In April 1997, the Texas Historical Commission completed the excavation of a small French ship named La Belle. Built in 1684 and possibly given as a gift to Robert Cavalier de la Salle from King Louis XIV of France, the little ship La Belle was one of four vessels that left France in an ill-fated attempt to found a colony at the mouth of the Mississippi River. In 1686, two years after leaving France, the vessel ran aground in Matagorda Bay on the Gulf Coast of Texas. The wreck of La Belle not only provides a unique example of a poorly-documented ship type, but also serves as an early example of many new design and construction techniques in use in the French shipyards. Although only about a third of the hull has survived, sufficient information can be extracted to reconstruct the appearance of the original vessel. The archaeological evidence, in conjunction with naval documents, contemporary models and drawings, and firsthand accounts of its appearance, can be used to answer questions about its assembly and the shipbuilding practices of the seventeenth century. What type of ship was this? How was it designed and built, rigged and outfitted? For an oceangoing vessel, La Belle was very small, but the techniques used to build it were analogous to those used for larger ships, providing a concise and manageable example for the period.

This article documents the construction of two models of La Belle. The first model, constructed during the early phases of the reassembly of the archaeological remains, was used to determine the correct lines and arrangement of the hull. As conservation of the remains progressed, new discoveries were made that contribute to our knowledge of its appearance. The second model incorporates these new findings. The purpose of the models is not only to represent the overall appearance and layout of the original ship, but also to recreate the methods and sequence of its construction.

Evolution of the Barque Longue

Before an accurate set of lines could be reconstructed, it was necessary to determine the type of vessel represented by La Belle. It is widely believed that La Belle is an example of a vessel type called a barque longue, but what was a barque longue?

The term barque longue applies to a range of small vessels first recognized as a distinct type by the French navy in 1675. The classification of barque longue was officially replaced by corvette in 1676. However, vessels in both these classes vary in size and complexity. Between the 1670s and the mid-eighteenth century, the barque longue grew and evolved into what was later considered a sloop of war or light frigate.

Perhaps the earliest representation of a barque longue is from the album of Jean Jouvé dated 1679. This small, undecked vessel carried only a simple two-masted rig and, at most, a few swivel guns as armament (fig. 1). This was...
certainly not a vessel intended for a transatlantic crossing. Eventually, with the addition of a deck, these ships began to carry light four-pounder carriage guns.

The only official record of La Belle refers to it as a barque of forty to fifty tons. Joutel’s journal provides the most complete description of La Belle. Referred to as a bark throughout the journal, Joutel introduces La Belle as “a little frigate, carrying six guns.” Falconer’s Marine Dictionary defines a bark as “a general name given to small ships: it is however peculiarly appropriated by seamen to those which carry three masts without a mizen top-sail.” It is difficult to determine whether the definitions and translations provided by Falconer’s dictionary can be applied to a vessel built a century earlier. However, there is less ambiguity in Joutel’s use of the word frigate. One of the defining features of frigates is the use of a three-masted ship rig. Joutel later mentions a collision between l’Amiable and La Belle in which “the vessel La Belle would have been in danger of perishing, but escap’d with the loss of its mizen, which came by the board.”

Another eyewitness account from the Spanish sailor Juan Enriquez Baroto provides further evidence that the vessel had three masts. Coming upon the remains of La Belle in 1687, one year after it ran aground, Baroto states: “On the beach was found the other gun carriage and the main yard, which was measured and found to be sixteen cubits. We brought this yard and that of the fore topsail for making oars, and from that of the foresail boom was made four oars. Captain Pedro de Yriarte took that of the mizen also.” The mizen yard would have carried a lateen sail and would be easily distinguishable from the yards for the fore and main masts.

If these eyewitness accounts are accurate, it is difficult to refute the assertion that La Belle carried three masts. As a commander on board Le Joly, Henri Joutel had sufficient knowledge of French ships to give a reliable description of the rigging of La Belle. This is significant, for it provides the only evidence that the barque longue had evolved into a form that could be considered a light frigate.

