

Technical Communication



A bronze cannon from *La Belle*, 1686: its construction, conservation and display

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Introduction

An example of how important a single object can be for the identification of an archaeological site is the bronze cannon (artefact no. 00753) raised from a shipwreck (site designation 41MG86) discovered in July 1995 during a remote-sensing survey in Matagorda Bay on the Texas coast (Carlin & Keith, 1996). Working under the aegis of the Texas Historical Commission, survey director J. Barto Arnold III immediately realized that it might be the wreck of *La Belle*, a *barque longue* known to have been lost in 1686 during the failed attempt of noted French explorer Robert Cavelier Sieur de La Salle to found a colony on the coast of what is now the state of Texas. In the hope that they might securely identify the site, the cannon and a variety of other artefacts were brought to the Ships of Discovery conservation laboratory at the Corpus Christi Museum of Science and History for cleaning, analysis, and conservation (Fig. 1). Although hundreds of other artefacts were recovered from the shipwreck during the 1995 test excavation, the bronze cannon was the most impressive and helpful in identifying the site. Additionally, it has served as a symbol of

the project and a rallying point for fundraising efforts. It is now the nucleus of a travelling exhibit, '*La Belle*, the Mystery of La Salle in the Gulf,' prepared by the Museum and now touring the state. This report includes descriptions of the cannon, the conservation processes used, and the travelling exhibit that resulted.

Evidence of construction

The cannon is 72 inches (183 cm) in total length and weighs 792.5 lb (360.2 kg). The bore is difficult to measure precisely, but is close enough to the specified diameter of a four-pounder, 3.3 inches (84 mm), to make a positive identification (Anon, 1996: 93). When cleaned, the cannon was found to be highly decorated (Fig. 2). Forward of its astragal and fillets the muzzle is surrounded by eight repetitions of an acanthus leaf and blossom design in relief, a commonly-used motif imitating Corinthian column capital decoration. Although the cannon bears no numerical date, it does carry an armorial device which securely dates its manufacture to the years immediately preceding La Salle's departure from France in 1684. The device, composed of a pair of crossed anchors entwined by a banner bearing the inscription



Figure 1. The bronze cannon after conservation.

'LE COMTE DE MONTMORIN MOUNTS THE BARRIL SECOND REINFORCEMENT' (Fig. 3). The Count of Bourbon, Comte de Bourbon, was in France from 1669 to 1699. The cannon cast in 1684 bears his title.

The floral decoration on the barrel forward of the muzzle appears to be an acanthus leaf and blossom stylized to resemble a column capital. It wraps around the barrel and terminates at the muzzle on either side, like the chase undecorated. The decoration is somewhat bug-eyed. The dolphins are named 'L' of Louis XIV between the barrels and carries a large 'L'. Four unevenly spaced rings on the barrel in line with the crowned 'L' in the

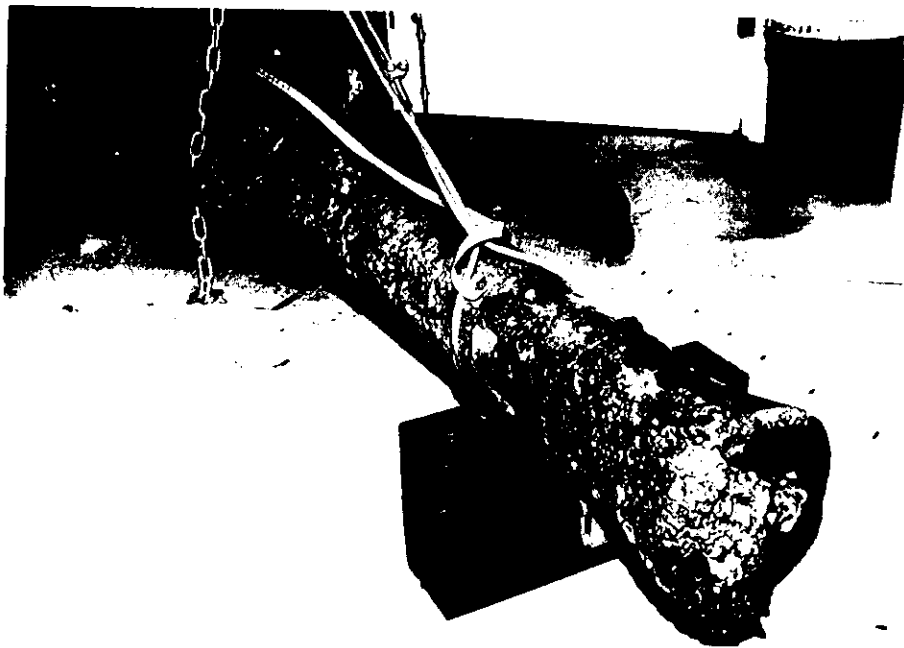


Figure 1. The cannon before cleaning, as it arrived at the Ships of Discovery conservation lab. (D. H. Keith)

