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SETTLEMENT BASE OF THE NEOLITHIC BANDED FLINT MINES IN KRZEMIONKI OPATOWSKIE – AN OUTLINE OF THE ISSUES

ABSTRACT

Sałacińska B. and Sałaciński S. 2022. Settlement base of the Neolithic banded flint mines in Krzemionki Opatowskie – an outline of the issues. *Sprawozdania Archeologiczne* 74/1, 67-104.

The analysis of the Middle and Late Neolithic settlement pattern confirms the thesis of the significant role of the middle Kamienna river basin in the region of the Sandomierz Upland and the Ilża Forehills as the settlement base for banded flint mines in the area of Krzemionki Opatowskie. Some of the settlements of the Funnel Beaker culture located in the northern and central part of the Sandomierz Upland could be related to exploitation and processing of the: banded and the Świeciechów flint raw materials. The area of the right-bank tributaries of the Kamienna river is considered a settlement base for the prehistoric banded flint mines of the Globular Amphora culture.

The surface survey and test excavation carried out in the middle course of the Kamienna river in the Ilża Forehills, as well as archaeological excavations in the mining field, showed the existence of quite numerous sites from the Neolithic and the Early Bronze Age.

Keywords: Funnel Beaker culture, Globular Amphora culture, Sandomierz Upland, Ilża Forehills, Neolithic settlement, flint raw materials

Received: 06.04.2022; Revised: 26.05.2022; Accepted: 27.10.2022

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INTRODUCTION

The prehistoric banded flint mines in Krzemionki Opatowskie, Ostrowiec Świętokrzyski district, were discovered in 1922 by the outstanding geologist Jan Samsonowicz. The mines have been studied by several generations of Polish archaeologists, and the results of their work have been published in specialist and popular science national and European publications. The main focus was on the issues of prehistoric mining, production and distribution of products and conservation issues (Sałaciński 1997; Matraszek and Sałaciński 2005, 74-89; Sałacińska and Sałaciński 2007; Bąbel 2015, 28-41). The on-mine and next-to-mine settlement was dealt with on a smaller scale. Naturally, all researchers recorded facts related to this issue (Krukowski 1939, 79-83; Żurowski 1962, 28; Borkowski *et al.* 1989, 196-207; Zalewski 1989; Sałaciński 1997, 22-23; Bąbel 2015, 129-131, 183-199; Gamble *et al.* 2018, 73).

In this article, we want to pay attention to the issues related to the settlement base of communities that carried out prehistoric exploitation of banded flint in the mines in Krzemionki Opatowskie. We focus on selected archaeological sites, mentioning their location, chronology and cultural affiliation. The full development of this issue would, however, exceed the volume of this type of publication.

The territorial coverage of the study includes the southern fringes of the Iłża Forehills (the central part of the Kamienna river basin, the immediate vicinity of the complex of banded flint mines in Krzemionki Opatowskie) and the northern edge of the Sandomierz Upland (basin of the Kamionka, Obręczówka, Gierczanka and upper Opatówka rivers), located within the Kielce Upland (Kondracki 1994, 207, 212, 213). The chronological and cultural scope of the study covers the Neolithic (the Funnel Beaker culture – FBC, the Globular Amphora culture – GAC) and marginally the Early Bronze Age (the Mierzanowice culture – MC).

GEOLOGICAL AND ENVIRONMENTAL CONDITIONS

The Iłża Forehills and the Sandomierz Upland are two different regions in terms of geology, geomorphology and environment. The Iłża Forehills is located within the outcropping of rocks of the Jurassic period, and in its eastern part, in the lower reaches of the Kamienna river – of the Cretaceous period ones. It lies in the so-called north eastern Mesozoic fringe of the Holy Cross Mountains. In prehistory, this region was a place of extracting various siliceous rocks – “chocolate” flints, banded flints, Świeciechów and Ożarów flints.

The landform of the region is characterised by low ranges of hills. There are mainly sandy and sandy-rocky podzolic and pseudo-podzolic soils here. The most important river is the Kamienna river, and except for this, the area is largely devoid of surface waters.

Small, essentially periodic watercourses and surface ponding occur in Ostrowiec Świętokrzyski and Kolonia Milkowska (Budziszewski and Michniak 1989, 151; Kondracki 1994, 207; Kowalski 1997, 19; Jedynak *et al.* 2008, 49-51).

The foundation of the Sandomierz Upland is a geological continuation of the Holy Cross Mountains. The whole upland is covered by loess deposits of considerable thickness. The land area is quite flat, cut by the valley systems of the Vistula tributaries – Koprzywianka and Opatówka rivers, and the tributaries of the Kamienna river – Świślina, Kamionka, Obręczówka and Gierczanka rivers (some of the river names have been changed: Gierczanka to Przepaść, and Obręczówka to Krzczonowianka; some rivers on physical and geographical maps have different names: Kamionka/Szewnianka, Garbutka/Garbatka; the article uses the old names of rivers, accepted and still used in the archaeological literature: *cf.* Kowalski 1975b; Jedynak 2009, 157; Kaptur 2010, 55; Galka 2016; Kowalewska-Marszałek 2019, 128). The northern border of the upland is formed by the Kamienna river valley and the slope of the loess cover between Ćmielów and Zawichost. The fertile loess soils belong to the brown earth class, and sometimes to the black earth class (Kondracki 1994, 207, 212, 213). It is a region that was seen as conducive to settlement and farming already since the Neolithic (Kowalewska-Marszałek 2019, further literature there).

