Archers at Potočka zijalka?

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Izvleček

Čeprav obstajajo posamezne najdbe, ki nakazujejo uporabo lokov in puščic v paleolitiku, v arheološki stroki ni poenotenega mnenja o začetkih lokostrelstva. Glavni razlog je v minljivosti snovi, iz katerih je bila izdelana lokostrelska oprema. Posredni dokaz o uporabi loka v paleolitiku bi utegnile biti majhne kamene in koščene konice. Majhne koščene konice iz Potočke zijalke so bile povod za preverjanje domneve o obstoju lokostrelske opreme in lokostrelstva v aurignacienu. V Potočki zijalki je bilo odkritih 125 dobro ohranjenih koščenih konic, šest je bilo datiranih z radiometrično metodo AMS ^{14}C in so stare okoli 32 tisoč let.

Ključne besede: Slovenija, Potočka zijalka, paleolitik – aurignacien, koščene konice, lokostrelstvo

Abstract

Archaeological finds indicate the use of bows and arrows in the Palaeolithic, though there is no consensus among archaeologists as to its beginnings. The main reason for this lies in the perishable materials used to make archery equipment. Among the finds that could offer indirect evidence for the use of bows in the Palaeolithic are small stone and bone points. Of the latter, the small bone points found in the cave of Potočka zijalka, Slovenia, led to a reconsideration of the existence of archery and archery equipment in the Aurignacian. The cave revealed 125 well preserved bone points, six of which were established to be roughly 32 ky old using the AMS ^{14}C radiometric method.

Keywords: Slovenia, Potočka zijalka, Palaeolithic – Aurignacian, bone points, archery

INTRODUCTION

Potočka zijalka and its bone points

The first traces of Ice Age hunters in the south-eastern Alps, in Slovenia, were unearthed over 80 years ago in one of the largest and most picturesque Palaeolithic sites in the high Alps, in the cave of Potočka zijalka* (1630 m asl) on the mountain of Olševa. Systematic excavations at the cave were conducted by Srečko Brodar in the years 1928–1935.[1]

Brodar found 134 well preserved bone tools, which included the earliest needle known in the world thus far, as well as 125 bone points. The excavations also yielded a great number of exceptionally well preserved remains of the cave bear (*Ursus spelaeus*), which included 150 skulls, but also the remains of numerous other animals, such as musk-ox teeth (*Ovibos moschatus*). A particularity among the animal remains is the perforated cave bear mandibles. The bone material as well as the samples from the cave, kept at the old gymnasium in Celje, was destroyed during Allied bombing of the town in the last days of World War II. The stone and bone tools kept at the museum of Celje,

* Srečko Brodar spelled the name of the cave as ***Potočka zijalka*** in his first publication in 1928. The name stuck and has been used by authors, including myself, ever since. It was only in 2010 that I chanced upon the correct spelling, which is ***Potočka zijavka*** (zijavka, meaning a gaper in English, was used in: Deschmann 1856; Laibacher Zeitung, 9. 3. 1876, 436; Deschmann 1888, 169; *Krajevni leksikon Slovenije* 3, 1976, 230, 565; *Slovar slovenskega knjižnega jezika* 5, 1991, 886). The erroneous spelling from 1928 is now in general use (*Slovenski pravopis,* 2001, 886).

[1] Brodar 1928, 3; Brodar S., Brodar M. 1983.

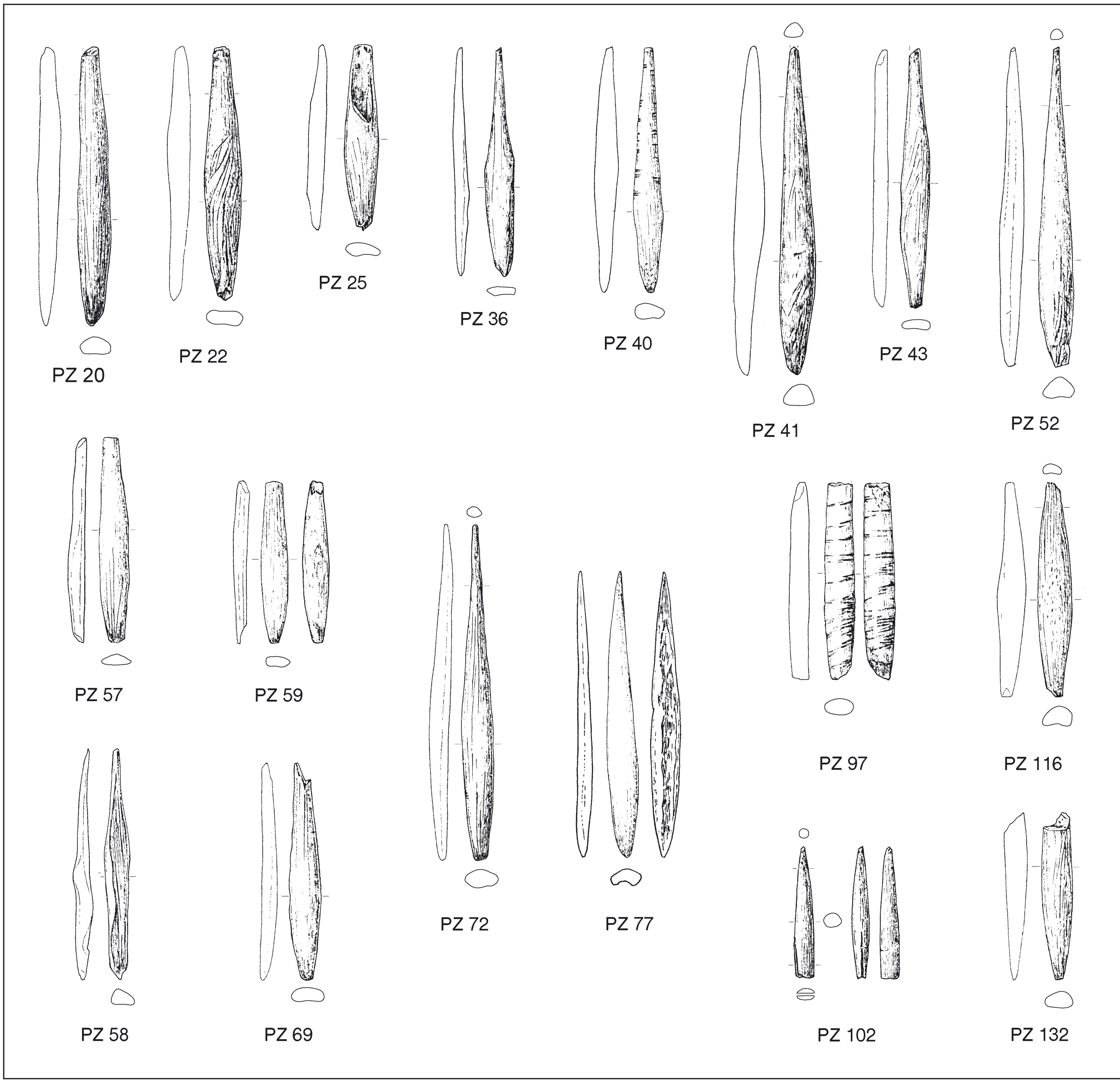

Fig. 1: Small bone points from Potočka zijalka. Scale 1:2 (supplemented after Brodar S., Brodar M. 1983).
Sl. 11: Majhne koščene konice iz Potočke zijalke (dopolnjeno po Brodar S., Brodar M. 1983). M. = 1:2.

however, escaped the same fate and saw the liberation unscathed. Excavation at Potočka zijalka was again conducted in the years 1997–2000.[2] Apart from that, six bone points found during the first excavation were dated with the AMS ^{14}C radiometric method, which established them to be roughly 32 ky old.[3]

The bone points from Potočka zijalka were treated in detail in the author's doctoral thesis.[4] They were divided into two main types, namely flat and spindle-shaped.[5] The largest point has the preserved length of 19 cm, while the smallest measures 4 cm. The bases of these points are either flat, flat-oval or oval. The different sizes are indicative of their use. The large spindle-shaped and flat points could only have been used as lance-heads. The small points, on the other hand, could have been used as arrow-heads (*fig. 1*): PZ 20, PZ 22, PZ 25, PZ 36, PZ 40, PZ 41, PZ 43, PZ 52, PZ 57,

[2] Rabeder, Pohar 2004.
[3] Pacher 2001; Turk 2007.
[4] Odar 2008a.

[5] On the typology of points see: Albrecht, Hahn, Torke 1972; Albrecht, Hahn, Torke 1975; Brodar M. 1985; Knecht 1993; Turk 2002; Turk 2005.

PZ 58, PZ 59, PZ 69, PZ 72, PZ 77, PZ 97, PZ 102, PZ 116 and PZ 132.[6]

Beginnings of archery

Archery and archery equipment hold a special place in the development of the human mind and technology. The bow differs from other cold weapons in that it stores energy within. It is the earliest composite weapon that acts as a spring and transforms the slow human muscle power into fast mechanical movement. What is most interesting is that this simple device did not undergo significant changes and represented, over very long periods, the main long-range weapon for both hunters and warriors.

The feats of technology as results of human needs appeared and fell into disuse independently in various parts of the world. For archery equipment, the time and place of its first use is not known. An important circumstance in that respect is that, until recently, it was made of perishable organic materials, which are only rarely preserved in the archaeological record.

An indirect evidence of the possible use of the bow during the Late Palaeolithic in Europe is provided by the Solutrean shouldered points,[7] one of which was found in Slovenia, at the cave site of Jama v Lozi.[8]

The shouldered points were recently joined by a wooden part of a supposed bow found in the 1970s at Mannheim, Germany. According to the most recent interpretation put forward in 2006, the worked piece of a pine branch supposedly represents the earliest remains of a bow found thus far. A particular feature of this find is a notch on the preserved end of the branch (*fig. 2*). The firing test using a reconstruction of the bow, measuring roughly a metre when strung, was successful and arrows, fired with the draw force of 11.36–13.64 kg, landed up to 80 m away. The wood sample taken from the supposed bow revealed the age of 17,737 years, which is chronologically comparable, for instance, to the Solutrean shouldered points from Layer IV of the French cave site of Combe Saunière (17470 ± 249 BP).[9]

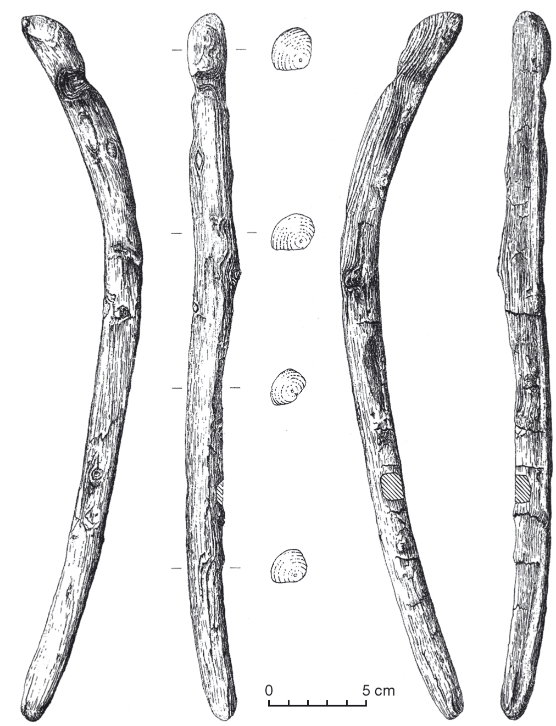

Fig. 2: Remains of the supposed bow from Mannheim, Germany (after Rosendahl et al. 2006, fig. 1).
Sl. 2: Ostanek domnevnega loka iz Mannheima v Nemčiji (po Rosendahl et al. 2006, sl. 1).

Other supposed remains of a simple bow, also made of pine, were found at the Stellmoor site in the German state of Schleswig-Holstein. The site is dated into Younger Dryas, 11–10.3 ky ago. The pine used for the bow was brought from elsewhere, since the wider area of the site at that period is believed to have been covered by tundra. Pine, however, is a poor choice for archery equipment and probably indicates the unavailability of more suitable woods, such as yew. For instance, bows made of pine were until recently used by hunters in northern Siberia.[10]

Of interest for the topic of archery is the research by Medvedev, who treated Old Russian bows and crossbows.[11] In the catalogue, he assembled metal arrow-heads, but also over a hundred various bone arrow-heads. The latter appear in archaeological

[6] Odar 2006a, 62–64.

[7] Geneste, Plisson 1993, figs. 1, 5.

[8] Brodar, Osole 1979a, 140–141; Brodar, Osole 1979b, 181–182, pl. 12: 7; Brodar 1986, 23–75, pl. 11: 20.

[9] Rosendahl et al. 2006; Geneste, Plisson 1993, 118.

[10] Rausing 1997, 33–34; Bergman 1993, 100.

[11] Medvedev 1966.

