaner, 1860: 204, 228). Since the only warships used for carrying horses were *uixers* there must have been a distinct construction difference from a typical galley. Without having a stern post as an obstruction, a galley with a fan-stern could easily unload horses from its low flat stern onto a beach. The flat-stern would also have lent itself to the addition of a port providing direct access to the hold.

The full- or round-stern is by far the most ubiquitous form of stern construction and persisted until the galley went out of use in the early 18th century. The stern was formed by the

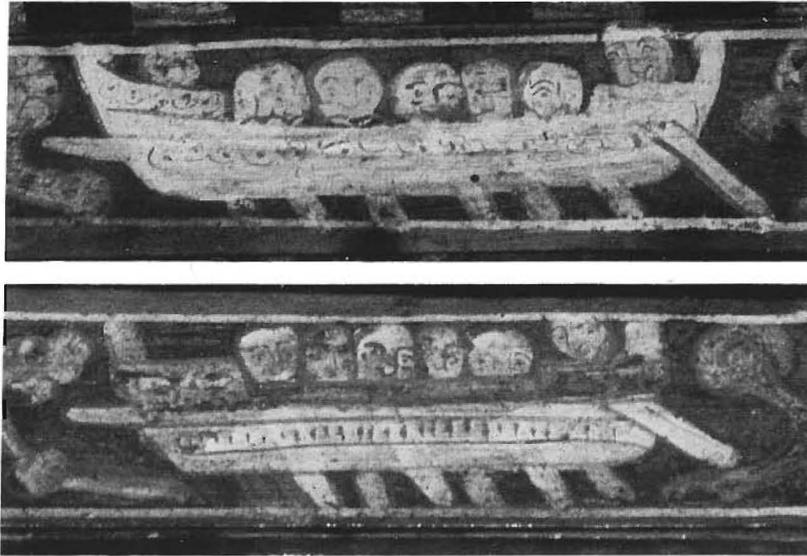


Figure 6. Large *galee* painted on *tablitas* on the ceiling of the Palau Nadal in Barcelona. The ceiling is dated to c. 1300. These are the largest warships depicted on the ceiling.

bending of all the wales and strakes into a tight curve at the stern post, which gave the vessel a round, upturned stern. Representations from the first half of the 13th century often have the 'wings', but these seem to be additions to, or the ends of, the caprail turned upwards (Fig. 1, top & bottom; Fig. 13).

One of the major problems in analysing Catalan warship types has been the lack of representations of the different vessels employed by the fleets. Besides the large *galea* and *uixer* classes of warships, there were a variety of smaller warships and vessels used to support the fleet. Fortunately, a painted ceiling in the Palau Nadal in Barcelona, dating to around 1300, provides us with some insight into the vessels in use at that time. On the beams of the ceiling seven distinct ship types are depicted, ranging from large galleys to small oared vessels. Most of the vessels are warships, but several others appear to be support ships. The absence of large merchantmen suggests that the artist was representing the Catalan fleet. The ceiling is particularly important for it gives us, for the first time, a view of an entire medieval fleet and its auxiliaries.

Two classes of *galea*, the largest galley type mentioned in the chronicles, appear to be represented on the ceiling. The first of these ships

(Fig. 6) have the high fore and stern castles identified as *taula*^[1], and they have a higher freeboard than the other galleys depicted. In the 14th century this class of vessel would be called *galera gruesa* because of their heavy construction and high fighting castles. As with other warships, it carries a ram, the function of which was probably as much for protection of the bow during ramming as for offence, since it only extends slightly beyond the stem post.

The large Catalan warships in the second half of the 13th century were built with 100–150 oars (Muntaner, 1860: 547). There are no Catalan documents listing the dimensions for 13th-century warships, but a Provençal galley contract of 1275 gives us a good approximation. The galleys were to have 108 oars, an overall length of 39.5 m, a beam of 3.7 m and a depth of 2.1 m (Bass, 1972: 207). By the mid-14th century, the number of oars on some Catalan galleys had increased to as many as 180 oars (Capmany, 1787, appendix 1: 2). This may be due to an overall increase in the size of the warships, but it is equally plausible that this increase was the result of the addition of extra oars using the new *a terzaruolo* rowing system. Venetian documents show that from 1320–1539, the overall length of war galleys

