PLISSN 0081-3834

SPRAWOZDANIA ARCHEOLOGICZNE

INSTYTUT ARCHEOLOGII I ETNOLOGII POLSKIEJ AKADEMII NAUK

KRAKÓW 2020

SPRAWOZDANIA ARCHEOLOGICZNE

INSTYTUT ARCHEOLOGII I ETNOLOGII
POLSKIEJ AKADEMII NAUK

SPRAWOZDANIA ARCHEOLOGICZNE

KRAKÓW 2020

Editor's Address
CENTRE FOR MOUNTAINS AND UPLANDS ARCHAEOLOGY, INSTITUTE OF ARCHAEOLOGY AND ETHNOLOGY, POLISH ACADEMY OF SCIENCES, 31-016 KRAKÓW, UL. SŁAWKOWSKA 17

Ministry of Science and Higher Education
Republic of Poland

Volume financed by the Ministry of Science and Higher Education from the founds for science popularization activities, Contract Nr 651/P-DUN/2019

PL ISSN 0081-3834
DOI: 10.23858/SA/72.2020.2

Printed by
PARTNER POLIGRAFIA Andrzej Kardasz, Grabówka, ul. Szosa Baranowicka 77, 15-523 Białystok

Edition: 300 pcs.

Sprawozdania Archeologiczne is regulary listed in the: SCOPUS, CEJSH, ERIH Plus

CONTENTS

Sprawozdania Archeologiczne is regulary listed in the International Current Awareness Service: Anthropology. Selected material is indexed in the International Bibliography of social and Cultural Anthropology.
Indexed in:
IBZ – International Bibliography of Periodical Literature
IBZ – CD-ROM

Dedicated to Professor Jan Machnik for His 90th Birthday

SPRAWOZDANIA ARCHEOLOGICZNE 72/2, 2020
PL ISSN 0081-3834
DOI: 10.23858/SA/72.2020.2.1728

FIELD SURVEY AND MATERIALS

Marcin Wąs[1], Lucyna Domańska[2], Seweryn Rzepecki[3]

MIDDLE PALAEOLITHIC FLINT ARTEFACTS FROM CENTRAL POLAND. CASE STUDY OF THE SITE OF POLESIE 1, ŁOWICZ DISTRICT, ŁÓDŹ VOIVODSHIP

ABSTRACT

Wąs M., Domańska L., Rzepecki S. 2020. Middle Palaeolithic flint artefacts from Central Poland. Case study of the site of Polesie 1, Łowicz district, Łódź voivodship. *Sprawozdania Archeologiczne* 72/2, 169-199.

This paper deals with the presentation of flint artefacts of Middle Palaeolithic provenience discovered during the excavations at the site of Polesie 1 in the central part of Central Poland. An in-depth analysis of its morphology, taphonomy and readable technological features helped uncover some elements of the products of the Micoquian tradition. This article discusses these extraordinary findings in the context of their importance as the northernmost such finds on the map of Middle Palaeolithic sites in Poland. Selected elements of research on paleoenvironmental conditions of the studied area are also presented as key points in the discussion on the possibilities of researching the Neanderthal settlement ecumene within the Polish Lowland.

Keywords: Middle Palaeolithic, lithic analysis, Neanderthal settlement, Micoquian, Pleistocene in Central Poland

Received: 09.04.2020; Revised: 07.05.2020; Accepted: 02.08.2020

1 Institute of Archaeology and Ethnology, University of Gdańsk, Bielańska 5, 80-851 Gdańsk, Poland; marcin.was@ug.edu.pl; https://orcid.org/0000-0001-9140-2694
2 Institute of Archaeology, University of Lodz, G. Narutowicza 65, 90-131 Łódź, Poland; lucyna.domanska@uni.lodz.pl; https://orcid.org/0000-0002-9978-8306
3 University of Lodz Branch in Tomaszów Mazowiecki, Konstytucji 3 Maja 65/67, 97-200 Tomaszów Mazowiecki, Poland; seweryn.rzepecki@uni.lodz.pl; https://orcid.org/0000-0002-8101-0686

INTRODUCTION

Rescue excavations carried out at the site of Polesie 1 (Łódź voivodship, Łowicz district, Łyszkowice commune) yielded numerous and diverse relics of prehistoric settlements, prominent among which was a settlement and a sepulchral complex of the Trzciniec culture (Górski *et al.* 2011; Domańska *et al.* 2012; 2013). Among the collected artefacts representing various categories, an assemblage of flint artefacts composed of 449 specimens was distinguished by its abundance. On this basis, Early Bronze Age assemblages as well as older ones (*i.e.*, Neolithic, Mesolithic and Late Palaeolithic) were delimited (Domańska and Wąs 2011).

In the process of fieldwork, a large number of erratic flints (about 200 pieces) were recorded in addition to some flint products from hunter-gatherer and early-agrarian societies. In the phase of desk research, the preliminary classification of the entire flint collection revealed several specimens with distinct industrial surfaces. However, considering their state of preservation, they varied from the predominating flint artefacts dated to periods from the late Palaeolithic, Mesolithic and Neolithic to the Early Bronze Age. A brief analysis of the technological features and general morphology of the several, aforementioned artefacts helped uncover some elements among them which are characteristic of flint products of Middle Palaeolithic provenance. The present study aims primarily to provide the reader with the knowledge of these particular artefacts. They are not only quite an intriguing collection – they also give rise to considerations about the presence of settlement traces linked with an occurrence of Neanderthals in Central Poland.

It should also be also pointed out that the presence of materials of Middle Palaeolithic provenance at Polesie 1 was earlier only signalled by the authors (Wąs 2009; Domańska *et al.* 2012; 2013). Recently, this site was also mentioned in some wider studies dealing with the Middle Palaeolithic in Poland (*e.g.* Sudoł 2013; Wiśniewski *et al.* 2019).

THE SITE

Research

The site of Polesie 1 was discovered during surface surveys and test excavations conducted by the Professor Konrad Jażdżewski Foundation for Archaeological Research in Łódź (Domańska *et al.* 2012). The excavations, which preceded the construction of the A2 motorway, were of rescue character and were carried out by a team representing the University of Łódź Foundation led by Lucyna Domańska and Seweryn Rzepecki. During four excavation seasons carried out in the years 2005-2008, an area of 17 ha was explored, and the relics of settlement – constituting almost a complete cross-section from the pre-modern periods up to the modern times – were recorded.

The method used to obtain the historical materials was extremely important for the issue of the presence of traces from the Middle Palaeolithic. The exploration of the site was fully subordinated to the methodology of excavations on the large-area archaeological sites located in the zone of their overlap on the linear construction project (in this case: the construction of the motorway). The humus layer, with a thickness of up to 30 cm, was removed using mechanical equipment, and its base was cleaned thoroughly with shovels. The further earthworks predominantly included the recording of cultural features and their thorough exploration. The sources were recorded in quarters of ares within the arbitrary layers.

It should be emphasized that at the beginning of the excavation, a significant part of the site was heavily damaged. The historical materials were located throughout a large area in sub-surface levels.

The state of preservation of the features, their distribution and the large fragmentation index of the material recorded in the near-surface layers of the site confirmed a significant degree of destruction of the site. This was caused not only by cultural factors occurring in prehistory (*i.e.* intensive settlement in different periods, economic activity and accompanying deforestation), but also by natural ones (*i.e.* aeolian processes and water erosion), as well as by some modern factors such as agrotechnical operations and illegal storage of garbage, for example. Agricultural works – notably deep ploughing, were invasive and destructive to the historical material (Twardy 2008). Those factors significantly disturbed the original context and the cultural layers, and transformed the subsurface stratigraphic profiles containing relics of settlement from distant periods of Prehistory. Consequently, the relationship between the distinguished features and the materials within arbitrary levels was the source of many baffling issues.

Location of the site

The site of Polesie 1 (AZP 61-57/42) is located in the Łowicz-Błonie Plain, constituting the south-western part of the Central Masovian Lowland (Fig. 1; Solon *et al.* 2018). This mezoregion lies to the south and south-west of the Warsaw Basin, southeast of the Kutno Plain and east of the Koło Basin and the Łask Heights. From the south, it borders the Łódź Hills and the Rawa Heights, and from the east it meets the Warsaw Plain (Kondracki 1994, 132; Solon *et al.* 2018). In terms of topography, this region is a flat denudation plain with differences in elevation ranging from 84 to 110 m.a.s.l.

The excavated area of the site extends over the northern edge of the plateau. It stretches between two watercourses with a meridional course – the Zwierzynka in the east and the Ruczaj in the west (Fig. 3). Running from south to north, their waters feed the River Bzura, whose valley is located about 9 km from the site. To the north of the site, there is an extensive flood plain, separated from the aforementioned fluvioglacial plain by a long smooth, gentle slope, which occupies a larger part of the study area (Fig. 4). The land of the site

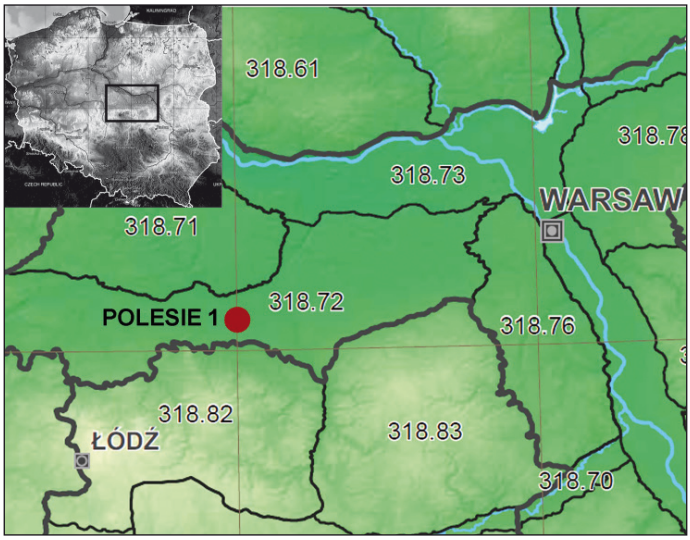

Fig. 1. Location of Polesie 1 in the context of physical-geographical regionalization (acc. Solon *et al.* 2018). Key: 318.61 – Płońsk Heights, 318.70 – Lower Pilica River Valley, 318.71 – Kutno Plain, 318.72 – Łowicz-Błonie Plain, 318.73 – Warsaw Basin, 318.76 – Warsaw Plain, 318.78 – Wołomin Plain, 318.82 – Łódź Hills, 318.83 – Rawa Heights (after: Solon *et al.* 2018 – altered)

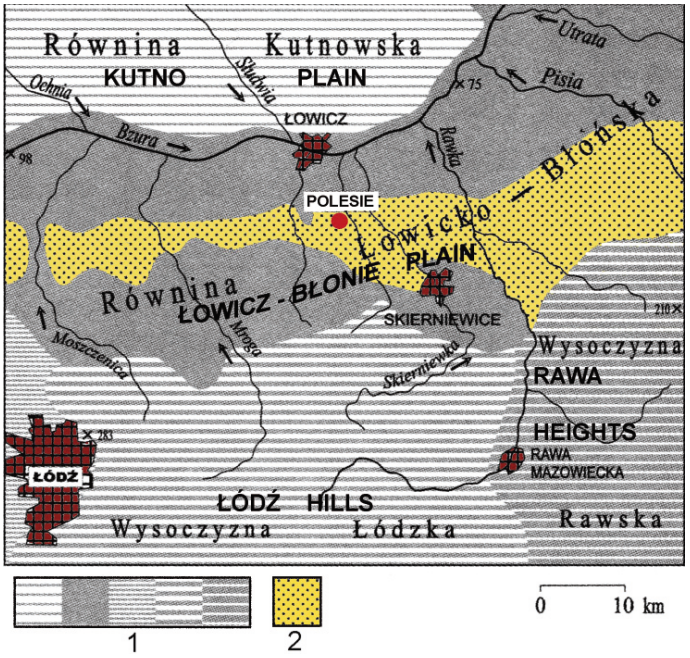

Fig. 2. Location of Polesie 1. Key: 1 – boundaries of physical-geographical units; 2 – area of the "*huge alluvial fans*" (after: Twardy and Forysiak 2011, 228 – altered)

