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THE CEMETERY OF THE TRZCINIEC CULTURAL CIRCLE COMMUNITY IN ŁUBNA IN LIGHT OF RADIOCARBON CHRONOLOGY (AMS)

ABSTRACT: The barrow cemetery in Łubna (Łubna-Jakusy), Poland, excavated shortly after World War II, is one of the best-known necropolises in the western area of the Trzciniec Cultural Circle. During the archaeological research conducted by K. Jażdżewski, up to 27 mounds were excavated. In this article, the authors present and specify the absolute chronology of this site. Thanks to a search in the museum storerooms, it was possible to obtain osteological material, which was subsequently dated in the Poznań Radiocarbon Laboratory using the AMS method. These absolute dates combined with the results of a study of the archaeological material allowed the chronology of almost half of the excavated barrows to be defined. The dates obtained thanks to modelling functions answer the question about the timeframe the necropolis was in use. Additionally, the authors present a probable scenario for the development of the cemetery in Łubna, outlining the direction of expansion and characterizing its spatial arrangement.

KEY WORDS: barrow cemetery, absolute chronology, ^{14}C, the Trzciniec Cultural Circle, Łubna cemetery

INTRODUCTION

The cemetery in Łubna (Łubna-Jakusy), Sieradz County, Łódź Voivodeship, Poland, is one of the most famous barrow necropolises of the Trzciniec Cultural Circle (TCC) society. It is also the eponymous site of the so-called 'łubieńska group' of the Trzciniec Culture (Gardawski 1959). The cemetery was excavated at the end of the 1940s by K. Jażdżewski and the results of this fieldwork were partially described in a rather original manner (source-relating and synthesizing, but not typically monographic) by A. Gardawski (1951). Despite significant progress in research on the absolute chronology of the TCC in the last two decades, which has resulted in numerous radiocarbon (^{14}C) dates (e.g., Górski *et al*. 2003; 2011, 118-120; 2012; Makarowicz 2010, 30-54; Muzolf 2019; Makarowicz *et al*. 2021), so far – due to the deficiency of reliable ^{14}C measurements from Łubna (see: Górski, Makarowicz 2012) – the issue of the chronometry of this cemetery has not been wider discussed.

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Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The aim of this article is to establish the absolute chronology of the barrows from Łubna for which radiocarbon dates were obtained using accelerator mass spectrometry (AMS) and to propose a scenario for the development of the entire cemetery. This was possible thanks to the dating of organic materials (human bones) from burial pits and mounds curated in a museum collection. In the original publication (Gardawski 1951), the Łubna barrows and their archaeological materials were discussed in a very laconic way; therefore, in this article (prior to the repeated monographic publication of all available materials) the excavation documentation and materials (mainly pottery) curated at the Archaeological and Ethnographic Museum in Łódź were used. However, only the most representative pottery and metal objects from the dated barrows are presented and discussed here. New plans of the barrows were also made, sometimes significantly different from the original published figures.

I. CEMETERY IN ŁUBNA – SPATIAL ARRANGEMENT

The cemetery in Łubna-Jakusy site 1 is one of the largest excavated TCC barrow cemeteries, with 27 mounds (Zakrzewski 1924; Gardawski 1951; Makarowicz 2010, 225f; Muzolf 2020). It is located in the south-eastern (SE) part of the Greater Poland Lowland, near the southern edge of a low pla-

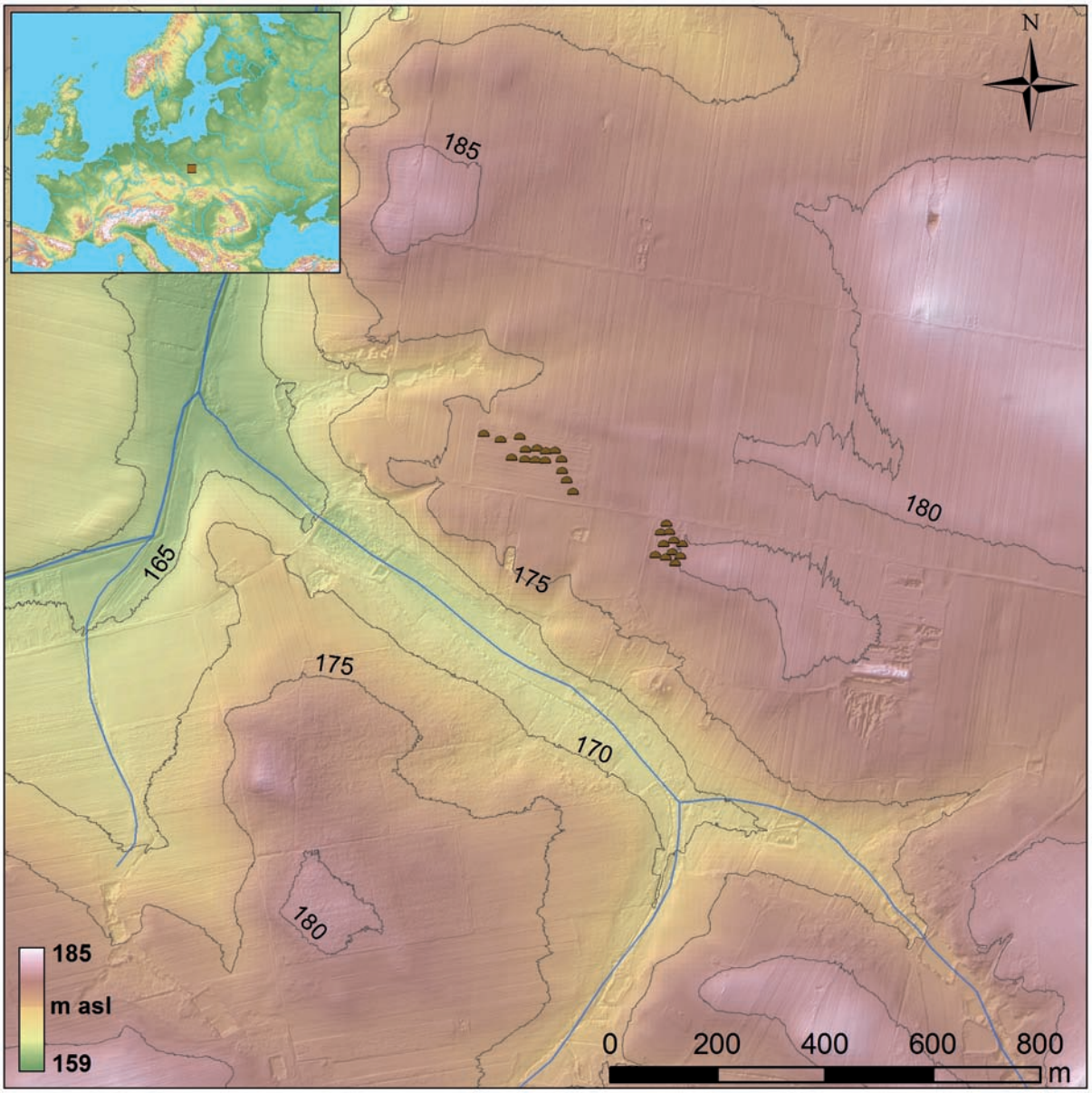

Fig. 1. Location of the Łubna-Jakusy necropolis. Prepared by Jakub Niebieszczański

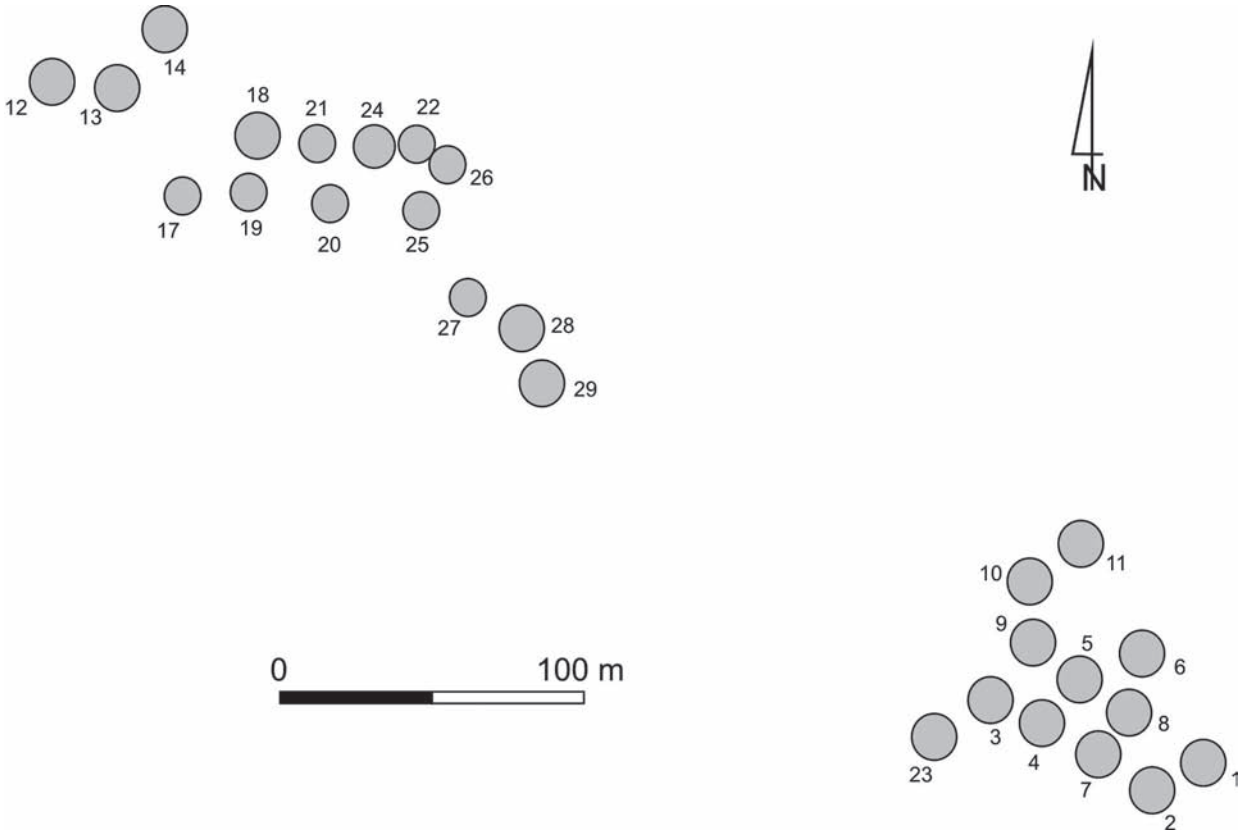

Fig. 2. Spatial arrangement of the Łubna-Jakusy barrow-cemetery

teau – a headland falling towards the Cienia watercourse, about 400 to 450 m from its bed (Fig. 1). On the north, south, and west, the hill is surrounded by a wet valley (Gardawski 1951, 2f). The barrows appeared in two groups (Fig. 2): the north-west group (hereinafter: NW Barrow Group or Group I) consists of 15 mounds, and the south-east group (SE Barrow Group or Group II) is formed by 12 mounds. The first of the above-mentioned concentrations consists of Mounds 12 to 14, 17 to 22, and 24 to 29, while the second was made up of Barrows 1 to 11 and 23. Some (Barrows 15 and 16) documented by Z. Zakrzewski in the 1920s, were later verified by K. Jażdżewski to be natural hillocks, hence the discontinuous numbering of burial mounds in the literature (Zakrzewski 1924; Gardawski 1951, tabl. I).

The mounds in Group I are less agglomerated and more linear in arrangement and extend along a NW – SE axis over a distance of about 210 m. In this cluster, three smaller concentrations of mounds can be distinguished, with three, nine and three barrows from the NW to SE, respectively, located 20 to 25 m apart. In the cluster of nine barrows, the mounds were arranged either into five smaller concentrations of three mounds each or two almost parallel linear systems in the middle, formed by five mounds in the north and four in the south. Group II is located 150 m SE of the first. The mounds here form a more agglomerated system than in Group I, covering an area of approximately 100 × 90 m. In the central part of the group, one can observe two linear systems of barrows with four monuments each located on a NW – SE axis (Makarowicz 2010, 225-226).

The distances between the nearest barrows in both groups range from a few to several metres (Fig. 2). The height (0.1 to 0.9 m) and diameter (up to several meters) of the mounds before the excavation in 1946 varied due to damage caused by recent agrarian activity, however, their original parameters are unknown. The NW Barrow Group mounds were better preserved and their height ranged from 0.6 m, while the mounds in the SE Barrow Group were lower: 0.1 to 0.3 m (Gardawski 1951, 5), except Barrows 1 and 2 with height above 1 m excavated by Zakrzewski (1924).