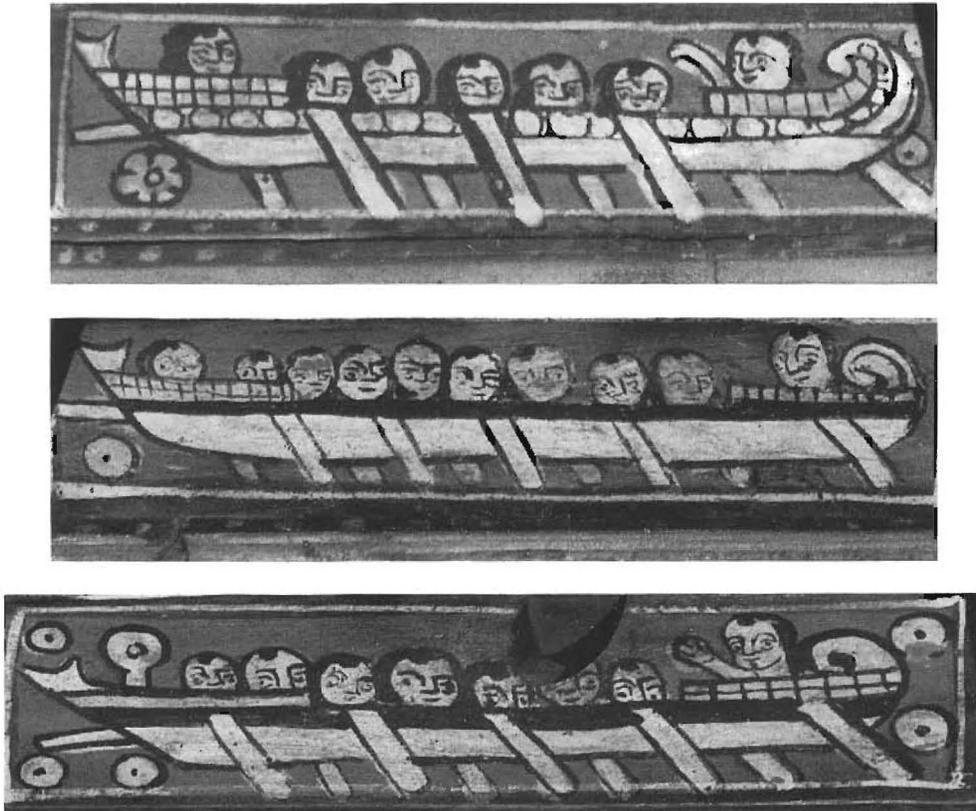


Figure 7. *Gallees* or *galeras* on the ceiling of the Palau Nadal. These appear to be an intermediate class of galley with lower *taulas* and freeboard than the larger galley depictions. The upper depiction is the only large galley on the ceiling that appears to have 'wings'.

virtually remained the same, 40.2–41.8 m. The beam of the galleys for this period also remained between 4.5 and 5.1 m (Anderson, 1962: 56). These figures are very close to the 39.5 m overall length of the Provençal galleys. This suggests that the number of rowers is not necessarily a good indicator of the size of the vessel.

The second class of *galea* has a lower freeboard (Fig. 7). Its fore and stern castle are like those previously discussed, but are not as high. All the ships have fighting platforms but two have what appears to be only a rail on the *taula*. The first galley in Fig. 7 has a stern apparently similar to that of the galleys in Fig. 13, or even a fan-stern, whereas the other have round-sterns. While Muntaner makes no distinction between the large galleys, Desclot uses the words *galea* and *galera* throughout his chronicle when speak-

ing of large warships. The two words may be synonymous for one type of vessel, but in one passage, the King of Aragon exclaims with amazement how fourteen *galeras* have won a victory equal to fifty *gallees* (Desclot, 1949, III: 124), indicating a possibly subtle but real difference. By the 14th century the term *galera* had become a generic word for any type of war galley. The medium war galleys, such as in Fig. 7, were referred to as *galeras bastardas*.