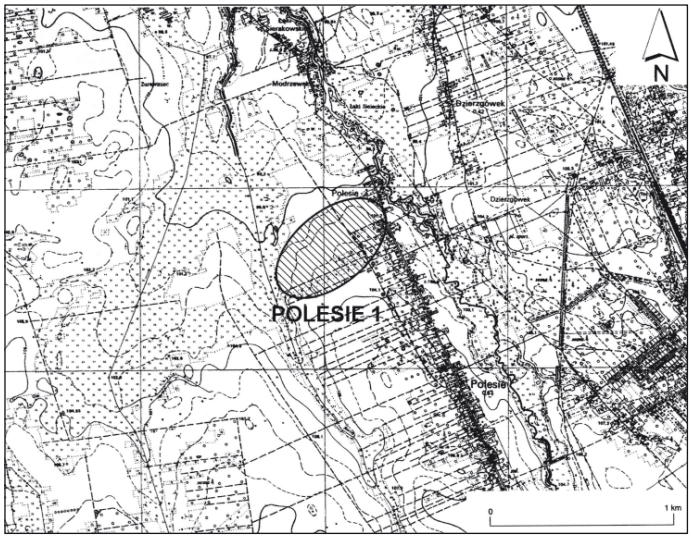

Fig. 3. The site of Polesie 1 on a topographic map (after: Górski *et al.* 2011, 15 – altered)

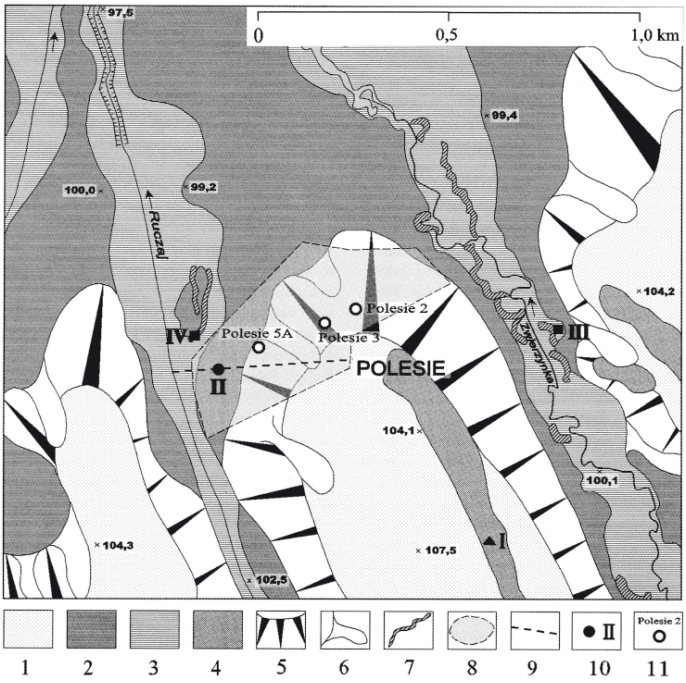

Fig. 4. Geomorphological sketch of the area of Polesie 1: Key: 1 – fluvioglacial plain; 2 – flood terrace; 3 – bottom of the valley; 4 – aeolian layers; 5 – more important slopes; 6 – denudation hollows; 7 – traces of paleovalleys; 8 – archaeological site; 9 – geological cross-section line; 10 – lithological profile with slope sediments; 11 – lithological profiles with source sediments (after: Twardy and Forysiak 2011, 230 – altered)

slopes to the north and also, in its peripheral parts, to the east and then to the west – towards the river valleys that constitute its boundary. The land slopes do not exceed 1-2°; they increase to several degrees only in the valley zones. The differences in the elevation of the terrain within the area of the site range at about 3-4 m (from 99 m. a.s.l. in the Ruczaj floodplain to 104 m. a.s.l. in the central part of the site), which, considering the spatial extent of the site, gives grounds for assessing it as relatively flat, with low differentiation of relief.

Land relief and geological structure

The area of Polesie 1 was shaped during the Riss and the Vistulian glaciations by the waters of the melting ice sheet (Twardy and Forysiak 2011). The water network of the site area is formed by the River Bzura along with the right-bank southern tributaries flowing from the Southern Masovian Hills, among which the most important are: the Skierniewka, the Moszczenica, the Mroga, the Pisia, the Rawka and the Utrata. They form a network of parallel, small river valleys, oriented SSE-NNW, which cut the extensive sand-gravel, fluvioglacial plain, extending eastwards and westwards, into a series of smaller and quite similar patches (Twardy 2008, 48). The extent of the plain on the S-N axis is accompanied by an increase in altitudes from c. 100 m. a.s.l. in the north, up to about 110 m. a.s.l. in the south. This is also where the fluvioglacial sands of the Warta glaciation meet the northern slopes of the Łódź Hills. They constitute a several-kilometre-wide zone of the late Warta fluvioglacial accumulation in the form of "huge alluvial fans" filling a broad part of the Warsaw-Berlin Urstromtal near Skierniewice. The site of Polesie 1 is located in the central part of this zone range (Twardy 2008, 48, and further literature within). The cutting of the aforementioned fans by rivers flowing from the south had already taken place at the end of the Warta glaciation. Here, a lack of Eemian Interglacial deposits in the valleys should be emphasized, and this might confirm the age of their cutting. The fans are mainly composed of sand and gravel fractions which have a thickness of several meters. The sediments form a latitudinally extended zone between the northern slopes of the Rawa, Skierniewice and Siedlce Uplands, and the axis of the Warsaw-Berlin Urstromtal. Although their genesis and age still remain a subject of debate, two main groups of views on their origin can be distinguished. One of them underlines the fluvial genesis associated with an accumulative activity in the lower sections of the rivers draining the aforementioned uplands northward. From a chronological point of view, this process took place both in the Eemian and the Vistulian cycles, or only in the Vistulian. Another suggestion accentuates the glacial origin of sediments building the fans. Its supporters treat this zone as the fluvioglacial level formed between the northern slopes of the Łódź Heights, the Rawa and Skierniewice Uplands, and the Warta glacier. The proponents of this genesis accept the chronologically older, late Wartanian origin of the fringes of the sand series (Twardy 2008, 38-39 – and further literature within). Therefore, the sand series that is part of the "huge alluvial fans"

has a polygenic character, because it could be formed by the waters released from melting blocks of dead-ice deposited in the Urstromtal, as well as by the waters from small, extra-glacial rivers flowing north from the southern uplands (*e.g.*, the Łódź Heights). At the end of the Vistulian, the primary alluvial fan series was covered by blow sands. The lithological studies carried out in the zone of huge alluvial fans, supported by OSL dating, prove the aeolian provenance of the series of cover sands, whose accumulation took place alternatively with the slope processes in the variable climatic conditions of the Vistulian. This process can be divided into four aeolian phases dated from the Grudziądz interstadial to the late Vistulian.

In addition to the aforementioned interpretative concepts for the genesis of the area on which Polesie 1 is located, a view linking the genesis of a series of sediments with a shorter slope transport was also put forward. Additionally, a suggestion was made that the sandy plain of the site should be considered part of the Radzymin-Błonie level distinguished within the Warsaw Basin. Unfortunately, its western range does not include the region of Polesie 1 and, moreover, it is formed of clay sediments, which means different sediments from the ones present at the site of our interest (Twardy and Forysiak 2011, 228 – and further literature within; Balwierz *et al.* 2009).

The fluvioglacial plain, with a thickness of several meters, is built from poorly diversified sands, slightly muddy sands and, sporadically, gravels (Fig. 5), deposited in the form of repetitive, horizontal layers. The material is purely mineral, non-carbonate and, in some parts, quite strongly enriched with oxidized iron compounds. At a depth of 0.5 to 1.5 m, there is a record of the periglacial environment (in the form of layers with involutions and small fissure structures), most probably of late Wartanian and Vistulian origin (Twardy and Forysiak 2011). The top, a several-dozen-centimetre-thick layer of fluvioglacial sands, has a blurred structure and, in some parts, a slightly larger admixture of silt. Also, a slightly higher level of aeolisation of quartz grains is observed here. It is worth noting that the presence of ferruginous compounds, as well as the degree of aeolian quartz rounding, are the features observed on the surfaces of the flint artefacts that are the subject of this publication.

The area of the site extending over the valleys of the rivers Zwierzynka and Ruczaj is part of the wide zone of "plains of the alluvial fans," probably of a fluvial origin and from the Vistulian age (Fig. 5). The formation of overflow terraces, which form part of the site in the vicinity of the Zwierzynka and the Ruczaj valleys, presumably took place in the Plenivistulian and the late Vistulian. They gained their morphological shape as a result of intense erosion at the turn of the Plenivistulian and late Vistulian (high meadow terrace) and the late Vistulian and the Holocene (low meadow terrace). The formation of this terrace was still ongoing in the Upper Plenivistulian (after a short warming during the Konin-Maliniec II interstadial), as indicated by the radiocarbon determinations for the Polesie II lithological profile (LOD 1380: 21,990±350 years BP), obtained from a thin, radiocarbon-dated peat insert. Analyses of the geological cross-sections recorded in the western and eastern parts

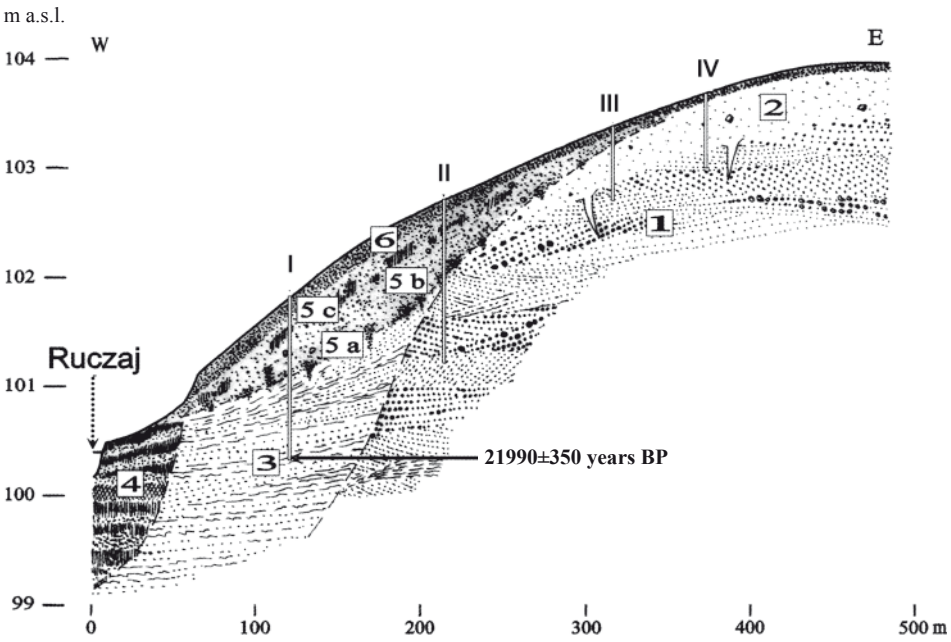

Fig. 5. Geological cross-section through the right part of the Ruczaj River bank and the adjecent fluvioglacial plain at the Polesie 1 site. Warta glaciation: 1 – layered sands and glacial gravels with pseudomorphoses after the ice wedges in the ceiling; 2 – unstructured silty sands; Vistulian: 3 – sands and layered muds with detritic intrusions; river; Holocene: 4 – organic muds and layered sands; with peat spacers; fluvial (riverine); Neoholocene: 5a – accumulation level of fossil soil with roots; faded; 5b – humic sands; unstructured; sloped; 5c – level of hardpan in sediments as above; interrupted by roots and plowing; 6 – contemporary soil with archaeological materials; I – IV – lithological profiles (after: Twardy and Forysiak 2011, 234 – altered)

of the site prove that the Wartanian fluvioglacial plain is built of sands and gravels covered with a surface layer of Neoholocene formations. The latter are particularly well-detectable in the slope parts where, in the Ruczaj valley, they lie not only in the Wartanian fluvioglacial deposits but also in the Vistulian alluvial deposits (Fig. 5).

In the near-surface part, the terrace is built of sand material with silty intersections, forming thin laminae. A quartzite-grain abrasion analysis indicates a clear increase in the aeolisation of the material by about 50-55%. Along with the other parameters, this indicates conversion of the fluvioglacial material in the fluvial and aeolian environment, with an indication of aeolisation of quartz grains typical of the Upper Plenivistulian formations. These alterations can also be treated as a reference point and a genetic background for the taphonomy and tribological changes visible on the flint artefacts dated to the Middle Palaeolithic.