In the better-preserved monuments, between one and four graves were discovered (e.g., Barrow 6), located in various sectors under the mound, most often on or slightly dug into the ancient surface level. They

were oriented mainly along a NW – SE axis. Based on the few published plans, some of the graves (main burials?) were located in the central parts of the barrows. Some had stone constructions (Barrows 3, 4, 6, 9, 22), while in others, only a single or several large stones were discovered. In six cases, the remains of the deceased were preserved and buried as inhumations (in Grave 1 of Barrow 6, one of the bones was burned), with one or two individuals in the antipodal position. In Barrows 3, 4, 6 (Grave 1), and probably 22, the deceased were oriented NE – SW, while double graves from mounds 7 and 20(?) and probably 6 (Graves 2 to 4) were placed along a NW – SE axis (Gardawski 1951, 58). Due to poor preservation, the age and sex of the individuals buried in graves were not defined during excavation. In the mounds, vessel fragments, flint and stone artefacts, as well as animal bones and traces of burning in the form of charcoal concentrations (fires? hearths?) were also documented in the grave fill. In the original publication about the Łubna cemetery (Gardawski 1951), neither the dimensions of the barrows nor the characteristics of their profiles (except for the simplified profile of Barrow 4) were included. A relatively modest selection of the material from the graves and mounds was presented, mainly characteristic pottery and bronze artefacts. Thanks to the re-analysis of the field documentation, it is known that in most of the barrows a thin layer of the ancient surface was preserved, into which the graves were usually dug. Due to the condition of the monuments, the methodology, and the state of research, their exact location cannot be indicated in all cases.

Based on the typological and stylistic analysis of metal artefacts and pottery, as well as spatial analysis, the Łubna cemetery was proposed to have been in use for several generations (roughly 150-200 years – Makarowicz 2010, 226). Pottery materials represent the classic phase of the TCC (Materials of the Group A type in Lesser Poland, and materials of the HT1-HT3 types in the Polish Lowland – Górski 2007; Makarowicz 1998; 2010).

II. THE CHRONOLOGY OF THE BARROWS

Thanks to funding from several research projects, 12 AMS radiocarbon dates were obtained from eleven Łubna barrows (no. 1-3, 6, 7, 13, 20, 23, and 25-27). Below, the material culture and structural characteristics of the dated barrows are presented before the radiocarbon results are discussed.

II.1. Characteristics of dated barrows

Five of the 15 Group I mounds were dated, including those located in the NE (Barrow 13) and central-S (Barrows 20, 25, 26 and 27) sectors of this concentration. Six ^{14}C dates were measured and repeated dating for the individual from Grave 2 in Barrow 25 indicated the same result (Table 1). For Group II, radiocarbon dates were obtained from six barrows (1 to 3, 6, 7 and 23) located in the SE and E sectors and SW edge of this cluster. Due to the overly schematic drawings of the plans for Mounds 1 and 2 presented in the original publication (Zakrzewski 1924), they were not included in this article.

Barrow 1 was documented on the SE edge of Group II (Fig. 2; Gardawski 1951, tabl. 1). This mound, along with Barrows 5, 8 and 9, co-created a linear arrangement oriented along a NW – SE axis. Barrow 1 was located about twelve metres SE of Barrow 8 and seven metres NE of Barrow 2. It had a circular shape in plan with a diameter of 16.0 m and height of 1.4 m. No information was recorded on its stratigraphy. At a depth of 1.3 to 1.4 m, several human bones (approximate orientation of the deceased was NW – SE) and a bronze dagger (probably part of the grave equipment) were recorded. At a depth of 0.8 to 0.9 m, fragments of pottery vessels were also encountered (Zakrzewski 1924, 277f). Several dozen fragments of a 'barrel' pot and sherds of other vessels were scattered over a 2.0 × 1.0 m area at various depths in the NE sector of the barrow, not far from its central point (Górski, Makarowicz 2012, 335-336).

Barrow 2 was located on the SE edge of Group II (Fig. 2; Zakrzewski 1924; Gardawski 1951, tabl. I). Together with Barrows 3, 4, and 7, it created a linear arrangement oriented on a NW – SE axis. It was situated ten metres SE of Barrow 7 and seven metres SW of Barrow 1. Its plan was circular, with a diameter of 10.0 m and a height of 1.4 m. No information was available on its stratigraphy. To the S and SW of the centre of the barrow, at a depth of 1.3 to 1.4 m, several small fragments of heavily damaged human bones were recorded. During the excavation, traces of decomposed bones were also observed (the individual was buried on a SE – NW axis), and (near the arm?) a bronze pin with a rolled, flattened, twisted, and arched head was documented. In the mound, at various depths (from the top to a depth of 1.1 m) and in various sectors of the barrow, mostly in the cen-

tral part, several dozen sherds from different types of pottery vessels and flint fragments were documented (Zakrzewski 1924, 278-280). It can be assumed that the pin was a part of the grave equipment, but it is difficult to unequivocally classify the pottery material in the same way (Górski, Makarowicz 2012, 336-337).

Barrow 3 (Fig. 3) was located on the SW edge of Group II, about five metres NW of Barrow 4 and ten metres NE of Barrow 23 (Fig. 2; Gardawski 1951, tabl. I). Together with Mounds 4, 7, and 2, it formed a linear arrangement extending along a NW – SE axis over a distance of about seventy metres. The de-

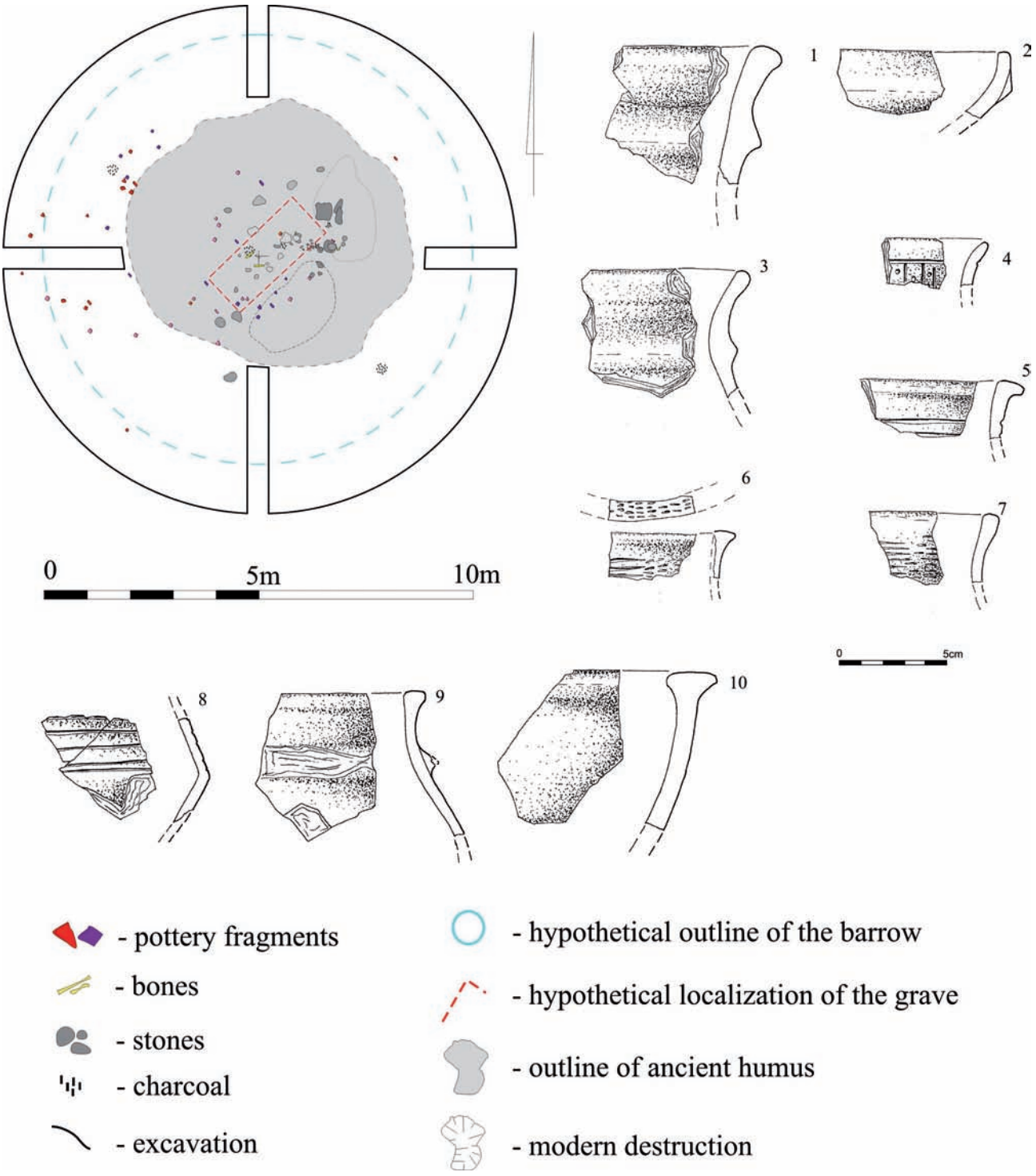

Fig. 3. Plan and selected material from Barrow 3

scribed barrow was circular in shape with a diameter of 11.4 m and a height of 0.65 m. Three layers were distinguished in the profile: modern humus, yellow sand mixed with humus that formed the mound, and – below – ancient humus (10-15 cm thick).

There were numerous clusters of charcoal and several dozen vessel fragments in the mound. At a depth of about 0.4 m, stones of considerable size were documented, four of which formed a linear structure extending along the NE – SW axis, and a darker layer of soil was observed on its right side. Below, there were more loosely arranged stones, among which – in the yellow sand – fragments of two human long bones and teeth were discovered. Below them, more stones with no clear arrangement were observed. The last and also the largest occurred at a depth of 1.0 m and to the NE of the long bones. At a depth of about 0.8 m, a second area of darker soil was registered. Potsherds and flints were documented throughout the mound.

According to A. Gardawski (1951, 10), two graves were recorded in Barrow 3, but after analysing the documentation, it seems that only one grave was located in the central sector of the barrow. Based on the location of the teeth and long bones, it can be concluded that the deceased was buried with the head to the NE. This is also indicated by the grouping of stones that form the perimeter of the burial pit, which were arranged along a NE – SW axis. No grave goods were discovered in the pit, although there was charcoal beneath the bones (Gardawski 1951, 10).

Barrow 6 (Fig. 4) was located in the central-E part of Group II, respectively about eight metres N of Barrow 8 and NE of Barrow 5. Its shape was similar to an oval measuring 10.0 x 9.35 m and had a height of 0.35 m (Fig. 2; Gardawski 1951, tabl. I). The stratigraphy in the barrow was as follows: a thin layer of modern humus, a mound with yellow sand mixed with ancient humus (5 to 15 cm thick) preserved mostly in the central part, and yellow sand forming the ancient ground surface.

Three graves were distinguished in the barrow (one of them is not certain), located close to each other along the NW – SE axis and dug into the ancient humus. Above them, at a depth of about 0.5 m, four clusters of pottery were observed. Two were in the NW sector, one on the N side of Grave 2 and one in the SE part. Fragments of pottery and charcoal were recorded in the mound.

Grave 1 was in the NW sector. It had a square shape measuring 1.4 x 1.4 m. A skull and long bones were discovered within it, placed on a stone. Grave 2 was documented in the central sector of the barrow and was T-shaped. Its dimensions were 2.24 × 1.7 m. On the SE side, a 'vestibule' was observed, in which bones were discovered. Several stones were recorded in the fill and formed an irregular arrangement stretching along a NW – SE axis. The deceased was a male aged 50-60 years at death (Pospieszny *et al*. 2021) with his head oriented to the NW. Two earrings with a spiral plate and a spike (Fig. 4:5) and a pin with a flat head were also found in the burial pit. Conversely, the alleged Grave 3 was a rectangular pit with dimensions of 1.9 × 1.0 m. In its central part, there was a stone and a fragment of Mierzanowice culture pottery.

Barrow 7 (Fig. 5) was situated in the SE part of Group II and formed a linear arrangement with three other barrows (3, 4, and 2) oriented on a NW – SE axis. It was located eight metres SE of Mound 4 and twelve metres to the NW of Barrow 2 (Fig. 2; Gardawski 1951, tabl. I). Its plan was an oval shape with dimensions of 13.9 × 12.8 m, and its height was 0.9 m. The mound's stratigraphy was similar to that of Barrow 6 and contained a thin layer of modern humus, a mound made of yellow sand mixed with humus (10-15 cm thick). Below that, there was yellow sand that formed the ancient surface.

In the central sector of the barrow, at a depth of about 1.3 m, a burial pit was discovered dug into the ancient humus. It had a rectangular shape with dimensions 2.2 × 1.3 m and was oriented on the NW – SE axis. Probably two individuals were buried there, as indicated by a skull placed in the NW part and teeth located in the SE. In its fill were three pins with rolled and flattened heads, *Rollenkopfnadeln* (Fig. 5:7-9; Gardawski 1951, 16) and two earrings with spiral plates and spikes (one is now missing; Fig. 5:10), as well as animal teeth were also found. The mound contained fragmented pottery, flint, and charcoal.

