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EARLY IRON AGE HOARD FROM JODŁOWNO, NORTHERN POLAND

Kamil Nowak* – Paweł Gan**

The hoard from Jodłowno, near Gdańsk, about 27 km from the coast of the Baltic Sea in northern Poland, was found in 2021. The hoard, comprising 68 metal artefacts, was accidentally discovered during an authorised metal detector survey in the area. Its upper part was disturbed upon discovery, but the lower one has remained intact, enabling the reconstruction of the finds' position within the deposit. The hoard included four cast hollow ankle rings, six bow-shaped neck rings, two pieces of casting waste, three neck ring and bracelet fragments, four forged blades and fragments, and forty-nine cast metal bars. The paper aims to present this unique find assemblage from Poland and the results of the first attempt at reconstructing the production methods of certain artefacts by analysing the traces on their surfaces.

A jodłownói, 68 fémtárgyból álló kincsleletet 2021-ben fedezték fel Észak-Lengyelországban, Gdańsk közelében, a Balti-tenger partjától mintegy 27 km-re, fémdetektorral a területen végzett engedélyezett kutatás során. Az együttest felfedezője részben megrongálta, de alsó része épségben megmaradt. Ez lehetővé tette a leletek depozíciós kontextusának rekonstrukcióját. Az együttes főbb tárgyai: üreges öntött bokagyűrűk (4 db), masni alakú nyakgyűrűk (6 db), öntvényhulladék (2 db), nyaklánc- és karkötőtöredékek (3 db), kovácsolt pengék és töredékeik (4 db), valamint rudak (49 db). A cikk célja, hogy bemutassa ezt a Lengyelországban egyedülálló leletet, és megpróbálja rekonstruálni a kiválasztott leletek készítési technológiáját a felületükön megőrződött nyomok elemzése alapján.

Keywords: *Early Iron Age, metal hoard, hollow ankle rings, bow-shaped neck-rings, bars/rods, traceology*

Kulcsszavak: *kora vaskor, fémdepó, üreges lábperecek, pszeudo-tordírozott torques, nyersanyagrúd/öntvény, nyomelemzés*

Introduction

The metal hoard from Jodłowno in the Gdańsk district of the Pomorskie Voivodeship in northern Poland (*Fig. 1*) was discovered during an authorised metal detector survey at the end of August 2021. The detector gave a strong signal indicating the presence of objects buried at a depth of 70 cm. After digging a large pit, the metal detectorist found a stone, under which he discovered metal objects covered in green patina. At this point, he should have been warned by the significant depth, the presence of the stone, and the appearance of the first metal object, stopped digging and called in archaeologists for support. Unfortunately, he did not do so but removed some items first, including three anklets, seven rods or bars, and a neck-ring fragment, thus destroying the upper part of the depot and making it impossible to reconstruct the original position of some items. He deserves thanks nonetheless because after removing a few items, he stopped, reported the find, and gave the position of the findspot to the local bureau of the Provincial Office for the Protection of Cultural Property in Gdańsk, which commissioned an authentication excavation (Gólczyński 2022; Nowak et al. 2023).

The archaeological excavation was conducted in early September 2021. The site's exploration began by removing the topsoil layer, under which the round soil stain of the pit dug by the metal detectorist a few

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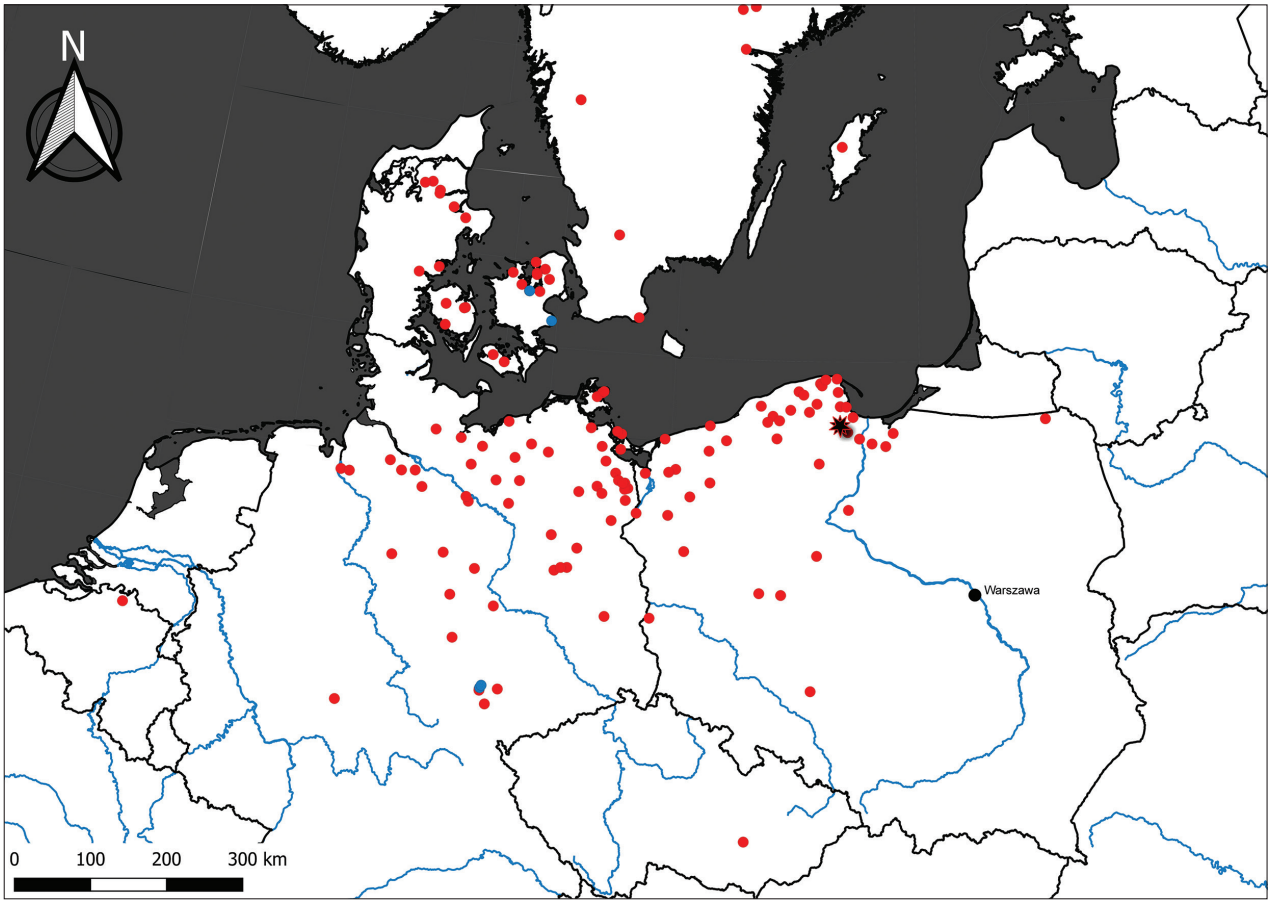