It should be noted that the land relief, formed essentially in the Vistulian, did not undergo any significant changes in its later periods. The changes that occurred in the Holocene, as a result of the impact of a number of climatic and environmental factors, as

well as by anthropogenic mechanisms confirmed by the intensive settlement of this area in prehistory, were only a "retouch" of the original relief formed in the earlier, cold cycles: the Wartanian – glacial and the Vistulian – periglacial (Twardy and Forysiak 2011, 235). In addition, the area of the Łowicz-Błonie Plain, where Polesie 1 is located, is classified as a morphogenetic area with a balance of degradation and aggradation, and a very low intensity of geomorphological processes (slope, fluvial and aeolian types). The flat lay of the land present in the territory of the site significantly limited the development of the slope processes to a low scale. The proximity of the small rivers Ruczaj and Zwierzynka, which drained the poorly outlined river valleys, reduced the intensity of the geomorphological processes connected with erosion, transport and fluvial accumulation. The intensity of the aeolian processes generated by westerly wind was, on the other hand, inhibited by the valley zones, meridionally cutting the fluvioglacial plain. As a result of the existing conditions and the limiting factors, the thickness and distribution of the sediments accumulated thanks to the slope, aeolian and fluvial processes are insignificant in the area of Polesie 1.

Overview of the occupational history of site

The site of Polesie 1, viewed through the prism of archaeology, has a multicultural character. The excavations revealed traces of the presence of Stone Age societies, cultures of the Bronze Age and the Early Iron Age, as well as features and artifacts from the modern period. The oldest recorded sequence of relics from the site are small flint inventories linked with the hunter-gatherer societies representing the Late Palaeolithic Swiderian culture, and also to the younger (by at least 2000 years), Late Mesolithic Janislavice culture. The remains of the culture of the Eneolithic, agrarian communities are far better represented. Among them, the most archaeologically discernible materials are pottery and flint materials of the Funnel Beaker culture as well as some younger and less numerous artefacts associated with the late phase of the Corded Ware culture (Domańska *et al.* 2012). Among all the historical materials and the identified artefacts obtained through the excavations, the remains of settlements from the Early Bronze Age associated with the Trzciniec culture have the most numerous representation (Górski *et al.* 2011). Over the duration of the occupation of the site by the "Trzciniec" communities, for more than 700 years, there were at least five settlements and two cemeteries built within its area (in addition, two single tombs were identified there). Around the sepulchral zones, residential and economic zones evolved over the centuries: from a dispersed settlement pattern towards a larger settlement centre. Certainly, the intensity of the settlement here, in the aforementioned period, most notably affected the state of preservation of some older settlement relics, which is particularly significant in the context of the issues undertaken by the authors. A multitude of the features, such as economic pits, sepulchral structures and the remains of pole frame houses, contributed to the destruction of the earlier stratigraphic arrangement and the anthropogenic arrangement. Relics of the settlement of the Lusatian culture

is a far more poorly represented category in the prehistoric material from Polesie 1. On the other hand, two settlement phases are clearly recognizable here: the early ("Trzciniec-Lusatian") and the full development phases. The data concerning spatial exploitation by communities representing the Pomeranian culture, living there in the Early Iron Age, and the later Przeworsk culture seem even less discernible. In the modern period, the site of Polesie 1 arguably served as an agricultural hinterland for the potential settlement growing nearby.

The outline (supra) of the settlement changes at Polesie 1 makes us aware of the scale of the transformations that it has undergone over the millennia. Those alterations significantly disturbed the old systems and relics of the presence of human communities (destruction of the earlier anthropogenic layers, the artefacts and the original arrangements of the artefacts), and they also led to the successive remodelling of the primeval topography of the site. In the quite monotonous, flat landscape of the site, the processes initiated by human activity launched a series of changes to the original relief and the layers that built it (Twardy and Forysiak 2001, 227). Geological and geomorphological traces of activities of various geodynamic processes were recorded in the slope, fluvial, aeolian and biogenic formations within the territory of the site and its immediate vicinity (Twardy and Forysiak 2011; Balwierz 2011).

Certainly, such factors figure prominently, while traversing the character of the post-depositional processes and the taphonomy – in a broad sense, that have left their mark on the condition (quantity and quality) of a small collection of flint artefacts dated to the Middle Palaeolithic.

MATERIALS

Spatial distribution of the Middle Palaeolithic artefacts

An attempt to analyse the dispersion of flint products at Polesie 1 presents a true challenge due to a serious disturbance of the original stratigraphic sequences in the subsequent phases of occupation of the study area. Although the artefacts of Middle Palaeolithic provenance constitute a rather stray-find collection, devoid of archaeological context or even more specific stratigraphic context, on the scale of the whole explored area – they tend to accumulate in one part of the site (Figs 6 and 7). The artefacts representing this period (*i.e.* 1 core and 5 tools) make a vast, stray-find collection that extends over a distance of about 100 metres from NW-SE. Flakes show a far greater dispersion – they can be cautiously treated as Middle Palaeolithic in chronology. Their horizontal distribution is significantly broader than in the case of the aforementioned tools and the core, although 4 of them are located in the same zone of the site, in close proximity to the tools and the core. Two other specimens were located in the central part of the study area, as a result of which the separation between the most distant flakes is about 300 meters.

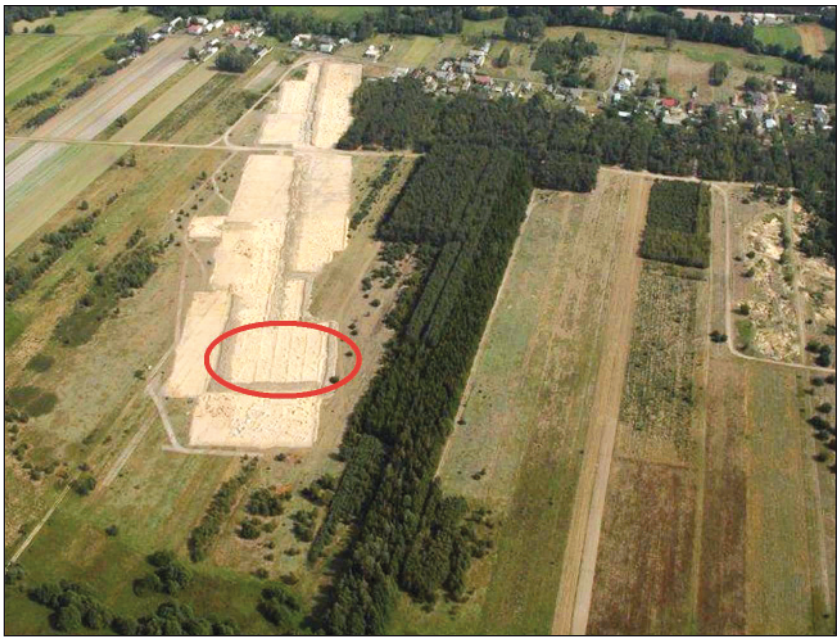

Fig. 6. View of Polesie 1 from the west, with marked zone of occurrence of Middle Palaeolithic artefacts

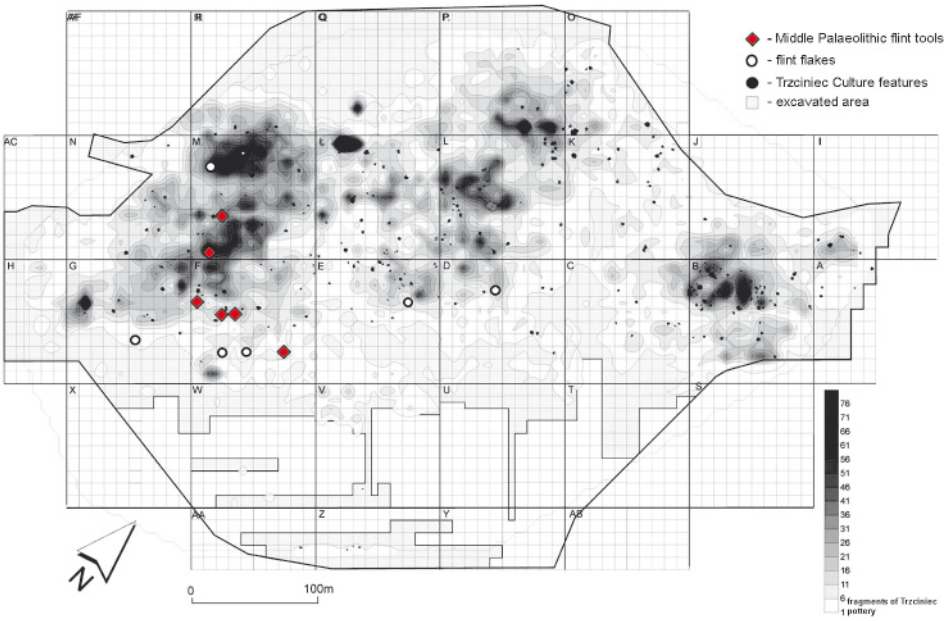

Fig. 7. Planigraphy of Middle Palaeolithic flint artefacts at Polesie 1 against the background of relics of the Trzciniec culture settlement from the Early Bronze Age (acc. Domańska *et al.* 2013 – altered)

Analysing the horizontal distribution pattern of the artefacts from the study period in the context of the multicultural character of the site, it should be noted that the study material is located on the margin of the primary zones of particularly abundant materials from the younger periods of prehistory. Especially notable is the almost fringe location of the prevailing relics, representing a settlement of the Trzciniec culture from the Early Bronze Age. Despite the fact that the deposition of Middle Palaeolithic artefacts outside the primary stratigraphic context is, undoubtedly, of secondary character, an additional post-depositional factor, blurring their distribution pattern, should be noted here. This factor was the intense process of anthropogenic transformations of the site during the intensively developing occupations in the Neolithic, the Early Bronze Age and the later periods as well.

Currently, the zone of dispersion of the Middle Palaeolithic artefacts is located within the area of the lanes of the A2 motorway.

Description of the Middle Palaeolithic artefacts

1. Inv. F37, excavation unit F31b, layer n 1

Simple, oval side-scraper, preserved nearly in its entirety, with broken tip. Dimensions: length 77 mm, width 46 mm, thickness 20 mm (Fig. 8: 1; 10: 1). This tool was made of a massive, partly cortical flake. The whole tool is moderately rounded and smoothed, which is clearly visible on the arrises. The lower portion of the tool is the ventral surface of the blank with a reduced proximal end. The bulb was removed by recurrent, centripetal blows, which gave the lower part of the side-scraper a rather uniform, flattish form. Its surface also reveals some natural post-depositional changes in the form of "linear" frost fissures with a rusty discolouration. In addition, mottled discolourations, similar to a rusty ferruginous patina, occur, which corresponds to the changes captured during the analysis of the sand and gravel deposits on which the site is built The distal portion of the tool shows only one part of the impact scar from the previous stage of knapping the blank. The rest of the surface is taken up by the impact scar resulting from the retouch that shaped the tool, with traces of outwashed cortical (original) surface. The studied surface of the tool is covered with a delicate, pale blue, oxidation patina. The side-scraper was formed by retouching one edge, which extends nearly over the full length of the specimen – from its base in the proximal part of the blank to the apex of the distal end. In this case, the retouching process is quite heterogeneous, *i.e.* less invasive and semi-abrupt in the lower part, but more extensive and more invasive in the distal part, where it locally takes the form of stepped-retouch. The edge opposite to the retouched one has the form of a blunted half-back obtained by chipping, which divided the blank transversely and slightly diagonally to the axis of the blank. Also, two smaller impact scars are clearly evident, confirming the chipping actions (which shaped the tool) from the same direction as those that formed its flat back. It was also affected by several, lighter, centripetal blows, which finely thinned

