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THE SETTLEMENT OF THE BADEN CULTURE AT GRODKOWICE SITE 4, WIELICZKA DISTRICT, IN THE LIGHT OF THE RESULTS OF EXCAVATION FROM 1959, 1962-163 AND NEW ANALYSES

ABSTRACT

Borowska A. The settlement of the Baden culture at Grodkowice Site 4, Wieliczka district, in the light of the results of excavation from 1959, 1962-163 and new analyses. *Sprawozdania Archeologiczne* 74/2, 165-188.

This paper presents results of excavations conducted by Zdzisław Sochacki at Grodkowice Site 4 in 1959, 1962-1963. An area of 1.15 hectares was explored during these three seasons and 50 features of the Baden culture were unearthed. The recovered materials have never been published completely. The storerooms of the Faculty of Archaeology of the University of Warsaw accommodate a collection of pottery vessels from this site, and these vessels were subjected to a number of analyses. As a result of multi-proxy approach in the analysis of the pottery, mainly examination focussing on plant macro-remains, it was possible to establish the type of the economy of the Baden culture society at the site. Mineral and petrographic analyses indicated the composition and details of vessel production. Another important aspect of the study is an attempt at establishing the chronology of the settlement in relation to the pottery style. Radiocarbon dating contributed to clarification of this issue.

Keywords: Baden culture, settlement, ceramics, radiocarbon dating, petrographic analysis
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INTRODUCTION

The objective of this article is to provide a general presentation of pottery materials recovered in the course of excavations conducted at Grodkowice Site 4, Kłaj municipality, Wieliczka district, Małopolskie Voivodeship (Polish Archaeological Record 104-59/58). The work was directed by Zdzisław Sochacki (1927-2011), who explored a part of a Baden culture settlement during three field campaigns (1959, 1962, and 1963; Sochacki 1963; 1964; 1971). Apart from lithic material, pottery was the main type of artefacts recovered from the site. Except for a few fragments, the pottery can be regarded as homogeneous in terms of the cultural affiliation. However, the analyses have never been finished and results of that work have never been fully published. Therefore, this is a good reason to present at least brief general information regarding selected aspects of the pottery discovered at the settlement. It must also be added that some of the artefacts were examined by multi-proxy approach, which is a perfect extension of the research done in the site.

HISTORY OF THE RESEARCH AND THE AVAILABLE SOURCES

The interwar period was a critical one in the history of the site, when a Baden culture amphora was found by accident in 1937. Many researchers must have realized the significance of this discovery since soon after the War, Kazimierz Bielenin decided to organize a surface survey in the area. He found more fragments of Baden culture vessels and flint tools, which confirmed earlier speculations. However, research was conducted on thi site with greatest intensity in the late 1950s.

Adam Krauss explored a Baden culture settlement-pit in the course of rescue excavations in 1957 (Sochacki 1964, 35). This discovery was definitely a stimulus to launch systematic excavations, which were conducted by Sochacki in connection with land development involving the construction of the Experimental Laboratory of Plant Cultivation and Acclimatization (Zakład Doświadczalny Hodowli i Aklimatyzacji Roślin – ZDHiAR) in Grodkowice.

The major difficulty is the absence of the field documentation from the excavations, as well as the fact that an unidentified number of artefacts have been lost. Although some of them have been published, some of the artefacts cannot be found in the storerooms of the Faculty of Archaeology of the University of Warsaw (FA UW) or in the collection of the Province Heritage Monuments Protection Office in Kraków. Thanks to personal communication from Albert Zastawny, whom I am sincerely grateful, it is clear that they are not to be found in the Archaeological Museum in Kraków or its Branch in Nowa Huta. All attempts at establishing the location of the artefacts and documentation have failed. Consequently, the analyses and conclusions must be based on incomplete information from Sochacki's publications and materials collected by FA UW.

The results of previously conducted analyses have appeared in literature solely in form of short communications and reports (Sochacki 1963; 1964; 1967; 1970; 1971; 1980). Considering the available data, it was concluded that 50 features were unearthed in the course of the three excavation campaigns.

During the first season, launched in 1959, 20 features were unearthed, however, only 13 were explored. Another 17 features were discovered in 1962, but 15 were explored. In the final year of the work 13 pits were excavated and explored, together with another nine from the previous seasons. Owing to the rather fragmentary information, it is very difficult to estimate the area of the excavations and of the site. On the basis of the published plan it can be supposed that an area of approx. 1.15 ha was explored. However, the discoveries led Sochacki not only to confirm the existence of an extensive Baden culture settlement, but also to establish that the settlement probably occupied an area of approx. 2.5 ha (Sochacki 1963, 35). Simple calculations clearly indicate that at least a half of the site is still to be excavated.

The rather sparse amount of information about the region of Wieliczka-Bochnia is detrimental to the number of publications concerning this area (Zastawny 2000, 15, 16). The main reason is the type of research conducted there. Out of 41 sites, 35 have only been subjected to surface surveys. A mere seven settlement sites, including Grodkowice 4, were excavated, at least partially: Brzezie Site 1, Chełm Site 1, Gdów Site 2, Szarów Site 5, Wiatowice Site 2, Kokotów Site 13. Out of the latter, only three have been published to a considerable degree: Brzezie Site 1 (Godłowska 1969a; 1969b), Chełm Site 1 (Cabalska 1969; Cabalska 1975; Zastawny and Brzeska-Zastawna 2018) and Kokotów Site 13 (Zastawny 2014).

A working visit to the site was organized in autumn 2018. On the basis of geographic coordinates, field surveys, and, above all, personal communications from the local population, it was established that the area researched by Sochacki is now entirely covered by the buildings of ZDHiAR. Despite that, a geophysical survey was conducted in August 2019 to check whether remains of the Baden culture settlement or traces of earlier archaeological trenches could be found in the undeveloped area.

GEOPHYSICAL SURVEY

The non-invasive survey was undertaken mainly because of the absence of field documentation and unsatisfactory results of the surface survey. An area of 1.5 ha was examined. It contained the highest elevation of the hill (approx. 280.5 m a.s.l.) and the slope along the eastern border of the developed area, probably the place explored by Sochacki. The difference between the flat area of the highest elevation of the hill and the base of the slope ranged between 25 and 40 m. Wiesław Małkowski of FA UW conducted the field work and analysed the data.

