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**THE BRONZE HOARD OF THE PILINY CULTURE
FROM RZEPEDŹ IN SOUTH-EASTERN POLAND**

ABSTRACT

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On 20th January 2015 the co-author of this paper Piotr N. Kotowicz received information about an accidental discovery of bronze artefacts in the village of Rzepedź (Sanok district, Subcarpathian province). The discoverers — Łukasz Solon and Ewelina Turzańska from Sanok, stumbled upon them the day before, while wandering around the village. According to the oral relation of Ł. Solon on the background of the brown earth and yellowish grass, he spotted a fragment of an item resembling “shaft-hole axe”, which was clearly visible thanks to the green patina covering it. The intrigued finder unearthed it by digging a rather shallow dig (up to 15 cm), revealing in its vicinity additional five pieces of bronze coiled spirals. Realizing the importance of the finds he took out the items, but refrained from further exploration of the dug hole. When the unearthed items were shown at the Historical Museum in Sanok, it became clear that they might be a part of a hoard from the Bronze age.

Key words: Bronze Age; Piliny culture; bronze hoard

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On 20th January 2015 the co-author of this paper Piotr N. Kotowicz received information about an accidental discovery of bronze artefacts in the village of Rzepedź (Sanok district, Subcarpathian province). The discoverers — Łukasz Solon¹ and Ewelina Turzańska from Sanok, stumbled upon them the day before, while wandering around the village. According to the oral relation of Ł. Solon on the background of the brown earth and yellowish grass, he spotted a fragment of an item resembling “shaft-hole axe”, which was clearly visible thanks to the green patina covering it. The intrigued finder unearthed it by digging a rather shallow dig (up to 15 cm), revealing in its vicinity additional five pieces of bronze coiled spirals. Realizing the importance of the finds he took out the items, but

¹ Mr. Łukasz Solon is a history lover and for many years he has been co-operating with the Historical Museum in Sanok. Thanks to him the archaeological collection was enriched by a number of extremely interesting finds discovered by random discoverers in the lands of south-eastern Poland (cf. e.g. Kotowicz 2013).

refrained from further exploration of the dug hole. When the unearthed items were shown at the Historical Museum in Sanok, it became clear that they might be a part of a hoard from the Bronze age. After consultation with the Krosno Office of the Provincial Heritage Monuments Protection Office, it was decided to go to the place of the discovery and secure possible further finds as well as undertake rescue excavations at the site where the artefacts were discovered.² Swift action was forced by the fear of illegal treasure hunters operating in the area.

Upon the arrival, it was found that the discovery was made in the western part of the old part of the village, on the southern edge of plot no. 46/1, situated almost on the edge of the above-the-floodplain terrace on the left bank of the valley of a small watercourse — Rzepedka (Fig. 1:1). This terrace creates here characteristic “promontory” with southern exposure, advancing between this small valley and a nameless stream running on its eastern side and flowing to the Rzepedka (Fig. 1:2–3). The discovery took place at the altitude of 489 m a.s.l.

In the place indicated by the discoverer partially backfilled pit of the diameter of 15 cm and similar depth was observed as well as some dug-out earth, from which the discovered items were supposedly obtained (Fig. 2:1). The dig did not cut below the humus layer. In the course of checking the area next to the pit with the use of metal detector, in the loose soil further fragments of bronze multi-coil spirals were encountered. After the pit was trowelled, the next level was tested with the metal detector, which resulted in obtaining a strong signal. It was decided, therefore, to set up a small excavation unit oriented according to the cardinal directions and with the dimensions of 60 × 60 cm. Then, the extended excavation unit was explored by thin mechanical layers until the level of destruction, i.e. approx. 15 cm (Fig. 2:2) was reached. Each time the spoil earth was checked with the metal detector. In the loose soil another piece of spiral ring as well as a single pottery sherd³ and a single animal bone were revealed. After reaching the destruction level the removal of humus was continued within the entire area of the excavation unit.

At the depth of approximately 25 cm from the ground surface, in the centre of the excavation unit further spirals began to appear in situ. Below, at the level of 28 cm, in the excavation unit clayish, yellow sterile earth emerged. On its background an outline of a feature with the shape resembling an oval and with dark brown fill became visible. The northern and eastern edges of this feature were limited by a vessel wall of reddish colour visible in cross-section. In the fill subsequent coiled spirals and single stones were identifiable. The dimensions of the feature at the level of the discovery were 28 × 26 cm (Fig. 2:3; 3:1). Exploration of the feature was started, however, due to the weather conditions, it was decided not to section it. Still, an effort was made to secure the walls of

² In addition to Piotr N. Kotowicz and Łukasz Solon also Marcin Glinianowicz, M.A. from the Museum of Folk Architecture of Sanok took part in the work.

³ This is a piece of a body of a vessel with both surfaces being beige and dark grey cross-section. It was smoothed on the outside and made of clay body with crushed mineral and ceramic temper, and sand admixture (?).

