

ARCHAEOLOGICAL SOURCES IN THE REGION OF WIETRZYCHOWICE CULTURE PARK. NON-INVASIVE PROSPECTION AND ABIOTIC ELEMENTS OF GEOGRAPHICAL ENVIRONMENT. SUMMARY

Introduction

(Piotr Papiernik)

The current publication has been created thanks to the implementation of the project “Study and Publication of the Results of Non-invasive and Interdisciplinary Research in the Region of Wietrzychowice Culture Park” financed by the Minister of Culture and National Heritage as part of the programme “Preserving Archaeological Remains”. The study presents the results of non-invasive prospection performed within three stages of the task “Archaeological Sources in the Region of Wietrzychowice Culture Park”, conducted in the years 2013-2018, and supplemented by work completed as part of statutory activities of the Museum of Archaeology and Ethnography in Łódź and Professor Konrad Jażdżewski Foundation of Archaeological Research.

The history of archaeological research in the region of Wietrzychowice dates back to 1873, when the “admirer of antiquities” – Natalia Kicka, together with count Józef Bniński excavated the Kuyavian long barrow at Żurawica (N. Kicka 1987). The end of the 19th c. and the beginning of the 20th c. is the period when amateur archaeologists describe and unearth “giants’ graves”, inter alia, at Tymień and Komorowo. The first fully scientific archaeological research in the region of Wietrzychowice was begun by Professor Konrad Jażdżewski in 1934. During three seasons of field works, he discovered and excavated clusters of long barrows at Leśniczówka (K. Jażdżewski 1935, 1936a), Obałki (K. Jażdżewski 1936c, 1936e) and Wietrzychowice (K. Jażdżewski 1936b, 1936h). Together with Stanisław Madajski, Professor made an inventory survey of over 30 of this type of features located in the region of today’s communes of Izbica Kujawska, Lubraniec, Topólka and Boniewo (K. Jażdżewski 1936f). The development of research was disrupted by World War II. Further works on the long barrows were resumed in the late 1940s and the early 1950s (W. Chmielewski 1952). The research conducted by the Museum of Archaeology and Ethnography in Łódź under the supervision of Professor Konrad Jażdżewski resulted in the exploration and reconstruction of clusters of the long barrows at Wietrzychowice (I. Jadczykowska 1970, 1971), Sarnowo (W. Chmielewski 1952; L. Gabałówna 1968, 1969; H. Wiklak 1975, 1982, 1983, 1986) and one feature at Gaj (W. Chmielewski 1952). Thanks to Professor’s efforts, the long barrows were protected as part of Archaeological Park and Nature Reserves, which in the 21st c. were transformed into Wietrzychowice Culture Park at Wietrzychowice and Gaj and Sarnowo Culture Park (c.f. P. Papiernik 2016a).

Archaeological research in the region of Wietrzychowice was resumed by the Museum of Archaeology and Ethnography in Łódź and Professor Konrad Jażdżewski Foundation of Archaeological Research in 2009. It aims at multidisciplinary research which would facilitate the recognition of archaeological finds from the Stone Age and elements of geographical environment in the region of Wietrzychowice Culture Park. The programme entails excavations of the Funnel Beaker culture sites (settlements and cemeteries), and the verification of archival data of unexcavated Kuyavian long barrows. Until 2020, the works have been conducted at 7 sites (Gaj, site 1, Lubomin, site 5, Osiecz Mały, sites 8 and 8A, Śmieły, site 3, 9 and 10 and Wietrzychowice, site 1). Alongside the excavations, archaeological-nature research was conducted by means of three trenches wet-excavated, which resulted in discovering biogenic sediment in the close vicinity the sites at Osiecz Mały and Śmieły. Other research referring to the area in question included the geological, geomorphological and the soil cover studies. The third element of the work was a comprehensive non-invasive prospection, which was conducted during the implementation of the third edition of the task “Archaeological Sources in the Region of Wietrzychowice Culture Park”. The research focused on the area designated by four sheets of Polish Archaeological Record (AZP) (no 52-45, 52-46, 53-45, 53-46), which at the same time mark the boundaries of the explored area, symbolically known as “the region of Wietrzychowice Culture Park”. It is almost exclusively situated in the district of Włocławek, province of Kuyavia-Pomerania, in the area of the communes of Izbica Kujawska, Boniewo,

Lubraniec and Chodecz (fig. 1). In geographical terms, the discussed area belongs to the Kuyavian Lakeland, which is part of the Greater Poland Lakeland (after J. Kondracki 2002).

The results of the conducted works in the area in question will be successively published in the editorial series "Archaeological Sources in the Region of Wietrzychowice Culture Park", as part of the previously mentioned research. The first research topic included in the current publication refers to the results of non-invasive prospection. The next volumes will present the results of archaeological works conducted at megalithic settlements and cemeteries of the Funnel Beaker culture, as well as the effects of archaeological-nature research.

Non-invasive research methods used in the region of Wietrzychowice Culture Park

(Piotr Papiernik, Rafał Brzejszczak, Piotr Kittel, Wojciech Tołoczko, Joanna Wicha, Piotr Wroniecki)

While conducting archaeological works in the region of Wietrzychowice Culture Park, five different non-invasive research methods have been applied. These include: verification reconnaissance survey, detailed archaeological inventory survey on the surface of the site, air prospection, geophysical prospection and geochemical prospection.

Reconnaissance survey

Reconnaissance survey has been conducted in four areas of the Archaeological Picture of Poland (numbers: 52-45, 52-46, 53-45, 53-46) covering 160 sq km (fig. 1). Systematic archaeological works were conducted in the years 2009-2018.

The works have yielded artefacts dated from the late Palaeolithic to the late Middle Ages found at 1.4 thousand archaeological sites, over one thousand of which were newly discovered (fig. 2). The above results were obtained with the assumption that the whole area has to be penetrated twice, and that optimum time is chosen for conducting archaeological works. Double penetration of the explored area is necessary to eliminate all types of temporary obstacles, connected with the changeability of crops and agricultural works. On the basis of our own, long experience it was assumed that the prospection would be conducted at the end of winter and the beginning of spring, i.e. after the melting of the snow cover and before resuming spring field agricultural works (fig. 3). This period is conducive for observation, due to the fact that most ground is void of vegetation, or the latter is very low and still frozen, whereas the upper soil layer is rinsed by rain and thaw water. This is particularly important in areas with heavy soils on clayey substrate. The above conditions are necessary for the discovery of small archaeological artefacts, particularly flint stones. In practical terms, the period of optimum observation in consecutive years did not exceed two weeks and occurred between the 20th of February and the 20th of March. Only in 2013, as a result of heavy snowfall at the end of March and the beginning of April, were the archaeological works carried out at the beginning of April.

Autumn reconnaissance survey was deliberately abandoned. This part of year is considerably less conducive for observation. Some fields are still being cultivated or covered by aftercrops. They also undergo works connected with harvesting or preparing land for winter season. Moreover, the winter cereals sown in September are at the stage of vegetating and intensive growth, which makes field observation very difficult. Our over 20-year experience indicates that spring prospection in Kuyavia is twice as efficient as the autumn one. This does not only refer to the number of the recorded archaeological sites, but the assemblages of artefacts obtained as a result of the works. During the spring penetration they are considerably more numerous and diversified in terms of chronology and raw material.

During the works, the unearthed movable artefacts were marked on topographic maps at the scale 1:10 000. Additionally, an orthophotomap and GPS tracking unit were used for a better terrain orientation. Archaeological sites were continuously designated during the reconnaissance survey. The boundaries between particular sites were designated with the help of the record of the spatial distribution of

artefacts and its chronological assessment, as well as the analysis of landform. Documentation of the research was completed in accordance with the rules presented in the study “Archaeological Picture of Poland. Instructions for Completing Documentation of Reconnaissance Survey and Filling In the Catalogue Card of Archaeological Artefact” issued by the National Heritage Board of Poland.

The examined area was, in its major part, accessible to reconnaissance survey observation. The terrain encompassed arable land, which underwent systematic cultivation, mainly of crops and root crops. In some areas, the observation was hampered by forests or in towns (Izbica Kujawska) or larger villages (Błenna, Lubomin) by buildings. It can be assumed that the above obstacles constitute slightly over 10% of the excavated area. As a result, they should not be very significant for the obtained results of the reconnaissance survey.

The reconnaissance survey resulted in the positive verification or unearthing a number of sites, containing artefacts from the Stone Age. These include artefacts typical of particular cultural-chronological levels with the following provenience:

1. Late Palaeolithic – 10 sites
2. Mesolithic – 59 sites
3. Linear Pottery culture – 48 sites
4. Stroke-ornamented ware culture or/and the Brześć Kujawski group of the Lengyel culture – 9 sites
5. Funnel Beaker culture – 497 sites
6. Globular Amphora culture – 107 sites
7. Corded Ware culture – 12 sites

The explored archaeological sites were crucial for conducting various analyses and types of research presented in other sections of the current publication. It should be assumed that the remains of the Stone Age are present in a larger number of sites. However, these are flint artefacts with no distinctive features that would allow them to be attributed to particular cultures. Sometimes it is possible they may be dated to the Bronze Age.

Detailed archaeological inventory survey on the surface of the sites

A detailed reconnaissance survey, which involved a geodetic, three-dimensional record of all archaeological artefacts was conducted on the surface of the selected sites. During excavations, each unearthed artefact was allocated a different inventory number and a detailed location XYZ, with error below 2 cm. In the years 2015-2016 terrain analysis was conducted by means of a laser tachometer (fig. 4). Since 2017 GPS Hi-Target surveying instrument has been used, together with iHand controller, working in the RTK mode (fig. 5). Obtaining georeferenced data enables the correlation and comparison of the results of non-invasive research.

A detailed archaeological inventory survey was conducted at 24 sites. The works were carried out in two settlements of the Linear Pottery culture, as well as sixteen settlements, six cemeteries and two settlement points of the Funnel Beaker culture. The excavations have yielded diverse movable artefacts. Between 48 and 3890 objects have been unearthed at particular sites. In most cases these are small-size artefacts. Pottery fragments between 1cm and 2cm were prevalent. Large fragmentation prevented their cultural attribution. Consequently, most artefacts were dated to very general chronological categories, such as: the Neolithic, late Neolithic, early Bronze Age, Bronze Age, or even pre-historic times.

In the whole research programme, the analysis of spatial distribution of artefacts has been regarded as the basic method, which allowed the description of the excavated sites in terms of settlement chronology, its spatial diversity and the extent of artefact preservation. The application of numerical spatial distribution system enabled analysing data according to chronological, raw material and typological division of particular assemblages. In the case of some sites it was possible to determine the area of inhabitation, corresponding with different inhabitation phases. It was also possible to distinguish elements which would reflect spatial planning, especially the Linear Pottery culture and the Funnel Beaker culture settlements. Moreover, data referring to the detailed location of artefacts enabled the verification of aerial, geophysical and geochemical prospection by means of archaeological objects. It was possible to compare cultural layers, recessed features, and most importantly, underground structures and deconstructed mounds of the Kuyavian long barrows.

Aerial prospection

The research relied on aerial prospection as the basic method used to locate the archival Kuyavian long barrows, as well as search for new features, unknown from written accounts from the 19th and 20th c (R. Brzejszczak, P. Papiernik 2017). Moreover, it was used for the exploration of the settlements from the Funnel Beaker culture and the Linear Pottery culture, where a detailed archaeological inventory survey was conducted.

In the years 2013-2014 aerial prospection was conducted from the board of a plane. Four flights were conducted in that period. They were not sufficient for the needs of the planned research. Therefore, since 2014, unmanned aircraft has been used for aerial prospection, steered by means of radio waves. It was an eight-rotor drone on platform DJI S1000, equipped with gimbal Zenmuse Z15 with a camera and a video camera Panasonic GH3, as well as the possibility of recording image with the resolution 16.1 megapixels and film with the resolution "Full HD" (fig. 6). The application of this type of equipment provides broader possibilities than flying over an explored area several times. The advantage of a drone is evident in the freedom of steering and being able to regulate the height and length of flights. Importantly, it is also possible to have a greater flexibility of the flight time and to react more quickly to the changing conditions of the observed terrain. A complete control over flight parameters, such as flight altitude, and the angle of taking photographs allows for the maximum information to be obtained. It is possible to take several hundred photographs during a single flight, which lasts over a dozen minutes, including the condition of hovering.

Overall, during the project, 200 flights had been conducted, during which 35 839 photographs had been taken over an area of c.a. 38 sq km. The photographs were taken in different seasons (between February and October) and aimed at capturing vegetation or soil discriminants, which would point to the presence of archaeological features. The flight altitude of particular flights varied between 85 and 210 m and the surface of the prospection area during a single flight varied from 10 to 80 ha. The prospection is based on photographing the same place multiple times in order to confirm the observation in the conditions of different humidity and lighting of the terrain and in different crop vegetation periods. After positive interpretation, the aerial documentation is rectified on the basis of characteristic terrain points, and then the photographs are georeferenced.

The aerial prospection resulted in establishing or credibly identifying the location of five archival clusters of long barrows (Leśniczówka, site 1; Lubomin, site 5; Łania, site 1; Obalki, site 1; Tymień, site 11) and three single long barrows (Osiecz Mały, site 8A; Skarbanowo, site 14; Śmiely, site 1). Most probably there were seven remains of long barrows, not previously mentioned in the literature on the subject (the region of Błenna, Chociszewo, Gaj, Kazimierowo, Osiecz Mały, Józefowo, Wiszczelice). Most of them were only observed in 2018 or 2019 and require further non-invasive research.