'LE COMTE DE VERMANDOIS' surmounts the barrel just in front of the second reinforce acanthus leaf decoration (Fig. 3). The Count of Vermandois, Louis de Bourbon, was the *Grand Admiral* of France from 1669 to his death in 1683, and cannon cast in royal foundries during that period bear his title (Boudriot, 1992: 26).

The floral decoration in high relief on the barrel forward of the fourth ring appears to be an acanthus blossom pattern stylized to resemble the *fleur-de-lys*. It wraps around the top of the barrel, but terminates at the midline of the trunnions on either side, leaving the underside of the chase undecorated. Other than being somewhat bug-eyed and toothy, the dolphins are naturalistic. The crowned 'L' of Louis XIV is placed prominently between the breech reinforcement rings and carries a large *fleur-de-lys* at its apex. Four unevenly-spaced holes are set around the barrel in line with the foot of the crowned 'L' in the first reinforce. These

were created by the crown pieces or chaplets, parts of the iron armature originally set inside the mould to hold the lower end of the core (bore insert) in place during casting. Spaced 90 degrees apart, they are approximately 45 degrees offset from the vent.

Surrounded by a 'scallop shell' and floral pattern in the vent field, the vent itself is angled rearward 77 degrees from horizontal, entering the bore 0.125 inches (3 mm) in front of its terminus. The vent was found to be partially occluded by a poorly-preserved material which disintegrated during cleaning. The obstruction may have been the bronze corrosion products which formed a tube shape as they grew inside the touch hole. Alternatively, the vent may have been sealed with a solid metal plug, or sleeved with a tube of less resistant metal. Armstrong (1994: 15) reports the presence of a threaded vent in an English bronze saker cast by the Owen (spelled 'Owyn' on the cannon) brothers in

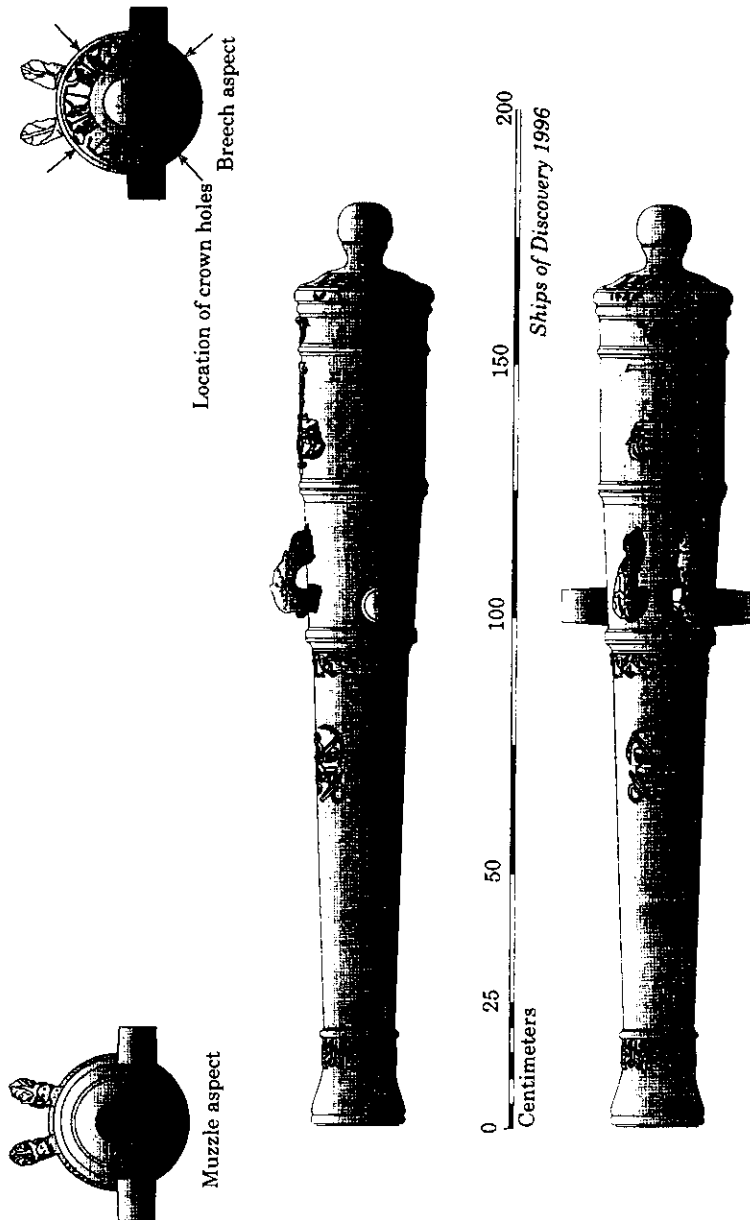


Figure 2. Drawing of the cannon. (D. H. Keith)