The two analysed regions are geographically separated by the Kamienna river valley, and in terms of communication, as a water communication route – it connects them.

CHRONOLOGICAL AND CULTURAL FRAMEWORK

Since the discovery of the mining complex in Krzemionki Opatowskie, several generations of Polish archaeologists and other researchers related to archaeology, initially on a secondary basis, and then on a larger scale, dealt with the problem of the settlement base of Neolithic banded flint mines. The traces of settlement located within mine complexes, in places adjacent to the mining field in the area of natural water reservoirs – sinkholes, in staged flint processing camps located between mines and miners' mother settlements, as well as in users' settlements were analysed (selected works: Krukowski 1939; Krzak 1961; 1962; 1993; Żurowski 1962; Kruk 1973; 1980; 2008; Balcer 1975; 2002; Kowalewska-Marszałek 1986; 2018; 2019; Borkowski *et al.* 1989; 1991; Migal and Jaworowska 1992; Zalewski 1996; Sałaciński 1997; Kruk and Milisauskas 1999; Jedynak *et al.* 2008; Jedynak and Kaptur 2008; Uzarowicz-Chmielewska and Sałacińska 2013; Bąbel 2014; 2015; Sałaciński and Sałacińska 2020).

The complex of banded flint mines in Krzemionki Opatowskie itself is located in the Iłża Forehills. In terms of geological structure, it is located in the north-eastern periphery of the Holy Cross Mountains, in the area of the Magoń-Folwarczysko syncline (Budziszewski and Michniak 1989). It is situated about 3-3.5 km from the Kamienna valley (distance measured in a straight line to the east).

The prehistoric exploitation of banded flint in Krzemionki Opatowskie was carried out in the form of surface pits, pit-niche, stall-and-pillar and stall mines. The population of the FBC began the extraction of the banded flint with use of mining methods. They exploited shallow pit and pit-niche mines. This is confirmed by the finds of FBC pottery sherds, coming from the outer part of the mining field. The population of the GAC continued to exploit and developed extractive mining techniques – exploitation was carried out in stall-and-pillar and stall mines. This is confirmed by the finds of pottery fragments of this culture and the forms of roughouts and of tool semi-finished products with quadrilateral section – axe blades and chisels.

After the end of GAC, the exploitation of banded flint disappears, and products made of this raw material are rarely found in the inventories of the Corded Ware (CWC) and Złocka culture. Such a break could last from the end of the GAC to the beginning of the Bronze Age and amounted to about 400-500 years (Balcer and Kowalski 1978, 138-139).

There was a renewal of use of the mine on a limited scale in the Early Bronze Age when communities of the MC began activity in the mining area re-digging Neolithic waste heaps. This is confirmed, among other things, by pottery sherds, semi-finished products of bifacial axes and remains of hoes (Borkowski *et al.* 1989, 201-203; Migal and Jaworowska 1992, 52, 54, 56; Krakowska 1996; Migal and Sałaciński 1997, 105; Sałaciński 1997, 23; Balcer 2002, 21; Bąbel 2014, 80; 2015, 113, 114, 185-193; Sałaciński and Sałacińska 2020, 363-368). In the Sandomierz Upland, mainly bifacial axes and heart-shaped projectile points were found in MC assemblages and in the form of loose finds. Furthermore traces of banded flint tools are known from the sites of the Trzciniac culture in the Sandomierz and Lublin Uplands, proving the use of banded material to a negligible extent in the Bronze Age (Balcer and Kowalski 1978, 139, 140).

Of utmost significance for research on the importance of prehistoric exploitation of banded flint are the analysis of Bogdan Balcer and Krzysztof Kowalski on the distribution of products of this raw material, mainly axe blades and chisels with quadrilateral section in the FBC and GAC, and bifacial axes in contexts of the MC. The maximum range of occurrence of banded flint artefacts in the FBC was 250 km from the deposits, and in the GAC – 660 km from the deposits, while in the MC – 65 km from the deposits (Balcer and Kowalski 1978; Balcer 2015, 128, 129).

A very important issue is the dating of the mine complex in Krzemionki Opatowskie and of the banded flint exploitation of the settlement base. The earliest phases of banded flint exploitation occurs in the years 5000-4700 BC. On the other hand, the most intensive mining work was carried out in the period of 3600-3000 BC, with most of the analysed samples falling within a shorter range of approx. 300 years – from 3300 to 3000 BC (Borkowski and Zalewski 1992; Pazdur *et al.* 1992; Nowak 2009, 327, 334; Bąbel 2015, 124-128). The exploitation of banded flint in niche mines was estimated at around 3340 BC or 3220 BC, in pillar mines around 3370 BC or 3340 BC, 3210 BC and in stall mines 3270 BC or 3110 BC, 3070 BC (Borkowski and Zalewski 1992; Pazdur *et al.* 1992).