What evidence do the archaeological remains hold to indicate how La Belle was rigged? Remains of mast steps for both the foremost and the main mast have survived. However, the absence of a mizen mast step among the recovered material does not rule out the possibility of a mizen mast.

Taking into consideration the steep rake of its sternpost, the proposed reconstructed length of La Belle places the main mast slightly forward of the longitudinal center point. No reliable contemporary representations of twomasted vessels place the main mast so far forward, suggesting that a third mast was needed to balance the rig. This would be particularly true if the main mast was square rigged, as indicated by Baroto’s reference to the main yard. Thus the preponderance of evidence, both historical and architectural, points to La Belle being a three-masted vessel.

From Joutel’s journal, it is known that La Belle was armed with six guns. It appears that six four-pounder cannon composed the typical armament for a barque longue of this size.

When the remains of La Belle were first encountered by two pilots from Baroto’s ship, they reported finding “a lost ship that has three fleurs-de-lis on its poop; six pieces of artillery, mounted, woolled, and hove down; two iron swivel guns without chambers, which they brought in our canoe.” From this description, it appears that there were six carriage guns on deck secured with lashings. Baroto himself observed five swivel guns the next day “that fire a ball up to four pounds... still upon their carriages, lashed to the side of the ship.” The discrepancy in the number of observed carriage guns may indicate a misuse of the term carriage in the second passage. One swivel gun recovered from the wreck had a bore diameter close to that of a four-pound ball. It is possible that the swivel guns would have been lashed to the sides of the vessel when not in use. While discussing the ordinance, he states that the hull has “eight portholes and as many other flues.” If the word flue indicates the pipe or post attached to the side of the vessel to support a swivel gun, then seven of eight guns were accounted for at the time. The single swivel gun recovered by the Texas Historical Commission could be the eighth gun that fell from the side of the hull before the ship was found by Baroto.

What of the eight portholes mentioned by Baroto? It was common for vessels to have more gunports than the actual number of guns on board. Cannon could be moved from one side of

Fig. 2. Drawing of a light frigate from the album of Guérout du Pas.
the vessel to the other to increase the firepower of a broadside or to transfer weight to adjust the vessel's trim while sailing.

All evidence indicates that La Belle was a frigate, just as Joutel described. Its appearance may have been similar to a light frigate illustrated by Guéroult du Pas in 1710 (fig. 2).

**Reconstructing a set of lines**

A large amount of data is available for a reconstruction of the lines of La Belle. The dockyard manuscript prepared in December 1686, two years after it was built, gives many of the overall dimensions needed for its reconstruction. A set of reconstructed lines based on the archaeological remains, drawn by Greg Cook for the Texas Historical Commission (fig. 3), provides a good first impression of the shape of its hull.

The first step in producing a set of lines for La Belle was to determine the shape of the midship section. Fortunately, a large portion of the starboard side of the hull at midships has survived. Adjusted so the centerline of the frame is vertical, the remains of the midship frame form the basis of the reconstruction. In Joutel's description, the draft of La Belle is given as seven feet (2.268 m). If this is accurate, the archaeological remains represent almost the entire midship section up to the waterline. Figure 24 shows a representative section near midships that combines the archaeological and archival data.

Once the shape of the midship section was determined, the next step was to define the longitudinal profile of the vessel (fig. 4). The length of the keel was known from both the archaeological remains and the dockyard

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Fig. 3. Reconstructed lines of La Belle from data gathered during the excavation and disassembly. Courtesy Texas Historical Commission.

Fig. 4. Reconstructed longitudinal profile incorporating dimensions from the Rochefort dockyard manuscript.
Reconstructed lines of the French Light Frigate

La Belle
Built in the French shipyard at Rochefort 1684

Drawing: G. Grieco

Fig. 5. Reconstructed set of lines used to build the models.

manuscript, and the rest of the hull was reconstructed from the remaining dimensions provided in the document. It appears that the overall length of the vessel was measured from the rabbet of the stem to the rabbet of the sternpost at about the height of the deck. The value for the rake of the stem describes the distance between the forward end of the keel and the forward end of the overall length. The rake of the sternpost is measured from the after end of the keel to the aft perpendicular of the vessel. Knowing that the after face of the sternpost is raked seventy-four degrees and that the rake measures one foot, six inches (48.8 cm), it was calculated that the height at which the length was taken was approximately eight feet, three inches (2.683 m). This corresponds closely to the height of the deck. By transferring this height to the stem and using the known value for the rake of the stem of four feet, six inches (1.463 m) at this point, the curve of the bow was established. The profile of the bow was completed by continuing the curve to a height of twelve feet (3.902 m).

