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# Berço manuelino from the wreck of Santiago

Berço manuelino del naufragio de Santiago

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### **ABSTRACT - RESUMEN**

The breech-loading rail guns appeared in Europe in the 15th century, and in the next century they were widely used as light naval artillery. They were characterized by a high rate of fire, thanks to the use of replaceable chambers a mug-shaped device called a chamber or breech block, previously charged with gun powder and a projectile. In Portugal they were called 'berço', called 'verso' in Spain. These guns were commonly found on board ships sailing East on the Carreira da India during the reign of King D. Manuel I and earned the nickname 'manuelino' after this ruler. A *berço manuelino* marked Durr 876 is housed in the KwaZulu Natal collection in Pietermaritzburg, South Africa. This cannon was salvaged from the *Santiago* shipwreck that sank in the Bassas da India atoll in the Mozambique Channel in 1585. It is an excellent example of the *berço manuelino* from the period of their widespread use in the Portuguese fleet. Its condition is satisfactory, considering that the cannon lay for 400 years on a coral reef flooded by sea waves. *Berço manuelino* Durr 876 witnessed one of the most famous and tragic maritime disasters of the 16th century, described in numerous accounts.

Las pistolas giratorias de retrocarga aparecieron en Europa en el siglo XV, y en el siglo siguiente fueron ampliamente utilizadas como artillería naval ligera. Se caracterizaban por una alta cadencia de tiro, gracias al uso de recámaras reemplazables en forma de taza llamadas cámara o bloque de recámara, previamente cargadas con pólvora y un proyectil. En Portugal se les llamaba 'berço', llamado 'verso' en España. Estas armas se encontraban comúnmente a bordo de barcos que navegaban hacia el este en la Carreira da India durante el reinado del rey D. Manuel I y se ganaron el apodo de 'manuelino' en honor a este gobernante. Un *berço manuelino* marcado Durr 876 se encuentra en la colección KwaZulu Natal en Pietermaritzburg, Sudáfrica. Este cañón fue rescatado del naufragio de Santiago que se hundió en el atolón de Bassas da India en el canal de Mozambique en 1585. Es un excelente ejemplo del *berço manuelino* de la época de uso generalizado en la flota portuguesa. Su estado es satisfactorio, teniendo en cuenta que el cañón estuvo durante 400 años sobre un arrecife de coral inundado por las olas del mar. *Berço manuelino* Durr 876 fue testigo de uno de los desastres marítimos más famosos y trágicos del siglo XVI, descrito en numerosos relatos.

# Keywords - Palabras clave

Berço manuelino; breech-loading swivel gun; Portuguese cannon; wreck of Santiago; Bassas da India; Mozambique Channel.

*Berço manuelino*; pistola giratoria de retrocarga; cañón portugués; el naufragio de Santiago; Bassas da India; Canal de Mozambique.

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#### BERÇO MANUELINO FROM THE WRECK OF SANTIAGO

*Berço manuelino* is a breech-loading small cannon, loaded with an interchangeable chamber, shooting bullets at a distance of about 400 meters. The gun was mainly used on sailing ships, mounted on a swivelling stand and installed on the fore- and aftercastles. *Berço manuelino* from the wreck of *Santiago* dates most probably from the reign of King João III (1521–1557). This type of cannon was developed during the reign of the king Manuel I *O Venturoso* (1495–1521)—hence the name.

The breech-loading swivel guns appeared in Europe in the 15th century. They had two distinguishing features: they were mounted on a swivel (forquet) allowing easy rotation of the gun and used a breech loading system. These guns were loaded using movable chambers, previously loaded with a gunpowder charge. The loaded chamber was inserted into the recess in the rear part of the cannon, blocked with a wedge, and then fired. Because charging was done in advance and separately, the breech-loading swivel guns were exceptionally quick-firing for their time. Their disadvantage was a leaky connection between the chamber and the barrel, causing the loss of part of the powder gases. However, this was compensated by the high rate of fire, as a large number of charged chambers could be prepared in advance. The Portuguese name for such guns is 'berço', which literally means "a cradle", but in this case it is a gun lock—a recess into which the loaded chamber is inserted (Fig. 1).



Figure 1. Scheme of a breech-loading swivel-gun. Drawing: P. Kardasz.