The most common representation is that of galleys with a similar design to the second type of *galea* (Fig. 8), but which lack a forecastle of any type and have rowers all the way forward in the vessel. These may be another type of *galea*, but the lack of a forward *taula* suggests they are probably representations of a *galea lleugera* or *galera sutil* (light galleys). It is also possible that

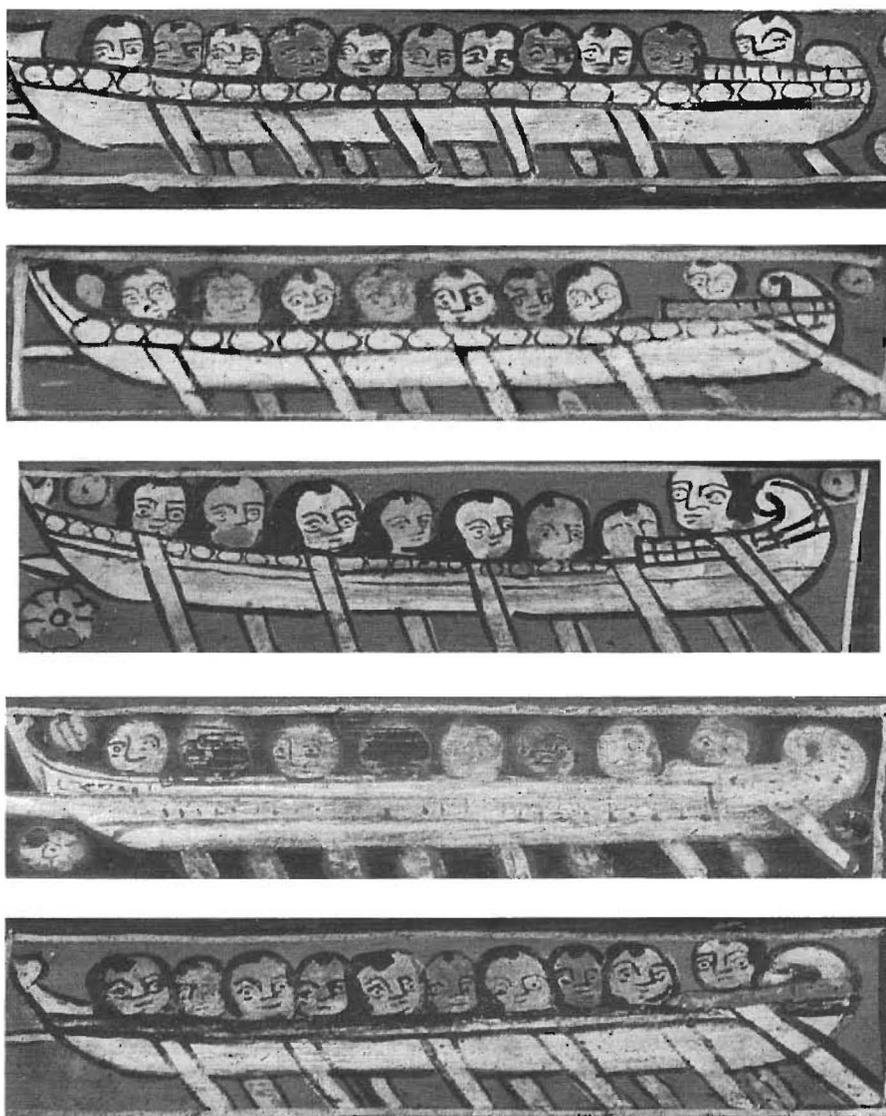


Figure 8. Five different depictions of a class of galley which are either *galees lleugeras* or *galiotes*. Unlike the larger galley depictions these lack a forecastle and have oarsmen placed completely forward in the vessels.

they may be what Muntaner refers to as *galiotes*. This term is used infrequently but generally as a synonym for light galleys. In later usage the term referred to ships which were between heavy and light galleys in size and carried 60–80 oarsmen (Guilmartin, 1974: 213, n. 2). As with the previous warship types, these galleys appear to have round-sterns.

The smallest warship depicted is shown in

Fig. 9. The vessel has a flat-stern and carries a ram, but it is different from all the other ship representations in that the upper torsos of the rowers can be clearly seen and are not hidden behind the bulwark. Its size suggests it is a *sagetia*, which was a common small galley carrying 16 oars (Capmany, 1779: 52; Desclot, 1949 III: 96).

The next four representations are probably



Figure 9. A *tablita* from the Palau Nadal at the Museo de Arte de Catalunya of a *sagetia*. The *sagetia* or 'arrow', was the smallest warship, and was used for raiding and dispatch work in Mediterranean navies.