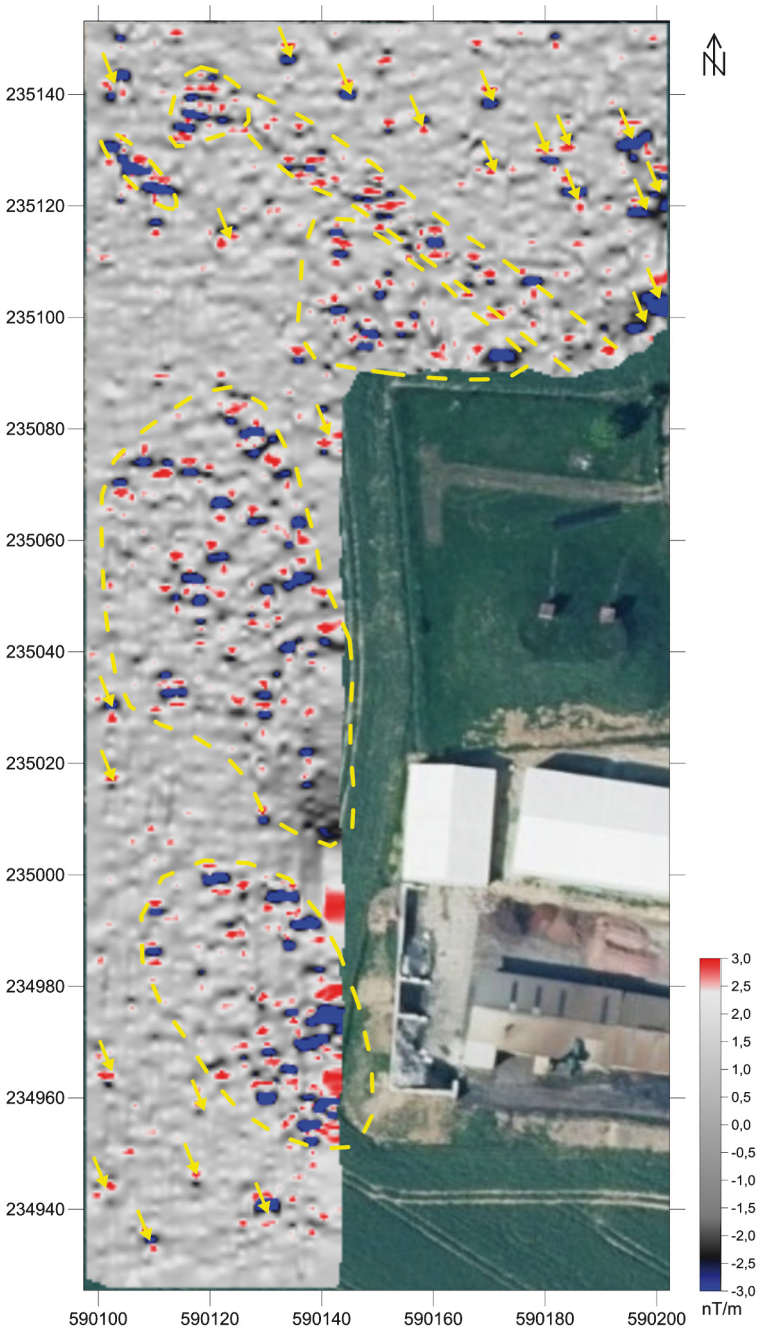


Fig. 1. Interpreted magnetic map with distinguished anomalies. Author: W. Małkowski

The data were acquired with a caesium vapour magnetometer equipped with the Global Navigation Satellite System. The bi-directional survey was made at 2-metre intervals and the probes were placed horizontally at a distance of 1 m. The values of the total magnetic field strength vector ranged from 49350 to 49550 nT and the values of the pseudo-gradient of the horizontal component of this field reached -20/+30 nT/m. Fig. 1 shows the measurement results. Isolated anomalies, clusters of anomalies, as well as linear changes were distinguished in the data set. The isolated anomalies are marked with yellow arrows and the clusters of dipole anomalies are circled with a yellow dashed line. The anomalies are not generated by the terrain, but most likely reflect burned elements in the archaeological layers, the presence of burned organic or clay substances or isolated metal objects. Due to the low or middle-range dynamics of the changes in the values (-3+3 nT/M), the clusters of anomalies might possibly correspond with archaeological features.

GEOGRAPHIC LOCATION

The researched area is situated approximately 30 km east of Kraków. According to the geographic division of Poland, it belongs to the meso-region of Kraków Plateau (Solon *et al.* 2018). The latter is a part of the macro-region of the Sandomierz Lowland, which, in turn, is a part of the sub-province of North Subcarpathia. It is limited by the Vistula Lowland in the north, the Skawina Trench in the west, as well as the Wieliczka Plateau and Bochnia Plateau in the south and east (Fig. 2).

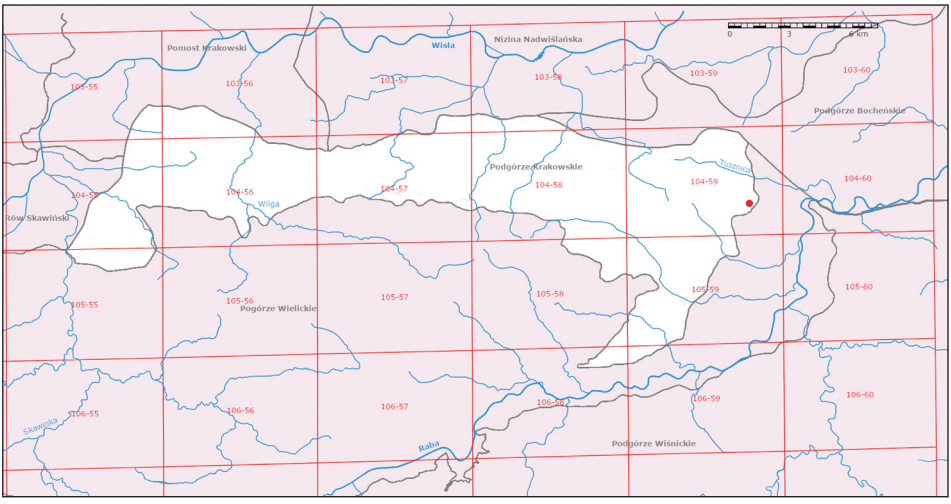


Fig. 2. Grodkowice Site 4. Location in the Cracow Foothill region (division after Solon *et al.* 2018). Author: Agata Borowska

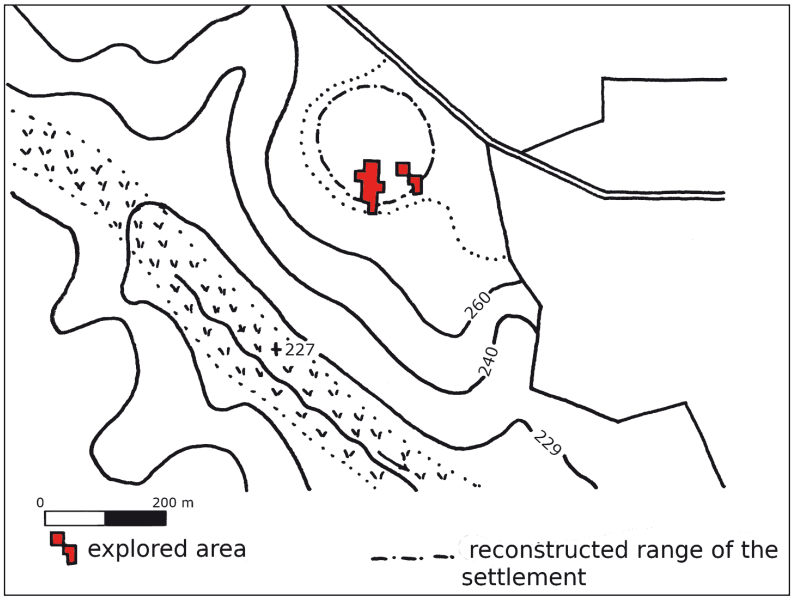


Fig. 3. Reconstructed range of the settlement with excavated trenches. After Sochacki 1971, abb. 2

Fig. 4. Northward view of the site. Photo: A. Grabarek

Numerous stretches of hills and hillocks, divided by a dense network of river valleys, are a characteristic feature of this area. The hills might reach a height of 300 m a.s.l. Grodkowice Site 4 is located on one of such hills.