To complete the lines of the stern, the shape of the transom was determined. The height of the wing transom is given as nine feet, four inches (3.035 m), but no other dimensions are provided. In order to determine the length of the wing transom, the French naval regulations of 1673 were examined. The document mandates that the wing transom should be two-thirds of the extreme breadth, or ten feet (3.252 m), if the extreme breadth is measured to the outside of the midship frame.

For the reconstruction, the shape of the vessel was assumed to be a sloop or light frigate. The main deck ran from the bow to just aft of the mizzen, where a break in the deck of two feet (sixty-five cm) forms the floor of a small stern cabin. A short quarterdeck in the stern and a forecastle deck in the bow were located three feet (1.138 m) above the main deck.

Based on these data, a set of lines were created (fig. 5). Sections provided in reconstructed lines drawn by Greg Cook were used to guide the process. Remains of internal bulkheads served as templates and provided a means of checking the curvature of these sections. A series of lines were drawn and manipulated until a fair hull was established, conforming closely to the reconstructed lines of the vessel.

Reconstructing the Hull

The most valuable source of information for the construction of the models was the archaeological remains of the ship. The surviving frames and internal structure of La Belle provide the most reliable evidence of its construction. For this reason, it was considered desirable to display as much of the internal structure of the model as possible. Planking the entire vessel would have obscured important information. In order to best exhibit the reconstruction of the actual archaeological remains, one side of the vessel was left unplanked, allowing the internal structure to be viewed within the hull. Because a significant portion of the starboard side of the ship has survived, this side was completely reconstructed. The port side was not planked, leaving the frames exposed.

Modeling the Frames

Before construction of the models could begin, accurate templates were required for each component of the keel, stem, sternpost, and frames. Templates for the longitudinal timbers were derived directly from the construction drawings. In order
to create molds for the thirty square frame timbers, additional drawings were required. Using a set of lines superimposed over the drawing of the framing plan, the curvature of each frame pair was lifted from the drawing and plotted as a section. Because each pair was composed of overlapping timbers, three faces were plotted to establish the bevel of the external molded faces. Once the outline of the frame was plotted, the molded thickness, as measured from the actual timbers, was used to establish the internal bevels of the frames.

To complete the drawing, the locations of the butt joints between each timber were marked. Using these drawings, templates for the individual floors and futtocks of each frame were obtained.

Paper copies of each template were affixed to pieces of wood, which were then planed to the appropriate sided dimensions. Each timber was then sawn to shape and filed to obtain the correct bevel (fig. 6). Using the body plan of the hull as a mold loft, the frames were assembled from the individual floors and futtocks (fig. 7).

The construction of the keel, stem, and apron was relatively straightforward. Fastened together using the appropriate scarfs, the only deviation from the original construction was the use of bamboo dowels in place of iron fasteners. Although the types of fasteners used on La Belle were known, data regarding their precise locations was not available at the time that the models were built. To avoid confusion, only those iron fasteners whose locations had been accurately determined were represented in the model. The remaining fasteners were represented by bamboo "treenails" using the general overall pattern of the original fasteners.

Fig. 7(below). Lofting the frames using the body plan of the hull as a guide.

Fig. 8 (right). The hawse timbers preassembled and fastened to the forward-most square frame.
A characteristic feature of French ship construction is the absence of cant frames. In keeping with this tradition, the frames of La Belle are all square frames. To fill in the curvature of the bow forward of the first square frame, an assembly of hawse timbers creates a nearly solid wall of timber up to the stern (fig. 8). Bolted together laterally, and fastened at their heels to the forward-most frame, these timbers were often reduced in their sided dimension over part of their length to permit air circulation between them.

