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# A Leading Analysis: Lead Objects from Early 18th Century French Frigates, The Natière Shipwrecks

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*An underwater archaeological excavation was carried out between 1999 and 2008 by the DRASSM, a department of the French Ministry of Culture, and ADRAMAR, a non – profit organization, on the wrecks of two French frigates discovered on the Natière reef off St. Malo (France): the Dauphine, sunk in 1704, and the Aimable Grenot, wrecked in 1749. Lead had multiple uses aboard ships due to its resistance to corrosion, its weight, malleability and potential for reuse; however, it has been little studied by archaeologists. Lead artifacts recovered from these shipwrecks are described and compared with French archives, in order to build a typology of shipboard lead.*

## Introduction

Since ancient times, lead has found multiple uses on ships because of its properties that are ideally suited to the maritime environment. A thorough study of these lead artifacts is relevant since they have mostly been neglected until now. Research in this field was initiated by the author, and focuses on lead aboard post-medieval shipwrecks, from the 15th to the 19th century. This paper will outline the study of lead discovered on the two Natière shipwrecks, which are representative French sites of the 18th century. This article is divided in three parts: an overview of the Natière underwater archaeological site, followed by a description of the different lead objects found on the site and their distribution on both shipwrecks, and finally, a detailed description of some of these lead artifacts.

## The Natière Archaeological Site: Two French Frigates from the 18th Century

An underwater archaeological excavation was carried out between 1999 and 2008 by the Département des Recherches Archéologiques Subaquatiques et Sous Marines (DRASSM), a department of the French Ministry of Culture, and the *Association pour le Développement de la Recherche en Archéologie MARitime* (ADRAMAR), a non – profit organization, on the wrecks of two French frigates discovered on the Natière reef off St. Malo (France) (L'Hour and Veyrat 2000-2004; L'Hour and Veyrat 2010). One has been identified as the *Dauphine* (Natière 1), a light frigate built in the royal dockyard of Le Havre in 1703 for privateering, which sunk in December 1704 (Archives Départementales d'Ille-et-Vilaine [ADIV] 1704). The other is the *Aimable Grenot* (Natière 2), a large frigate built in Granville for a private ship-owner in 1747, initially armed for privateering, then for trade before it wrecked in May 1749 (ADIV 1749).

## Lead on the Natière: A Large and Diversified Corpus

Among the 3,000 recordings on the Natière sites, 1,881 artifacts are made with lead (including 1,797 lead shots), grouped into 177 individual find numbers, which represents 4% of the total number. On this site, lead is present under various shapes, dimensions and functions, such as lead rolls and lead sheets, scuppers, various weights, lead shots, oil lamps, inkwell and tobacco boxes. Collectively they touch on every aspect of shipbuilding and life aboard an 18th century French frigate. It is a really good way to get up close and personal with the story of the Natière shipwrecks and their sailors.

Detailing this corpus, some differences appears in the types of finds from both shipwrecks and in their distribution. For example, the number of lead shots recorded is totally different between the two shipwrecks, and some of the shipboard important equipment like fishing weights or scuppers are numerous on the *Dauphine*, while completely absent on the *Aimable Grenot* (Table 1). These disparities will be discussed later in this paper. Lead shots excluded, more lead objects have been found on the *Dauphine* than on the *Aimable Grenot*. A possible explanation of this disparity is perhaps the major salvage undertaken on the *Aimable Grenot* (ADIV 1749) as compared to the *Dauphine*, but lead objects were certainly not the most valuable to recover.

| | Dauphine | Aimable Grenot |
|---|---|---|
| Sounding weights | 1 | 1 |
| Scale weights | 2 | 4 |
| Fishing weights | 3 | 0 |
| Unidentified weights | 2 | 1 |
| Lead strips and sheets | 45 | 7 |
| Lead rolls | 2 | 1 |
| Scuppers | 8 | 0 |
| Inkwell | 1 | 0 |
| Tobacco boxes | 0 | 2 |
| Tea box | 0 | 1 |
| Oil lamp | 0 | 1 |
| Composite tools | 1 | 1 |
| Total without lead bullets | 65 | 19 |
| Lead bullets | 84 | 1713 |
| Total with lead bullets | 149 | 1732 |

*Table 1. Repartation Of Lead Artifacts On La Natiere Shipwrecks*

## Description and Thorough Study of the *Natière* Lead Artifacts

***Lead as Raw Material: A Standardized Production?***

On both shipwrecks, numerous lead strips and square sheets have been found. The complete square sheets seem to be standardized. Indeed, their average dimensions are 33.5 x 27.8 x 0.4 cm, or close to one foot long for one line thick (one French foot is 32.48 cm and one line is 0.23 cm), which might have been the standard sheet size.