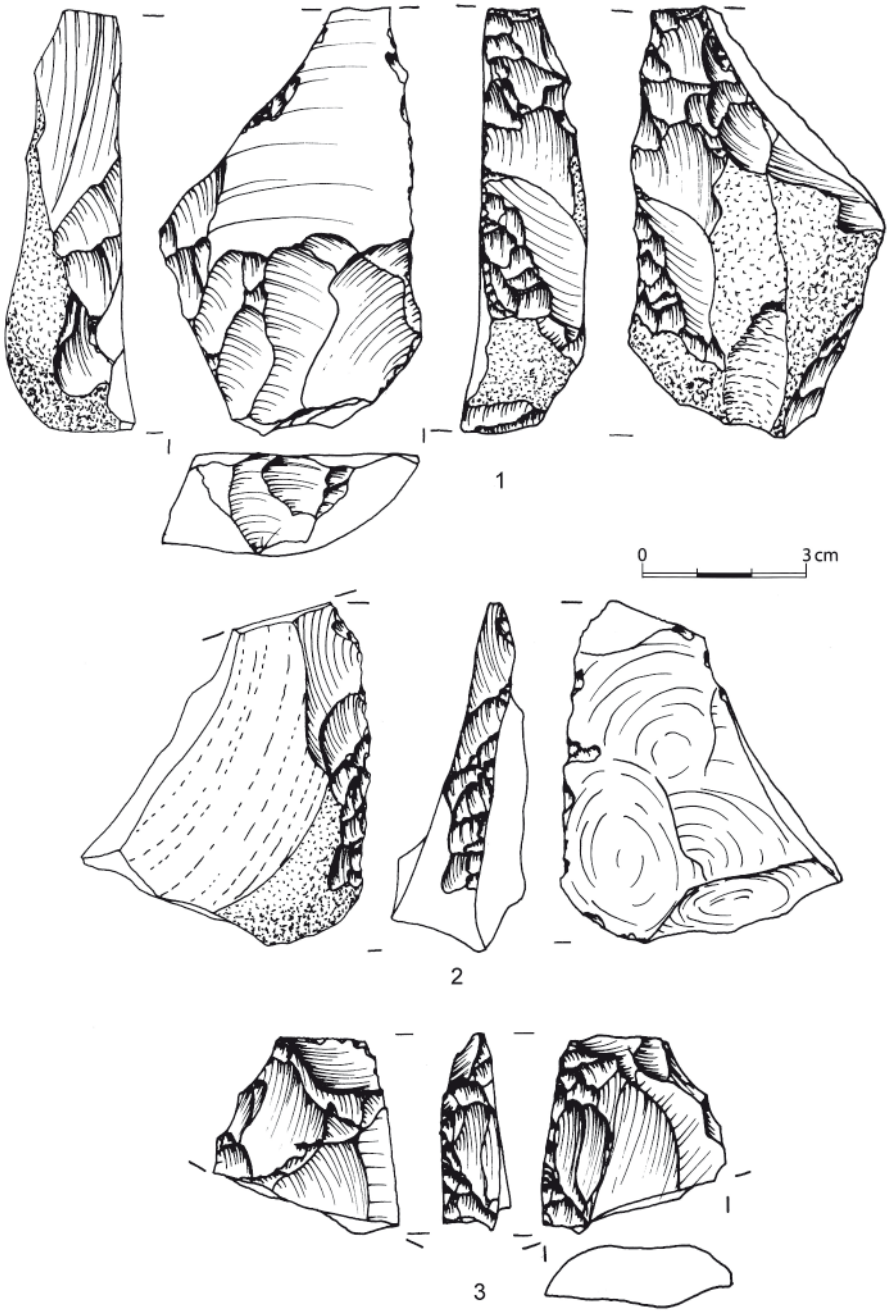

Fig. 8. Polesie 1 site. Middle Palaeolithic flint artefacts (illustrated by M. Wąs)

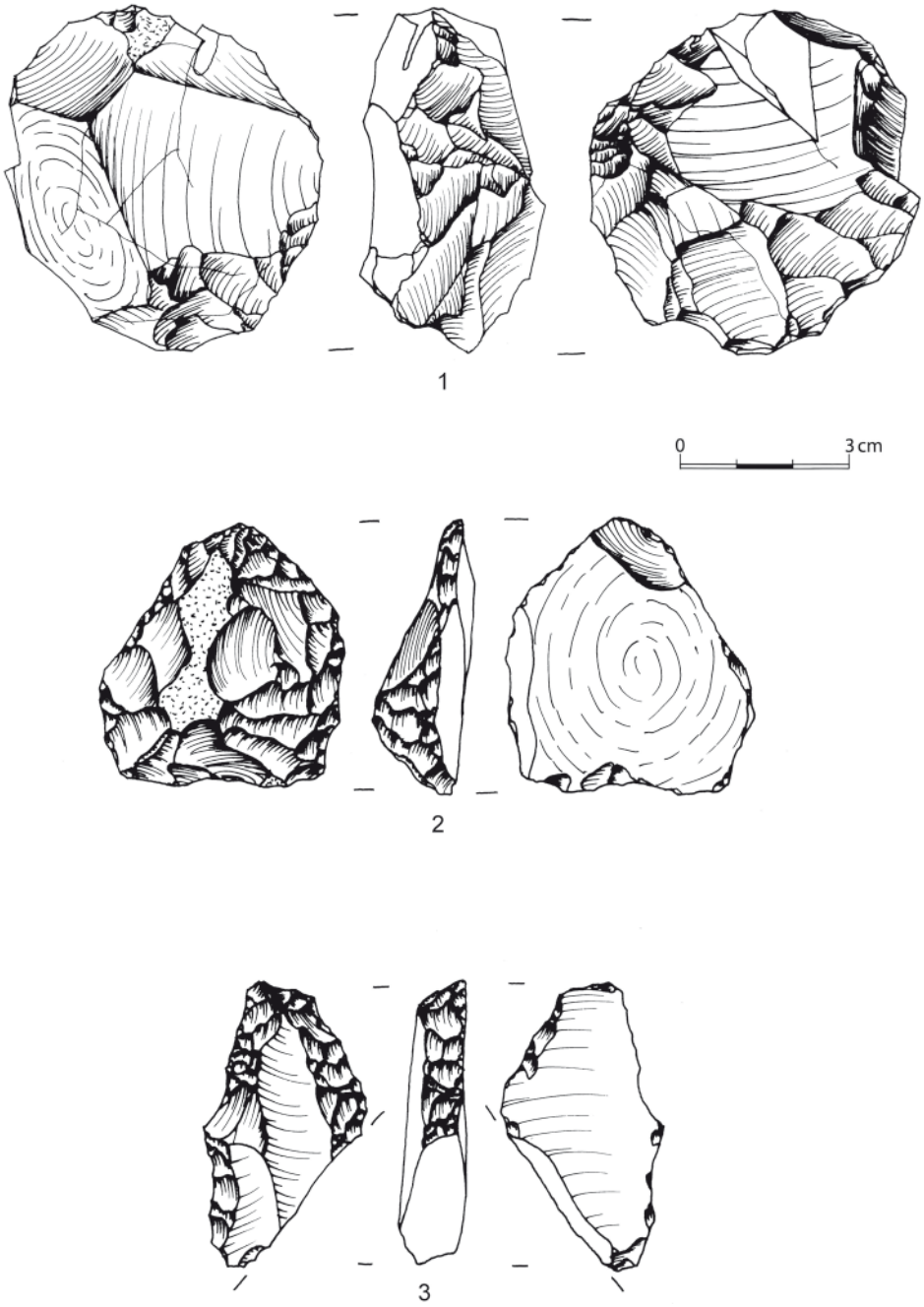

Fig. 9. Polesie 1 site. Middle Palaeolithic flint artefacts (illustrated by M. Wąs)

the whole tool in the distal part of the upper surface. In this way, the removal of the cortex was performed in part of the upper surface. This specimen has its tip broken off, and no traces of the corrective actions were recorded here. Morphologically, this tool refers to the Klausennische knives with thinned, proximal ends (Weiss *et al.* 2018).

2. Inv. F402, excavation unit F44a, layer m 4

Simple, straight side-scraper, preserved nearly in its entirety (Fig. 8: 2; 10: 2). Dimensions: length 62 mm, width 52 mm, thickness 20 mm. The specimen is made of a flattish chunk of Baltic flint. The upper surface of the scraper is a natural concretion, which shows a fragment with the outwashed core and a larger fragment with natural fissures, covered with a pale-rusty patina. The lower surface is uniform, slightly patinated with frost fissures. The tool shaping treatments were applied to one edge of the chunk, which was then modified with the use of continuous retouch. The course of retouch is a bit convex, and it starts just above the thicker, proximal end as semi-abrupt retouch, changing – in the apical part – to semi-flat retouch. This is the thinnest part of the tool and has a transverse break. The surface opposite to the retouched one is a natural, flattish back. The analyzed side-scraper is characterized by a natural form of concretion, without any "industrial" traces of its processing. It can be assumed that the parameters and general morphology of the chunk led to its selection for adaptation as a tool, which was was accomplished via shaping measures that were limited to retouch of one edge only.

3. Inv. F627, excavation unit F78a, layer m 1

Convergent side-scraper, preserved in its entirety (Fig. 9: 2; 11: 2). Dimensions: length 48 mm, width 43 mm, thickness 15 mm. The specimen is made of a natural chunk of Baltic flint. The lower part of the tool is the area with natural frost or mechanical fissures, covered with a pale-rusty patina. The upper surface is almost completely transformed by retouch; only in the central part was a fragment of the external surface of the concretion with the outwashed cortex preserved. This surface of the tool is also covered with a pale-blue patina. The tool forming operations covered its three edges, giving the side-scraper a form similar to a triangle. For this reason, the specimen can be formally classified as a convergent side-scraper with retouch on the proximal end. In the lower part, the specimen reaches its maximum thickness, while it is clearly thinned near the apex, located on the longitudinal axis of the tool. Despite the circumferential character of the retouch, the differences between individual edges are clearly visible. The base of the tool is a semi-abrupt, retouched edge. It passes smoothly and articulately onto one of the sides (left), which is a bit angular above the proximal end. This edge is also shaped by semi-abrupt retouch, which appears less invasive in the apical part. The opposite edge (right) has an arcuate shape, and the retouch is diversified in terms of its range. At least two areas of retouch can be distinguished here. One of them covers the surface of the side-scraper from the edge to its central part, and the second one is edge retouch. The morphology of the tool indicates that it is a residual specimen whose apical part was probably larger in its original form. It seems likely that the reduced tool was reworked in its apical part, possibly because

it was worn out and used. An indirect indication in this respect is the scar visible in the apical part in the lower portion of the side-scraper.

4. Inv. M132, excavation unit M92a, layer n 1

Convergent side-scraper, fragmentarily preserved, and with a broken proximal end (Fig. 9: 3; 11: 3). Dimensions: length 49 mm, width 32 mm, thickness 11 mm. This specimen was made of a flake of unidentified flint, with negative flake scars on its dorsal surface. It might be Baltic or Jurassic flint, as indicated by its colouration and punctiform, white-gray discolourations (which are probably specific of both kinds of flint with fossil inclusions). This tool does not have any post-depositional changes in the form of a patina, but some moderate smoothing and aeolian-derived polishing are detectable. The scale of these changes is varied throughout the whole specimen. The lower surface of the tool is the ventral surface of the blank, showing the features of a massive flake. In spite of the post-depositional changes, clear cracking ripples are seen on it, which suggests that the proximal end was broken off of the preserved tool. The upper surface shows three, clear negative scars having an opposite direction to the direction in which the blank was flaked. Typologically, the specimen is closer to convergent side-scrapers, although it also possesses features making it similar to denticulate tools. It was shaped by retouching the two edges that contact the distal part of the blank to form a short, transverse tip. The retouch on both edges is semi-abrupt, but each differs in its form. The longer, preserved edge was retouched to form two shallow notches, which, contacting each other, give it a somewhat denticulate form. The opposite edge is much more homogeneous in terms of the process and form of retouch. The prior apex of the scraper was subjected to secondary retouch, which gave it a slightly transverse and oblique form in relation to the axis of the tool; above all, it clearly distinguishes itself from its two lateral edges. Additionally, a small point was recorded on one of the edges, either from breakage or at a point of impact. This piece (next to the largest side-scraper in the assemblage – Fig. 8: 1; Fig. 10: 1) is the only analyzed tool in the assemblage that was not made from a natural blank, but rather from a modified flake blank.