The sequence of raising the frames on the models may be a bit of a departure from the actual sequence. While constructing the models, the midship frame was raised first. Then, every third frame forward and aft was fastened into position on the keel. After every third frame was erected, the intermediate frames were inserted. Recent observations of the remains of La Belle suggest that the floors and futtocks of the intermediate frames were installed separately after the other frames were erected.

Figure 9 shows the two completed frame models. From this point, the construction of the two models varied in many ways. A complete description of the construction of each of the models would be repetitive. Instead, this study will focus on the construction of the second model, highlighting the lessons learned from the construction of the first when appropriate.

**Hull Planking**

The remains of at least fourteen strakes of planking were excavated on the starboard side of the shipwreck. The reconstructed midship section indicates the likely existence of one more plank below the wale. If this is the case, the seams of all the lower planks are represented at midships. The widths of the inner faces of the hull planking were recorded for nine frames at the time that the hull remains were disassembled. Using the planking width, the seams of each plank were transferred to the appropriate frame on the model. The locations of scarfs, stealers, and drop strakes were marked on the outside of the frames. Using a batten, it was simply a matter of connecting the dots to determine the run of the individual strakes. The scarfs and plank ends then fell easily into place within the strakes. In reconstructed areas not represented by archaeological remains, the batten was allowed to run fair to complete the strakes. By allowing the shape of the hull to determine the run of the planking, remarkably uniform hood ends were obtained in the bow and stern (fig. 10).

Strips of poster board were used as spiling battens. With the batten clamped to the frames, the contour of the exposed edge of the previous plank was transferred to the batten using a compass. The batten was then used as a template for the next plank.

The fair run of the planking allowed the use of straight-sided planks. Where the edges of adjacent planks diverged, stealers were used. The capacity to use straight, almost parallel-sided planks minimized waste and increased the efficiency of the planking. The ease with which the hull was planked and the similarity between the
shapes of the spiles and the original planks indicate that the reconstructed shape of the model is close to that of the actual vessel.

Ceiling

Some difficulties were encountered during the first attempt at installing the ceiling on the model. Although it had been assumed that the process began at the keelson and proceeded outward, it quickly became evident that this was not the correct sequence. The inner strakes feathered out to sharp points at the bow and stern, where they encountered the four outer strakes, indicating that they were installed last. In the case of La Belle, an outer notched strake was inserted first, followed by two ceiling planks. A second stringer was then notched to fit like the outer timber. With these four strakes in place, the remaining planks were installed, working from the keelson outward.

The filler piece that sealed the edges of the ceiling was set into shallow beveled notches in the sides of the frames (fig. 11). Tool marks around the notches indicate they were sawn using the outer edge of the ceiling stringer as a guide. This could not have been accomplished if the external planking was in place at this height. The hull was planked either ceiling-first or simultaneously inside and out. Only iron spikes were used to fasten the ceiling planks until the outer planking was attached. Treenails were then used to fasten the outer hull planking from the outside through to the ceiling. As it was difficult to control the direction of the auger when boring holes for the treenails, the treenail pattern on the external planking is more uniform than that on the ceiling.

The tight fit between the filler pieces and the external planking suggests two possibilities. Either the filler pieces were installed prior to the planking and fairied to the depth of the adjacent frames, or the outer plank was attached after the notches were cut, with considerable care taken to shape the filler pieces to the complex contour of the inner faces of the frames and planking. Judging from the tight fit between the filler piece and the external planking, the first method seems more likely. Figure 12 shows these filler pieces prior to installation, and figure 13

Fig. 11. Notches cut in forward and after faces of the frames for the filler pieces.

Fig. 12 (left). Filler pieces cut to fit around the frames. Fig. 13 (right). Filler pieces in place along the edge of the outermost ceiling plank. The riders of the mast step can be seen in the lower right corner.
Fig. 14 (left). Forward and aft rider timbers of the main mast step. The notches in the faces of the riders will accept the ends of the mast step partners.