According to archival sources and archaeological sites, lead was often carried on ships in a form that could be used directly, such as standardized square units, as described above, or under the shape of "lead rolls" called in French *plombs en table,* (Savary des Brulons 1726: 880) which are long sheets, rolled up several times on themselves. Two lead rolls have been found on the *Dauphine*, and one on the *Aimable Grenot* (Figure 1 and Table 2). All of them have been rolled up five times on themselves. Their width is rather different — the one on the *Aimable Grenot* (72 x 27 cm) is more than twice the width of those on the *Dauphine* (33 x 20 cm).

This difference could be the result of the technological improvements in the 45 years separating both shipwrecks. Indeed, the development of international maritime trade during the 18th century may have increased the quantity of lead needed on board, to replace any missing shipboard equipment or repair the hull, for longer trips. At the same time, a new process appeared in England enabling the production of longer sheets (Saint-Albine 1731). It is called "cold rolled", or *laminoir* in French. Lead sheets are squeezed between two cylinders in order to reduce their thickness and increase their width.

This difference in the lead rolls' width could also result of variable sizes of shipboard lead sheets carried together, adapted to the different needs on board. In its 1726 *Dictionnaire Universel de Commerce*, Savary des Brulons states that lead sheets should vary from 15 to 72 French inches (40.6-194.9 cm), depending on their intended use (Savary des Brulons 1726:880). With these uncut sheets, the caulker was able to quickly patch up any leak in the hull. Indeed, lead is soft enough to be worked and nailed directly. The patch had to be applied to the outside of the hull, as stated by the *Ordonnance de Louis XIV pour les armées navales et les arcenaux de marine* (1689), most times with a layer of tarred oakum between the patch and the leak, by the caulker hanging from a bosun's chair. It was one of the most dangerous jobs on board. In 1781, Bertin, a Marine commissioner in Marseille, wrote in a letter that of all the specialists […] caulkers are, certainly, the most interesting and essential;


*Figure 1. Three lead rolls of the Natière Shipwrecks (Photo by Teddy Seguin 2005, 2006 and 2010).*

navigation, trade and the lives of sailors depend on the integrity and ability of these men (Bertin 1781).

***Shipboard Lead Equipment***

Caulkers were also in charge of the evacuation of water on board. For this purpose, holes were made through the hull and sheathed with a lead pipe to prevent water from soaking into the various timber and frames (Figure 2). These lead pipes, called scuppers, were fastened to the hull and deck planks, using specific forged copper nails with square sections and flat heads, as visible on artifacts Nat 343, 347 and 348, as it is well described in various written sources (Boudriot 1977:144). They are called in French: *clous à plomb* (Missiessy Quies 1789:74).

Scuppers are also useful for understanding a shipwreck position and structure. If the whole length of a scupper is found on a wreck (both circular ends, used to fastened the scupper, are still present), it enables archaeologists to estimate the thickness of the full wall assembly: ceiling, frames and outer planking. When still present on a ship structure, they are located symmetrically at regular intervals along the ship's side. This way of fitting out is very well described in written sources (Willaumez 1831:199). Scuppers, being entirely made from lead, are very heavy and resistant to corrosion, they are often found in situ on archaeological sites, like on the *Dauphine* shipwreck. So, when they are still present and found in situ on the wreck site, their position can provide clues as to the orientation of the ship. These fittings are so crucial that it is hard to understand why there were none found on the *Aimable Grenot* site.

Studying the *Dauphine* site plan, two lead pipes can be seen near the stem of the vessel, they were very damaged and crushed by the wrecking process. From their position, they could be interpreted as hawsepipes, used to protect the anchor cables. They were left in situ, and their exact dimensions not recorded, but written sources give us clues as to how they might have been. In Aubin's marine dictionary (1702:409) the ratio between the ship length and hawse diameter is stated: the hawse on a 134 ft. long ship should be proportioned … the 1st should be 12 inches in diameter. Blaise Ollivier (1736:150) also explains the ratio between the circumference of the anchor cable and the size of the hawsepipe: its diameter is close to three-quarters of the cable circumference. Both these sources lead to a measurement of 12 French inches for the *Dauphine*'s hawsepipes. These ratios may provide a useful means for estimating ship dimensions.