Being in collections of the KwaZulu Natal Museum in Pietermaritzburg, South Africa, the *berço manuelino* Durr 876 comes from the Portuguese carrack *Santiago*, which was wrecked on the reefs of the Bassas da India atoll in the Mozambique Channel on the 19<sup>th</sup> August 1585, while on a voyage from Lisbon to Cochin on the route known as *Carreira da Índia*. *Santiago* was a very big carrack (port. *nau*). Described as "the biggest and best vessel sailing on the Indies route" (Duffy, 1955: 56), but such pompous descriptions apply to many ships of the time. Nevertheless, it was *Santiago* that was chosen in 1585 by the admiral of the Indian fleet for his own sea voyage. So it must have been a large and impressive ship. *Santiago*'s displacement was not less than 900 tons. A ship of this size must have been about 50 meters long (LOA), with a keel length of 33 meters and a maximum width of 16.5 meters.

In December 1977, the Swiss treasure hunter Ernst Klaar easily located the site of the *Santiago* disaster. During repeated illegal explorations of the site, Klaar acquired numerous artefacts from *Santiago*. Some of them were purchased by the Natal Museum in Pietermaritzburg, South Africa, several others by the Museu de Marinha in Lisbon.

The museum collections (KwaZulu Natal Museum in South Africa, Museu de Marinha in Portugal) include 16 cannons from *Santiago*. These are:

- 1 pcs. *camelo*,
- 2 pcs. colubrina,
- 6 pcs. berço manuelino,
- 3 pcs. *camelete*,
- 4 pcs. falconete.

Colonel Nuno Valdez dos Santos believes that in total Santiago was armed with 24 cannons of various sizes (Santos, 1986: 46).

### CATALOGUE

Most muzzle-loading cannons in South Africa have been identified, registered, measured and catalogued in a registry known as "Durr<sup>1</sup> Record of Muzzle Loading Cannon in South Africa" (de Vries & Hall, 2001: 23-24). The register was created by Gerry de Vries and Jon Hall and currently records 1,056 cannons.<sup>2</sup>

### DESCRIPTION

Durr 876 ex *Santiago* is a swivel gun *berço* of 72 mm bore. The gun was breech-loaded with an iron chamber, which was not found on the wreck; probably corroded away completely. The assumption that the chamber was made of iron is confirmed by another artefact. At the archaeological site where the Durr 876 gun comes from, one severely corroded powder chamber was found. It was made of iron and thanks to conservation efforts, it was preserved. It is highly probable that the missing chamber from Durr 876 was also made of iron. The cannon is cast in bronze (gunmetal). Noteworthy in this piece is the asymmetric nature of the receiver, the recess in which the powder chamber was located. The thickness of the walls on the left side is 45 mm, and on the right side it is 58 mm (Van Oordt & De Vries, 2006: 24). There are no signs of serious corrosion or erosion and it is likely that the weapon was manufactured, albeit unintentionally, in this asymmetric way. The receiver near the bore has a hollow cup shape on the right side. It can be assumed that at some point the bullet fell out of the bore and over time, affected by the sea water, it eroded into the shape of a cup. The cannon was probably loaded when it sank. There are remnants of a wadding still in the bore. The *berço* on the top of the chase has heavily faded markings, made in raised relief: the coat of arms of Portugal, an armillary sphere and a single "C", most likely the founder's mark. None of these markings are clear and all have been heavily obliterated by erosion.

### MARKINGS

The Durr 876 cannon shows three markings foremost on the upper chase: Portuguese coat of arms, armillary sphere and supposed manufacturer's mark, all made in raised relief. The markings are in raised relief on a raised shield.

The Portuguese royal coat of arms is located on the upper chase, closest to its muzzle. The drawing is heavily eroded, only fragments of the outer frame of the coat of arms are clearly legible. The original form of the coat of arms is debatable. The existing interpretation (Van Oordt & De Vries, 2006: 37) suggests that the lower part of the coat of arms has a triangular shape.

However, a closer examination of the coat of arms suggests otherwise. In the author's opinion, the base of the motif is more likely flat or very gently curved rather than pointed as they illustrate. It appears to have been the same motif with a flattish base on another falconet in the collection of the Kwa Zulu Natal Museum (Durr 881). Unfortunately, the motif is not well enough preserved to be sure. However, the muzzle-loading cannon (Durr 884) does have a motif that is similar to, but not exactly the same, as the Van Oordt and De Vries interpretation (Fig. 2).