Aerial prospection was also used in non-invasive research of twelve settlements of the Funnel Beaker culture and the Linear Pottery culture. In those cases, there were records of pre-historic settlement features, the range of the so called cultural layer, as well as modern and contemporary changes in landform, i.e. no-longer present building development, utility features, as well as elements of defence systems from World War I and II.

Geophysical prospection

Geophysical research as a non-invasive method of archaeological prospection enables the recognition of surface traits of geological layers with no direct penetration of the structure of the ground. On the basis of the prospection results, it is possible to indicate the place of the potential presence of archaeological structures and determine their characteristics. Geophysical methods are sensitive to many kinds of remains of past human activity and the resulting from those subsequent changes in geological structure. The interpretation of the obtained assemblage of artefacts is based on the analysis of the contrast between natural geological background and visible changes in the value of the measured traits.

Magnetic measurement method is used for fast measurement of an area and for detecting many types of features. They are particularly sensitive to features which underwent thermal processing and which contain ferromagnets. They allow detection of : pits, intrusions, daub, brick, charred timber, kilns

or hearths. The research was conducted by means of 2-axis magnetometer (fig. 7). The total explored area equals 36.5 ha.

Electrical Resistivity measurement method has been used to supplement the previously mentioned magnetic prospection. It allows finding differences in geological build and subsurface structures. On the basis of the results it was possible to distinguish high and low resistivity zones. The former may be connected with the fills of archaeological features, filled-in trenches and disturbed stratigraphic points (intrusions). The latter usually indicate places of accumulation of larger rock crumbles, such as walls, rows of stones or rocky debris. The data were recorded by means of Geoscan Research RM-15D Advanced, in configuration with electrodes *Wenner* with electrodes 0.5 m apart and the density of measurement 1x1 m (fig. 8). The total explored area equals c.a. 3 ha.

Georadar measurement method has been used to supplement the picture of stratigraphy of subsurface structures. The results are presented in the form of georadar cross-sections. The georadar used in the research was Utsi Electronics brand, equipped with the shielded antenna, with 400 MHz frequency. The measurements were obtained in cross-sections 1m apart from one another. The total explored area equals 1.5 ha.

The final result of digital processing of geophysical data is their two-dimensional visualisation at the scale of 256 shades of grey, so called "time-slice". In most cases it allows obtaining optimum information which may attest the presence of subsurface archaeological features on the basis of the analysis of anomalies' shapes.

Geochemical phosphate field prospection

Geochemical analysis of phosphorus content was carried out as part of non-invasive archaeological research. In the years 2015-2018, 2302 soil samples were tested in a total area of approximately 0.41 sq m (the sites of: Wietrzychowice, Osiecz Wielki, Pawłówek, Tymień and Łania). Samples for analysis were taken from the test grid (10 x 10 m or 10 x 20 m), from the depth of 1.0 m, most often from the substrate deposits, using a hand auger, Eijkelkamp.

A simplified method of field determination of phosphorus in soil was developed. It was based on R. Eidt's (1973) method and modified (P. Kittel and M. Sygulski 2010, P. Kittel et al. 2017, P. Sikora et al. 2017). According to Arrhenius (1950), the molybdate method was used for the determination of phosphorus. The modification of the field method was developed by W. Tołoczko (Department of Physical Geography, University of Lodz) and P. Kittel (Department of Geomorphology and Palaeogeography, University of Lodz).

The applied method consists of placing on a sheet of filter paper two soil samples measured with special templates and their mineralization during which organic, inorganic and mineral forms of phosphorus are converted into orthophosphoric anions. After mineralization in nitric acid with the addition of molybdenum anions, the new forms of phosphorus give a yellow colour from β -phosphomolybdic acid.

Then, after adding 4 drops of an aqueous solution of L-ascorbic acid, phosphomolybdenum blue is formed, blue in colour. The size and intensity of the blue colour on the filter paper is a measure of the amount of phosphorus in the tested soil sample.

In our research, the assessment of phosphorus content in soil was carried out according to the adopted scale in the range from 0 to 5 degrees, where 0 means no phosphorus or its very low level, and 5 an exceptionally high content of phosphorus in the soil.

Non-invasive reserach of Kuyavian long barrows situated in the region of Wietrzychowice Culture Park

(Piotr Papiernik, Rafał Brzejszczak, Joanna Wicha, Piotr Wroniecki, Piotr Kittel)

One of the major aims of non-invasive research in the region of Wietrzychowice Culture Park is the location of "archival" cemeteries of the communities of the Funnel Beaker culture. On the basis of detailed 19th and 20th c. accounts it has been established that the cemeteries were found at Gaj (2 long bar-

rows, one of which was excavated by W. Chmielewski in 1952), Komorowo (1 long barrow, unexcavated – K. Jażdżewski 1936f), Leśniczówka (today's Arciszewo, 6 or 7 long barrows, 4 of which were excavated – K. Jażdżewski 1935; 1936a), Lubomin (5 long barrows, unexcavated – K. Jażdżewski 1936d), Obalki (4 long barrows, 3 of which were excavated by K. Jażdżewski and one by W. Kersten (K. Jażdżewski 1936c, e; W. Tetzlaff 1961), Osiecz Mały (1 long barrow, unexcavated – I. Jadczykowa 1970), Śmieły (1 long barrow, unexcavated – I. Jadczykowa 1970), Tymień (at least 5 long barrows excavated by R. von Erckert – W. Chmielewski 1952), Wietrzychowice (5 long barrows, all excavated – K. Jażdżewski 1936b, h; I. Jadczykowa 1970; 1971), Wólka Komorowska (2 long barrows, unexcavated – K. Jażdżewski 1936i). The list should be completed by one or two cemeteries with an undetermined number of long barrows, situated in the region of the following villages: Żurawice, Łania, Sarnowo (K. Jażdżewski 1936f; 1936g; W. Chmielewski 1952), one of which was excavated by N. Kicka (1876). The features from the region of Komorowo and Wólka Komorowska were searched by means of aerial prospection only. The results will be presented elsewhere. The study has been supplemented by the results of non-invasive research of the newly discovered features at Gaj and Osiecz Mały, site 8 (fig. 11).

The search for long barrows was begun by the application of geophysical and aerial prospection, which was followed by geochemical prospection and a detailed archaeological inventory survey on the surface of the sites. Basing on the experience from 2012-2015, it was decided that further works would be conducted by integrating the results of different methods of non-invasive research. Initial recognition of selected areas was conducted on the basis of the analysis of aerial photographs, which turned out to be the most efficient in determining the potential location of the Kuyavian long barrows thanks to the application of a drone. Plausible remains were those characterised by discernible vegetation and soil discriminants, appropriate size and shape. After their verification in different seasons, a detailed search for archival data was conducted (e.g. archival data from the 19th c. and the 1st half of the 20th c.). This was followed by the analysis of landform, in order to rule out natural or modern forms. The next step involved a detailed archaeological inventory survey on the surface of the sites. This aimed at gathering relevant information about the number and spatial distribution of archaeological artefacts, which verified and supplemented data from the aerial prospection. The last stage was geophysical research, due to the considerable cost involved.

Results of research

Gaj, site 1 (AZP 53-45/8)

The works primarily focused on geophysical prospection. In 2014 magnetic measurement was conducted in the area of c.a. 3ha, which allowed determining a detailed location of long barrow no 2. Moreover, it was possible to explore structures connected with the rear part of long barrow no 1 (fig. 13). Additionally, electrical resistivity measurement method was used on some part of long barrow no 2, which completely confirmed the location of the feature. On the basis of geophysical research, comprehensive, rescue excavations of long barrow no 2 had been planned, which were subsequently completed in the years 2014-2016 (P. Papiernik, J. Wicha, D. K. Płaza 2018).

Gaj, site 3 (AZP 53-45/10)

In 2015 vegetation discriminants were recorded at the site, whose shape and size resembled a Kuyavian long barrow (fig. 14). These led to detailed research, such as aerial prospection, geophysical prospection and a detailed archaeological inventory survey. The works did not bring about an unambiguous result relating to the presence of the remains of the Kuyavian long barrow. However, we are of the opinion that there was a megalith built by the communities of the Funnel Beaker culture, which is implied by the aerial prospection and a detailed archaeological inventory survey. It is possible to observe a clear correlation between the distribution of pottery material of the Funnel Beaker culture which, together with flint artefacts, form one, not very compact cluster (covering an area of 20 ares – fig. 16) and the location of the plausible long barrow, determined on the basis of aerial photographs. No confirmed evidence provided by geophysical measurements may result from the extent of destruction of the feature or from its construction, which after 5 thousand years is no longer detectable in magnetic research (c.f. fig. 17).

Gaj Stolarski, site 2 (AZP 53-45/201)

In the years 2015-2019 non-invasive research was conducted at the site, such as aerial prospection, geophysical prospection and a detailed archaeological inventory survey (fig. 12), in order to verify a possible presence of the Funnel Beaker culture cemetery (fig. 12). However, the conducted works did not confirm the assumed location of the remains of the Kuyavian long barrows. Detailed results of archaeological works (c.f. fig. 15, 16) and geophysical research (fig. 16, 17) confirm one another. Consequently, the presence of a megalithic cemetery at the site in question should be ruled out.

Leśniczówka, site 1 (AZP 52-46/78)

In the years 2015-2017 intensive aerial prospection was carried out (fig. 19) in the region of site no 1 at Leśniczówka (today's Arciszewo). It aimed at a precise location of a megalithic cemetery of the Funnel Beaker culture, especially features unexplored before World War II.

Archaeological works at Leśniczówka, site 1, were begun by K. Jażdżewski, who unearthed and described 6 long barrows, 4 of which were excavated. He also published the results of the works (1936; c.f. W. Chmielewski 1952), including a situational map of the works at the site and a selection of photographs taken during the excavations. On the basis of his works, K. Jażdżewski (1936) concluded that the site was a megalithic settlement and cemetery of the Funnel Beaker culture.

The conducted aerial prospection helped find clear traces of a cluster of three long barrows, excavated in the 1930s (long barrows no I, III and IV – fig. 21). The fourth long barrow (no II) excavated by K. Jażdżewski was located south of the other three – previously mentioned features. According to the information provided by K. Jażdżewski (1936), the cemetery at Leśniczówka consisted of 6 or 7 long barrows. The conducted prospection allowed, with great probability, locating two of them (fig. 22). The first feature of the completely levelled long barrow is situated c.a. 160m north of the main cluster. It is c.a. 80 m long, oriented along the line NE-SW (fig. 22B), i.e. similarly to the features excavated in 1934. The other feature is probably 300 m away in the direction of south-west. Unlike other long barrows at the site, its axis would go along the line N-S, with a slight inclination westwards (fig. 22A). As regards the long barrow in question, it is important to observe its quite regular layout, discernible at the front (fig. 22A). It seems that these are remains of the so called cult building, similar to the ones that were excavated at Gaj and Obalki (W. Chmielewski 1952). However, during the prospection it was not possible to find the last long barrow at the cemetery at Leśniczówka. It is likely that it is situated in the area of one of the nearby forests and as such it was impossible to detect during the prospection. Besides, it was probably already heavily destroyed, as K. Jażdżewski described it as “plausible”. Aerial prospection also allowed recording different types of discriminants: soil, vegetation and humidity ones which would indicate the location of features connected with the community of the Funnel Beaker culture, which was also mentioned in the literature on the subject (K. Jażdżewski 1936; H. Młynarczyk 1982).

Lubomin, site 5 (AZP 52-45/66)

The first account of the Kuyavian long barrows at Lubomin comes from 1936. According to K. Jażdżewski (1936d) five features were discovered in the village of Lubomin Poduchowny, four of which were heavily destroyed by field works. The fifth one was preserved to the height of 2 m. It was 11 footsteps wide and c.a. 40 footsteps long. All features were void of cairns, which had been deconstructed during World War I and used by the German army to build local roads. K. Jażdżewski provided information about making maps of the features and photographing the long barrows. The documentation, however, went missing during World War II.

During reconnaissance survey in 2013, an earthen mound was discovered, whose length and shape resembled the Kuyavian long barrows (c.f. fig. 23). On the basis of the archival data, it has been concluded that these are probably remains of long barrow no 1, described by K. Jażdżewski.