1543, and suggest that the piece had been made in the late 15th century. When cleaned, the cannon was found to be 8.1 mm in diameter and 1.2 m in length, and the peacock pattern was visible at the base of the barrel around the muzzle.

The numerical base ring, 'N° 4'



Figure 3. The armorial device. (Juan Rodriguez)

1543, and suggests that the threads may have been added to receive a liner after the piece had seen much use (Armstrong, 1994: 20). When cleaned, the vent on the *Belle* cannon was found to be 0.32 inches (8.1 mm) in diameter, 3.5 inches (88.9 mm) in length, and perfectly smooth inside. The acanthus pattern in low relief surrounding the base of the breech is similar to the one around the muzzle.

The numerical markings incised on the base ring, 'N° 4' to the left of the vent and

'N° 741' to the right, were puzzling at first. Although the cannon was a four-pounder, it seemed unlikely that its calibre would be marked on its base ring. The 'N°' before the '741' and the fact that the cannon weighed 792 lb seemed to argue against the possibility that the '741' referred to the piece's weight. When two other bronze four-pounder cannon were discovered deep in *Belle's* hold, the marks on their rings only deepened the mystery.¹ These cannon appear to match precisely the one



Figure 4. Markings on the base ring of one of the matching bronze cannon. (John de Bry)

described in this article, save for the base ring markings. One of these cannon bears the stamped numerals '746', followed by a curious mark in superscript which looks like the letter 'u' with a horizontal line through it, followed by 'N° 84.' The other cannon shows similar markings except that the first number is '744' and the second is '85' (Fig. 4). Unlike the markings on the cannon described in this article, those on the two newly-discovered cannon are clustered on their base rings just to the right of the vent field.

The mystery was finally solved by intensive research in French archives. Combing various records for additional information about La Salle's unlucky expedition, John de Bry of the Center for Historical Archaeology discovered a document which not only explained the significance of the base ring numbers, but also the value of the French pound at the time the cannon were cast and the fact that the cannon were carried as cargo, rather than as part of the ship's battery. Dated 15 September 1682, the document contains an inventory of 42 iron and bronze cannon removed from the warship *Faucon*, including four bronze four-pounders (*Archive du Port de Rochefort*, I H3 5). The inventory numbers and weights given for the four-



Figure 5. Spiral grooves around the walls of the bore. (D. H. Keith)

pounders match precisely the markings on the three guns excavated from *La Belle*.² The document also establishes that they were cast at the Rochefort foundry under the direction of master founder Jean La Tâche. As the Rochefort foundry began production in 1670 and La Tâche died in 1679, the cannon must have been cast during that interval.

The bore measured 61.6 inches (1.565 m) in length. The interior of the bore bears a clear, broadly spaced spiral pattern (Fig. 5). Armstrong (1994: 15) reports what may be a similar pattern inside the bore of the Owen saker mentioned earlier, identifying it as '... marks from a left handed reaming bar ...', but there is another possibility. Writing in 1540, Biringuccio (Smith & Gnudi, 1959: 241) mention that some cannon-makers reinforced the cores used to create bores in their cannon by spirally wrapping them with iron wire, the impression of which

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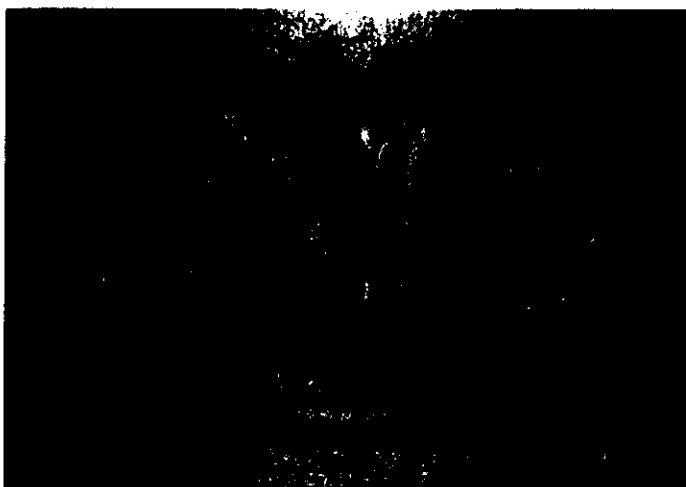