Fig. 1. The findspot of the Jodłowno hoard (marked with an asterisk) and the distribution of hollow cast ankle rings (red) and ankle ring moulds (blue) (map by K. Nowak is based on Schacht 1982; Jensen 1997; Hoffmann 2000; Jantzen 2008; Fudziński, Fudziński 2010; Scheltjens et al. 2013; Bucka 2016; Schmidt 2016; Augstein 2017; Golec 2017; Warmenbol 2017; Dzięgielewski K. et al. 2019; Grønnegaard 2019; Thrane, Juottijärvi 2020; and Schopper, Brather 2021)
1. kép. A jodłownoi kincs lelőhelye (csillaggal jelölve), valamint az üreges öntött bokagyűrűk (piros) és a bokagyűrű-formák (kék) eloszlása (térkép: K. Nowak, Schacht 1982; Jensen 1997; Hoffmann 2000; Jantzen 2008; Fudziński, Fudziński 2010; Scheltjens et al. 2013; Bucka 2016; Schmidt 2016; Augstein 2017; Golec 2017; Warmenbol 2017; Dzięgielewski K. et al. 2019; Grønnegaard 2019; Thrane, Juottijärvi 2020 és Schopper, Brather 2021 alapján)

days before became visible. Archaeologists also found the flat stone (repositioned by the metal detectorist) at a depth of approximately 70 cm and a wealth of metal objects covered in intense green patina, still in their original position, beneath that (*Fig. 2. 1–2*).

The artefacts were arranged carefully in the hoard (*Fig. 3*). The original deposition can be reconstructed as follows:

Level 1 (bottom level of the deposit): ingots or rods, blades and their fragments, necklaces, casting waste, and a hollow bracelet fragment. The exact position of the last two is unknown. The rods or bars and the related items were arranged in two bunches placed beside each other at an angle of approximately 80 degrees. Six neck rings were stacked in the central part of the deposit, wedged in the corner between the touching ends of the bunches of bars. The neck rings were likely connected or tied together, as indicated by the piece of organic cord preserved in a loop of one of them, while the anklet was put inside them.

Level 2: three anklets – removed by the discoverer who, unfortunately, did not remember their arrangement. Initially, he reported that they were lying side to side in a triangle but later admitted that he does not remember as he was 'overwhelmed with emotions' during digging. It is more likely that all four anklets were stacked on each other, possibly in pairs, forming a cylinder (one cylinder/tube; four anklets were stacked on each other).

The assemblage was covered with some organic material, perhaps grass or reed, as evidenced by some imprints on anklets Nos. 1 and 3, with

Fig. 2. Jodłowno hoard, excavation phases. Upper part of the deposit. 1: cleared to the level of the stone covering the metal objects, repositioned by the discoverer; 2: hollow ankle ring and bars *in situ* (photo by P. Gólczyński)
2. kép. A jodłownói kincs feltárásának fázisai. A depó felső része. 1: a fémtárgyak a kőpakolás szintjéig megtisztítva, a felfedező által visszahelyezve; 2: üreges bokagyűrű és rudak in situ (P. Gólczyński fotója)

themost distinct imprints visible on anklet No. 1 (*Fig. 4. 1*). The plant remains are undergoing scientific analyses. As the imprints did not show a clear pattern, the metal objects were probably simply covered with some plant parts.

Level 3: a flat stone covering the entire deposit. Above that, the pit of the depot was filled with soil to level.

Typology and chronology

The hoard comprised 68 metal objects (of copper and copper alloy; Nowak, Gan, in press) weighing around 10,500 g in total: four cast hollow ankle rings, six bow-shaped neck rings, two pieces of casting waste, three neck ring and bracelet fragments, four forged blades and their fragments, and 49 metal bars.

The deposit included four hollow ankle rings (Nos. 1, 2, 3, and 17; *Fig. 4. 1–4*) and the fragment of a hollow open bracelet with slightly bulging ends (No. 18; *Fig. 4. 11*). The anklets could be sorted into two pairs based on weight, decoration, and size. The first pair consisted of large hollow ankle rings decorated with two groups of three ribs at each end (*Fig. 4. 1–2*). The ends are close to each other and parallel. The dimensions of these items are very similar: their outer diameters are 148 and 144 mm, inner diameters 80 and 81 mm, heights 67 and 69 mm, respectively, and the wall thickness ranges between 1 and 1.4 mm. They weigh 559 and 438 g, respectively. The artefacts of the second pair (Nos. 2 and 3) are smaller (*Fig. 4. 3–4*). The decoration of the pieces of the pair is identical (comprising transverse ribs at the ends), just like their extents: both have a 136 mm outer and 82 mm inner diameter, a thickness of 55 mm, a wall thickness of about 1.2 mm, and a weight of 351 g. Unlike the first pair, the ends of these anklets do not touch, and one end is slightly askew. They belong to the type of hollow cast ankle rings known as *Nordische Hohlwulste, Hohlwulstringe, Vulstringe,* or *Turbanringe* (e.g. Schacht 1982; Golec 2017; Schopper, Brather 2021, 66–70; Jiráň et al. 2023), a catalogue of which was compiled over forty years ago by Sigrid Schacht (1982). Since then, the database has expanded by including discoveries from northern Poland (e.g. Dobrzany, Stargard district, Zachodniopomorskie Voivodeship; Gdynia-Karwiny, Reda Rekowo, Pomeranian Voivodeship – Bucka 2016, 467; Fudziński, Fudziński 2010; Dzięgielewski et al. 2019), Germany (including Großeibstadt, Lkr. Rhön-Grabfeld in Bavaria; Stolpe auf Usedom, Lkr. Vorpommern-Greifswald in Mecklenburg-Vorpommern – Schmidt 2016; Augstein 2017; Ragow, Lkr. Dahme-Spreewald and Angermünde, Lkr. Uckermark in Brandenburg – Schopper, Brather 2021), and Denmark (Hvidelandsgård and Hareholm, Zealand, Horsens, Jutland, Mariesminde, Hoard No. II, Funen – Grønnegaard 2019; Thrane, Juottijärvi 2020). One of the authors is currently working on completing a find catalogue with a typological analysis, which includes a precise classification of large, cast *Hohlwulstringe* and hollow ankle rings of smaller diameters.

The map illustrating the distribution of this type (*Fig. 1*) reveals an apparent concentration in northern Poland, northern Germany, and Denmark.

1

2

Fig. 3. Jodłowno hoard, excavation phases. Lower part of the deposit *in situ*. 1: northern side: six stacked neck rings and a hollow ankle placed inside them; 2: southern side: two bunches of bars placed at an angle with necklaces and hollow ankle rings 'wedged' between them (photo by P. Gólczyński)

3. kép. A jodłownói kincs feltárásának fázisai. A depó alsó része *in situ*. 1: északi oldal: hat egymásra helyezett nyakgyűrű és a beléjük dugott üreges bokagyűrű; 2: déli oldal: két, ferdén elhelyezett köteg rúd, közéjük „ékelt" nyakláncok és üreges bokagyűrűk (P. Gólczyński fotója)

Finds have also been reported from central and eastern Germany, Sweden, the Czech Republic (Moravia), and Belgium (e.g. Býčí skála Cave, Moravia or Beerse, province of Antwerp – Scheltjens et al. 2013; Golec 2017). While the find from Moravia is currently the southernmost known, the type must have been spread in the wider area. Recently, a hoard was discovered in Stíčany, Chrudim district, eastern Bohemia (Jiráň et al. 2023); it contained several small hollow ankle rings resembling southern types, with analogies, for example, in Poland (e.g. Kluczbork, Łany – Seger 1936, 170–173, Abb. 107–108).