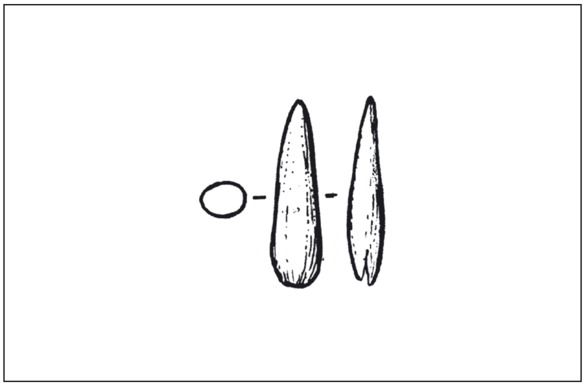

Fig. 3: Small bone point from the cave of Istállóskő, with the remains of the split on the base, once formed part of an arrow (after Hahn 1977, pl. 145: 6). Scale 1:1.
Sl. 3: Majhna koščena konica iz jame Istállóskő z ostankom razpoke na bazi je bila nekoč sestavni del puščice (po Hahn 1977, t. 145: 6). M. = 1:1.

complexes from various periods across the world, but also in ethnographic sources and folk tales.[12]

To return to small bone points, they were also found in the Late Palaeolithic cave sites of Vogelherd, Germany,[13] and Istállóskő, Hungary.[14] Of particular interest is the smallest known spindle-shaped bone point from Istállóskő, which is only 2.5 cm long (*fig. 3*).[15] For Potočka zijalka, Brodar wrote as early as 1928 in the Jutro newspaper that artefacts of prehistoric man made of bone, mostly in the form of arrows, as well as charred wood were found in the cave.[16] A similar supposition regarding the small points from Istállóskő was voiced by Vertes in the 1955 publication, adding that archaeologists did not believe in the existence of bows prior to the Holocene warm period.[17] In the revision study of Istállóskő, conducted in 2002, the authors interpreted certain bone points as arrow-heads without offering an explication.[18] The supposition that Potočka zijalka was visited by hunters equipped with bows, has not yet been systematically verified either.[19] This incited me to conduct a practical verification of the possibility of archery being practiced at Potočka zijalka.

PRACTICAL RESEARCH

Making arrows

The defining criterion for arrow-heads is tied to the thickness of the wooden shaft of the arrow, whereby the most suitable thickness is around one centimetre. Autochthonous peoples across the world came to this finding through experience. One centimetre should thus also be the thickness of the widest part of the base, regardless of whether the point is flat or spindle-shaped.[20]

For my experiments, I made copies of bone points, primarily of the PZ 102 bone point with a split base (*figs. 1, 4*). The small, up to 10- cm long points can be made in one of two ways. The first involves reshaping an oblong bone fragment into a point by using a stone tool and the technique of planing or smoothing. The second involves cutting the point from the whole bone.

The most difficult to make was the split on an oval base, which took countless attempts using stone flakes and a wooden mallet. The difficulty lies in the fact that once the bone cracks, the crack spreads rapidly and, more importantly, uncontrollably. If the mallet is struck too hard against the stone anvil, the crack that occurs runs into the surface of the point, whereby one of the two halves of the split base falls off. Making a split-base point therefore primarily requires a great amount of feeling. One can attempt to direct the crack by making a groove on the sides of the base, though this does not guarantee success. The split is easier to make if it runs parallel to the interior and exterior wall of the compact bone.

The PZ 102 point (*figs. 1, 4*), which served as the model for the reconstructed points, must have been considerably longer when first used, possibly 10 cm or more. Every time its tip broke off, the user sharpened it.[21] This is logical, due to the fact that making points for one-time use only would be highly time and energy consuming. Evidence of repair can also be seen on a point from the cave of Istállóskő, where both halves of the split base broke off through use (*fig. 3*). The user then reshaped the base, which inevitably led to the point being shortened. Such a point could then only have been used as an arrow-head.

[12] Ellis, 1997; Junkmanns 2001, 11, 49, figs. 10, 65; Širok 1961, 16–21.
[13] Hahn, 1977, 87–90.
[14] Hahn 1977, 121–123.
[15] Hahn 1977, pl. 145: 6.
[16] Brodar 1928, 3.
[17] Vertes 1955, 111–131.
[18] Dobosi 2002, 90–96.
[19] Odar 2006a, 62–64; Odar 2008b, 12–13.
[20] Cattelain 1997, 219–228.
[21] On the sharpening of points: Guthrie 1983, 279, 290, 292; Knecht 1997, 204–205; Pokines 1998, 880; Turk 2002; Odar 2006a, 62, fig. 4.

Fig. 4: The smallest bone point, PZ 102 (*fig. 1*), measures 4 cm in length (photo D. Badovinac). Enlarged.
Sl. 4: Najmanjša koščena konica PZ 102 (*sl. 1*) meri v dolžino 4 cm (foto D. Badovinac). Povečano.

Forms of bases indicate two ways of hafting points to wooden shafts.[22] The flat-based points are inserted into the split of the shaft and tied with a string of natural fibres. The oval-based points call for a different method of hafting, where the hafting end on the shaft is hollow. The flat-oval-based points, on the other hand, can be attached both into the split or the hollow of the shaft.

Literature on Palaeolithic hunting equipment reveals different graphic suggestions for the manner of hafting of both main point types.[23] However, authors in their reconstructions do not explain how the Aurignacian or Magdalenian makers of hunting equipment drilled 5–10 cm deep holes into shafts of lances or javelins by using stone tools, since it is such holes that enable secure hafting of spindle–shaped bone points onto wooden shafts.

Knecht, who conducted practical experiments using replicas of supposed javelins, wrote thus: *"Each point was hafted to a wood foreshaft that, in turn, was seated in a socket constructed of metal tubing attached to the end of a fletched wood shaft"*.[24] Also using a metal tubular foreshaft and other artificial materials in his experiments was Guthrie.[25]

The solution to the problem that Knecht and Guthrie faced in their practical experiments can be found in the remains of archery equipment from much later periods. Metal arrow-heads can have a flat tang, a circular tang or a socket. These three different forms impose three different manners of hafting.[26] The shafts for hafting points with a flat tang or a socket could be made of any kind of wood, whereby some species were more suitable than others. Tree species most suitable for hafting tanged arrow-heads are either those with a soft pith or a hollow stem, such as *Viburnum opulus*, *Sambucus nigra* and various species of reed.[27] A trilobate pyramidal arrow-head, found at the Late Antiquity cemetery at Lajh in Kranj, for example, even has part of the tubular wooden shaft preserved.[28] The bone points from Potočka zijalka and elsewhere, with an oval base, demanded a similar solution as the tanged arrow-heads made of metal. Bases of bone points being much thicker than bases of metal points, the only suitable wood is elder, since it offers a wide enough tube for hafting variously large points. Elder pith enables a good grip to the point. [29]

Inserting a split-based arrow-head into an elder shaft requires a wedge to be inserted into the arrow's split (*fig. 5*). When, upon firing, the point pushes into the elder shaft, the wedge subjected to drag pushes apart the base at the split and presses the two halves firmly against the interior walls of the shaft. In order to prevent longitudinal splitting of the shaft, its exterior has to be bound with natural fibres of animal or plant origin before inserting the point. I am of the opinion that, by splitting the base, hunters sought to prevent the arrow-head from falling out of the elder shaft during flight and during extraction of the arrow from the prey. The wedged split also prevents the bone arrow-head from sinking into the tubular shaft when hitting the prey.

As for elder, my initial archery experiments with a home-made target showed it to be unsuit-

[22] Odar 2006a, 62–63, fig. 5.
[23] Guthrie 1983; Knecht 1997, fig. 2; Pokines 1998; Horusitzky 2004, figs. 21–22.
[24] Knecht 1997, 197.
[25] Guthrie 1983, 279.
[26] Odar 2006a; Odar 2006b, 255–257.
[27] Eckhard 1996, 24, fig. 4.
[28] Stare 1980, 79 (cat. no. 79), pl. 125: 8.
[29] Turk 2005, 459; Odar 2006a, 62–64, figs. 4–7; Odar 2008b, 12–13, fig. 3.

Fig. 5: Reconstruction of the spindle-shaped PZ 102 point with a wedge in the split base, inserted into a shaft. Binding of plant fibres prevents the split to spread along the shaft. Enlarged.
Sl. 5: Rekonstrukcija konice z zagozdo v razcepu in v naperek vstavljena vretenasta konica z razcepom na bazi. Ovoj iz rastlinskih vlaken preprečuje podolžno širjenje razpoke po naperku. Povečano.

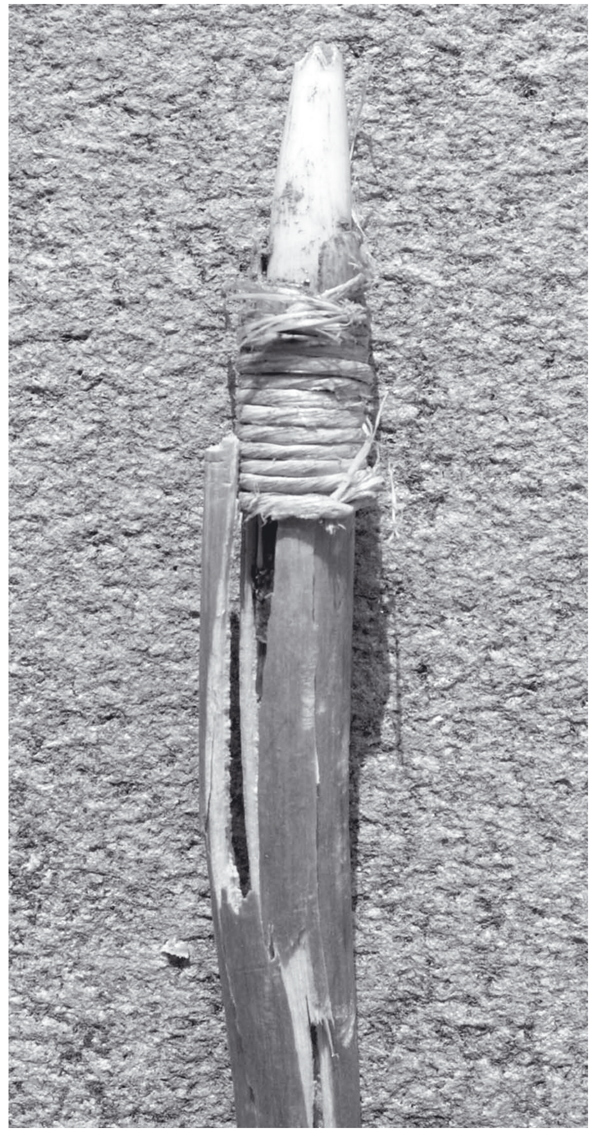

Fig.6: Shots fired at a simple target as a rule caused the elder shafts to yield due to strike force. Enlarged.
Sl 6: Pri strelih na preprosto tarčo so bezgovi naperki praviloma popustili zaradi udarne sile. Povečano.

able for making shafts. The striking force caused most elder shafts to break in several places (*fig. 6*). A different solution needed to be found. This was revealed by ethnographic studies of both extinct and extant autochthonous bow hunters. Archers of the Kua tribe of the eastern Kalahari, Botswana, and archers of the Hadza tribe, living south-east of Lake Eyasi, northern Tanzania, for example, both haft arrow-heads onto shafts by way of a tubular foreshaft.[30] This led me to use elder to make foreshafts rather than shafts in my experiments as a possible solution for hafting bone arrow-heads with oval and flat-oval bases.

[30] Bartram 1997, 325, 334.

Archery experiment

Most arrows destroyed during previous experiments left me with three reconstructed arrows to be used in the archery experiment (*fig. 7*). All three were composed of spruce shafts fletched with bird feathers, an elder foreshaft and a bone point. Two foreshafts were glued to the shafts (*fig. 7:* a,c), while one was detachable (*fig. 7:* b). The shaft with the detachable foreshaft had experienced a longitudinal break along the middle during previous experiments. In spite of this, the damaged arrow was reused.