The settlement is situated on a clay and loess hill, locally called "Lisia Góra" (Fox Mountain), reaching a height of approx. 280 m a.s.l. (Figs 3; 4). During the occupation of the settlement, there was a watercourse located approximately 300 m south of the highest elevation of the area, which is indicated not only by the well-marked valley, but also the vegetation, whose present growth reflects the old riverbed. Despite the considerable elevations of the land surface, ranging from 20 to 40 m, this was the closest source of water for the inhabitants of the settlement.

ANALYSIS OF THE SOURCES

Due to the absence of documentation, the interpretation and reconstruction of the settlement should be approached with caution. At the same time, this state of affairs requires references to the general information about the features (drawings and description) provided by Sochacki. This rather guarded approach is a consequence of the absence of information regarding the methodology of his research. It is reflected in the unclear system of numbers assigned to the features (on object labels and published plans), missing details of the location of the artefacts, spatial relations between the features and basic data concerning their shapes and dimensions. Even the preserved inventory numbers found on the artefacts do not reveal the rationale behind the system of classification. In the case of sealed assemblages, the information compiled by Sochacki does not make it possible to associate them with the material available now. Considering these difficulties, we decided to leave the numbers of the features unchanged since we hope the missing documentation will be found and the material will be systematically organized.

Features

Fifty features were unearthed and explored during the three research seasons at Grodkowice Site 4. Only four of them were briefly published (Sochacki 1970, fig. 14c, 17a; 1980, fig. 20: 9; 21). Only the concentration of the features situated in the southern portion of the settlement were described in more detail, however, more because of their function rather than because of the characteristics of their structures, as could be expected (Sochacki 1971, Abb. 3). According to the information provided by Sochacki, the features discovered at the Baden culture settlement at Grodkowice included dwellings, refuse pits, open hearths, a clay-sourcing pit, as well as a structure that possibly had a ritual function (Sochacki 1963, 38).

This does not change the fact that taking the available data into account, it is not possible to state the exact number of the different categories of features or their functions.

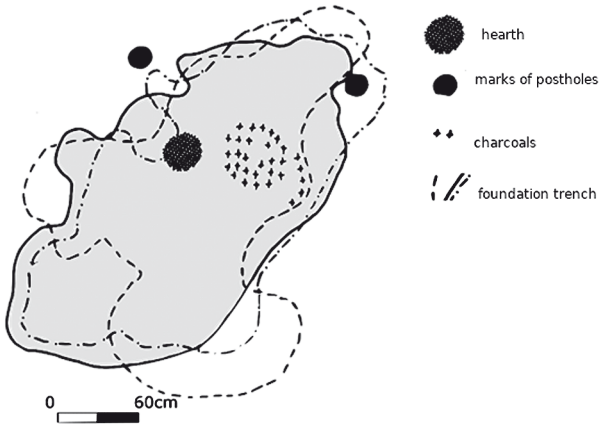


Fig. 5. A post-hole feature at Grodkowice Site 4. After Sochacki 1980, pl. XX.9

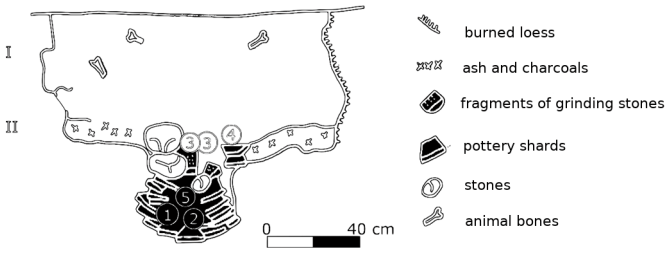


Fig. 6. Feature 17/59/63 profile. I-II – layers of the fill, 1 – broken stone axe, 2 – broken vessel, 3 – spindle whorls, 4 – glass bead, 5 – decayed organic substance, broken vessels, fragments of grinding stones and unworked stones. After Sochacki 1980, pl. 21

Nevertheless, a certain regularity was observed and it could be regarded as a canon of the procedures undertaken in the past studies. This is mainly connected with pit-houses and semi-pit-houses, which sometimes showed relics connected with post-holes. The establishing of their function did not draw upon the actual manner of their exploitation, but was usually associated with their big surface area. However, considering the fact that most of them were relatively small, reaching slightly more than 2 m diameter, such a conclusion is not entirely obvious, at least not in the context of interpretation of some of the features (Sochacki 1971, 14c). If the poor state of preservation precluded interpretation, the identification of the function of the feature was probably arbitrary and such a feature was described as a dwelling or a household structure.

The interesting features which Sochacki had regarded as dwellings include structures sunken in the ground, with an hearth inside and a roof which was possibly supported with

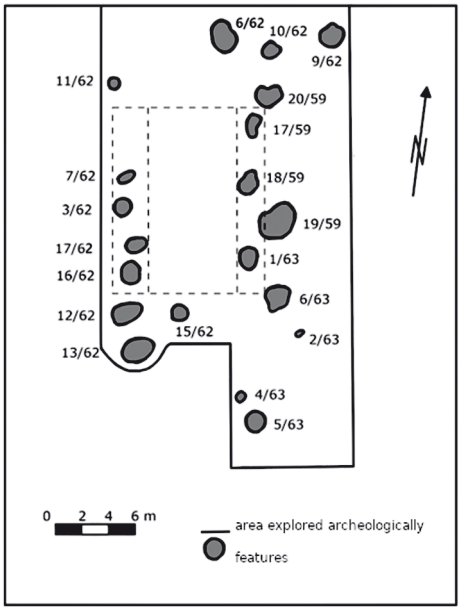


Fig. 7. Map of the southern part of the settlement with reconstructed outline of the house. After Sochacki 1971, fig. 4, as presented by Balcer 2012, fig. 46

posts (Fig. 5), sometimes also with a layer of vessel fragments laid flat, which perhaps were relics of the floor.

In the context of the analysis of the nature of particular structures and their functions, Feature 17/59/63, with its bottom covered with pottery fragments, is an especially interesting one. In its centre there was a pit whose fill, apart from vessel sherds, contained fragments of grinding stones, unworked stones and spindle whorls (Fig. 6; Sochacki 1963, 38). It seems that this feature should rather be treated as remains of a kiln than a structure of a ritual function, the latter being suggested earlier by Sochacki (1964, 36). This new interpretation is definitely supported by the strongly burned, or even deformed fragments of vessels. Parallel features can be found *e.g.* at the Funnel Beaker culture settlement at Bronocice, where they were described as kilns/firing structures (Kruk and Milisauskas 1981, 71). It is also possible that initially it was a pit with a storage vessel placed inside, which was then destroyed by exposure to high temperature. Perhaps the pit was a part of a larger household complex. The absence of the documentation and, consequently, of the context of the discovery preclude drawing further conclusions.

Feature 5/62/63, a relic of a big above-ground structure measuring 6 × 8 m, also deserves attention. Inside there were remains of two hearths and marks of postholes. The dimensions, distinguishing the feature among the others found at the site, and its location in the centre of the settlement at the top of the hill, suggested a significant function, but

one that it is difficult to conclusively establish function (Sochacki 1970, 345). This brief description provides no clues to regard this feature as exceptional.