In most studies, the northern hollow ankle ring variant is typically dated to Period 6 of the Bronze Age/Ha D (e.g. Łuka 1966; Schacht 1982, 17; Jensen 1997, 75; Hoffmann 2000, 140; Heynowski 2006, 55–57; Thrane, Juottijärvi 2020, 30). Some proposed, however, to push back its dating to the beginning of the Early Iron Age (Blajer 2001, 62; Ha C2a/750–600 BC – Dzięgielewski 2017, Fig. 2; Dzięgielewski et al. 2019, 31).

The hoard also includes six bow-shaped neck rings (Nos. 23–28; *Fig. 4. 5–10*) with a decoration imitating twisting. These artefacts have similar dimensions and weights (465 g, 465 g, 483 g, 493 g, 550 g, and 599 g). Some or all neck rings were tied together, as evidenced by a piece of organic material in the loop of one of them.

Fig. 4. Jodłowno hoard. Neck-rings, hollow anklets, and small items (photo by W. Ochotny)
4. kép. A jodłownói kincs. Nyakgyűrűk, üreges bokadíszek és kisebb tárgyak (W. Ochotny fotója)

Fig. 5. Jodłowno hoard. Forged blades and a bar bound together with organic material, forming a 'pocket' (photo by P. Gólczyński)
5. kép. A jodłownói kincs. Szerves anyaggal összecsomagolt, kovácsolt pengék és egy rúd, amelyek egy csoportot alkotnak (P. Gólczyński fotója)

Bow-shaped neck rings have eastern and western type variants (e.g. Hoffmann 2000, 124): the folded ends of the western-type specimens touch the bow, while the eastern ones do not. According to the current scholarly consensus, the western variants were produced in Pomerania, while the eastern, considered a younger imitation, originated from the Sambia Peninsula (Petersen 1929; Engel 1935, 258). However, Mirosław Hoffmann pointed out that most specimens of the western variant (nine pieces) and all eastern variants (seventeen pieces) have been found in western Masuria and the Sambia Peninsula, indicating that they had been produced most probably in these regions (Hoffmann 2000, 124–125). Specimens of the western variant have also been discovered in Kujawy, e.g. in a settlement at Kamieniec, Toruń district (Garbacz-Klempka et al. 2016, 52, Fig. 7).

The neck rings in the Jodłowno hoard belong to the western variant (with endings folded back on the bow). M. Hoffmann has narrowed down the dating of this variant to the Ha D–Lt A phases, suggesting that the two variants were in fashion contemporaneously (Hoffmann 2000, 125).

The hoard also contains artefact fragments and casting waste. One of the fragments is a cast, hollow bracelet with slightly bulging ends (*Fig. 4. 11*); it is larger and has thicker walls than the intact ankle rings in the hoard. Its surface is smooth. Besides, two fragments come from relatively thin rod ornaments (*Fig. 4. 12–13*) decorated with transverse or diagonal groups of cast-in grooves, representing types common in the Early Iron Age.

Production waste includes two casting jets with two runners (*Fig. 4. 14–15*). Their shape is different, particularly the reservoirs and feeders (in the shape of the pouring basin), suggesting that they come from castings of artefacts of types other than the ones in the depot. Unfortunately, they lack distinctive features that enable their precise typological and chronological classification.

Furthermore, the hoard contains objects referred to as semi-finished blades and their fragments. These blades and an ingot were bound together with a piece of string (*Fig. 5*). The 'blades' are thin metal plates with numerous marks of forging. One blade, remarkably well-preserved, was bent in two (see *Fig. 5*). The deposit also includes some fragments of similar objects (*Fig. 4. 17–19*). The complete blade may be a semi-finished long knife or dagger, and the fragments shall probably be interpreted similarly.

The largest group of metal artefacts in the deposit are rods or bars, 49 pieces in total, weighing 5,395 g. This extensive assortment exhibits a significant diversity in size and shape, as illustrated by *Fig. 6*. Two main types can be distinguished: those with a semicircular and an oval cross-section. The shape of most bars is irregular, and the surfaces are uneven, especially on one side. It is important to note that all rods within the assemblage are fragments, mainly the middle part or end of larger bars; thus, unfortunately, it is impossible to determine their original length. Bars of various sizes and weights rarely appear in Early Iron Age hoards in Poland. A previous find from Bieszków, dated to the Ha D period, contained only five pieces (Orlicka-Jasnoch 2013, 506). In comparison, the hoards from Swarzewo and Słupsk contained approximately 150 bars each (Dzięgielewski et al. 2019, 32).

Another fascinating find assemblage to be mentioned as an analogy to the Jodłowno hoard is a Bronze Age Period 6 depot from Calbe in Saxony-Anhalt, Germany (Hoffmann 1959), particularly rich in metal objects, including socketed axes, cheekpieces, and kidney-shaped bracelets. It also comprised nineteen bars in different shapes and sizes, with a combined weight exceeding 7 kg, and three cast hollow ankle ring fragments (Hoffmann 1959, Plates 41–43).

Based on the observations above and some items with high chronological value, e.g. the hollow ankle rings and bow-shaped neck-rings, the Jodłowno hoard could be dated to the Early Iron Age, which, according to M. Hoffmann (Hoffmann 2000, 125),

Fig. 6. Jodłowno hoard. Bars of various sizes, some still bundled (e.g. No. 1) (photo by W. Ochotny)
6. kép. A jodłownói kincs. Különböző méretű rudak, némelyik még mindig kötegben (például 1. sz.) (W. Ochotny fotója)

the bow-shaped neck rings may narrow down to the late Early Iron Age (Ha D), while K. Dzięgielewski proposed to push back the dating of this type to the Ha C phase based on unpublished compilations and seriation analysis (Dzięgielewski 2017, Fig. 2). The classification and dating of the complex record of this period require further research; therefore, in this paper, the accepted dating is used, based on which the deposit could be assigned to the younger phase of the Early Iron Age (Ha D, 650/600–500/450 BC – Dzięgielewski 2017, 297).

Surface marks and the reconstruction of production methods

The objects were subjected to a thorough macroscopic and microscopic examination to identify production marks and use-related traces on their surfaces. At that point, they were generally in good condition despite not being thoroughly cleaned from soil and conservated. The surfaces of hollow ankle rings Nos. 1, 3, and 4 featured organic imprints, likely grass or a similar plant, suggesting that they had been bound or covered prior to deposition. Not counting ingots, most items in the hoard are pieces of jewellery, including anklets, neck rings, and fragments, which represent a considerable challenge in identifying use-wear traces. Such items are primarily associated with various forms of polishing and abrasion, in the case of which identifying specific usage patterns may be difficult. Besides, wear marks may develop in use, appearing, e.g. as partially eroded rasp marks.