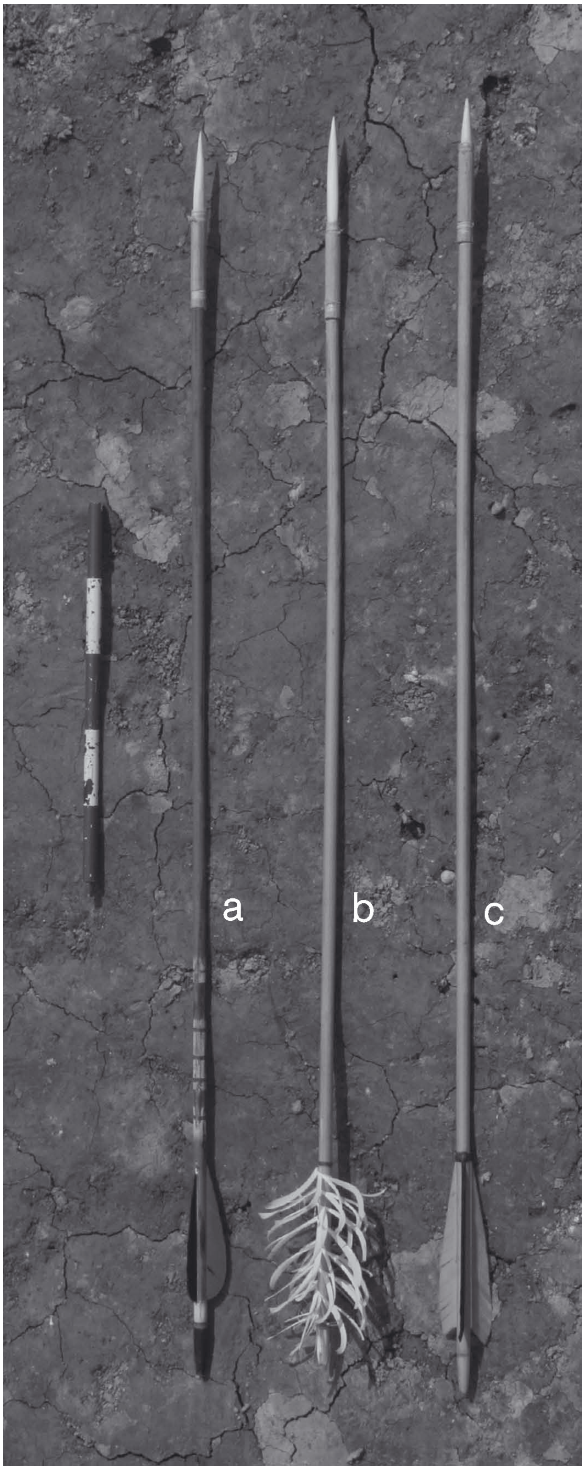

Fig. 7: Arrows composed of wooden shafts, elder foreshafts and bone points prior to the archery experiment (photo L. Rozman).
Sl. 7: Puščice, sestavljene iz lesenih naperkov, bezgovih vmesnikov in koščenih konic, pred lokostrelskim preizkusom (foto L. Rozman).

Fig. 8: Archer M. Podržaj with a simple bow just before the first shot, positioned 20 m from the target. Draw force of the bow was 20 kg (photo L. Rozman).
Sl. 8: Lokostrelec M. Podržaj z enostavnim lokom tik pred prvo sprožitvijo, oddaljenost od tarče je 20 m. Potezna sila loka je 20 kg (foto L. Rozman).

The experiment was conducted on 2 October 2008, at the Ljubljana Zoo. Present at the experiment were Marjan Podržaj, archer, Luka Rozman, archaeologist who photographed the event, and the author.

– A simple Indian bow with a draw force of 20 kg was used.

– The distance between the archer and the target, in the form of a skinned leg of beef, measured 20 m (*fig. 8*).

First shot (*fig. 9*)

Arrow (*fig. 7c*), elder foreshaft (8 cm) glued to the spruce shaft (80 cm), split-based bone point (5 cm):

– lateral impact on the bone,
– bone point undamaged,
– elder foreshaft undamaged,
– spruce shaft broken.

Second shot (*fig. 10*)

Arrow (*fig. 7a*), elder foreshaft (8 cm) glued to the spruce shaft (72 cm), split-based bone point (7 cm):

– meat pierced,
– elder foreshaft undamaged,
– arrow undamaged.

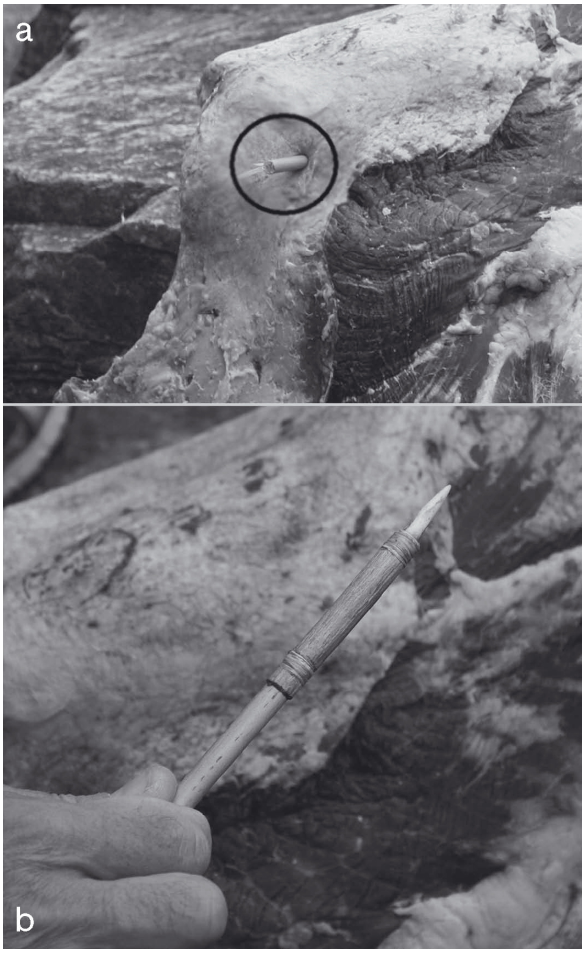

Fig. 9: Shot 1: a – arrow (*fig. 7: c*) hit the bone laterally; b – shaft broke due to strike force, point and foreshaft remained undamaged (photo L. Rozman).
Sl. 9: Strel 1: a – puščica (*sl. 7: c*) je bočno naletela na kost; b – naperek se je zaradi udarne sile zlomil, konica in vmesnik sta ostala nepoškodovan (foto L. Rozman).

Fig. 11: Shot 3: arrow (*fig. 7: a*) hit the bone laterally. The strike force caused the foreshaft to yield, point and shaft remained undamaged (photo L. Rozman).
Sl. 11: Strel 3: puščica (*sl. 7: a*) je bočno naletela na kost. Zaradi udarne sile je vmesnik popustil, konica in naperek pa sta ostala nepoškodovana (foto L. Rozman).

Fig. 10: Shot 2: arrow (*fig. 7: a*) pierced through the target undamaged (photo L. Rozman).
Sl. 10: Strel 2: puščica (*sl. 7: a*) je tarčo prebila nepoškodovana (foto L. Rozman).

Third shot (*fig. 11*)

Arrow (*fig. 7a*), elder foreshaft (8 cm) glued to the spruce shaft (72 cm), split-based bone point (7 cm):
- lateral contact on the bone,
- bone point undamaged,
- elder foreshaft broken,
- shaft undamaged.

Fourth and fifth shot (*fig. 12*)

Arrow (*fig. 7b*), elder foreshaft (8 cm) detachable from the damaged spruce shaft (70 cm), full-based bone point (10 cm):
- meat pierced,
- elder foreshaft undamaged,
- arrow undamaged.

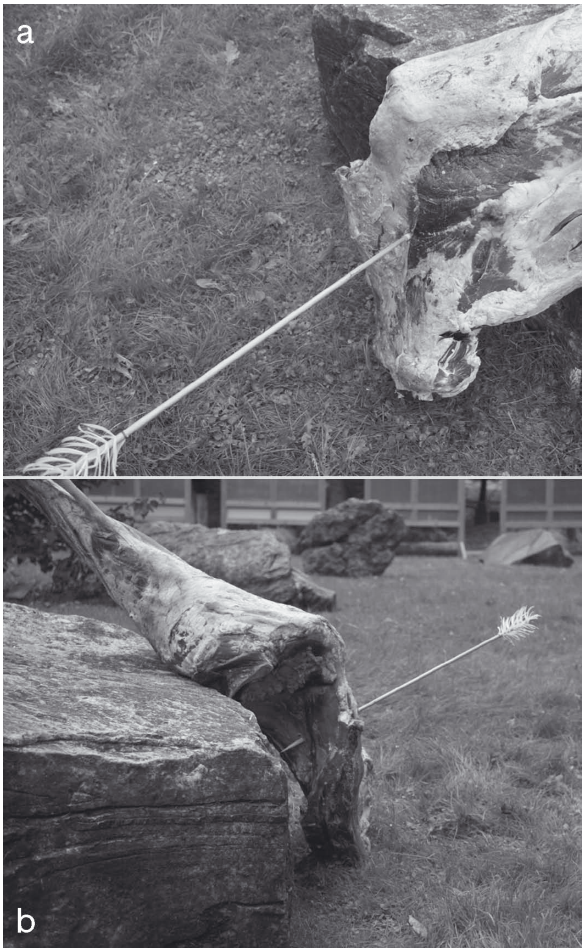

Fig. 12: Shots 4 and 5: arrow (*fig. 7: b*) pierced the target undamaged in both shots (photo L. Rozman).
Sl. 12: Strel 4 in 5: puščica (*sl. 7: b*) je v obeh poskusih prebila tarčo brez poškodb (foto L. Rozman).

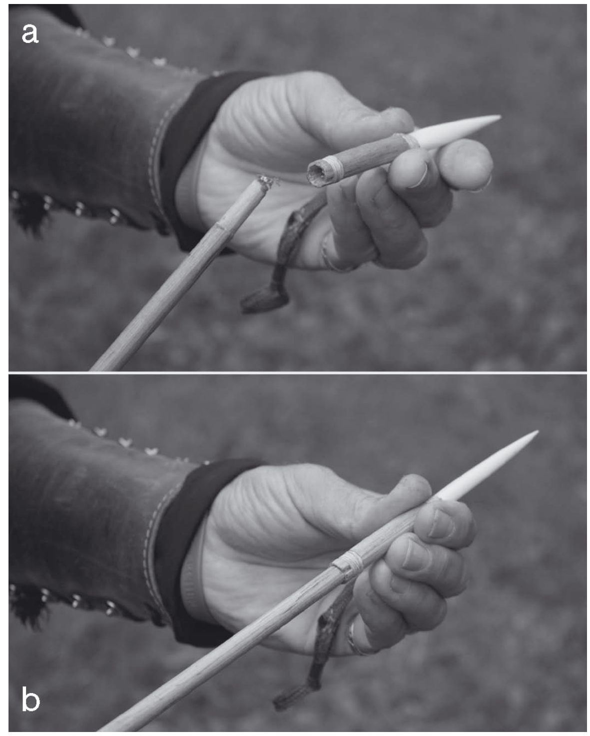

Fig. 13: Prior to Shot 6: hafting the point with foreshaft onto a shaft (b) after extraction from the target (a) (photo L. Rozman).
Sl. 13: Pred strelom 6: namestitev konice z vmesnikom na naperek po izdrtju iz tarče (foto L. Rozman).

Sixth shot (*figs. 13, 14*)

Arrow (*fig. 7b*), elder foreshaft (8 cm) detachable from the damaged spruce shaft (70 cm), full-based bone point (10 cm):
– frontal impact on the bone,
– tip of bone point damaged,
– elder foreshaft broken,
– shaft undamaged.

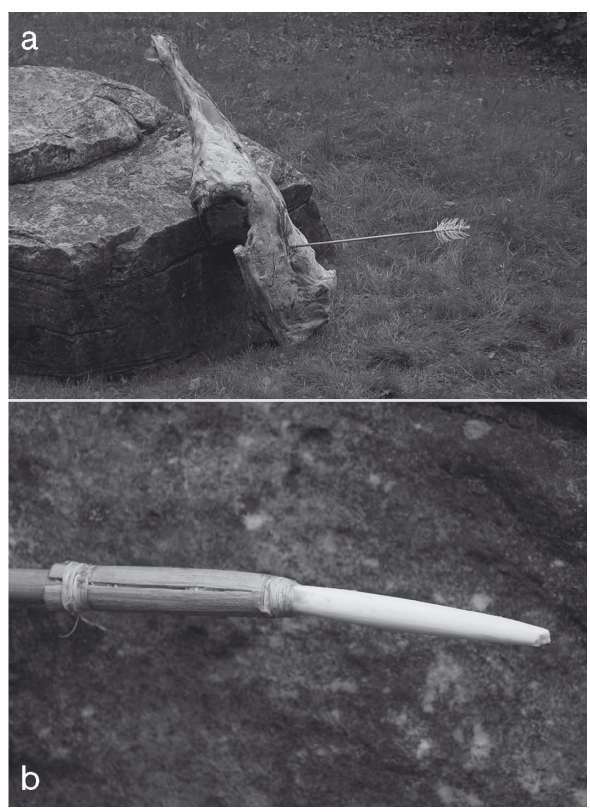

Fig. 14: Shot 6: arrow (*fig.7: b*) hit the bone (a) frontally. The binding on the lower part of the foreshaft yielded under strike force and the shaft slid into the foreshaft (b). The tip of the point was crushed (photo L. Rozman).
Sl. 14: Strel 6: puščica (*sl. 7: b*) je čelno zadela kost. Ovoj na spodnjem delu vmesnika je zaradi udarne sile popustil, in naperek je zdrsnil v vmesnik. Vrh konice se je zdrobil (foto L. Rozman).

EXPERIMENT FINDINGS

Some of the bone points from Potočka zijalka come very close to the ideal shape of a cylindrical point, which leads me to suppose that the PZ 102 point measured around 10 cm when first used, as is the length of the PZ 72 point (*fig. 1*). The PZ 102 point was most probably reused several times as an arrow-head and sharpened after every damage to its tip. It is less likely that archers made arrow-heads of bone for one-time use only, since my preparations for the experiment showed that the difference in the time it takes to make either a short or a long arrow-head of bone is not substantial, and it is much easier to sharpen a damaged bone point than make a new one each time. For that reason I am of the opinion that the bone arrow-heads from Potočka zijalka indicate repeated reshaping.