Figure 6. Detail of acanthus decoration showing tool pattern.
(Juan Rodriguez)

would appear as a spiral groove inside the bore after casting. Armstrong states that the spiral in the bore of the Owen saker is one turn per 2.5 inches (63.5 mm). Biringuccio says the spacing between the iron wire spirals around a core should be not more than 2 dita (c. 2 inches, 50 mm). The spirals in the bore of the *Belle* cannon appear to be slightly irregularly spaced 1.6 inches (41 mm) apart, at an angle of about 22 degrees. The crisp bore detail may be an indication that the cannon had not seen much service. Cast iron shot were found near the cannon, as well as a large quantity of small lead shot of various diameters, perhaps representing canister shot.

Close inspection of the surface of the cannon around the armorial device and around some of the floral decorations revealed the distinct pattern created by the tool used to blend the decorations, moulded separately (Boudriot, 1992, V:pl. XIII), onto the surface of the original model from which the cannon mould was made (Fig. 6). The surface appearance of the cannon varies considerably from the breech to the muzzle. At the muzzle the surface is smooth and well-preserved, but the cascabel, the base ring and the top

of the first reinforce—particularly around the crowned 'L'—are rough and pitted. That this difference in condition is not due to cleaning and conservation treatments, but rather existed from some point in the remote past, even from manufacture, is verified by the slabs of intact concretion removed from the breech area which show, in negative relief, that the cannon's surface bore the same rough finish when the concretion began to form (Fig. 7). Biringuccio (Smith & Gnudi, 1959: 250, 259) mentions that 'sponginess' on the surface of a cast bronze cannon can result from an incompletely dried (clay) mould, or from an insufficient mass of bronze in the 'feeding head' reservoir above the muzzle. Armstrong (1994: 12) reports 'heavy honeycombing' on the muzzle of the Owen saker which he attributes to selective corrosion of the tin component and speculates that the condition may have resulted from differential cooling rates between the upper and lower portions of a buried, vertically cast cannon. Writing at about the same time as the Owen cannon was cast, Biringuccio states that it is considered good practice to add a quantity of raw tin to the molten bronze in the 'filling head' during casting

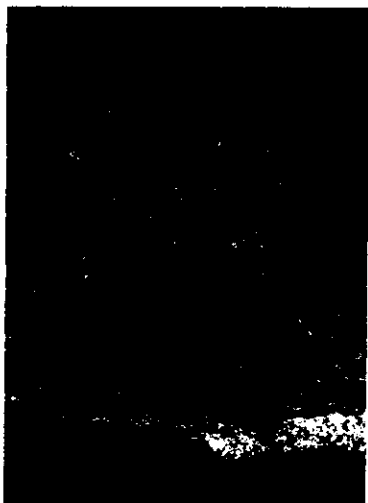


Figure 7. A slab of concretion removed from the foot of the crowned 'L' showing that the rough surface existed before concretion began to form. (D. H. Keith)

in order to make the bronze 'fat'. Without benefit of further metallurgical testing it is not possible to ascertain whether the striking difference in surface condition is the result of a manufacturing flaw, use, or deterioration on the seabed.

The absence of mould marks, longitudinal or transverse, indicates that the cannon was cast in an essentially one-piece, one-use, clay mould. Although passing reference to how cannon were cast is easily found in the literature, most of these are sketchy and wholly inadequate for either enabling a modern founder to cast a cannon in the same manner or for alerting the archaeologist/conservator as to what to look for. Guilmartin (1981: 68; figs 8 & 8a) comes closer than most, but certain important observations are lacking. The keys to understanding the process can be found in Biringuccio's 16th-century description of bronze cannon founding (234-260; appendix A, fig. VI), and in 18th-century diagrams such as those reproduced by de Beer (1991).