Macroscopic analysis has revealed production-related traces suggesting that certain artefacts may have been deposited unused. These traces were further investigated to provide a precise characterisation. Photographic documentation of the findings was accomplished using a Dino-Lite digital microscope and a Nikon SMZ745T stereoscopic microscope, part of the equipment available at the Institute of Archaeology of the Nicolaus Copernicus University in Toruń.

The two pairs of hollow ankle rings exhibit differences in surface treatment. The pieces of the first pair, anklets Nos. 1 and 17, have relatively rough surfaces with more pronounced traces of surface treatment. Upon closer examination, the surface of these ankle rings revealed production-related traces in the form of sprues and irregularities located along the inner edge of the rolled metal sheet, especially around the rim of the gap along their inner side, while the rest of the surface is smooth. The weight

Fig. 7. A sprue in the form of a massive transverse rib inside hollow ankle ring No. 1 (no scale; photo by W. Ochotny)
7. kép. Az 1. számú üreges bokagyűrű belsejében lévő masszív, keresztirányú borda formájú öntőcsap (méretarány nélkül; W. Ochotny fotója)

difference between the anklets of the pair is due to some casting nobs or sprues inside anklet No. 1 (see *Fig. 7*): a thin rib or plate positioned transversely to the ends, with a smaller sprue nearby. There is no trace of the reservoir (metal filling the casting basin where it was poured into the mould). Both items feature clear rasp marks from shaping the raw castings to improve their quality. These marks on anklet No. 1 are diagonal, concentrating primarily on the surface adjacent to the inner opening (*Fig. 8. 1–2*), while No. 17 bears considerably more, both transverse and diagonal marks (*Fig. 8. 3*), attesting to the maker's efforts to correct uneven surfaces and remove sprues (*Fig. 8. 4*). Some marks overlap the decorative ribs, partially filing them off (*Fig. 8. 5*); others, however, were intended to shape and refine those areas.

The second pair of hollow ankle rings reflects a more meticulous surface treatment. The outer surface of both pieces is carefully smoothed, exhibiting a consistent finish. Only slight metal sprues are visible along the inner edge, specifically within the inner space. Ankle ring No. 2 has a small, plate-like sprue remain at one end, akin to those preserved on the other, larger pair, while the distribution of the rasp marks is also similar (*Fig. 8. 6*) but less expressed, suggesting perhaps use-related abrasion (*Fig. 8. 7*). The zones between the decorative ribs were also filed (*Fig. 8. 8*). The surface of the second pair displays only a few imperfections, indicating higher quality than that of the first.

According to the current scholarly consensus (e.g. Schacht 1982; Jensen 1997, 73; Heynowski 2006,

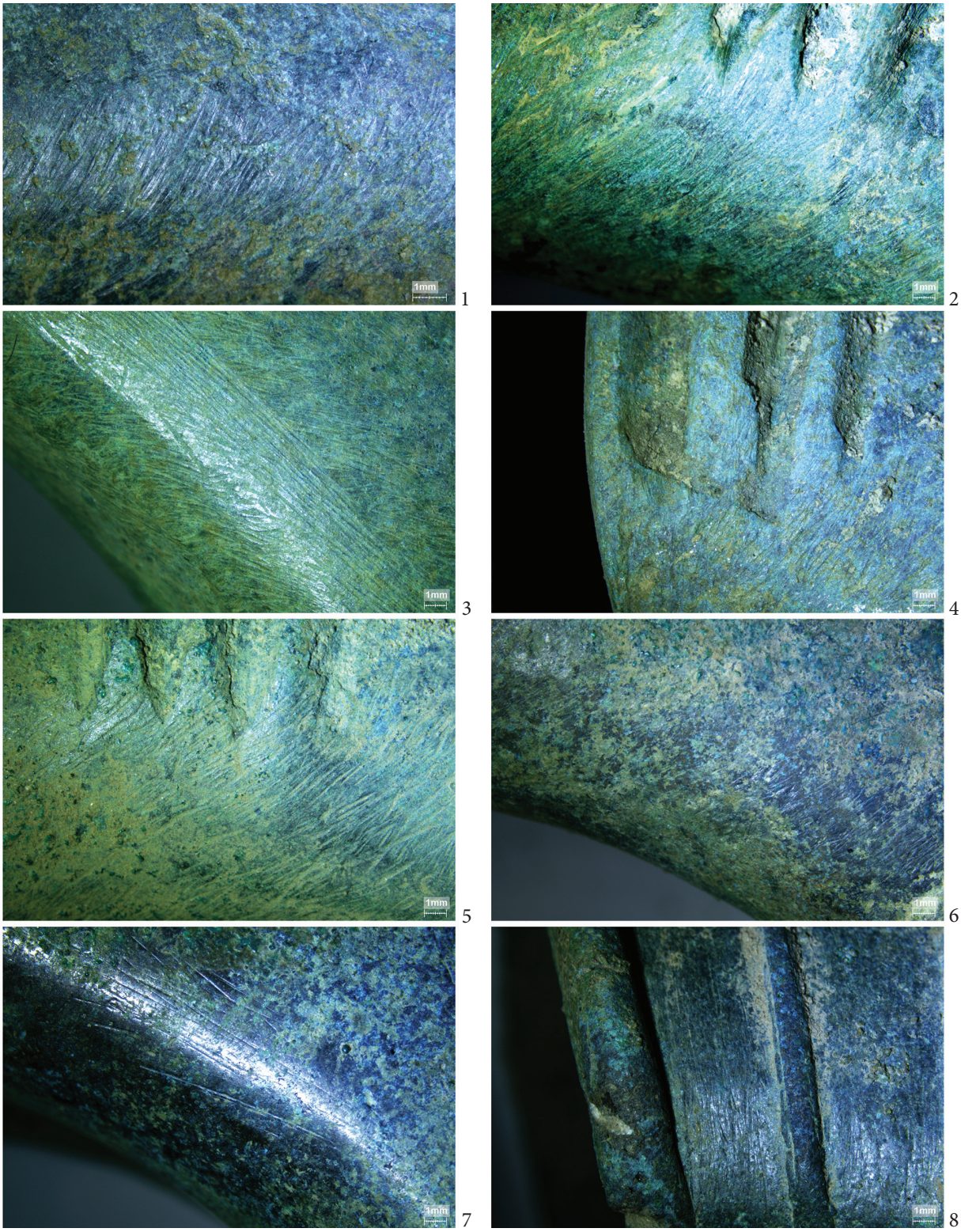

Fig. 8. Production-related marks on hollow ankle rings. 1–2: diagonal rasp marks in the lower part of the artefact; 3: area with differently directed rasp marks, the longitudinal ones eroding the diagonal ones; 4: rasped-off sprues; 5: rasp marks overlapping the decorative ribs; 6–8: rasp marks on smaller hollow ankle rings, including partially eroded ones (photo by K. Nowak)