| Rolls | Nat 411 | Nat 2086 | NAT 2447 |
|---|---|---|---|
| **Shipwreck** | Natière 1 | Natière 1 | Natière 2 |
| **Description** | Lead sheet rolled up 5 times | Estimation of the unrolled sheet : more than 72 cm long. Lead sheet rolled up 5 times | Estimation of the unrolled sheet : 111cm long.<br><br>Lead sheet rolled up 5 or 6 times |
| **Width (cm)** | 33 | 33 | 72 |
| **Depth (cm)** | 20.5 | 18-19 | 27 |
| **Total thickness** | 4 | 3.5 | 13 |
| **Inches** | 12.2x7.6x1.5 | 12.2x6.6x1.3 | 26.6x10x4.8 |
| **Sheet thickness (cm)** | .4 | .3 | .3 |
| **Weight (kg)** | 19 | 11.74 | unknown |

*table 2. Dimensions Of The Lead Rolls Found On The Natiere Shipwrecks*

## Lead: A Privileged Material for the Armament

Lead is the major metal used to produce the small ammunitions, mostly under the shape of lead shots for muskets and pistols. The number of lead shots discovered on The *Natière* wrecks is important: 1797 artifacts were recorded during the excavation. Their diameters vary from 1 to 1.5 cm, their weight from 9.7 to 27.5 g. Their distribution yet is surprising because most of them were found on the *Aimable Grenot*, which was outfitted for shipping, unlike the *Dauphine*, which was outfitted for privateering. So, if armament was essential for privateering at this time, this archaeological data shows that merchant ships seem to have been also well-armed, to protect themselves during long voyages.

Many cannon were also found on these wrecks, some with their vents still covered by lead aprons. Vial du Clairbois (1786:129), provides a good definition for this lead equipment, which translates as: "it is a lead sheet, measuring one foot square [32.48 x 32.48 cm], hammered on the gun in order to give it the shape, and cover the gun vent and touch hole to prevent water and any spark from entering the gun". Dimensions and shape of this lead object are the same as standardized lead sheets boarded as raw material. The only way to identify them as vent covers are their molded shape, which unfortunately might have been changed by the wrecking process, and also their direct association with the guns on site. On the *Natière* wrecks site, eight aprons could be identified using these criteria, which seems few compared to the number of guns on both sites (33 guns were recorded on the *Dauphine* and 7 on the *Aimable Grenot*). They might have been lost during the wrecking process or brought back up during some salvage operation, or still present on site and not found yet.

## Lead Weights: Sounding, Fishing and Measuring on Board

Lead weights (sounding leads, fishing weights and scale weights) are numerous on every ship. Indeed, lead as a heavy material, was perfectly suited to these functions. A sounding lead has been discovered on each of the *Natière* shipwrecks: Nat 627 discovered on the *Dauphine* and Nat 2729 found on the *Aimable Grenot*. Both of them present the same characteristic shape: long octagonal cylinders, with a cavity at the bottom and a hole for suspension at the top. Besides, they are very heavy (13.4 and 26.7 kg) and tall (40.2 and 47 cm). Lead Nat 2729, from the *Aimable Grenot* wreck, bear the Roman inscription "XXXXXIIII", which is the indication of its weight (54 lbs) in French pounds (26.7 kg).

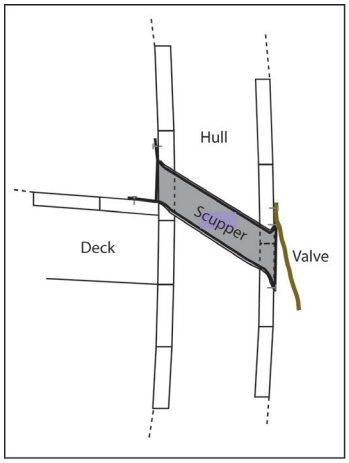
The principle of "sounding" is crucial for sailors and simple so it hasn't changed since ancient times. It consists of hanging a weight at the end of a line, then throwing it into the sea and measuring the vertical length of the line when the seabed is reached (Veyrat 2011). In order to know, not only the depth of the water column, but also the nature of the seabed (sand, rocks or shells…), a cavity at the base of the sounding lead was filled with tallow for sediments to stick to it. This way the sailor was able to bring back a sample to the surface. This

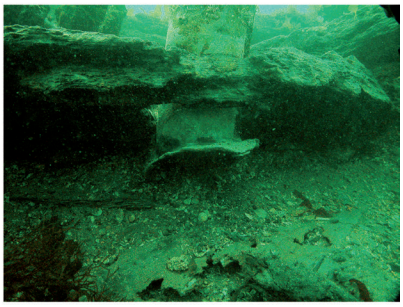
information was valuable for the sailors, and allows for the creation of very detailed charts. The sounding lead found on the wreck site of the *Elizabeth and Mary*, from New England that sank in 1690 on the north shore of the St. Laurence in Canada, still had tallow in its cavity. To the author's knowledge, it is the only known wreck to have been found with tallow remaining in the cavity. Jennifer Poulin of the Canadian Conservation Institute has conducted a composition analysis that revealed the tallow is made with fat from a ruminant animal (Poulin 2012:4).