The partially published plan of the settlement (Fig. 7) is also confusing. It presents its southern part with two clearly distinguished concentrations of features, which supposedly might have been separated by a communication route (Sochacki 1971, 52). However, according to Bogdan Balcer, the two lines of pits, that is, the western one consisting of four features and the eastern one consisting of three features, would rather mark the walls of a big residential building (Fig. 7). According to his reconstruction, the surface area was approx. 90-100 m^2 and it showed strongly marked typological similarities to late, Badenized Funnel Beaker culture structures (Balcer 2012, 127, 128). Nevertheless, the dimensions of the postholes are a weakness of this concept. Assuming that the scale recorded in the drawing is correct, some of the pits marking the walls reach diameters ranging from 2 to at least 4 m. In my opinion, it seems that Sochacki's hypothesis, despite the absence of supporting records in the fragmentary documentation, is more likely. In particular, the principle of interpretation of large features as residential or household structures would suggest that the concentration of the features and their logical distribution indicate two separate concentrations divided by an obviously marked empty space – the supposed communication route. It is definitely possible that each big pit might have accommodated two or even three posts supporting a roof. However, Sochacki as the director of the research did not propose such a hypothesis. This means that either Sochacki did not show sufficient sense of observation, or Balcer went too far in his interpretation. Another issue is connected with the reconstruction of the course of the walls. Why were Features 11/62, 12/62, 13/62 not taken into consideration? Or the course along a line with features 15/62, 4/63, 5/63 and a parallel line on the other side? It seems that in this case, the dimensions of the features or the distances between them were the reason. On one hand, we can observe sufficient imagination to reconstruct a big house with posts, on the other hand, this imagination is too limited to conceive a big house with a gabled roof, much bigger than what would normally be expected. Features from the remaining part of the site, which was not shown on the plan, were characterized by a dispersed and irregular pattern of location. This is similar to the situation at most of Baden culture sites in Małopolska (Sochacki 1971, 52, 53).

Pottery vessels

As a consequence of the missing part of the material, it is impossible to conclusively establish the percentages of the categories of material evidence. The inventory prepared for the current study shows that fragments of pottery vessels are the biggest group that now survive. After the reconstruction of forms and reduction of the number of sherds by joining broken ones, the material belonging to the collection of FA UW from the exploration of the features and cultural layers, as well as from the surface surveys, consists of 4943 fragments of vessels. Most of them (4220) come from the fills of the 46 features. This

