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Iwona Sobkowiak-Tabaka[1], Grzegorz Worobiec[2]

LEAF IMPRESSION OF BURDOCK ON NEOLITHIC POTTERY FROM ZAGAJE SMROKOWSKIE (MIECHÓW UPLAND, POLAND)

ABSTRACT

Sobkowiak-Tabaka I., Worobiec G. 2025. Leaf impression of burdock on Neolithic pottery from Zagaje Smrokowskie (Miechów Upland, Poland). *Sprawozdania Archeologiczne* 77/2, 217-231.

This study examines Neolithic pottery from Zagaje Smrokowskie, Site 10, which features a burdock leaf imprint on one of the vessel bottoms. Burdock has been present in human settlements across vast areas of Eurasia, as evidenced by numerous discoveries of its macroremains. However, this is the first finding of a burdock leaf imprint on Neolithic pottery in Poland. The identification of leaf imprints on pottery enhances our understanding of pottery production techniques and provides valuable insight into the local flora.

Keywords: Neolithic, Lengyel culture, pottery, leaf impression, archaeobotanical analysis
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1 Faculty of Archaeology, Adam Mickiewicz University, ul. Uniwersytetu Poznańskiego 7, 61-614 Poznań, Poland; iwosob@amu.edu.pl; ORCID: 0000-0001-5913-1177
2 W. Szafer Institute of Botany, Polish Academy of Sciences, ul. Lubicz 46, 31-512 Kraków, Poland; g.worobiec@botany.pl; ORCID: 000-0002-2916-9905

1. INTRODUCTION

Plants provide humans with essential resources, including raw materials, fuel, medicines, and food, forming a key component of the human diet. The remains, such as pollen, phytoliths, starch granules, and macroremains (charred, uncharred, and impressions), provide valuable evidence for palaeobotanical reconstructions. These remains help us to understand past environments and non-dietary uses of plants, such as the production of ropes, mats, or pottery temper (*e.g.*, Moskal-del Hoyo *et al.* 2017; Bakels 2020; Cabanes 2020; Henry 2020). In the present paper, we focus on the analysis of leaf imprints found on the bottom of a Lengyel culture vessel recovered during investigations at Site 10 in Zagaje Smrokowskie, Słomniki commune.

2. MATERIALS AND METHODS

2.1. Archaeological context

Site 10 in Zagaje Smrokowskie (50.273164, 20.020678) is located in the Miechowska Upland, north of the town of Słomniki, within the Nida Basin mesoregion (Kondracki 2009; Solon *et al.* 2018). More specifically, it is on a large peninsula formed at the confluence of two seasonal watercourses (Fig. 1).

Fig. 1. Location of Zagaje Smrokowskie, Site 10.
Prepared by I. Sobkowiak-Tabaka

The site was excavated between 2016 and 2019 as part of the construction of the S-7 expressway, specifically the Moczydło-Szczepanowice-Widoma-Zastów-Kraków section. The research, commissioned by the General Directorate for National Roads and Motorways, Kraków Branch, was conducted by a consortium comprising the University of Wrocław, Adam Mickiewicz University in Poznań, and the Archaeologia Silesiae Science Foundation. Inga Fabiszak led the excavations.

The excavations conducted over an area of nearly 2.5 hectares uncovered 399 features associated with multicultural settlement at the site (Minta-Tworzowska 2022). Of these, 224 were attributed to the Lengyel Culture (Pleszów-Modlnica phase), while a smaller number were linked to the Malice, Funnel Beaker, Mierzanowice, and Lusatian Cultures.