Barrow 13 (Fig. 6 and 7) was erected in the NW part of Group I, as part of a three-monument arrangement. It was located less than five metres east of Barrow 12, the farthest W in the described group and about sixteen metres SW of the small Barrow 14 (Fig. 2; Gardawski 1951, tabl. I). The mound was similar in shape in plan to an irregular circle ('helmet-shaped'), 15.0 × 14.2 m and 0.75 m high. The stratigraphy did not differ from other mounds: there was a thin layer of modern humus on the top, a mound of yellow sand mixed with humus, while on the bottom was ancient

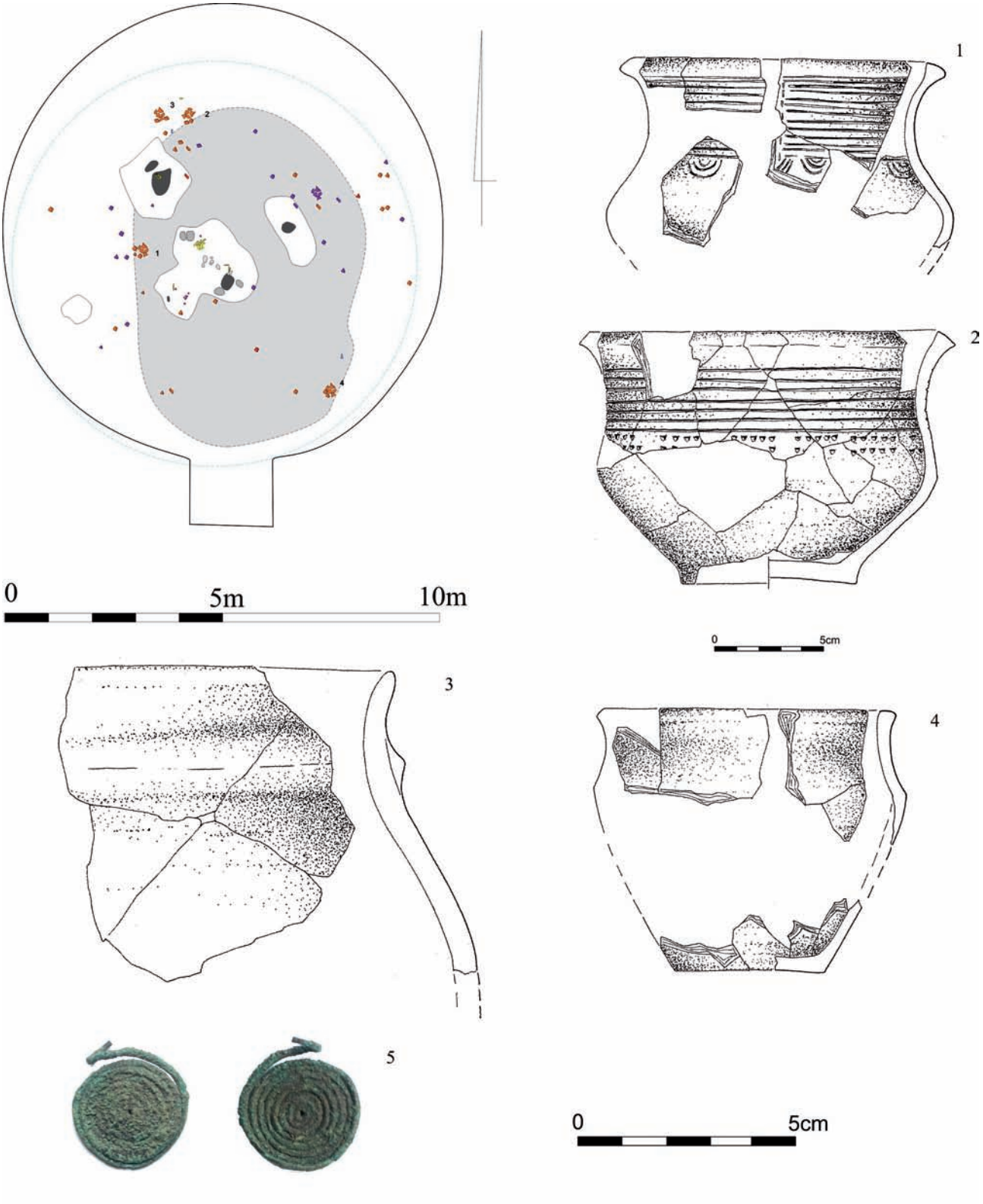

Fig. 4. Plan and selected material from Barrow 6

humus with a thickness of 5 to 15 cm, underlain by subsoil consisting of yellow sand.

The burial pit was in the central sector. Its NE part was destroyed by a modern trench. The burial was most probably located along the NE – SW axis, as indicated by the stones situated in its NW part and single pieces of surrounding edges. Charcoal and vessel fragments were also noted inside. In the burial