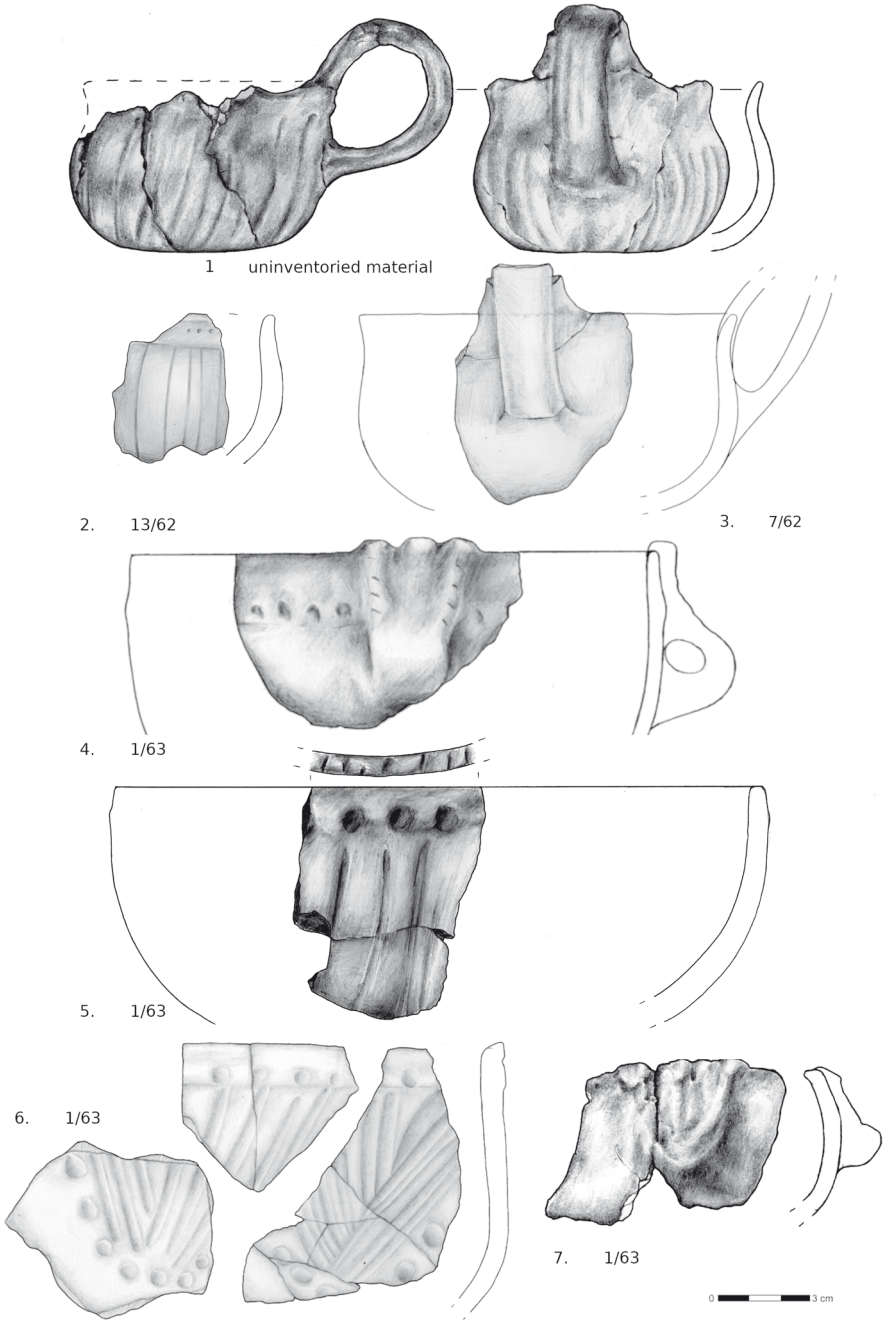


Fig. 8. Grodkowice Site 4. Selected pottery. Author: Agata Borowska

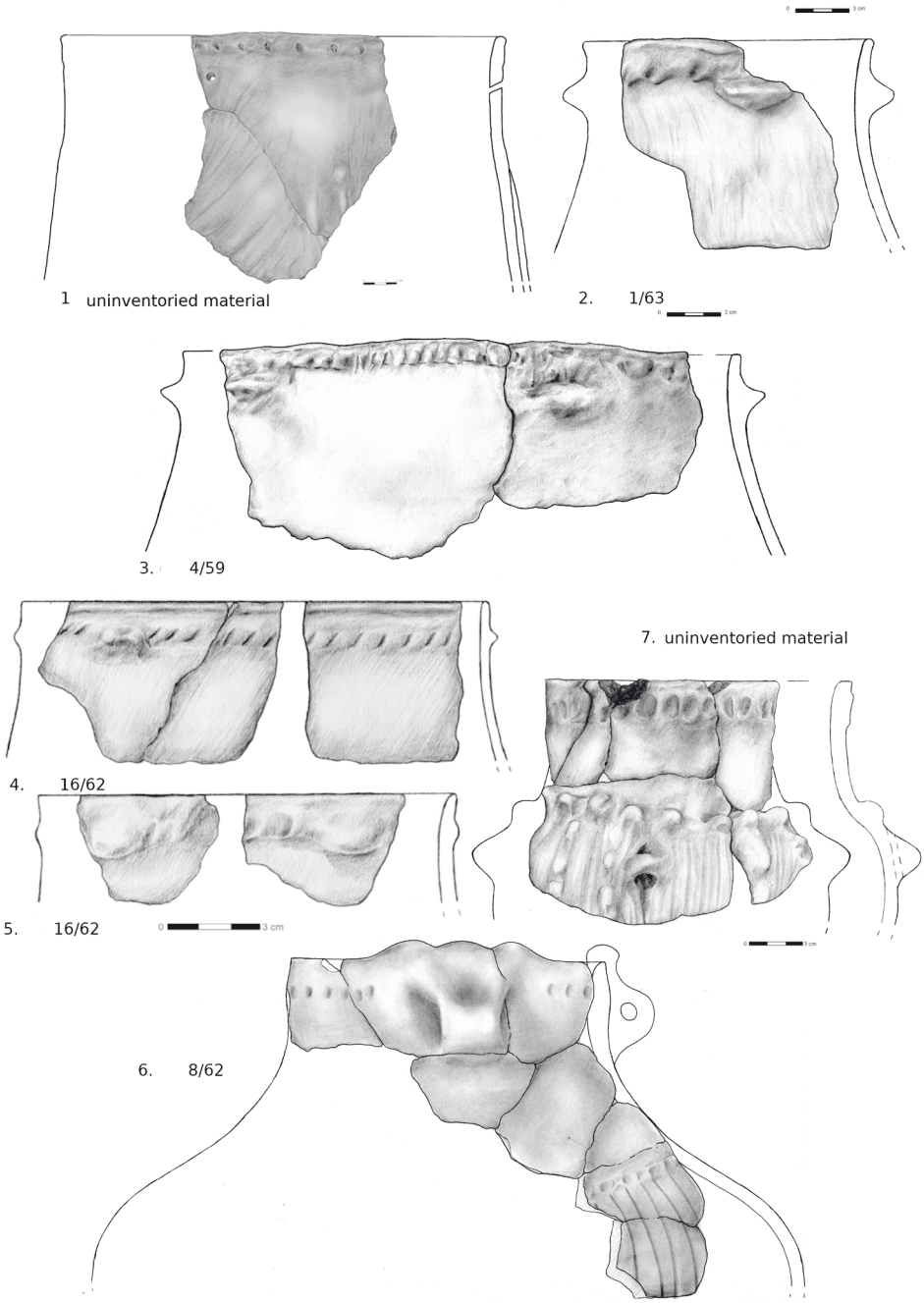
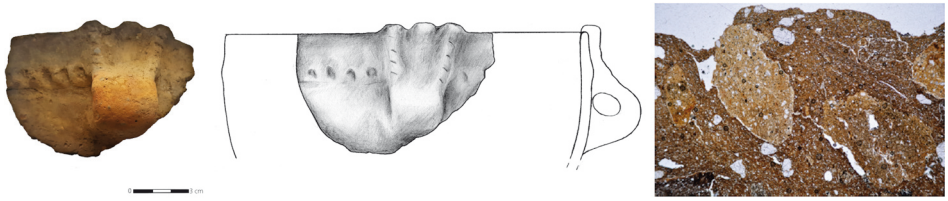


Fig. 9. Grodkowice Site 4. Selected pottery. Author: Agata Borowska

Sample no. 1



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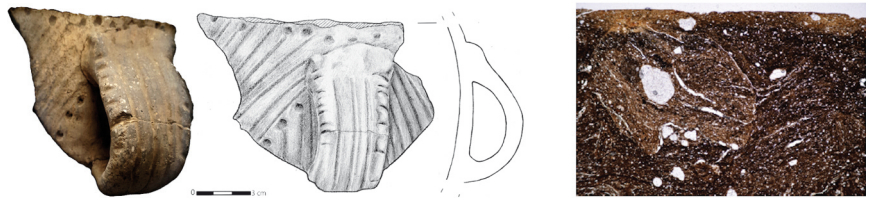

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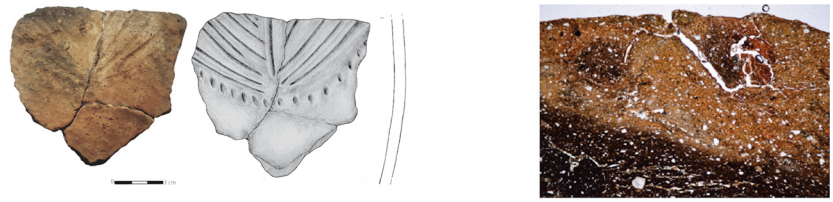
Sample no. 3



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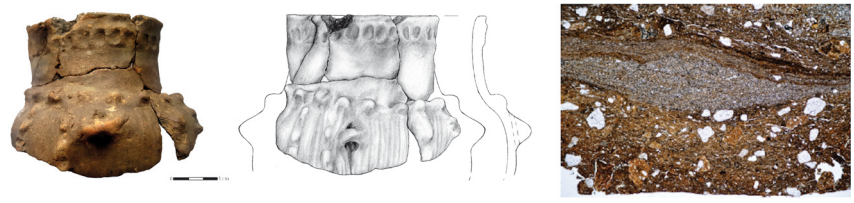
Sample no. 4



a b c

Fig. 10. Pottery samples and photomicrographs.
Author: A. Rauba-Bukowska (1: c, 2: c, 3: c, 4: c), Agata Borowska (1: a, b, 2: a, b, 3: a, b, 4: a, b)