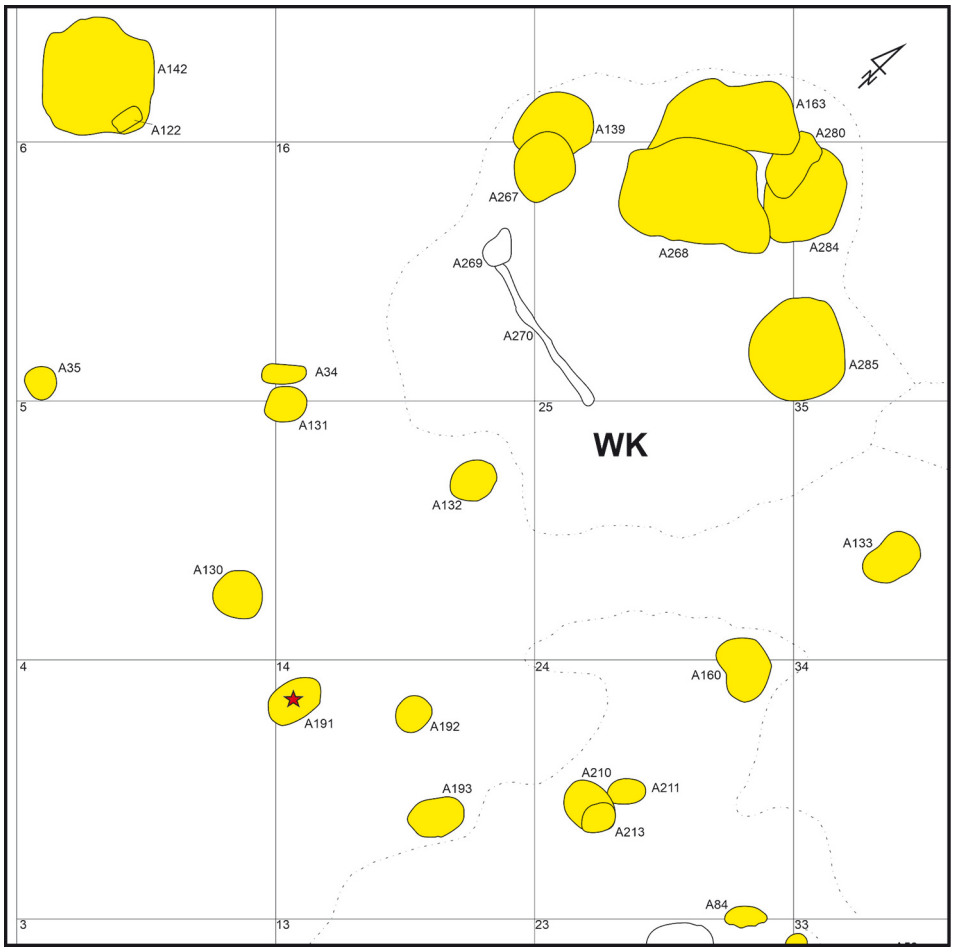

Fig. 2. Zagaje Smrokowskie, Site 10. Location of Feature A191 – red star.
Drawn by P. Wesołowska, graphic design by I. Sobkowiak-Tabaka

In total, nearly 11,500 pottery fragments were recovered, along with dozens of spindle whorls and weaving weights, lumps of daub, a fragment of an anthropomorphic figurine, several bone tools, as well as artefacts made of shell, flint, and stone. Additionally, human and animal remains were also found.

The analysis of feature distribution reveals a notable concentration of pits on the site, likely formed by the reuse of these locations after older structures fell out of use or were destroyed by fire. It is also possible that the creation of new economic pits was influenced by the presence of above-ground buildings, now invisible, which may have limited available space for such features. This could have led to the formation of a distinctive plaza-like