I further observed in experiment preparations that the split on the base is appropriate for oval-based points inserted into tubular shafts. In other hafting manners, such a split does not realize its full potential, as several authors have already shown.[31] It seems that the split was an attempt at technological improvement in hafting bone points onto wooden shafts, which did not prove very effective.[32] In the development of points, some authors sought to place the split-based points before the appearance of solid-based ones.[33] The former do not differ from the latter in shape, and Mitja Brodar justifiably refuted such a development scheme.[34]

In planning the experiment itself, I had naturally hoped for a successful bow test. However, I did not anticipate such an interesting outcome. The bow test involved six shots using three arrows. In the first shot, the arrow made a lateral contact with the bone, whereby the force of impact caused the shaft to break in the middle. The bone point and the elder foreshaft, which were glued together, remained completely undamaged and the plant binding on the foreshaft withstood the impact. The second shot was flawless. The arrow easily penetrated the 20 cm of flesh and remained undamaged. It was therefore reused in the third shot. This time it made a lateral contact with the bone. The elder foreshaft, glued to the shaft, disintegrated completely upon impact. The bone point and the shaft remained undamaged. The third, last arrow with detachable elder foreshaft and cracked shaft was used in the fourth and fifth shots. It penetrated the flesh undamaged. It was reused again for the sixth shot, when it frontally hit the bone. The binding of the foreshaft yielded at the point of contact with the shaft, which caused the shaft to be pushed into the foreshaft. The foreshaft with the point was not separated from the shaft, which withstood even the third impact. The tip of the bone point broke off.

The archery experiment showed the small bone points from Potočka zijalka to be suitable for use as arrow-heads. As for hafting the oval- or flat-oval-based bone points onto shafts, the important technical solution would be to use a tubular foreshaft of elder. The latter is best not glued to the shaft, but only stuck onto. Thus upon impact, the elder foreshaft as the weakest link of the arrow takes most of the strike force and breaks, leaving the shaft undamaged, whereby the archer can make a new foreshaft much quicker and easier than a fletched shaft. Even a damaged shaft takes the strike force, but only if the elder foreshaft is detachable. The relief of the strike force by way of the foreshaft also protects the bone arrow-head from serious damage.

The archery experiment yielded results that correspond closely to the results of a similar experiment carried out to compare the penetration force of arrows with either wooden or stone heads. Surprisingly, sharpened wooden points, which are of the same shape as the small bone points from Potočka zijalka, were found to have a penetration force that was only 10 per cent smaller than the penetration force of the stone points.[35]

DISCUSSION

The small spindle-shaped points, such as the PZ 102, are the same as the distal ends of cylindrical (Solutrean and Magdalenian) points (*fig. 15*).[36] Two cylindrical bone arrow-heads, typologically easily comparable to the above-mentioned Solutrean or Magdalenian points, were found fired some 5000 years ago at a 35-year-old man. One penetrated his chest and the other hit the nasal cavity.[37] It is

31 Horusitzky 2004, 21–26.
32 Turk 2002, 26; Horusitzky 2004.
33 Knecht 1997, 195.
34 Brodar 1985, 19.
35 Waguespack et al. 2009.
36 Pokines 1998; Petillon 2006.
37 Junkmanns 2001, 34, fig. 49.

hardly possible for these two points to have been hafted onto javelins thrown at the victim with the aid of a javelin-thrower (*propulseur* in French), since no such remains have yet been found in the archaeological contexts of the European Holocene. There have, however, been numerous finds of the remains of archery equipment.

The earliest examples of javelin-throwers appear in the Solutrean. An example was found at Combe Saunière, in Layer IV,[38] where also 170 shouldered points were unearthed. Geneste and Plisson attempted, on the basis of practical experiments, to establish whether these points formed parts of either javelins or arrows. Their finding is significant:[39] "*The kinetic energy of a spear thrown with a spearthrower is considerable, principally because of its large mass (150 g). The speed of the spear thrown with a spear-thrower, on the order of 20 to 25 m/s ... never attains the speed of those thrown with bows.*[40] *The weakness of the characteristics of impact left on the Solutrean shouldered points ... could therefore be attributed to either the light weight of the Solutrean projectiles, or the weak force of the Solutrean system of projectile technology or even to a combination of these two factors. ... The ballistic characteristics of Solutrean shouldered points ... indicate that these slender, light projectile points are improper for arming heavy handles.*"

It follows from the above that heavy shafts could only have formed parts of javelins and light shafts of arrows. In spite of this, however, the authors leave the question of javelins versus arrows open. The answer would perhaps be easier to give if they knew, at the time of their experiment, of the supposed bow remains from Mannheim mentioned above.

This leads us to the possibility of the use of javelins in the Aurignacian and, consequentially, at Potočka zijalka. Javelin hunting would be conclusively proven by javelin-throwers, yet so far, no such remains dating to either the Aurignacian or the Gravettian have been found. The known remains of javelin-throwers, some 130 parts in various states of preservation, were made of bone or antler, while the wooden parts have disintegrated. By far the highest number came to light in southern France, along the Dordogne River and in the Pyrenees. Other sites are situated in Spain, Switzerland and Germany. The oldest example is roughly 20 ky old and the youngest some 12 ky, while the great majority of the datable javelin-throwers fall into the narrow timeframe between 13,800 and 12,400 BP.[41]

Fig. 15: Reconstruction of point PZ 102. The point was supposedly much longer when first used. Scale = 1:1.
Sl. 15: Rekonstrukcija konice PZ 102. Konica je bila pred prvo uporabo veliko daljša. M = 1:1.

However, absence of evidence is not yet evidence of absence, and the answer needs to be sought elsewhere. Concerning the topic of the use of arrows, the research of most interest is that on the cross-section forms of humeri in the males of both

[38] Geneste, Plisson 1993, 119.
[39] Geneste, Plisson 1993, 131.
[40] Junkmanns 2001, 57.
[41] Cattelain 1997; Stodiek 2009.

human species, Neanderthals and Cro-Magnons,[42] since the form of upper extremity bones could indicate certain activities of the individuals. The bones of male representatives of Neanderthals (Mousterian) and the early Cro-Magnons (Aurignacian, Gravettian) show a difference in the thickness and form of the compact bone in left and right humeri. The humeri of leading arms, usually the right, have a thicker compact bone. The same difference in both human species led some authors to infer that Neanderthals and early Cro-Magnons performed the same movements, connected to the hunting technique.[43] They also drew attention to the difference in the form of humeri between the early (Aurignacian, Gravettian) and later Cro-Magnons (Solutrean, Magdalenian and later), which they explained through the change in the hunting technique during the Late Upper Palaeolithic. The humeri of Neanderthals and the early Cro-Magnons of the male sex are thicker in both anteroposterior and mediolateral planes. Furthermore, the right humeri are evenly thicker than the left ones in both planes. The humeri of the male representatives of the later Cro-Magnons are rounder in cross-section and therefore have the same resistance force on both planes. The even thickening of the humeri on mediolateral and anteroposterior planes was thought to prove throwing and, consequentially, the use of javelins.[44] Since this was only a supposition, Schmitt, Churchill and Hylander set out to test it in practice.[45] The experiment was to show whether, in thrusting, it is the lagging arm holding the rear of the lance that provides most force and how the strike force in thrusting is transferred from the lance to the front and rear arms. The findings of this thrusting experiment confirm the supposition put forward by the study of bone remains, namely that Neanderthals and early Cro-Magnons hunted with lances and that javelins had not yet been in use.

The users of bone points strove to mortally wound their prey as soon as possible. For this reason, they were making variously long points, whereby the size of the point was linked to the size and aggressiveness of the prey as well as to the manner of hunting. Hunting with a lance is dangerous, since the hunter is in direct contact with the animal fighting for its life. The lances must therefore have been durable enough to withstand the forces appearing in repeated thrusting into the animal.

Lances with slender cylindrical and other small points would not be effective, since these kinds of points would break at first thrust into an irritated animal due to their small thickness. Moreover, hafted onto 2–3 cm thick shafts they would be too small to be effective. For thrusting with a lance, bone points needed to be thick or wide enough as well as long enough. This corresponds closely to the findings from the study of large flat and spindle-shaped bone points from Potočka zijalka and other sites. The distal ends of these points widen from the apex to the base and the points are widest on the transition from the distal end to the base. Javelins with such points would not be effective and were rather equipped with slender cylindrical (Magdalenian) bone points.[46]

Javelin-throwers were found predominantly in southern France and in Spain, as stated above.[47] In my opinion, the introduction of hunting using a javelin in these areas is tied to the ecological changes during the last glacial maximum (OIS 2) and directly after it. These ecological changes certainly caused a change in dietary habits of the hunter-gatherer communities, who developed a new kind of hunting weapon – javelin with a javelin-thrower – as a response to the change. Due to poor reliability, such javelins were only suitable for hunting large mammals living in troops in open country. The technique of hunting with javelins and javelin-throwers appeared in southern France and in Spain in the Solutrean, and fell into disuse with the end of the Palaeolithic.

Of all cold weapons, it is the bow and arrow that enables hunting of the widest range of prey on land, in water and in the air, which explains the development of numerous variants of bows, arrow shafts and arrow-heads up to this day. In the Palaeolithic (as well as Mesolithic and Neolithic), arrow-heads were made of wood, bone and stone. The wooden arrow-heads have not been preserved. The advantage of the bone arrow-heads lies in the possibility of repeated use, since the stone heads usually break at first use, especially if the arrow misses the prey. In connection with

[42] Trinkaus, Churchill, Ruff 1994; Churchill, Formicola 1997; Trinkaus, Churchill 1999; Trinkaus, Ruff 1999a; Trinkaus, Ruff 1999b.

[43] Churchill, Weaver, Niewoehner 1996.

[44] Tullos, King 1973; Ganior et al. 1980; Pappas, Zawacki, Sullivan 1985.

[45] Schmitt, Churchill, Hylander 2003.

[46] Stodiek, Paulsen 1996; Pokines 1998; Petillon 2006.

[47] Stodiek 1993; Cattelain 1997; Stodiek 2009.

that, S. L. Kuhn observed, when studying Italian sites, a considerably stronger presence of bird bone remains in the Aurignacian layers than in the Mousterian layers beneath; ground-nesting birds, such as partridges, apparently became an important element in the food chain in the Early Aurignacian.[48] Moreover, it is to the Aurignacian that date the first numerous finds of flutes, which were made of bird bones.[49] Kuhn went on to write that Stone Age communities during the Holocene warm period used bow and arrow mostly to hunt animals difficult to catch, such as rabbits, birds or fish. At Combe Saunière, numerous remains of birds, but also wolves and foxes were found.[50] Foxes and small mammals are not most effectively hunted with a javelin. Much more suitable is the bow, with which animals down to the size of a partridge can be shot within a 25–40 m range.[51]

If the supposition on the use of bow and arrow in the Aurignacian is correct, than the question of the origin of archery is naturally posed. For the moment, it seems that we can tie the appearance of bow and arrow hunting in Europe to the arrival of anatomically modern humans, the Cro-Magnons. Hunters may have used numerous other hunting techniques, but these cannot be proven with the archaeological method.

CONCLUSION

Potočka zijalka, due to the great number of various bone points, enables a good insight into the hunting techniques of the Aurignacian hunters. The archery experiment using replicas of small bone points from Potočka zijalka was successful and justifiably allows, together with all other data, the use of archery equipment during the Aurignacian to be proposed.

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CATALOGUE
(*fig. 1*)

PZ 20 (inv. no. 774)
Position: rear of the cave, layer unknown.
Bone point with upper distal end broken off. Fracture surface rounded. Planing traces well visible. Cuts, probably forming a spiral, heavily planed away across the entire surface. Edges wavy along the entire length. Base oval. Distal end goes from oval to round in section towards the tip. L. 79.0 mm; w. 9.0 mm; th. 6.0 mm; weight 4.7 g.

PZ 22 (inv. no. 773)
Position: rear of the cave, layer unknown.
Bone point with upper distal end broken off. Fracture surface rounded. Planing traces visible. Cuts, probably forming a spiral, heavily planed away across the entire surface, fresh cuts on the edges not planed. Edges wavy along the entire length. Base flat. Distal end goes from oval to round in section towards the tip. Spongiosis preserved on the base. L. 71.0 mm; w. 10.7 mm; th. 6.0 mm; weight 4.6 g.

PZ 25 (inv. no. 777)
Position: rear of the cave, layer unknown.
Bone point with upper distal end broken off. Fracture surface rounded. Planing traces visible. Cuts visible. Edges wavy along the entire length. Base flat. Distal end goes from oval to round in section towards the tip. Spongiosis and medullary channel preserved along the entire length. L. 53.0 mm; w. 10.0 mm; th. 4.6 mm; weight 2.4 g.

PZ 36 (inv. no. 786)
Position: rear of the cave, Layer 4, above.
Bone awl/point on a bladelet. Distal end rounded. Base flat. Distal end goes from oval to round in section. Spongiosis preserved on the base. L. 65.7 mm; w. 2.6 mm; th. 1.4 mm; weight 1.4 g.