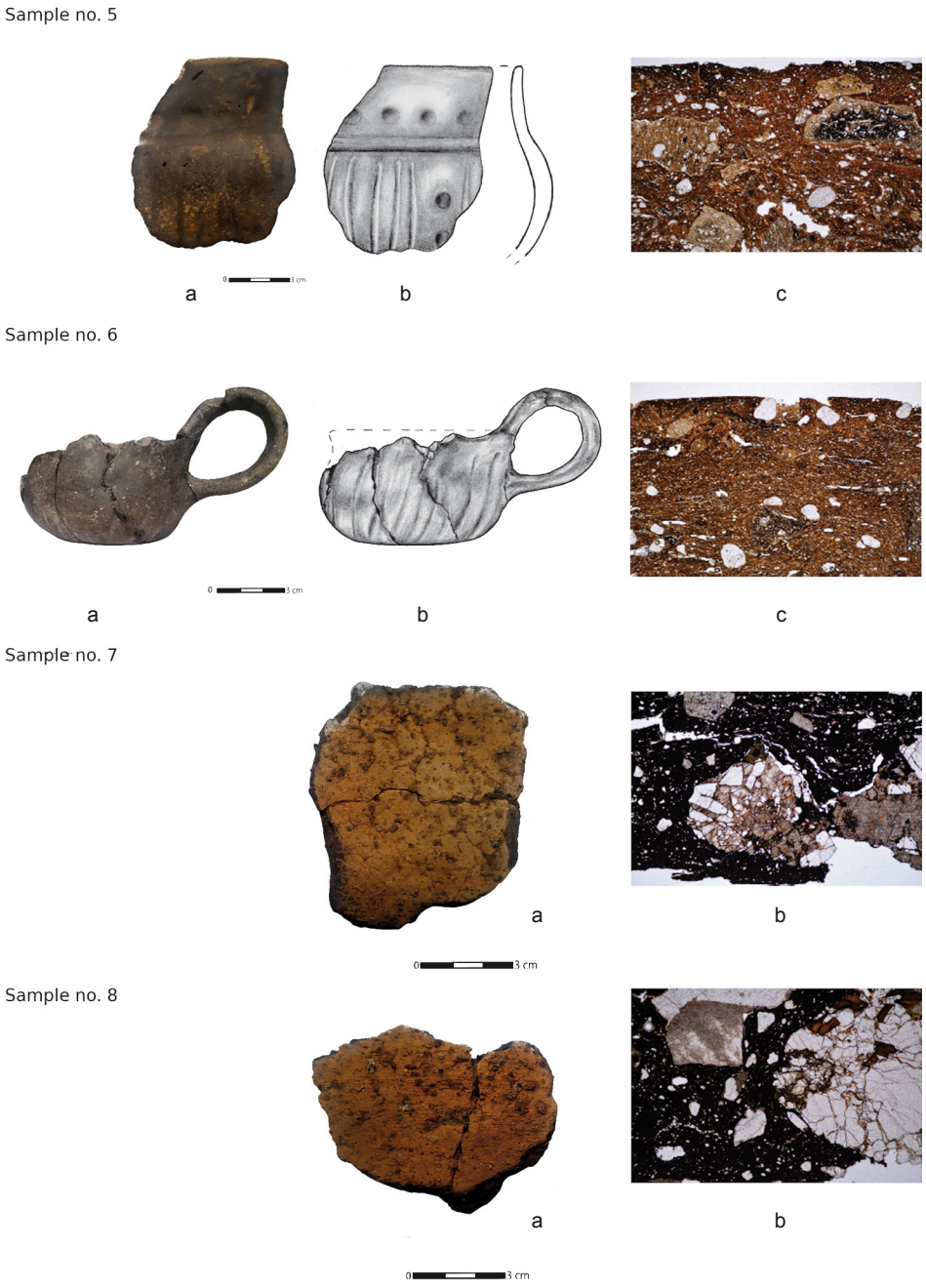


Fig. 11. Pottery samples and photomicrographs.
Author: A. Rauba-Bukowska (1: c, 2: c, 3: b, 4: b), Agata Borowska (1: a, b, 2: a, b, 3: a, 4: a)

group was characterized by the homogeneity of the ceramic fabric, except for the inventory from Feature 5/59/63, where, apart from Baden culture pottery, five sherds of vessels displaying different technological properties, possibly dated to the Early Bronze Age, were found.

The classification of the types and varieties of vessel forms was based on the analysis of sources from Kraków Nowa Huta (Bober 1994; 2015; 2018) and adjusted for the sources analysed in this paper. Due to the limit of the length of the publication, we present only examples of the most important forms of vessels. The pottery material includes a few typological groups: mugs, scoop-like vessels, bowls, amphorae and pots.

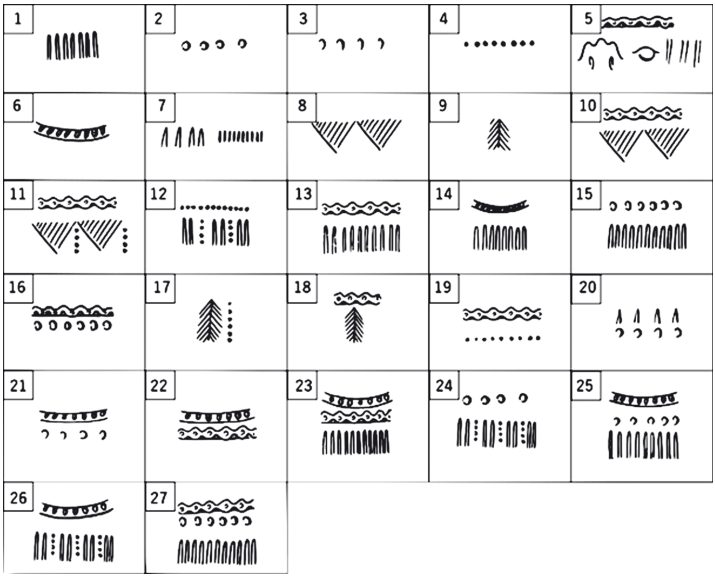
The mugs are vessels with ribbon-like handles extending over the rim and rounded, sometimes slightly flattened bellies, as well as indistinct bottoms. They usually bore no decoration, but some of them were decorated with groove patterns and sometimes groove patterns combined with stamped ornamentation (Fig. 8: 1). Both decorated and undecorated mugs are common artefacts at Baden culture sites in Poland and Europe. Their forms remained generally unchanged since the emergence of the Baden culture (Rook 1971, Pl. 9: 3, 13: 11, 26: 15; Sochacki 1988, Pl. 22: b.23). The differences between vessels mainly involve changes in the proportions of the handles and in the decoration styles: apart from the groove patterns, there were groove and stamp patterns, in which rows of horizontal and vertical stamp impressions surround vertically fluted areas (Bober 1994, 21; Sochacki 1988, Pl. 26: 3). Undecorated mugs and ones decorated only with grooves were the most common at the analysed material from Grodkowice Site 4. Only one fragment of a vessel form decorated with narrow vertical fluting and a horizontal line above it (Fig. 8: 2) as well as one fragment of a vessel decorated with vertical and horizontal fluting combined with stamp decoration can be found in the records (Fig. 11: 1a, b).

The category of scoop-like vessels included ones with ribbon-like handles extending over the rim, with the diameter of the rim bigger than the diameter of the belly and usually an indistinct bottom (fig. 8: 3). Just like the mugs, some were decorated, others were not. Grooves were the only decoration pattern used in this category of artefacts (Bober 1993, Pl. 4: 18, 5: 4, 7: 23; Rook 1971, Pl. 4: 3, 8, 11: 9, 24: 3, 29: 4; Sochacki 1988, Pl. 38: 8, 9). No scoop-like vessels with conical bottom were identified, however, such vessels were found at Baden culture sites in the area surrounding Kraków, *e.g.*, at Kraków Zesławice Site 21.

Bowls are vessels with a wide opening and semi-circular or conical belly, and quite often with a handle extending from the rim of the mouth (Fig. 8: 4-7). Baden culture bowls are characterized by a long chronology and diverse forms at its different stages (Bober 1993, Pl. 8: 9; 9: 1; 12: 3; Rook 1971, Pl. 3: 7, 10: 5, 15: 1, 42: 7, 43: 5, 44: 1, 5, 9; Sochacki 1988, Pl. 1: 10; 8: 4; 20: 6; 26: 16, 22). They presented various types of decoration (nos. 1, 2, 3, 5, 6, 11, 12, 13, 14, 21, 24 and 25 according to the motifs and patterns in Table 1). Interestingly, ruffling of the rims was observed only in this group of vessels. It is generally thought that the origins of conical bowls might be found in the Funnel Beaker culture or

Table 1. Decoration motives and patterns with corresponding graphic representation

Decoration motifs	14. grooves and ruffled rim
1. grooves	15. grooves and finger impressions
2. finger impressions	16. cordon/nodule/handle and finger impressions
3. finger and fingernail impressions	17. chevron and stamp impressions
4. stamp impressions	18. chevron and cordon/nodule/handle
5. cordon/nodule/handle	19. cordon/nodule/handle and stamp impressions
6. ruffled rim	20. finger impressions and imprint decoration
7. elongated ruffle impressions	21. finger impressions and ruffled rim
8. open triangles	22. cordon/nodule/handle and ruffled rim
9. chevron	23. grooves, cordon/nodule/handle and ruffled rim
Decoration patterns	24. grooves, finger and stamp impressions
10. cordon/nodule/handle combined with open triangles	25. grooves, finger impressions and ruffled rim
11. cordon/nodule/handle combined with open triangles and stamp impressions	26. grooves, stamp impressions and ruffled rim
12. grooves combined with stamp impressions	27. grooves, finger impressions and cordon/nodule/handle
13. grooves and cordon/nodule/handle	



Lengyel culture (Sochacki 1980, 16). The most common decoration motifs (Table 1, nos. 1, 2, 3, 5, 6, 11, 12, 13, 14, 21, 22, 24, and 25), combined with Ózd type handles, have parallels at many Baden culture site of late classical chronology (Sochacki 1980, 87).