The first step in the process was to create a model of the cannon's symmetrical shape

without decoration (dolphins, trunnions, mouldings, cascabel, armorial device, or floral reliefs). This blank model, probably made around a wooden core wrapped with rope and finished with clay, determined the cannon's basic shape and dimensions. Biringuccio states that the simplest moulds in the first half of the 16th century had three parts: breech, body, and bore core. To these would often be added two trunnion caps and a guide for the core fitted above the muzzle (Smith & Gnudi, 1959: 238). Eighteenth-century schematics show a more elaborate, but probably more efficient way of casting cannon in sand after the master model had been cut into sections, but this technology was probably not available to the founders of the *Belle* cannon. In either case, the trick was to attach the reinforce rings, trunnions, dolphins, and other decorations to the surface of the blank in such a manner and with such a material that the solid blank could be driven out of the mould once it had hardened (taking advantage of the taper that every piece of ordnance has). The decorations remaining in the mould when the 'blank' was removed subsequently could be melted, burned or scraped out.

It was also necessary to install iron chaplets inside the mould to hold the breech end of the bore core precisely in the centre of the mould, even against the force of hundreds of pounds of cascading molten bronze. A filling chamber was added above the muzzle section which acted as a funnel to receive the molten bronze from the furnace, as a reservoir to insure the mould would fill completely, and as an attachment point for the upper end of the bore core. After pouring the bronze and letting it cool for several days, the exterior clay or sand mould was shattered, the core extracted, the excess bronze in the filling head cut off and the vent cleared (if part of the mould) or drilled.

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model to be re-used and re-decorated with a minimum of effort, streamlining the manufacturing process at the expense of artistic symmetry. Where the patterns on the muzzle and the back of the breech wrap completely around the cannon to re-connect with themselves, there are obvious mismatches. These observations may be physical evidence of the implementation of the Ordinance for French Naval Forces of 1674, in which limits to decoration are specified in order to save time and increase production:

Les ornements des pièces seront conformes aux modèles qui seront envoyés par Sa Majesté, en qui il sera observé de les rendre fort unis, à cause de la quantité qu'il en faut pour la marine, ce qui ne permet pas d'employer le temps nécessaire pour les mouler & pour réparer les ornements. The decorations of the pieces will be in accordance with the models which will be sent by His Majesty, and it will be noted that they will be made very uniform, because of the quantity required for the Navy, which does not allow the necessary time to mould and repair the ornaments'.

Conservation

From the time it was raised, the cannon was kept moist. Once in the laboratory it was placed in a mild steel tank lined with a $\frac{1}{16}$ inch (1.6 mm) EPDM (ethylene-propylene terpolymer) rubber sheet and filled with tap water adjusted to pH 10 with the addition of sodium carbonate. Castors were attached to the tank to facilitate moving it and special wooden cradles were installed inside to distribute the weight of the cannon over the delicate rubber liner and prevent punctures. A mobile 2000 lb (909 kg) capacity floor crane made it possible to remove and replace the 792 lb (360 kg) cannon and more it about the laboratory as necessary. The relatively inexpensive floor crane was found to be much more versatile than an overhead trolley and chain fall combination.

Approximately 65% of the exterior surface of the cannon was covered with

marine encrustation. Most of this encrustation was relatively easy to remove using wooden wedges and a rubber mallet. The bore, however, was another problem. Because residual corrosion products and extraneous material in the bore would provide sites for continuing corrosion, a great deal of effort and ingenuity was expended to make the bore as clean as possible. A small opening in the concretion at the muzzle permitted the insertion of a water hose to flush the bore of loose sand and debris. Afterwards, the bore was found to be approximately 60% filled with shell and a cement-like concretion made up of sand, marine precipitates, and corrosion products.

The bore was cleaned using a combination of chemical and mechanical procedures designed to remove the concretion while preserving delicate bore detail. Initial cleaning was accomplished by elevating the muzzle approximately 20 degrees, and filling the bore with a 5% hydrochloric acid solution. A clay dam across the lower half of the muzzle enabled the acid solution to reach most of the bore. After the acid reaction subsided, the clay dam was removed, the barrel depressed, and the depleted acid allowed to drain out. The bore was then flushed with tap water and the concretion softened and loosened by the acid was souged out using a $\frac{3}{4}$ inch (19 mm) copper pipe cut diagonally to provide a point on one side. While this instrument was very effective in dislodging the shell and concretion, its metal was too soft to damage the bronze sides of the bore. Another invaluable tool was a $\frac{1}{2}$ inch (12.7 mm) steel rod to which a hard plastic disk cut in the shape of a half circle was bolted. This device served as a hoe which could be used to rake out debris dislodged by the acid and gouging procedures. As the bore opening increased due to cleaning, the diameter of the half-disk on the hoe was increased also.