PZ 40 (inv. no. 790)
Position: rear of the cave, Layer 5, middle.
Bone point, almost completely preserved. Tip broken off. Fracture surface sharp. Planing traces visible. Cuts, probably forming a spiral, heavily planed away, fresh cuts visible on the edges of the distal end. Edges wavy along the entire length. Base oval. Distal end goes from oval to round in section towards the tip. Compact bone almost

[48] Kuhn 2002, 89.
[49] Münzel, Conard 2009; Conard 2009.
[50] Geneste, Plisson 1993, 118.
[51] Pope 1991, 26–28.

fully reshaped. Spongiosis preserved on the base. L. 70.0 mm; w. 8.0 mm; th. 6.0 mm; weight 3.2 g.

PZ 41 (inv. no. 791)
Position: rear of the cave, Layer 4, below.
Bone point, almost completely preserved. Tip broken off. Fracture surface sharp. Planing traces well visible. Cuts heavily planed away. Edges almost straight. Base oval. Distal end goes from oval to round in section towards the tip. Compact bone almost fully reshaped. Spongiosis remains preserved on the bottom of the base. L. 93.0 mm; w. 9.5 mm; th. 8.5 mm; weight 6.5 g.

PZ 43 (inv. no. 793)
Position: rear of the cave, Layer 4 below.
Bone point, almost completely preserved. Tip broken off. Fracture surface sharp. Planing traces well visible. Cuts heavily planed. Edges wavy along the entire length. Base flat. Distal end goes from oval to round in section towards the tip. Spongiosis and medullary channel preserved on the base and partly on the distal end. L. 74.0 mm; w. 8.5 mm; th. 3.6 mm; weight 2.5 g.

PZ 52 (inv. no. 801)
Position: rear of the cave, Layer 5, above.
Bone point, almost completely preserved. Tip broken off. Fracture surface sharp. Planing traces visible. Cuts heavily planed away on the edges. Edges wavy along the entire length. Base flat-oval. Distal end goes from oval to round in section towards the tip. Spongiosis and medullary channel preserved on the base on partly on the distal end. L. 92.0 mm; w. 9.8 mm; th. 6.0 mm; weight 4.7 g.

PZ 57 (inv. no. 805)
Position: rear of the cave, Layer 4, above.
Bone point with distal end broken off. Fracture surface sharp. Planing traces visible. Cuts not visible. Edges slightly wavy on the distal end. Base flat. Distal end goes from oval to round in section towards the tip. Spongiosis preserved along the entire length. Point made on a fragment. L. 59.0 mm; w. 8.2 mm; th. 4.0 mm; weight 2.2 g.

PZ 58 (inv. no. 3652)
Position: rear of the cave, Layer 5, above.
Bone awl/point, almost completely preserved. Tip broken off. Fracture surface sharp. Planing traces visible. Cuts not visible. Edges slightly wavy on the distal end. Base oval. Distal end goes from oval to round in section towards the tip. Spongiosis preserved along the entire length. Point made on a fragment. L. 66.0 mm; w. 6.5 mm; th. 4.0 mm; weight 1.7 g.

PZ 59 (inv. no. 806 – replica of artificial material)
Position: rear of the cave, Layer 5, middle.
Bone point, destroyed. Replica made of artificial material with distal end broken off. Fracture surface sharp. Planing traces visible. Cuts not visible. Edges wavy along the entire length. Base flat. Distal end goes from oval to round in section towards the tip. L. 46.0 mm; w. 7.3 mm; th. 4.0 mm.

PZ 69 (inv. no. 813)
Position: rear of the cave, Layer 4, middle.
Bone point with upper distal end broken off. Fracture surface sharp. Planing traces visible. Cuts not visible. Edges wavy along the entire length. Base flat. Distal end goes from oval to round in section towards the tip. Spongiosis preserved along the entire length. L. 62.0 mm; w. 9.0 mm; th. 4.0 mm; weight 2.6 g.

PZ 72 (inv. no. 816)
Position: rear of the cave, Layer 5, above.
Bone point, almost completely preserved. Tip broken off. Fracture surface rounded. Planing traces well visible. Cuts heavily planed. Edges wavy along the entire length. Base flat-oval. Distal end goes from oval to round in section towards the tip. Spongiosis preserved on the basal and distal ends. L. 96.0 mm; w. 9.0 mm; th. 5.5 mm; weight 4.1 g.

PZ 77 (2006 returned from Erlangen)
Position: rear of the cave, Layer 5, middle.
Bone point, completely preserved. Planing traces poorly visible. Cuts visible. Edges slightly wavy on the distal end. Base flat. Distal end goes from oval to round in section towards the tip. Spongiosis preserved almost along the entire length. L. 80.0 mm; w. 8.7 mm; th. 4.0 mm; weight 2.6 g.

PZ 97 (inv. no. 835)
Position: cave entrance, Layer 7.
Point made on a tusk with upper distal end broken off. Fracture surface sharp. Planing traces visible. Cuts forming a spiral well visible across the entire surface. The surface wavy along the entire length. Oval in section. Compact bone fully reshaped. L. 56.0 mm; w. 9.3 mm; th. 6.0 mm; weight 3.3 g.

PZ 102 (inv. no. 837a)
Position: cave entrance, Layer 5.
Bone point, completely preserved. Planing traces not visible. Cuts on the base heavily planed. Surface not wavy. Oval split base. Distal end round in section. Compact bone fully reshaped. L. 38.0 mm; w. 6.0 mm; th. 5.0 mm; weight 0.8 g. (*fig. 4*).

PZ 116 (inv. no. 852)
Position: cave entrance, Layer 7.
Bone point, almost completely preserved. Tip and bottom of the base broken off. Fracture surfaces sharp. Planing traces well visible. Cuts not visible. Edges slightly wavy along the entire length. Base oval. Distal end goes from oval to round in section towards the tip. Spongiosis remains preserved on the distal end. L. 61.0 mm; w. 10.0 mm; th. 7.0 mm; weight 3.2 g.

PZ 132 (inv. no. 836a)
Position: cave entrance, Layer 7.
Bone point with preserved base and lower distal end. Fracture surface sharp. Planing traces well visible. Cuts visible on the edges of the distal end below the fracture. Edges wavy. Base oval. Compact bone fully reshaped. L. 46.6 mm; w. 9.8 mm; th. 6.0 mm; weight 2.1 g.

Translation: Andreja Maver

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Lokostrelci v Potočki zijalki?

UVOD

Potočka zijalka in koščene konice

Pred 83 leti so bile odkrite prve sledi ledenodobnih lovcev v jugovzhodnih Alpah na ozemlju Slovenije. Srečko Brodar je v letih med 1928 in 1935 vodil sistematična izkopavanja v enem od najmogočnejših in najslikovitejših paleolitskih najdišč v alpskem visokogorju, v jami Potočka zijalka* (1630 m) na Olševi.[1]

Srečko Brodar je odkril 134 dobro ohranjenih koščenih orodij, od tega najstarejšo do sedaj znano koščeno šivanko in 125 koščenih konic. Z izkopavanji je prišlo na dan izjemno število dobro ohranjenih ostankov jamskega medveda (*Ursus spelaeus*), vključno s 150 lobanjami, kot tudi ostanki mnogih drugih živali, npr. zobje moškatnega goveda (*Ovibos moschatus*). Svojevrstno posebnost predstavljajo naluknjane čeljusti jamskega medveda. Vse kostno gradivo in vzorci, shranjeni v stari gimnaziji v Celju, so bili uničeni med zavezniškim bombardiranjem Celja v zadnjih dneh druge svetovne vojne. Kamena in koščena orodja, ki so bila shranjena v muzeju, pa so osvoboditev dočakala nepoškodovana. Nova izkopavanja v Potočki zijalki so potekala v letih 1997 do 2000.[2] Šest koščenih konic je bilo datiranih z radiometrično metodo AMS ^{14}C in so stare okoli 32 tisoč let.[3]

S koščenimi konicami iz Potočke zijalke sem se podrobno ukvarjal v doktorski disertaciji.[4] Koščene konice iz Potočke zijalke delimo v dva glavna tipa, ploščate in vretenaste.[5] Največja konica ima ohranjeno dolžino 19 cm, najmanjša 4 cm. Baze teh konic so ploščate, ploščato ovalne ali ovalne. Različne velikosti konic kažejo na njihovo uporabnost. Velike vretenaste in ploščate konice so bile lahko uporabljene le kot sulične osti. Predstavljene majhne koščene konice pa bi lahko bile uporabljene kot puščične osti (*sl. 1*): PZ 20, PZ 22, PZ 25, PZ 36, PZ 40, PZ 41, PZ 43, PZ 52, PZ 57, PZ 58, PZ 59, PZ 69, PZ 72, PZ 77, PZ 97, PZ 102, PZ 116 in PZ 132.[6]

Začetki lokostrelstva

Lokostrelstvo in lokostrelska oprema imata posebno mesto v zgodovini razvoja človeške misli in tehnologije. Lok se od ostalega hladnega orožja loči po tem, da v sebi shrani energijo. Gre za najstarejše sestavljeno orodje, ki deluje kot vzmet in počasno človekovo mišično moč spremeni v hiter mehanski gib. Najzanimiveje je, da se ta preprosta naprava ni dosti spreminjala in da je bila skozi dolga obdobja glavno orožje na daljavo tako za lovce kot za bojevnike.

Tehnološki podvigi, ki so posledica potreb ljudi, so se na različnih delih našega planeta neodvisno pojavljali in izginjali v pozabo. Kdaj in kje je bila lokostrelska oprema prvič uporabljena, ne vemo. Do nedavnega je bila namreč izdelana iz minljivih organskih snovi, ki se le redko ohranijo v arheoloških sklopih. Posredni dokaz o morebitni uporabi loka v evropskem mlajšem paleolitiku so solutreenske izrobljene konice.[7] V Sloveniji je bila izrobljena konica odkrita v Jami v Lozi.[8]

Izrobljenim konicam se je nedavno pridružil leseni del domnevnega loka iz Mannheima v

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* Srečko Brodar je ime jame črkoval kot ***Potočka zijalka*** v prvi objavi leta 1928. Ta zapis se je ustalil in smo ga nato uporabljali vsi. Šele leta 2010 sem po naključju spoznal, da je pravilno črkovanje imena jame ***Potočka zijavka*** (ZIJAVKA: Deschmann 1856; Laibacher Zeitung, 9. 3. 1876, 436; Deschmann 1888, 169; Krajevni leksikon Slovenije III, 1976, 230, 565; Slovar slovenskega knjižnega jezika V, 1991, 886). Črkovanje iz leta 1928 je prešlo v splošno rabo (Slovenski pravopis 2001, 886).

[1] Brodar 1928, 3; Brodar S., Brodar M. 1983.

[2] Rabeder, Pohar 2004.

[3] Pacher 2001; Turk 2007.

[4] Odar 2008a.

[5] O tipologiji konic: Albrecht, Hahn, Torke 1972; Albrecht, Hahn, Torke 1975; Brodar M. 1985; Knecht 1993; Turk 2002; Turk 2005.

[6] Odar 2006a, 62–64.

[7] Geneste, Plisson 1993, sl. 1, 5.

[8] Brodar, Osole 1979a, 140–141; Brodar, Osole 1979b, 181–182, t. 12: 7; Brodar 1986, 23–75, t. 11: 20.

Nemčiji. Obdelan kos borove veje je bil odkrit v 70. letih 20. stoletja. Po najnovejši razlagi iz leta 2006 naj bi predstavljal do sedaj najstarejši ostanek loka. Najdba je pritegnila pozornost zaradi zareze na ohranjenem koncu obdelane borove veje (*sl. 2*). Preizkus streljanja z rekonstruiranim lokom, ki vpet meri okoli 1 m, je bil uspešen. Puščice, ki so bile sprožene s potezno silo 11,36–13,64 kg, so poletele do 80 m daleč. Vzorec lesa iz domnevnega loka je pokazal starost 17.737 let, kar je časovno primerljivo s solutreenskimi izrobljenimi konicami iz plasti IV v francoskem jamskem najdišču Combe Saunière (17470 ± 249 BP).[9]

Domnevni ostanki enostavnega loka, ki je bil prav tako izdelan iz bora, so bili odkriti tudi na najdišču Stellmoor v nemški deželi Schleswig-Holstein. Najdišče Stellmoor je datirano v mlajši dryas pred 11.000–10.300 leti. Bor za izdelavo lokov je bil prinesen od drugod, saj naj bi na širšem območju takrat uspevala tundra. Ker je borov les slaba surovina za izdelavo lokostrelske opreme, verjetno drugih primernejših vrst lesa, kot je na primer tisa, ni bilo na razpolago. Loke iz bora so še nedavno uporabljali lovci v severni Sibiriji.[10]

Zanimiva je raziskava Medvedeva, ki je obravnaval staroruske loke in samostrele.[11] Poleg kovinskih puščičnih osti je v katalogu zbranih tudi nad 100 najrazličnejših koščenih puščičnih osti. Te se pojavljajo v arheoloških sklopih iz različnih obdobij po vsem svetu, v etnografskih virih in v ljudskih pripovedkah.[12]

Majhne koščene konice so bile odkrite v mlajšepaleolitskih jamskih najdiščih Vogelherd v Nemčiji[13] in Istállóskő na Madžarskem.[14] Posebej zanimiva je najmanjša znana vretenasta koščena konica iz jame Istállóskő, ki v dolžino meri le 2,5 cm (*sl. 3*).[15] O nekaterih konicah iz Potočke zijalke je S. Brodar že leta 1928 v dnevniku Jutro zapisal, da so odkrili *”izdelke (artefakte) prazgodovinskega človeka iz kostnine, pred vsem v obliki puščic ali strelic, pa tudi lesno oglje”*.[16] Podobno je leta 1955 o majhnih konicah iz jame Istállóskő domneval Vertes, a je dodal, da stroka ne verjame v obstoj lokov pred holocensko otoplitvijo.[17] V revizijski študiji jame Istállóskő iz leta 2002 so avtorji nekatere koščene konice opredelili kot puščične osti brez dodatne obrazložitve.[18] Domneva, da so v Potočko zijalko zahajali z loki opremljeni lovci, še ni bila sistematično preverjena.[19] Zato sem se odločil za praktično preverjanje možnosti o obstoju lokostrelstva v Potočki zijalki.