Figure 10. Probable depiction of a *taride*, which was an oared transport used for carrying soldiers and horses.

support vessels; this distinction is based solely on the lack of a ram. Several types of oared vessels were pressed into service during war, the largest being the *tarides* and *brisses*, which were essentially oared transports used for carrying soldiers and horses (Bofarull, 1898: 9). A contract between Louis IX and the Genoese for the construction of a *taride*, dated 1246, gives the overall length as 35.7 m and a maximum beam of 4.1 m. A contract for Charles I, of 1268, states that the *taride* should be 37.7 m long, have a beam of 4 m, and carry 120 oars (Pryor, 1987, V: 18–19, 105, 115). The ship in Fig. 10 may well be a *taride* or *brissa*. That this is a substantial vessel is shown by *taulas* both fore and aft and a quarter-rudder that protrudes from beneath a high bulwark and sterncastle. The high, recurved stem post is typical of merchantmen of this period and the lack of a ram indicates the vessel was not primarily a warship. This ship may be what Muntaner called a *taride encastellades* (with castles) or a *taride de bandes* (high bulwarks), since it appears to have both (Muntaner, 1860: 518, 525).

The ship type in the chronicles most commonly referred to, besides the *galees*, are the *llenys armats* (armed *llenys*), which could have

40–80 oars (Muntaner, 1860: 442; Desclot, 1949, III: 124; IV: 14). This class of ship was used primarily for dispatch work and for bringing fleeing enemy vessels to bay so that the *galee* could catch and engage them. The fact that Muntaner makes the distinction that they were armed indicates the vessels were probably not light galleys in the full military sense. This is supported by a passage which refers to the capture of *llenys* loaded with cargo (Muntaner, 1860: 299). The ship in Fig. 11 is probably a *llenys* for several reasons. Unlike the larger ship representations the heads and necks of the rowers are visible over the side, the *taulas* are nothing but a light rail through which both the forward rower and the helmsman can be seen, and there is no ram.

A contract of 1360 at the Cathedral of Barcelona for the building of a *llenys* gives an indication of the size of the earlier *llenys* (Madurell y Marimon, 1968: 190). Based on the contract, the *llenys* would have been 21.75 m in overall length with a depth in hold of 2.1 m². The contract specifies 5.18 m width of ceiling planking to completely cover the floors. The overall length compares favourably with the descriptions of vessels with 40–80 oars.

The smallest vessels used were called simply

Table 1. 13th-century ship types in the Catalan chronicles

13th-century names	Vessel type	Oars ¹	Length ²	Beam
Galea	Heavy war galley	100–150	39·5	3·7
Uixer	War galley/transport	45–120		
Galera	Medium war galley ³	80–150		
Galiote ⁴	Medium-light war galley	60–80		
Galea lleugera Galea sutile	Light war galleys	45–80		
Sagetia ('arrow')	Light patrol galley	16		
Ileny armat	Armed merchant galley	40–80	21·8	5·2+
Taride brisse	Oared transports	112	37·4	10·0
Barque armada	Armed boat or barge	24	12·4	2·1

¹The number of oars listed is simply a range of known values for the particular vessel and are not absolute values. A single value reflects the only known number of oars for that type of vessel.

²The overall lengths and beams are given in metres and come from building contracts. This is only one value representing one ship and are examples and not absolute values.

³Desclot makes a subtle distinction between a *galea* and a *galera* but gives no information concerning the difference. The values are based on 14th-century documents.

⁴The term *galiote* appears in both Desclot and Muntaner without any further information. It may simply be another term for a light gallery, though in the 14th century the term was definitely specific. The values are based on 15th- and 16-century ships (Guilmartin, 1974: 23, n. 2).