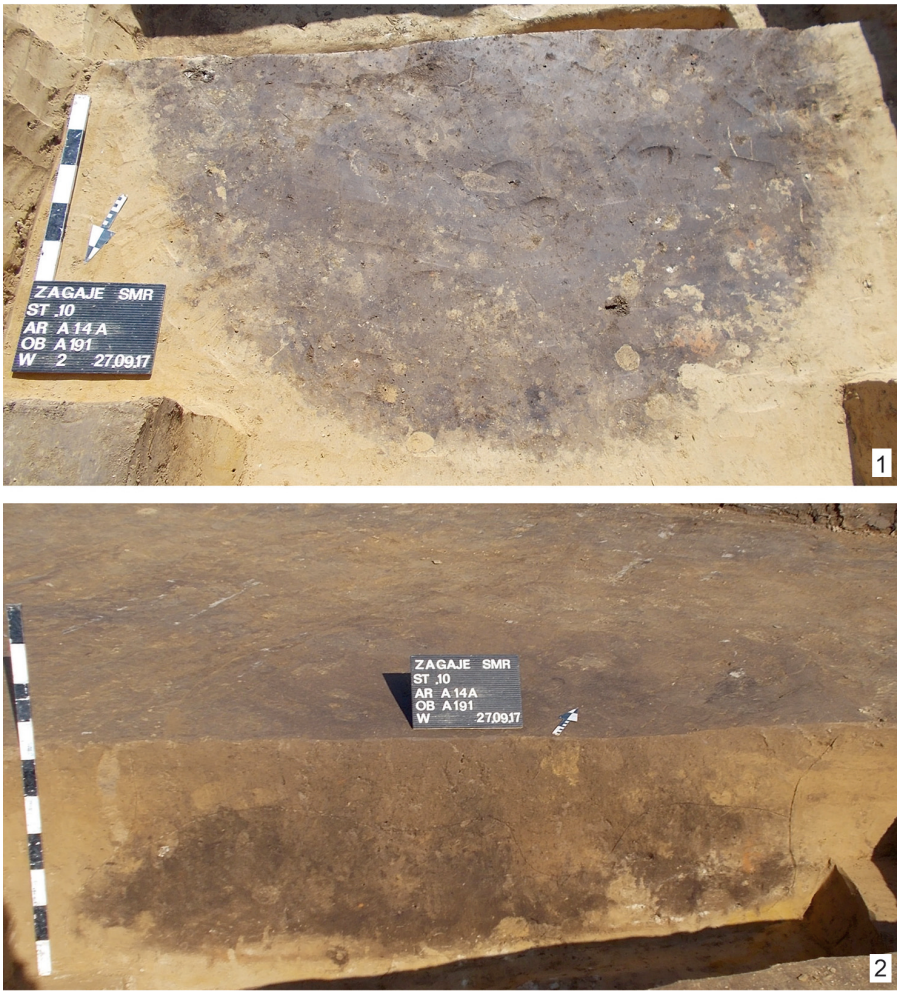

Fig. 3. Zagaje Smrokowskie, Site 10. Feature A191. 1 – plain of the feature, 2 – cross-section. Photo by I. Fabiszak