In order to verify the assumption that the remains of the long barrow are part of the “archival” cemetery, described by K. Jażdżewski, works were conducted at the site, mainly of non-invasive character. Long barrow no 1 was explored first. It was visible at the top of a small terrain elevation. Aerial prospection indicated that the mound was damaged by the extraction of sand and gravel. From the east, the photographs present a layout of a gravel pit, which provided raw material for building a local road in the

1990s (c.f. fig 24:A). Consequently, rescue works were conducted which aimed at documenting the layers of the long barrow at a section of 45 m, visible in the escarpment of the gravel pit (fig. 24:B). Apart from the damaged section, it was possible to observe the top of the long barrow in the archaeological trench. The feature was explored by means of a magnetic method and a georadar, which helped detect the primary layout of the base and the eastern wall. On the basis of the conducted works it can be assumed that the long barrow was c.a. 68 m long, 10 m wide and was oriented along the line N-S with an inclination of 15° westwards (fig. 25). In the years 2014-2018 aerial prospection of the site was carried out a number of times in order to find the other long barrows described by K. Jażdżewski. In total, 12 flights were performed as a result of which different soil and vegetation discriminants were observed. On the basis of those, it was possible to determine the location of at least 4 long barrows. It should be underlined that during a single photographic session, the features in question looked very distinct. As a rule, only some of them were visible and not always in the same way. The final interpretation of the aerial prospection was based on fragmentary data obtained from a number of flights (c.f. fig. 27). The next stage was making a double detailed archaeological inventory survey, which indicated that the area of the site had been intensively inhabited in the past. The observed spatial distribution of vessel fragments of the Funnel Beaker culture is quite essential. Their considerable number was recorded within the boundaries or in the close vicinity of the mounds of the long barrows (c.f. fig. 28, 29). Other materials of the Funnel Beaker culture form two small clusters with not-numerous artefacts, which may be interpreted as the remains of a short-lived activity, possibly linked with the functioning of a cemetery. Geophysical prospection provided further data. It was made by means of a magnetic method with the use of a georadar (fig. 31). Both methods confirmed the presence of underground structures in the places indicated by aerial prospection. In three cases the correlations are so great that coincidental similarity has to be ruled out (c.f. fig. 27 and 31).

To sum up the research at site 5 at Lubomin, it should be observed that diversified non-invasive research conducted over the period of 6 years allowed the recognition of the Funnel Beaker culture cemetery, which seemed completely damaged. The cemetery most probably consisted of 5 or 6 long barrows, out of which 4 or 5 formed a compact cluster in the southern part of the site. The group was constructed along the line E-W, with the bases in the east. The sizes of the long barrows are difficult to determine, but it can be supposed that their length was diversified. The longest long barrow may have reached the length of 100 m. It is worth pointing out additional structures at the front of two long barrows, which were observed in aerial photographs and in one case in geophysical prospection. Most probably these are remains of cult buildings, analogous to the ones excavated at Gaj (long barrow no 1 – W. Chmielewski 1952, long barrow no 2 – c.f. P. Papiernik, J. Wicha, D. K. Płaza 2018), Obalki (K. Jażdżewski 1936e) or Leśniczówka (K. Jażdżewski 1936a).

Łania, site 1 (AZP 52-46/24)

The Funnel Beaker culture cemetery in the region of the villages : Żurawica, Łania and Sarnowo was excavated by N. Kicka (1876), but its presence was also confirmed by K. Jażdżewski (1936f; 1936g). According to W. Chmielewski (1952) the accounts refer to one cemetery, situated on the boundaries of the three villages.

The remains of the cemetery were searched for with the use of a drone. The penetrated area was very large (fig. 32), as the archival data did not include any relevant information referring to the features' location. Moreover, reconnaissance survey did not bring about any traces of the remains in the area in question. The only indication might be a cluster of quite large erratic boulders, recorded at site 1 at Łania, where in 2013 not very numerous artefacts were unearthed, mainly connected with the Neolithic. The drone flights had not brought about desirable results for quite a long time. In autumn 2016, clearly visible soil discriminants were recorded, which helped determine the possible location of 5 long barrows. Further prospection in 2017 and 2018 confirmed the findings, but they did not provide unambiguous results (c.f. fig. 33). In 2019 works were conducted, which involved a double analysis of spatial distribution of archaeological artefacts at the site. They were performed in the area of 4.3 ha. In total, only 157 objects were recorded (including 114 fragments of pottery, 20 flint artefacts, 21 crumbles of daub and 2 fragments of charred bones – fig. 34). Vessel fragments included 5 fragments of the Linear Pottery culture, 43 fragments of the Stroke-ornamented ware culture or the Brześć Kujawski group of the Lengyel

culture and 14 fragments of the Funnel Beaker culture. Pottery material from the linear cycle was mainly found in the northern part of the site, but some of it was also recorded within the boundaries of long barrow no 4 (c.f. fig. 33). The material attests short-lived inhabitation in the early and middle Neolithic. It is interesting to observe the distribution of vessel fragments of the Funnel Beaker culture, which are spatially connected with all the barrows. The concentration of daub found at the front of long barrow no 3 is also worth considering (fig. 33:B). The observation confirms the account of K. Jażdżewski (1936a, p. 116), who provided information about charred clay in one of the long barrows at Żurawica. During the works at the site, quite a large number of medium-sized stones (c.a. 20-30 cm in diameter) was observed. After their analysis, it turned out that they are linked with the remains of the long barrows, mainly features 1 and 3 (c.f. fig. 33:B).

Relevant information about the location of the long barrows at Łania was provided by geophysical research (fig. 36). It detected underground structures, which confirmed data from the aerial prospection.

To sum up the research at site no 1 at Łania, it should be assumed that the cemetery of the Funnel Beaker culture was found and initially recognised. It consisted of at least 5 Kuyavian long barrows. The current state of research in the area of the site in question does not rule out the presence of other cemeteries in the vicinity. An important premise for further research is finding another possible long barrow in 2019, located 400 m south of the site in question.

Obałki, site 1 (AZP 52-46/84)

The site was unearthened and excavated by K. Jażdżewski in 1936. He recorded 4 Kuyavian long barrows and 2 round kurgans. Three megalithic long barrows of the Funnel Beaker culture were excavated in 1936. During World War II a German archaeologist W. Kersten explored the fourth Kuyavian long barrow and one round kurgan (W. Tetzlaff 1961). During the reconnaissance survey in 2013, the location of the site in question was established on the basis of K. Jażdżewski's documentation, especially the situational map of the site (map extract, scale 1:1000) and a detailed map of the distribution of the long barrows (scale 1:1000).

The area of site no 1 at Obałki underwent systematic drone aerial prospection in the years 2015-2018 (fig. 38). The research aimed at finding the only unexcavated round kurgan and detecting other potential, previously unexplored archaeological features. The long barrows unearthened by K. Jażdżewski were found on a small terrain elevation, in the centre of the photographed area (fig. 38). The land was dramatically transformed in the 20th c. New buildings were erected in the village of Kolonia Obałki, which changed the layout of roads and the division of fields, in comparison with 1936. Local forests had been grubbed up and in some places, sand and gravel was extracted. Some natural reservoirs dried up or were overgrown, while the inhabitants set up several small ponds. All this had an impact on conducting the prospection of site no 1 at Obałki.

Taking into account the above observations, the results of aerial prospection were ambiguous. With great probability, two trenches made by K. Jażdżewski were found (fig. 39) and the place of the long barrow excavated by W. Kersten. Additionally, it seems that the remains of the unexcavated round kurgan were also detected. Aerial photographs revealed the presence of a number of other soil and vegetation discriminants, some of which are of anthropogenic character. It is possible that two round kurgans described by K. Jażdżewski formed part of a larger complex of features of this type. In order to remove any doubts, the site should undergo comprehensive, primarily geophysical, research.

Osiecz Mały, site 8 (AZP 52-46/85)

The site was discovered during the reconnaissance survey conducted in the years 2009-2011. At the end of September and the beginning of October 2011, archaeological probe survey was carried out, followed by rescue excavations of the settlement of the Funnel Beaker culture in the years 2012-2013 (P. Papiernik 2011, 2012, 2013). Additionally, in 2013 verification-probe survey was conducted in the place of the Kuyavian long barrow remains, marked as site 8a. In the same year, comprehensive geophysical research was conducted and the first aerial prospection of the whole area of site 8. On the basis of the results of the research, the remains of an unknown Kuyavian long barrow were found, located next to the settlement of the Funnel Beaker culture.

The possible remains of the Kuyavian long barrow underwent systematic aerial prospection in the years 2013-2019 (fig. 40). Only three times were the vegetation and soil discriminants observed, which could be interpreted as faintly preserved remains of a megalith. The results of magnetic measurement of the place revealed a linear cluster of anomalies, whose size and shape correspond with the Kuyavian long barrows (fig. 41). Further observations were provided by the archaeological inventory survey of artefacts. Vessel fragments of the Funnel Beaker culture, as well as flint artefacts were accumulated in one area (fig. 42:B), which corresponds with the aerial and geophysical prospection. It should be observed that the obtained material of the Funnel Beaker culture are, in spatial terms, clearly separated from the area of the settlement, which is situated further north, in the vicinity of the tunnel valley.

To sum up the search for the Kuyavian long barrow, it should be concluded that there is a number of premises which attest the presence of a megalith at site no 8 at Osiecz Mały. It was probably built beyond the boundaries of the Funnel Beaker culture settlement, along the line SSW-NNE, with the base in the south. Its size is difficult to determine due to the poor state of preservation.

Osiecz Mały, site 8A (AZP 52-46/85)

The search for the Kuyavian long barrow discovered by K. Jażdżewski on the border of the forest and arable fields, c.a. 400 m east of the main cluster of megaliths at Wietrzychowice (I. Jadczyk 1970, fig. 1) was conducted in 2012. Basing on the analysis of magnetic measurement which encompassed 3 ha of arable fields adjacent to the forest, one structure was detected, which with some probability could be interpreted as the remains of a megalith. The area was marked as site 8a in Osiecz Mały. In order to remove any doubts, a verification survey trench was dug in 2013 (covering an area of 150 sq m), which contained traces of a cairn in the form of holes after looted boulders and the completely levelled mound (P. Papiernik, P. Kittel, D. K. Płaza, J. Wicha 2018).

Skarbanowo, site 14 (AZP 52-46/278)

In the search for the Kuyavian long barrow mentioned by K. Jażdżewski (1936) at Skarbanowo, aerial prospection was carried out, covering an area of 250 ha (fig. 44:A), during which 1500 photographs were taken. After many futile attempts, in 2018 two places were chosen as a possible location of the long barrow in question, basing on soil and vegetation discriminants. Following a detailed archaeological inventory survey, the southern part of the excavated area was chosen as a more likely location of the long barrow in question. This is site no 14 at Skarbanowo, where magnetic measurement was conducted in 2019 (fig. 34:B). The obtained results of the research are compatible and indicate Skarbanowo as a plausible location of the “archival” long barrow. However, due to the poor state of preservation of artefacts, its closer description is quite difficult. Aerial observations indicate that the primary length of the long barrow did not exceed 100 m (fig. 48).

Śmięły, site 1 (AZP 53-46/14)

Information about the long barrow at Śmięły was provided by I. Jadczyk (1970), who after K. Jażdżewski states that “350 m south of the main cluster of long barrows” at Wietrzychowice one other long barrow is situated in the area of the village of Śmięły. The long barrow cairn was deconstructed and the mound was levelled in c.a. 1920. I. Jadczyk indicates a possible location (1970, fig. 1) of the feature in question, basing on the documentation from the period before World War II and informs about an unsuccessful attempt to find it by means of a small survey trench dug in 1969.

Another attempt to find the long barrow at Śmięły was resumed in 2013 by conducting geomagnetic research over an area of 3 ha. Unfortunately, it did not bring about desirable results, as no structures corresponding to the searched feature were detected. Further works were carried out with the use of regular aerial prospection. The expected effect was achieved in June 2015, when a characteristic vegetation discriminant was observed during an intensive drought. (c.f. fig. 49:B). On the basis of aerial prospection, geomagnetic measurements were resumed in 2017 (fig. 50). This time, a structure was visible, whose size and shape directly corresponded with the Kuyavian long barrows (fig. 50). It turned out that the previous research had been conducted in an area adjacent to the searched feature from the north. Both in aerial photographs and in the image of the geophysical prospection a regular feature is visible on the eastern

side of the long barrow, which may correspond with the survey trench from 1969 (c.f. fig. 49:B; 50). A detailed archaeological inventory survey was conducted twice in the area of the site, covering 1.5 ha. It provided further valuable information. In the place of the remains of the long barrow and in its close vicinity not-numerous artefacts were found, mainly connected with the Funnel Beaker culture. Other vessel fragments come from the modern period and are linked with cultivating crops in the area (c.f. fig. 49, 50).

To sum up, it should be observed that the search for the long barrow at Śmieły, deconstructed nearly 100 years ago, after many unsuccessful attempts, was culminated with a success. It is essential that during the search, a much larger area was explored and no similar structures were found, which is confirmed by K. Jażdżewski, who pointed out that single Kuyavian long barrows were built beyond the boundaries of larger cemeteries.

Tymień, site 11 (AZP 53-45/147)

The archival cluster of long barrows at Tymień will be presented in the chapter devoted to the research of the settlements of the Funnel Beaker culture.

Wietrzychowice, site 1 (AZP 53-46/18)

Megalithic cemetery at Wietrzychowice was unearthed by K. Jażdżewski in 1934. It was excavated in 1935, and in the following year one well-preserved long barrow, marked as no 3, was reconstructed (K. Jażdżewski 1936, W. Chmielewski 1952). Further excavations at Wietrzychowice were carried out by the expedition of the Museum of Archaeology and Ethnography in Łódź in the years 1967-1969 (I. Jadczykowa 1970, 1971). At the same time the remaining four long barrows from the main cluster at Wietrzychowice were excavated under the supervision of K. Jażdżewski, including the newly discovered one by S. Madajski. An unsuccessful attempt was made to verify the location of the megalith at Śmieły (Z. Błaszczuk, I. Jadczyk, K. Jażdżewski 1970).