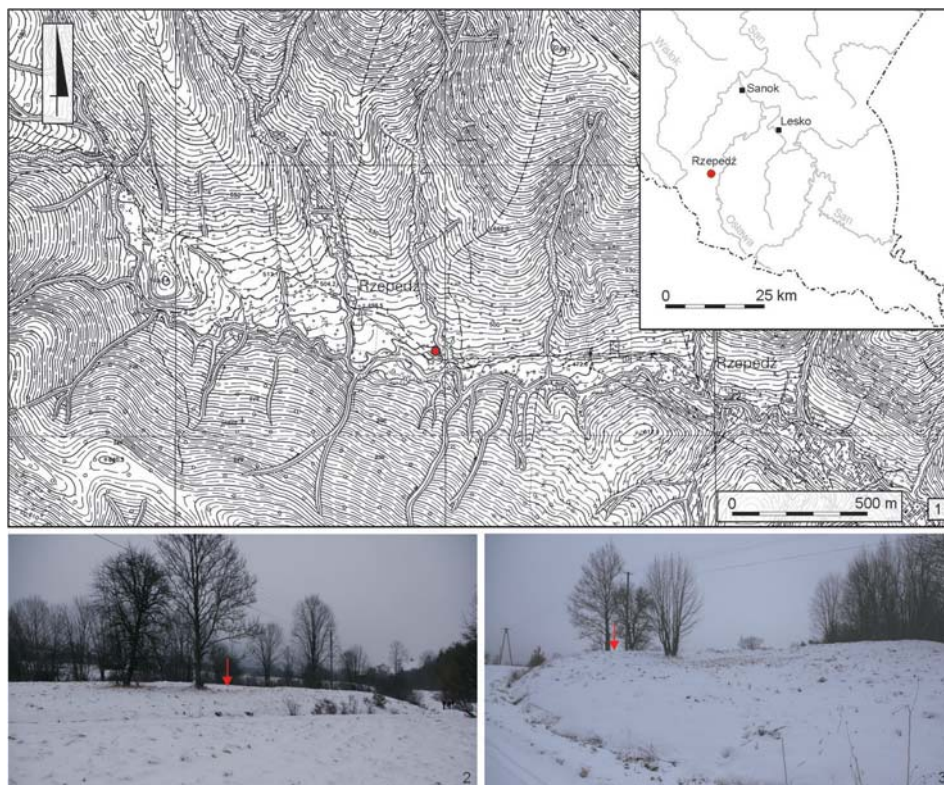


Fig. 1. Rzepedź, Sanok district, Subcarpathian province. The location of the place of the discovery of the hoard of bronze items: 1 — location on the map; 2 — view of the place of the discovery of the hoard from the west side; 3 — view of the place of the discovery of the hoard from the south-east side. Processed by P. Kotowicz; Photo by M. Glinianowicz.

the vessel. Visible spirals were gathered, and underneath them twisted fragments of subsequent ones appeared. Next to the eastern wall of the feature there was also a half of a bracelet with turned up terminals. South-west of the feature a darker spot was noticed on the background of the sterile earth. However, after trowelling it back it turned out to be a mole hole.

At the depth of 40 cm the feature became of regular oval shape, and its size decreased to 25 × 23 cm. Further fragments of spiral rings appeared, and underneath them in the central part a hard surface emerged, which was initially considered to be the bottom of the vessel (Fig. 2:4–6; 3:2). Artefacts were excavated, and then the remaining fill of the feature inside the vessel was explored, exposing at the very bottom the second fragment of the bracelet, lying under the first one (Fig. 2:7–8; 3:3). An attempt was made to extract the remaining part of the vessel in one piece, but unfortunately the fragility of the vessel lead to its crumbling into small pieces during that operation. It turned out that the vessel was originally placed on a sandstone slab with the thickness of 1.1–1.2 cm. It had the shape of



Fig. 2. Rzepedź, Sanok district, Subcarpathian province. The place of the discovery of the hoard of bronze items: 1 — backfilled pit dug by the finder; 2 — excavation unit set up at the site of the pit dug by the finder (depth of c. 15 cm); 3 — surviving ceiling of the deposit of bronze items (depth of 28 cm); 4–6 — deposit of the bronze items with visible relics of the ceramic vessel (depth of 40 cm); 7–8 — base of the bronze items deposit — the level of the stone slab with the remains of the pottery vessel (depth of 45 cm). Photo by M. Glinianowicz.

an irregular quadrilateral with rounded edges. Unfortunately, a significant part of it was already completely eroded and preserved only fragmentarily. On its surface areas with traces of green patina are visible (Fig. 7:2). The slab was at the same time the floor of the feature and it was located at the depth of 45 cm from the ground surface.

The fieldwork confirmed the initial presumption that the items discovered a day earlier are part of a hoard of bronze objects. The artefacts were probably inserted into a clay container, which then was turned upside down and deposited in dug-out pit on beforehand prepared flat stone slab (Fig. 2:6; 7:3; 8). Unfortunately, as the result of ploughing only heavily fragmented upper part of the vessel survived. It has 18 cm in diameter, and the maximum diameter of the

