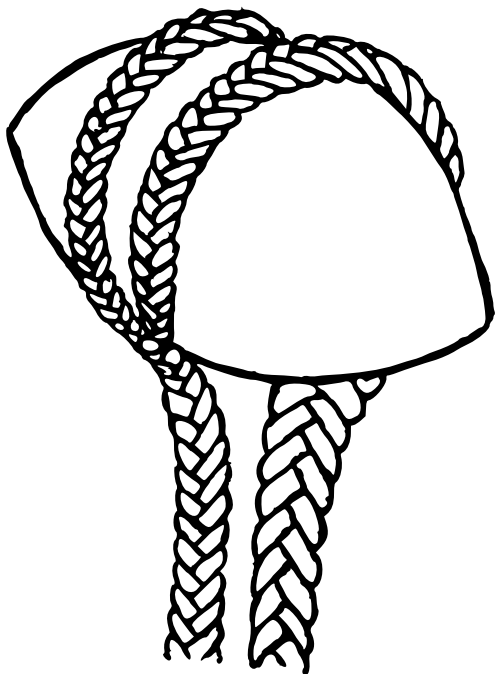


KHERMADION

Issue 3



Sling projectiles

KHERMADION Issue 3

Published April 2, 2025

Text by Robert Kai Zimmermann

Illustrations by Robert Kai Zimmermann

The third issue of KHERMADION presents various types of sling projectiles, both modern and historical.

Contents

| | | |
|----------|-------------------------|-----------|
| 1 | Introduction | 1 |
| 2 | Sports balls | 3 |
| 3 | Rusty balls | 4 |
| 4 | Clay projectiles | 6 |
| 5 | Stones | 7 |
| 6 | Glandes | 8 |
| 7 | Inscriptions | 10 |
| 8 | References | 13 |

1 Introduction

Slings are capable of throwing a wide variety of projectiles. Historically, projectiles made of stone, clay, and even metal were widely spread. These traditional sling projectiles were all used for warfare, among other things, and should therefore be used with great care.

Nowadays, balls from various sports such as tennis, golf or lacrosse enjoy great popularity as well. They are readily available, somewhat less dangerous, and have standardized weights.

The weight of sling projectiles usually ranges from 20 g to 400 g^[8] and the higher their density is, the further they can fly.^[1] Their shape is round, often spherical or biconical, and the latter proved to be particularly suitable for slinging.

Biconical projectiles are rotationally symmetric and their cross-section corresponds to the intersection of two partially overlapping circles. Figure 1 shows this shape and its construction from two circles. Biconical projectiles were known at least since the 7th millennium BC^[5] and can be shot point-first, while their elongated shape allows them to rest in the pouch more securely.

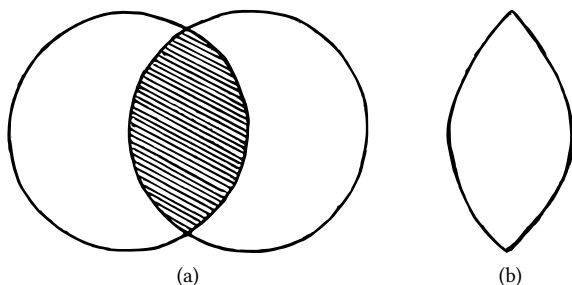


Figure 1: The intersection of two overlapping circles (a) yields a biconical shape (b).

2 Sports balls

Tennis balls, featuring a consistent shape and weight, are popular training projectiles. Due to their low density and their felted surface they slow down quickly during flight, which in turn makes them relatively safe. To slightly improve the aerodynamics of a tennis ball, you can pull a balloon over it. Many other sports balls are suitable for slinging, as well. Table 1 shows a selection of suitable balls.

| Sport | Mass [g] | Diameter [cm] |
|----------|----------|---------------|
| Squash | 24 | 4.0 |
| Golf | 45 | 4.2 |
| Tennis | 55 | 6.5 |
| Lacrosse | 143 | 6.3 |
| Baseball | 145 | 7.0 |
| Cricket | 160 | 7.2 |

Table 1: Properties of various sports balls.^[3]

3 Rusty balls

Rusty balls are balloons, filled with fine sand or wet clay. They have a higher density than tennis balls and a smooth surface, allowing them to reach greater distances. They are especially useful for training as during manufacture, their weight can be set freely. Also, they do not bounce back from their target as much. They do, however, hit considerably harder than tennis balls, and have to be used with more care.