In the years 2015-2018 archaeological probe survey was conducted at the site, which aimed at the exploration of settlement structures situated between the long barrows. A total area of 1123.25 sq m was excavated within the boundaries of 28 trenches. Numerous artefacts were unearthed, dated from the Mesolithic to the Middle Ages. The most numerous material belonged to the Stroke-ornamented ware culture, the Funnel Beaker culture, the Sarnowo and the Luboń phase, and from the early Bronze Age. They may be interpreted as the remains of short-lived human activity or small settlements.

In the years 2013-2014 non-invasive research was carried out in the area of Wietrzychowice Culture Park (fig. 42), which involved geochemical analysis and geophysical prospection. The exploration required work in a forested area, mainly with an old-growth forest.

Marking the content of phosphorus in the ground with a field method was conducted in the area of 30 ha. 1501 samples were analysed with hand geological probes (fig. 53).

Within the analysed samples obtained in the area of Wietrzychowice Culture Park, the content of phosphorus was between 0 and 5 degree of concentration. Almost 30% of samples have 2 degrees of concentration, i.e. they are characterised by a medium phosphorus content. 35% of samples have 1 or 0 degree of concentration. Over 20% of samples are at the level of 3 degrees, 12% – 4 degrees and 2% – 5 degrees.

It is considered that the concentration of phosphorus at the level of 0-2 degrees is the concentration of geochemical background. The obtained distribution of phosphorus content in the ground proves intensive, or at times very intensive anthropogenic impact on the environment in at least ¼ of the explored area. This corresponds with a long-lasting inhabitation of an extensive area. Settlement activity that occurred in the area resulted in an increased accumulation of organic remains, especially of animal origin.

The map of the distribution of phosphorus content in the ground presents three larger sample clusters with a high or very high admixture of the element (fig. 53):

I – the north-eastern part of the explored area, in the close vicinity of archaeological site Osiecz Mały no 8. It is the most extensive cluster, containing 15 samples with phosphorus content at the level of 5 degrees and c.a. 70 samples with the content at the level of 4 degrees. Only single, usually scattered samples had 1 or 0 degree of concentration. The area of the cluster encompasses c.a. 6 ha. The extensive area with

a high phosphorus content and the fluid changes in the content indicate the presence of geochemical record of settlement remains, i.e. the continuation of the multi-cultural settlement – site 8 at Osiecz Mały, confirmed by the excavations (fig. 53, 54).

II – the western part of the explored area on the north-western side of the tunnel valley, characterised by the greatest phosphorus concentration in the ground, in the vicinity of a field path. There were 9 samples with phosphorus level at 5 degrees. The character of dispersion of high phosphorus content in the ground indicates that it is a geochemical record of the remains of a settlement. It is additionally confirmed by the presence of a cultural layer with charcoals and fragments of charred daub. The observations are compatible with the reconnaissance survey, during which three sites were discovered in the close vicinity of the forest and two inside the Wietrzychowice forest. They attest the presence of the remains of pre-historic settlement in this area (fig. 53, 54). The material obtained at the sites is mainly connected with the Lusatian culture, but it is also linked with the Funnel Beaker culture and the early Bronze Age.

III – central part of the explored area in the close vicinity of megalithic long barrows. There are 6 points with phosphorus level at 5 degrees and 25 with 4 degrees. Dramatic changes in the phosphorus content in the ground are quite characteristic, as well as numerous samples with low phosphorus content (fig. 53). Such geochemical record is typical of settlement sites, infrequently used or cemeteries with scattered graves. The above observations are compatible with archaeological data, especially the results of the probe survey.

We should pay attention to the presence of eight small clusters of high phosphorus content, marked with letters A-H. These are most probably geochemical traces of settlement points connected with a temporary or infrequent inhabitation of small areas (fig. 53). In the case of cluster A we can indicate its proximity to the Kuyavian long barrow (Osiecz Mały, site 8A). Cluster H is adjacent to the site, marked as 32 in the Archaeological Picture of Poland (AZP) (fig. 54).

To sum up, it should be observed that the obtained results of geochemical prospection, i.e. marking the phosphorus content in the ground with a field method is compatible with the results of archaeological works conducted in the area. At the same time, they allow designating the boundaries of the already discovered archaeological sites and indicating places of potential settlement remains. Consequently, they facilitate efficient planning of further research in the area of Wietrzychowice Culture Park.

The main aim of geophysical prospection was non-invasive exploration of the accessible area of the Wietrzychowice forest with the magnetic method. In connection with heavy forestation of the area, the works were conducted in three regions of Wietrzychowice Culture Park, in the area of 3 ha, including 0.38 ha in the western part, 0.96 ha in the eastern one (fig. 55).

Magnetic anomalies, potentially identifiable with the searched archaeological features, linked with megalithic constructions were detected in each explored forested area of Wietrzychowice Culture Park (fig. 55:B). In the western part, these are dipolar zones along the edge of the tunnel valley and linear and point anomalies of increased magnetic susceptibility (fig. 55:B; 56). In the central part these are clusters of point anomalies of increased magnetic susceptibility, which may correspond to the remains of the features (fig. 55:B; 56). The most interesting anomalies from the group are situated in the area between the long barrows. It should be highlighted that the material used for building the long barrows has such a strong magnetic field that it prevents any anomalies from being recorded in its close vicinity. In the eastern zone there are clusters of point anomalies of increased magnetic susceptibility and linear anomalies, whose shape is bent almost at the right angle. This might indicate their anthropogenic character (fig. 55:B; 57). In the southern area there are points of increased magnetic susceptibility, which may result from stratigraphic disturbance in the form of inclusions (fig. 55:B; 58).

The changes in the landform connected with contemporary infrastructure, such as information plaques, bridges, or transport routes rules out some places from the possibility of conducting magnetic research, as the measurement might be disturbed. At the same time forest works which are performed in order to conduct reconnaissance survey involve ground changes and may impact the results of geophysical works. The accumulation of material with magnetic qualities and furrows after forest ploughing, although invisible on the surface, are recorded in magnetic research and may only be differentiated from the potential archaeological features during archaeological excavations.

It is not entirely certain whether the recorded anomalies are caused by the remains of human activity. Unambiguous interpretation would only be possible after thorough or fragmental verification of selected magnetic anomalies. It would allow creating an interpretation key, thanks to which anomalies would be allocated to features responsible for causing them. Currently, the interpretation may only be based on the experience with analogous cases and supported by the analysis of the character of the anomalies and their places of occurrence.

Summary

Commencing the long-lasting programme of research in the region of Wietrzychowice Culture Park, it was decided that the works would aim at a more precise location of monumental long barrows of the Funnel Beaker culture, known from the 19th and 20th c. accounts. The task seemed difficult and arduous, with no positive results of systematic reconnaissance survey. As a result of several years of experience, a method was worked out which involved a complementary application of three ways of non-invasive research : aerial prospection, geophysical prospection and a detailed archaeological inventory survey on the surface of the sites. Consequently, detailed data were obtained which enable an accurate location of apparently completely destroyed cemeteries and single graves. In some cases the conducted research also allows the recognition of a spatial layout of cemeteries, the size of particular graves, as well as the assessment of the state of preservation of the explored features and whole sites. Unfortunately, most of the located megaliths are heavily destroyed. Thus, the purpose of the current research is not only to recognise, but also to preserve the features. The archaeological works aim at creating a protection plan or, in some cases, conducting rescue excavations, which would prevent a complete destruction of the features as a result of intensive field works.

Non-invasive research of Neolithic settlements situated in the region of Wietrzychowice Culture Park

(Piotr Papiernik, Joanna Wicha, Rafał Brzejszczak, Piotr Wroniecki, Piotr Kittel)

Comprehensive reconnaissance survey conducted in the area of Wietrzychowice Culture Park has resulted in discovering numerous remains of Neolithic settlement, including over 200 settlement sites. Given the supraregional significance of the discoveries, it was decided that comprehensive, non-invasive research of 16 selected sites would be carried out. The sites are connected with the Linear Pottery culture and the Funnel Beaker culture. The works aimed at the recognition of the size, internal diversity and the extent of preservation of the settlements, as well the chronological description of each site.

The applied non-invasive research methods included: aerial, magnetic and geochemical prospection, as well as a detailed archaeological inventory survey of artefacts, documented on the surface of the sites. In the case of two settlements of the Linear Pottery culture, all the above mentioned methods were used. As regards the Funnel Beaker culture sites, diverse methods were used, above all the detailed inventory of archaeological artefacts and aerial prospection.

Settlements of the Linear Pottery culture

Reconnaissance survey conducted in the region of Wietrzychowice Culture Park resulted in discovering a new cluster of the Linear Pottery culture settlement (fig. 59), which consisted of 48 sites, including 17 settlements (P. Papiernik, J. Wicha, D.K. Płaza 2018). Two sites underwent non-invasive research. Reconnaissance survey revealed traces of top sections of archaeological features in both of them.

Both sites, i.e. site no1 at Pawłówek (AZP 52-46/54) and site no 33 at Osiecz Wielki (AZP 52-46/193) underwent non-invasive research with all the methods enumerated above. Both settlements yielded clusters of pottery material from the Linear Pottery culture, which attest the presence of recessed features (c.f. fig. 61, 76). The size and the linear character of the clusters may indicate the presence of clay pits – structure typical of the Linear Pottery culture, connected with building long houses, also known from the region of Kuyavia (c.f. J. Pyzel 2010). The observations are confirmed by aerial and geophysical prospection, and at site 33 at Osiecz Wielki, also by geochemical prospection. Decorative motifs and morpho-

logical features of well-preserved sherds from the Linear Pottery culture, yielded during the research, indicate that most artefacts should be linked with the note (classical) phase, or in Kuyavia – the early phase (fig. 63-65, 75; after R. Grygiel; J. Pyzel). The obtained assemblages of flint material have typical traits of linear culture flint processing (fig. 66-67, 76; c.f. B. Balcer 1983; R. Grygiel 2004; J. Kabaciński 2010; P. Papiernik 2016). As regards the site at Osiecz Wielki, the distribution of pottery material from the Linear Pottery culture indicates that the area of the settlement is larger than the one designated on the basis of the reconnaissance survey and it exceeds 3 ha. At Pawłówek the artefacts from the Linear Pottery culture were mainly recorded within the boundaries of 70-80 ares. However, the distribution of flint artefacts is wider than the vessel sherds, which may signify that the remains of the Linear Pottery culture settlement occupied a larger area. This view is confirmed by geochemical research, which reveals increased level of phosphorus content, south of the alleged sites of the Linear Pottery culture (c.f. fig. 74B, 82).

The results of non-invasive research at Osiecz Wielki have revealed three zones, which differ in the state of preservation of the site (fig. 72). The least transformed part is situated in the northern section of the site. It is characterised by the most even distribution of archaeological artefacts of different chronology. Moreover, aerial photographs presented a dark humus level of contemporary soil. The process of destruction was recorded in the southern part of the site, where artefacts from the Linear Pottery culture were found within the boundaries of the clusters in clearly visible humus sediment which came from the damaged archaeological features. The third zone encompasses the eastern part of the site. It was destroyed by a brickyard, which is confirmed by historical data, as well as aerial and magnetic prospection.

The results of non-invasive research have confirmed the presence of permanent settlements of the Linear Pottery culture at both sites. The fragmentation of artefacts and the tops of archaeological features visible on the surface indicate a gradual destruction of the sites.

The Funnel Beaker culture settlements

Verification reconnaissance survey in the region of Wietrzychowice Culture Park indicated that the area was intensively inhabited by the communities of the Funnel Beaker culture. 497 sites connected with this culture were recorded, including 153 settlements. 14 sites underwent non-invasive research (fig. 81), 13 of which were described as settlement remains. In one case, non-invasive research supplemented earlier excavations. The remains are situated in different parts of the excavated area and in different environmental habitats.

The developmental phases of the eastern group of the Funnel Beaker culture were described with the use of terminology, introduced to the literature on the subject by K. Jażdżewski (1936, 1961, 1970), W. Chmielewski (1952), L. Gabałówna (1968, 1970, 1971) and T. Wiślański (1979). Thus, relative chronology of the assemblages was established on the basis of the division into the following phases: Sarnowo phase, Wiórek phase, with the possibility of distinguishing its older –early-Wiórek phase, Luboń phase, with the Radziejów group (c.f. A. Koško 1981, M. Rybicka 1995). The classification of artefacts has been used after R. Grygiel (2016), who described the development of the Funnel Beaker culture in the region of Brześć Kujawski and Osłonki, dividing it into: early, classical and late phases.

Most sites were located on the substrate of clayey sands, weakly clayey sands, or sands changing into clayey sands or weakly clayey sands. Two sites were located on loose sands. Only site no 24 at Śmieły (AZP 53-46/78) was situated on clayey sands and clay, which was why it was included in the research. The same refers to site no 27 at Skaszyn (AZP 52-45/174), whose interesting location at the floor of the tunnel valley (fig. 81) made it an attractive place to conduct non-invasive works.

The conducted non-invasive research confirmed the presence of settlements at 12 sites. Only in the case of Skaszyn, site 27 and Śmieły, site 24, no traces of permanent settlement were recorded. In the case of other sites, the remains of the Funnel Beaker culture were discernible in the form of cultural layers, damaged by field works. They were documented by aerial prospection and a detailed archaeological inventory survey of artefacts.