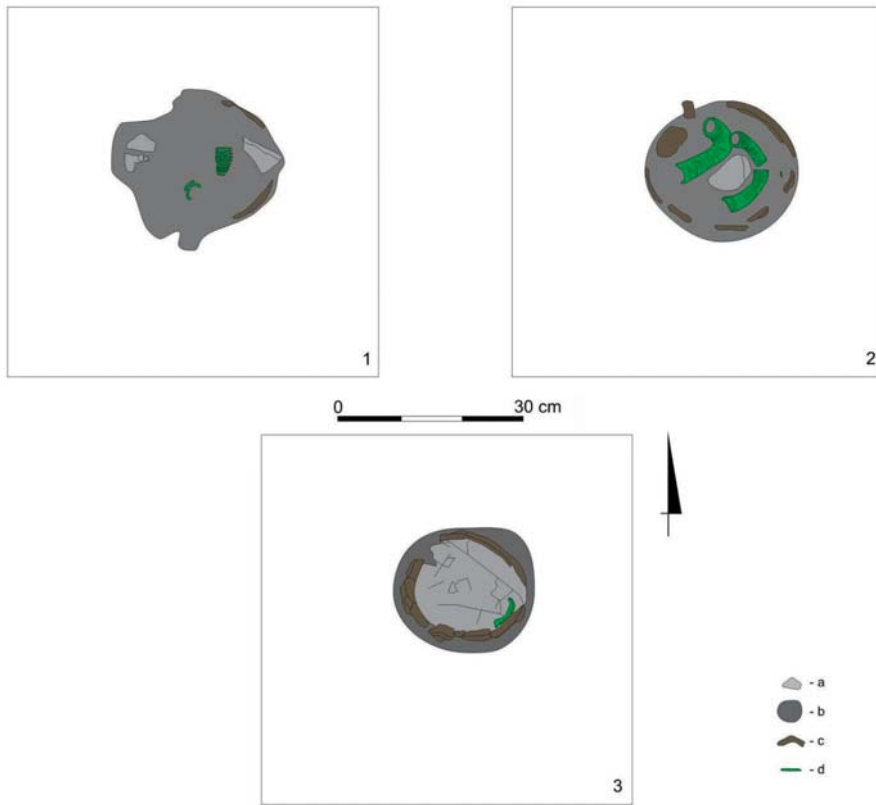


Fig. 3. Rzepedź, Sanok district, Subcarpathian province. The excavation unit with the location of the hoard of bronze items: 1 — surviving ceiling of the bronze items deposit (depth of 28 cm); 2 — deposit of the bronze items (depth of 40 cm); 3 — base of the bronze items deposit — the level of the stone slab and the remains of the pottery vessel (depth of 45 cm).

Markings: a — stones and the stone slab — support; b — fill of the feature; c — fragments of the pottery vessel; d — bronze items. Drawing by P. N. Kotowicz.

vessel body is 22 cm.⁴ The vessel has slightly everted, obliquely truncated (and rounded at places) rim (Fig. 7:1). The colour of the smooth external walls is highly varied, in some places brick-like, elsewhere brown, or even beige. From the inside the walls are grey and dark grey. Occasionally green patina is visible on them. Additionally, traces of smoothing are visible in the upper part. The cross-section of the vessel is bi-colour. The clay body was tempered with crushed ceramic and natural admixtures. The latter one left numerous small cavities in the body.

⁴ A question arises whether the disc-butted shaft-hole axe and few spirals found in humus were originally in the vessel, or were deposited next to it. The former possibility seems to be indicated by the similar size of the vessel (the mentioned maximum diameter of the body is 22 cm) and the length of the disc-butted shaft-hole axe (22.1 cm).



Fig. 4. Bronze items constituting the hoard from Rzepedź after the initial cleaning.
 Photo by D. Szuwalski.

In total there were 38 bronze items in the vessel, including a disc-butted shaft-hole axe, a bracelet and 36 pieces of spiral rings (Fig. 4). The entire set weighs 1366 g. Undoubtedly, the bronze disc-butted shaft-hole axe is the most magnificent item within the deposit (Fig. 5:1; 6:1). It is preserved in its entirety, and is characterized by long, slender and asymmetric blade that through a tapered neck turns into shaft-hole sleeve extending to the both sides of the neck. In the middle of the sleeve there is an arched ridge and it is followed by the neck of the butt quadrangular in cross-section. The butt ends with round convex disc finished with a tapering spike. The edges of the neck are raised on both sides, the sleeve is cylindrical, at the top finished with an everted, regularly notched flange. Shafting hole, round at the top turns into oval at the bottom. Dimensions of the find: length — 22.1 cm; working blade width — 4.7 cm; sleeve length — 9.3 cm; inner sleeve diameter 1.9 × 1.9 cm and 1.9 × 2.1 cm; butt length — 5.2 cm; butt disk diameter — 4.4 cm; weight — 753 g. In turn, the bronze bracelet preserved in two big fragments (Fig. 5:2; 6:2) and 11 very small pieces. It is oval, hollow inside and with V shaped profile. Its terminals are bent outwards, ovably marked and thickened. They are cut straight. The dimensions of the item — 6.8 × 8.8 cm; thickness (reconstructed) — 3.0 cm; width of the terminals — 1.8 cm. Weight — 58 g. The largest group of artefacts consists of 36 pieces of coiled spirals (Figs. 5:3–38; 6:3–38), among which there are single pieces having respectively: 5, 10, 17, 20, 21, 23 and 25 coils and two fragments having 4 coils, there are also a single specimen with 3 coils, four fragments of double coils, as well as 22 fragments with single coil or less. They are all made of bronze wire with circular