Fig. 15 (right). Installation of the mast step partners.

shows them in place, bordering the ceiling plank on the model. The riders of the mast step can be seen in the bottom right corner.

Mast Steps

Aside from slight erosion at the ends of the port arms of the floor riders, the main mast step has survived in its entirety. Figure 14 shows the two rider timbers prior to installation over the ceiling. The curvature of the lower face of these timbers was taken directly from the archaeological remains. Because they fit snugly against the ceiling in the model, these timbers helped to verify that the shape of the hull in this area was accurate. Figure 15 illustrates the way in which the beveled ends of the mast step partners locked tightly between the notches in the riders, preventing lateral movement of the heel of the mast. Figure 16 shows the complete mast step assembly with buttress timbers and filler pieces inserted between the ends of the partners.

Although only part of the foremast step has survived, the symmetry of the structure permitted a full reconstruction (fig. 17). A plank inserted between the notches in the opposing arms supported the aft face of the heel of the foremast.

Fig. 16 (left). Completed main mast step assembly.

Fig. 17 (right). Heavy breast hook in the bow serving also as the step for the foremast.
Deck Framing

Nothing remains of the original deck structure of La Belle. Without the benefit of archaeological remains, the scantlings of the timbers are difficult to determine. Careful examination of models, drawings and treatises such as the Album de Colbert and the Album del Marquez de la Victoria helped to determine the relative sizes of the individual timbers forming the deck framing. Once the sizes of the deck beams were estimated the scantlings of the other components of the deck were calculated.

The first step in installing the deck was to determine the run of the deck clamps. Estimating the height of the clamps from the deck heights on several early eighteenth-century drafts, it appears that on a vessel with one continuous deck from bow to stern, the upper face of the clamp is typically flush with the upper edge of the lower wale at midships. This point was established for the wale during the reconstruction of the midship section. Running parallel with the top of the lower wale through the waist of the vessel, the clamp begins to diverge toward the stern as it rises on the inside faces of the futtocks to butt against the forward face of the wing transom. However, if La Belle was a sloop of war or light frigate, its main deck would not have run all the way to the stern. Olivier made the following observations concerning sloops of war of twelve guns: “Such vessels should have but a single deck, with the guns only as far as the mizzen mast, where the upperworks should be raised two feet, with a quarterdeck three feet above the upper deck. In the event that we should build sloops of war of ten, eight, six or four guns, they should be fitted out like those of twelve guns.” A break in the deck just aft of the mizzen mast, with a deck two feet (sixty-five cm) below it and a quarterdeck three feet (1.138 m) above, suggests the presence of a stern cabin. For this reason, the main deck clamp would have supported deck beams back to frame XIIID. From XIIID aft, the deck beams of this small stern cabin would have been supported by the ceiling plank two feet (sixty-five cm) below the clamps.

Having less sheer than the wales, the clamp typically dips below the level of the lower wale in the bow. This configuration varies from ship to ship. Ships often had a small bulkhead just aft of the hawse holes to catch water draining from the anchor hawser. Forward of this bulkhead was a scupper with its outboard end centered between the two wales. If the clamp dipped too low, this area would not drain properly. To avoid this problem, the deck clamp was positioned at a height that allowed a drainage angle of about thirty degrees from the top of the deck.

Next, the locations of the deck beams were determined. Figure 18A indicates the deck beams whose presence is indicated by the surviving internal structures. The lower image, 18B, shows the beams that supported the stanchions of the three bulkheads and the pump well, as well as the beam that supported the upper end on the notched stanchion amidships. The upper image in figure 19A illustrates the addition of beams to support the fore, main, and mizzen masts. Forward of the first bulkhead and the notched post, beams were added to frame the forward and main hatches. The hatch aft of the pump closet required another beam. The lower image shows the addition of a beam aft of the foremost to support the bitts of the wind-
lass. Three additional beams were positioned to break up spans of more than three feet (97.6 cm). In order to tie the clamps together at the bow and to add lateral strength, a breasthook was notched down into the clamps and bolted through the futtocks. With molded dimensions equivalent to those of the deck beams, the breasthook also served as a fastening surface for the forward ends of the waterways and planking.