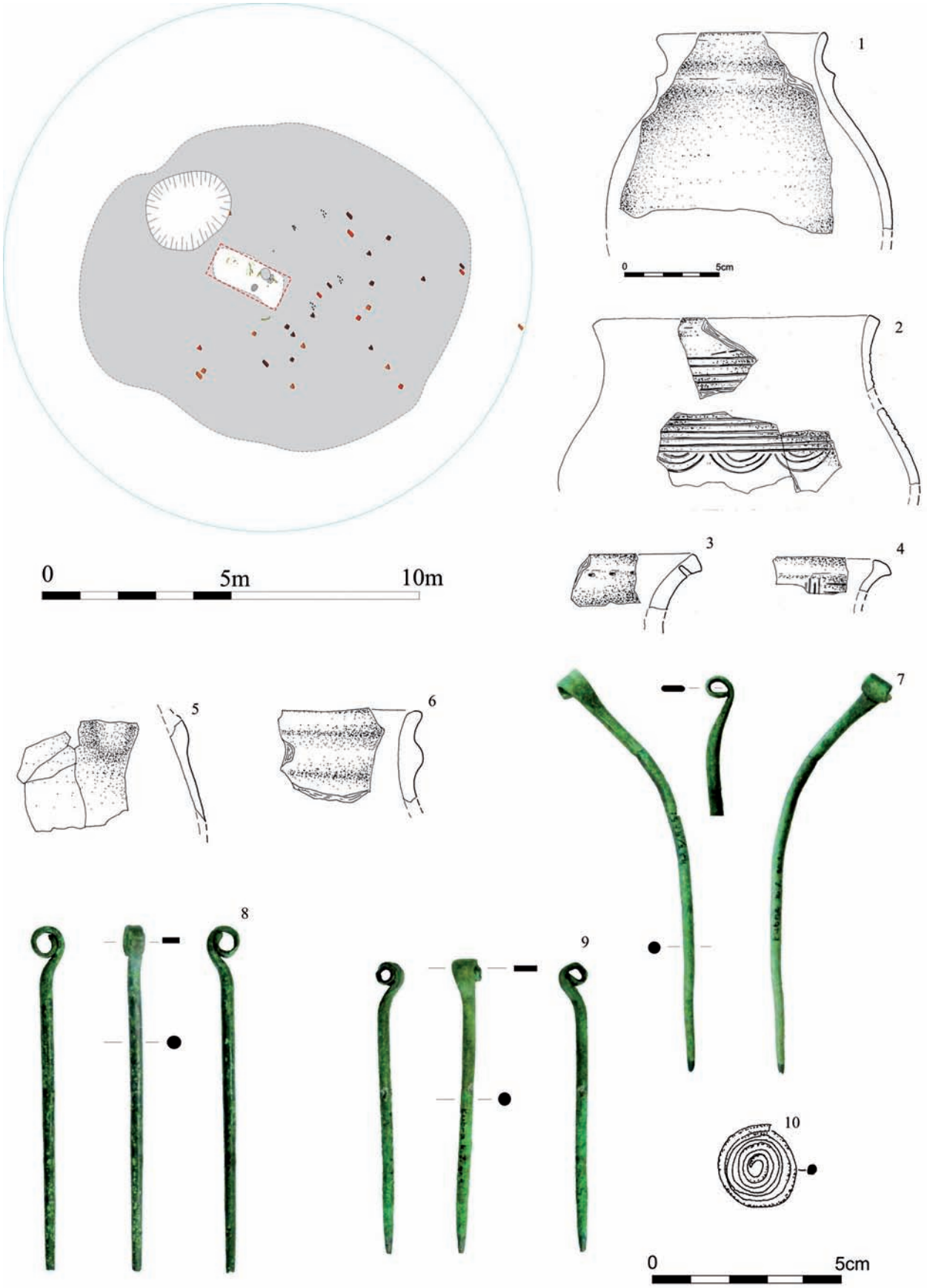

Fig. 5. Plan and selected material from Barrow 7

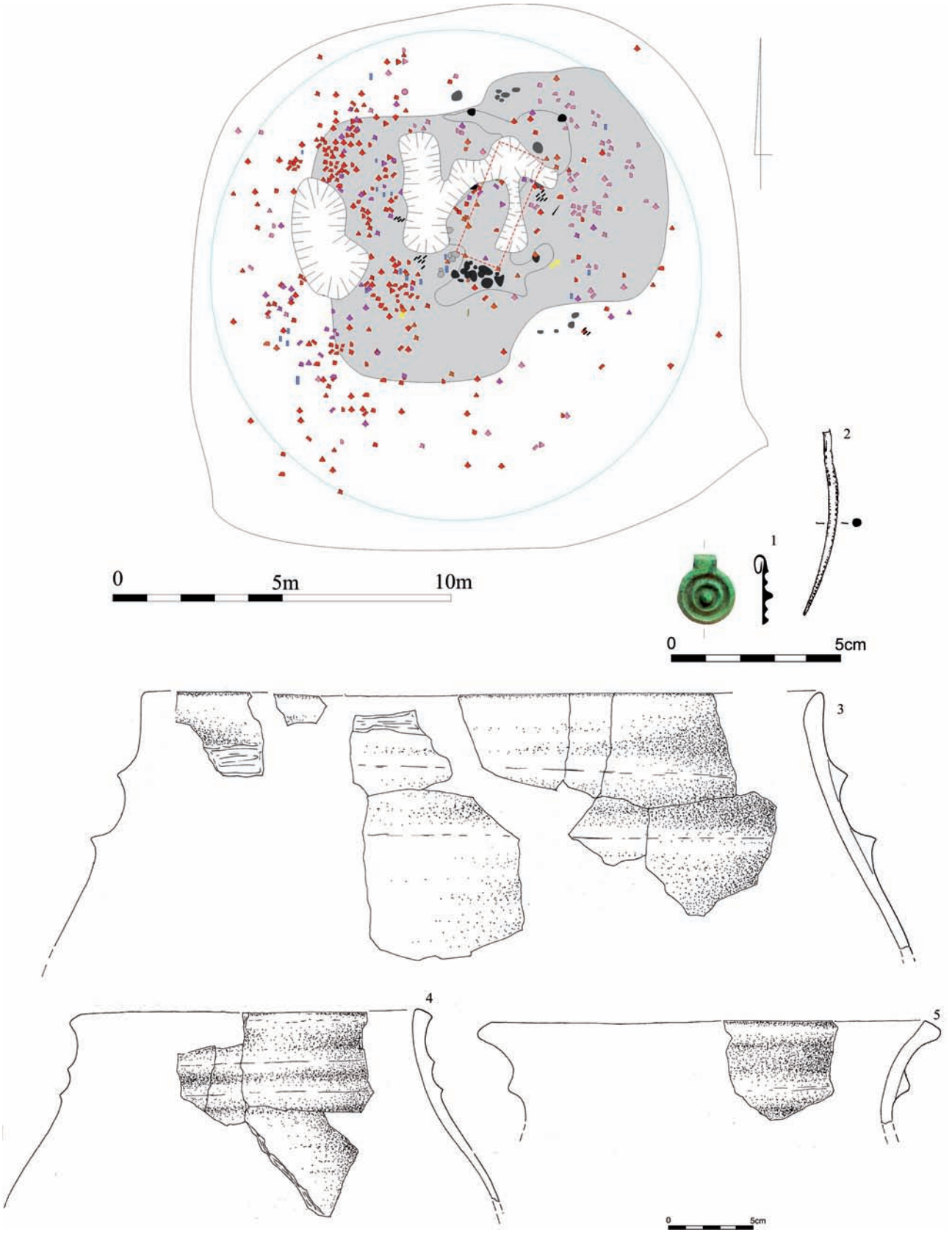

Fig. 6. Plan and selected material from Barrow 13

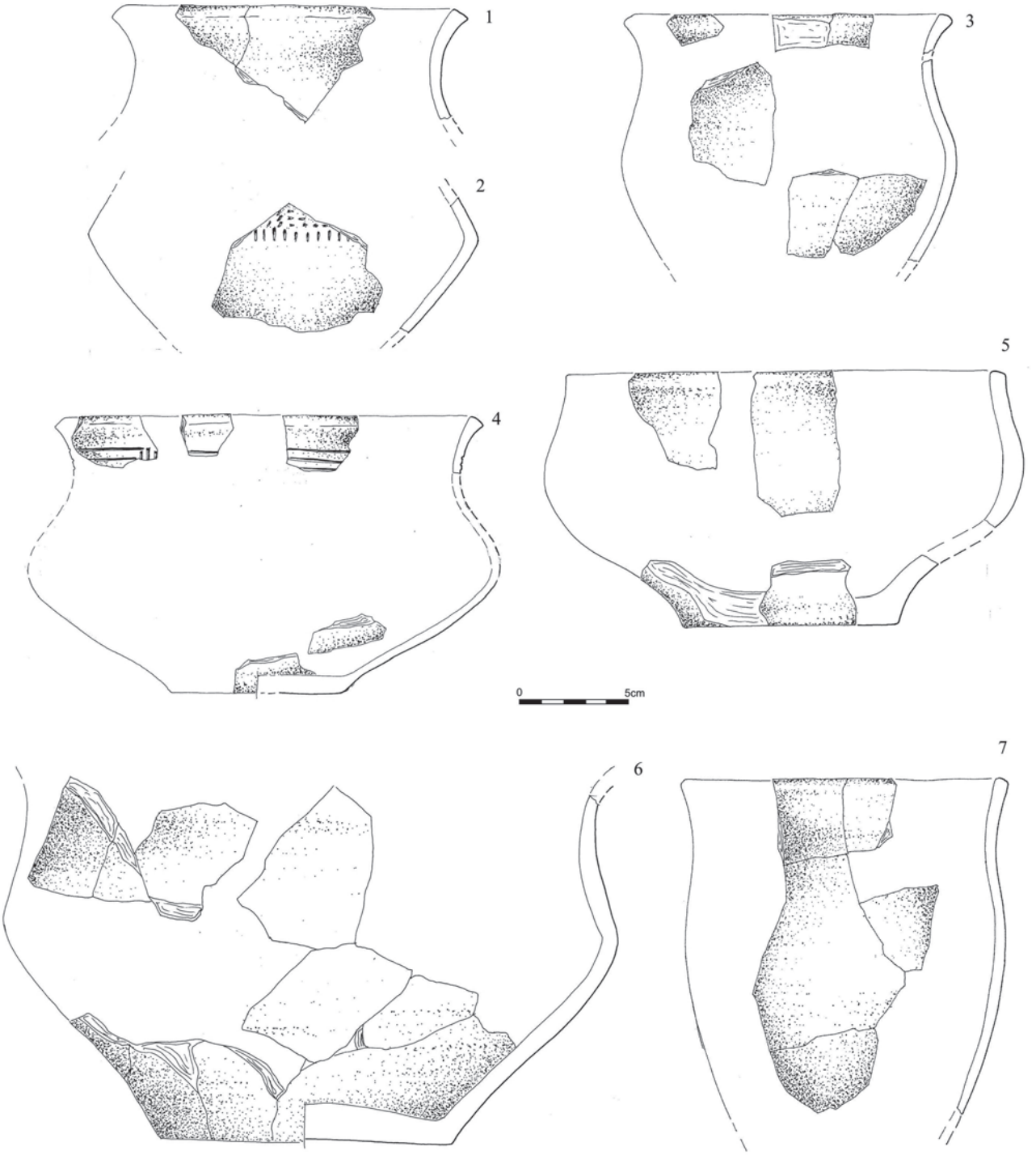

Fig. 7. Selected material from Barrow 13

fill in the NE of the burial pit, a bronze pin with a hat-shaped head and a pendant with a plate were discovered (Fig. 6:1). At a short distance from the burial pit, a *Rollenkopfnadel* pin (now broken; Fig. 6:2) was recorded. In the mound, especially in its W sectors, a significant number of pottery fragments, flints, single animal bones, and charcoal fragments were documented.

Barrow 20 (Fig. 8) was located in the central part of Group I, within a linear arrangement of four mounds (17, 19, 20, 25) extending along an E – W axis. It was located fifteen metres east of Barrow 19 and seventeen metres to the east of Mound 25 (Fig. 2; Gardawski 1951, tabl. I). In plan, it had a circular shape with a diameter of 8.7 m and its height was 0.2 m. The N part of the mound was heavily dam-

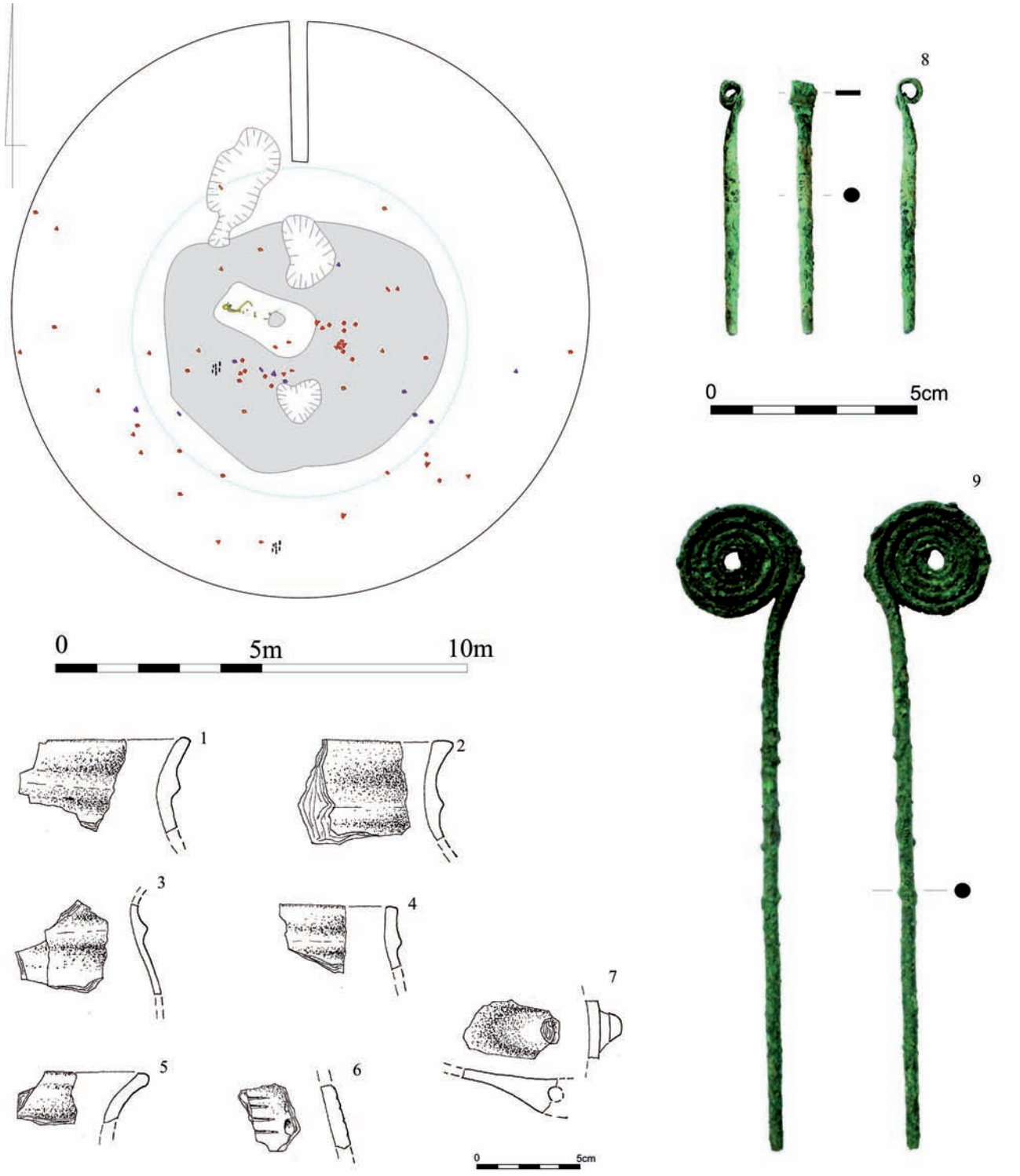

Fig. 8. Plan and selected material from Barrow 20

aged by modern trenches. The arrangement of layers was analogous to other barrows: modern humus was distinguished in the top layer, the mound was built of yellow sand mixed with humus, and below, there was an ancient humus layer 15 to 20 cm thick of yellow sand.

In the central sector along the NW – SE axis, a burial pit with a shape similar to an irregular oval (2.4 × 1.4 m) was dug into the ancient humus. Two individuals were folded antipodally – with their heads towards the shorter sides of the pit and with their long bones oriented inwards (Gardawski 1951, fig. 10).

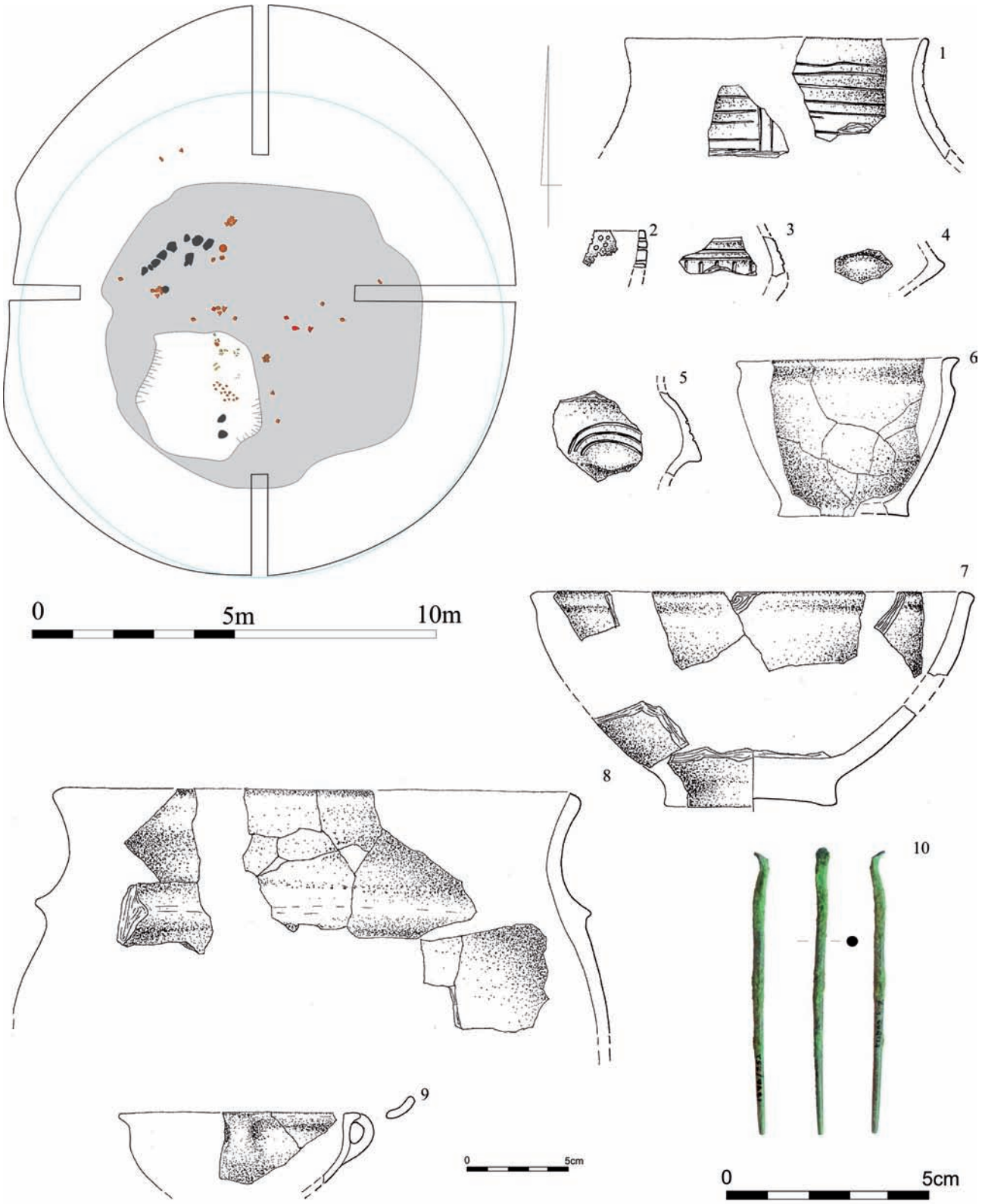

Fig. 9. Plan and selected material from Barrow 23

The skeleton of the deceased lying on its left side in the W sector of burial was better preserved whereas the remains of the second individual were incomplete. The first individual was defined as a male aged 40-50 years (Pospieszny *et al*. 2021). Two pins were noted in the tomb: a specimen of the *Rollenkopfnadeln* type (Fig. 8:8) and one with a crosier-shaped head, a *Spiralkopfnadeln* (Fig. 8:9). In the mound,