When the bulk of concretion was removed from the lower side of the bore,

the cannon was rotated and the acid treatment repeated to dislodge the unaffected concretion on the upper side of the bore. This procedure was repeated until only a small amount of material remained. Composed primarily of the exudate or adhesive used by certain types of molluscs to attach their shells to a substrate, this material was both resistant to acid and very difficult to remove mechanically. After a series of experiments on identical material on the cannon exterior, it was discovered that a 5% solution of ammonium acetate (containing 0.1% ammonium hydroxide) would dissolve it.

While the bulk of the heavy encrustation on the exterior of the cannon was readily removed, in some places shell fragments remained attached to the surface by their resistant exudate and some concretion tended to remain in the deeper folds and crevices around the decorations. The mollusc exudate could be readily removed with ammonium acetate only if it had not been allowed to dry. Once the exudate had dried it was necessary to rehydrate it by prolonged soaking (a week or more) in water with a wetting agent in order for the ammonium acetate to dissolve it effectively. At the end of each day the cannon was repeatedly washed with tap water until litmus paper revealed no indication of acid residue. Between treatments the cannon was stored in an alkaline (pH 10) solution of tap water.

The vast majority of encrustation was removed from both the bore and exterior by two or three people working over a four-day period. When the bulk of the encrustation had been removed, the cannon was swabbed thoroughly inside and out with a 2.5% solution of gluconic acid to remove any calcium or magnesium deposits which may have resulted from immersion in tap water. It was then thoroughly rinsed with de-ionized water before being placed in electrolytic reduction to ensure chloride removal. Inside the

EPDM-lined electrolysis tank the cannon was surrounded by an expanded steel mesh anode and a $\frac{1}{2}$ inch (12.7 cm) diameter mild steel threaded rod was inserted into the bore. The rod was centred in the bore by $\frac{1}{4}$ inch (6.3 mm) thick acrylate triangles spaced along its length. The electrolyte was 108 gallons (408.81) of a 4.5% sodium carbonate solution in de-ionized water. 'Quantab[®]' test strips were used to monitor the chloride concentration, which initially was less than 20 ppm. The conditions of electrolysis were set to relatively high current densities (exterior 0.3 Amp/ft² [0.03 Amp/dm²], interior 0.5 Amp/ft² [0.05 Amp/dm²]) to provide maximum chloride removal and to effect a high scrubbing rate by hydrogen evolution to remove corrosion products. This is in contrast to conditions normally specified for an iron artefact where initial efforts are to reduce the lower (Fe⁺²) iron oxides to improve surface integrity. A pump circulated the electrolyte from the exterior of the gun through the bore, through a filter, and back into a tank at a nominal circulation rate of 3 gal/min (11.3 l/min). After 19 days of electrolysis, during which time the chloride concentration was checked frequently, no significant increase could be seen.

A loose, dark brown or black hydrous film was found coating the cannon following electrolysis. Qualitative spot tests indicated that the film was predominantly iron. Although the source of this iron appeared to be in the bore, visual inspection of the bore prior to and during electrolysis did not reveal its origin. It is possible that the iron emanated from parts of the iron chaplets still embedded in the cannon's bronze body, or from the exposed portions of the chaplets that encircled the core to keep it aligned during casting.

On completion of electrolysis the cannon was vigorously scrubbed and washed with de-ionized water and immersed in a tank containing 5% citric acid with 1% thiourea

as a corrosion inhibitor (10% weight) M. The gun was rotated after one hour and removed with a wire brush. The surface was then decorated with a

After the surface was brushed, the cannon was rinsed in de-ionized water, washed with a 5% carbonate solution, and then rinsed with traces of a 1.0% solution of 2:8 mixture of alcohol. The solution was suspended in the vent of the BTA solution. When horizontal, it was dried, it was a 15% solution

The cannon was then sugared (Fig. 8). The cannon was posed using a wire through the traced photograph (Fig. 2). The chaplet holes, trunnions, true and bore: traditional three-dimensional armorial symbol of room-temperature rubber. Saved from this bronze. Protected from the saved to surface coating

is a corrosion inhibitor, and 0.023% (by weight) MACOL OP-30 (70)¹⁶ surfactant. The gun was removed from the citric acid after one hour and spots of corrosion were removed by scrubbing with a soft nylon brush. This procedure was repeated several times, the convoluted surfaces of the decorations requiring particular attention.

After the cannon was clean and its surface brought to an even colour, it was rinsed in running de-ionized water and washed with a 0.5% solution of sodium carbonate followed by another extensive rinse with de-ionized water to remove all traces of soda ash. When litmus paper tests indicated that all alkalinity was removed, the cannon's surface was mopped with a 1.0% solution of Benzotriazole (BTA) in a 2:8 mixture of de-ionized water and alcohol. Using the floor crane, the cannon was suspended from its muzzle and with the vent plugged the bore was filled with the BTA solution. After draining the solution from the gun, it was positioned horizontally and allowed to air dry. When dry, it was sprayed with a light coating of a 15% solution of Incerlac¹⁷ in toluene.