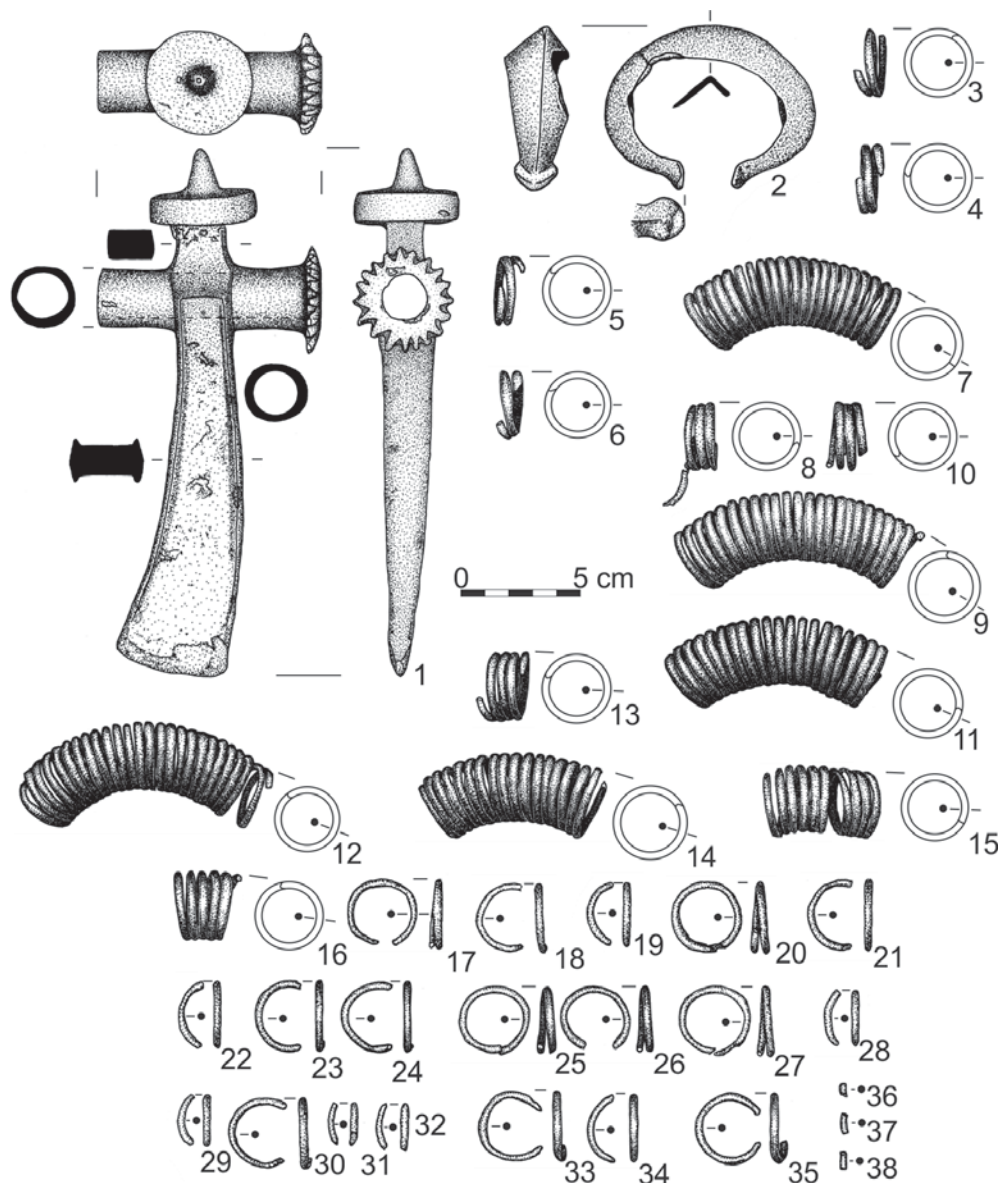


Fig. 5. Rzepedź, Sanok district, Subcarpathian province. Bronze items: 1 — shaft-hole axe; 2 — bracelet; 3–38 — multi-coil spiral rings. Drawing by P. N. Kotowicz; redrawn by A. Sabat.

cross-section and wound in rings or, at least, curved. Dimensions of the items: external diameter — approx. 3.0 cm; wire diameter — 0.3 cm. Weight — 555 g.

The analysis of the individual components of the hoard renders the possibility to date it to the Early Bronze age. Obviously, the disc-butted shaft-hole axe with spike on the butt and decoration of “toothed” ornament on one side of