5. Inv. M458, excavation unit M63b, layer m 2

Prądnik knife (Ciemna-type knife), preserved in its upper portion (Fig. 8: 3; 10: 3). Dimensions: length 35 mm, width 33 mm, thickness 12 mm. This tool was made of Baltic flint. Apart from delicate smoothing of the arrises, there are no traces of more significant post-depositional transformations. The preserved specimen has a number of diagnostic features that can be used to provide its precise, typological classification. Certainly, it is a bifacial tool, representing the type of planoconvex knives, *i.e.*, with morphological diversification on both faces of the tool. The arrangement of the negative scars and the manner in which the surface and edges were shaped indicate the presence of morphological elements typical of "Prądnik-type" tools, such as: a back, a half-back, an apex, a short point, the tip of the point and, above all, a burin-like spin off scar (Krukowski 1939-1948; Sobczyk 1975). A more detailed analysis of the pattern and chronology of negative scars allows us to conclude that the described specimen is a fragment of a modified or repaired tool, whose

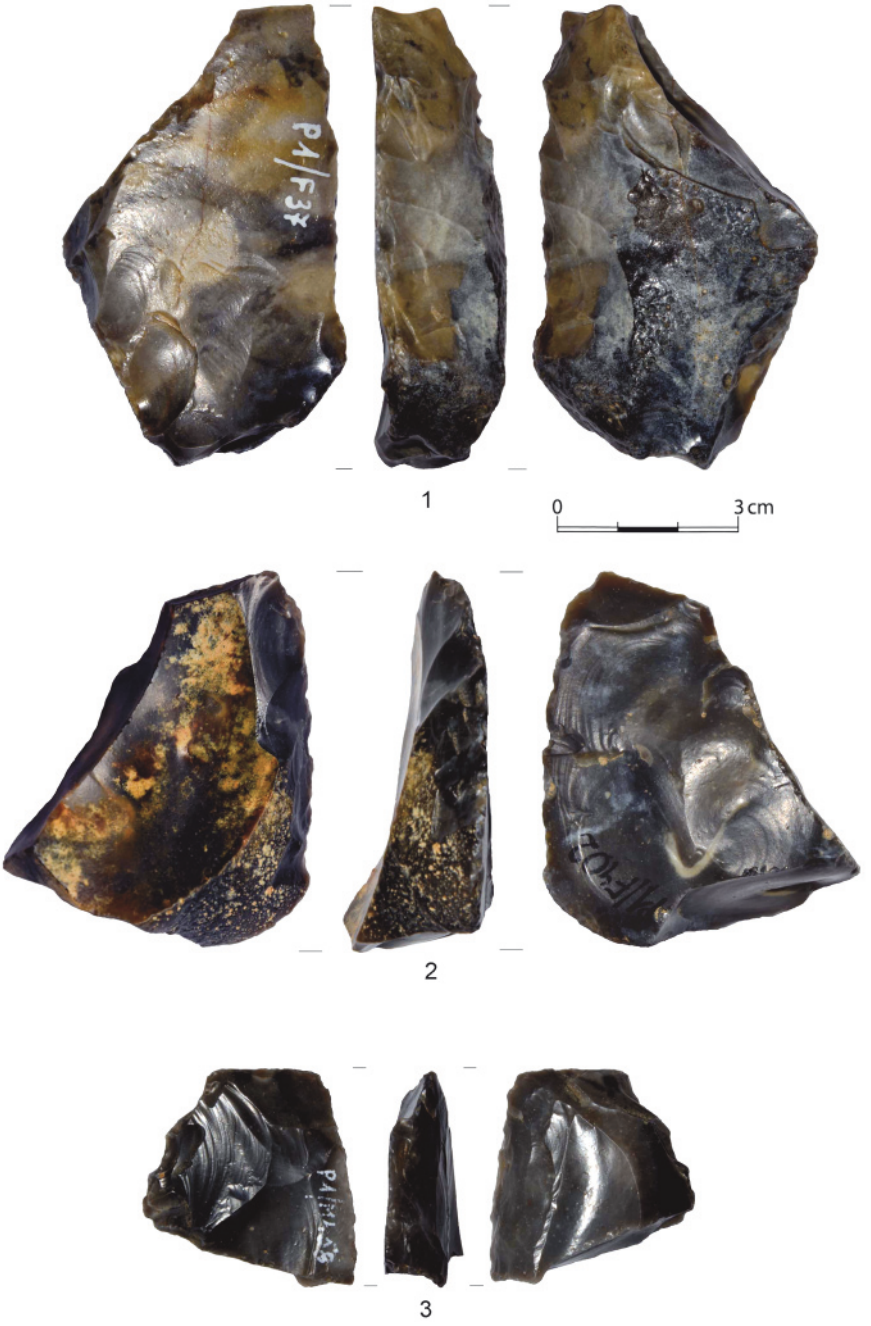

Fig. 10. Polesie 1 site. Middle Palaeolithic flint artefacts (photo by M. Wąs)

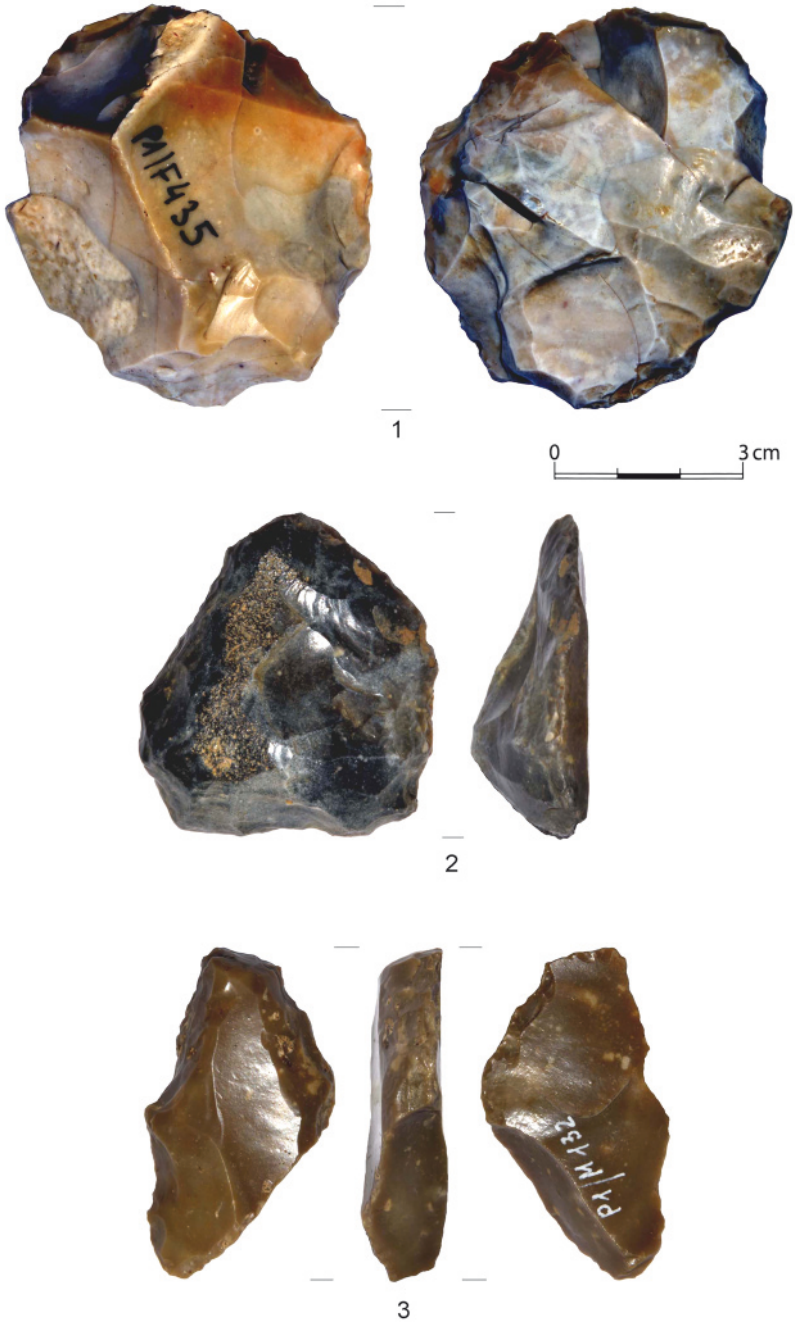

Fig. 11. Polesie 1 site. Middle Palaeolithic flint artefacts (photo by M. Wąs)

traces are particularly well visible on the relatively flat, ventral face with the burin-like spin off scar. One of the elongate negatives located parallel to the blade is probably a relic of the earlier phase of shaping the tool – a relic of the "dominant blow" (Jöris 1992; 2001; Urbanowski 2003; Migal and Urbanowski 2006; Frick *et al.* 2017; Frick 2020). The pattern of negatives on the more convexly formed, dorsal surface, is far less disturbed by subsequent repairs, which are particularly well detectable in the area of the transverse break of the tool. Also, noteworthy is the character of the break – its surface has traces that suggest the break occurred as a result of the lateral force affecting the surface of the side-scraper. The detachment of the last burin-like flake, which was performed in order to sharpen the cutting edge, was probably unsuccessful, as the edge was hinged, precluding the possibility of the further resharpening of this part of the tool.

6. Inv. F435, excavation unit F45d, layer m 2

Discoidal (or sub-discoidal) core (Fig. 9: 1; 11: 1). Dimensions: length 64 mm, width 58 mm, thickness 30 mm. This artefact is made of Baltic or Jurassic flint. Post-depositional transformations (especially a whitish patina on the surface) preclude a precise classification of the raw material used to make the tool. In addition, the specimen has frost fissures which resulted in the chipping off of two fragments – a small one near the flaking edge, and a larger fragment of one of the working surfaces. The smoothing of the arrises is also a result of post-depositional changes, but its scale is diverse within the body of the core. A great majority of the negative scars are quite clear, allowing for the identification of the sequence of core reduction. In only in one fragment are the processed surfaces more heavily obliterated. This core can probably be classified as the changed orientation type. A clear sequence of centripetal, circumferential blows is visible on the primary exploitation surface; thus, it would seem that it served as the flaking face. After obtaining a large enough flake, an attempt was made to remove flakes from the opposite direction, which resulted in the acquisition of short, hinged flakes, rendering the further reduction of this core plane impossible. A consequence of this action was the reorientation of the fragment, using the previous platform as a flaking face. In this way, a single, flattish, broad flake was obtained; this activity was preceded by the preparation of the zone for flaking on the circumferential striking platform. An analysis of this part of the core allows us to conclude that the obtained flake was a *chapeau de gendarme* type, typical of Levallois debitage (*e.g.*, Van Peer 1992). The next sequence of blows was directed at the area located next to the negative scar of the aforementioned detachment. Unfortunately, this attempt was unsuccessful, as the obtained flakes were too short, and also hinged, which eventually put an end to the possibility of further exploitation of the core.

The foregoing description indicates that the assemblage obtained from Polesie 1 contains the forms typologically distinguishable within the classification framework of the Middle Palaeolithic products present in the literature (*e.g.*, Ginter and Kozłowski 1975). Some of them possess the features which allow for their classification as "knife-like" tools (especially Figs. 8: 1 and 8: 2). They have a retouched, distally-thinned working edge and

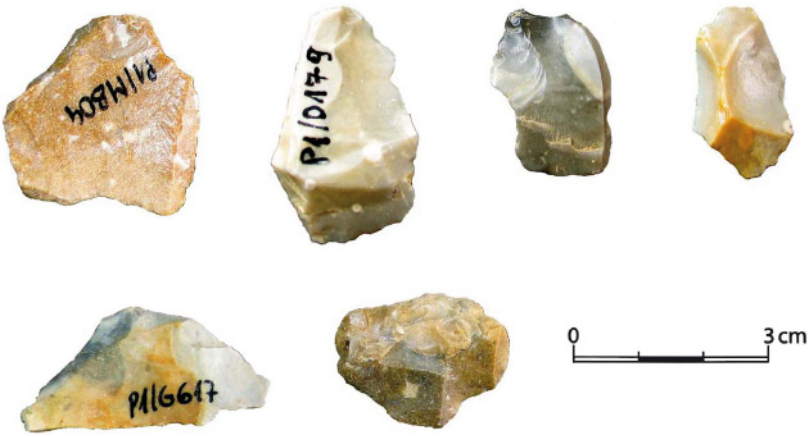

Fig. 12. Polesie 1 site. Flint flakes distinguished as Middle Palaeolithic (photo by M. Wąs)

an opposing blunt surface, which is a natural break that was adapted as the back of the tool (also referred to as "*couteau à dos naturèlle*"; *cf.* Sudoł and Cyrek 2013). These specimens either possess partial surface retouch or they are completely devoid of it (Fig. 8: 2).

In addition to the aforementioned six types of specimens, six flakes having features of Middle Palaeolithic debitage were identified (Fig. 12). Only the complete specimens with prepared butts, which refer in their form to the faceted butts from Levallois debitage, were classified here (some indirect hints resulting from the analysis of the discoidal core were taken into account). The most vital datum was the state of preservation of the surface of the flakes, which was analogous to the retouched pieces and the core described before. It is worth noting here that their spatial pattern is, in large part, quite similar to the scatter pattern of the side-scrapers and the core.