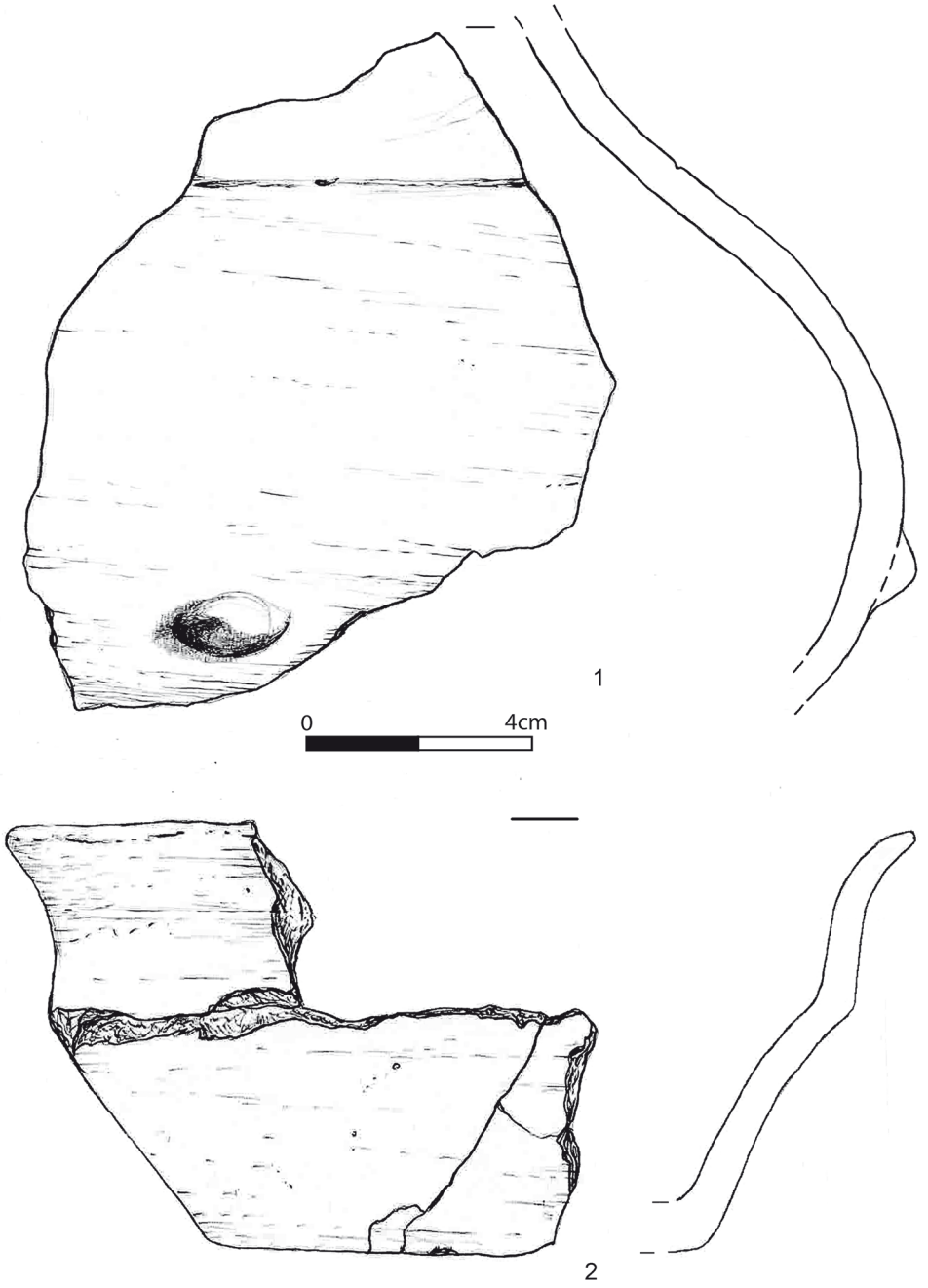

Fig. 4. Zagaje Smrokowskie, Site 10. Vessels from Feature A191.
1 – a fragment of an amphora, 2 – fragments of a bowl. Drawn by B. Piotrowska

area that is still recognisable today. A total of 11 feature clusters were identified, ranging from 5 to 21 features, comprising sunken features, pits, buried graves, post holes, and ditches.

Feature A191, which yielded the pottery fragment with leaf impression, was located in the southwestern part of the site, in the vicinity of the other Lengyel culture features (Fig. 2). It comprised an oval-shaped pit, measuring 220 cm in length, 150 cm in width, and 75 cm in depth (Fig. 3). The vertical cross-section of the pit was trapezoidal. The fill consisted of dense, clay-rich humus with highly decomposed daub.

The feature yielded 60 pottery fragments, including 10 rims, 45 body sherds, three bases and two lugs. The outer surface of the vessels was predominantly smooth and polished. Of the 56 fragments, the majority contained an admixture of grog, while four contained white and sporadically red stone grits. In 57 cases, the break was monochromatic, while in three cases, it was two-colored.

Only the forms of two vessels could be reconstructed: an amphora with a nodule beneath the most considerable swell of the belly (Fig. 4: 1), and a sharply profiled bowl with a mouth diameter of 16 cm and a base diameter of 10 cm (Fig. 4: 2). On one of the bases (approximately 10 cm in diameter, and 1 cm of thickness), the impression of a leaf was identified (Figs 5, 6: 1).

Additionally, eight worked flint pieces were recovered from the pit – one preparation flake, four flakes from single-platform cores, two blades from single-platform cores, and one chunk. All items were made from Jurassic flint (Sobkowiak-Tabaka 2022).

The technological, morphological, and stylistic analyses of the pottery have enabled us to establish the chronology of the Lengyel Culture (Pleszów-Modlnica phase) settlement, dated between 4800 and 4100 BC (Kamieńska and Kozłowski 1990; Kaczanowska 2006; Włodarczak 2017, fig. 1).

2.2. Methods

The macromorphological description of leaf impression is based on the nomenclature proposed by Ellis *et al.* (2009). The material was identified based on available publications and by comparison with fresh plant material collected for the purpose. Macrophotographs were made using a NIKON Coolpix 995 digital camera.

3. RESULTS

Systematics
Family: Asteraceae Dum.
Genus: *Arctium* L.
Arctium sp.
Material: Zagaje Smrokowskie Site 10, A191. One leaf imprint on pottery (Figs 5 and 6: 1).