the sleeve is the most characteristic item. Such specimens are classified as type B3 according to I. Nestor (Przybyła 2009, Fig. 72, 4) and are slightly later than type B2 which includes specimens without the characteristic shape of the sleeve that is generally flat or slightly thickened (*cf.* Blajer 1987, 97). Many analogies to this type of disc-buttet shaft-hole axe are also encountered among the finds discovered on the southern side of the Carpathian Mountains, although specimens with “toothed” termination of the sleeve are not common. One such disc-buttet shaft-hole axe was found in Slovakia, in Rimavská Sobota district, in the village of Hostice (Hungarian Gesztete) and is associated with the Ópályi horizon (Mozsolics 1973, 20, 139, Table 77B; 4a) that is dated to the beginning of phase BrD (*cf.* Przybyła 2007, 577). In south-eastern Poland similar specimens are rare finds. Five specimens of subtype B2 according to the typology by I. Nestor were recorded in the hoard from Stefkowa, Lesko district, which was discovered already in 1870s. (Blajer 1987, 91–104, Figs. 1–6; 1990, 29–30, 136–137, Tables CVI–CVIII). However, these items, in juxtaposition to the find from Rzepedź, which is in the focus of our interest here, are slightly older and they are generally dated to Br C (Blajer 2001, 98; Gedl 2004, 38; Czopek 2012, Table I). Another “disc-buttet shaft-hole axe of Hungarian type” was supposedly discovered in 1876 in Ulucz, Brzozów district, at site 1 (“Dębnik” hill). Unfortunately, the artefact itself did not survive, and the drawing documenting it is lost (*cf.* Parczewski 1984, 206–208; Czopek 2012, Table I). Finally, one should also mention a stray find discovered in Strachocina, Sanok district, which is dated to Br C2 and Br D (Fig. 9; Zielińska 2007, 8, Fig. 3:1; Czopek 2012, Table 1). It is, indeed, this last piece that is the most similar to the specimen from Rzepedź when it comes to the typology. Specimen with the toothed termination of one side of the sleeve was classified by Marek Gedl as type B3, which, together with similar disc-buttet shaft-hole axes of type B2, occurs in the eastern part of the Polish Carpathian Mountains. However, there are two major differences between these two artefacts. First of all — the manner in which the sleeve is formed, which in the second variant does not have the characteristic “toothed” decoration (alike the disc-buttet shaft-hole axes from Stefkowa mentioned earlier). Secondly — the chronology differs. In the case of the disc-buttet shaft-hole axes of B3 type (so the ones similar to these from Strachocina and Rzepedź) one should consider dating within cusp of BrC and BrD, however, the disc-buttet shaft-hole axes of B2 type may be considered relatively earlier ones (*i.e.* according to Marek Gedl within the time frame between the end of the second and beginnings of the third period of the Bronze age or in case of B2 type — the middle of the second period of the Bronze age — Gedl 2004, 38, 39, Table 8, 53).

Another rather distinctive object is a bracelet with ogival profile and ends bent outwards to form terminals that was preserved in two parts. Its closest analogy was found in a hoard of bronze items discovered in not distant Załęże, in the vicinity of Jasło. The mentioned deposit included, among others, two identical rim ornaments (Moskwa 1976, 339, Fig. 88:f; Blajer 2003, 246, 248, Fig. 4:a, d) and is dated to the BrD (Blajer 2001, 328, no. 80; 2003, 248; Czopek 2012,



Fig. 6. Rzepedź, Sanok district, Subcarpathian province. Bronze items: 1 — shaft-hole axe; 2 — bracelet; 3–38 — multi-coil spiral rings. Photo by D. Szuwalski.

Table I:13). The correlation between this deposit and the Piliny culture environment seems to be undeniable. A hoard from Kisgyőr, Borsod-Abaúj-Zemplén district in Hungary containing similar bracelets is associated with phase I of the Piliny culture, which is dated the BrC, while three hoards from Slovakia, from: Almad', Gemer (hoard I) and Ožďany (all in okres Rimavská Sobota) are affiliated with the horizon Buzica (Aranyos), which is correlated with the late phase of the Piliny culture dated to BrD/HaA1 (Blajer 2003, 248). In the case of the hoard from

Zależne its southern origins are very strongly stressed (Przybyła 2009, 256). However, due to the fact that it also contains elements not having clearly Piliny culture connotations (Czopek 2012, 62), it is considered to be a deposit of local products, which might have been produced by the population of the Piliny culture inhabiting the areas on the north side of the arc of the Carpathian Mountains (Blajer 2003, 248).

In turn, the coiled spirals with the inner diameter similar to the analysed ones have quite an extensive chronology (Blajer 1990, 65; 2013, Table 8:9). Similar items occurred in the hoard from Tornyošnemeti, Borsod-Abaúj-Zemplén district in Hungary (Mozsolics 1973, Table 76:5), and in a few hoards from the Polish territory in: Hłomcza, Sanok district (Muzyczuk, Pohorska-Kleja 1996, Table IX:11), Stawiszycze, Sanok district (*cf.* Blajer 1990, Table CV:7–15), Steklno, Gryfin district (Blajer 1990, Table CXI:12–18), Wojcieszyn, Nakło district (Blajer 1990, Table CXXIV:5–8).

It is also worth to make some remarks regarding the vessel, in which the hoard from Rzepedź was deposited. Unfortunately, it is badly preserved (only fragments of the rim survived, which rendered the chance to reconstruct the upper part of the vessel). This is probably a pot like vessel, perhaps with rounded or even spherical body. The condition of the vessel does not allow reliable assignment of this form to pottery inventories of the Piliny culture. At the same time similar forms known from the area of Polish Carpathian Mountains should be mentioned. Among them there is a pot-like vessel similar to the one discussed here discovered together with characteristic pottery with knobs in the same feature at Ladzin, site 12, Krosno district, or the one discovered in Sanok–Biała Góra, site 3, Sanok district (Gedl 1998, Tables XXVI, 9; XXXVII, 1). Analogies, though less matching, can be found also in ceramic materials discovered at site 1 in Hłomcza, Sanok district (Muzyczuk, Pohorska-Kleja 1994, Tables I, 9; II, 1; IV, 2). From the area of south-eastern Poland also a settlement associated with the Piliny culture discovered at site 56 in Sanok, Sanok district should be mentioned. In a fill of feature no. 1 similar, undecorated pots but of much smaller diameter and temper that included grains of granite and grog (crushed pottery) were found (*cf.* Bober 1992, 151, Tables I:10, II:4). With precautions this settlement is dated to the Br C and D (Pohorska-Kleja, Zielińska 1992, 163; Czopek 2012, Tab. I). It seems that, given the state of the preservation of the vessel from Rzepedź — the most in place would be indeed indicating “Carpathian” analogies, without ultimate pointing to their cultural affiliation (which, of course, in the case of this zone is not obvious). Therefore, it might be suggested that perhaps we are dealing in this case with a situation, in which the hoard of metal objects with clearly southern origin was deposited in the vessel that bears the characteristics of local pottery production, regardless of what culture it could be associated with or whether we would point to its Piliny culture traits. The latter is of course not to be excluded in the situation when the presence of pottery materials of the Piliny culture on the northern side of the Carpathian Mountains is beyond dispute (*cf.* Czopek 2012, 66).