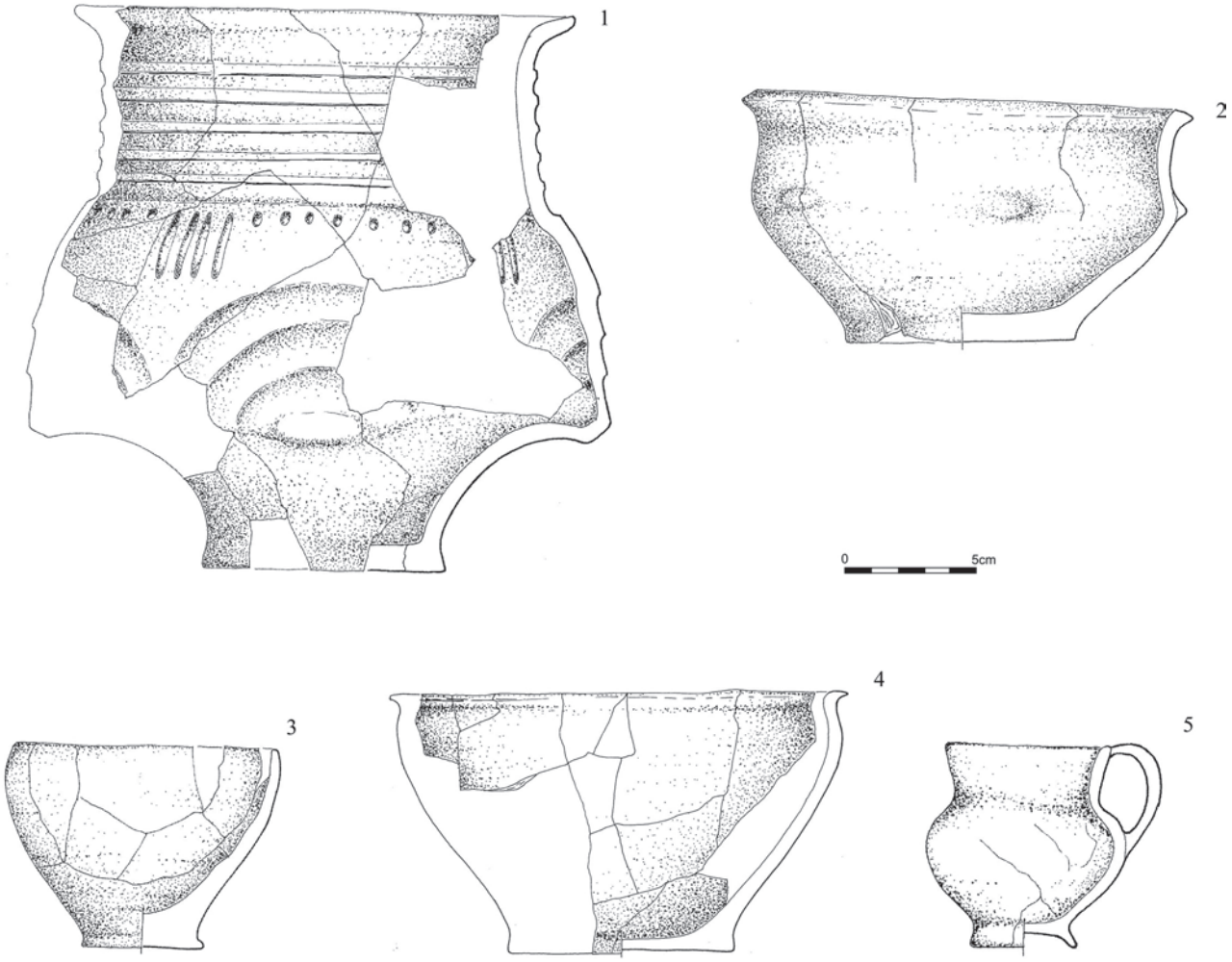

Fig. 10. Selected material from Barrow 23

fragments of vessels and charcoal were also documented.

Barrow 23 (Fig. 9 and 10) was located on the SW edge of Group II, about nine metres SW of Barrow 3 (Fig. 2; Gardawski 1951, tabl. I). Its mound was oval in plan with dimensions of 13.15 × 12.2 m and a height of about 0.4 m. The stratigraphy reproduced on the basis of the original documentation was consistent with the structure of the other mounds: there was a thin layer of modern humus on top, a mound of yellow sand mixed with humus, and below was a layer of ancient hummus about 15 cm thick on top of subsoil (yellow sand).

The SW part of the barrow was destroyed where there was also probably a burial pit (Grave 2 according Gardawski 1951, 28). This is indicated by fragments of human bones and fragments of a vessel, as well as bronze artefacts. In the NW sector, a grave structure consisting of a dozen stones was observed situated on the NE – SW axis (Grave 1). Its N and W 'walls' form a regular half-shaft and were better preserved, while the S and E walls were formed by four stones along the NE – SW axis. On its E side, there were three intentionally fragmented vessels, as well as a small spiral ornament (the *Salta Leone* type) and fragments of a bronze pin (Fig. 9:10; Gardawski 1951, 28). No skeletal remains were observed in the construction. Charcoal was recorded in the mound and ancient humus layer.

Barrow 25 (Fig. 11) was the farthest E monument in the linear arrangement of four barrows (17, 19, 20, 25) located in the central part of Group I (Fig. 2; Gardawski 1951, tabl. I). Its mound was oval in plan measuring 14.0 × 13.5 m and 0.2 m in height. Based on the documentation, the barrow's stratigraphy was as follows: under the modern humus there

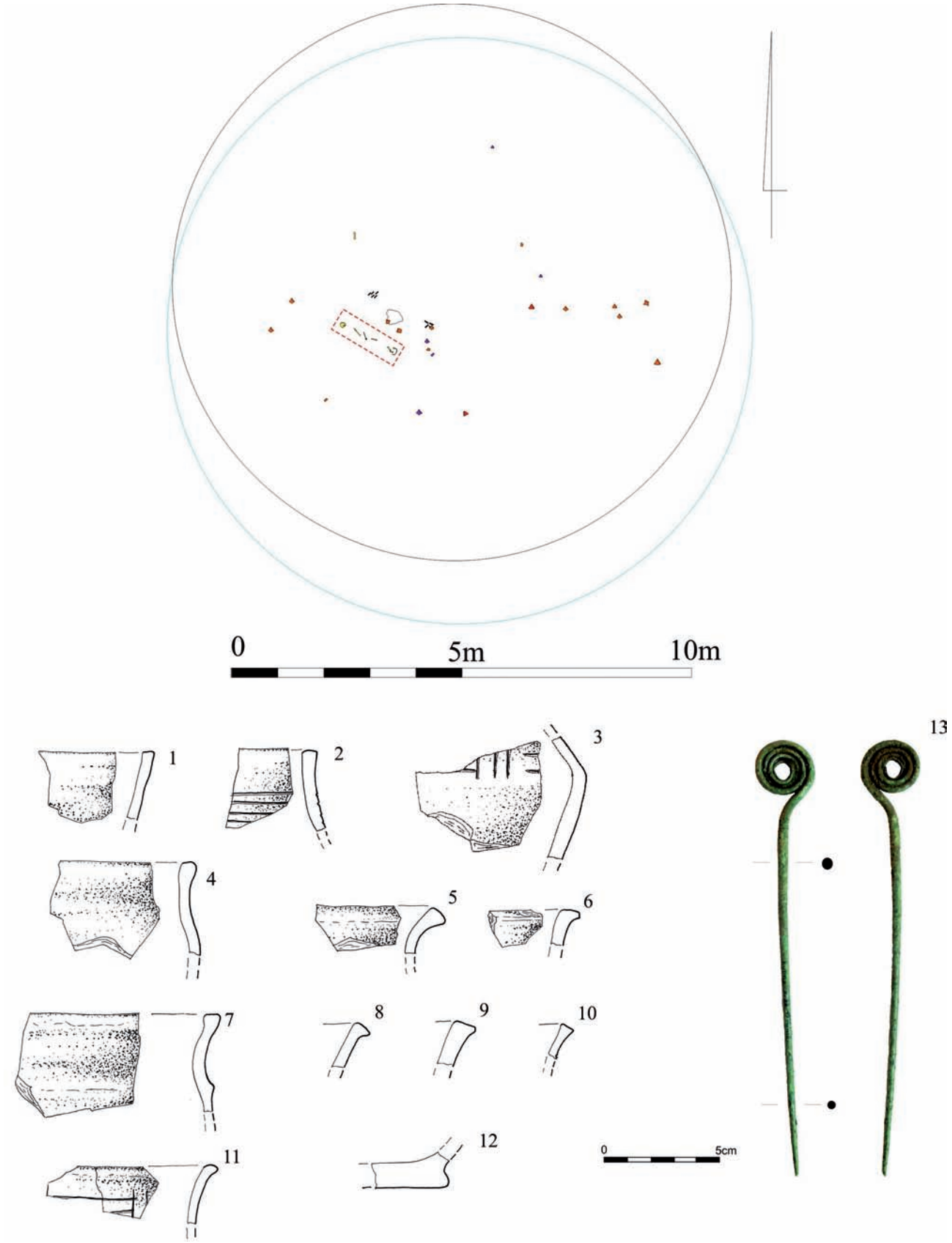

Fig. 11. Plan and selected material from Barrow 25

was a poorly preserved mound on top of a dark-grey ancient humus layer about 20 cm thick.

In the SW sector of this barrow, closer to its centre, a rectangular grave pit was observed dug into the ancient surface and situated on the NW – SE axis. Several long bones were found in it, originating from two individuals arranged antipodal on their side with their heads towards the shorter sides of the pit. One of the individuals was male, aged 20-30 years at death (Pospieszny *et al*. 2021). In the central part of the grave-pit, a pin with a crosier-shaped head, a *Spiral-kopfnadeln*, has been found (Fig. 11:13). Fragments of vessels, flints, charcoal, and an animal tooth were also documented in the mound (Gardawski 1951, 29).

Barrow 26 (Fig. 12) was located in the NE part of Group I (Fig. 2; Gardawski 1951, tabl. I), three to four metres SE of Barrow 22. It created a linear arrangement of five monuments (with Barrows 18, 21, 24, 22, and 26) about 80 m in length and situated on a W – E axis. The mound was circular in plan, with a diameter of 12.0 m and it was 0.35 high. The east side was destroyed by a modern trench. The stratigraphy in the burial mound was as follows: contemporary humus, a mound of yellow sand mixed with humus, and ancient humus 5 to 20 cm thick under a portion of the mound. Below, was yellow sand – subsoil.

In the central sector of the mound, at a depth of 0.2-0.3 m, a cluster of several dozen stones was recorded, which formed a rectangular structure (cover of grave) with dimensions of 1.9 × 1.3 m and oriented on the NW – SE axis. It was built directly on the top of the ancient humus layer. In the central sector of the grave, the skull and long bones of one individual were discovered. Several fragments of vessels and charcoal were also documented in the mound.

Barrow 27 (Fig. 13) was situated in the SE part of Group I, ten metres NW of Barrow 28 and seventeen metres SE of Barrow 25 (Fig. 2; Gardawski 1951, tabl. I). Its mound was similar to a circle with diameter of 14.0 m and it was 0.3 m high. The arrangement of layers was the same as in most of barrows: under a thin layer of modern humus there was an mound of yellow sand mixed with humus lying on top of a layer of ancient humus 5 to 15 cm thick. Below was the subsoil – yellow sand.

In the central part of the mound, at a depth of about 0.3 m, a significant stone structure (3.0 × 2.0 m) was documented. Erratics, up to a depth of 0.7 m,

