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Examining the Flight Capabilities of Neanderthal Spears

Ryan Scheck

Advisor : Bruce Hardy

Abstract

The purpose of our project was to determine if wooden spears which date back to Neanderthal times were effective throwing weapons. We started by researching the size and materiel of the spears found in Schöningen. We then made full size replicas using sycamore wood, due to its similar hardness to that of the pine of which the originals were made. Our first attempt at replicating a throw by a Neanderthal was using a ballista since Kenyon students can't throw spears that well, but for safety's sake, we had to change methods. Next we used a spear thrower, or atlatl, to try to achieve those velocities, and we did. Then I created several atlatl spear-darts which had the metal tips replaced with wood tips similar to the tips of the spears, and threw at a simulated animal made up of ballistics gelatin covered with cow hide. We had one spear penetrate through the hide and a few inches into the gel at 23 m/s. The rest either missed the target or bounced off the hide with a bent tip. The decreased mass of these darts compared to the spears, and the slightly lower velocity compared with what a Neanderthal would have thrown will make a difference in the energy delivered to the target and could have resulted in a lethal wound. Since we cannot conclude whether a larger, faster spear would penetrate and cause a lethal wound, our results remain inconclusive.

Fig. 1: Schöningen Spear (Pfarr)

Introduction

Neanderthals are the modern humans closest ancestors. They lived in Europe from around 400,000 to 25,000 years ago. They were also commonly believed to have lesser intelligence than the modern man, and lack the ability to plan ahead and thus lack the mental capacity to create a throwing spear. There is a set of spears which were unearthed in Schöningen, Germany, which fit the time frame from when Neanderthals would have inhabited the area (Fig. 1). These spears are also weighted with the center of gravity in the front third of the spear, indicating the weapons may have been used as throwing implements. Due to their large size, many anthropologists have concluded that the spears must have been thrusting implements without testing the possibility of them being used as throwing implements. It is our goal to conduct tests with projectiles similar to the spears, at speeds similar to what a Neanderthal would have thrown at, to determine if these spears are viable throwing weapons.

Experimental Design

Our experimental setup used two different ways of accelerating spears or spear like projectiles to the speeds we desired. We selected 30 m/s as the target speed because that is the speed which Olympic javelin throwers throw spears of similar weight. Unfortunately we do not have any Olympic javelin throwers on campus, and Kenyon students are not nearly as good at throwing spears, so we had to devise other ways of launching the projectiles. Our first method was to use a roman style ballista to replicate the speeds (Fig. 2). A ballista uses the tension in two coils of rope on either side to drive a replica spear (Fig. 3) made of sycamore, which is of a similar hardness as pine which was used in the original spears, forward. Unfortunately, a ballista is not very efficient, and loses a lot of energy. Thus we had to tension the ropes very tightly, and as a result bent the ½ in. steel rods and ¼ in steel plates we were using and still only achieved 13 m/s as measured using a high-speed camera and tracking software. At that point we discontinued the ballista due to safety concerns.