According to their important dimensions, the sounding weights from the *Natière* site were probably used in deep waters. Pacini (1843) illustrates this complex and difficult operation. At reduced sailing speed, sailors are standing outside the hull, and each one is holding a section of the sounding line (Figure 3). The sailor, nearest to the stem, throws the sounding lead and lets his section of the line go. Every sailor along the ship's side does the same until the line stops when the lead hits the seabed. This dangerous operation requires well-trained sailors, used to working together. These objects were fundamental aboard for the survival of the ship and its crew, and they are of great interest to archaeologists to understand the technical knowledge of sailors at this time (Veyrat 2011).

Also of interest to archaeologists is the common presence of marks on this type of weight. These marks could represent a symbol of property, like a broad arrow for the Royal Navy or a "*fleur de lys*" for the French Navy, or they could be a number (in Roman or Arabic letters) indicating weight, like what was found on Nat 2729. This last type of mark is very interesting, because it might indicate which type of weight system was used: English, French, Dutch or other pounds. It also provides an idea for the origin of the ship, or at least the sounding lead. Archaeologists have to be very careful with this kind of interpretation. Lead is such a common material that it might have been exchanged frequently, for example, when a ship was captured.

Here is a short description of other shipboard lead equipment in the same category (Figure 4). Three small weights were found on *Dauphine* (Nat 1842, 2113 and 2279). They are quite similar in dimension, but they have a totally different shape. Indeed, Nat 1842 is spherical (8 cm high for 5.9 cm of diameter and a weight of 0.23 kg); Nat 2113 has a square section (6.2 cm high for 2.5 x2.5 cm at its base and a weight of 3.82 kg) and Nat 2279 a circular one (9 cm high for 5 cm of diameter at its base and a weight of 0.73 kg). The functional identification of these weights should be conducted, not on their shapes, which could look like small sounding leads, but according to their dimensions. Indeed, a size under 10 cm and a weight under 5kg is not enough to take the sounding line vertically to the seabed (Veyrat 2012). Therefore, they should be identified as fishing weights, suspended



Scupper crossing the hull on the *Dauphine*

Scuppers found on the *Dauphine*


*Figure 2. Scuppers of the Dauphine (Drawing by Thierry Boyer, 2010; Photo by Teddy Seguin 2000-2007).*

Nat 659

Nat 2729

| Num Iso | Shippreck | Site localisation | Description | Total height (cm) | Base width (cm) | Weight (kg) |
|---|---|---|---|---|---|---|
| 659 | Natière 1 | I23-I24 | Octogonal section, hole at the top and cavity in its base No inscription | 40,2 | 7 | 13,38 |
| 2729 | Natière 2 | C 19-3 | Octogonal or circular section cavity in its base «XXXXXIIII» inscribed | 47 | 9,5 | 26,65 |

*Figure 3. Sounding leads Nat 659 and 2729, and sounding in deep-waters (Photo by Teddy Seguin 2007 and 2010; Fatio in Pacini 1843:202).*


*Figure 4. Other lead artifacts found on The Natière shipwrecks. (Photos by the author 2012 and Teddy Seguin 1999-2007).*

to a fishing line, or weights for fishing nets. The variety of shape recorded illustrates the non-standardization of this production. This equipment was valuable for supplying the crew with fresh fish during long journeys and supplementing the lack of food on board. None have been found on *Aimable Grenot.*

Another type of lead weight found on site is interpreted as scale width. A total of six lead scale weights have been found on The *Natière* shipwrecks. There are two kinds, differentiated by shape. Two weights have a circular cross section with two opposing flat sides (Nat 1137 and Nat 2033). They also have two holes on their top, probably to hang them with a ring to a scale arm. The other four weights are more or less spherical (Nat 627, 1608, 2532 and 2961). All of them are very light (from 18 to 338 g), and their weight seems to be more in the range of the medicinal pounds used specially for apothecary and medicine (one Troy pound in apothecary weights 373 g). These kinds of weights could have been used to measure gunpowder or medicinal products. Scale weights are more often recovered than the scale itself, as they are made of lead.