Construction of the deck framing began by dovetailing the deck beams two inches (5.4 cm) into the clamps (fig. 20). The dovetail joints increased the lateral strength of the hull and tied the sides of the vessel together. With all the beams placed in their proper positions, the locations of the hatch carlings and mast partners were marked.

These timbers had the same dimensions as the deck beams and were set into beveled notches in the fore and aft faces of the beams. Next, the locations of the carlings, windlass bitts, main bitts, and bowsprit step were determined.

Next, the beams were reinserted into the clamps. Filler pieces measuring two inches by four inches (5.4 cm by 10.8 cm) were inserted between the dovetails in the beams to fill the space between the top of the clamps and the bottom of the waterways. The two waterway timbers were then placed over the ends of the beams (fig. 21). The waterway timbers measured eight inches by four inches (21.7 cm by 10.8 cm) and were notched over the deck beams to a depth of two inches (5.4 cm). With the waterways in place, the carlings and ledges were inserted.
Deck Planking

On both models, only the starboard side of the deck was planked. This not only permits the inspection of the internal construction features, but also allows the details of the deck framing to be seen. Due to the absence of archaeological evidence, the deck planking pattern on La Belle will never be determined for certain. The deck planking of the model approximates the appearance and planking patterns of models from the seventeenth and early eighteenth centuries.

Thin strips were cut from black plastic binder cover sheets to insert between the planks to represent the tarred seams. Each plank was fastened to each deck beam using two one inch (2.7 cm) diameter treenails. Figure 22 shows the completed deck planking.

Gunports

Before the gunports were cut and framed, their locations were determined. Many factors were considered in determining the placement of cannon on a narrow-decked vessel like La Belle. Structures such as hatch coamings, masts, pumps, and bitts, can prevent them from being withdrawn from their ports. Outside of the hull, the location of the fore and main mast channels can dictate the placement of gunports. The breadth of the vessel is also a limiting factor. The barrel of a four-pounder cannon is six feet (1.951 m) long. With a deck less than fourteen feet (4.553 m) wide and a foot of tumblehome in the waist, two cannon barely fit abreast with the port lids closed. Forward and aft of midships, the narrowing of the deck would prevent this arrangement entirely unless the guns were drawn in at an angle. Consideration must also given to the gun crews who fired the guns. Seventeenth-century French naval regulations required a minimum spacing of six feet, six inches (2.114 m) between the guns on larger warships to provide room for the crews to service them.

The reconstructed breadth of the gunports was calculated to be eighteen inches (48.8 cm) square. This calculation was later confirmed by a single gunport lid found during the excavation of La Belle. The frames were erected on eighteen-inch (48.8 cm) centers, conveniently allowing the top timbers of two adjacent frames to be used to frame the sides of the ports.

Fig. 22. Deck planking on the starboard side of the model.

Fig. 23. Longitudinal profile of second La Belle model showing placement of three gunports on each side.
Two possible configurations were formulated. The first configuration relied on Enriquez Barroto’s description of the hull and assumed the use of eight gunports. Employed on the first model, this arrangement allowed the forward two pairs of guns to be secured inboard with the gunports closed, but the space available on deck between the aftermost pairs of ports was not sufficient for two guns to be positioned abreast. This suggests an eight port configuration using only six guns. With four guns in the forward four ports, the two aftermost guns could be used one per pair of ports and moved from side to side as necessary. The second configuration assumed that only six ports were present (fig. 23). In this arrangement, space would have been tight between the aftermost pair of guns. However, with a slight angling of the carriages, both guns could have been run in when the ports were closed.

Once the locations of the ports were estimated, the top timbers at the port openings were cut to a height of eleven inches (29.8 cm) above the deck. A three inch (8.1 cm) thick lintel raised the sill to the required height of one foot, two inch (37.9 cm). A second timber of the same dimensions formed the upper edge of the gunport.