8. kép. Készítési folyamatokkal kapcsolatos nyomok az üreges bokagyűrűkön. 1–2: átlós reszelőnyomok a lelet alsó részén; 3: különböző irányú reszelőnyomokkal tarkított terület, ahol a hosszanti reszelőnyomok roncsolták az átlósakat; 4: lereszelt varratok; 5: a díszítőbordákat átfedő reszelőnyomok; 6–8: részben erodált reszelőnyomok a kisebb üreges bokagyűrűkön (K. Nowak fotója)

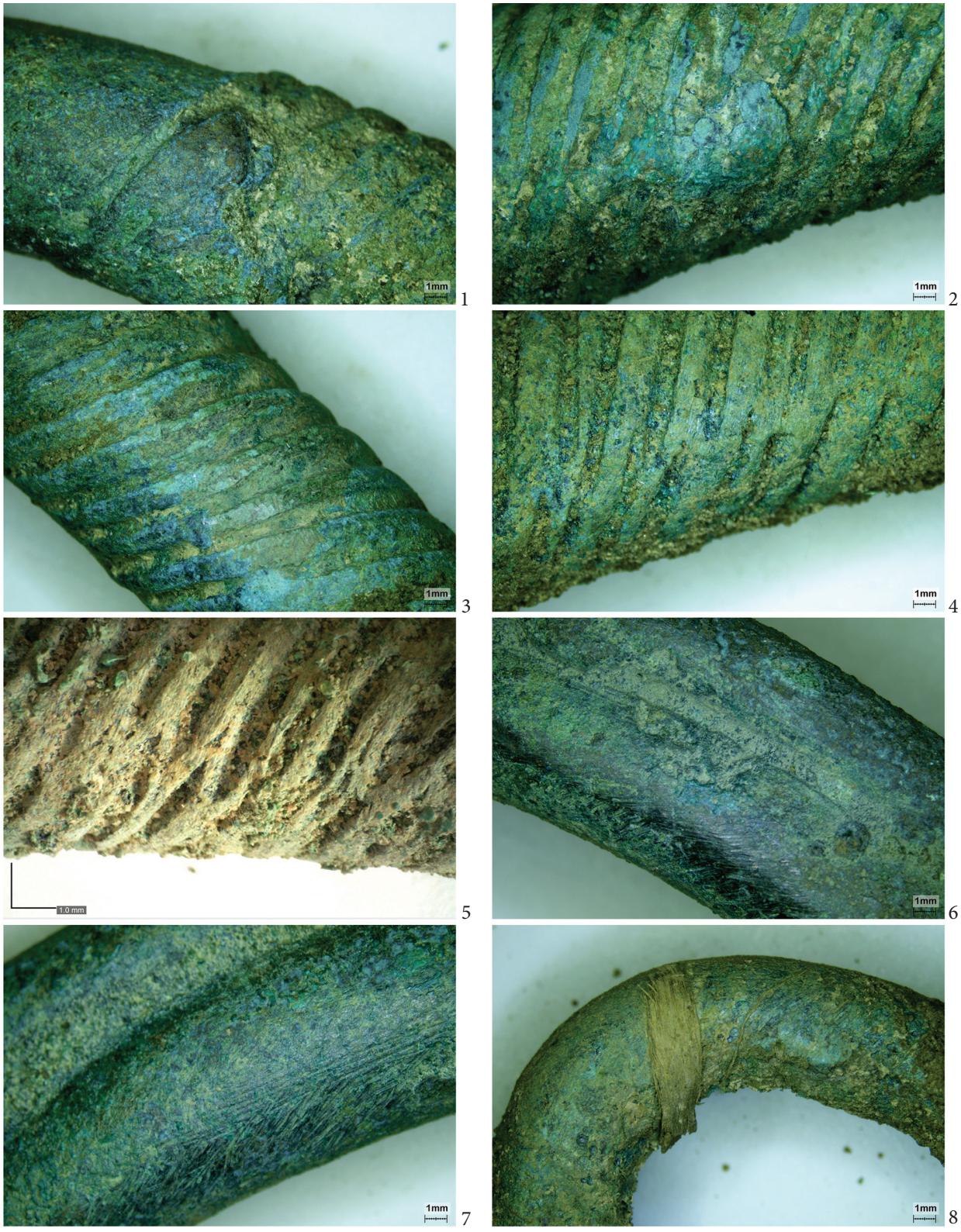

Fig. 9. Production-related marks on bow-shaped neck-rings: 1–2: sprues indicating the use of disposable casting moulds; 3–5: defects in the execution of the ornament in the wax model; 6–8: rasp marks and some organic residue in the loop of a neck-ring (photo by K. Nowak)

9. kép. Készítési folyamatokkal kapcsolatos nyomok az íj alakú nyakgyűrűkön. 1–2: egyszer használható öntőformákra utaló öntőcsapok; 3–5: hibák a díszítés kivitelezésében a viaszmodellben; 6–8: reszelőnyomok és némi szerves maradvány egy nyakgyűrű fülében (K. Nowak fotója)

56; Dzięgielewski et al. 2019, 30), hollow ankle rings were produced using the lost wax technique. This technique involves creating a wax model of the object first, which is then covered in clay and fired. The firing melts the wax away, leaving a cavity to be filled with metal. After pouring out the wax, the mould was fired thoroughly and then used. It is difficult to determine whether a mould was used immediately after firing. The thin walls of the hollow ankle rings and the presence of casting moulds support that (Simon 1972, Taf. 59. 1.8–10.13; Simon 1982, Abb. 6. 1.3; Jensen 1997, 73, Fig. 25. 2–6; Jantzen 2008, 69–70, Taf. 12, 47–49; compare the location of the mould finds on *Fig. 1*). The sprues at the ends of the decorative ribs on ankle ring No. 17 may indicate lost wax casting as their shape may reflect the deformation of the wax model. Furthermore, the intact internal transverse sprues in anklet No. 1 (see *Fig. 7*) and the partial ones in Nos. 2 and 17 were likely created during the preparation of the wax model to stabilise the ceramic mould and prevent the cracking or distortion of the model. It is also possible that they had a role in facilitating metal flow into the mould cavity. It is important to note that the production method of hollow ankle rings could not be reconstructed entirely due primarily to the meticulous finishing of their surfaces, which included the removal of most production-related marks.

The other type of artefact bearing production marks in the hoard is bow-shaped neckrings. While their overall quality is pretty good, these items display numerous sprues and irregularities: for example, No. 28 has a significant casting defect at the transition between the decorated and the smooth zones (see *Fig. 4. 10*). These were crafted using the lost wax technique, as evidenced by the lumpy sprues on their surfaces and the ornamentation (*Fig. 9. 1–2*). The neck rings were decorated with a cast-in spiral pattern imitating twisting, incised into the wax model. Close examination has revealed several imperfections in the execution of the patterns: the cuts are irregular, particularly on the inner side, and do not maintain a consistent width (*Fig. 9. 3*); the lines often do not meet on the inner side but intersect, indicating that they were incised into a soft model (*Fig. 9. 4–5*). Seemingly, the maker did not invest significant effort into precise execution in the less visible areas. Finishing-related traces include grinding marks near the loops, primarily at the sprues, clearly showing the maker's intent to remove those and improve the overall look of the item (*Fig. 9. 6–8*).