RAZISKAVA

Izdelava puščic

Kriterij, ki opredeljuje puščične osti, je povezan z debelino lesenega naperka. Najprimernejša je debelina okoli 1 cm. Do te ugotovitve so prišla prvobitna ljudstva po vsem svetu po izkustveni poti. Toliko naj bi meril najširši del baze ne glede na to, ali gre za ploščato ali vretenasto konico.[20]

Pri izdelavi posnetkov koščenih konic za potrebe različnih preizkusov sem pozornost usmeril predvsem v izdelavo posnetkov koščene konice **PZ 102** z razcepom na bazi (*sl. 1, 4*). Majhne, do 10 cm dolge koščene konice je mogoče izdelati na dva načina. Pri prvem s kamenim orodjem preoblikujemo v konico podolgovat odlomek kosti s tehniko struženja ali brušenja. Drugi način je izrezovanje konice iz cele kosti.

Največ težav je povzročala izdelava razcepa na ovalni bazi. Po vztrajnem pridobivanju izkušenj s kamenimi odbitki in z lesenim tolkačem mi je vendarle uspelo izdelati razcepe na bazah konic. Težava je v tem, da ni lahko narediti želene razpoke ali razcepa na kosti. Ko kost enkrat poči, razpoka hitro in predvsem nenadzorovano potuje po svoje. Če z lesenim tolkačem premočno udarimo po kamenem cepiču, se razpoka izteče v površino konice, pri tem pa eden od dveh krakov odpade. Zato je za izdelavo razcepljene baze potrebno predvsem obilo občutka. Razpoko ali razcep je veliko lažje narediti, če ta poteka vzporedno z notranjo in zunanjo steno kostne kompakte. Z izdelavo utora na bokih baze lahko poskušamo usmeriti razpoko, vendar takšen utor ni zagotovilo za uspeh.

Konica PZ 102 (*sl. 1, 4*) je morala biti precej daljša pred prvo uporabo, dolga lahko tudi 10 cm ali več. Po vsakem zlomu vrha konice jo je uporabnik

[9] Rosendahl idr. 2006; Geneste, Plisson 1993, 118.
[10] Rausing 1997, 33–34; Bergman 1993, 100.
[11] Medvedev 1966.
[12] Ellis, 1997; Junkmanns 2001, 11, 49, sl. 10, 65; Širok 1961, 16–21.
[13] Hahn, 1977, 87–90.
[14] Hahn 1977, 121–123.
[15] Hahn 1977, t. 145: 6.
[16] Brodar 1928, 3.
[17] Vertes 1955, 111–131.
[18] Dobosi 2002, 90–96.
[19] Odar 2006a, 62–64; Odar 2008b, 12–13.
[20] Cattelain 1997, 219–228.

ponovno ošilil.[21] To je povsem logično, saj bi bila izdelava konic za enkratno uporabo nepotrebna izguba časa in energije. Dokaz o popravilu kaže tudi konica iz jame Istállóskő, pri kateri sta se ob uporabi odlomila tudi oba kraka na bazi (*sl. 3*). Zato je uporabnik na novo oblikoval bazo. Pri tem je nujno prišlo do skrajšanja baze. Tako skrajšano konico je bilo mogoče uporabiti le kot puščično ost.

Oblike baz nas vodijo k dvema načinoma pritrjevanja konic na lesen drog .[22] Najobičajnejši način je vsaditev konice s ploščato bazo v razcep droga, ki je nato povezan z naravnimi vlakni. Drugačen način pritrjevanja narekujejo konice z ovalno bazo. Pri teh je moralo biti nasadilo na drogu votlo. Konice s ploščato ovalno bazo pa je mogoče pritrditi tako v razcep droga kot tudi v cevast drog.

V literaturi o paleolitski lovski opremi najdemo različne nazorne predloge o načinih pritrditve obeh glavnih tipov konic na lesen drog.[23] Avtorji pri svojih rekonstrukcijah ne pojasnijo, na kakšen način naj bi aurignacienski in magdalenienski izdelovalci lovske opreme v lesene drogove sulic ali kopij navrtali 5–10 cm globoke luknje premera do 1 cm s kamenimi orodji. Prav tovrstne luknje omogočajo zanesljivo pritrditev vretenaste koščene konice v lesen drog.

Pri Knechtovi, ki je izvedla praktične preizkuse metanja posnetkov domnevnih kopij, beremo,[24] da "*je bila vsaka konica pritrjena na lesen vmesnik, ta pa je bil nasajen v kovinsko cev, ki je bila nameščena na operjen lesen drog*".. S kovinskim cevastim vmesnikom in drugimi umetnimi snovmi si je pri svojih preizkusih pomagal tudi Guthrie.[25]

Rešitev težave, s katero sta se soočila Knechtova in Guthrie pri praktičnih preizkusih, ponujajo ostanki lokostrelske opreme iz veliko mlajših obdobij. Kovinske puščične osti lahko imajo ploščat trn, tulec ali okrogel trn. Tri nasadila narekujejo tri različne načine nasaditve na lesen naperek.[26] Naperki za nasaditev konic s ploščatim trnom ali s tulcem so bili lahko iz poljubnega lesa, pri čemer so nekatere vrste lesa primernejše od drugih. Za nasaditev puščičnih osti s trnom so bile primerne tiste vrste lesa, ki imajo mehko sredico ali pa so votle, na primer mlada brogovita (*Viburnum opulus*), bezeg (*Sambucus nigra*) in različne vrste trstike.[27] Trokrilna piramidasta puščična ost, ki je bila odkrita na poznoantičnem grobišču na Lajhu pod Kranjem, ima ohranjen del cevastega lesenega naperka.[28]

Koščene konice iz Potočke zijalke, pa tudi od drugod, ki imajo ovalno bazo, so zahtevale podobno rešitev kot kovinske puščične osti s trnom. Ker so baze koščenih konic veliko debelejše od baz kovinskih konic, je primeren le bezeg, ki ima dovolj velik premer cevi za nasaditev različno velikih konic. Bezeg ima v sredini strženj, ki omogoča dober oprijem konice.[29]

Kadar želimo puščično ost z razcepom na bazi vstaviti v bezgov naperek, je treba v razcep puščične osti vstaviti zagozdo (*sl. 5*). Ob potisku konice v bezgov naperek deluje na zagozdo sila upora zaradi strženа. Zato zagozda vse bolj razpira krilci na bazi konice in ju trdno pritiska ob steno naperka z notranje strani. Da preprečimo podolžno cepljenje naperka, je treba njegovo zunanjost povezati z naravnimi vlakni rastlinskega ali živalskega izvora, preden vstavimo konico. Menim, da so lovci z razcepom na bazi poskušali preprečiti izpad puščične osti iz bezgovega naperka med letom in pri izdrtju plena. Zagozden razcep v cevastem naperku preprečuje, da bi se koščena puščična ost pri zadetku v plen ugreznila v naperek.

Začetni lokostrelski preizkusi z doma narejeno tarčo so pokazali, da je bezeg kot naperek neprimeren. Zaradi udarne sile so bezgovi naperki praviloma počili na več mestih (*sl. 6*). Poiskati je bilo treba drugačno rešitev. To ponujajo etnografske študije izumrlih kot še danes živečih prvobitnih lovcev lokostrelcev. Lokostrelci pri plemenu Kua na vzhodu puščave Kalahari v Botsvani in pri plemenu Hadza jugovzhodno od jezera Eyasi v severni Tanzaniji puščične osti pritrdijo na naperek s pomočjo cevastega vmesnika.[30] Zato sem v preizkusu namesto naperka iz bezga uporabil bezgov vmesnik. To je možna rešitev za namestitev koščenih puščičnih osti z ovalno in ploščato ovalno bazo na naperek.

Lokostrelski preizkus

Ker sem v predhodnih lokostrelskih preizkusih uničil večino rekonstruiranih puščic, so mi bile na

[21] O šiljenju konic: Guthrie 1983, 279, 290, 292; Knecht 1997, 204–205; Pokines 1998, 880; Turk 2002; Odar 2006 , 62, sl. 4.

[22] Odar 2006a, 62–63, sl. 5.

[23] Guthrie 1983; Knecht 1997, sl. 2; Pokines 1998; Horusitzky 2004, sl. 21–22.

[24] Knecht 1997, 197. Prevedel B. Odar.

[25] Guthrie 1983, 279.

[26] Odar 2006a; Odar 2006b, 255–257.

[27] Eckhardt 1996, 24, sl. 4.

[28] Stare 1980, 79 (kat. št. 79), t. 125:8.

[29] Turk 2005, 459; Odar 2006a, 62–64, sl. 4–7; Odar 2008b, 12–13, sl. 3.

[30] Bartram 1997, 325, 334.

razpolago le še tri (*sl. 7*). Vse tri so bile sestavljene iz smrekovega naperka s krilci iz ptičjega perja, bezgovega vmesnika in koščene konice na vrhu. Dva vmesnika sta bila na naperek prilepljena (*sl. 7*a–c), en vmesnik s koščeno konico je bil snemljiv (*sl. 7b*). Naperek puščice s snemljivim vmesnikom je pri predhodnih lokostrelskih preizkusih vzdolžno počil po sredini. Kljub temu smo poškodovano puščico uporabili.

Lokostrelski preizkus smo izvedli leta 2008 v Živalskem vrtu Ljubljana. Pri preizkusu je bil navzoč lokostrelec M. Podržaj, arheolog L. Rozman pa je dogodek fotografiral. Uporabili smo enostaven indijanski lok s potezno silo 20 kg. Razdalja med lokostrelcem in tarčo je merila 20 m (*sl. 8*). Tarča je bila goveje stegno z odstranjeno kožo.

Prvi strel (*sl. 9*)

Puščica (*sl. 7c*), bezgov vmesnik (8 cm), prilepljen na smrekov naperek (80 cm), koščena konica z razcepom na bazi (5 cm):
– bočni dotik kosti
– koščena konica nepoškodovana
– bezgov vmesnik nepoškodovan
– zlom smrekovega naperka.

Drugi strel (*sl. 10*)

Puščica (*sl. 7a*), bezgov vmesnik (8cm), prilepljen na smrekov naperek (72 cm), koščena konica z razcepom na bazi (7 cm):
– preboj skozi meso
– bezgov vmesnik nepoškodovan
– puščica brez poškodb.

Tretji strel (*sl. 11*)

Puščica (*sl. 7a*), bezgov vmesnik (8cm), prilepljen na smrekov naperek (72 cm), koščena konica z razcepom na bazi (7 cm):
– bočni dotik kosti
– koščena konica nepoškodovana
– zlom bezgovega vmesnika
– naperek nepoškodovan.

Četrti in peti strel (*sl. 12*)

Puščica (*sl. 7b*), bezgov vmesnik (8 cm), snemljiv s poškodovanega smrekovega naperka (70 cm), koščena konica s polno bazo (10 cm):
– preboj skozi meso
– bezgov vmesnik nepoškodovan
– puščica brez poškodb.

Šesti strel (*sl. 13, 14*)

Puščica (*sl. 7b*), bezgov vmesnik (8 cm), snemljiv s poškodovanega smrekovega naperka (70 cm), koščena konica s polno bazo (10 cm):
– čelni nalet na kost
– vrh koščene konice poškodovan
– zlom bezgovega vmesnika
– naperek nepoškodovan.

UGOTOVITVE IZ PREIZKUSA

Ker se nekatere koščene konice iz Potočke zijalke močno približajo idealni obliki cilindričnih konic, domnevam, da je bila konica **PZ 102** pred prvo uporabo dolga okoli 10 cm, kot je dolga konica PZ 72 (*sl. 1*). Konica PZ 102 je bila verjetno uporabljena večkrat kot puščična ost in po vsaki poškodbi vrha na novo ošiljena. Malo je namreč verjetno, da bi lokostrelci izdelali puščično ost iz kosti samo za enkratno uporabo. Pri izdelavi krajše ali daljše puščične osti iz kosti ni bistvene razlike v časovnem vložku. Veliko lažje je namreč ošiliti poškodovano koščeno konico kot vsakič izdelati novo. Zato menim, da lahko v Potočki zijalki opazujemo pojav večkratnega preoblikovanja puščičnih osti.