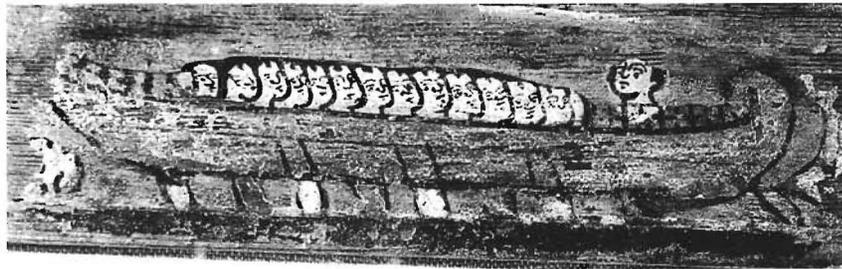


Figure 11. A *tablita* at the Museo de Arte de Catalunya from the ceiling at the Palau Nadal of a *lley armat* with a fan-stern. Unlike the other galley representations this ship does not carry a ram and has neither a forecastle nor a sterncastle.



Figure 12. *Barques armades* from the Palau Nadal. These small boats were armed and used for light dispatch work, inter-fleet transport, and harbour guard duty.

barques armades (armed boats or barges) which could have up to 24 oars (Muntaner, 1860: 442). A document contracting for the building of a *barca* in 1307 lists the overall length as 16 *goarum*, or approximately 12·4 m (Madurell y

Marimon, 1968: 189). Like later *barques armades* their function was probably to move personnel between ships or the shore, and also to act as light dispatch boats. The boats in Fig. 12 are undoubtedly this type of vessel.

All the ships at the Palau Nadal have their oars arranged on one level, this was not the case for the warships which had immediately preceded them. The iconography reflects the dramatic change in the system of rowing which involved substantial design changes in the vessels themselves.

The warships of this period had two rows of oars. One row of oars was placed above the other, with the upper row of oars offset horizontally from the oars below to prevent interference during rowing. This arrangement of rowing with one man to an oar on two separate levels^[3] was a direct descendant of the Byzantine navies (Dolley, 1948: 48). The ships lacked the Roman *apostis*, or outrigger, which had allowed the thole-pins to be moved outboard, increasing the leverage of the oarsmen. This lack of an *apostis* prevented the construction of large warships with a row of oars placed above the lower two levels. Without the outrigger the proper oar gearing could not be obtained, which, coupled with the height of the thole-pins and the increased oar lengths, would have made use of the oars on an upper third level an extremely exhausting process. The addition of a third level would also have entailed raising the sides of the galley. This would have substantially increased the weight of the vessel and raised the centre-of-gravity dangerously high for such narrow-beamed vessels, for even without the third level stability was a problem with these vessels. This is indicated in the account by Desclot of the Battle of Las Hormigas where a French galley capsized when struck on the beam by another because too many men had rushed to one side.

The galleys in the *Cantigas de Santa Maria* (Fig. 3) and on the *biga* at the Museo de Arte de Catalunya (Fig. 13, lower galley) both show the rowing system with the two offset levels of oars and the lack of an outrigger. It has been argued that the light rail on the galleys painted on the *biga* are in fact outriggers, but this seems unlikely for two reasons. First, there are several representations of ships with two rows of oars from this period which lack any outrigger, indicating that for this system an outrigger was not used (Figs 2, 3, 5). Second, the rail appears to be vertical and does not project outboard from the hull. This can be clearly seen on the right hand galley where the rail passes inboard of the quarter-rudder housing.

Despite the problems and limitations, the Catalans seem to have experimented with the limited use of a third oar or *tarsol* during the second half of the 13th century. These oars had lead counter-weights and appear to have been an optional addition to a ship for increasing its speed. Muntaner states that the addition of *tarsols* increased the speed of the light galleys, but goes on to say that only 20% of the fleet should be equipped with them, implying that their use reduced the actual fighting ability of the ship. He further states that 'Whoever is admiral or commander of Catalan galleys will do wisely not to carry *tarsols* in the galleys, but enlisted crossbowmen . . .' (Muntaner, 1860: 259). This passage indicates the galleys had the option of carrying the *tarsol* and could accommodate crossbowmen or rowers but not both.

It is unknown if the *tarsol* was simply the third oar in the *a terzaruolo* system or an addition to the earlier system. That the oar appears to have been optional indicates that it was simply an addition to the old system. It seems unlikely that galleys would be constructed to accommodate a third seat which would be used less than 20% of the time, if at all. If the third bench had existed, there would have been space for the third oarsman and the decision of whether to take crossbowmen or *tarsols* would not have arisen. This also hints that the *tarsol* was used only on the light galleys, since the problem of accommodating extra rowers and bowmen would probably not have existed on the larger galleys of the fleet.