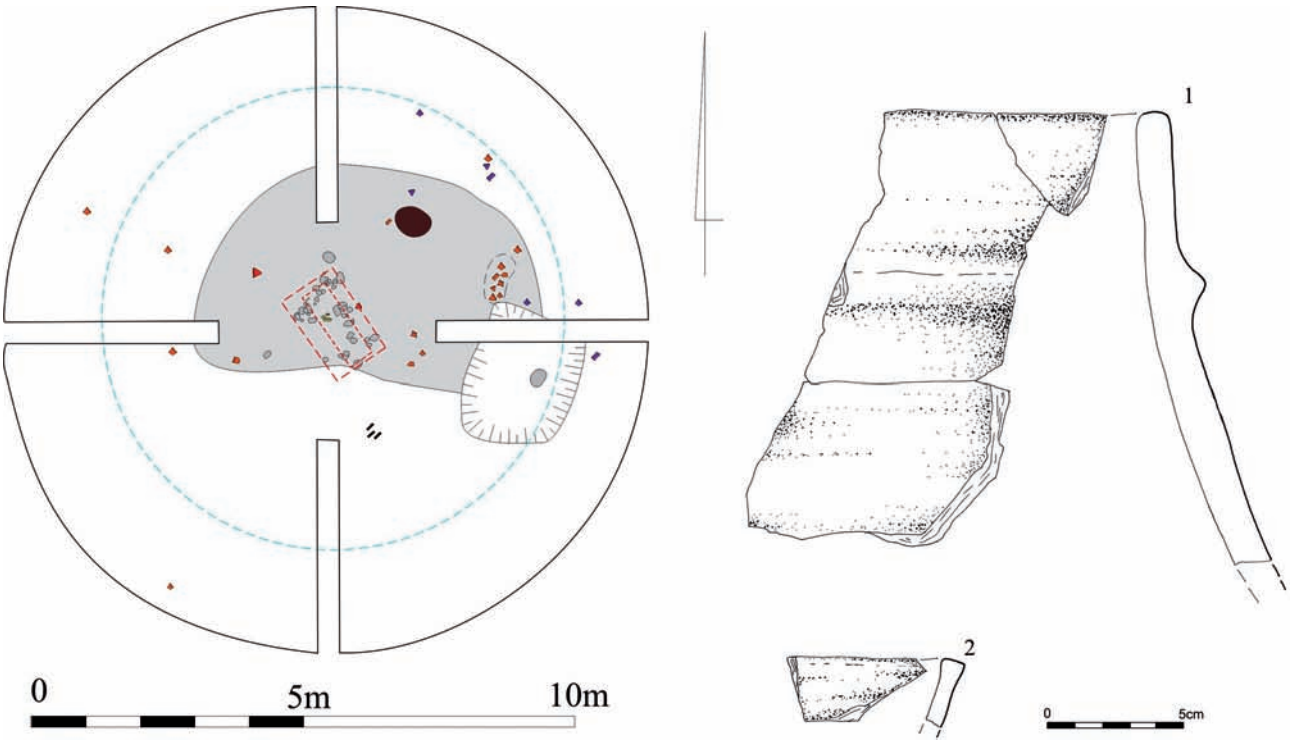

Fig. 12. Plan and selected material from Barrow 26

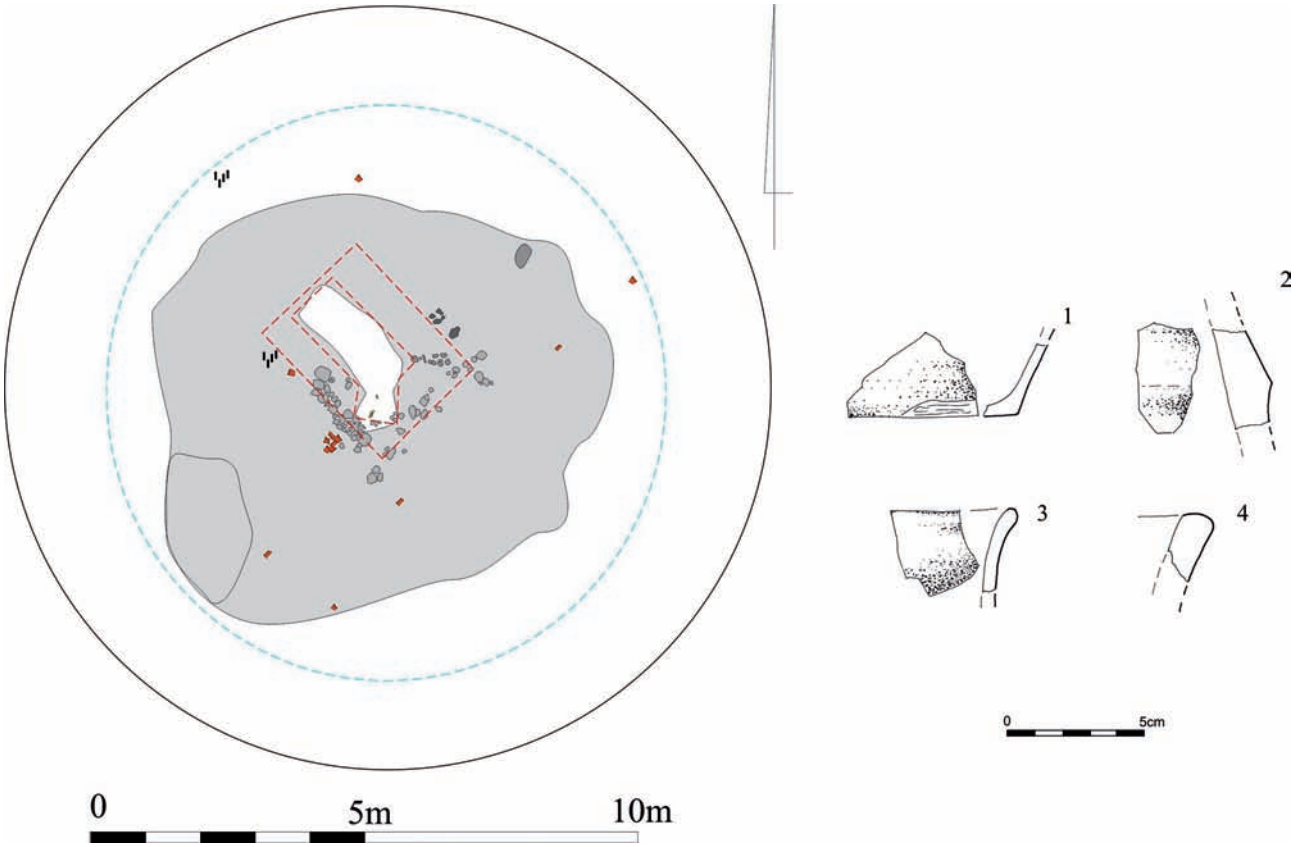

Fig. 13. Plan and selected material from Barrow 27

surrounded the burial pit on the SW and SE sides. At this level, the outline of an irregularly shaped burial pit with dimensions of 2.2 x 1.1 m and dug about 0.25 m into the ancient humus was also observed. In the SE part of the grave there were long bones and teeth. Several fragments of pottery and charcoal were found in the mound (Gardawski 1951, 30).

II.2. Chronometry of individual barrows

Human bones preserved in under-mound graves from ten barrows and those in the fill of one mound were dated using the AMS method at the Poznań Radiocarbon Laboratory. All dates were made on short-lived organic material and the standard error was 30-40 years (Table 1). The Oxcal v. 4.4.4 program was then used to calibrate the radiocarbon dates (Bronk Ramsey 2009; 2021) using the latest IntCal 2020 calibration curve for the northern hemisphere (Reimer *et al*. 2020), which were then modelled using the KDE_model and KDE_plot functions (Bronk Ramsey 2017).

The oldest date from the cemetery comes from a destroyed grave with a possible stone and wooden construction located in the central sector of Barrow 13. Only a small number of bones has survived from the skeleton. The obtained date – 3410±40 BP (Poz-138296) after calibration includes a wide date range of 1877-1564 BC (95.4%), which can be very likely limited to the segment 1745-1629 BC (68.3%) (Table 1). Modelling further narrowed the time period in which the mound was erected to the periods of 1742-1599 BC (81.2%) or 1699-1614 BC (66.3%) (Table 1). It can therefore be assumed with a high degree of probability that the first dated barrow in Łubna was built in the 17th century BC.

The bronze artefacts documented in the grave – a pin with a hat-shaped head, an earring with a spiral plate, and a spike and pin of the *Rollenkopfnadel* type (Fig. 6:1, 2) – do not contradict this chronology, but neither do they help narrow it. They can generally be placed at the end of the BA2 and into the BB1 phases according to P. Reinecke's periodization (Gedl 1983, 65, tabl. 60; Kłosińska 1997, tabl. I: 7 and fig. 12). Pins with rolled and flattened heads are present

from the beginning of the Bronze Age to the period of the early Lusiatian culture (Gedl 1983, tabl. 60; Essen 1985, tabl. 39). The earring with a spiral plate has analogies in, for example, the hoard from Jaworze Dolne dated to the end of the Early Bronze Age (Blajer 1990, 112, tabl. XLI). The pottery represents the early classic horizon of the TCC (S-shape profiled pots with omnidirectional applied horizontal cordons of the G111 type, vases of the W21 type with methope ornamentation, W22 vases, P22 cups, undecorated profiled bowls, multiplied horizontal engraved lines, punctured points, and thickened and obliquely cut bevelled rims; Fig. 6 and 7). These features are characteristic of HT1 and HT2 types in the Polish Lowlands dated to 1850/1800-1500/1450 BC (Makarowicz 1998; 2010, fig. 1.7) and types A1 in Lesser Poland dated to 1650-1500/1400 BC (Górski 2007, tabl. 34). The radiocarbon dating is therefore consistent with the expected dates determined based on the chronology of metal products from the grave and indirectly on the stylistic analysis of pottery from the mound.

The fragment of long bone from the stone-construction grave in Barrow 27 (NW Barrow Group) produced a date of 3350±30 BP (Poz-138149). After calibration at the 2σ confidence level, this includes the range of 1736-1536 BC (including 1692-1536 BC with a probability of 89.1%), while the probability of distribution at the likelihood level of 68.3% gives three nearly equal intercals within the period of 1686-1545 BC. The modelled dates obtained using the KDE_model function slightly narrow the interval, which at the 2σ confidence level covers the years from 1690-1531 BC, and at the 1σ level – 1638-1541 BC (Table 1).

About 40 mostly undiagnostic pottery fragments were recorded in the mound, which made it impossible to precisely assess its chronological position (Gardawski 1951, 30). However, several diagnostic pottery fragments (including one with an applied horizontal rib – Fig. 13:2) suggest the collection is dated to the classic phase of the TCC.

A slightly younger date of 3340±35 BP (Poz-94904) was determined from a bone sample from Grave 1 in Barrow 7; it is also the oldest date for a barrow in Group II (Table 1). After calibration, at the 2σ level, it dates to 1736-1518 BC, and with slightly lower probability, it covers the segment from 1692-1518 BC (90.5%). At the 1σ level, this period is slightly narrower: 1659-1540 BC, and with a lower probability, it dates to 1635-1540 BC (61.5%). The modelled and calibrated dates cover the period 1686-1517 BC (95.4%) and 1626-1538 BC (68.3%), respectively, and only insignificantly indicate the barrow's chronology.

The pottery from the mound is heavily fragmented (about 150 sherds). Diagnostic pottery fragments (e.g., decorated with knobs and applied horizontal cordons, multiple incised horizontal lines in combination with engraved arches, and metopes – Fig. 5) generally represent the classic TCC phase. Bronze artefacts – *Rollenkopfnadel* pins (Fig. 5:7-9) and earrings with snail-shaped plates – are long-lived items, occurring both in the BA2 and BB1-BB2 periods, which does not contradict the absolute chronology (Gedl 1983, tabl. 60).

Two, slightly younger and identical dates (3335±35 BP) were obtained from Grave 2 in Barrow 25 (Poz-69668 and Poz-94907) from the SW Barrow Group. After calibration, they fell within the interval of 1735-1516BC (2σ), and there is a high probability that the age of the dated bones covers the segment of 1631-1536 BC (65.5%). By modelling the dates using the KDE_model option, the chronological range narrowed to the period of 1678-1514 BC (95.4%), and with a high probability (68.3%) to the period of 1623-1538 BC.

Pins with a crosier-shaped head (*Spiralkopfnadeln*) identical or similar to the specimen from the described barrow (Fig. 11:13) are found in BA2-BD contexts according to P. Reinecke, both in TCC and in the Tumulus Culture, for example in under-barrow graves (e.g., Gedl 1983, 34, tabl. 60; Essen 1985, tabl. 39). Particularly noteworthy is the specimen from the collective Grave 98 in Żerniki Górne, in which one of the individuals was radiocarbon dated to the period 1498-1378 BC (Makarowicz *et al*. 2021).

About 150 potsherds come from the mound, including fragments decorated with applied horizontal ribs, multiplied horizontal incised lines, and metopes patterns indicative of the classic phase of the TCC development.

In Barrow 20, bones from Grave 1 (Poz-94906) were dated. After calibration, the measured date of 3310±30 BP gave a range of 1669-1504 BC (95.4%), which can be limited to the years 1612-1536 BC with a reliability of 68.3%. In turn, thanks to the modelling of dates using the function indicated above, the ranges of 1627-1506 BC (95.4%) and 1606-1536 BC (68.3%) were obtained.

The two pins recorded in the grave (*Rollenkopfnadeln* and *Spiralkopfnadeln* – Fig. 8: 8, 9) occur

within a wide chronological range (BA2-BB2; Gedl 1983, tabl. 60; Dąbrowski 2004, 34). The pottery from the mound (about 100 fragments) represent the classic phase of the TCC development, as indicated by the patterns of applied horizontal ribs, horizontal multiplied incised lines, and vertically pierced ears (Fig. 8: 1-7).

Barrow 26 of the NW Barrow Group produced a date of 3305±30 BC (Poz-138089) from the central grave. After calibration, unmodelled dates indicate the period of 1631-1502 BC (94.9%), and with a high probability they cover the period of 1612-1534 BC (68.3%). In turn, the modelled dates (the KDE_ model option) are within the range of 1623-1506 BC (95.4%), and with a high degree of probability fall within the period 1608-1535 BC (68.3%).

The artefacts from the mound (over 250 pottery fragments – Gardawski 1951, 30) are mostly undiagnostic. Among the diagnostic vessel patterns was a large fragment of a pot with applied horizontal ribs and a thickened rim (Fig. 12).

Another radiocarbon date (Poz-94905) was obtained from Grave 2 in Barrow 6, located in the SE Barrow Group – 3305±35 BP. After calibration, with a probability of 92.0% it produced a range of 1642-1501 BC, and with a probability of 68.3% it narrowed to the years between 1614 and 1533 BC. Thanks to the use of date modelling, it can be concluded that the episode during which the under-barrow burial was in use took place in the period of 1636-1500 BC (95.4%), and with a high reliability (68.3%) it refers to the section from 1610-1532 BC (Table 1). The pottery from Grave 2 is not very diagnostic, but can be generally classified – on the basis of macro- and micromorphological traits – to the classic phase. More diagnostic are the vessels and their fragments from the mound (Fig. 4; W21 vases with etched decorations of multiple incised lines, arches, and impressed dots, G111 and G123 pots, and knobs encircled by incised semi-circles – Gardawski 1951, tabl. IV: 10-13; Makarowicz 1998; 2010, tabela 1.1., ryc. 1.2.; Górski 2007, 81-87; tabl. 30). Analogous to the specimens from the discussed barrow (Gardawski 1951, 15) are bronze earrings made of spirally-twisted wire with bent ends, which were documented in Dacharzów in Grave 1a (Florek, Taras 2003, fig. 6e-g). A date made from the bones of one of the individuals in this grave (Poz-89345, 3275 ± 35 BP; Makarowicz *et al*. 2021) gave after calibration (with a probability of 88.7%) a similar time interval (1622-1493 BC) to the date of the characterized barrow.