Bulwarks

Before the bulwarks were planked, several fittings were installed in the framing above the wales. Scuppers were needed on La Belle to allow water to drain from the deck. Typically, ships were equipped with several scuppers in the waist of the vessel and in the manger at the bow. By the early eighteenth century, lead scupper pipes were already in use aboard ships in the French and English navies. In the case of La Belle, however, no lead artifacts that resembled scuppers were found among the archaeological remains. It is possible that the lead linings were scavenged from the hull after its grounding, although it is equally possible that its scuppers were not lead lined. Bored elm blocks with leather linings were commonly used as scuppers during the fifteenth and sixteenth centuries. The practice was still in use aboard English vessels during the late seventeenth and early eighteenth centuries and may have been used on vessels of other nationalities as well. Considering the absence of evidence for metal linings, wooden scuppers appear to be the best solution. Contemporary drawings of small vessels depict five to seven scuppers in the waist and one at the bow for the manger. Because cutting a hole for the scuppers in one of the wales would have compromised the strength of the timber, contemporary drawings show the outlet of the scuppers in the strake between the two wales. Placing the deck clamp at the height of the lower wale, the angle from the top of the deck to the outlet of the scupper is close to forty-five degrees (fig. 24). For the reconstruction of La Belle, five two-inch (5.4 cm) scuppers were provided in the waist and one in the bow.

While sailing, several lines of rigging must run through the sides of the hull. To assure the proper lead of the sheets and braces, three sets of fairlead blocks were set into the hull (fig. 25). Positioned between the second and third frames forward of midships, a
single sheave block on each side of the hull trimmed the fore sheets. Between the second and third frames aft of midships, a double sheave block is provided for the fore yard braces. Finally, a double sheave block for the main sheet and braces is set between the sixteenth and seventeenth frames aft.

After these elements were installed, the planking of the bulwarks was completed. The reconstructed midship section was used to define the dimensions of the planking. Externally, the planking was composed of parallel-sided planks that continued the curve of the wales up the side of the vessel. Contemporary drawings of small vessels and frigates indicate that the space between the upper wale and the molding below the waist rail typically consists of three strakes, with a single strake between the waist rail and the sheer rail, and another between the sheer rail and the drift rail. By dividing the space between the wale and the molding, it was determined that three nine-inch (24.4 cm) wide planks were required. Continuing up the sides of the stern, two additional nine-inch (24.4 cm) planks alternating with two three-inch (8.1 cm) moldings provided the height necessary for the quarterdeck. One additional plank in the bow provided the height needed for the forecastle deck. The reconstructed thickness of the planking in the upperworks was one inch (4.1 cm).

Armament

As mentioned earlier, the armament carried on La Belle included two types of ordnance: six iron carriage guns firing four-pound balls, and breech-loading iron swivel guns. Several artifacts relating to these guns have survived. Although no four-pounder long guns were recovered from the wreck, two four-pounders were among the guns excavated from the remains of Fort St. Louis on the Gulf Coast of Texas. Using scale drawings, models of the barrels were turned in brass at the scale of one to twelve, and then blackened to imitate the appearance of the original iron guns. Measurements from a single gun carriage recovered from the wreck were used to reconstruct the carriages for the model (fig. 26). Interesting features of the recovered carriage include the deep mounting holes for the trunnions and the flat capsquare locking the trunnion in place. It is more typical to have the trunnion resting in a semicircular notch half the depth of the trunnion, with the upper surface held in place by a capsquare forged with a corresponding semicircular contour. The reason for the position of the trunnions on the sides of the gun carriage on La Belle is unknown.

A related artifact recovered from the hull consists of concretions containing a ring bolt and an associated hook bolt (fig. 27). Clearly intended for securing the gun tackle to the bulwarks, the conserved artifacts furnish several important pieces of data. Preserved by the corrosion products of the iron, a large section of the wood through which
the bolts were fastened has survived. Although the original thickness of the wood has diminished, a rove for the forelock of the hook-bolt has corroded into the position where it rested against the outer surface of the hull planking. Neither the rove nor forelock has survived on the ring bolt; however, the remains of the shank indicate that the bolt ran through timber approximately two inches (5.4 cm) thicker than the hook. This suggests that the hook pierced the outer hull planking while the ring bolt penetrated a wale. Superimposing a scale image of these artifacts over the bulwarks of the reconstructed midship section, the angle of the bolts and their lengths provides supporting evidence for the reconstruction (fig. 28).