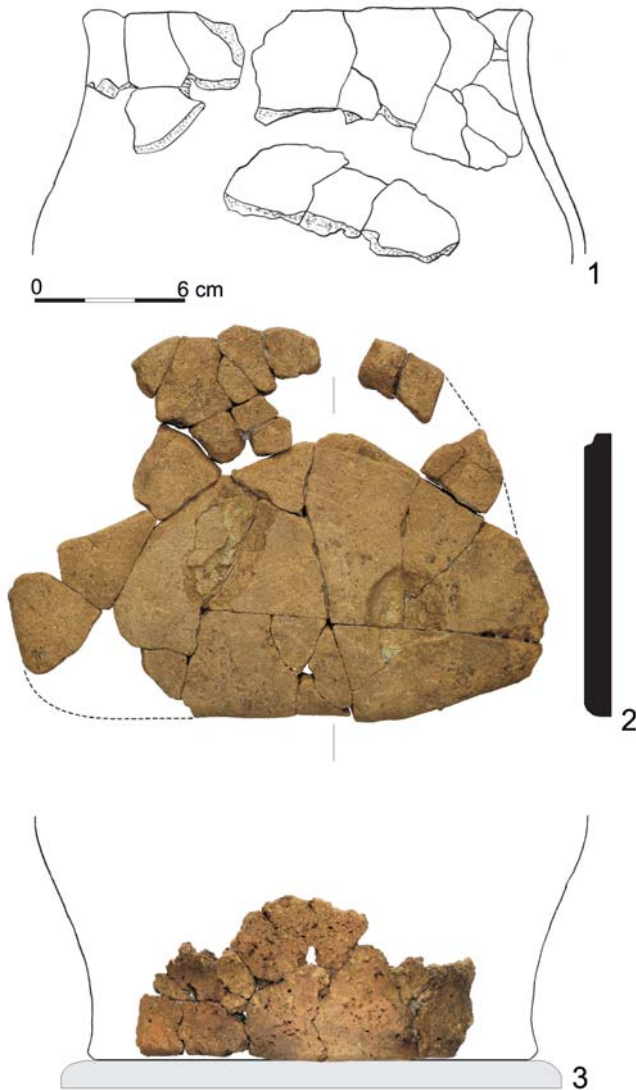


Fig. 7. Rzepedź, Sanok district, Subcarpathian province. 1 — pottery vessel; 2 — stone slab — support; 3 — reconstruction of the placement of the vessel on the stone slab.

Drawing by P. N. Kotowicz; Photo by D. Szuwalski.

Basing on the conducted analysis it can be stated that the distinct elements of the hoard allow for its association with the transcarpathian milieu of the Piliny culture and date it to phases Br C-D. The fact of the presence of the bracelet in the hoard that has the analogy in the hoard from Załęże dated to Br D, may indicate that the chronology of the hoard discussed here might need to be narrowed down to this period. This then would allow dating the hoard from



Fig. 8. Artistic reconstruction of the layout of hoard from Rzepedź. Photo by D. Szuwalski.

Rzepedź to the c. 13th century BC (Czopek 2012, Fig. 2). Yet another important issue, although quite difficult at the current stage of the research is to determine which local cultural environment should be associated with the deposit from Rzepedź, just like the other discoveries that have counterparts in the inventory of the Piliny culture, such as the hoard from Stefkowa, or stray finds of dis-buttet shaft-hole axes from Strachocina and Ulucz (?) (cf. Gedl 1998, 139, 140). Perhaps we are dealing here not only with the transcarpathian influences of this cultural entity, but with the physical presence of its representatives in the eastern part of the Polish Carpathian Mountains (Czopek 2012, 67). It could have been confirmed by the finds from site 56 in Sanok-Jerozolima, which in the literature of the subject had been associated with the Jasło group of the Otomani-Füzesabony culture (cf. Gancarski 1994; critically Gedl 1998, 74; Przybyła 2009, 177), in the case of which it is said that there is no reason not to associate them with the Piliny culture (Czopek 2012, 66). If we agree with the hypothesis claiming the presence of the representatives of the Piliny culture population in the basin of the Upper San river than the question of how the items from the discussed deposit reached Rzepedka stream remains open. The most reasonable explanation seems to be that it must have taken place as the result of the use of communication route running from the area of Slovakia through Łupków Pass that is merely 15 km away from the place of the hoard discovery. After crossing the pass, newcomers from the south moved along the Oslawa river valley towards the San river valley and Sanok. In the literature of the subject there are, additionally, arguments put forth that the finds from the



Fig. 9. Shaft-hole axe from Strachocina, Sanok district, Subcarpathian province.
Photo by D. Szuwalski.

basin of the Upper San may have resulted from direct contacts on the east-west direction, with its enclave by the Dunajec (Czopek 2012, 68).