The unearthed pottery and flint artefacts from the Funnel Beaker culture confirm the Wiórek phase of inhabitation at all sites, including its older phase (Komorowo, site 9 – AZP 53-45/44,45), Tymień, site 11 – AZP 53-45/147), and most probably the younger phase (Łania, site 4 – AZP 52-46/263). What is more, 4 sites (Józefowo, site 19 – AZP 52-45/36, Kazimierowo, site 44 – AZP 52-45/440, Szczkówek, site

30 – AZP 53-46/230, Pasięka, site 25) yielded older artefacts connected with the Sarnowo phase. These were fragments of plates (fig. 101) and mouth sherds, decorated with irregular stamps under the rims (fig. 90: 2, 3; 91: 8,10; 100: 7). The finds indicate that the explored area was the place of the development of the Funnel Beaker culture in Kuyavia. Special attention should be paid to site no 19 at Józefowo, where an abundant flint assemblage was obtained. It consisted of 82 artefacts, including 37 specimens made from chocolate flint, which is characteristic of the Sarnowo phase (E. Niesiołowska-Śreniowska 1982, 1986; L. Domańska 1995; P. Papiernik, J. Wicha 2018). It should be assumed that also in this case, most artefacts from chocolate flint are connected with this phase. Moreover, it was observed that spatial distribution of these forms is smaller than of the pottery from the Funnel Beaker culture, which may indicate that the settlement of the early phase of the Funnel Beaker culture occupied the western part of the site, not exceeding 1ha.

The analysed pottery assemblages consisted of not numerous fragments of vessels, which may be linked with the Luboń phase. Artefacts of this type were unearthed at Pasięka st. 25-26 (AZP 52-45/94-95; fig. 124: 1, 125: 1), Sokołowo, site 1 (AZP 52-45/125; fig. 136: 1), and possibly Komorowo (fig. 107: 4-5). However, the materials do not form a significant group of artefacts, which might point to permanent inhabitation at any of the explored sites.

The distribution of artefacts, frequently occurring in small clusters, may indicate the presence of archaeological features or remains of the so called cultural layer. A good example of this is site no 30 at Szczkówek, where well-visible clusters of artefacts were recorded. The correlation of the results of the distribution of artefacts of the Funnel Beaker culture and aerial prospection indicated that the clusters overlap with places marked as archaeological features in aerial photographs (c.f. fig. 139, 142). Within the boundaries of three settlements (Chociszewo, site 32 – AZP 53-45/258), Józefowo, site 19, Pasięka site 25, 26), clusters of daub were recorded, which together with the results of aerial photographs may point to the presence of house remains in this place. Moreover, crumbles of daub with plant imprints were found at Józefowo. These are probably traces of a wicker braid (fig. 96). Site no 4 at Łania yielded a small number of daub crumbles, which were found in a biggest cluster of the Funnel Beaker culture artefacts. This may also indicate the presence of features built with clay in this region.

The results of research at site 11 at Tymień are quite interesting. All the non-invasive methods presented above were used at the site. On the basis of archival data it was assumed that a cluster of Kuyavian long barrows were recorded at the site. They underwent amateur excavations conducted by von Erckert in the 19th c (W. Chmielewski 1952:93). In the central part of the site there were 4 zones of big concentration of the Funnel Beaker culture artefacts, separated by areas where the artefacts were less numerous. The zones are several dozen metres long and they are located along the line E-W (fig. 147: B). It is possible that the places correspond with the mounds of the Kuyavian long barrows which contain re-located material from the older settlement of the Funnel Beaker culture. The conducted geophysical prospection did not bring about any indication as to the presence of the Kuyavian long barrows at the site. Despite the large number of recorded anomalies, their archaeological source is difficult to determine. They may have been caused by a considerable destruction of the site. Similar results were provided by geochemical research, which indicate temporary and not very intensive exploitation of the area in the past. This is contradicted by archaeological research, which has yielded 2895 artefacts. This is probably linked with the destruction of the site and several centuries of field works.

The conducted non-invasive research provided a large number of examples, proving the destruction of archaeological artefacts. It is visible in the fragmentation of pottery materials, whose large number can be found on the surface and in the remains of a cultural layer and tops of archaeological features, recorded in aerial photographs. The settlement at Komorowo is of special character. It consists of 3 clearly-visible clusters of vessel sherds and flint artefacts (fig. 106). The gaps in artefact occurrence may result from modern changes in the landform of the site, recorded in aerial prospection (fig. 109). It revealed the course of trenches, currently filled in and levelled. One trench was left after a ditch and the second one, probably after an anti-tank trench from World War II – part of fortifications Stellung B1, built around Włocławek in 1944 (M. Pracki, K. Bazela 2018). A similar situation was recorded at site 32 at Chociszewo, where German field fortifications from World War II intersected the site from the east to the west. Another example is the site at Skaszyn, site 26 (AZP 52-45/173), where artefacts were found in

two clusters (fig. 128: B). However, the division is connected with the functioning road (fig. 127), which at the culmination section was recessed in the ground and it is currently filled in. Its course has been also recorded in aerial photographs (fig. 132). Site no 1 at Sokołowo is intersected by an asphalted road from Izbica Kujawska to Lubomin.

Only in two cases, i.e. Wiszczelice, site 17 and 18 (AZP 53-45/256, 257) and Szczkówek, site 30, were the surfaces of the site, including the artefacts, well-preserved. Aerial photographs presented extensive structures, which are most certainly the remains of a cultural layer. What is more, the artefacts obtained at Wiszczelice are not very fragmented.

Summary

The non-invasive research, conducted in the region of Wietrzychowice Culture Park has confirmed permanent settlement of the Linear Pottery culture and the Funnel Beaker culture in the area. Moreover, it has provided information about the chronology, size and expanse of inhabitation, as well as the state of preservation of artefacts.

In the case of the settlements of the Linear Pottery culture, a number of features was found by means of different methods. The features mainly included clay pits, linked with the building of post houses – a typical element of early-agricultural settlement. The obtained artefacts confirm inhabitation in the note phase and possibly in its early phase, after R. Grygiel (2004) and J. Pyzel (2010).

Permanent settlement of the Funnel Beaker culture has been confirmed at 12 sites, where discernible remains of cultural layers and archaeological features were recorded, with the help of aerial prospection and a detailed archaeological inventory survey of artefacts. Only in the case of site no 27 at Skaszyn and site no 24 at Śmięły was no permanent inhabitation confirmed. Numerous pottery and flint artefacts indicate that all sites were inhabited in the Wiórek phase. It is particularly important to distinguish materials from the Sarnowo phase at 3 or 4 sites. They indicate that the explored area was the place of the formation of the Funnel Beaker culture in Kuyavia. Only very few vessel fragments can be linked with the Luboń phase and they do not point to a permanent inhabitation of the sites in that period.

The documented archaeological artefacts of the Funnel Beaker culture indicate the size of the excavated settlements. On the basis of the distribution of pottery and flint artefacts (fig. 83: B; 88: B; 99: B; 106: B; 111: B; 121: B; 123: B; 128: B; 134: B; 139: B; 144: B; 147: B; 158: B), and the recorded range of cultural layers, the extent of inhabitation at particular sites can be estimated between 1.5 and 3.5 ha. However, in many cases, one site contained material of the Funnel Beaker culture with different relative chronology. Thus, the actual size of the Funnel Beaker culture settlements, understood as one inhabitation phase of the site, could be smaller.

Non-invasive research provided many examples of artefact and feature destruction. Intensive agriculture, including the deep ploughing method and a common application of subsoiling contributed to the destruction of archaeological artefacts and features. It is particularly visible in the case of sites with clear differences in height, e.g. terrain elevation with a steep slope. Moreover, at many sites the observed destruction resulted from the building of roads, utility and dwelling buildings, fortifications from World War II, ditches, or even brickyards.

Search for the Kuyavian long barrows by means of aerial prospection

(Rafał Brzejszczak, Piotr Papiernik)

Positive verification of megalithic cemeteries known from archaeological sources, as well as the “new long barrows” at Gaj and Osiecz Mały prompted further works to search for Kuyavian long barrows. In the area, an abundant Funnel Beaker culture site was recorded during the reconnaissance survey, but there was no information about the presence of megaliths. On the basis of the collected data, it was deemed likely that cemeteries were present at the explored area, but they were never described in the 19th and 20th c accounts. Basing on the verification reconnaissance survey, 10 areas were designated (fig. 163:A-J), where the probability of finding unknown Kuyavian long barrows was the greatest. Aerial

prospection was conducted in 2019, with 4 flights at different seasons. Additionally, photographs taken in the years 2013-2018 were reanalysed. In total 30031 photographs, documenting the area of 33 sq km underwent analysis.

Structures recorded during at least two different flights were regarded as potential long barrows. After the approximate assessment of size and location of the possible long barrows, their location was subsequently checked using archival maps and the reconnaissance survey. This aimed at eliminating soil and vegetation discriminants whose shape and size might accidentally resemble the searched long barrows, but which, as a matter of fact, turned out to be contemporary changes of landform (e.g. fragments of ditches, elements of arable fields), or natural structures (e.g. small depressed areas).

Positive results, which require further verification, have been obtained in the region of the villages Komorowo and Tymień (fig. 163:G). The recorded determinants, with their shape and size, may indicate the presence of the Kuyavian long barrows. The long barrow unearthed at Komorowo (fig. 164:A) may correspond with the megalith described by K. Jażdżewski (1936a) and W. Chmielewski (1952). The potential long barrow at Tymień requires further verification, due to the presence of the Funnel Beaker culture pottery in the place of the observed trapezoidal structure (fig. 165:B).

In 2019 in connection with unclear accounts about the number of megalithic cemeteries in the region of the villages of Łania and Żurawica, additional aerial prospection was conducted, which broadened the range of our previous observations. 0.5 km south of the cluster of the long barrows at Łania (site 1), a trapezoidal shape, 75 m long, was discovered, with its wider part oriented to the east (fig. 167). There was another, less discernible structure in the vicinity.

In June 2019, material for further analysis and verification was provided by photographs taken in the region of the village of Nowa Wieś. 250 m away from the basin of Duliwec Lake there was a clearly discernible vegetation discriminant, which may point to the previously unknown Kuyavian long barrow (fig. 168). The estimated length of the feature is 65m and the width of the base – 14m. Additional aerial photographs taken in April 2020 confirmed the earlier findings.

In the region of the village of Pasięka, aerial prospection was conducted in the area of c.a. 1.8 sq m. It resulted in discovering a possible megalith, in the vicinity of site no 25 in this village. The discriminant was recorded three times and it is 50 m long (fig. 169).

During aerial prospection conducted at site 30 at Szczkówek and its vicinity, a trapezoidal anomaly was recorded several times in different seasons. Its size may indicate the presence of the remains of a megalith. The potential long barrow is only discernible in its front section (fig. 170).

The other areas covered by aerial prospection did not reveal any traces of the previously unknown Kuyavian features. The possible long barrows, described above, were located in different places of the explored area, especially in the neighbourhood of the settlements from the Wiórek phase of the Funnel Beaker culture. It should be assumed that for some concentrations of the Funnel Beaker culture sites, it was impossible to find not only larger clusters of long barrows, but also single features of this type. The current state of research may reflect the pre-historic picture, but it may also result from an imperfect research method. It should be observed that most regions described above underwent aerial prospection for one year only, which is not sufficient for accurate research, basing on our experience from Lubomin, site 5, Łania, site 1, Osiecz Mały, site 8 and Śmieły, site 1.

Geological structure and the development of landform and surface geological structure in the region of Wietrzychowice Culture Park (Małgorzata Roman)

The area in question (enclosed between 18°43'45" – 18°56'05" E longitude and 52°21'45" – 52°27'35"N latitude) with respect to the structural units of the Cenozoic bedrock lies within the Kujawy Swell, in the central zone of salt tectonic activity. The Cenozoic substrate consists of Upper Permian/Zechstein salts (in the Izbica Kujawska salt dome vicinity), while the remaining area is made up of calcareous Middle and Upper Jurassic rocks, and occasionally Lower Cretaceous clastic deposits. The presence

of salt structures in the Cenozoic substrate is related to the local manifestations of the ascension of brine almost to the ground surface. The Cenozoic formations (Paleogene, Neogene and Quaternary) form a continuous cover, however, the terrain surface is composed of only Quaternary sediments (Pleistocene and Holocene). The Quaternary thickness varies from 15.5 m to over 150 m.