Fig. 2: Ballista

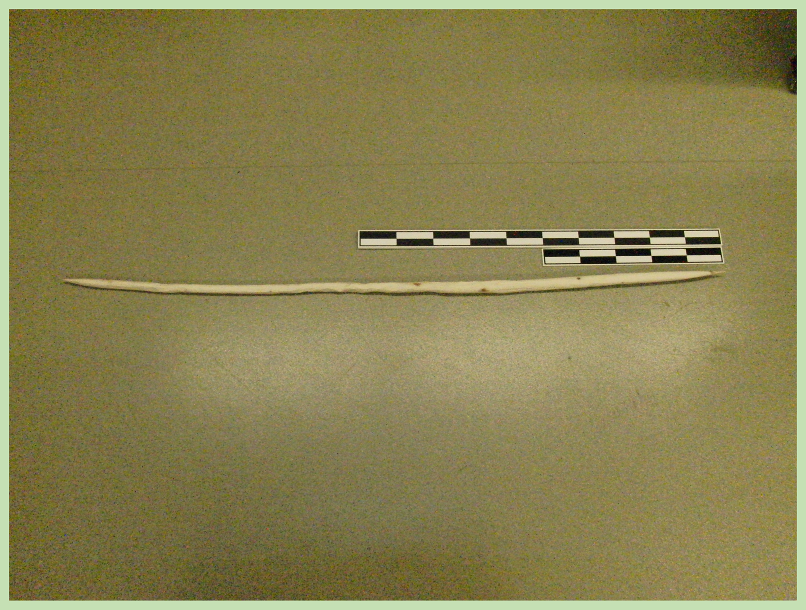
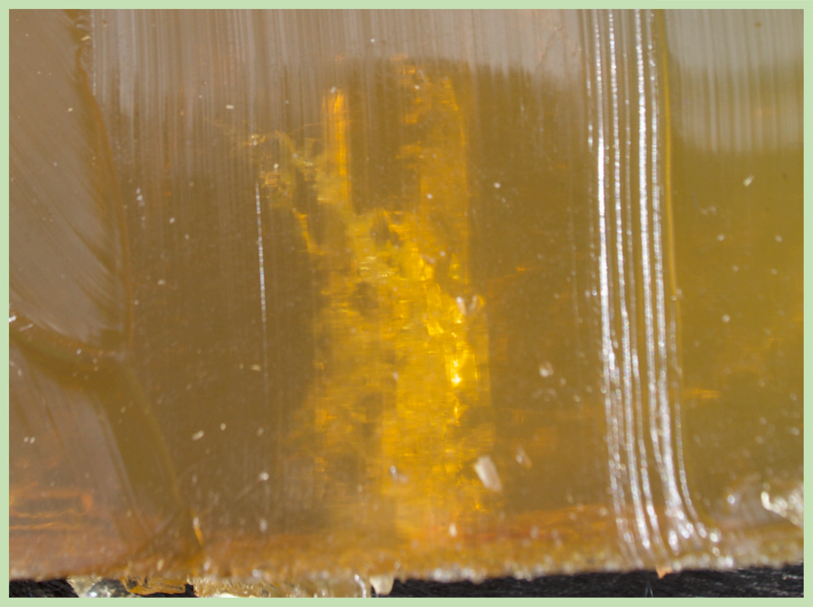


Fig. 3: Spear Replica

Experimental Design Continued

The other method of propulsion was to use an atlatl (Fig. 4). An atlatl works by extending the lever arm of the user, which applies more torque to the dart, and allows the user to achieve forces much greater than throwing by hand. Additionally, since the darts are flexible, the torque can be applied continuously vs. a stiff dart which would only capture the force when it is parallel to the dart. (Fig. 8) The increase in torque over a simple throw can be seen in the equation t=RxF, where t is the torque, and RxF is a cross product of the lever arm, and the force applied. With the atlatl, this simplifies to t=R(F), so increasing the lever arm at all will vastly increase the torque by using a longer lever arm. Another way to see this is in the equations for circular motion, where the tangential velocity (what the velocity of the spear is) is equal to the angular velocity times the radius. Since the atlatl increases the radius, or lever arm, significantly, and maintains if not increases the angular velocity, it will greatly increase the velocity of the projectile. With this method, we measured speeds of around 25-30 m/s with a high speed camera and tracking software. In order to be able to use an atlatl, I created darts which had the factory metal tips replaced with wooden tips similar to what would have been on the spear, (Fig. 4). They were mad out of sycamore wood and used a belt sander to shape it. Then we drilled a hole in the bottom and inserted the shaft from the dart. The target we used was two containers of ballistics Gel, covered with a fresh cow hide (Fig. 6). This simulates throwing at an actual animal.

↑Fig. 4: Atlatl & Dart



↑ Fig. 5: Wound made by Dart (2 ¼ in).

↑ Fig. 6: Cow-box Target

↑ Fig. 7: Spear-Dart &Target

↑ Fig. 8 Flex of the Dart

Results

We did 25 throws at the target with the hybrid spear-darts. Most of the throws missed, but a couple did hit their mark. Of the 6 which hit the target, only one penetrated a 2 ¼ In. at 23 m/s and the rest bounced off with a broken tip (Fig. 5). This leaves us with inconclusive results because we did have a spear-dart which penetrated enough to cause a lethal wound, but the spear-darts do not have the same mass as a spear, and were not going at our target speed. This increased mass and velocity would lead to much larger forces being applied to the target on impact and very well could deliver a lethal wound.

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