It is worth to also say few words about the context of the discovery of the hoard itself and the possible interpretations thereof. The custom of depositing hoards in vessels is not anything new — from the area of Poland a number of similar examples are known (Blajer 1990, 77; 2013, 86, 87); the find of this type that is the closest territorially comes from a settlement in Hłomcza, where a hoard of small bronze items and glass beads was deposited in a vessel. However, the hoard from Hłomcza is significantly younger and it is dated to the early Iron Age (Gedl 1998, 50, 51; Muzyczuk 2003, 343–350, Figs. 4:2–6, 5:1–8, 6:1–15, 7:1–18). At the same time, the fact that the vessel was deposited upside down and placed on a stone slab is an original custom hitherto unregistered. Undoubtedly, the owner of items took care of their safety. The issue whether this was done in an isolated place, or within a functioning settlement (as in the case of the mentioned hoard from Hłomcza — *cf.* Gedl 1998, 50) remains open. This question can only be answered through archaeological excavations, but it is worth mentioning that during the exploration of the hoard, in the eastern profile of the excavation area a thin layer (1–2 cm) having similar colour as the fill of the feature was observed at the contact surface between humus and sterile earth. Currently, it is not known whether this represents a relic of a cultural layer, or this is a trace of digging activity at the time when the vessel with the hoard was deposited. In addition, from the humus layer another pottery sherd was obtained that certainly does not come from the vessel, in which the hoard was deposited. This may suggest the latter possibility.

Due to the inability to carry out at the moment more extensive excavations at this location three samples of soil were collected in order to at least partially explain these doubts. They were obtained from the feature in which the hoard was discovered to subject them to specialistic analysis. The first (P1) was sampled from the upper, ceiling part of the feature (at the depth of 15 cm), the second

(P2) was taken from almost the very bottom of the feature (level of 40 cm), and the third (P3) was obtained from the inside of one of the multi-coil spirals that were lying within the feature.

Determination of elements was performed with atomic absorption spectrometry (AAS) procedure. A Contr AA 700 spectrometer (Analytik Jena, Niemcy) was used. For the determination of the following metals: K, Zn, Ca, Mg, Cr, Mn, and Na flame atomic absorption spectroscopy (FAAS) was implemented, while for Pb, Cd, and Co graphite furnace atomic absorption spectroscopy (GFAAS) was employed. Designation of each chemical element was performed three times. Dried soil samples were weighed in the amount of approx. 0.5 g and 8 cm³ of acid mixture of 65% HNO₃ and 30% H₂O₂ Suprapur (Merck, Germany) was added in the ratio 3:1 and then mineralized in a microwave digest system (Ethos One) in the two-stage programme with temperature rising from the room temperature to 200°C in 15 minutes and then maintaining this temperature for a further 35 minutes. The standard reference material was prepared in the same way (NCS ZC 73005, NIST, USA). To perform the calibration curve for the determination of each element the ICP standard was used (multi-element standard IV, CertiPUR®, Merck, Germany).

The soil samples were analysed for the elements characteristic of the biosphere, including elements known as heavy metals. Cadmium and lead are regarded as the most toxic metals readily accumulating in human body, non-biodegradable, and referred to as unnecessary for living organisms (Ware 2001; Walker *et al.* 2002). In the case of cadmium in all of the analysed samples its content was similar (0.061–0.069 mg/kg). This indicates that the samples come from uncontaminated and sparsely populated areas. According to the study by Biernacka and Małuszyński (2006) in the areas of that type cadmium content is within the range 1.4–3.2 mg/kg, while in the case of the areas affected by strong anthropogenic processes it reaches even the range of 8–64 mg/kg. With respect to lead these figures are 40–124 mg/kg and 392–1736 mg/kg respectively. In the soil environment lead accumulates close to the surface, it is non-biodegradable and does not deteriorate, hence contributing to the pollution of the environment (Jakubowski 1993). The analyses carried out showed the lowest lead content in the soil sample originating from the top layer located above the vessel (0.8 mg/kg), while the highest was determined for the soil sample collected from inside of the bronze spiral (9.6 mg/kg). However, such a high rate may indicate the additive of lead in the bronze from which the said item was made. From the metallurgical analyses there are cases known, in which fairly significant share of this element was registered in bronze items (*cf.* Trybała-Zawiślak 2015, 265, Table 1). Although lead has a positive effect on the fluidity of the alloy and significantly increases its foundry qualities, it has very adverse effect on the strength of finished products (Cofła-Broniewska, Hensel 1996, 149, 151; Dąbrowski 2009, 192). Today, lead is considered as a threat to the environment and human health (Goch, Goch 2005), but in the past its toxic properties were not noticed, as shown by its widespread use in the production of, among others:

Table 1

The total element content in the soil samples from the ceiling of the feature (P1), base of the feature (P2), and the interior of the bronze spirals (P3) (mg/kg of soil and g/kg of soil \pm SD).