The youngest ^{14}C dates come from four barrows located in Group II (SE). From mound 23 (SW edge of the group) comes the date 3225±35 BP **(**Poz-69667). In this case, the result of the non-modelled and modelled dates obtained earlier differs only slightly. After calibration, the ranges were 1544-1418 BC (93.7%) and 1512-1446 BC (68.3%). In turn, thanks to the KDE_model function, the burial of the deceased in an under-grave burial took place in the period of 1546-1423 BC (90.2%), and with a high probability fell within in the range of 1519-1453 BC (68.3%).

Pottery from these graves and mounds are highly diagnostic for the classic phase of the TCC (S-shaped G111 pots with applied horizontal ribs, a M22 bowl, a P22 cup, a M22 vase, a D21 jar, and also decorations of incised lines, knobs encircled by semi-circular grooves, applied horizontal ribs, and metopes, indicate the younger period; Fig. 9; Górski 2007). The vase with knobs and semi-circular groove decorations discovered in the described mound (similar to A122 amphorae according to J. Górski) can be classified as belonging to the type A4 complexes (Górski 2007, 66-67, 101-102), showing a connection with 'Transcarpathian' inspirations from the Otomani-Füzesabony culture (Kłosińska 1997, 135; Makarowicz 1999, 233-238; 2015, 118; Górski 2003, 100-105; 2007; Górski, Makarowicz 2007, 102; Muzolf 2013).

The bones of an individual from the grave in Barrow 3 produced a date of 3220±30 BP (Poz-138088), which after calibration (non-modelled dates) fell within the ranges of 1533-1427 cal BC (95.4%) and 1507-1448 BC (68.3%). After using the KDE_model command, the results were similar – 1538-1427 BC with a probability of 95.4% and with a high reliability, 1511-1451 BC (68.3%).

The pottery from this barrow was heavily fragmented (around 300 fragments; Gardawski 1951, 10), but the decoration still represents the classic phase of the TCC (e.g., circular applied horizontal ribs, horizontal incised lines, impressed points at the rim edges, and thickened and rounded rims – Fig. 3).

A similar date was obtained for the deceased from the grave in Barrow 2 – 3210±40 BC (Poz-31489). Its calibration determined the mound was erected in the periods of 1543-1406 BC (94.6%), and with high probability (68.3%) – 1506-1438 BC. The modelled dates (using KDE_model) were similar, ranging from 1546-1415 BC (91.7%) and 1514-1442 BC (68.3%).

In this case, the decorations on the fragmented pottery is also typical for the classic horizon of the TCC (e.g., applied horizontal ribs, multiplied hori-

zontal incised lines, metopes, and thickened rims that were cut on the outside– Górski, Makarowicz 2012, fig. 7), that is HT1-HT3 in the Polish Lowlands (Makarowicz 1998, 88-92; 2010, table 1.1.) and A1 – A2 in the upland zone (Górski 2007). The bronze pin with a rolled and flattened head (Gedl 1983, plate 35:562) is a long-lived product occurring from the early Bronze Age to the Early Lusatian culture; therefore, it cannot corroborate the indicated relative chronology (Gedl 1983, tabl. 60).

The last of the dated monuments (Barrow 1) differs significantly from the chronology of the others. The date obtained – 3030±35 BP (Poz-31488) – after calibration produced wide ranges of 1405-1197 BC (92.9%) and 1305-1223 BC (49.4%). After modelling, they narrowed – concentrating respectively in the periods of 1421-1332 BC (87.2%) and 1397-1341 BC (68.3%). Material probably from the grave (Zakrzewski 1924) – i.e., an S-shaped pot (type G112?) with two vertically pierced ears and a dagger blade with three perforations (Górski, Makarowicz 2012, fig. 6) – may indicate a later stage in the TCC development (the late Trzciniec horizon); however, they are not very precise chronological determinants (Górski, Makarowicz 2012, 336). The dagger has an analogy in the specimen from the barrow of the Tumulus culture in Smoszewo (Kostrzewski 1924, 266, fig. 17; Jaeger, Pospieszny 2011, fig. 2: 9).

III. DATING THE CEMETERY IN ŁUBNA – INTERPRETATION

Significant chronological differences among the dated Łubna barrows indicate the sequence of their erection. By using the KDE_model and KDE_plot

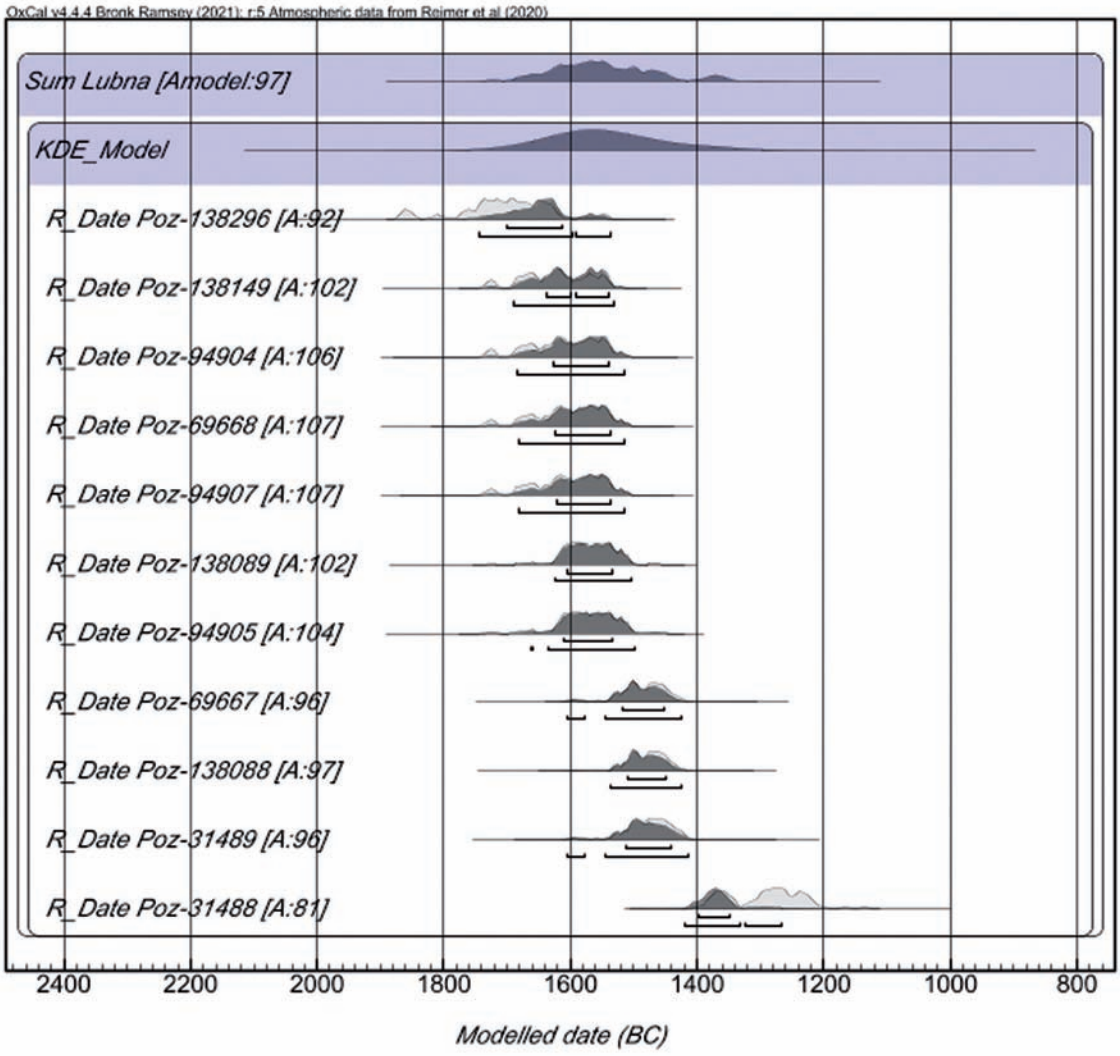

Fig. 14. The ^{14}C measurements from the Łubna-Jakusy cemetery – KDE_model (Oxcal v.4.4.4; Bronk Ramsey 2009; 2021)

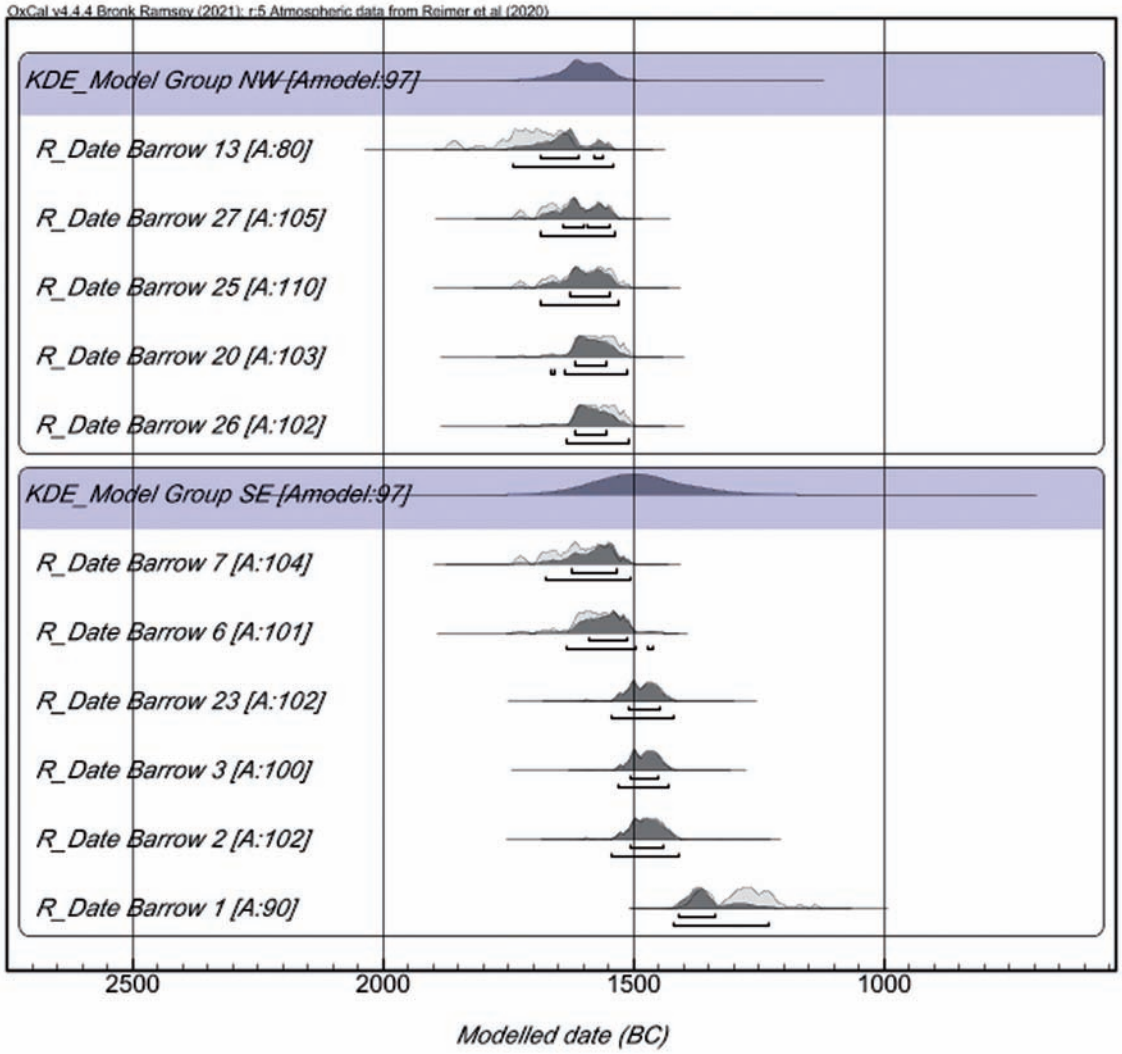

Fig. 15. The ^{14}C measurements from the NW (top) and SE (bottom) barrow groups at the Łubna-Jakusy cemetery. KDE_model (Oxcal v. 4.4.4; Bronk Ramsey 2009; 2021; Reimer *et al*. 2020)

functions of the Oxcal 4.4.4 calibration program, it was possible to determine the probable scenario of the cemetery's development and the approximate duration of its use on the basis of the series of obtained ^{14}C dates (Fig. 14 to Fig. 16). Modelled dates suggest that the first barrows, 13 and 27, appeared in Group I (NW), while the last – Barrows 2 and 1 – were built in Group II (SE). So, it seems that, in general, the erection of the barrows on the scale of the entire cemetery could have been carried out from the NW to the SE. However, despite the seniority of some of the barrows from Group I, these two mound clusters functioned synchronously for a long period, as evidenced by the results of modelling dates from both clusters in Łubna presented separately. Overall, the use of the KDE_model function suggests an earlier appearance of the NW group of barrows and, at the same time, a much longer duration of the practice of erecting of the SE group (Fig. 14). However, it should be clearly emphasized that the presented interpretation of the radiocarbon results should be treated as hypothetical, due to the limited series of obtained dates.