The cannon was recorded using the techniques suggested by Roth (1989 Figs 1, 2, 3 & 8). The final scale drawing was composed using CorelDRAW 6, and enhanced through the use of scanned, scaled, and traced photographs of decoration details (Fig. 2). Other documentation included chaplet hole dimensions, dolphin dimensions, trunnion dimensions, bore diameter and bore spiral dimensions. In addition to traditional recording in two dimensions, a three-dimensional flexible mould of the armorial device, which has become the symbol of the project, was made using room-temperature vulcanizing silicone rubber. Several epoxy casts were made from this mould and coloured to resemble bronze. Portions of the concretion spalled from the cannon during cleaning were saved to provide a record of detail and surface condition before conservation.



Figure 8. Back wall of the bore, showing the chaplets intersecting in the centre. (D. H. Keith)

After cleaning, the interior of the bore was examined visually in an attempt to determine the configuration of the chaplets, the manner in which the vent was formed, and the nature of the spiral grooves. The first inspection was done with an ACMI TF-33 borescope, a fibre-optic instrument designed to enable engineers to inspect the blades of aircraft turbines without dismantling their cowlings. While it was possible to see quite a lot of complicated detail—enough to convince the investigators that the spiral grooves are traces of the core, rather than marks left by reaming after casting, and that the vent was created in the mould, rather than being drilled or punched after casting—the precise configuration of the chaplets remained a mystery. In order to solicit the opinions of other investigators it was necessary to obtain photographs. The terminus of the bore and the spiral grooves on the sides of the bore were recorded through the simple expedient of using a camera equipped with a telephoto lens and light supplied by the borescope (Fig. 8). However, recording some of the most important detail required a more elaborate solution. A local dentist allowed the use of his Acucam¹⁸ intra-oral fibre-optic camera equipped with $\times 30$ magnification and a colour video printer. Photographs obtained using this equipment revealed

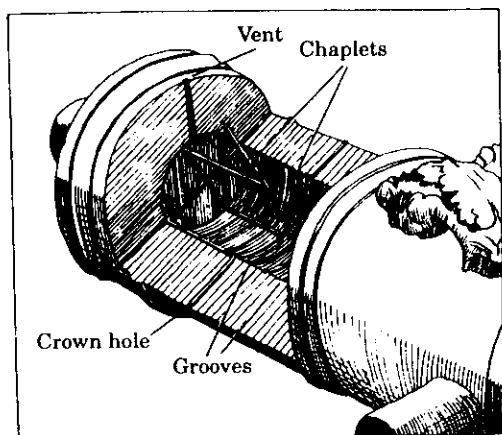


Figure 9. Diagram to show the suspected configuration of the chaplets. (D. H. Keith)

that the chaplets were made of 3 mm square-section iron rods which pass through the sides of the breech reinforce to enter the bore, make a right-angle turn, and descend approximately 7 cm to the back of the bore. Here they appear to make another right-angle turn to cross or intersect near the centre of the back of the bore, forming an armature to capture and hold immobile the breech end of the core (Fig. 9). Most of the iron of the chaplets has disintegrated, leaving only its impression in the bronze. However, some of the iron survived to complicate conservation efforts. Experimentation with devices such as the Acucam[®] undoubtedly will yield clearer photographs and better documentation in the future.

Carriage reconstruction

With the encouragement of the Texas Historical Commission, the exhibit department of the Corpus Christi Museum of Science and History undertook the preparation of a small travelling exhibit utilizing the artefacts recovered from the site in 1995. As excellent information on late 17th-century French cannon carriages exists (Boudriot, 1992: 46, pl. 59), it was decided to manufacture a replica for the

cannon.³ Boudriot's scale drawing, made from dimensions specified in documents, was scaled down to match the dimensions of the smaller *Belle* gun (Fig. 10). The carriage was fabricated using original material—white oak and wrought-iron. The foundation of the carriage is the heavy wooden bed to which the axle trees and sides, or cheeks, are joined by through-bolts. A compromise on the authenticity of our design, necessitated by available materials, was the lamination of two 3 × 10 inch (76 × 254 mm) baulks to make each cheek. In the 17th century the cheeks would have been made of single slabs of white oak. In order to gain the necessary height, the cheeks of carriages made for larger cannon, such as the example illustrated by Boudriot (pl. 59) were made up from two slabs edge-joined using a locking scarf. Axle trees and trucks were turned on a lathe. The sides of the trucks were bevelled slightly in order to minimize binding against the axles or retainer pins. To compensate for the deck camber, the muzzle trucks were made larger than the breech trucks. The carriage was rough-finished and stained, and the cannon was insulated from direct contact with the oak and iron hardware by discreet plastic inserts.