TAPHONOMY AND STATE OF PRESERVATION OF THE ARTEFACTS

The study artefacts show a number of features that are the result of secondary changes of natural origin (*cf.* Stapert 1976). These changes include post-depositional transformations, and can be the subject of taphonomic and petroarchaeological analyses (Fernandes and Raynal 2006). In the case of the stone artefacts dated to the Middle Palaeolithic, all kinds of modification to the surface (patination) or edges (breakages and "pseudo-retouch"), as well as the readability of the arrises are analysed following the tribological concepts (Burroni *et al.* 2002). These transformations can be of tectonic, chemical, cryogenic or other provenance. Post-depositional changes recorded on the surfaces of the Middle

Palaeolithic artefacts are, however, relatively frequent effects of the modifications which the flint products undergo during water transport (*cf.* Hosfield and Chambers 2003). The diagnostic features for long-lasting and intensive water transport are, predominantly, *arętes* and breakages occurring on edges (Chu and Hosfield 2020). These characteristics are macroscopic, and therefore no use of optical instruments is required for their identification. The presence of clear, bifacial traces of abrasion is explained as a result of the purely physical impact of the aquatic environment and its components on the transported flint artefact (Chambers 2003). This phenomenon is typical, especially of materials with Lower and Middle Palaeolithic provenance, found in gravelly fluvial deposits (Shackley 1974; 1978; Hosfield 2011). On the other hand, numerous faces with the traits of aeolisation and a pale blue patina suggest the exposure of flint artefacts to the conditions of intense or long-lasting aeolian processes and post-depositional processes on the surface (Glauberman and Thorson 2012).

Note that these remarks are of particular importance in the case of the artefacts analysed here, and notably the geological context of finding them. Clear instances of "smoothing" (visible on their surfaces), the abrasion of arrises, fine – though not too numerous – notches on the edges of the blades, and probably also the pale-rusty and pale-blue discolourations of the surfaces may suggest that the artefacts were subjected to a range of factors related to both water transport and the dynamics of aeolian processes (see also: Caux *et al.* 2018; Fernandes *et al.* 2007; Thiry *et al.* 2014). Undoubtedly, a number of post-depositional transformations confirm the redeposited character of the Middle Palaeolithic artefacts from Polesie 1. Unfortunately, both the scale of this phenomenon as well as the location of the original stratigraphic context of the artefacts, from which they were certainly moved, are now intractable problems.

CHRONOLOGICAL AND TAXONOMICAL NOTES

The geomorphological context and the circumstances in which the artefacts presented in this article were obtained preclude the possibility of treating them as relics of the Middle Palaeolithic site *in situ*. Even if we assume that it was originally located in the place covered by the excavations, it would have been seriously disturbed due to natural and anthropogenic factors in the younger periods. Alternatively, they may be relicts of a site that was originally located in the vicinity of the excavated area. Here, the suggestive "linear" scatter pattern of the artefacts is consistent with the slope angle of the landform on which the site is located. Particularly suggestive is their location in the slope zone of the northern part of the post-glacial plain bordering the extensive, fluvial terrace, within the Warsaw-Berlin ice-marginal valley. However, the scale of disturbance of the original spatial pattern of the artefacts is impossible to determine. Even if we accept the interpretation of the context of the features in question being in fact of a secondary (midden) character, nothing

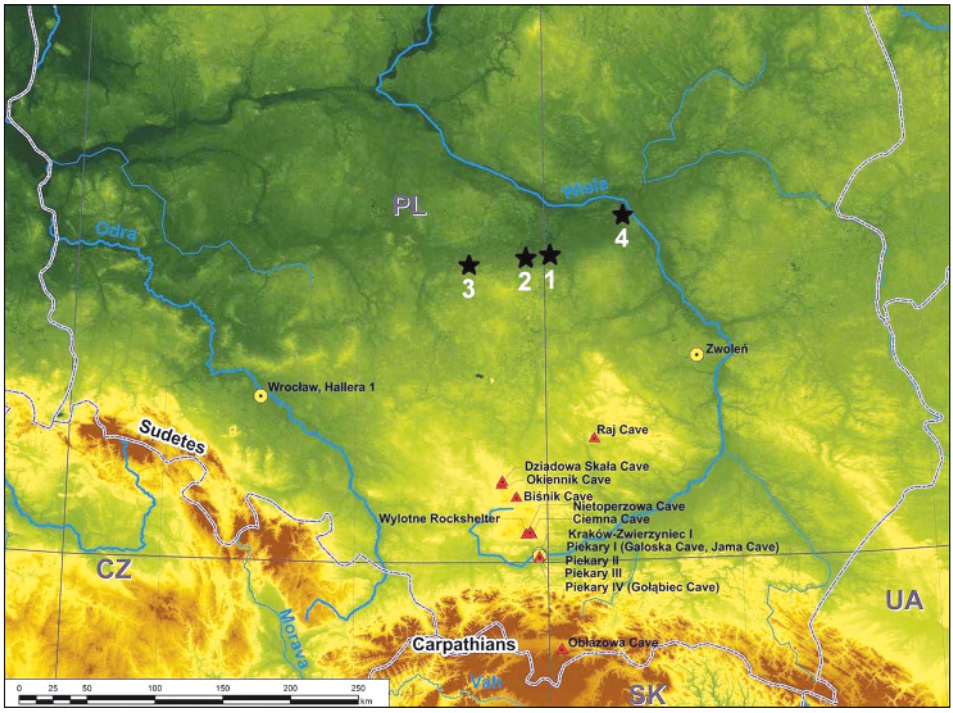

Fig. 13. Location of Polesie 1 and other sites from Central Poland with potential finds dated to the Middle Palaeolithic, against the background of major sites from the Eemian and Vistulian periods in Poland (MIS4 – MIS5d). Key: black stars – sites from Central Poland (1 – Polesie; 2 – Skaratki; 3 – Mount St. Margaret; 4 – Łomianki); yellow circles – other open-air sites; red triangles – cave sites (after: Wiśniewski 2016, 57 – altered)

can diminish the fact that they are the oldest traces of human presence in this part of Mazovia. Despite the fact that the assemblage from Polesie 1, of such an early age, is a single find in the scale of the Polish Lowlands, it significantly enriches the source base for the Middle Palaeolithic in Poland. Additionally, it proves that the artefacts related to Neanderthal settlement patterns may be found far to the north of the zone of the Southern Polish Uplands (*cf.* Sudoł 2013; Wiśniewski *et al.* 2019).

In this context, it is worth turning to the older references suggesting the presence of Middle Palaeolithic sites in the Polish Lowlands (especially in Central Poland). Two sites from the study period are known from the Central Masovian Lowland area: Skaratki and Mount St. Margaret (Fig. 13; Polish: Góra Św. Małgorzaty; Chmielewski and Kubiak 1962; Chmielewski 1975).

Skaratki, situated about 14 km to the west, is the site with the closest geographical proximity to Polesie (Chmielewski and Kubiak 1962; Chmielewski 1964; 1975). Skaratki has already been firmly established in the literature, and it was particularly frequently

mentioned in the syntheses of the prehistory of Polish lands as the northernmost Polish Middle Palaeolithic site. According to the source publications, one of the horizons of the fossil bog located in the vicinity of Skaratki yielded some mammoth remains that possessed traces of cuts and intentional breakage, which were believed to be the results of human activity (Chmielewski and Kubiak 1962). In addition, single pieces of charcoal and a stone chunk were found on the level of their deposition. That level was dated to the turn of the Eemian interglacial and the Early Vistulian glaciation (Chmielewski and Kubiak 1962; Chmielewski 1975). Apart from the aforementioned finds, there are not enough convincing premises confirming the anthropogenic character of the site. The recent archaeozoological analyses significantly question the earlier findings, especially the functional interpretation, according to which it was a hunting camp (Wojtal 2007, 117). According to Piotr Wojtal, the interpretation of this find as a relic of a kill-site, where the partial butchering of a dead (?) mammoth carcass took place, is acceptable. The lack of any essential and diagnostic elements of the mammoth skeleton that could have supported the thesis suggesting the hunting character of the site can be explained by the activity of scavenger animals, which probably dragged the carcass away from the site, as well as by a number of other, natural processes. Nevertheless, the most important problem that appears in the context of the study area is the lack of flint artefacts throughout the site in Skaratki.

Another spot in which a potential find dating back to the Middle Palaeolithic is located lies 44 km west of Polesie 1, at a site in the village of Mount St. Margaret near Łęczyca. Unfortunately, not more than a single flint side-scraper found on the southern slope of a small hill towering over the valley has been mentioned so far – and only a few times. Its morphology has not been fully defined yet – the publications mentioning the site do not contain any characteristics or illustrations of this artefact; however, its Early-Vistulian provenance was suggested (Chmielewski 1964; 1970; 1975; Chmielewska and Chmielewski 1975).

A separate example that fits in the group of potential traces of the Middle Palaeolithic in Central Poland is the recently published stray find of a bifacial piece of the blade type, found in the Vistula alluvium in the vicinity of Łomianki, near Warsaw (Wąs and Migal 2017).

The lack of any analogous finds in the close vicinity of Polesie forces us to search for similar specimens in the inventories obtained from sites located further to the south.

While looking for the data facilitating the cultural attribution of the flint products that we have already described, it should be first of all stressed that tool types such as side-scrapers and knifes with natural half-backs are known specifically from sites representing the Micoquian tradition. This is exemplified by a re-utilized and transformed biface from the Wylotne rock-shelter, as well as by some pieces from Pietraszyn 49 and Samborowice (Mańka *et al.* 2004; 2006; Targosz 2006; Wiśniewski *et al.* 2019; Fajer *et al.* 2008). Similar features are also observed in the case of some Prądnik knives from Ciemna Cave (Krukowski 1939-1948; Kowalski 1967; Urbanowski 2003; Valde-Nowak *et al.* 2014; 2016). Zwoleń, located within the Southern Mazovian Upland, is the closest geographically

researched site that yielded some products similar to the specimens obtained from Polesie 1 in terms of stylistics and technology (Schild 2005). The abundant inventory, occupying several stratigraphic levels, included similar tools made of chocolate flint (Tomaszewski 2005).

Due to the geographically isolated character of the find, devoid of a clear archaeological and geological context, there is not enough data to provide even an approximate chronological framework of the site under consideration within the Middle Palaeolithic periodization in Central Europe. Only the morpho-technical characteristics of the features can be perceived as relics of "techno-cultural" phenomena that occurred in particular phases of the Middle Palaeolithic. Looking at the study artefacts from a chronological perspective, they can be hypothetically associated with the characteristics of flint technology operating in the wide spectrum identified with the isotopic MIS5 stage, including the MIS5e substage, basically corresponding to the Eemian interglacial (*cf.* Wiśniewski 2012; 2016). Even the dates obtained for the aforementioned sites from which the well-researched Micoquian inventories originate do not permit a more precise dating of the products from Polesie 1. It is worth mentioning that the vast majority of the researched and dated Micoquian sites are linked with the Early Vistulian period (MIS 5d – 4). Those are the cave sites (Biśnik Cave – complex E, Deszczowa Cave – layers IV-VI, Ciemna Cave and Wylotne rock-shelter) as well the open-air sites (Maków and Zwoleń – the upper cultural level) (Sudoł 2013). Assemblages A2 and A3 from the Biśnik Cave and Piekary III are dated to the Eem Interglacial (MIS 5e). Apart from the already existing data, which prove that the oldest inventories are linked with the Micoquian tradition that occurred in the Polish lands (mainly in the south) as early as during the MIS 8-6 periods (however, the chronological spectrum of the Micoquian could be even wider, *i.e.*, from MIS8 – early assemblages from the Biśnik Cave, to MIS3 – Stajnia Cave), there is not sufficient evidence or such early dates for the finds from Polesie 1 (*cf.* Cyrek 2002; 2010; Żarski *et al.* 2017). On the other hand, some of the well-dated Micoquian sites with knives represent younger periods – MIS 4 or MIS 3 (*i.e.* Ciemna Cave, Pietraszyn 49a, Stajnia Cave) (Valde-Nowak *et al.* 2016; Wiśniewski *et al.* 2019; Żarski *et al.* 2017).

If we accept the assumption that the obtained collection of artefacts is a relic of the presence of Neanderthals in the study region, a cautious attempt can be made to indicate the period in which that could have potentially taken place. It is most likely that humans inhabited the areas of the Wartanian alluvial fans in the Eemian cycle (MIS 5e). Considering the possibility that those areas were explored in the Early Vistulian (as, for example, W. Chmielewski suggested) because of hunting expeditions that were led northward, it seems that, alternatively, inhabitation could have taken place during some relatively warmer periods, such as the Brörup and Odderade Interstadials (MIS 5c, MIS 5a), for example, or in the colder periods, when the head of the ice-sheet was farther north, *e.g.*, in the Świecie stadium (MIS 4) (see: Behre *et al.* 2005). It should be emphasized, however, that these considerations are entirely hypothetical.