The sum of the probability distributions for all ^{14}C measurements from the cemetery shows that the highest probability density is roughly in the period of 1620-1500 BC (Fig. 14). Taking into account the radiocarbon dates obtained after modelling with the KDE_model function for the first barrow erected in Łubna (Barrow 13) of 1742-1599 BC (81.2%) and 1699-1614 BC (66.3%), and the last mound to be built (Barrow 1) in 1421-1332 BC (87.2%) and 1397-1341 BC (68.3%), the approximate duration of the use of entire necropolis can be estimated at 270-300 years. However, omitting the slightly 'outlying' date

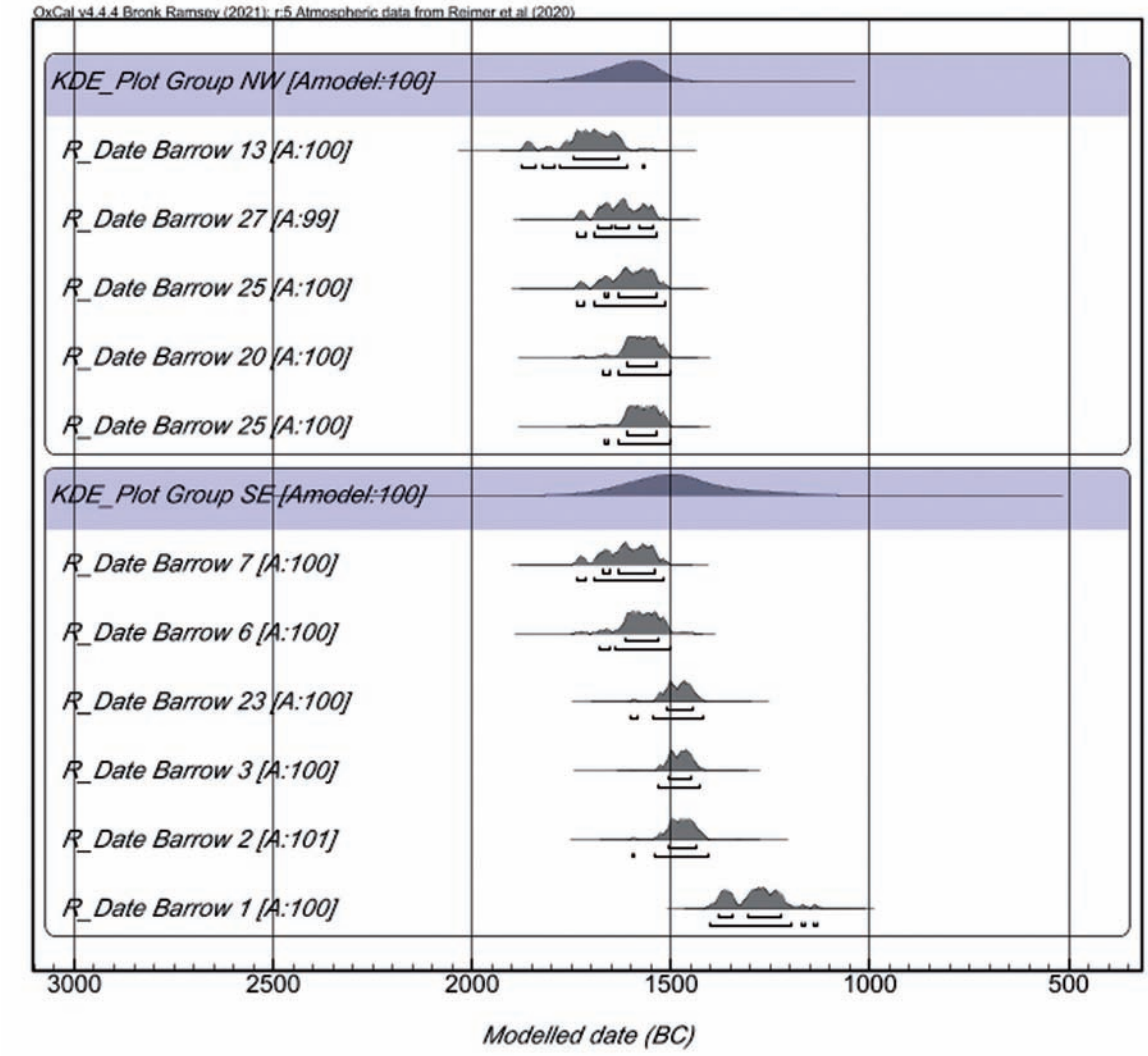

Fig. 16. The ^{14}C measurements from the NW (top) and SE (bottom) barrow groups at Łubna-Jakusy cemetery. KDE_plot (Oxcal v. 4.4.4; Bronk Ramsey 2009; 2021; Reimer *et al*. 2020)

from the youngest barrow (Mound 1), and considering the most recent barrow (Mound 2) was dated to 1546-1415 BC (91.7%) and 1514-1442 BC (68.3%), a significantly narrower range during which the cemetery was in use is evident. By comparing similar probability ranges, this period of utilization can be estimated at approximately 170-200 years. Adding to that radiocarbon analysis, the typological-chronological analysis of objects from Barrow 1 (the dagger and vessel) confirms that it was erected at the end of the 15th or the beginning of the 14th century BC – i.e., after the classic phase of TCC development – which makes the 'long chronology' of the cemetery in Łubna more probable. It could have been used by as many as a dozen or so (10-12) generations.

The dual mound clusters at Łubna are also interesting, in light of the existing knowledge about the funeral rituals and the social structure of the TCC population. The possibility that two separate groups of origin (lineages) used the Łubna necropolis should be considered, with an autonomous space in which mounds were erected, under which some of the dead were buried (Górski 1996, 207-208; Makarowicz 2003, 134-147; 2010, 276-278, 280; Makarowicz *et al*. 2021).

Despite the small series of ^{14}C dates, it seems that the case of Łubna confirms the regularities observed in the barrows of the Komarów culture, the SE enclave of the TCC in Bukivna cemetery (Ukraine). In one linearly arranged group of barrows, successive monuments were erected in different places within this general plan, but not always side by side (in one direction) in chronological order (Makarowicz *et al*. 2018). Conversely, in the Łubna cemetery, in three

cases (Barrows 1 and 2, 3 and 23, as well as 20 and 25) the chronology of the neighbouring barrows is similar, so – taking into account the time intervals after calibrations – they could have been built more or less at the same time or shortly after one another. It seems that the presented scenario of the arrangement of the cemetery space suggests that it was probably based on the general concept of the linear (NW Barrow Group) and linear-group (SE Barrow Group) development. Because the remaining barrows have not yet been dated, the order in which all the barrows were erected in both concentrations cannot be more precisely reconstructed.

The presented analysis of the ^{14}C chronological series of the Łubna barrows refers to the interpretation of their linear or linear-group arrangements (Makarowicz *et. al*. 2018, 2019). These were not 'accidental', but intentional and even planned, and this custom was common among 'barrow communities' both in the Eurasian steppes and far from them towards western Europe (e.g., Bourgeois 2013; Chernykch, Daragan 2014; Makarowicz *et al*. 2019). It was a type of cultural code signalling the group's connection with the ancestors buried within the barrows, clearly communicating generational continuity reflected precisely in the linear arrangement of the burial space, as well as the generational relationship between the dead from the neighbouring mounds.

The differences between the cemetery in Łubna and the much more numerous and often larger necropolises in the eastern part of the TCC area, especially in the upper Dniesterbasin, in Podolia and Volhynia, can be seen in the fact that it was established on an previously uninhabited area. In the case of cemeteries of the upper Dniester TCC variant – the Komarów culture – among others, Bronze Age barrows were erected within existing linear and linear-group mound arrangements of the Corded Ware culture community (Makarowicz *et al*. 2016, 2019).

CONCLUSIONS

The necropolis in Łubna is one of the largest barrow cemeteries in the western TCC area for which a series of ^{14}C measurements has been obtained. Twelve radiocarbon dates were made for 11 barrows (40.7% of the total number of barrows at the site), hence the interpretation of the chronological and spatial development of the presented necropolis should be considered preliminary. The results obtained thanks to date modelling suggest that the construction of the cemetery lasted a maximum of 200-300 years (1700/1600-1500/1400 BC) and took place primarily in the classic stage of TCC development, which is confirmed by the stylistic analysis of pottery and metal artefacts (with the possible exception of Barrow 1). In general, this period witnessed the appearance of extensive barrow cemeteries in the TCC, suggesting an intensification of the phenomenon of erecting these monuments after it had slowed or completely disappeared in other areas during the Early Bronze Age (Makarowicz *et al*. 2019).

Based on the modelling of the set of radiocarbon dates and its interpretation within the context of knowledge about the TCC cemeteries, a probable scenario for the development of the necropolis in Łubna has been obtained. It can be summarized as follows:

1. Barrows in the cemetery were erected systematically; the first was built in the NW part of the necropolis (Group I).
2. The cemetery was generally built from NW to SE, but dates indicate that this was not done in a linear arrangement.
3. Within the two observed clusters of barrows, monuments were erected to a large extent within the same period. It is possible that they represented the sub-territories of two separate lineages. Future magnetometric studies in the space between Groups I and II will allow this concept to be verified and determine whether other barrows were present, which would suggest the spatial continuity of the necropolis.
4. Group II, the SE concentration of mounds, was used for a longer period, and also contained the most recently built burial mounds.

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Table 1. Radiocarbon dates from the Łubna-Jakusy cemetery (Oxcal v.4.4.4.; Bronk Ramsey 2009; 2021; Reimer *et al.* 202)

No	Barrow/feature	Lab. no	Material	BP	Unmodelled BC		Modelled BC	
					68.3%	95.4%	68.3%	95.4%
1.	1/grave	Poz-31488	bone	3030 ± 35	1379-1346 (18.9%) 1305-1223 (49.4%)	1405-1197 (92.9%) 1173-1163 (1.1%) 1143-1231 (1.5%)	1397-1341 (68.3%)	1421-1332 (87.2%) 1324-1267 (8.2%)
2.	2/grave	Poz-31489	bone	3210 ± 40	1506-1438 (68.3%)	1600-1589 (0.9%) 1543-1406 (94.6%)	1514-1442 (68.3%)	1606-1579 (3.7%) 1546-1415 (91.7%)
3.	3/grave	Poz-138088	bone	3220 ± 30	1507-1448 (68.3%)	1533-1427 (95.4%)	1511-1451 (68.3%)	1538-1427 (95.4%)
4.	6/grave 2	Poz-94905	bone	3305 ± 35	1614-1533 (68.3%)	1681-1653 (3.5%) 1642-1501 (92.0%)	1610-1532 (68.3%)	1663-1660 (0.2%) 1636-1500 (95.2%)
5.	7/grave 1	Poz-94904	bone	3340 ± 35	1659-1656 (6.7%) 1635-1540 (61.5%)	1736-1716 (4.9%) 1692-1518 (90.5%)	1626-1538 (68.3%)	1686-1517 (95.4%)
6.	13/mound	Poz-138296	bone	3410 ± 40	1745-1629 (68.3%)	1877-1842 (7.6%) 1824-1795 (3.5%) 1780-1611 (83.7%) 1574-1564 (0.8%)	1699-1614 (66.3%) 1572-1567 (1.9%)	1742-1599 (81.2%) 1590-1540 (14.2%)
7.	20/grave 1	Poz-94906	bone	3310 ± 30	1612-1536 (68.3%)	1669-1656 (1.5%) 1635-1504 (93.9%)	1606-1536 (68.3%)	1627-1506 (95.4%)
8.	23/grave	Poz-69667	bone	3225 ± 35	1512-1446 (68.3%)	1601-1586 (1.7%) 1544-1418 (93.7%)	1519-1453 (68.3%)	1606-1576 (4.6%) 1562-1556 (0.6%) 1546-1423 (90.2%)
9.	25/grave 2	Poz-94907	bone	3335 ± 35	1665-1659 (2.8%) 1631-1536 (65.5%)	1735-1717 (3.8%) 1691-1516 (91.7%)	1623-1538 (68.3%)	1678-1514 (95.4%)
10.	25/grave 2	Poz-69668	bone	3335 ± 35	1665-1659 (2.8%) 1631-1536 (65.5%)	1735-1717 (3.8%) 1691-1516 (91.7%)	1623-1538 (68.3%)	1678-1514 (95.4%)
11.	26/grave	Poz-138089	bone	3305 ± 30	1612-1534 (68.3%)	1665-1659 (0.6%) 1631-1502 (94.9%)	1608-1535 (68.3%)	1623-1506 (95.4%)
12.	27/grave	Poz-138149	bone	3350 ± 30	1686-1651 (21.1%) 1645-1607 (26.6%) 1581-1545 (20.6%)	1736-1717 (6.4%) 1692-1536 (89.1%)	1638-1601 (28.1%) 1590-1541 (40.1%)	1690-1531 (95.4%)

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