To make a Rusty ball, take at least ten balloons and cut off their throats, as shown in figure 2. Fill one balloon with a lump of wet clay or moist sand, for example. Don't cut the throat of the first balloon too short, so that you can close it with a knot after filling it. When choosing the weight of the filling, don't forget to take the weight of all the balloons into account. Put the remaining balloons one after another over the first one, so that the holes of the balloons are alternately on opposing sides. Don't use too few balloons, otherwise the Rusty ball may already deform in the sling prior to the throw and release poorly.

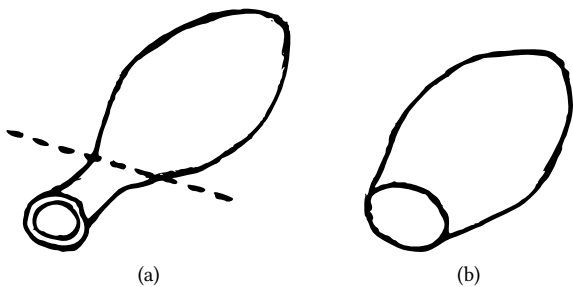


Figure 2: A balloon before (a) and after (b) cutting off its throat.

4 Clay projectiles

Projectiles formed out of clay are cheap and easy to produce, and are the least dangerous of the three traditional sling projectiles. Historically, both air-dried and fired clay projectiles were used.^[12] Air-dried clay has a lower density than stones and lead, reducing the attainable range and power. Only when fired the characteristics of clay approach those of stone.

Clay can be pressed into shape using two-part molds, as was done in antiquity,^[12] but also shaped by hand or rolled between flat or curved boards. The resulting projectiles are usually spherical, biconical or ovoid.^[12]

For rolling a clay projectile using a flat board, take a ball of clay and put it on a flat surface. Take a flat board, gently press it on the clay and circle the board horizontally. This will create a double cone which can then be formed into a biconical shape by hand.

You can also use two curved boards, which, when put on top of each other with their concave sides facing inwards, form a long channel with the desired cross-section. Put a ball of clay in between them and gently press the boards together. Then start to slide them back and forth to roll the clay into shape.

5 Stones

Stones are probably the oldest and most iconic sling projectiles. Smooth pebbles and cobbles occur naturally at riverbanks and beaches and are generally favored over ragged rocks, because uneven and sharp edges increase air drag and cause unpredictable trajectories. Correspondingly, the biblical figure David is told to have chosen five smooth stones from a brook before slaying Goliath with his sling.^[7, 1. Sam. 17:40]

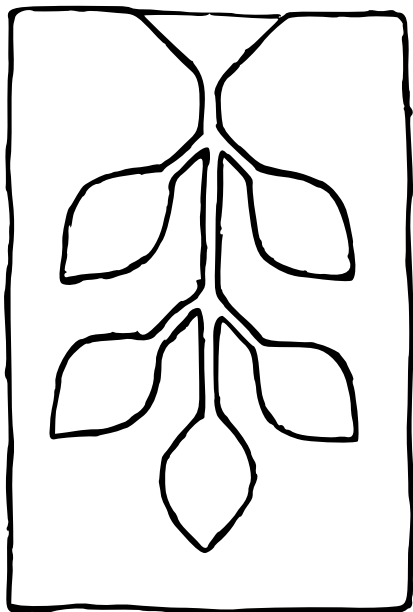
Historically, in places where smooth pebbles were not available in sufficient quantities, raw stones were also hewn into a biconical shape.^[5] Stones can be slung to considerable distances and pose a great threat if not used with care.

6 Glandes

Historically, lead projectiles were used exclusively for war, both in ancient and medieval times.^[2] Their Roman name *glandes*, which means *acorn* and refers to the projectiles' shape, is still often used. They usually have a biconical, acorn- or almond-like shape, but spherical glands were found as well.^[12] Due to their high density, they allow for the highest possible distances of several hundreds of meters.^[1] Correspondingly, they are very dangerous projectiles, and should only be used by proficient slingers in a controlled environment.

In ancient times, lead glands were usually cast using two-part molds made of clay^{[6][12]} They consist of a main channel which branches out into secondary channels leading to oval cavities.^[12] Figure 3 shows the cross-section of such a mold. Often, the glands were hammered and their edges sharpened after casting to increase their effect.^[12]

In contrast to that, in medieval times glands were not cast, but hammered directly from bits of lead.^[2]



(a)

Figure 3: A mold for casting lead projectiles.

7 Inscriptions

Leaden glandes often bore various inscriptions which roughly fall into the following categories:^{[10][9][11]}

- The name of a person, such as the commander of the military unit that made or used the glandes
- The name of a city or people
- The name of a deity
- A sarcastic phrase directed at the enemy
- Evocations directed at the bullet and its desired effect
- Small symbols and emblems

These writings were carved into the molds back-to-front.