The area in question is located in the south-eastern part of the Kuyavian Lakeland, in the terrain embraced by the Płock ice-lobe during the late Vistulian (=Weichselian) maximum (19-18 ka BP) related to the Poznań (=Frankfurt) phase. The last Scandinavian ice-sheet played the main role in forming the surface geological structure and relief of the examined area. The predominant landform in the area is the morainic plain at 105–125 m AMSL, mainly composed of till and locally covered by fluvioglacial sands with gravels between 0.5 – 1.5 m thick, reaching 4 m alongside glacial troughs (tunnel valleys). The morainic plain is intersected by numerous tunnel valleys of various range and usually of meridional orientation which are visible in the present relief by sequences of narrow lakes, peat-bogs and slight watercourses. The glacial troughs are sometimes accompanied by eskers forming rows of hillocks, several meters high, with the longest esker (7 km) between Modzerowskie and Chotelskie Lakes. The landscape of the area is dominated by the isolated moraine ridge of Izbica Kujawska, reaching the height of 144.1 m AMSL, rising 25-40 m above the surface of the morainic plateau. The hill is an example of the so-called palimpsest glacial relief, i.e. a form that combines in its structure older elements, remaining from the previous ice sheet advance, as well as the younger glacial ones. Well-visible landforms include overridden terminal-moraines, reaching the height of over a dozen meters, which mark pre-maximum short ice sheet stand-stills during transgression. These hillocks are arranged in two ranges with more or less latitudinal course: Izbica Kujawska – Osiecz Mały and Modzerowskie Lake – Karaśnia Lake. Landforms associated with the deglaciation of the area include: dead ice moraines, kames, kame terraces, outwash plains, as well as concave forms such as extensive melting depressions, now featured by peat-bog plains, and small kettle holes, commonly occupied by diluvia and boggy sediments.

In the Holocene, during the last 11.7 thousand years, the landforms formed in the Vistulian glaciation underwent further transformation. These changes were mainly associated with the ongoing climate change, the development of vegetation and the appearance of man. An expression of these changes is, inter alia, the formation of erosive cuts, the disappearance of lakes and the creation of lake and peat plains as well as the transformation of many landforms, also as a result of exploitation of raw materials and peat, watercourse regulation and melioration.

Description of the soil cover and the relationship between the Stone Age settlement and the soil conditions of Wietrzychowice Culture Park (Michał Jankowski, Marcin Sykuła)

The aim of the chapter is to characterize the soil cover as regards soil types and grain-size class distribution. A special focus has been put on the relationship between the Stone Age settlement and soil conditions in the context of human preferences regarding the location of settlement points and selected cultural features.

Basing on the assumption of non-invasive data acquisition specified in the project, the study mainly involved the analysis and interpretation of existing cartographic and remote sensing materials, verified during field reconnaissance. The basic data on the typology of soils was obtained from soil-agricultural maps at the scales 1:25 000 and 1:5 000 – for agricultural areas and private forests, and from soil-habitat maps at the scale 1:5 000 – for forest areas managed by the State Forests, National Forest Holding.

The typology of soils presented on the soil-agricultural maps was originally made in the 1950s and 1960s, according to soil classification now largely outdated. It has been reinterpreted and updated to the present state of knowledge about soil science as much as possible. After compiling the updated content of soil-agricultural maps and soil-habitat maps, the final map of soil types is presented in a form compliant

with the latest version of the Polish Soil Classification (SGP 6 – PTG 2019). Soil grain-size classes were analysed, taking into account their variability up to a depth of 150 cm with the division into 4 layers:

- surface deposits (in the layer with a thickness <50 cm),
- subsurface deposits with a ceiling at a depth of <50 cm,
- subsurface deposits with a ceiling at a depth of 50 – 100 cm,
- subsurface deposits with a ceiling at a depth of 100 – 150 cm.

All cartographic studies were made in the ESRI ArcGIS Pro software.

The soil cover of the surroundings of the Wietrzychowice Cultural Park shows a structure typical of the young glacial lakeland landscape. The soils occurring here were formed from Quaternary deposits accumulated during the late Pleistocene and the Holocene.

The clay-illuvial soils (Luvisols) have the greatest share in the soil mantle, covering 48.3% of the area (nearly 8050 ha). These are soils formed under the cover of fresh or moist deciduous forests of the fertile oak-hornbeam class, as a result of the lessivage soil-forming process ongoing in sandy-loam and heavier deposits. Rusty soils (Brunic Arenosols) are the second most common soils in the study area. They cover 18.5% of the area (3,072 ha). These are soils formed of deep or medium-deep (over 1 m thick) sandy sediments (loose and slightly loamy sands), under the vegetation of trophically weaker variants of fresh broadleaved and mixed forests, with the character of oak-hornbeam and oak forests. Hydromorphous soils are an important element of the soil cover in the vicinity of Wietrzychowice. Black earths (Gleyic Chernozems/Phaeozems) cover 11% of the studied area (1840 ha), mucky soils (Umbric Gleysols/Arenosols) 8.6% (about 1210 ha) and organic soils – peat soils (Histosols) and murshic soils (Murshic Histosols) 8.6% (1430 ha) and 3.1% (510 ha) respectively.

Mineral sediments predominate in the analyzed area. Most of them are materials with variable texture in the vertical soil profile, generally referred to as "loam-covering sands". In the major part of the studied area, we can observe the tendency of increasingly finer material to be deposited deep into the soil, changing from sands to sandy/medium loam. The topsoil is dominated by the light loamy sands and slightly loamy sands, occupying 32.6% and 30.3% respectively. In total, the sandy sediments cover more than 77% of the analyzed area. Organic materials, peat and mursh occupy in total over 11% of the area. The large texture change is visible in soils at the depth of 50-100 cm. In this depth range, sandy loams clearly begin to dominate, covering about 52% of the area. The second widely spread type of soil is loose sand covering 20%.

The analysis of the distribution of sites documented in archaeological research against the background of soil conditions showed clear regularities, visible for individual parts of the Stone Age, as well as for individual Neolithic cultures. Human settlement preferences are revealed both in the context of soil typology and its grain size distribution. Overall, in the study area 47.5% of the total of 737 Stone Age archaeological sites are located on clay-illuvial soils, 42% on rusty soils, 6% on black earths and 4% on mucky soils. In the scale of the entire epoch, as much as 51% of the sites are located in the places covered with slightly loamy sands and 27% in the places of light loamy sands. In general, the surface sandy deposits, together with loose sands and heavy loamy sands (about 7% each), constitute as much as 92% of locations of all archaeological sites.

The broadest spectrum of soil types and mineral deposits is occupied by the Funnel Beaker Culture and the Globular Amphora Culture. The settlement of the Funnel Beaker culture was located on all types of soils with a grain size ranging from loose sands to light loams.

Particular attention was paid to the analysis of the soil cover around four groups of Kuyavian long barrows, at sites: Gaj 1, Lubomin 5, Łania 1 and Wietrzychowice 1. It was observed that all of them are located in similar soil conditions. In all cases, the barrows were built on convex forms of land covered with rusty soils (in case of Gaj 1 in mosaic with clay-illuvial soils) built of deep or medium-deep sandy sediments.

The conducted analyses prove preferential character of the Stone Age settlement in relation to soil conditions. The regularities found are undoubtedly very indicative, and therefore quite surprising. It is obvious that Stone Age communities could not choose their location by the typological-genetic and granulometric classifications of soils in force today, based on scientific knowledge developed in the second half of the 20th century. It should be assumed that the regularity of the distribution of settlement

and cultural points is directly related to ecological and habitat conditions, which by their nature are closely correlated with the genetic, physical and chemical features of soils. The habitat conditions had to be reflected primarily in the nature and density of the vegetation, and after its removal, they shaped the conditions of human existence.

Environmental conditions of the Stone Age settlement location in the region of Wietrzychowice Culture Park

(Piotr Kittel, Piotr Papiernik, Sebastian Tyszkowski, Mateusz Płóciennik)

The excavations extended over an area of 185 sq m, located in the early post-glacial zone of the Kuyavian Lakeland. The highest point of the excavated area reaches 146.5m AMSL and is situated on the slope of the hills at Izbica Kujawska. The lowest point – 91.9 m AMSL is located at the valley floor of the Sarnówka river. Terrain inclination runs from south-east to north-west. We can observe diverse landform, such as Izbica Kujawska moraine embankment. Contemporary surface hydrological network is formed by 4 larger lakes and not very dense network of small watercourses, including the Noteć and Sarnówka rivers, as well as an unnamed watercourse flowing through Osiecz Wielki.

The main aim of the analysis was to establish the relationship between the location of the settlement units and abiotic elements of natural environment, i.e. landform – primarily surface geological structure.

The research was based on maps of the surface geological structure and geomorphology of the area, made by M. Roman (current volume). Geological and geomorphological maps have been rectified and correlated with spatial data, using the GIS system. Moreover, maps of surface deposits were used made by M. Jankowski and M. Sykuła (current volume). Base maps (geological, geomorphological, and surface deposit ones) were digitalised to shapefile format. A polygon feature layer was created, with polygon features corresponding with sections made on particular maps. The area of each map section was then calculated.

Tabular presentations of archaeological sites from selected chronological periods have been created. For some periods, the function and type of the site was also specified. The research was conducted at the sites of the Stone Age, divided into: the late Palaeolithic, Mesolithic, Linear Pottery culture, Stroke-ornamented ware culture, Brześć Kujawski group of the Lengyel culture, Funnel Beaker culture, Globular Amphora culture, Corded Ware culture. For the Funnel Beaker culture settlement, the sites have been functionally divided into: cemeteries, settlements and settlement points. For the Globular Amphora culture, the sites have been functionally divided into: settlements and settlement points. As regards the Palaeolithic and Mesolithic sites, campsites were also included. In total, 744 sites underwent analysis. The data from the Archaeological Picture of Poland were introduced to the GIS system. The analysis of the site density was conducted with Kernel method with the radius of 2000 m.

In order to analyse the site location in relation to landform, data from aerial laser scanning were used. The landform model was used to determine coordinates of the sites of the Archaeological Picture of Poland, as well as statistical data of morphology for the whole researched area. The analysis of downslope and exposure zone was also conducted.

Subsequently, maps were made which presented the distribution of archaeological sites against the background of geological structure, landform (numerical terrain model and geomorphology), as well as surface deposits.

The equidistant method has been applied with the radius of 0.5 km and 1 km in the vicinity of each explored site in order to determine a broader context of the Stone Age settlement in relation to the surface geological structure and landform. Due to a small number of sites of the Stroke-ornamented ware culture and the Brześć Kujawski group of the Lengyel culture, they were not included in the statistical analysis. The obtained results were each time compared with the percentage of each analysed section in the whole explored area. Moreover, the distribution of the analysed archaeological sites has been compared with the dispersion of surface sediments present in their vicinity, using PCA (Principal Component Analysis) and CVA (Canonical Variate Analysis).

From the topographical point of view, it is interesting to observe that most sites, especially settlements (or campsites) were set up on weakly or gently sloping areas. The sites on even, almost flat areas were usually oriented along WN line.

The obtained results of the analysis of basic statistical indicators referring to geological surface structure and landform data in the region of the excavated sites, allow drawing conclusions about the reasons why communities in particular periods were attracted or prevented from settling down in these areas. It is evident that Palaeolithic settlements are usually found in marshy areas (currently peats) or near lakes on loamy substrate. Near the campsites there were large expanses of slightly loamy sands. A similar situation occurred in the case of Mesolithic campsites, where a statistically relevant feature is overrepresentation of peat areas. The settlement occurred on marshy areas with a high percentage of slightly loamy sands and light loamy sands. From the geomorphological perspective, the *Hügelland* (hilly terrain) is the major factor of settlement attractiveness.

In the case of early Neolithic settlement, loamy substrate dominates in the geological structure of the Linear Pottery culture sites. It is made up of light dusty loams and light loams. The settlement did not occur on sandur sediments. There is a slight preference of peat and humus sands. It is important to observe that the Linear Pottery culture settlements are not found in the close vicinity of terminal moraines, dead-ice moraines, kame terraces and, to a lesser extent, eskers.

Permanent settlement of the Funnel Beaker culture usually occurred on substrate with a high percentage of loamy sands. There is a tendency for Funnel Beaker culture settlements to be found on slightly loamy sands and light loamy sands. These tendencies are statistically relevant for the Funnel Beaker culture settlements. In the vicinity of the Funnel Beaker culture settlements, moraine *Hügellands*, as well as sandur sediments are always accessible. The settlements were also set up on sandy loam substrate, and less frequently on loose sands. Some settlements prefer marshy areas, at that time occupied by moorsh and peat. The Funnel Beaker culture cemetery and its vicinity is set up on the substrate of loam with a wide access to sandur sediments. In comparison with the data obtained for the Funnel Beaker culture settlements, it is possible to observe the preference of cemetery sites to be located on light loamy sands and a lower percentage of organic sediments. At the same time, there are more areas made up of loose sands. Funnel Beaker culture cemeteries are usually located near unenclosed waters and away from extensive marshy areas. Globular Amphora culture settlements usually occupy areas with a high dispersion of biogenic sediments and loamy areas, usually loamy sands. Globular Amphora culture sites were frequently located in the close vicinity of extensive zones made up of organic sediments, currently peat and moorsh. These sites usually centre around tunnel valleys or kettle holes.

The tendencies described above are also confirmed by PCA and CVA analyses. They attest that most archaeological features at the site were set up on the substrate with heavy loamy sands, with the average level for the area. Palaeolithic campsites were established in areas which are now largely occupied by peats. Linear Pottery culture and Funnel Beaker culture settlements tended to stay away from peat areas. Globular Amphora culture settlements, as well as Palaeolithic and Mesolithic campsites, were usually set up on the substrate with a higher percentage of mud deposits. They tended to stay away from areas with heavy loamy sands. On the contrary, Corded Ware culture settlements preferred heavy loamy sands over mud deposits. No clear tendency is visible regarding the distribution of archaeological sites on loose sands.