Also found on the wreck was a loaded swivel gun attached to its post and mounting hardware (fig. 29). The conserved gun was 54.55 inches (1.478 m) long from the muzzle to the tip of the tiller (fig. 30). The muzzle had a bore of 3.42 inches (9.3 cm), close to the bore diameter of the four-pounder carriage guns. Although Baroto mentions that the swivel guns appeared to be capable of firing a four-pound ball, the breach of the barrel contained a two-inch ball and the chamber held a powder charge with a wooden plug. Primarily used as an anti-personnel weapon, the gun could also have fired a handful of small shot.

Iron swivel guns were used aboard vessels from the sixteenth through the eighteenth centuries. Examples of wrought iron, stave and hoop constructed weapons almost identical in design and dimensions to the one found on La Belle have been found on shipwrecks from as early as the sixteenth century. The post and mounting hardware still attached to the gun were more unusual finds. The swivel was set into a hole in the top of the five-inch (14.9 cm) diameter post. A two-inch (6.1 cm) wide iron band encircles the top of the post, and four inches (10.8 cm) down from the band a two-flanged iron strap that went around the

Fig. 28. Drawing of the bulwarks of La Belle showing how the hook and ring bolt may have been oriented.

Fig. 29 (left). The swivel gun recovered from the wreck of La Belle.

Fig. 30 (below). Photograph of the swivel gun after conservation. The breech chamber and wedge are not shown in this photo. Courtesy of the Conservation Research Laboratory.
front of the post and twisted ninety degrees to fix the post to the top of the caprail. Each flange had three holes down the center for the nails that attached it to the top of the caprail. Examination of many contemporary drawings and treatises did not reveal any images of a swivel post with this configuration.

**Rigging**

At the time the models were constructed, few artifacts from the rigging of *La Belle* had been identified and conserved. Therefore, the reconstruction has focused on the hull of the vessel as it would have looked as a bark or light frigate. The rig employed on the model is a generic rig representative of ships of this class during the late seventeenth century. Although the heel of the main mast was recovered, not enough of it has survived to determine its maximum diameter at the deck. Mast dimensions were estimated from the sizes of various deadeyes (fig. 31) recovered from the site. A single topmast fid (fig. 32) provided additional clues for the dimensions of one of the topmasts. Preliminary dimensions for the spars and rigging were taken from contemporary formulas and adapted according to the mechanical advantage necessary for the proper function of the component. Where the dimensions of rigging elements such as deadeyes and certain types of blocks were known, scale copies were constructed and implemented in the rig.

**Conclusions**

The primary question of this study was “What is a *barque longue* and what can *La Belle* tell us about this type of vessel?” Existing descriptions of the *barque longue* were heavily influenced by its long history as a small, undecked vessel. Every contemporary source describing a *barque longue* depicts a ship with only two masts. The problem lies in the fact that *La Belle* is too developed to fit the accepted definition of a *barque longue* but too small to fit the definition of a frigate. With this in mind the problem becomes, “which type of vessel is more similar structurally?”

If *La Belle* was a *barque longue*, its remains indicate that the development of the vessel type has been underestimated. Eyewitness accounts of the vessel, as well as the archaeological remains, provide a great deal of evidence that this ship fit the description of a sloop or frigate in every aspect except size.

Construction of the models was remarkably straightforward, a good indication that many of the assumptions made during the reconstruction of the upperworks and rig were plausible. Enough evidence exists to establish a high degree of confidence that the final configuration of the hull is realistic. Although the rig is based on only a few surviving artifacts, the results are appropriate in both size and arrangement. This reconstruction supports the argument that the *barque longue* evolved into a much more substantial vessel than previously assumed and that there was little to distinguish this type from the sloops and light frigates of the French Navy.
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