Some fragments also display production marks. The fragment of a hollow cast bracelet has a small ceramic fragment preserved inside (*Fig. 4. 11*), providing insight into its making by indicating the lost-wax technique. Numerous sprues hint that the surface of the casting was far from flawless.

The hoard also contains bracelet and/or neck ring fragments decorated with transverse or diagonal bunches of grooves. No. 11 in particular reveals that the pattern was created during casting (involving a single-use casting mould; i.e., the patterns were incised into the wax model). This fragment also includes the pouring basin part and has irregularities on the surface. Lost wax casting mould fragments with convex and concave patterns have been discovered in numerous Early Iron Age settlements in Poland, such as Sobiejuchy in Żnin district or Kamieniec in Toruń district, Kuyavian-Pomeranian Voivodeship (Harding et al. 2004, 62–63, Pl. 27; Garbacz-Klempka et al. 2016, 50, Fig. 2). While fragment No. 12 was made using a single-use casting mould, the particulars of the chaine opératoire are unclear: it has sprues or casting seams where the halves of a two-part casting mould would typically meet, and surfaces on either side of the seam are different (one decorated, the other smooth), indicating that the casting mould was two-part. However, further investigation is required to confirm this hypothesis.

Based on their surface, bars with a semicircular cross-section were cast in short open channels or 'gutters' with a rounded bottom; it is difficult to tell, however, whether these were deepened into casting moulds or the ground. The bars come in various sizes and shapes, their irregularity suggesting a carelessly hand-formed negative. The bars were cast clearly without a cover, as indicated by the corrugated upper surfaces and the traces of solidification at points where the melt was in contact with the air. Bars with an oval cross-section also have uneven surfaces, which may reflect a production method akin to those with a semicircular cross-section. The oval cross-section of the bars may not be related to the shape of the negative but the process of solidification instead, in the course of which a rounded upper part formed. However, it cannot be ruled out that the two types were crafted using different methods or in different workshops – if so, and the workshops used diverse alloys, the latter could be confirmed by the results of the ongoing material analyses.

No visible mark hints at the splitting of the bars. The fracture surfaces are generally irregular,

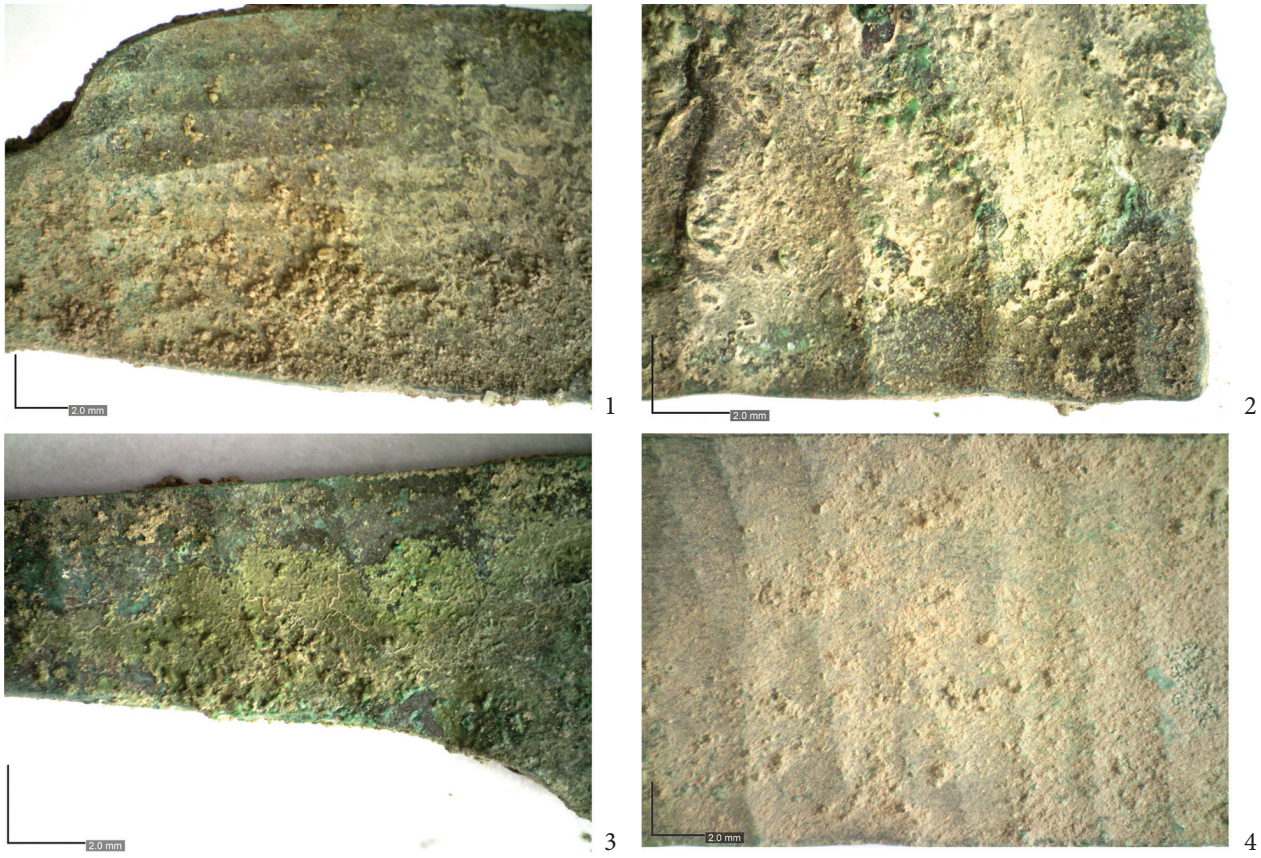

Fig. 10. Blades and fragments. Traces of forging. 1: hammering marks in two directions; 2–3: deep and wide blow-marks on the blade and hilt; 4: dense forging marks (photo by K. Nowak)
10. kép. Pengék és töredékek. Kovácsolás nyomai. 1: kalapálás nyomai két irányban; 2–3: mély és széles ütésnyomok a pengén és a markolaton; 4: sűrű kalapálásnyomok (K. Nowak fotója)

although some suggest a partial incision followed by fracture (e.g. *Fig. 6. 4, 15, 18*). Current investigations focus on the fragmentation of the bars to determine if high temperatures were involved in the breaking.