Description: small fragment of a large leaf, 10.5 cm × 7.0 cm, leaf margin not preserved. Primary venation pinnate, primary vein (midvein) rather thick, 0.2-0.3 cm wide. Secondary veins are relatively thick, up to 0.3 cm wide, and distinctly protrude above the leaf blade. Three pairs of secondary veins are preserved, alternate, and form variable angles of 30-40° with a primary vein. Secondary veins are straight or slightly curved toward

Fig. 5. Zagaje Smrokowskie, Site 10. The base with the leaf imprint.
3D scan made on Keyence CMM Seria VL-700 by M. Gembicki, graphic design by I. Sobkowiak-Tabaka

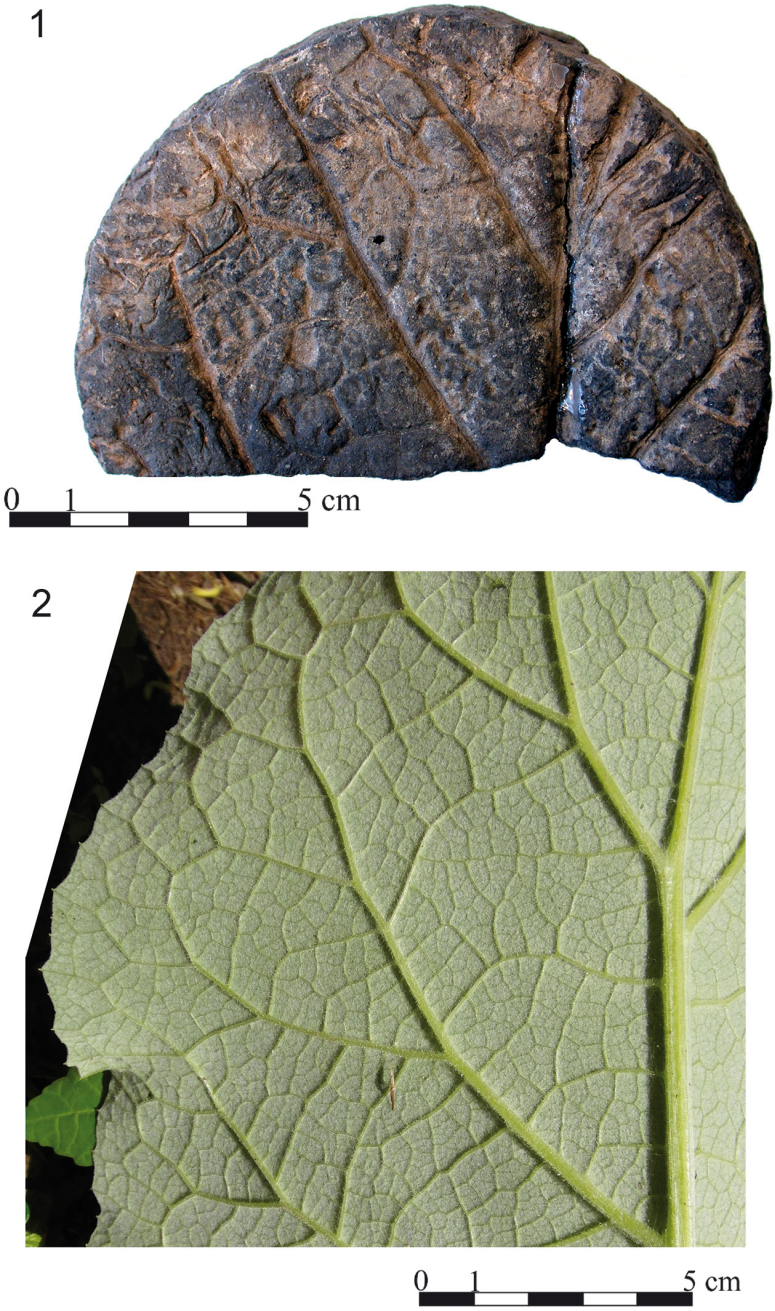

Fig. 6. 1 – Leaf imprint of *Arctium* sp., Zagaje Smrokowskie, Site 10.
2 – Apical part of the modern leaf of *Arctium* sp. Photo by G. Worobiec

the leaf margin. On the left side of the leaf, the lowest secondary vein and the branch of the following secondary vein form the loop. Still, its shape is not precise due to the deformation of the leaf lamina during pottery preparation. Tertiary venation is weakly percurrent; about 1-2 tertiary veins occur per 2 cm of secondary vein length. Quaternary venation is probably reticulate.