Stone Age settlement in the region of Wietrzychowice Culture Park in the light of non-invasive prospection (Piotr Papiernik, Joanna Wicha, Dominik Kacper Płaza)

In the region of Wietrzychowice Culture Park, 592 sites have been recorded, with 744 confirmed Stone Age settlement incidents. The latter have a definite cultural and chronological character. A vast majority has been recognised by means of reconnaissance survey conducted in the years 2009-2018 (c.f. site catalogue). Archaeological artefacts which have been obtained as a result, allow the description of

inhabitation in the area in question, despite considerable limitations resulting from the search method (c.f. W. Rączkowski 2012). Non-invasive research carried out at 28 sites has furnished relevant information. What is more, the description of the settlement has been based on preliminary results of excavations at 8 sites, conducted in the region of Wietrzychowice Culture Park since 2011 (c.f. P. Papiernik, P. Kittel, D. K. Płaza, J. Wicha 2018; P. Papiernik, J. Wicha 2018; D. K. Płaza 2018).

Palaeolithic

The oldest traces of settlement in the explored area are connected with the Late Palaeolithic. The materials of this chronology have been recognised at 10 sites (fig. 203). In all cases these are meagre assemblages consisting of several flint artefacts at the most. In total, the assemblages contained: 14 blades (fig. 29:3), 2 cores (see D. Płaza, J. Wicha, P. Papiernik 2017, fig. 4: 1) and 3 tools (fig. 204). They were distinguished on the basis of the characteristic method of flint artefact production (M. Dziewanowski 2004, 2006). Technological elements of obtaining blade semi-product from double-platform cores with the common flaking surface, typical of Late Palaeolithic industries, were regarded as diagnostic (R. Schild 1975).

Late Palaeolithic or early Mesolithic settlement is linked with a fragment of a wooden harpoon from site no 9 at Śmieły (P. Papiernik, D.K. Płaza 2017, p. 145). It was unearthed in a trench, situated in a bay of Karaśnia Lake, by means of wet-site excavations (P. Papiernik, D.K. Płaza 2017; P. Papiernik, P. Kittel, D. K. Płaza, J. Wicha 2018).

A small sample of materials connected with the Palaeolithic, obtained from a large number of sites, does not allow a more detailed cultural or chronological description of the assemblage in question. It allows a very general assumption that the identified Palaeolithic materials can be linked with the Swiderian culture, whose community inhabited the excavated area during the last Glaciation. The location of the unearthed sites indicates that the campsites were primarily set up in the close vicinity of water reservoirs. This conclusion is confirmed by the location of seven sites, which were recorded on the shores of today's lakes or in peat areas of tunnel valleys, occupied by the following lakes: Chotelskie, Karaśnia, Modzerowskie and Wólka Komorowska (c.f. fig. 203).

The discovery of other sites in the region of Wietrzychowice Culture Park confirms observations already made in the literature on the subject that the Kuyavian Lakeland was part of ecumene of Palaeolithic hunters. There are at least 50 sites containing Palaeolithic material in Kuyavia (c.f. D. Płaza, J. Wicha, P. Papiernik 2017).

Mesolithic

The explored area has yielded settlement remains from the Middle Stone Age at 59 sites (fig. 205). Flint artefacts typical of the Mesolithic were recorded during the reconnaissance survey (55 sites), mainly conducted in the years 2009-2013 (53 sites) and during non-invasive prospecting (3 sites), as well as the excavations (4 sites).

The analysis of Mesolithic forms, particularly cores and blades, indicates that they are stylistically and technologically diversified. The first group consists of material from the older part of the Mesolithic, when the process of core exploitation was performed by directly striking a stone. The obtained blade semi-product is quite irregular, the core preparation is weak, frequently of blade-flake character with a changed orientation (so called A and B style after T. Galiński 2002, or the *first* style after P. Dmochowski 2002). Such materials are also connected with some microliths, including a truncated piece of the Komornica type (fig. 208:5) and a blade backed point (fig. 208: 11). The second group consists of cores for blades (fig. 206; 207: 4), microlithic blades (fig. 208: 12), which with their regularity and morphological features link with forms known from the Late Mesolithic (c.f. R. Schild, M. Marczak, H. Królik 1975; M. Kobusiewicz 1999, pp. 90-93). Such relative chronology also refers to trapezoidal microliths (fig. 208: 1) and microburins (fig. 208: 3). Thus, it should be assumed that the explored area was inhabited by groups of different cultural tradition, developing throughout the whole of the Mesolithic in the area of today's Poland. The observations referring to the chronological span and cultural diversity are confirmed by the materials unearthed during the excavations. A trial trench set up at site no 9 at Śmieły (covering an area of 46 sq m) has yielded an assemblage of 1.1 thousand flint forms, which attest multiple settlement

incidents, linked with the early and Late Mesolithic. Archaeological works conducted in the vicinity of Kuyavian long barrows, at Wietrzychowice, site 1, have revealed the remains of at least four Mesolithic campsites of different chronology.

The remains of Mesolithic settlement have been unearthed in two natural environment zones. As regards the numerous group of sites, mainly located in the southern part of the explored area, it is possible to observe their connection with tunnel valleys of contemporary lakes and biogenic sediment, which in the Early and Middle Holocene may have had the form of water reservoirs. Thus, it can be concluded that these are classic Mesolithic campsite locations, connected with the exploitation of lakes and their immediate peripheries (c.f. Z. Bagniewski 1996; M. Kobusiewicz 1999; T. Galiński 2011). The sites unearthed in the morainic plain, near small watercourses and endorheic depressions are of interest, as they indicate different landscape zones exploited by Mesolithic settlers. It is essential that both groups contain materials typical of the Early and Late Mesolithic.

To sum up the remarks on Mesolithic settlement, it should be underlined that the conducted research attests permanent inhabitation of the explored area, and hence the Kuyavian Lakeland, by Mesolithic communities of different cultural traditions (c.f. D. K. Płaza 2015). The observations, especially those referring to the Late Mesolithic, herald further valuable research, especially with regard to the neolithisation process in Kuyavia, as well as mutual relationships between hunters-gatherers and early-agricultural communities in a broad area of central Poland.

Neolithic

Linear Pottery culture

The research conducted in the region of Wietrzychowice Culture Park have yielded previously unknown settlement clusters of the Linear Pottery culture, consisting of 48 sites (fig. 210). Two sites (Osiecz Wielki, site 33, Pawłówek, site 1) underwent comprehensive non-invasive research, which helped recognise the culture in question.

Pottery materials of the Linear Pottery culture, mainly those obtained from the surface of the sites, do not allow a detailed chronological analysis of the unearthed artefacts. Nevertheless, the stylistics of the engraved lines which occur independently and together with the music note pattern (fig. 31: 1; 63; 64: 2, 6-8; 65: 1, 2, 4-6; 75: 2, 4-6; 211: 1, 3-6, 8; 212: 1, 2, 5, 8, 9) and the character of the remaining decorative elements (finger and finger nail impressions – fig. 31: 2, 3; 64; 65: 3; 211: 2, 9-12; 212: 3, 4, 7, 11, 12; knobs – fig. 31: 3; 64: 4, 5; 75: 5; 211: 7, 12; 212: 4; decorative bands – fig. 212: 6) indicate that most of the obtained material is connected with the music note phase of the Linear Pottery culture and a possible presence of the early phase in the area of Kuyavia (L. Czerniak 1994; R. Grygiel 2004; J. Pyzel 2010).

Flint assemblages, particularly those obtained from the settlements, consist of a number of forms typical of the Linear Pottery culture, such as: end-scrapers (fig. 66: 6; 76: 8; 213: 1, 3, 5), truncated pieces (fig. 66: 4, 5; 76: 2; 213: 2, 4) and perforators (fig. 213:6) made from “*mediolithic*” blades, including imported raw materials (c.f. B. Balcer 1986; L. Domańska 1995; J. Kabaciński 2010; P. Papiernik 2016b). They include forms with, the so called sickle-gloss (fig. 66: 3; 213: 2). Initial core for blades, made from chocolate flint and unearthed at Osiecz Wielki, site 38 (fig. 214) is also probably linked with the Linear Pottery culture. It is interesting to observe forms made from Jurassic flint and recorded at 5 sites. They may indicate the presence of the Linear Pottery culture settlement with a relatively early chronology.

Spatial layout of the unearthed sites points to the fact that the Linear Pottery culture settlement encompassed the whole explored area, except for the most elevated parts of the terrain, over 125 m AMSL (fig. 210). It is possible to observe that the sites form perceptible clusters, and may be connected with separate, smaller settlement structures.

The analysis of the environmental context of the site location points to evident settlement preferences. Settlers tended to exploit relatively fertile, loamy areas of the morainic plain (c.f. P. Kittel, P. Papiernik, S. Tyszkowski, M. Płóciennik, current volume; M. Jankowski, S. Sykuła, current volume), which tallies with the present state of knowledge on the subject (c.f. J. Pyzel 2010). Such areas were sites of settlement remains (fig. 210), which consisted of a considerably large number of artefacts (pottery, flint and stone forms), recorded in an extensive area between 0.5 and 3 ha. The presence of stable settlements with the remains of building development has been confirmed by the excavations at Osiecz Wielki, site 33 and

Pawłówek, site 1, which have already been thoroughly discussed. Some sites in the area in question were also recorded on sandy substrate (c.f. M. Jankowski, S. Sykuła, current volume). In most cases, the obtained materials are scarce and consist exclusively of kitchenware fragments (or possibly flint artefacts – c.f. site catalogue). On the basis of field observations, it can be assumed that four of them are the remains of small campsites connected with economic exploitation of the area, particularly expanses near lakes and peat terrain (fig. 210).

The presented research for the first time documented the inhabitation of the Kuyavian Lakeland by early Neolithic communities. The recognition of yet another area inhabited by the Linear Pottery culture is connected with the discoveries from the last decade, which have brought about an increase in the number sites connected with the culture in different parts of the Polish Lowland (c.f. L. Czerniak, J. Pyzel, M. Wąs 2016, fig. 1; A. Gackowski 2015). In the case of Kuyavia, particularly important excavations were conducted along A-1 motorway (c.f. M. Wiśniewski, L. Kotlewski, ed. 2013; J. Pyzel 2010), which revealed stable settlement along the edge of the Vistula valley. We are of the opinion that the current state of knowledge on the range and significance of the Linear Pottery culture settlement in lowlands results from the state of research and further discoveries should be expected which would reveal the presence of linear pottery culture sites in other areas of the Polish Lowland, primarily Kuyavia and Greater Poland.

Stroke-ornamented Ware culture and the Brześć Kujawski Group of the Lengyel culture

Pottery material connected with younger linear pottery cultures has been recognised at only 9 sites (fig. 215). These are scarce assemblages of pottery with stroke-ornamented fragments, typical of the late phases of the Stroke-ornamented Ware culture (c.f. M. Zápotocka 1970, 2007; R. Grygiel 2008; W. Wojciechowski 1989). In the light of the classification of Kuyavian assemblages, such materials should be treated either as the early phase of the Brześć Kujawski Group of the Lengyel culture, according to R. Grygiel (2008), or as the late Linear Pottery culture, which precedes the Brześć Kujawski group, according to L. Czerniak (2017; c.f. also 1980, 1994). However, no sites have been distinguished which would reveal settlement traces of the Brześć Kujawski Group of the Lengyel culture. This indicates that no stable Middle Neolithic settlement functioned in the area in question, as opposed to the Kuyavian Upland, e.g. the region of Brześć Kujawski and Osłonki (R. Grygiel 2008).

Funnel Beaker culture

The artefacts of the Funnel Beaker culture have been found at 497 sites (fig. 216), which makes it a dominant culture in the Polish Lowland, as regards the density of settlement (c.f. M. Nowak 2009, pp. 380-386). At the current stage of research, we can enumerate 12 megalithic cemeteries (c.f. P. Papiernik, R. Brzejszczak, J. Wicha, P. Wroniecki, P. Kittel, current volume), 97 settlements and 392 settlement points.

Stylistic diversity of the obtained pottery materials indicates that the chronology of the settlement of the Funnel Beaker culture should be linked with the whole period of the culture development in Kuyavia. The oldest materials are connected with the Sarnowo phase and were found at 9 or 10 sites, located in different parts of the explored area (fig. 217 :A). The accepted diagnostic features include plate forms (fig. 101) and decoration in the form of irregular posts under the vessel rim (fig. 90: 1-3; 91: 8), S-shaped (E. Niesiołowska-Śreniowska 1994; P. Papiernik, R. Brzejszczak 2018; por. też. R. Grygiel 2016; L. Czerniak, A. Koško 1993; S. Rzepecki 2004, M. Nowak 2009). The fact that a relatively large number of sites was recorded which attest the inhabitation of the explored area during the formation of the Funnel Beaker culture in Kuyavia is hardly surprising, bearing in mind that the eponymic site at Sarnowo is located 3.5 km away from the northern border of the area in question.

Settlement of the Wiórek phase of the Funnel Beaker culture has been confirmed at 22 sites evenly distributed over the whole explored area (fig. 217:B). It seems, however, that the number is far too small. Artefacts with the Wiórek type of decoration have been obtained from each site that underwent more thorough research than the reconnaissance survey. Pottery material indicates a great stylistic and morphological diversity (fig. 83; 90: 6, 7; 91: 7, 9; 100: 1, 2, 8-10; 107: 6-8; 112; 113; 124; 125: 2, 3; 129: 1-9; 135; 140; 145: 148: 3-10; 159), chronologically corresponding to different sections of this phase in Kuyavia.