An exciting class of artefacts consists of a fully preserved, bent blade (*Fig. 4. 16*) and fragments of similar blades (*Fig. 4. 17–19*). As mentioned, these are semi-finished knives or daggers crafted from metal bars using a particular precision forging technique (see *Fig. 10. 1–4*). Traces of multidirectional forging can be observed on their surfaces, with some hammering marks running along the object, which lengthened the bar, and others running longitudinally, which widened it. Semi-finished knives forged from bars (rather than cast) count as a novelty in the archaeological record of Poland. The use of casting moulds for knives is well-documented in the record of earlier periods both in Poland and elsewhere (e.g. at the settlement in Dębnica, Lower Silesian Voivodeship, or in hoards from Waldsieversdorf, Brandenburg, and Görzig, Saxony-Anhalt, as well as in graves from Klein Jauer, Brandenburg, and Vyšný Kubín I, Žilina Region, Slovakia; Götze 1920, 69–71, Pl. 2. 1–5; Laser 1957; Kaletyn 1964; Čaplovič 1987; Bönisch 2000). In the case of the items discovered in Jodłowno, it can be hypothesised that the knives were fashioned from a piece of pre-processed raw material similar to the bars found in the deposit. The ongoing comprehensive element composition analyses of the hoard will allow us to verify if the knives and the bars have been made from the same raw material.

Conclusions

The Jodłowno hoard was carefully deposited in three levels (described above). The lowermost level consisted of neatly arranged bars and blades. These artefacts can be considered semi-finished products, showing evidence of fragmentation and forging. They were placed in the depot in two bunches, forming a spatial boundary and creating a space for the neck rings. The six neck rings placed between them were tied together upon internment; the production

traces they display indicate they were castings in the preliminary shaping stage, awaiting finishing (rasping and filing). The first hollow ankle ring was placed inside the cylinder of stacked neck rings. It still had some sprues and featured rasp marks. The arrangement of the remaining three ankle rings is unknown. Considering the original 70 cm relative depth where the hoard was found, it is probable that the hollow anklets were stacked, potentially in pairs, as this arrangement is common in Early Iron Age metal hoards, e.g. Pluckow, Mecklenburg-Vorpommern, and Gdynia-Karwiny Site 1 (Petzsch 1933, 11; see also Dzięgielewski et al. 2019, 69 with more examples). Assuming that the anklets were stacked (the smaller pair on top of the bigger), the topmost items of the depot would be the smaller pair of anklets, clearly used. The pile of metal objects was covered with organic material. The lack of reliable information from the finder prevents us from determining whether the stone covering the assemblage was placed directly on top of the plant remains.

The Jodłowno hoard reflects metallurgical activity. The presence of casting waste (casting jets), raw or semi-processed castings (bars), and unused items (neck rings and the large pair of anklets) link the depot with metalworking. Future research shall focus on determining the raw material and lead isotope composition of the discovered items, as these will enable us to shed light on various questions, including whether the objects were made from a single or more type of alloy (coming from a single source or not), thus contributing to a comprehensive understanding of their life trajectory.

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REFERENCES

Augstein, M. 2017: 'Elite graves' in Bavaria. Considerations of practices, status and communication of early Hallstatt communities. In: Schumann, R., van der Vaart-Verschoof, S. (eds.), Connecting elites and regions. Perspectives on contacts, relations and differentiation during the Early Iron Age Hallstatt C period in Northwest and Central Europe. Leiden, 237–253.

Blajer, W. 2001: Skarby przedmiotów metalowych z epoki brązu i wczesnej epoki żelaza na ziemiach polskich. Kraków.

Bönisch, E. 2000: Bestattung in aller Form – Das Grab eines Bronzegießers aus der Niederlausitz. Ausgrabungen im niederlausitzer Braunkohlenrevier 1999, 67–84.

Bucka, K. 2016: Dobrzany, miasto, okolice, gm. loco, pow. stargardzki, stan. nieokreślone. Stargardia 10 (2015), 467.

Čaplovič, P. 1987: Orava v praveku, vo včasnej dobe dejinnej a na začiatku stredoveku. Martin.

Dzięgielewski, K. 2017: Late Bronze and Early Iron Age communities in the northern part of the Polish Lowland (1000–500 BC). In: Bugaj, U. (ed.), The past societies. Polish lands from the first evidence of human presence to the early Middle Ages 3: 2000–500 BC. Warszawa, 295–340.

Dzięgielewski, K., Longa, A., Langer, J., Moskal-del Hoyo, M. 2019: Contextualisation of the Early Iron Age hoard of bronze objects discovered in Gdynia-Karwiny, site 1. Recherches Archéologiques. Nouvelle Serie 10, 21–78. https://doi.org/10.33547/RechACrac.NS10.02

Engel, C. 1935: Vorgeschichte der altpreußischen Stämme. Untersuchungen über Siedlungsstetigkeit und Kulturgruppen im vorgeschichtlichen Ostpreußen 1. Königsberg.

Fudziński, P., Fudziński, M. 2010: Skarb przedmiotów brązowych z Redy-Rekowa stanowisko nr 19. Pomorania Antiqua 23, 209–214.

Garbacz-Klempka, A., Kowalski, Ł., Gackowski, J., Kozana, J., Piękoś, M., Kwak, Z., Cieślak, W. 2016: Pracownia metalurga kultury łużyckiej w Kamieńcu, pow. Toruń. Wyniki badań nad procesem odlewniczym ozdób obręczowych z zastosowaniem stopów modelowych. In: Garbacz-Klempka, A., Kozana, J., Piękoś, M. (eds.), Nauka i technologia. Monografia. Odlewnictwo metali nieżelaznych. Kraków, 47–70.

Gólczyński, M. 2022: Sprawozdanie z ratowniczych badań archeologicznych na działce nr 148/1, przy ul. Głównej w Jodłownie, gm. Przywidz. Unpublished report available in the archives of the Provincial Office for the Protection of Cultural Property in Gdańsk. Gdańsk.

Golec, M. 2017: The phenomenon of Býčí Skála Cave. Landscape, cave and mankind. Archaeologica Olomucensia 1. Olomouc.

Götze, A. 1920: Wald-Sieversdorf. Die vor- und frühgeschichtlichen Denkmäler des Kreises Lebus. Berlin, 69–70.

Grønnegaard, T. 2019: Hvidelandsgård. Kulturhistorisk rapport for arkæologisk prøvegravning og udgravning forud for anlægsarbejde, report. Hillerød.

Harding, A., Ostoja-Zagórski, J., Palmer, C., Rackham, J. 2004: Sobiejuchy: A fortified site of the Early Iron Age in Poland. Polskie Badania Archeologiczne 35. Warszawa.

Heynowski, R. 2006: Randbemerkungen zum Hortfund von 'Schlöben'. In: Teegen, W.-R., Cordie, R., Dörrer, O., Rieckhoff, S., Steuer, H. (eds.), Studien zur Lebenswelt der Eisenzeit. Festschrift für Rosemarie Müller. Berlin, New York, 49–68. https://doi.org/10.1515/9783110202809.49

Hoffmann, W. 1959: Ein Bronzefund aus der jüngsten Bronzezeit aus Calbe, Kr. Schönebeck. Jahresschrift für mitteldeutsche Vorgeschichte 43, 222–227.