4. DISCUSSION AND CONCLUSIONS

The leaf described above, used as an underlay for the preparation of the pottery, must have belonged to a plant with relatively large and tough leaves. It must also have been easy for the prehistoric potter to obtain, which means it would have grown near the potter's workshop. Therefore, the list of native plants that could have made this impression is somewhat limited and restricted to those of the Miechów Upland, where Zagaje Smrokowskie is located. The leaf impression studied is somewhat incomplete (small fragment without leaf margin) and, therefore, a taxonomical determination is based only on the morphology of the veins, arrangement of the secondary veins and their shape, and the size and shape of third-order venation. The discussed impression presumably represents an imprint of a small fragment of the apical part of a rather large leaf. Strongly impressed veins, that is, grooves left in the bottom of the pottery by the veins protruding above the lamina, clearly indicate that the lower (abaxial) side of the leaf was impressed and the veins were rather large. These features along with pinnate venation, the preserved loop between the lowest secondary vein and the branch of the next secondary vein, and the shape and density of weakly percurrent tertiary venation (about 1-2 tertiary veins per 2 cm of secondary veins) point to the leaf of one of the species of the genus *Arctium* L. (burdock) (Fig. 6: 2).

The other plants whose leaves could be compared with the leaf impression from the pottery (namely those that have relatively large leaves and are common in the area of the Miechów Upland) are *Tussilago farfara* L., species of *Petasites* Mill., species of *Rumex* L., *Armoracia rusticana* G. Gaertn. *et al.*, as well as *Acer pseudoplatanus* L., *Acer platanoides* L., and species of *Verbascum* L. The leaf of *Arctium* could, however, be distinguished from these plants in several respects. Leaves of *Tussilago farfara* (coltsfoot) and species of *Petasites* (butterburs) differ from the impression on pottery described above in palmate venation and visible different venation networks. The same concerns the leaves of the maples *Acer pseudoplatanus* and *Acer platanoides*. Moreover, these leaves differ considerably in their distinctly lobate shape. Species of *Rumex* (docks), ruderal plants common near human settlements, have visibly thinner secondary veins compared to those from Zagaje Smrokowskie. *Armoracia rusticana* (horseradish) leaves have rather thick midveins and moderately thick secondary veins. This feature, along with the festooned semicraspedodromous secondary venation (forming multiple loops) of horseradish leaves, clearly differs from the discussed pottery impression from *Armoracia rusticana*. Finally,

the leaves of the *Verbascum* (mulleins) species are usually distinctly narrower compared to the presumed width of the leaf, which is impressed on pottery. Moreover, the leaves of mulleins are usually distinctly tomentose. Summarising the above discussion, we can conclude that the leaf impression from the pottery from Zagaje Smrokowskie represents a fragment of the apical part of the burdock leaf.

Another issue is to determine to which species of *Arctium* the impression in question belongs. Species of the genus *Arctium* (Asteraceae family) have leaves that are usually rather large and coarse, with a cordate base, and can reach several tens of centimetres in length. Budrocks are widely known for their mechanism of seed dispersal, which involves seeds easily catching on to animal fur and human clothing (epizoochory). Representatives of the *Arctium* genus are native to Europe and northeast Asia, including northern India (Lim 2015). There are four species of native burdocks in Poland: *Arctium lappa* L., *A. minus* (Hill) Bernh., *A. nemorosum* Lej., and *A. tomentosum* Mill. (Mirek *et al.* 2020). Among them, the most common species are *A. lappa* (great burdock), *A. minus* (lesser burdock), and *A. tomentosum* (woolly burdock) (Repplinger *et al.* 2007). They are apophytes (native plants that occur in man-made habitats), usually found in nitrophilous ruderal communities (*Arction lappae* alliance) in typical rural settings, such as abandoned fields, roadsides, pastures, verges, and woodland edges on fresh or slightly dry soils (Hadač 1978; Sudnik-Wójcikowska and Koźniewska 1988; Matuszkiewicz 2002; Mueller-Bieniek and Woch 2012; Tokarska-Guzik *et al.* 2012; Leuschner and Ellenberg 2017). *Arctium minus* can thrive in warm and dry habitats, whereas *A. lappa* and *A. tomentosum* are mainly found in wetter places (Leuschner and Ellenberg 2017). On the contrary, *A. nemorosum* is found infrequently in forest communities (Zając and Zając 2001). The leaf imprint from Zagaje Smrokowskie could be compared with leaves of *Arctium lappa*, *A. minus*, and *A. tomentosum*. However, it is rather fragmentary, and, therefore, it is not possible to determine to which of the three most common species of burdock it belongs (*A. nemorosum* as an uncommon species can be excluded). Nonetheless, among the discussed common burdocks, the leaf *Arctium lappa* seems most probable as the source plant of the imprint from Zagaje Smrokowskie, considering the size and leaf architecture of the leaves of *Arctium lappa*, *A. minus*, and *A. tomentosum*.