The drawing also suggests, that there are only five 'quinas' shields on the coat of arms, and there are no castles on the bordure. From 1557, the coat of arms should include seven castles. There seems to be no basis for such an interpretation. Not having any castles on the bordure would be a serious mistake for the founder. Although the gun is badly damaged, it appears that the outline of a bordure is visible on the shield (Fig. 2, left)

<sup>&</sup>lt;sup>1</sup> The name "Durr" comes from the name of the sponsor of much of the early artillery research in South Africa. John Durr was a real estate agent from Constantia in what is now the Western Cape Province, owner of Storm Durr Estates, now known as Durr Estates. <sup>2</sup> January 2023.



*Figure 2*. On the left: the coat of arms of Portugal of the Durr 876 cannon (photo: Gavin Whitelaw 2024). On the right, the coat of arms of Portugal of the Durr 881 cannon (photo: P. Kardasz 2023).

The author has attempted to reconstruct the original appearance of the coat of arms drawing. This proposal appears to be the most likely (Fig. 3).



Figure 3. An attempt to reconstruct the coat of arms of Portugal on a Durr 876 cannon. Drawing: P. Kardasz.

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The armillary sphere is located as a central mark on the upper chase. The ecliptic band runs NW-SE. The drawing is heavily eroded, only the outer frame of the sphere is clear (Fig. 4).



*Figure 4*. Armillary sphere of the Durr 876 cannon. A solid line means an existing drawing, a dashed line means an obliterated drawing. On the right, a reference image—the armillary sphere similar to Durr 876, ecliptic NW-SE, presented due to its better state of preservation. Drawing and photo: P. Kardasz.

Farthest from the muzzle, as the third mark, is a slanted 'C'. This is interpreted as a mark of the foundry or founder. This marking has yet to be satisfactorily associated with any known founder. As a possible hypothesis, it should be assumed that these may be foundry marks (not the founder's) or trademarks of the company ordering the cannon.

# **PROOF MARKS**

The Durr 876 gun (as well as all other guns from the wreck of *Santiago*) has no visible proof marks. It is not known if there was a standard method for proofing firearms in the early 16th century, it is assumed that satisfactory results were obtained by the trial and error method.

# CALIBRE

A cannon coming out of the foundry may differ slightly from the design due to manufacturing methods, allowable tolerances, shrinkage of castings, and aesthetics of the finished product.

If an internal barrel diameter of 72 mm is assumed, due to the required difference between the diameter of the bore and the diameter of the projectile<sup>3</sup> of 1/16 of the diameter of the projectile, the diameter of the projectile (a ball) would be 67.5 mm. If we accept that this 72 mm diameter may have grown 1.5 mm due to

<sup>&</sup>lt;sup>3</sup> Windage.

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wear and corrosion, then we will get the probable designed barrel diameter of 66 mm. The unit of measure used in Portugal in the early 16th century was p'e (foot) = 329,8 mm. A diameter of 66 mm is equal to  $\frac{1}{5}p'e$ . This is approximate equivalent to 2 pounders, according to the British calibre system. The actual weight of the ball was probably 0,45 kg (stone) (de Sousa, 2021: Quadro 4, Van Oordt & De Vries, 2006: 31), a lead one 0,67 kg (Marzia, 2014: XX).

### **GUNMETAL OF THE 16TH CENTURY**

The formula of the bronze alloy has been modified over the centuries. In the mid-16th century, an alloy of 100 parts copper, 10 parts latten and 8 parts tin was used to obtain a 'gunmetal'. Latten was an alloy of copper and zinc (Blackmore, 1976: 407). Impurities of the 16th century alloys, unintentional or perhaps also intentional—added experimentally—incorporation of zinc, lead, antimony and other elements, and residual and imperfect mixing and casting methods lead to estimates of the strength of the 16th century bronze at 18 to 20 MPa. By comparison, modern true bronze or bronze is 90% copper and 10% tin, resulting in a strong, resilient alloy with a yield strength of 145 MPa. (Van Oordt & De Vries, 2006: 30)