The carriage required hand forging from mild steel: 36 fasteners and other hardware, including axle retainer pins, trunnion cap squares, forelock bolts, nails, keys, cap lock pins, stay bolts, ring bolts, hook bolts, staple hinges, and cleats. Some of the items could be made from the plans alone. However, fabrication of others, such as the forelock bolts that pass through the cheeks, bed, and axletrees, could not be undertaken until the wooden parts of the carriage had been assembled in order to be sure of the final dimensions. The only compensations for incorrect forelock bolt length are to countersink the bolt head in case the shank is too short, or to add washers or vary the width of the key if the shank is too long.

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Figure 11. Cannon on exhibit. (Ron Randolph)

and applied to the exterior of the clay-surfaced model; that the final cannon mould was made in two or more transversely-separated pieces rather than in a two-piece longitudinally-separated mould as seen in Carpenter (1993: 88, pl. 188); that the core used to create the bore was made in clay wrapped with iron wire; and that a problem occurred during casting which left the cannon superficially marred but still functional.

The decoding of the base ring numbers shows how much can be learned from such ancillary markings when a determined effort is made to connect archaeological

findings with archival research. In addition to revealing that the cannon was one of a set of four which had previously been aboard the warship *Faucon*, the markings revealed that the value of the French *livre* when the cannons were cast (between 1669 and 1679) was 1.069 the value of the modern pound. It is also apparent that the four-pounders, found dismantled and deep in *La Belle's* hold, were the four bronze cannon that Louis XIV granted to La Salle specifically for the defence of his colony, rather than part of *La Belle's* ordnance complement. The fact that the cannon were in the hold rather than at Fort St.

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Louis (the name La Salle gave to the place where he disembarked most of the colonists) begs the question of whether he intended to move the colony or to establish another outpost.

Although bronze is a durable and relatively easy material to clean, bronze cannon can be deceptive. The presence of iron chaplets in the bore as well as in the walls of the breech mean that they should be treated as composite artefacts. One minor conservation problem has occurred: over a period of weeks, fine sodium carbonate crystals appear on the cannon's exterior surface. These are easily wiped off, leaving no trace. It is interesting that Armstrong (1994: 14) observed exactly the same phenomenon after treating the Owen Brothers cannon. Perhaps extending the rinsing period would obviate this condition.

The cannon was cleaned, documented, and conserved and an exhibit was designed and constructed in less than 12 months. Production of the carriage, deck, and bulwark led to an increased appreciation for the many considerations that go into the construction of a carriage and its placement on a ship's deck. For example, the

checks of the carriage are parallel to the sides of the cannon, which naturally taper from breech to muzzle—an important feature to bear in mind when forging the iron cap squares which secure the trunnions to the tops of the cheeks. A year after conservation treatment was completed, the cannon appears to be faring well, in spite of less than ideal conditions encountered during its tour.

Acknowledgments

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Notes

- [1] Only three matching bronze four-pounders have been recovered from the site. However, the impression in marine encrustation of a fourth, identical cannon was discovered adjacent to the place where the cannon described in this article was found. It can be deduced that the impression was made by the missing fourth cannon from the *Faucon* inventory, N° 3, weighing 745 livres. Even without knowing how much time must pass before such an impression can be formed, or how long the impression takes to 'heal' after the object forming it is removed, it is tempting to speculate that the fourth cannon lies somewhere nearby, having been accidentally dragged off the site in the recent past by a shrimp trawler's net or a fouled anchor.
- [2] The 'N°' preceding the '741' on the base ring of the subject of this article was a mistake: the # (pound) symbol precedes the weight designation on both the other recovered cannon. It is easy to understand how such an error could have been made. The # symbol is used interchangeably to signify 'pound' and 'number' even today.
- [3] In 1996 the fragmentary remains of a naval gun carriage were discovered on the site. As *La Belle* carried only four-pounders, there can be little doubt that this carriage was built to fit the type of cannon described in this article. Careful measuring and extrapolation of the preserved parts of the carriage should enable the construction of an even more authentic replica in the future.

References

- Anonymous, 1996, *L'Ame et la Lumière*, (Exhibit Catalogue). Centre Historique des Archives Nationales, Paris.