Izkaže se, da je razcep na bazi primeren za konice z ovalno bazo, ki so nasajene v cevast naperek. Pri drugih načinih pritrjevanja pa takšen razcep ne pride do prave veljave, kot so pokazali že drugi.[31] Zdi se, da je bil razcep na bazah konic poizkus tehnološke izboljšave pri pritrjevanju koščenih konic na lesen drog, ki pa se ni najbolje obnesel.[32] Nekateri avtorji so poskušali konice z razcepljeno bazo razvojno umestiti pred pojav konic s celo bazo.[33] Konice z razcepljeno bazo se po obliki ne razlikujejo od konic s celo bazo, zato je M. Brodar takšno razvojno shemo upravičeno zavrnil.[34]

Čeprav sem upal na uspešen lokostrelski preizkus, pa se kljub vsemu nisem nadejal tako zanimivega izida. S tremi puščicami smo izvedli šest strelov. Pri prvem strelu se je puščica bočno dotaknila

[31] Horusitzky 2004, 21–26.
[32] Turk 2002, 26; Horusitzky 2004.
[33] Knecht 1997, 195.
[34] Brodar 1985, 19.

kosti. Silovitost trka je povzročila zlom naperka v sredini. Koščena konica in bezgov vmesnik, ki sta bila zlepljena, sta ostala povsem nepoškodovana, rastlinska ovoja na vmesniku sta zdržala. Drugi strel je bil brezhiben. Puščica, ki je z lahkoto prebila meso debeline 20 cm, je ostala nepoškodovana. Zato smo jo ponovno uporabili pri tretjem strelu. Tokrat je puščica bočno zadela kost. Bezgov vmesnik, ki je bil zlepljen z naperkom, je zaradi udarca povsem razpadel. Koščena konica je ostala nepoškodovana, prav tako naperek. S tretjo, zadnjo puščico smo začeli četrti strel. Puščica s snemljivim bezgovim vmesnikom in z razpokanim naperkom je v četrtem in petem strelu meso prebila brez poškodbe. Isto puščico smo sprožili še tretjič. V šestem strelu je puščica s snemljivim vmesnikom čelno zadela kost. Ovoj vmesnika je popustil na spoju z naperkom, zato je naperek zdrsel vanj. Vmesnik s konico je še vedno tičal na vrhu naperka. Razpokan naperek je vzdržal tudi v tretje. Vrh koščene konice se je zdrobil.

Lokostrelski preizkus je pokazal, da bi bile majhne koščene konice iz Potočke zijalke primerne za uporabo kot puščične osti. Pomembna tehnična rešitev bi bil cevast vmesnik iz bezga. Ta je omogočal namestitev koščenih konic z ovalno ali ploščato ovalno bazo na naperek. Pomembno je tudi spoznanje, da je za puščično ost bolje, če bezgov vmesnik ni zlepljen z naperkom, temveč je nanj le nataknjen. Pri naletu puščice v trdo snov bezgov vmesnik kot najšibkejši člen pri puščici sprejme večino udarne sile in se zlomi, naperek pa zato ostane nepoškodovan. Kot je pokazal preizkus, udarno silo prenese tudi poškodovan naperek, če je bezgov vmesnik snemljiv. Lokostrelec veliko hitreje in lažje naredi nov bezgov vmesnik kot naperek s krilci. Ublažitev udarne sile s pomočjo bezgovega vmesnika varuje tudi koščene puščične osti pred večjimi poškodbami.

Rezultati lokostrelskega preizkusa se povsem skladajo s podobnim preizkusom, pri katerem so strokovnjaki primerjali prebojnost puščic z lesenimi in kamenimi konicami. Najbolj preseneča ugotovitev, da je prebojnost lesenih ošiljenih konic, ki so po obliki enake majhnim koščenim konicam iz Potočke zijalke, le za 10 odstotkov manjša kot prebojnost kamenih konic.[35]

RAZPRAVA

Majhne vretenaste konice, kot je konica PZ 102, so enake kot terminalni deli cilindričnih (solutreenskih in magdalenienskih) konic (*sl. 15*).[36] Dve cilindrični koščeni puščični osti, ki bi ju tipološko zlahka pripisali solutreenu ali magdalenienu, sta bili pred približno 5000 leti sproženi v 35-letnega moškega. Ena konica se mu je zarila v prsi, druga je zadela nosno votlino.[37] Zato bi se lahko vprašali, ali nista bili ti konici nameščeni na kopji, ki sta bili s pomočjo metalnega vzvoda (fr. propulseur) sproženi v žrtev. Odgovor je nikalen, saj v celotnem holocenu v evropskih arheoloških sklopih še niso bili odkriti ostanki metalnih vzvodov, zato pa precej ostankov lokostrelske opreme.

Najzgodnejši primerki metalnih vzvodov se pojavijo v solutreenu, npr. v plasti IV v Combe Saunièru.[38] V isti plasti je bilo 170 izrobljenih konic. Geneste in Plisson sta poskušala na podlagi praktičnih preizkusov ugotoviti, ali so bile izrobljene konice nameščene na kopja ali na puščice. Pomenljiva je njuna ugotovitev:[39] "*Kinetična energija kopja, sproženega z metalnim vzvodom, je zavidljiva zaradi teže kopja (150 g). Hitrost kopij (20–25 m/s) nikoli ne doseže hitrosti puščic. Zlomi na solutreenskih izrobljenih konicah kažejo na to, da so bile pritrjene na lahke naperke, ali pa kažejo na šibko jakost lovskega pribora ali celo na kombinacijo obojega ... Balistične značilnosti solutreenskih izrobljenih konic kažejo, da so bile te vitke in lahke konice neprimerne za namestitev na težke naperke.*"

Težki naperki so torej lahko le naperki kopij, lahki pa le naperki puščic. Kljub vsemu avtorja pustita odprto vprašanje: kopja ali puščice? Mogoče bi bil odgovor lažji, če bi že v času njunega preizkusa vedela za domnevni ostanek loka iz Mannheima, ki ga omenjam na začetku.

Kako pa je z možnostjo uporabe kopij v aurignacienu in posledično v Potočki zijalki?

Do sedaj niti v aurignacienu niti v gravettienu niso bili odkriti ostanki metalnih vzvodov, ki bi nedvomno dokazovali lov s kopjem. Od metalnih vzvodov so se do danes ohranili le tisti deli, ki so bili izdelani iz kosti in rogovja, leseni pa so propadli. Vseh do sedaj odkritih in različno ohranjenih koščenih delov metalnih vzvodov je vsega 130. Zdaleč največ vzvodov je bilo odkritih v južni Franciji ob reki Dordonji in na območju Pirenejev. Nekaj preostalih kosov izhaja iz Španije, Švice in Nemčije. Najstarejši primerek je star približno 20.000 let, najmlajši pa dobrih 12.000 let. Velika večina vzvodov, ki se dajo

[35] Waguespack idr. 2009.

[36] Pokines 1998; Petillon 2006.

[37] Junkmanns 2001, 34, sl. 49.

[38] Geneste, Plisson 1993, 119.

[39] Geneste, Plisson 1993, 131. Prevod B. Odar.

časovno umestiti, sodi v ozek časovni okvir med 13.800 in 12.400 pred sedanjostjo.[40]

Ker pa odsotnost dokaza še ni dokaz odsotnosti, je treba odgovor poiskati drugje.

Glede na obravnavano temo so najzanimivejše tiste raziskave, ki se ukvarjajo z obliko presekov nadlahti pri obeh človeških vrstah moškega spola, pri neandertalcih in kromanjoncih.[41] Oblika kosti zgornjih okončin bi bila lahko izpovedna pri razlagi nekaterih aktivnosti posameznikov. Pri moških predstavnikih neandertalcev (mousterien) in zgodnjih kromanjoncih (aurignacien, gravettien) je izražena razlika v debelini in obliki kostne kompakte pri levih in desnih nadlahteh. Nadlahti vodilne roke, praviloma desnice, imajo debelejšo kostno kompakto. Ista razlika pri obeh človeških vrstah je nekatere strokovnjake pripeljala do sklepa, da so neandertalci in zgodnji anatomsko moderni ljudje izvajali enake gibe, ki so povezani s tehniko lova.[42] Opozorili so tudi na razliko v obliki nadlahti med zgodnjimi (aurignacien, gravettien) in poznejšimi kromanjonci (solutreen, magdalenien itd.), ki jo pojasnjujejo s spremembo tehnike lova v poznem mlajšem paleolitiku. Neandertalci in kromanjonci moškega spola imajo nadlahti debelejše v anteroposteriorni ravnini kot v mediolateralni. Poleg tega so desne nadlahti debelejše od levih enakomerno v obeh ravninah. Moški predstavniki poznejših kromanjoncev imajo nadlahti, ki so v preseku bolj okrogle, zato imajo enako upornost proti silam v obeh ravninah. Enakomerna odebelitev nadlahti v mediolateralni in anteroposteriorni ravnini naj bi dokazovala metanje in posledično uporabo kopij.[43] Ker je šlo le za domnevo, so Schmitt, Churchill in Hylander izvedli praktični preizkus.[44] Z njim naj bi preverili, ali pri suvanju večjo moč prispeva sledeča roka, ki drži zadek sulice, in kako se udarna sila pri suvanju prenese s sulice na sprednjo in zadnjo roko. Ugotovitve iz praktičnega preizkusa s suvanjem potrjujejo domnevo, ki izhaja iz preučevanja kostnih ostankov, da so neandertalci in zgodnji kromanjonci lovili s sulicami in da kopja še niso bila v uporabi.

Uporabniki koščenih konic so stremeli k temu, da so plenu, kolikor hitro je bilo mogoče, zadali smrtno rano. S tem ciljem so izdelovali različno velike konice. Torej je bila velikost konice povezana z velikostjo in napadalnostjo plena ter načinom lova. Lov s ulicami je nevarno početje, saj je lovec med lovom v neposrednem stiku z živaljo, ki se bori za življenje. Zato so morale biti sulice dovolj trpežne, da so vzdržale sile, ki nastanejo pri večkratnem suvanju v žival.

Sulice s slokimi cilindričnimi in drugimi majhnimi konicami ne bi bile učinkovite, saj bi se zaradi majhne debeline zlomile že ob prvem sunku v razdraženo žival. Poleg tega na debelih suličnih drogovih s premerom 2–3 cm zaradi svoje majhnosti tudi ne bi bile učinkovite. Za suvanje s sulico so zato morale biti koščene, dovolj debele ali široke in tudi dovolj dolge. Ta ugotovitev se povsem sklada z ugotovitvami, ki izhajajo iz preučevanja velikih ploščatih in vretenastih koščenih konic iz Potočke zijalke in z drugih najdišč. Terminalni del teh konic se širi od vrha proti bazi. Na prehodu terminalnega dela v bazo so konice najširše. Kopja, ki bi imela nameščene take konice, ne bi bila učinkovita. Zato so bile na kopja pritrjene sloke cilindrične (magdalenienske) koščene konice.[45]

Metalni vzvodi za kopja so bili odkriti predvsem v južni Franciji in v Španiji.[46] Vpeljavo lova s kopjem na omenjenem območju povezujem z ekološkimi spremembami na višku zadnje poledenitve (OIS 2) in neposredno po njej. Ekološke spremembe so zagotovo povzročile spremembo prehranjevalnih navad lovsko nabiralnih skupnosti, ki so za te potrebe razvile nov tip lovskega orožja, kopja z metalnimi vzvodi. Takšna kopja so zaradi precejšnje nezanesljivosti primerna le za lov na velike sesalce, ki živijo v krdelu na odprtih prostranstvih. Tehnika lova s kopji in metalnimi vzvodi se je v južni Franciji in Španiji pojavila v solutreenu, s koncem paleolitika pa je odšla v pozabo.

Po drugi strani lokostrelska oprema od vseh hladnih orožij omogoča najširši razpon uplenitve živali na kopnem, v vodi in zraku. Prav v tem lahko vidimo razlog za razvoj številnih različic lokov, puščičnih naperkov in puščičnih osti vse do danes. Paleolitske (pa tudi mezolitske in neolitske) puščične osti so bile lesene, koščene in kamene. Medtem ko se lesene puščične osti niso ohranile, je bila prednost koščenih v možnosti večkratne uporabe. Kamene konice se po navadi zlomijo že ob prvi uporabi, še posebej če puščica zgreši plen. S. L. Kuhn je na najdiščih v Italiji opazil veliko večjo prisotnost kostnih ostankov ptic v aurignacienskih plasteh kot

[40] Cattelain 1997; Stodiek 2009.

[41] Trinkaus, Churchill, Ruff 1994; Churchill, Formicola 1997; Trinkaus, Churchill 1999; Trinkaus, Ruff 1999a; Trinkaus, Ruff 1999b.