The text of the chronicle also suggests that *tarsols* were only used on light galleys for pursuit, and there is no mention of employing them on the large galleys. In fact, light galleys are listed as *galea lleugera ab tarsols* (light galleys with *tarsols*). This is at direct odds with how the third oar in the *a terzaruolo* system was consistently used on the largest Mediterranean galleys until the introduction of the *a scaloccio* method in the 16th century. By 1320 Sanudo stated that all large galleys in a fleet should carry this third or even a fourth oar, which contradicts the advice of Muntaner (Sanudo, 1611: 57). On a large galley, the high freeboard would have necessitated an oar so long and heavy that its use would have been unfeasible.

For the above reasons, it seems that the *tarsol* was an optional oar used on light galleys. It

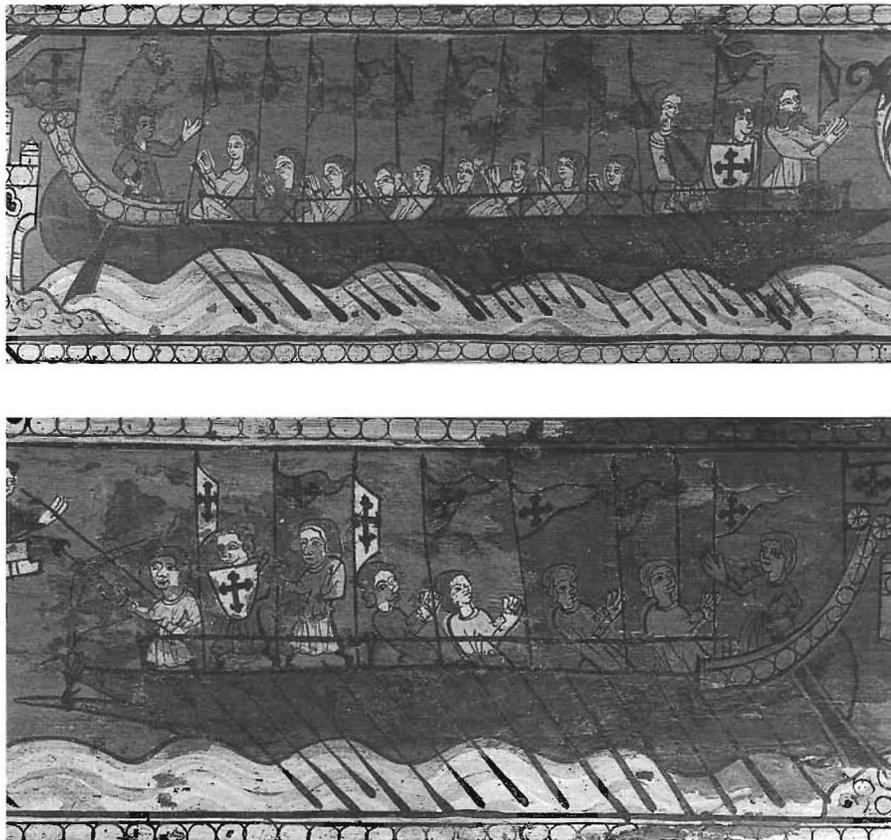


Figure 13. Details from a *biga* (painted beam) dated to the last quarter of the 13th century at the Museo de Arte de Catalunya. The *biga* conforms to the admonition of Muntaner to carry either *tarsols* or crossbowmen but not both. The upper galley is carrying *tarsols* on the upper level of three banks of oars. The lower galley is not carrying *tarsols* but does have crossbowmen in the forward *taula*.

was probably attached to the light rail which galleys often carried above the caprail. The upper Catalan galley in Fig. 13 appears to be using this system. Three different rows of oars can clearly be seen, which rules out the *a terzaruolo* system. The uppermost row is attached to the light rail running the length of the ship. The other galley uses only two rows of oars, neither of which rests on the railing. The galley without the *tarsols* carries a crossbowman whereas the galley with the *tarsol* has none, indicating the choice between either carrying *tarsols* or crossbowmen.