## Lead Oil Lamps: An Example of Lead as Precious Replacement Equipment

Another interesting piece of equipment found on the *Aimable Grenot* was a lead oil lamp (Nat 2631). This object presents a triangular shape, with one angle folded up and a concave opposite side. The bottom of the lamp is also concave, to contain the oil. Different marks of lead bending and hammering can be observed on this lamp which should have been made from a standardize lead sheet of one line thick (0.3 cm). Lead is very heavy so it is useful to give stability to suspended objects like oil lamps. They are not usually described in written sources, as oil lamps are usually made with other metals like copper (Bourde de Villehuet 1773:57), ceramic or less often with pewter, but they are found on many archaeological sites of this period (five more are known from the author at this time). Their shapes are variable because most of them are made directly on board the ships, with raw and reused material to replace necessary missing equipment. This is a striking example of the usefulness of lead on board.

## Lead as Personal Belongings: The Intimacy of 18th century Sailors

Here are some examples of lead artifacts that are representative of shipboard personal activities. An inkwell was found on the *Dauphine* site (Figure 4): it presents a square section (3.8 x 3.1 x 4.9 cm high) with a hole on the top (0.9 cm of diameter) and a thick lead base inside (0.5 cm). This discovery is unusual but not isolated. Indeed, at least two other inkwells are known to the author, including a heart shaped example from the 1788-*Boussole* shipwreck (L'Hour and Veyrat 2007:104) and an inkwell with a square section from an early-18th century shipwreck found off the western coast of France (artifact n° 3210PPD29 in the DRASSM Database). If their shapes are variable, their design is the same: a thick lead base provides great stability to this type of object, which has to stay upright, even in a storm. The craftsmanship of the inkwell from the *Boussole* demonstrates how fine lead work could be. The one on the *Dauphine*, is quite simple, with square section, as it was most probably designed to be inserted into a wooden *écritoire* (portable writing desk) to be more aesthetic.

As said before, no inkwell has been found on the *Aimable Grenot*, but other artifacts illustrate the private life on board. Four oval lead objects have been identified as the remains of two tobacco boxes similar to the one depicted on a painting by Frans Van Mieris II (1747). According to their dimensions, there might have been two oval tobacco boxes of 2 cm high, closed by a piece of lead with a handle on the cover: the bottom Nat 6 (10.1 x 7.5 cm) matches with the cover Nat 428 (10 cm long) and Nat 21 (10 x 7.6 cm) with Nat 70 (9.3 x 7 cm). The way of keeping the case and the cover closed together is still unknown.

A lead tea caddy was also found on the *Aimable Grenot*, with the inscription "pv thé vert" in French ("pv green tea" in English). This box is rectangular (13 x 11.8 x 7 cm) and opened on its top by a large hole (3 cm).

All these artifacts reveal the importance of lead in personal belongings.

## Lead Isotope Analysis

Another valuable way to investigate lead material is through chemical composition analysis; however, resulting from the frequent reuse of this metal, analysis that could be carried out on lead objects is subject to important limitations. Raw material composition analysis can reveal the purity of the metal and the distinctive trace elements present. More importantly, lead isotope analysis, using ratios of lead isotopes, can match lead samples to their most likely ore source. Unfortunately, this type of analysis would not be really effective with objects coming from multiple lead recastings and mixings because their isotopic composition probably would not match to one unique mine. However, the use of simple chemical composition analysis might be conducted on lead artifacts if they came from a well-known site, in order to characterize a homogeneous group of production in the ship's equipment.

## Conclusion

To conclude, lead is a very common material, without the gleam of brass, gold or silver, but essential to all sailors and navies since ancient times. Indeed, this material is perfectly adapted to the maritime world: easy to cast and mould, very cheap and resistant to corrosion. Until now, its archaeological potential has been under evaluated. As a heavy material that stays in place, it often helps with the identification of archaeological sites. As the study of the *Natière* artifacts shows, the aim was to reveal the diversity of roles fulfilled by lead on board, and emphasize how valuable this kind of study could be to understand the sailors' daily lives. Besides, heavy lead items, such as scuppers, hawsepipes, sounding leads, and other objects, can help to determine wreck orientation, position and size. The goal here is that these artifacts will be viewed differently in the future and that lead will take its place as an essential part of the maritime material culture.

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