[42] Churchill, Weaver, Niewoehner 1996.

[43] Tullos, King 1973; Ganior idr. 1980; Pappas, Zawacki, Sullivan 1985.

[44] Schmitt, Churchill, Hylander 2003.

[45] Stodiek, Paulsen 1996; Pokines 1998; Petillon 2006.

[46] Stodiek 1993; Cattelain 1997; Stodiek 2009.

v spodaj ležečih mousterienskih. Pomemben prehranjevalni člen v zgodnjem aurignacienu so postale talne ptice, kot je na primer jerebica.[47] Zanimivo je, da prav v aurignacienu prvič srečamo številne koščene piščali, ki so bile izdelane iz ptičjih kosti.[48] V nadaljevanju Kuhn omeni, da so kamenodobne skupnosti v holocenski otoplitvi uporabljale lok in puščice predvsem za lov težko ulovljivih živali, kot so zajci, ptice ali ribe. V jami Combe Saunière je bilo odkrito veliko ostankov ptic kot tudi volkov in lisic.[49] Lov na ptice in majhne sesalce s kopji ni primeren. Veliko primernejša je bila uporaba loka, s katerim lahko dosežemo natančen strel do velikosti prepelice na razdalji 25–40 m.[50]

Če domneva o uporabi lokostrelske opreme v aurignacienu drži, potem se samo po sebi postavlja vprašanje o izvoru lokostrelstva. Novo tehniko lova povezujem s prihodom anatomsko modernih ljudi v Evropo. Lovci so lahko uporabljali še mnoge druge tehnike lova, ki pa jih z arheološko metodo ni mogoče dokazati.

SKLEP

Potočka zijalka prav zaradi velikega števila različnih koščenih konic omogoča dober vpogled v lovske tehnike aurignacienskih lovcev. Lokostrelski preizkus s posnetki majhnih koščenih konic iz Potočke zijalke je bil uspešen. Ob upoštevanju vseh drugih podatkov je domneva o uporabi lokostrelske opreme v aurignacienu upravičena.

Zahvala

Ta članek temelji na številnih razpravah o možni uporabi koščenih konic iz Potočke zijalke, ki sva jih imela z Ivanom Turkom z Inštituta za arheologijo ZRC SAZU in so me vodile k ideji o lokostrelskem preizkusu s posnetki majhnih koščenih konic iz Potočke zijalke. Preučevanje koščenih konic iz Potočke zijalke je omogočil Pokrajinski muzej v Celju ob dragoceni podpori Darje Pirkmajer. Predmete iz Potočke zijalke je fotografiral David Badovinac. Lokostrelski preizkus v Živalskem vrtu Ljubljana ne bi bil mogoč brez sodelavcev. Robert Flere je poskrbel za primerno tarčo, preizkus je izvedel lokostrelec Marjan Podržaj, dogodek pa je fotografiral arheolog Luka Rozman. Za pripravo slikovnega gradiva so poskrbeli Dragica Lunder-Knific, Mateja Belak in Drago Valoh. Vsem posameznikom in ustanovam se iskreno zahvaljujem za njihovo sodelovanje in trud. Zahvaljujem se tudi vsem recenzentom za njihove dragocene pripombe.

KATALOG
(*sl. 1*)

PZ 20 (inv. št. 774)
Lega: zaključek jame, plast neznana.
Koščena konica ima odlomljen zgornji terminalni del. Mesto preloma je zaobljeno. Sledi struženja so dobro vidne. Vrezi, verjetno vijačnica, so močno postruženi po vsej površini. Robova valovita po celi dolžini. Baza konice je ovalna. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Dolž. 79,0 mm; šir. 9,0 mm; deb. 6,0 mm; teža 4,7 g.

PZ 22 (inv. št. 773)
Lega: zaključek jame, plast neznana.
Koščena konica ima odlomljen zgornji terminalni del. Mesto preloma je zaobljeno. Sledi struženja so vidne. Vrezi, verjetno vijačnica, so močno postruženi po celotni površini, na robovih so sveži vrezi nepostruženi. Robova valovita po celi dolžini. Baza konice je ploščata. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Spongioza je ohranjena na bazi. Dolž. 71,0 mm; šir. 10,7 mm; deb. 6,0 mm; teža 4,6 g.

PZ 25 (inv. št. 777)
Lega: zaključek jame, plast neznana.
Koščena konica ima odlomljen zgornji terminalni del. Mesto preloma je zaobljeno. Sledi struženja so vidne. Vrezi so vidni. Robova rahlo valovita po celi dolžini. Baza konice je ploščata. Terminalni del proti vrhu prehaja iz ploščatega v okrogli presek. Spongioza in medularni kanal sta ohranjena po celi dolžini. Dolž. 53,0 mm; šir. 10,0 mm; deb. 4,6 mm; teža 2,4 g.

PZ 36 (inv. št. 786)
Lega: zaključek jame, plast 4, zgoraj.
Koščeno šilo/konica na lameli. Terminalni del šila/konice je oglajen. Baza šila/konice je ploščata. Terminalni del prehaja iz ploščatega v okrogli presek. Spongioza je ohranjena na bazi. Dolž. 65,7 mm; šir. 2,6 mm; deb. 1,4 mm; teža 1,4 g.

PZ 40 (inv. št. 790)
Lega: zaključek jame, plast 5, sredina.
Koščena konica je skoraj v celoti ohranjena. Vrh konice je odlomljen. Mesto preloma je ostro. Sledi struženja so vidne. Vrezi, verjetno vijačnica, so močno postruženi, sveži vrezi so vidni na robovih terminalnem delu. Robova valovita po celi dolžini. Baza konice je ovalna. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Kostna kompakta je skoraj v celoti preoblikovana. Spongioza je ohranjena na bazi. Dolž. 70,0 mm; šir. 8,0 mm; deb. 6,0 mm; teža 3,2 g.

PZ 41 (inv. št. 791)
Lega: zaključek jame, plast 4, spodaj.
Koščena konica je skoraj v celoti ohranjena. Vrh konice je odlomljen. Mesto preloma je ostro. Sledi struženja so dobro vidne. Vrezi so močno postruženi. Robovi skoraj ravni.

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47 Kuhn 2002, 89.
48 Münzel, Conard 2009; Conard 2009.
49 Geneste, Plisson 1993, 118.
50 Pope 1991, 26–28.

Baza konice je ovalna. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Kostna kompakta je skoraj v celoti preoblikovana. Ostanek spongioze je ohranjen na dnu baze. Dolž. 93,0 mm; šir. 9,5 mm; deb. 8,5 mm; teža 6,5 g.

PZ 43 (inv. št. 793)
Lega: zaključek jame, plast 4 spodaj.
Koščena konica je skoraj v celoti ohranjena. Vrh konice je odlomljen. Mesto preloma je ostro. Sledi struženja so dobro vidne. Vrezi so močno postruženi. Robova valovita po celi dolžini. Baza konice je ploščata. Terminalni del proti vrhu prehaja iz ploščatega v okrogli presek. Spongioza in medularni kanal sta ohranjena na bazi in deloma na terminalnem delu. Dolž. 74,0 mm; šir. 8,5 mm; deb. 3,6 mm; teža 2,5 g.

PZ 52 (inv. št. 801)
Lega: zaključek jame, plast 5, zgoraj.
Koščena konica je skoraj v celoti ohranjena. Vrh konice je odlomljen. Mesto preloma je ostro. Sledi struženja so vidne. Vrezi so močno postruženi na robovih. Robova valovita po celi dolžini. Baza konice je ploščato ovalna. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Spongioza in medularni kanal sta ohranjena na bazi in deloma na terminalnem delu. Dolž. 92,0 mm; šir. 9,8 mm; deb. 6,0 mm; teža 4,7 g.

PZ 57 (inv. št. 805)
Lega: zaključek jame, plast 4, zgoraj.
Koščena konica ima odlomljen zgornji terminalni del. Mesto preloma je ostro. Sledi struženja so vidne. Vrezi niso vidni. Robova rahlo valovita na terminalnem delu. Baza konice je ploščata. Terminalni del proti vrhu prehaja iz ploščatega v okrogli presek. Spongioza je ohranjena po celi dolžini. Konica je izdelana na odlomku kosti. Dolž. 59,0 mm; šir. 8,2 mm; deb. 4,0 mm; teža 2,2 g.

PZ 58 (inv. št. 3652)
Lega: zaključek jame, plast 5, zgoraj.
Koščeno šilo/konica je skoraj v celoti ohranjena. Vrh je odlomljen. Mesto preloma je ostro. Sledi struženja so vidne. Vrezi niso vidni. Robova rahlo valovita na terminalnem delu. Baza konice je ovalna. Terminalni del proti vrhu prehaja iz ploščatega v okrogli presek. Spongioza je ohranjena po celi dolžini. Konica je izdelana na odlomku kosti. Dolž. 66,0 mm; šir. 6,5 mm; deb. 4,0 mm; teža 1,7 g.

PZ 59 (inv. št. 806 – posnetek iz umetne snovi)
Lega: zaključek jame, plast 5, sredina.
Koščena konica je uničena. Zgornji terminalni del je bil odlomljen, mesto preloma ostro. Vidne so bile sledi struženja. Vrezi niso bili vidni. Robova sta bila valovita po celi dolžini. Baza konice je bila ploščata. Terminalni del je proti vrhu prehajal iz ovalnega v okrogli presek. Dolž. 46,0 mm; šir. 7,3 mm; deb. 4,0 mm; teža 4,1 g.

PZ 69 (inv. št. 813)
Lega: zaključek jame, plast 4, sredina.
Koščena konica ima odlomljen zgornji terminalni del. Mesto preloma je ostro. Sledi struženja so vidne. Vrezi niso vidni. Robova valovita po celi dolžini. Baza konice je ploščata. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Spongioza je ohranjena po celi dolžini. Dolž. 62,0 mm; šir. 9,0 mm; deb. 4,0 mm; teža 2,6 g.

PZ 72 (inv. št. 816)
Lega: zaključek jame, plast 5, zgoraj.
Koščena konica je skoraj v celoti ohranjena. Vrh je odlomljen. Mesto preloma je zaobljeno. Sledi struženja so dobro vidne. Vrezi so močno postruženi. Robova valovita po celi dolžini. Baza konice je ploščato ovalna. Terminalni del proti vrhu prehaja iz ploščato ovalnega v okrogli presek. Spongioza je ohranjena na bazalnem in terminalnem delu. Dolž. 96,0 mm; šir. 9,0 mm; deb. 5,5 mm; teža 4,1 g.

PZ 77 (2006 vrnjena iz Erlangna)
Lega: zaključek jame, plast 5, sredina.
Koščena konica je v celoti ohranjena. Sledi struženja so slabo vidne. Vrezi so vidni. Robova rahlo valovita na terminalnem delu. Baza konice je ploščata. Terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Spongioza je ohranjena skoraj po vsej dolžini konice. Dolž. 80,0 mm; šir. 8,7 mm; deb. 4,0 mm; teža 2,6 g.

PZ 97 (inv. št. 835)
Lega: vhod jame, plast 7.
Konica izdelana iz okla ima odlomljen zgornji terminalni del. Mesto preloma je ostro. Sledi struženja so vidne. Vrezi v obliki vijačnice so dobro vidni po celi površini. Površina valovi po celi dolžini. Konica ima ovalni presek. Kostna kompakta je v celoti preoblikovana. Dolž. 56,0 mm; šir. 9,3 mm; deb. 6,0 mm; teža 3,3 g.

PZ 102 (inv. št. 837a)
Lega: vhod jame, plast 5.
Koščena konica je v celoti ohranjena. Sledi struženja niso vidne. Vrezi na bazi so močno postruženi. Površina konice ne valovi. Razcepljena baza je ovalna. Terminalni del ima okrogli presek. Kostna kompakta je v celoti preoblikovana. Dolž. 38,0 mm; šir. 6,0 mm; deb. 5,0 mm; teža 0,8 g (*sl. 4*).

PZ 116 (inv. št. 852)
Lega: vhod jame, plast 7.
Koščena konica je skoraj v celoti ohranjena. Vrh konice in dno baze sta odlomljena. Mesti preloma sta ostri. Sledi struženja so dobro vidne. Vrezi niso vidni. Robova rahlo valovita po celi dolžini. Baza konice je ovalna. terminalni del proti vrhu prehaja iz ovalnega v okrogli presek. Ostanek spongioze je ohranjen na terminalnem delu. Dolž. 61,0 mm; šir. 10,0 mm; deb. 7,0 mm; teža 3,2 g.

PZ 132 (inv. št. 836a)
Lega: vhod jame, plast 7.
Koščena konica ima ohranjeno bazo s spodnjim terminalnim delom. Mesto preloma je ostro. Sledi struženja so dobro vidne. Vrezi so vidni na robovih terminalnega dela pod prelomom. Robova valovita. Baza konice je ovalna. Kostna kompakta je v celoti preoblikovana. Dolž. 46,6 mm; šir. 9,8 mm; deb. 6,0 mm; teža 2,1 g.

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