Total element content [mg/kg]	P1	P2	P3
Calcium (Ca)	81 \pm 0.004	60 \pm 0.006	108 \pm 0.003
Chromium (Cr)	38 \pm 0.003	44 \pm 0.004	53 \pm 0.003
Manganese (Mn)	343 \pm 0.01	390 \pm 0.01	383 \pm 0.03
Zinc (Zn)	51.8 \pm 0.05	77.5 \pm 0.08	78.8 \pm 0.007
Cadmium (Cd)	0.061 \pm 0.01	0.069 \pm 0.03	0.068 \pm 0.01
Lead (Pb)	0.8 \pm 0.01	5.5 \pm 0.02	9.6 \pm 0.02
Cobalt (Co)	8.3 \pm 0.08	8.1 \pm 0.1	9.7 \pm 0.03
Total element content [g/kg]	P1	P2	P3
Sodium (Na)	0.22 \pm 0.001	0.33 \pm 0.003	0.38 \pm 0.008
Potassium (K)	5.53 \pm 0.007	5.42 \pm 0.01	7.08 \pm 0.01
Magnesium (Mg)	5.05 \pm 0.004	5.70 \pm 0.001	5.27 \pm 0.003

bricks, roof tiles, window frames, pipes, tableware, jewellery and balance weights (Craig *et al.* 2003; Krzywy *et al.* 2010). When comparing the cobalt content with that of lead and cadmium again, one can primarily notice its relatively high content in the soil sampled from inside of the spiral. In contrast, there were no differences in the concentration of cobalt between the upper and lower part of the feature (respectively 8.3 and 8.1 mg/kg). On the other hand, zinc is one of trace elements essential for living organism, but its excessive levels are harmful, as when at high concentrations it accumulates in kidneys, liver, and it reduces the assimilability of iron, phosphorus, copper, and calcium (Szymański 2009). Zinc can enter human body through gastrointestinal tract or by skin contact, which is facilitated by its occurrence (e.g. zinc coat protects iron and steel surfaces from rusting — *cf.* Craig 2003). In the analysed samples obtained both from the bottom of the feature and the interior of the spiral comparable concentrations of this element were observed (mean value of 78 mg/kg). In the surface layer of the soil concentration of Zn equalled to 51.8 mg/kg, which may indicate the mobility of this micro-element within the soil layer to the depth of 15 cm or the presence of galvanized items within this hoard. It is rather unlikely that bronze products were also coated with zinc, although this element may be present in small amounts in the alloy (*cf.* Nosek, Stępiński 2007, 392, Table 1). According to the available data the average recorded content of this element in soil is 111 mg/kg (Koncewicz-Baran, Gondek 2010) that is 42% more than in the analysed

samples. According to Koncewicz-Baran and Gondek (2010) the average chromium content in soil is 40.73 mg/kg, representing 0.76% of the content of this element determined in the sample originating from the interior of the spiral (53 mg/kg). In the upper and lower part of the feature the Cr content was respectively 23% and 17% lower. This may indicate a chromium presence in the items found in the feature⁵ and the possibility of its accumulation at the bottom of the hoard. A high content of manganese (343–390 mg/kg) was observed in the analysed samples, but there are no perceptible differences in the concentration of this element between particular samples (higher content in the bottom part of the feature), which points out to an even distribution of this element in the soil at the depth between 15 and 40 cm. The content of Mn is relatively high as compared to the data presented in the literature of the subject, for example, according to E. Bulska, A. Wrzesińska, and J. Wrzesiński (1996) in the grave vessels and in the earth around them the content of manganese was equal to 24–43 µg/kg. In addition, it should be noted that since the antiquity, manganese salts and oxides were used in the production of vessels or tools (Kemmitt, Peacock 1973), hence the possibility that the manganese compounds were used to make the items found in the feature. Furthermore, a fundamental difference in the content of potassium and sodium in the analysed material was noted. Particular attention is brought to almost 20 times higher potassium content when compared to sodium, which indicates the presence of organic tissues and substances of animal origin within soil layers. The highest content of K and Na was detected inside the spiral (7.08 g/kg and 0.38 g/kg respectively), which confirms the assumption (Bulska, Wrzesińska, Wrzesiński 1996) that a container (in this case the coil) creates a partially closed system limiting the natural movement of inorganic salts in the soil. In turn, magnesium is a highly mobile element and hence its higher concentration in the lower part of the feature, where content as high as 5.7 g/kg of soil was recorded. This suggests that the area within which the feature was found and from where the samples were collected has not been used in recent years for agriculture. The calcium content in the analysed samples was very low, although in the sample from the interior of the spiral its content was the highest (108 mg/kg). The bedrock on which the soil developed might be responsible for the low content of this macroelement. Therefore, the low Ca content in the soil would be a natural consequence of such geological conditions.

The results presented are of preliminary nature. However, further examination of the soil samples collected within the hoard and their comparative analysis are planned. It will be done both in terms of a further specialised research, as well as in the context of future excavations that should provide information on wider archaeological context of this, indeed, very original find represented by the deposit from Rzepedź.

⁵ The presence of this element was reported, for instance, in the bronze items from the hoard discovered in Szczepieszyn, Zamość district (Nosek, Stępiński 2007, 392, Table 1).

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