There is no doubt that in the Neolithic, burdock, as it is known today, was also a common plant near human settlements in the Miechów Upland. This conclusion can be supported by two other finds of remains of leaves considered burdocks at archaeological sites in Poland. Among numerous impressions of leaves and branches of willows, Giżbert (1960) reported a single leaf impression of *Arctium lappa* on fragments of fired clay from the hearths of pottery kilns collected from the Roman Iron Age site at Igołomia near Kraków. Unfortunately, this impression was not documented with a photo, and therefore, it is not possible to verify its taxonomic assignment. Another record of burdock leaves from archaeological sites concerns a Bronze Age hoard from Cierpice, Poland (Gackowski *et al.* 2023). Among the sieved plant macroremains from the burial context were found leaf fibres considered to be remains of great burdock (*A. lappa*). However, in the case of this

relatively small (less than 10 mm) fragment of a leaf (Gackowski *et al.* 2023, fig. 10: c), it is difficult to say what species of burdock it represents and even to confirm with certainty whether it is indeed a burdock remnant. Nevertheless, the aforementioned reports of the presence of *Arctium* leaf remains in archaeological sites suggest that burdock was most probably a common plant near human settlements.

Common burdock, as an apophyte, has long accompanied people. The roots and leaves of young burdock, as well as the seeds, were eaten as a vegetable (van Zeist and Palfenier-Vegter 1981; Kuhnlein and Turner 1991; Łuczaj 2011; Mueller-Bieniek and Woch 2012; Raemaekers *et al.* 2013; Colledge and Conolly 2014; Lim 2015), and the plant is also used in traditional medicine (Chan *et al.* 2011; Mueller-Bieniek and Woch 2012; Lim 2015; Tobyn *et al.* 2016). Therefore, the finding of a burdock leaf imprint on Neolithic pottery from Zagaje Smrokowskie, along with other reports on leaves of *Arctium* from Poland (Giżbert 1960; Gackowski *et al.* 2023), confirms that *Arctium* was at least occasionally used in the human economy as early as the Neolithic.

The use of burdock fibres has been documented since the late 19th century. The fibres found in the plant's stalks are coarse, stiff, and strong, making them suitable for crafting durable ropes that are ideal for hauling and lashing. To separate the fibres, the stalks can be beaten with a stick on a stone or split and scraped with a dull knife, particularly when the stalks are still green and fresh (Dodge 1897).

The use of burdock leaves to make pottery may be for several reasons: they are relatively tough, and they are large enough to provide a basis for the preparation of pottery vessels. This *Arctium* impression suggests that pottery was prepared during a warm period of the year (presumably May-October). It is not entirely clear whether the pottery was fired with the leaf still adhering to the vessel base or after the leaf was separated; no apparent signs of a charred leaf blade were found on the leaf impression.

However, considering some archaeological and ethnographic observations and experiments, the first hypothesis appears more reliable, as impressions could only have formed. At the same time, the clay body of the vessel was still soft. It is relatively straightforward that these traces are associated with the vessel's shaping and/or drying process. Materials such as mats or large leaves would help prevent the wet clay from sticking to the flat surface and also facilitate the rotation of the vessel during the shaping of its walls. The pressure applied by the potter during the forming process, combined with the weight of the clay, would have left a distinct underlay impression (*e.g.*, Chinaya 2017; Moskal-del Hoyo and Lityńska-Zając 2018; Cioubanu and Tenciaru 2022).

Conclusions resulting from the study of a burdock leaf impression on Neolithic pottery from Zagaje Smrokowskie along with data obtained from other investigations of leaves (Giżbert 1960; Vilaça *et al.* 2004; Baiamonte 2015; Frumin and Tchekhanovets 2016; Arobba *et al.* 2017; Rennwanz 2018) and seeds (Costantini 1984; Amblard and Pernčs 1989; Endo and Leipe 2022; Endo *et al.* 2023) or impressions preserved on pottery worldwide confirm the opinion of Frumin and Tchekhanovets (2016) that analysis of plant imprints on pot-

tery can provide valuable data for the reconstruction of ancient settlement life and its environmental conditions.

It is also worth noting that macroremains of burdock are very rare in Polish Neolithic materials, and the imprint of a leaf from this species is the first well-documented find in Polish Neolithic contexts.

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