CONCLUSIONS

The Middle Palaeolithic products discovered at Polesie 1 are not merely traces of the origins of settlement in the vicinity. Their importance goes far beyond their contribution to the reconstruction of the history of the site itself; rather, they also enrich the image of the Middle Palaeolithic in Poland (*cf.* Kozłowski J.K. and Kozłowski S.K. 1977; Kozłowski 2004; Schild 2005; Wiśniewski 2006). The archaeological sites at which the finds dating to the Middle Palaeolithic were recorded are very rare in the zone located north of the Uplands and the Southern Polish high plains. As is known, Zwoleń represents the most prominent site in the zone of the Southern Mazovian Upland (Schild 2005). Against this background, Polesie 1, located in the Central-Mazovian Lowland area, is currently the northernmost site from the Middle Palaeolithic period in Poland; however, its special location should be accentuated here, along with two other sites: Skaratki and Mount St. Margaret. All of them are located at similar latitudes, creating a kind of sequence of potential points containing relics from the Middle Palaeolithic. Here, the convergence of their locations compared to the regional differentiation of Central Poland is striking: all of them are located just at the southern edge of the Warsaw-Berlin ice-marginal valley, and at the northernmost periphery of the Central Polish Uplands.

The location of such old relics of settlements in the sediment zone that built both huge alluvial fans and sanders in the glacial forefield has already been suggested in the literature (Waga *et al.* 2009). Obviously, further research is required to determine the original stratigraphic position of the material, as well as the scale of its displacement and the degree of natural transformation of the terrain forms and layers potentially containing artefacts. Assuming the late genesis of the glacial plain within which the site is located, it can be assumed that those areas (or parts of them) constituted rather stable, dry and – at the same time – flat concentrations of inselbergs, elevated above the lower levels, or the levels adjacent to the hydrographic network of the glacial forefield (*e.g.*, in the Eemian interglacial or the Early Vistulian glaciation; *cf.* Waga *et al.* 2009, 35).

It is also worth emphasizing that the presence of a Middle Palaeolithic site in the lowland zone should not come as a surprise, especially as compared to the settlement range from that period recognized hitherto (*cf.* Skrzypek *et al.* 2011; White and Pettitt 2011; Wiśniewski *et al.* 2013). There are known individual sites that define the northern periphery of the Neanderthal ecumene, most notably in other regions of Central, Eastern and Western Europe (*e.g.*, sites Lichtenberg and Königsaue in Germany, or Khotylevo in Russia; *cf.* Conrad and Prindiville 2000; Bosinski 2006; Kozłowski J.K. 2004; 2006; Howard *et al.* 2007; Rolland 2010; Hartz *et al.* 2012; Ocherednoi *et al.* 2014; 2014a; Picin 2016; Richter 2016). In the light of the cited data on the chronology of the selected Middle Palaeolithic sites in Poland, the question of dating the artefacts presented in this article must be limited only to the sphere of theoretical digressions.

To conclude, the example of the site of Polesie 1 (even if it does not constitute a homogeneous collection of an undisturbed primary system) clearly indicates the possibility that more sites linked to that period may be discovered in that part of the Lowlands in the near or distant future.

References

Balwierz Z. 2011. Wyniki analizy pyłkowej osadu za stanowiska Polesie-Zwierzynka i Polesie-Ruczaj. In J. Górski, P. Makarowicz and A. Wawrusiewicz (eds), *Osady i cmentarzyska społeczności trzcinieckiego kręgu kulturowego w Polesiu stanowisko 1, woj. łódzkie*. 1 (= *Spatium Archaeologicum* 2). Łódź: Instytut Archeologii Uniwersytetu Łódzkiego, 251-267.

Balwierz Z., Domańska L., Forysiak J., Rzepecki S. and Twardy J. 2009. Archeologiczne i paleośrodowiskowe badania wielokulturowego stanowiska Polesie 1, gmina Łyszkowice (centralna Polska). In L. Domańska, P. Kittel and J. Forysiak (eds), *Środowiskowe uwarunkowania lokalizacji osadnictwa*. Poznań: Bogucki Wydawnictwo Naukowe, 281-300.

Behre K. E., Hölzer A. and Lefdahl G. 2005. Botanical macro-remains and insects from the Eemian and Weichselian site of Oerel (northwest Germany) and their evidence for the history of climate. *Vegetation History and Archaeobotany* 14, 31-53.

Bosinski G. 2006. The Keilmesser Groups (Micoquian) in Germany. In S. K. Kozłowski (ed.), *Wylotne and Zwierzyniec: paleolithic sites in Southern Poland*. Warszawa, Kraków: Instytut Archeologii i Etnologii PAN, 383-400.

Burroni D., Donahue R., Pollard A. M. and Mussi M. 2002.The Surface Alteration Features of Flint Artefacts as a Record of Environmental Processes. *Journal of Archaeological Science* 29, 1277-1287.

Caux S., Galland A., Queffelec A. and Bordes J. G. 2018. Aspects and characterization of chert alteration in an archaeological context: A qualitative to quantitative pilot study. *Journal of Archaeological Science: Reports* 20, 210-219.

Chambers J.C. 2003. Like a rolling stone? The identification of fluvial transportation damage signatures on secondary context bifaces. *Lithics* 24, 66-77.

Chmielewska M. and Chmielewski W. 1975. Paleolit w Polsce Środkowej. *Prace i Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi. Seria Archeologiczna* 22, 9-25.

Chmielewski W. 1964. Dzieje grup ludzkich zamieszkujących ziemie Polski w plejstocenie. In W. Hensel (ed.), *Materiały do prahistorii ziem polskich*. 1. *Paleolit i mezolit*. Warszawa: Instytut Historii Kultury Materialnej Polskiej Akademii Nauk, 1-128.

Chmielewski W. 1970. Wpływ środowiska peryglacjalnego na osadnictwo ludzkie w górnym plejstocenie Polski. *Światowit* 31, 5-18.

Chmielewski W. 1975. Paleolit środkowy i górny. In W. Hensel and W. Chmielewski (eds), *Prahistoria Ziem Polskich*. Wrocław, Warszawa, Kraków, Gdańsk: Ossolineum, 9-158.

Chmielewski W. and Kubiak H. 1962. The find mammoth bonnes at Skaratki in the Łowicz District. *Folia Quaternaria* 9, 1-9.

Chu W. and Hosfield R. 2020. Lithic artifact assemblage transport and micro-wear modification in a fluvial setting: a radio frequency identification tag experiment. *Geoarchaeology* 35(4), 591-608.

Conard N. J. and Prindiville T. J. 2000. Middle Palaeolithic hunting economies in the Rhineland. *International Journal of Osteoarchaeology* 10, 286-309.

Cyrek K. (ed.) 2002. *Jaskinia Biśnik. Rekonstrukcja zasiedlenia jaskini na tle zmian środowiska przyrodniczego*. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Cyrek K. 2010. The Biśnik Cave in Southern Poland: reconstruction of the Palaeolithic cave habitation in relation to the environmental changes. In M. Burdukiewicz and A. Wiśniewski (eds), *Middle Palaeolithic Human Activity and Palaeoecology: New Discoveries and Ideas* (= *Studia Archeologiczne* 41). Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego, 69-94.

Domańska L. and Wąs M. 2011. Materiały krzemienne trzcinieckiego kręgu kulturowego ze stanowiska Polesie 1, gm. Łyszkowice, woj. łódzkie. In J. Górski, P. Makarowicz and A. Wawrusiewicz (eds), *Osady i cmentarzyska społeczności trzcinieckiego kręgu kulturowego w Polesiu stanowisko 1, woj. łódzkie*. 1 (= *Spatium Archaeologicum* 2). Łódź: Instytut Archeologii Uniwersytetu Łódzkiego, 276-283.

Domańska L., Rzepecki S., Makarowicz P., Górski J., Wawrusiewicz A., Solecki Ł., Kot K., Piotrowska M., Ficyk M. and Wąs M. 2012. Wyniki ratowniczych badań wykopaliskowych przeprowadzonych w latach 2005-2008 na stanowisku Polesie 1, gm. Łyszkowice, woj. Łódzkie. In S. Kadrow (ed.), *Raport 2007-2008*. Warszawa: Narodowy Instytut Dziedzictwa, 183-216.

Domańska L., Rzepecki S. and Wąs M. 2013. The Polesie site: from Neanderthal Man to the Motorway Builders. In Yung-jo Lee, Gao Xing and Xie Fei (eds), *Suyanggae and her neighbours: 16th International Symposium in Nihewan (China)*. Beijing: Oceanpress, 123-130.

Fajer M., Foltyn E. M., Foltyn E., Pawełczyk W. and Waga J. M. 2008. Site of older phase of the Middle Paleolithic at Samborowice (Upper Silesia). *Analecta Archaeologica Ressoviensia* 3, 9-47.

Fernandes P. and Raynal J. P. 2006. Pétroarchéologie du silex: un retour aux sources. *Comptes Rendus Palevol* 5, 829-837.

Fernandes P., Le Bourdonnec F. X., Raynal J. P., Poupeau G., Piboule M. and Moncel M. H. 2007. Origins of prehistoric flints: The neocortex memory revealed by scanning electron microscopy. *Comptes Rendus Palevol* 6, 557-568.

Frick J. A. 2020. Reflections on the term Micoquian in Western and Central Europe. Change in criteria, changed deductions, change in meaning, and its significance for current research. *Archaeological and Anthropological Sciences* 12(2), 1-39. DOI: 10.1007/s12520-019-00967-5.

Frick J. A., Herkert K., Hoyer C. T. and Floss H. 2017. The performance of tranchet blows at the Late Middle Paleolithic site of Grotte de la Verpillière I (Saône-et-Loire, France). *PLoS ONE* 12 (11), 1-44. e0188990 https://doi.org/10.1371/journal.pone.0188990.

Ginter B. and Kozłowski J. K. 1975 (1990). *Technika obróbki i typologia wyrobów kamiennych paleolitu i mezolitu*. Warszawa: PWN.

Glauberman P. J. and Thorson R. M. 2012. Flint Patina as an Aspect of "Flaked Stone Taphonomy": A Case Study from the Loess Terrain of the Netherlands and Belgium. *Journal of Taphonomy* 10(1), 21-43.

Górski J., Makarowicz P. and Wawrusiewicz A. (eds) 2011. *Osady i cmentarzyska społeczności trzcinieckiego kręgu kulturowego w Polesiu stanowisko 1, woj. łódzkie*. 1 (= *Spatium Archaeologicum* 2). Łódź: Instytut Archeologii Uniwersytetu Łódzkiego.

Hartz S., Beuker J. R. and Niekus M. J. L. Th. 2012. Neanderthal finds in Schleswig Holstein? – Middle Palaeolithic flint scatters in Northern Germany. In M. J. L. Th. Niekus, R. N. E. Barton, M. Street and Th. Terberger (eds), *A mind set on flint. Studies in honour of Dick Stapert*. Groningen: Barkhuis, Groningen University Library, 93-105.

Hosfield R. T. 2011. Rolling stones: understanding river-rolled Paleolithic artifact assemblages. In A. G. Brown, L. S. Basell and K. W. Butzer (eds), *Geoarchaeology, Climate Change, and Sustainability* (= *GSA Special Paper* 476). Boulder, Colorado: Geological Society of America, 37-52.

Hosfield R. T. and Chambers J. C. 2003. Flake Modifications during Fluvial Transportation: Three Cautionary Tales. *Lithics* 24, 57-65.

Howard A. J., Bridgland D., Knight D., McNabb J., Rose J., Schreve D., Westaway R., White M. J. and White T. S. 2007. The British Pleistocene fluvial archive: East Midlands drainage evolution and human occupation in the context of the British and NW European record. *Quaternary Science Reviews* 26, 2724-2737.

Jöris O. 1992. Pradniktechnik im Micoquien der Balver Höhle. *Archäologisches Korrespondenzblatt* 22, 1-12.

Jöris O. 2001. *Der spätmittelpaläolithische Fundplatz Buhlen (Grabungen 1966-69): Stratigraphie, Steinartefakte und Fauna des oberen Fundplatzes* (= *Universitätsforschungen zur prähistorischen Archäologie* 73). Bonn: Verlag Dr. Rudolf Habelt GmbH.