The amphorae include vessels with slender necks, gourd-shaped, pear-shaped or bi-conical bellies and handles located near the mouth or the belly (Fig. 9: 6, 7). The edge of the neck often features a cordon decorated with finger or stick impressions. The amphorae from the analysed site display types of decoration motifs nos. 1, 5, 13, 15 and 27 (Table 1). According to Sochacki, the vessels with bi-conical and pear-shaped bellies might be inspired by the Funnel Beaker culture while those with gourd-shaped bellies were probably original inventions of the Baden culture (Sochacki 1988, 71). The greatest diversity of the forms in this group falls to the developed, classical phase of the Baden culture (Bober 1993, Pl. 5: 1; 6: 14; 7: 18; 9: 4; Rook 1971, Pl. 37: 6, 67: 9). The amphorae were characterized by significant differences in dimensions, which led to distinguishing two separate categories at Kraków Zesławice Site 21: small amphorae and bigger vessels of a storage function (Sochacki 1988). This paper, however, observes a division based exclusively on the properties of shapes, and not on the supposed function of the vessels.

Another group of vessels are pots. This category includes forms with an S-shaped profile and the diameter of the mouth comparable with the diameter of the belly (Fig. 9: 1-5). In terms of the surface finish they can be divided into two classes: those with the belly covered with smudged clay and those with the belly polished with a burnishing stone. Small single or double nodules situated near edges are a common motif. Apart from this motif, they were decorated with cordons and finger impressions, as well as grooves and stamps.

The material from Grodkowice Site 4 definitely bears some resemblance to the materials associated with the Zesławice-Pleszów and Mogiła groups (Zastawny 1999, 19). Their potential association with the latter group stems from the absence of elements that are characteristic of the Zesławice-Pleszów group. The features that are common for both groups include rugged pot surfaces, decoration motives such as cordon, vertical grooves, open triangles, chevron, as well as patterns of grooves combined with stamp impressions.

The absence of such distinct forms as mugs with conical bottom, bipartite bowls, pseudo-kernos type vessels, or of the decoration motif of a diagonal criss-cross pattern, suggest the association of these materials with the Mogiła group. Bowls with a partition, conical mugs (the variety with a flattened bottom) and diagonal criss-cross pattern are additionally a remnant of the early classical style. It is characteristic that all stylistic transformations corresponding with successive phases of the development of the Baden culture in Małopolska are more clearly marked in the territory occupied by the Zesławice-Pleszów group. These features are not so obvious in the Mogiła group and it is more difficult to find parallels in the regions of their origin (Zastawny 1999, 25, 26; 2011, 441-446).

On the basis of stylistic features of the pottery (and considering chronological indications from the association of artefacts at Kraków Zesławice Site 21; Godłowska 1968, 107,

108; Sochacki, 62-102) it is possible to try to distinguish two phases of occupation of the settlement. The discriminants of these phases come from different objects and do not co-exist with each other. The first would correspond with the undecorated or fluted mugs, amphorae with handles inspired by the Viss type, as well as groove and cordon decoration. The characteristic features of the other one were the flattened handles of Ózd type, rich groove and impression motifs, motifs consisting of vertical and horizontal grooves, as well as the ruffling of the rim. The latter motif is rather problematic in the context of the analysis of the materials from Kraków Mogiła Site 55, where the ruffling of the rim is earlier in terms of chronology and is an element associated with the initial phase of the development of settlement activity at that site (Bober 1994, 33). Perhaps this dissimilarity results from the developmental differences between the Zesławice-Pleszów and Mogiła groups. Nevertheless, the inventory as a whole is accommodated within the range of forms and decoration styles of the late classical horizon of the Baden culture in Małopolska.

MINERALOGICAL AND PETROGRAPHIC ANALYSES

In the context of the analysis of pottery materials, it is important to understand the whole technological process of vessel production. Therefore, eight fragments of vessels from four features were selected for mineralogical and petrographic analysis (conducted by Anna Rauba-Bukowska of the Institute of Archaeology and Ethnology, Polish Academy of Sciences, whom I wish to sincerely thank).

Two samples came from Feature 1/63 (Fig. 10: 1, 2), two from Feature 5/59/63 (Fig. 11: 3, 4), one from Feature 4/59 (Fig. 11: 1) and one from Feature 12/62 (Fig. 10: 3), as well as another two from locations not identified precisely (Fig. 10: 4, 11: 2). The samples were cut into sections and slides were observed under polarizing microscope in transmitted light in order to identify the degree of mixing, firing conditions and temperature, as well as the composition of the ceramic fabric. The firing temperature was estimated on the basis of thermic transformation of clay minerals as well as observation of biotite, hornblende and glauconite.

The analysis revealed that the vessels were made of clay and fine-grained materials, which contained mica components. Crushed pottery material, the so-called grog was a significant ingredient (10.6 to 20.1%), and it was intentionally added to clay material. However, it was not particularly finely crushed, the grains ranged from 0.3 to 2 mm. Most of them displayed marks of secondary exposure to high temperature. Apart from grog, sand was also present in all the samples (up to 5% in the ceramic fabric). The ceramic fabric shows a low to medium degree of mixing, and banded colouring as well as accumulations of fine grains can be observed.

The samples from Feature 5/59/63 seem to reflect a different technology (Fig. 10: 3, 4). Most likely, they were fragments of one vessel. Although they also consisted of clay mine-

rals and fine-grained fraction, they contained a significant share of crystalline and igneous rocks derived from transformed feldspars, quartz, biotite and hornblende. Biotite flakes were another component, they might come from crushed rock intentionally added to the ceramic fabric. There were no indications suggesting addition of grog in this ceramic fabric.

On the basis of the mineral composition it can be concluded that the samples that evidenced the two different recipes for preparation of ceramic fabric were made of local raw materials. The differences were visible only in the intentional admixtures, contradictory in the addition of grog and sand or crushed rock. Other differences can be observed in the firing technology. The samples from Feature 5/59/63 were fired at a temperature of approx. 850 °C while the firing temperature of the other analysed samples reached 700-750 °C. Both processes were conducted in reduction firing conditions with limited availability of air. The microscopic examinations confirmed the conclusions of the macroscopic analysis. The analysed ceramics were characterized by the homogeneity of the fabrics and the firing method, with the exception of some of the material from Feature 5/59/63. In addition to the ceramics of the Baden culture, it probably contained material from a later period.

ABSOLUTE CHRONOLOGY

The main aim of the dating analysis was to establish the position of the settlement at Grodkowice Site 4 against the background of the regional development of Baden culture settlement activity, as well as to compensate for the information gaps resulting from the unsatisfactory state of the source base. Since Feature 17/63 contained charcoal fragments, the material was sampled and sent to the Poznan Radiocarbon Laboratory for analysis by ^{14}C AMS method. The radiocarbon date may also be compared with the results of conventional style-based dating of the pottery.

The measurements returned a date of 4440 ± 30 BP. The date was calibrated with OxCal v4.2.3 (Fig. 12). After calibration the range of dates fell to ranges of 3331-2931 BC (95.4% probability). Considering only the values representing the highest probability, the result falls within the range of 3127-3007 BC (52.6%) and 3331-3215 (31.9%).