We can enumerate assemblages which are classified as early-Wiórek ones, as well as chronologically younger assemblages, including assemblages with late-Wiórek elements (c.f. P. Papiernik, J. Wicha, R. Brzejszczak, P. Wroniecki, P. Kittel, current volume).

The conducted research has provided scarce data concerning the Funnel Beaker culture settlement in the Luboń phase. The presence of the youngest settlement in the area in question is primarily evidenced by the results of the excavations at Osiecz Mały, site 8 and Wietrzychowice, site 1 (c.f. P. Papiernik, P. Kittel, D. K. Płaza, J. Wicha 2018). Artefacts with such features have been only found at 5 or 6 sites (fig. 217:C) during the reconnaissance survey or detailed archaeological inventory survey. The total number of artefacts consists of: 9 vessel fragments with decoration (e.g. Lubomin, site 5 – fig. 29: 1, 3), or vessel morphology (e.g. fragment of a mug from Naczachowo, site 11) typical of the Luboń phase. The sites from the Luboń phase seem to occur mainly in the south-eastern part of the excavated area, on more elevated terrains and within the boundaries of the morainic plain (fig. 217:C).

The Funnel Beaker culture sites are not evenly distributed over the explored area. The conducted analysis of settlement density by means of the Kernel method (Kernel Density Estimation), with the search radius of 1 km, indicated the presence of at least 25 settlement clusters of the Funnel Beaker culture. These concentrations occupy areas between 1 and 5 sq km, and encompass from several to nearly 40 sites, with the maximum density of 19 sites per 1 sq km (fig. 218). The location of particular concentrations may be correlated with the results of the environmental conditioning of the site location. The clusters covering a larger area with a greater inhabitation density occur in the regions where the landform features, geological substrate and soil cover were considered conducive for the functioning of the Funnel Beaker culture settlement (c.f. P. Kittel, P. Papiernik, S. Tyszkowski, M. Płóciennik, current volume; M. Jankowski, S. Sykuła, current volume).

The Funnel Beaker culture material included the remains of 97 settlements (fig. 216), which are evenly distributed over the whole explored area, in each designated cluster (fig. 218). In the case of larger concentrations, we can observe several settlements situated not far from one another, sometimes within distance of 0.5 km. This seems to be connected with a diversified and relatively short chronology of inhabitation at particular sites. The process of long settlement functioning within one cluster was most thoroughly recognised in the area of Wietrzychowice cemetery, site 1 (c.f. P. Papiernik, P. Kittel, D. K. Płaza, J. Wicha 2018). During the excavations, pottery material with features of all phases of the Funnel Beaker culture was recorded near the long barrows. The research of settlement at Osiecz Mały, site 8 has yielded material, which stylistically points to different stages of the development of the Wiórek and Luboń phases. The excavations at Śmieły, site 3, has yielded artefacts connected with the younger section of the Wiórek phase. Additionally, detailed archaeological inventory survey at site 24 at Śmieły has indicated the functioning of another site in the Wiórek phase, whereas the reconnaissance survey, site 11 at Śmieły has revealed the presence of pottery from the Sarnowo phase.

Reconnaissance survey and non-invasive prospection have furnished some information with reference to the size of the settlements. It has been observed that the area with the Funnel Beaker culture artefacts does not exceed 4 ha at any of the excavated sites. Its size is commonly estimated between 1 and 2.5 ha. On the basis of non-invasive research, it can be concluded that the above areas should not be identified with places occupied by particular settlements, identifiable with one, chronologically compact phase of a site's inhabitation. It should be assumed that the actual settlements were smaller and they did not exceed 1-1.5 ha, which is also confirmed by the observations from Józefowo, site 19, Kazimierowo, site 44, Pasięka, site 25, or Chociszewo, site 5.

The excavated area has yielded 12 cemeteries of the Funnel Beaker culture, including 7 clusters and 5 separate long barrows. The sites have revealed the presence of 37 long barrows and 4 feasible ones (c.f. P. Papiernik, R. Brzejszczak, J. Wicha, P. Wroniecki, P. Kittel, current volume). The analysis of spatial distribution of the cemeteries leads to surprising conclusions. The cemeteries were only recorded in 6 designated settlement clusters of the Funnel Beaker culture, not always with the greatest inhabitation density (fig. 218). The picture of the small number of cemeteries in comparison with the well-developed settlement network is slightly improved if we take into account some other, feasible locations of long barrows, revealed in the aerial prospection in 2019 (c.f. R. Brzejszczak, P. Papiernik, current volume). Thus, the four clusters could be allocated to single long barrows. However, it is quite surprising that there

are no cemeteries that could be connected with the large clusters of sites located in the area of Skaszyno, Kazimierowo, Grochowiska, Szczkowo, Ciepliny, or Wiszczelice and the largest cluster between Izbica Kujawska nad Chotelskie Lake, where only one feasible long barrow was located (c.f. fig. 218).

At the current stage of research an attempt to interpret the relationship between the cemeteries and the remaining elements of the settlement network seems premature. We can only indicate the scope of research that needs to be done, as regards determining the chronology of the Kuyavian long barrows in the explored area, which at this moment has only been completed for long barrow no 2 at Gaj (P. Papiernik, J. Wicha 2018; D. K. Płaza 2018). Further prospection is also needed in order to verify the presence of feasible long barrows and search for new ones in the regions where cemeteries had never been recorded before.

Globular Amphora culture

The presence of the Globular Amphora culture has been recorded at 109 sites in the explored area (fig. 219). Characteristic pottery materials have been found during the reconnaissance survey (105 sites), non-invasive prospection (10 sites), and the excavations (4 sites). The above number of the explored sites indicates that the researched area can be included among the sites with the highest settlement density of the Globular Amphora culture in Kuyavia (M. Szmyt 1990; 1996).

There were two cist graves of the Globular Amphora culture present. The first one – of undetermined location – was excavated by R. von Erckert in 1879 (R. Virchow 1880) in the area of the village of Chotel. The second one underwent rescue excavations conducted by T. Wiślański and W. Tetzlaff (T. Wiślański 1966) in the area of the village of Zdrojówka. During the works of Polish Archaeological Record (AZP), the grave was allocated to site 10 at Świszewy. The materials from damaged graves were recorded at Gaj, site 1 (mound of long barrow no 1 – W. Chmielewski 1952), and possibly in the region of the village of Grochowiska (no determined location; T. Wiślański 1966) and Zagrodnicza (no determined location; L. Kozłowski 1921; T. Wiślański 1966). The materials collected by R. von Erckert during the excavations of the long barrows at Tymień (c.f. T. Wiślański 1966) raise many doubts. It seems that some of them may have come from one or more graves of the Globular Amphora culture.

The grave equipment from Zdrojówka (T. Wiślański 1966, fig. 14), Gaj site 1 (T. Wiślański 1966, fig. 13: 7, 8) and possibly graves from Grochowiska (T. Wiślański, fig. 13: 10, 11) and Zagrodnicza (T. Wiślański 1966, fig. 3, 6) may be linked with phase II (after T. Wiślański) or IIB-IIIa in Kuyavia (after M. Szmyt 1996).

Pottery assemblages linked with the Globular Amphora culture recorded during the reconnaissance survey and non-invasive prospection are fragmented, and rarely exceed 15 pottery fragments (c.f. site catalogue). They do not allow a chronological description of the recorded settlement of the Globular Amphora culture. In the vast majority of cases the function of particular sites is not possible to be attributed. Only in 13 cases could more permanent forms of the site's inhabitation be determined (fig. 219), due to more abundant assemblages found in the area of over 10 ares. Quite exceptional is site 4 at Łania, where the detailed archaeological inventory survey has revealed 264 fragments of the Globular Amphora culture pottery (table 17). Their spatial distribution, covering an area of c.a. 1 ha, indicates settlement remains (fig. 111:A), which should be linked with the classical or late phase of the Globular Amphora culture, on the basis of scarce decorated fragments.

The spatial distribution of the sites attracts attention, as it indicates that the settlement of the Globular Amphora culture is mainly located in the western part of the excavated area (fig. 219), covering terrains with distinct environmental features (c.f. P. Kittel, P. Papiernik, S. Tyszkowski, M. Płóciennik, current volume; M. Jankowski, S. Sykuła, current volume). We should pay attention to the vicinity of site 1 at Wietrzychowice, where permanent settlement of the youngest phase of the Funnel Beaker culture was recorded. Materials from the Globular Amphora culture are only represented by several vessel fragments in the vicinity of long barrow no 3 at Śmieli, site 3 (c.f. fig. 217: C). The above observations may contribute to the discussion on the co-occurrence of both cultures in Kuyavia at the end of the 4th and the beginning of the 3rd millennium BC (c.f. A. Koško 1990; M. Szmyt 1996).

Corded Ware culture

Artefacts linked with the Corded Ware culture have been recognized at only 12 sites (fig. 220). These are meagre assemblages consisting of maximum 3 vessel fragments, with decoration typical of the

Corded Ware culture. They do not allow for a more thorough description of the settlement of the culture in question. It can only be observed that the sites belonging to the culture in question occur in various parts of the explored area, mainly in its western section (fig. 220).

Conclusion (Piotr Papiernik)

Comprehensive, non-invasive research conducted in the region of Wietrzychowice Culture Park has brought about a surprising increase in the number of archaeological finds, fundamentally changing the state of knowledge based on the Polish Archaeological Record (AZP). Systematic aerial prospection conducted in the years 2009-2018 helped locate almost 600 sites linked with the Stone Age, which allowed the description of settlement from the Late Palaeolithic to the end of the Neolithic.

An unquestionable success of the excavations is the recognition of settlement changes in the area of the Kuyavian Lakeland, which has never been done before. The oldest, scarce finds connected with the Late Palaeolithic indicate seasonal penetration of the area by Swiderian culture communities. A considerable settlement growth occurred in the Mesolithic. The unearthened finds should be interpreted as the remains of Mesolithic communities of different cultural traditions, which permanently inhabited the explored area in the early and middle Holocene. The discovery of a large number of Linear Pottery culture sites in the settlement sequence is quite essential. They form a new, previously unknown, settlement cluster which indicates that the ecumene of the oldest farming communities also encompassed the area of the Kuyavian Lakeland. Interestingly, there are scarce finds linked with younger Danubian cultures, mainly limited to the Stroke-ornamented Ware culture, with no finds which would attest the presence of the settlements of the Brześć Kujawski Group of the Lengyel culture. The explored area turned out to be a place of intensive settlement of the Funnel Beaker culture communities, whose remains were found at almost 500 sites. It is important to observe that the finds from this culture are connected with all development phases, from the Sarnowo to the Luboń phase. The model of the maximum chronological span of the settlement of the Funnel Beaker culture, most thoroughly researched in the vicinity of the cluster of Wietrzychowice long barrows should be regarded as typical also with reference to other distinguished clusters. This has been confirmed by the results of non-invasive research of 12 settlements. The next stage of inhabitation, most probably to some extent contemporaneous with the Funnel Beaker culture, is connected with the Globular Amphora culture communities. The sites of this culture are numerous, but due to a small number of unearthened finds they are difficult to interpret in chronological or functional terms. The last element of Neolithic settlement includes meagre remains of the Corded Ware culture settlement, which indicate a not very well-determined penetration of the area by the communities of this culture in the final part of the Neolithic.

The presented works make use of large scale non-invasive research, such as aerial and geophysical prospection, geochemical research and a detailed survey of movable finds on the surface of settlements and megalithic cemeteries. During the search for the long barrows, it was essential to combine the observations based on aerial and geophysical prospection with the detailed archaeological inventory survey. Complementary application of these methods allowed a reliable and precise location of the remains of the long barrows, currently completely imperceptible on the ground. The results obtained by means of well-developed working method encourage further search for long barrows in other areas, also outside Kuyavia.

As regards the Linear Pottery culture and the Funnel Beaker culture, the simultaneous application of diversified methods allowed the recognition of sites in terms of inhabitation chronology, presence of archaeological features and cultural layers, as well as determining the state of preservation of archaeological remains. Therefore non-invasive prospection should be suggested as an element preceding traditional archaeological excavations. The former may facilitate better planning of scientific and conservation resources.

The research in the region of Wietrzychowice Culture Park has once more confirmed a major role played by systematic reconnaissance survey in settlement exploration. Scientific value of the research is strengthened by the conducted analyses of the environmental conditions of the sites' location. It can be clearly observed that Mesolithic communities, such as the Linear Pottery culture, Funnel Beaker culture and the Globular Amphora culture were selective in their settlement choice and tended to exploit different natural resources in particular chronological periods.

The presented studies are the first attempt to sum up the conducted non-invasive prospection and abiotic research of the elements of geographical environment in the region of Wietrzychowice Culture Park. They are also an evident proof that further works are needed, especially with regard to the acquisition of comprehensive data, which would help determine the chronology of settlement of particular cultures. In the case of the Funnel Beaker culture it is essential to determine the period of building the megalithic long barrows. The relationship between the Mesolithic and Neolithic communities in the context of late Mesolithic settlement of the Linear Pottery culture, Stroke-ornamented Ware culture and the Funnel Beaker culture may also be an interesting research topic.