By the end of the 13th century, this system was being replaced by the new *a terzaruolo* rowing system. The new system had the two or three oars all on the same level with their rowers sitting

on the same bench. The outboard ends of the benches are angled forward, allowing three men using separate oars to be accommodated. The *a terzaruolo* system was a major advance in that it permitted lighter and lower galleys to be built without sacrificing speed. By 1290, two men to a bench was in use and the third oar was in the process of being introduced (Sanudo, 1611: 57). The lack of multi-level rows of oars on any of the ships in the Palau Nadal reflects this change.

The use of the new rowing system and the increase in the number of rowers demonstrate the dramatic changes in the internal and external arrangements of the ships. In addition, around 1300, the method of steering was changed from quarter-rudders to a sternpost-mounted rudder.

The absence of representations of ships with fan-or flat-sterns after the start of the 14th century indicates that these vessels were disappearing from the scene.

The beginning of the 13th century had ushered in the dramatic rise for Catalunya as a major Mediterranean force; the 14th century had brought sweeping changes in the vessels which had been used to accomplish her ascendancy. The ships on the ceiling of the Palau Nadal offer an amazingly detailed snapshot of the Catalan fleet at the height of its power, and allow the various names used in the Catalan chronicles to be attached to actual ship depictions. Moreover, the *tablitas* show a fleet in transition using the new rowing system, but without an outrigger, and clinging to construction methods and a steering system which would disappear in a few decades. These vessels which had propelled Catalunya to power would, by the middle of the 14th century, either evolve into ship types with different names or, in the case of some, disappear from the sea forever.

Acknowledgements

The author wishes to thank the Museu Tèxtil d'Indumentària for permission to study and

photograph the ceiling of the Palau Nadal in the museum. The author also wishes to thank the Museo de Arte de Catalunya for permission to photograph the mural, *tablitas*, and painted beam currently on display, and for their kind help during his stay in Barcelona.

Notes

- [1] The word translates as *table* but the use of the word by Muntaner clearly implies it had another meaning. Foerster Laures (1987: 24) makes a convincing argument for interpreting this word as *castle* in the sense of forecastle or sterncastle.
- [2] The actual measurements used in the contract are *guhs* and *palms* which creates a problem in that there were several types of *palms* and *guhs* in use. Based on the type of *palm* used in various contracts, García Sanz (1977: 50) states that a *guh* was 0.777 m and a *palm de guh* was one third of that length.
- [3] Anderson (1962: 52) García Sanz (1977: 64) and Foerster Laures (1987: 22) all state that in the representations which have oars on two levels, the rowers are seated on the same bench on one level. This arrangement would be difficult with the thole-pins for the two oars set at different heights. The rower for the lower oar would be hard pressed to clear his blade for each of the next strokes. He also would have had to hunch over the oar to work it at such a steep angle, which would have been an extremely tiring and inefficient position.

References

- Anderson, R. C., 1962, *Oared Fighting Ships*. London.
- Bass, G. F., 1972, *A History of Seafaring*. London.
- Borfarull y Sans, F., 1898, *Antigua Marina Catalana*. Barcelona.
- Capmany, A., 1779, *Memorias Historicas sobre La Marina, Comercio y Artes de la Antigua Ciudad de Baelona*. Madrid.
- Capmany, A., 1787, *Ordenanzas de Las Armadas Navales de La Corona de Aragon*. Madrid.
- Desclot, B., 1949, *Crónica*. ed. Barcino, Barcelona.
- Dolley, R. H., 1948, The warships of the Late Roman Empire. *Journal of Roman Studies*, 38: 45–53.
- Foerster Laures, F., 1987, The warships of the Kings of Aragón and their fighting tactics during the 13th and 14th centuries AD. *IJNA*, 16.1: 19–29.
- García Sanz, A., 1977, *Història de La Marina Catalana*. ed. Aedos, Barcelona.
- Guilmarin, J. F., 1974, *Gunpowder and Galleys*. Cambridge.
- Madurell y Marimon, J., 1968, Antiguas construcciones de naves 1316–1740. *Hispania—Revista Española de Historia*, 28: 159–196.
- Muntaner, R., 1860, *Crónica Catalana de Ramon Muntaner*. Barcelona.
- Pryor, J. H., 1987, *Commerce, Shipping and Naval Warfare in the Medieval Mediterranean*. London.
- Sanudo Torsello, M., 1611, *Liber Secretorum*. Toronto.
- Throckmorton, P., 1988, *The Sea Remembers*. New York.