Twenty-four absolute dates were previously known from the area occupied by Zesławice-Pleszów and Mogiła groups. Two of them come from the region of Wieliczka-Bochnia and Bochnia (Kraków Bieżanów Site 8, Gdów Site 2; Zastawny 2015). The chronological ranges mentioned above overlap with the chronology of Kraków Mogiła Site 55, which was dated to 4435±35 BP (Feature 175) and 4430±35 BP (Feature 35). After calibration, they fall within the ranges of 3330-2924 BC (95.4% probability) and 3316-2941 BC (68.2% probability; Zastawny 2015, 95, fig. 4). Similar values were calculated for sites in Kraków Pleszów Site 17. Features 1237 and 876A returned dates which fall within the range of 3339-2922 BC (95.4% probability; (Godłowska and Gluza 1989, 251; Zastawny 2015, 98, fig. 6). The values from Kraków Zesławice Site 21, Features 97i and 140A, were 4420±43 BP

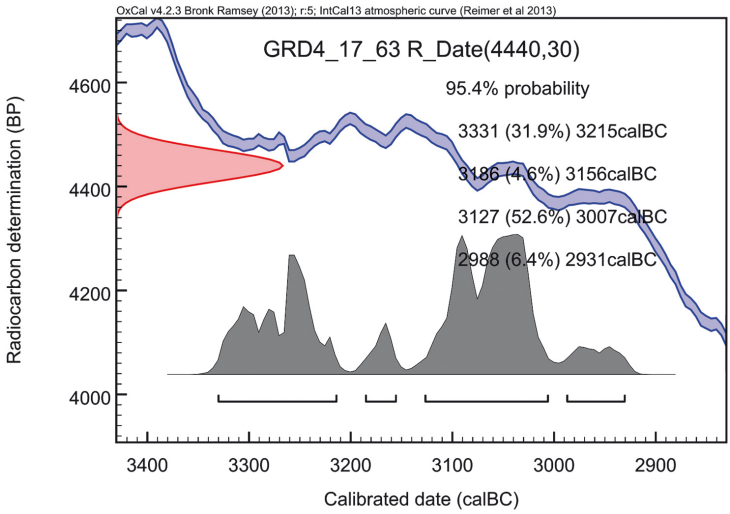


Fig. 12. Radiocarbon date for the charcoal sample from pit 17/63

and after calibration the dates ranged from 3330 to 2890 BC (95.4% probability; Furholt and Machnik 2006, 336).

The chronologies of the settlements at Kraków Mogiła Site 55, Pleszów Site 17, Zesławice Site 21 and Grodkowice Site 4 fell within the common range from 4445-4420 BP. This is the oldest phase of the development of Baden culture settlement activity in Małopolska (Zastawny 2015, 100). We might hypothesize that the settlement at Grodkowice Site 4 participated in the earliest phase of formation of permanent Baden culture settlements in Małopolska, if not for the lack of early classical elements in pottery. Perhaps the old wood effect is to blame. This issue certainly requires further research.

ANALYSIS OF PLANT MACRO-REMAINS

The archaeobotanic analysis focussed on fragments of fired daub with preserved plant imprints. The material, consisting of 162 daub fragments and four charcoal pieces, was examined by Grzegorz Skrzyński of the Museum of the Earth, Polish Academy of Sciences (Table 2). The samples came from the Features 3/59, 5/59, 7/59, 13/59, 12/62 (135 daub fragments and the charcoal) and the cultural layer, as well as the ground surface from Sochacki's excavations (27 daub fragments). The daub was broken into pieces to reveal plant imprints and then the imprinted plants were identified by morphological-comparative method with identification keys for diaspores and generative parts of plants (Kowal and Rudnicka-Sterna 1969; Jacomet 2006).

Table 2. Fragments of daub with preserved plant imprints

Feature	Number of fragments	Taxon	Numbar of imprints
3/59	30	*Triticum* sp.	1
		Cerealia	6
5/59	11	*Triticum dicoccon*	3
		Cerealia	2
7/59	74	*Triticum dicoccon*	6
		Triticum monococcum	1
		Hordeum vulgare	1
		Triticum cf. spelta	1
		Cerealia	12
13/59	19	*Triticum* sp.	1
		Cerealia	4
12/62	1	*Triticum* sp.	1
Cultural layer	24	*Triticum dicoccon*	1
		Triticum sp.	1
		Bromus secalinus	1
		Cerealia	7
Ground surface	3	*Poaceae*	4

The fragments of charcoal were identified on the basis of characteristic anatomical structure of the wood with the Schweingruber identification key (1978). The plant remains were compared with contemporary herbaria. The sampled material limits the possibilities of presentation of reliable data regarding the quantitative distribution of different species and genera. This could only be achieved by flotation of soil samples, which would result in a quantifiable assemblage. The analysis of daub samples delivers information about the qualitative composition of the plant remains (Marciniak *et al*. 2015, 127).

Cereal (Cerealia) remains dominated in the identified material. Wheat was the most represented and three species were identified: emmer (*Triticum dicoccon*), einkorn (*Triticum monococcum*) and spelt (*Triticum spelta*). The spikelets and chaff pieces which bore no distinctive morphological features were identified only to the level of genus (*Triticum*). Apart from the wheat species, remains of barley (*Hordeum vulgare*) were discovered. A carbonized grain of rye brome (*Bromus secalinus*), found in a lump of daub, is a relatively rare discovery due to its state of preservation. It was also the only identified weed. Apart from the plants mentioned above, there were some representatives of grasses (Poaceae). The remains of wood belonged to two taxa: pine (*Pinus sylvestris*) and birch (*Betula* sp.).

The analysis of plant remains showed that the inhabitants of the settlement definitely grew three species of wheat. The first two species are the most commonly found species at Neolithic sites in Poland (Lityńska-Zając and Nalepka 2012, 1032). Archaeobotanic studies indicate that together with barley they were the basic cereal crops. The proportion of the two

wheat species gradually decreased and lost significance while barley occupied a relatively stable position and only in the Roman period did it begin to dominate over other cereal species (Lityńska-Zając and Nalepka 2012, 1032). The proportion of spelt, although its presence was detected at Neolithic and Bronze Age sites, was never high in botanic material. This crop probably played a marginal role (Lityńska-Zając and Nalepka 2012, 1032).

CONCLUSIONS

This paper has presented the results of analyses of pottery material from the Baden culture settlement at Grodkowice Site 4, which belonged to the late classical Mogiła group from the vicinity of Wieliczka-Bochnia region, as well as the Kraków-Częstochowa Upland. The re-analysis of the archaeological remains excavated years ago by Sochacki has shed new light on the relics of settlement activity at Grodkowice Site 4. Despite a significant depletion of the original data, a consequence of a long period of storage of the artefacts and documentation in changing locations and conditions, we found a lot of new information, crucial for the understanding of the functioning of the societies occupying the area. The interdisciplinary analyses conducted in cooperation with researchers representing other fields of science has opened broader perspectives. The new radiocarbon dating suggests that the settlement functioned in roughly the same period as those situated at Kraków Mogiła Site 55, Pleszów Site 17 and Zesławice Site 21. The preferred model of economy is indicated by the remains of several species of cereals, including three species of wheat. The geophysical survey with the magnetometer raises hopes for further excavations at Grodkowice Site 4 since a significant part of the settlement might still be found in the ground.

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