Hoffmann, M. 2000: Kultura i osadnictwo południowo-wschodniej strefy nadbałtyckiej w I tysiącleciu p.n.e. Olsztyn.

Jantzen, D. 2008: Quellen zur Metallverarbeitung im Nordischen Kreis der Bronzezeit. Prähistorische Bronzefunde XIX/2. Stuttgart.

Jensen, J. 1997: Fra Bronze- til Jernalder en kronologisk undersøgelse. København.

Jiráň, L., Jílek, J., Vích, D. 2023: Erster Hort aus der Hallstattzeit in Ostböhmen (Stíčany, Bez. Chrudim). Praehistorische Zeitschrift 2023, 1–38. https://doi.org/10.1515/pz-2023-2005.

Kaletyn, T. 1964: Sprawozdanie z badań osady otwartej kultury łużyckiej w Dębnicy, pow. Trzebnica, w 1964 r. Śląskie Sprawozdania Archeologiczne 7, 16–17.

Laser, R. 1957: Ein spätbronzezeitliches Gußformendepot aus Görzig, Kr. Köthen. Ausgrabungen und Funde 2, 236–239.

Łuka, L. J. 1966: Kultura wschodniopomorska na Pomorzu Gdańskim. Gdańsk.

Nowak, K., Gan, P. in press: The Early Iron Age hoard from Jodłowno, northern Poland. Technological study of the metal raw material. Archäologisches Korrespondenzblatt.

Nowak, K., Gan, P., Fudziński, P., Palej, A., Gólczyński, M., Kwiatkowska, M. 2023: Skarb z Jodłowna, gm. Przywidz, pow. gdański, woj. pomorskie. Kontekst osadniczy oraz zagadnienia typologiczno-chronologiczne. Pomorania Antiqua 32, 91–114.

Orlicka-Jasnoch, J. 2013: Skarb przedmiotów brązowych i żelaznych z Bieszkowa, gm. Jasień. In: Jaszewska A., Kałagate S. (eds.), Wicina. Badania archeologiczne w latach 2008–2012 oraz skarb przedmiotów pochodzących z Wiciny. Zielona Góra, 491–537.

Petersen, E. 1929: Die frühgermanische Kultur in Ostdeutschland und Polen. Vorgeschichtliche Forschungen 2 (2). Berlin. https://doi.org/10.1515/9783111679938

Petzsch, W. 1933: Ein Depotfund der VI. Periode der Bronzezeit von Pluckow (Jasmund). Mitteilungen aus der Sammlung vorgeschichtlicher Altertümer der Universität Greifswald VI. Der Depotfund von Pluckow (Rügen) und andere bronzezeitliche Funde aus Vorpommern. Greifswald, 9–32.

Schacht, S. 1982: Die Nordischen Hohlwulste der frühen Eisenzeit. Wissenschaftliche Beiträge der Martin-Luther-Universität Halle-Wittenberg, 1982/68 (L18). Halle (Salle).

Scheltjens, S., Bervoets, G., Hertoghs, S., Delaruelle, S. 2013: Bewoning uit de late bronstijd en de vroege ijzertijd aan de Beekakkers in Beerse. Archeologische dienst Antwerpse Kempen, Rapport 47.

Schmidt, P.-J. 2016: Der spätbronzezeitliche Hortfund von Stolpe auf Usedom, Lkr. Vorpommern-Greifswald. Bodendenkmalpflege in Mecklenburg-Vorpommern 62 (2014), 27–80.

Schopper, F., Brather, S. 2021: Wuchtige Pracht. Neue Hohlwulstringe aus Ragow, Lkr. Dahme-Spreewald. Archäologie in Berlin und Brandenburg 2019, 66–70.

Seger, H. 1936: Schlesische Hortfunde aus der Bronze- und frühen Eisenzeit. Altschlesien 6/1, 85–182.

Simon, K. 1972: Die Hallstattzeit in Ostthüringen. Teil I: Quellen, Forschungen zur Vor- und Frühgeschichte 8. Leipzig.

Simon, K. 1982: Erzgewinnung und Metallgewerbe während der späten Bronze- und frühen Eisenzeit in Ostthüringen. Archeologia Polski 27/2, 343–358.

Thrane, H., Juottijärvi, A. 2020: A New Bronze Age hoard from Mariesminde at Langeskov on Funen, Denmark. Acta Archaeologica 91/2, 11–45. https://doi.org/10.1111/j.1600-0390.2020.12226.x

Warmenbol, E. 2017: The Early Iron Age in Belgium. Earth and fire, and also water. In: Schumann, R., van der Vaart-Verschoof, S. (eds.), Connecting elites and regions. Perspectives on contacts, relations and differentiation during the Early Iron Age Hallstatt C period in Northwest and Central Europe. Leiden, 201–219.

KORA VASKORI BRONZKINCS JODŁOWNO HATÁRÁBÓL (ÉSZAK-LENGYELORSZÁG)

Összefoglalás

A Jodłowno mellett talált bronzkincsben három réteg volt elkülöníthető. A legalsót gondosan elhelyezett rudak és pengék alkották, melyek mindegyike félkész termék; rajtuk kalapálás és szándékos törés nyomait lehetett megfigyelni. Két kötegben helyezték őket a depó gödrébe, és az általuk lehatárolt térbe került a hat egybefogott vagy összekötött nyakperec. A nyakpereceken látható nyomok alapján e tárgyak szintén félkész, finomításra (lereszelés és csiszolás) váró öntvények voltak. A legalsó üreges lábperec a nyakperecek belsejéből került elő, míg a másik három eredeti helyzete nem ismert. Tekintve, hogy a legfelső leletek is 70 cm-es relatív mélységben kerültek elő, a három lábperec feltehetően két oszlopban volt egymásra pakolva, mivel ez az elrendezés gyakori kora vaskori fémdepókban (pl. Pluckow, Mecklenburg-Vorpommern, Gdynia-Karwiny 1. lelőhely; Petzsch 1933, 11 és Dzięgielewski et al. 2019, 69, további példákkal). Ha a lábperecek valóban egymásra pakolva kerültek a depóba (a kisebb pár a nagyobb tetejére), annak legfelső lelete a kisebbik pár – jól láthatóan használt – lábperec volt. A fémtárgykupacot az elrejtők szerves anyaggal fedték le; megbízható információ híján (a depót megtaláló fémdetektoros nem emlékezett a részletekre) sajnos nem lehet megmondani, hogy a kő e szerves anyag felett, vagy közvetlenül a fémtárgyakon volt-e.

A Jodłowno mellett talált depó fémműves-tevékenységhez kötődik; ezt jelzi az öntési hulladék (öntőcsapok, öntecsek), félkész és félig feldolgozott nyersanyagok (rúd alakú ingotok) és befejezésre váró tárgyak jelenléte is. A kutatás következő lépését az előkerült leletek anyagösszetételi és ólomizotóp-elemzése jelenti, melyek eredményei várhatóan számos kérdést megvilágítanak majd, például, hogy a depó tárgyai egy- vagy többféle, illetve egy vagy több helyről származó nyersanyagból, ötvözetből készültek-e.