Kondracki J. 1994. *Geografia fizyczna Polski. Mezoregiony fizyczno-geograficzne*. Warszawa: PWN.

Kowalski S. 1967. Ciekawsze zabytki paleolityczne z najnowszych badań archeologicznych (1963-1965) w Jaskini Ciemnej w Ojcowie, pow. Olkusz. *Materiały Archeologiczne* 8, 39-46.

Kozłowski J. K. 2004. *Świat przed „rewolucją" neolityczną* (= *Wielka Historia Świata* 1). Kraków: Wydawnictwo Świat Książki.

Kozłowski J. K. 2006. The Moustero-Levalloisian and/or the Levallois-Mousterian: their place in the evolution and differentiation of the Mousterian techokomplex. In S. K. Kozłowski (ed.), *Wylotne and Zwierzyniec: paleolithic sites in Southern Poland*. Warszawa, Kraków: Instytut Archeologii i Etnologii PAN, 401-416.

Kozłowski J. K. and Kozłowski S. K. 1977. *Epoka kamienia na ziemiach polskich*. Warszawa: PWN.

Krukowski S. 1939-1948. Paleolit. In *Prehistoria ziem polskich*, z. 1 (= *Encyklopedia Polska P.A.U. 4/1*). Kraków: Polska Akademia Umiejętności.

Mańka D., Milewski M. and Targosz M. 2004. Neanderthal economy: recycling stone tools at Poland's Wylotne Shelter. *Antiquity* 78 (301), http://antiquity.ac.uk/projGall/manka/index.html.

Mańka D., Milewski M. and Targosz M. 2006. Homo neanderthalensis economicus – an example of reusing of the raw material in Middle Palaeolithic site Wylotne, Poland. In A. Wiśniewski, T. Płonka and J. M. Burdukiewicz (eds), *The stone: technique and technology*. Wrocław: Uniwersytet Wrocławski, Instytut Archeologii, SKAM Stowarzyszenie Krzemieniarskie, 91-96.

Migal W. and Urbanowski M. 2006. Pradnik knives reused. Experimental approach. In A. Wiśniewski, T. Płonka and J. M. Burdukiewicz (eds), *The stone: technique and technology*. Wrocław: Uniwersytet Wrocławski, Instytut Archeologii, SKAM Stowarzyszenie Krzemieniarskie, 73-89.

Ocherednoi A. K., Vishnyatsky L. B., Voskresenskaya E. V. and Nehoroshev P. 2014. News from the north-east fringe of Neanderthal Europe: recent work at Khotylevo 1 (Bryansk Oblast, Russia). *Antiquity Project Gallery* 88 (341), http://journal.antiquity.ac.uk/projgall/ocherednoi341.

Ocherednoi A. K., Salnaya N. V., Voskresenskaya E. V. and Vishnyatsky L. B. 2014a. New geoarcheological studies at the Middle Palaeolithic sites of Khotylevo 1 and Betovo (Bryansk Oblast, Russia): some preliminary results. *Quaternary International* 326-327, 250-260.

Picin A. 2016. Short-term occupations at the lakeshore: a technological reassessment of the open-air site Königsaue (Germany). *Quartär* 63, 7-32.

Richter J. 2016. Leave at the height of the party: A critical review of the Middle Palaeolithic in Western Central Europe from its beginnings to its rapid decline. *Quaternary International* 411, 107-128.

Rolland N. 2010. The early human occupation of high latitudes, boreal, continental and periglacial habitats: Middle Palaeolithic milestones in Northern Eurasia. In J. M. Burdukiewicz and A. Wiśniewski (eds), *Middle Palaeolithic Human Activity and Palaeoecology: New Discoveries and Ideas* (= *Studia Archeologiczne* 41). Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego, 15-46.

Schild R. (ed.) 2005. *The Killing Fields of Zwoleń. A Middle Paleolithic Kill-Butchering-Site in Central Poland*. Warszawa: Instytut Archeologii i Etnologii PAN.

Shackley M. 1974. Stream abrasion of flint implements. *Nature* 248, 501-502.

Shackley M. 1978. The behaviour of artefacts as sedimentary particles in a fluviatile environment. *Archaeometry* 20, 55-61.

Skrzypek G., Wiśniewski A. and Grierson P. 2011. How cold was it for Neanderthals moving to Central Europe during warm phases of the last glaciation? *Quaternary Science Reviews* 30, 481-487.

Sobczyk K. 1975. Problem prądnika w świetle taksonomii numerycznej. *Sprawozdania Archeologiczne* 27, 255-268.

Solon J., Borzyszkowski J., Bidłasik M., Richling A., Badora K., Balon J., Brzezińska-Wójcik T., Chabudziński Ł., Dobrowolski R., Grzegorczyk I., Jodłowski M., Kistowski M., Kot R., Krąż P., Lechnio J., Macias A., Majchrowska A., Malinowska E., Migoń P., Myga-Piątek U., Nita J., Papińska E., Rodzik J., Strzyż M., Terpiłowski S. and Ziaja W. 2018. Physicogeographical mesoregions of Poland: verification and adjustment of boundaries on the basis of contemporary spatial data. *Geographia Polonica* 91(2), 143-170. DOI 10.7163/GPol.0115.

Stapert D. 1976. Some natural surface modifications on flint in the Netherlands. *Paleohistoria* 18, 7-41.

Sudoł M. 2013. *Kultura mikocka na ziemiach polskich*. Manuscript of PhD thesis, Toruń: Instytut Archeologii UMK.

Sudoł M. and Cyrek K. 2013. Modyfikacje środkowopaleolitycznych wyrobów kamiennych na wybranych przykładach. In M. Nowak, D. Stefański, and M. Zając (eds), *Retusz – jak i dlaczego? „Wieloperspektywiczność elementu twardzowego"* (= *Prace Archeologiczne* 66). Kraków: Instytut Archeologii Uniwersytetu Jagiellońskiego, 29-46.

Targosz M. 2006. Analysis of the flint material of Micoquian-Pradnikian culture from layer 6 at Wylotne Rockshelter in Ojców. In S. K. Kozłowski (ed.), *Wylotne and Zwierzyniec: paleolithic sites in Southern Poland*. Warszawa, Kraków: Instytut Archeologii i Etnologii PAN, 161-177.

Thiry M., Fernandes P., Milnes A. and Raynal J. P. 2014. Driving forces for the weathering and alteration of silica in the regolith: Implications for studies of prehistoric flint tools. *Earth-Science Reviews* 136: 141-154.

Tomaszewski A. J. 2005. Lithic Artifacts. In R. Schild (ed.), *The Killing Fields of Zwoleń. A Middle Paleolithic Kill-Butchery-Site in Central Poland*. Warszawa: Instytut Archeologii i Etnologii PAN, 139-190.

Twardy J. 2008. *Transformacja rzeźby centralnej części Polski Środkowej w warunkach antropopresji*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.

Twardy J. and Forysiak J. 2011. Charakterystyka środowiska geograficznego okolic stanowiska archeologicznego Polesie 1 oraz neoholoceńskie zmiany jego budowy geologicznej i rzeźby. In J. Górski, P. Makarowicz and A. Wawrusiewicz (eds), *Osady i cmentarzyska społeczności trzcinieckiego kręgu kulturowego w Polesiu stanowisko 1, woj. łódzkie* 1 (= *Spatium Archaeologicum* 2). Łódź: Instytut Archeologii Uniwersytetu Łódzkiego, 227-250.

Urbanowski M. 2003. *Noże prądnickie jako element specyfiki techno-stylistycznej zespołów mikockich*. Manuscript of PhD thesis. Warszawa: Instytut Archeologii UW.

Valde-Nowak P., Alex B., Ginter B., Krajcarz M., Madeyska T., Miękina B., Sobczyk K., Stefański D., Wojtal P., Zając M. and Zarzecka-Szubińska K. 2014. Middle Paleolithic sequences of the Ciemna Cave (Prądnik valley, Poland): The problem of synchronization. *Quaternary International* 326-327, 125-145.

Valde-Nowak P., Alex B., Ginter B., Krajcarz M., Madeyska T., Miękina B., Sobczyk K., Stefański D., Wojtal P., Zając M. and Zarzecka-Szubińska K. 2016. Late Middle Palaeolithic occupations in Ciemna Cave, southern Poland. *Journal of Field Archaeology* 41(2), 1-18. DOI: 10.1080/00934690.2015.1101942

Van Peer P. 1992. *The Levallois Reduction Strategy* (= *Monographs in World Archaeology* 13). Madison: Prehistory Press.

Waga J. M., Foltyn E. and Sady A. 2009. Stanowisko w Gardawicach na Górnym Śląsku – potwierdzenie modelu migracji ludzi na przedpolu lądolodu odrzańskiego. In L. Domańska, P. Kittel and J. Forysiak (eds), *Środowiskowe uwarunkowania lokalizacji osadnictwa*. Poznań: Bogucki Wydawnictwo Naukowe, 29-38.

Wąs M. 2009. Problemy badawcze środkowopaleolitycznych materiałów krzemiennych z Mazowsza. Przypadek Polesia 1, pow. Łowicz. *Abstract book 6th SKAM Flint Technology Workshop, Małkocin 27-30.X.2009*. Szczecin, Małkocin, 14.

Wąs M. and Migal W. 2017. Środkowopaleolityczne ostrze znalezione nad Wisłą w okolicach Warszawy. In A. Marciniak-Kajzer, A. Andrzejewski, A.Golański, S. Rzepecki and M. Wąs (eds), *Nie tylko krzemienie – not only flints. Studia ofiarowane prof. Lucynie Domańskiej w 45-lecie pracy naukowo-dydaktycznej i w 70. rocznicę urodzin*. Łódź: Instytut Archeologii Uniwersytetu

Łódzkiego, Łódzka Fundacja Badań Naukowych, Stowarzyszenie Naukowe Archeologów Polskich, Oddział w Łodzi, 21-32.

Weiss M., Lauer T., Wimmer R. and Pop C. M. 2018. The Variability of the Keilmesser-Concept: a Case Study from Central Germany. *Journal of Paleolithic Archaeology* 1, 202–246.

White M. J. and Pettitt P. B. 2011. The British Late Middle Palaeolithic : an interpretative synthesis of Neanderthal occupation at the northwestern edge of the pleistocene world. *Journal of World Prehistory* 24(1), 25-97.

Wiśniewski A. 2006. *Środkowy paleolit w dolinie Odry*. Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego.

Wiśniewski A. 2012. *Przejawy zachowań technologicznych ludzi u schyłku plejstocenu środkowego. Przykłady z Europy Środkowej* (= *Studia Archeologiczne* 44). Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego.

Wiśniewski A. 2016. The First humans. Societies of the Lower and Middle Palaeolithic. In J. Kabaciński (ed.), *The Past Societies. Polish Lands from the First Evidence of Human Presence to the Early Middle Ages, vol. 1: 500,000 – 5,500 BC.* Warszawa: Instytut Archeologii i Etnologii Polskiej Akademii Nauk, 46-96.

Wiśniewski A., Adamiec G., Badura J., Bluszcz A., Kowalska A., Kufel-Diakowska B., Mikołajczyk A., Murczkiewicz M., Musil R., Przybylski B., Skrzypek G., Stefaniak K. and Zych J. 2013. Occupation dynamics north of the Carpathians and Sudetes during the Weichselian (MIS5d-3): The Lower Silesia (SW Poland) case study. *Quaternary International* 294, 20-40.

Wiśniewski A., Lauerb T., Chłoń M., Pyżewicz K., Weiss M., Badura J., Kalicki T. and Zarzecka-Szubińska K. 2019. Looking for provisioning places of shaped tools of the late Neanderthals: a study of a Micoquian open-air site Pietraszyn 49a (southwestern Poland). *Palevol* 18(3), 367-389.

Wojtal P. 2007. *Zooarchaeological studies of the Late Pleistocene sites in Poland*. Kraków: Institute of Systematics and Evolution of Animals Polish Academy of Sciences.

Żarski M., Winter H., Nadachowski A., Urbanowski M., Socha P., Kenig K., Marcinkowski B., Krzemińska E., Stefaniak K., Nowaczewska W. and Marciszak A. 2017. Stratigraphy and palaeoenvironment of Stajna Cave (southern Poland) with regard to habitation of the site by Neanderthals. *Geological Quarterly*, 61(2), 350–369. DOI: 10.7306/gq.1355.