# **GUNPOWDER OF THE 16TH CENTURY (SERPENTINE)**

*Serpentine* is a very finely ground gunpowder. In Portugal, the use of corned gunpowder is reported from the late 14th century, used primarily in handguns, like the serpentines, from where the serpentine gunpowder name arose. The artillery gunpowder would have a bigger grain, it is already in use in the late 16th century. Its ingredients: saltpeter, sulfur and charcoal, were first ground separately, then mixed and ground again. The final product had the consistency of fine dust. The formula of gunpowder in the middle of the 16th century was 66% saltpeter, 17% sulfur and 17% charcoal (which would give a maximum pressure of 50 to 55 MPa) (McConnell, 1988: 273). Peter Whitehorne (1573) reports that gunpowder from the early 16th century contained about 50% saltpeter in the formula (Ffoulkes, 1937: 85-90). The propellant charge therefore burned slower and had less power than modern gunpowder. The fact that the compressed charge of this powder did not have significant spaces between the grains through which the flame could advance rapidly further reduced the efficiency of the weapon. The process of the formation of granules of gunpowder,<sup>4</sup> was not yet widely used in the first half of the 16th century. The pressure obtained from modern gunpowder is 90 to 100 MPa, and the pressure of serpentine from the beginning of the 16th century is estimated at about 25 MPa (Gillet, Lefebvre and Galloy, 2004: 22).

# **DATING OF THE DURR 876 CANNON**

*Berço manuelino* Durr 876 was salvaged from the wreck of the *Santiago*, which sank in the Mozambique Channel in 1585. The date of the disaster allows us to unambiguously determine the year after which the cannon was definitely not manufactured (*terminus ante quem*).

The assumption that the cannons were thrown just before the ship's maiden voyage does not seem very likely. The gun could have been in active service for 20, 30, or even much longer. For example: the age range of cannons salvaged from the wreck of *Santissimo Sacramento* is 63 years; the oldest of the cannons is dated to 1590, and the newest to 1653. (Guilmartin, 2002: 62-69). Guns in service listed for HMS *Britannia* in 1736 included both cannons dated 1579 and 1705, a span of 114 years! Years of service don't really matter for bronze guns. The decrease in their condition resulted primarily from the number of shots fired, which negatively affects the calibre. Their gun carriages wore out more often than bronze cannons often outlived their ships by being transferred to the newer ones. At the beginning of the fifteenth century, Portugal, building and strengthening its empire, suffered from a constant shortage of artillery. The old guns were kept in service as long as possible. The date of the sinking of the ship from which the guns were recovered is only the latest possible date of manufacture, but it may well be a gun several decades old at the time of the disaster. In no way can it be assumed that the guns aboard each wreck were new or relatively new when the ship sank.

<sup>&</sup>lt;sup>4</sup> Corning.

A closer dating of the Durr 876 cannon is possible due to the presence of an armillary sphere on the upper chase. Dom Manuel I (reigned from 1495 to 1521) was the first Portuguese king to use the depiction of the armillary sphere as his royal standard. Thus, the cannon on which the armillary sphere is depicted was not made in the period preceding the reign of this king. However, the armillary sphere continued to be placed on cannons for many decades after the king's death. The armillary sphere was commonly used on Portuguese guns during the 16th century, most probably in the reigns of João III (1521–57) and Sebastião (1557–78) (Auret & Maggs, 1982: 6). Thus, its presence is only an indication, narrowing down the time period in which the cannon could have been manufactured.

Determining the exact date of manufacture of the Durr 876 cannon is therefore not possible.

#### SUMMARY OF THE MAIN DIMENSIONS OF THE BERÇO MANUELINO DURR 876 CANNON

- Total length base ring to muzzle (mm): 2614.
- Bore length (mm): 1947.
- Trunnion diameter (mm): 60.
- Weight (kg): cá. 470<sup>5</sup>.
- Calibre (mm): 72.
- Shot weight (kg): 0,45 (stone).
- *Charge weight (kg): 0,45 kg (Fig. 5).*



Figure 5. Berço manuelino, Durr 876. Markings interpreted by Ian Van Oordt & Garry De Vries. Drawing Ian Van Oordt.

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<sup>&</sup>lt;sup>5</sup> The actual weight of the cannon has not been determined due to the technical problem of weighing it. The given weight is calculated on the basis of data from to the *berço manuelino* Durr 879, also salvaged from the Santiago wreck, which is 200 mm, or 6%, shorter than the Durr 876. The Durr 879 has the weight incised into the top of the rear of the receiver: 7, 2 and 2 (*quintal, arroba, arratel*), equals 441,5 kg.

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