Clay projectiles were sometimes inscribed as well. Here, the writings were impressed into the wet clay.^{[4][11]}

Table 2 gives an overview of some inscriptions found on ancient lead projectiles. A selection of symbols and their meanings is listed in table 3.

| Inscription | Meaning | |
|-------------|---|------------|
| ΔΕΞΑΙ | Take! | [10][9][4] |
| ΓΑΒΕ | Catch! | [4][11] |
| ΠΑΠΑΙ | Ouch! | [10] |
| ΝΙΚΑ | Vanquish! | [10] |
| ΑΙΜΑ | Blood | [10][11] |
| ΤΡΩΓΑΛΙΟΝ | Sugar-plum | [9] |
| ΕΥ ΣΚΑΝΟΥ | Be lodged well! (inside the enemy's body) | [9][11] |
| ΡΟΥ ΓΕΥΣΑΙ | Have a taste of sumac! | [4] |
| ΑΚΚΙΠΕ | Take this! | [9] |
| ΦΕΡΙ ΠΟΜΠ | Hit the pompeians! | [12] |
| ΦΥΓΙΣΤΙΒΙΣ | Die, fugitives! | [12] |
| ΠΕΡΙΣΤΙΣ | | |
| ΛΑΝΤΟΝΙ | Die, Lucius Antonius, | [9] |
| ΚΑΛΒΙ | you baldhead! | |
| ΠΕΡΙΣΤΙ | | |
| ΠΕΤ ΚΥΛΛΟΝ | Hit the arse of Octavian! | [9] |
| ΟΚΤΑΒΙΑ | | |
| ΕΜ ΤΙΒΕ | Take this to your misery, wretch! | [12] |
| ΜΑΛΟΝ | | |
| ΜΑΛΟ | | |

Table 2: Some inscriptions found on Greek and Roman gaudes.

| Symbol | Meaning |
|-------------|--|
| Thunderbolt | Probably to let the projectile strike forth like a thunderbolt, reference to Zeus. |
| Lance | Probably refers to flying, stinging. |
| Anchor | Probably refers to naval battles, |
| Trident | reference to Poseidon. |
| Phallus | Used as an obscene insult. |
| Scorpion | Probably refers to stinging, biting. |
| Snake | The wasp might also be a reference |
| Wasp | to the buzzing sound of a projectile during flight. |

Table 3: Some symbols found on ancient glan-des.^{[10][11][12]}

8 References

- [1] Dietwulf Baatz. “Schleudergeschosse aus Blei – eine waffentechnische Untersuchung”. In: *Saalburg-Jahrbuch* 45 (1990), pp. 59–67.
- [2] Wendelin Boeheim. *Handbuch der Waffenkunde*. Leipzig: Verlag von E. A. Seemann, 1890. DOI: 10.11588/diglit.13832.
- [3] Christophe Clanet. “Sports Ballistics”. In: *Annual Review of Fluid Mechanics* 47 (2015), pp. 455–478. DOI: 10.1146/annurev-fluid-010313-141255.
- [4] Dov Gera. “Tryphon’s Sling Bullet from Dor”. In: *Israel Exploration Journal* 35.2/3 (1985), pp. 153–163. ISSN: 00212059.
- [5] Gil Haklay et al. “Up in Arms: Slingstone Assemblages from the Late Prehistoric Sites of En Zippori and En Esur”. In: *Atiqot* 111 (2023), pp. 1–22.
- [6] Lawrence Keppie. *Slingers and Sling Bullets in the Roman Civil Wars of the Late Republic, 90-31 BC*. Vol. 108. Archaeopress Roman

- Archaeology. Oxford: Archaeopress, 2023.
DOI: 10.2307/jj.8816103.
- [7] *King James Bible*. Cambridge University Press, 1769.
- [8] Manfred Korfmann. “The Sling as a Weapon”. In: *Scientific American* 229.4 (1973), pp. 34–42.
DOI:
10.1038/scientificamerican1073-34.
- [9] John McCaul. “On inscribed sling-bullets”. In: *Canadian Journal* (1864).
- [10] Steven L. Tuck. “”Ouch!” inscribed sling-bullets”. In: *Annual of the Museum of Art and Archaeology* 33-35 (1999-2001).
- [11] Wilhelm Vischer. *Antike Schleudergeschosse*. Basel: Balmer & Riehm, 1866.
- [12] Thomas Völling. “Funditores im römischen Heer”. In: *Saalburg-Jahrbuch* 45 (1990), pp. 24–58.