In the Sandomierz Upland, the beginnings of the FBC settlement are set at 3650/3600 BC, the intensification of FBC settlement falls in the years 3500-3300 BC, and its development could last until 2900/2800 BC.

The settlement in loess areas is considered representative for the south-eastern group of the FBC. On the Sandomierz Upland, there was one of the concentrations of the settlement of this culture. The aforementioned group appeared in different areas replacing the earlier settlement of the Lublin-Volhynian culture from its late stage. Its chronology was determined in older publications and was presented in detail by Piotr Włodarczak, who states that the determinations of the absolute age of assemblages from the Sandomierz Upland are consistent with the results of typological analyses developed for the materials of the south-eastern group of the FBC. Its inventories should be linked with the middle and the late stages of the classical phase of development, with the existence of large settlements, with two development stages: II (phase II-IIIa – from 3650 BC to 3400/3300 BC), and III (phase IIIb-IV from 3400/3300 BC to 2900/2800 BC), which can be synchronised with the two main classic development phases from the KPL settlement in Bronocice, Pińczów district (BR II and BR III). According to P. Włodarczak, it is possible to divide stage III into two shorter time sections IIIa and IIIb (Włodarczak 2006; Nowak 2009, 325-344; Kadrow 2009, 140-142; Kruk and Milisauskas 2018, 116-132, older literature there).

In the Sandomierz Upland, the GAC settlement began at the turn of the 4th and 3rd millennium BC, and perhaps the first centuries of the 3rd millennium BC. Until then, there were undoubtedly stable FBC settlements. Their disappearance probably took place during the first two centuries of the 3rd millennium BC as a result of the GAC population expansion, and – soon after – the CWC population expansion (Włodarczak 2006, 56, 57).

The Globular Amphora culture, according to Janusz Kruk and Sarunas Milisauskas, is dated in the Sandomierz and Lublin Uplands (Kruk and Milisauskas 1999, 192) to the range of approx. 2900 BC (2400 bc) to 2500 BC (2060 bc). These data are based also on the studies of Józef Ścibior and findings of Sławomir Kadrow and Marzena Szmyt for the eastern group of the Globular Amphora culture dated from 2950 to 2350 BC (Ścibior 1991; Kadrow and Szmyt 1996, 103-111).

SETTLEMENT TRACES WITHIN THE MINING FIELD IN KRZEMIONKI OPATOWSKIE (ON-MINE ENCAMPMENTS)

Stefan Krukowski, the author of an excellent monograph of banded flint mines (Krukowski 1939), was a precursor of research on prehistoric flint mining in Poland, and at the same time an outstanding expert in Krzemionki Opatowskie. He argued that the miners established encampments on the mining field and beyond it. These were not suitable for use in winter and their occupation was limited to the warmer seasons, they were located every year as open-air or sites with shelters. Population groups involved in the extraction

of banded flint were coming to the mines in the spring and were going back to their villages in the fall. Exploitation was discontinued for the winter. The miners also camped in the vicinity of the sinkholes, adjacent to the mines which were constituting for them a source of rainwater (Krukowski 1939, 77-80).

Traces of Neolithic and Early Bronze miners' camps (mainly in the form of pottery sherds of the FBC, the GAC and the MC) were discovered directly at the exploited mines (Borkowski *et al.* 1989, 201-203; Migal and Jaworowska 1992, 52, 54, 56; Migal and Sałaciński 1997, 105; Bąbel 2014, 80; 2015, 185-193).

In the area of the shaft of the deep stall mine 7/610, during the excavation work carried out by the Team for the Study of Prehistoric Flint Mining of the State Archaeological Museum in Warsaw, sixteen variously oriented post-holes were found and interpreted as the remains of a roofing structure covering the shaft. Also discovered were a miners' encampment, a complex of a domestic nature, bonfire traces and a flint processing workshop where axe blades were produced and mining tools of stone and flint were repaired. Apart from mass flint materials, fragments of the GAC ceramics were discovered in two clusters (Migal and Jaworowska 1992; Borkowski 1997, 46, 47). Vessels analogous to them have been discovered, among other places, at the settlement of the GAC in Mierzanowice (Balcer 1963, Pl. II: 3, IV: 4, V: 8, VII: 20, 21). The shaft roofing structure confirms the multi-season nature of mining works (Bąbel 2015, 97, 98). According to the radiocarbon dates, the settlement complex on the surface (encampment) should be dated to the calendar age range to 3280-2940 BC. From the excavations of the underground mine, dates of between 3460 and 2970 BC were obtained. Differences in chronological terms are explained by the influence of natural external factors (Migal and Jaworowska 1992, 55).

SETTLEMENTS WITH DEBRIS FROM VARIOUS STAGES OF FLINT PROCESSING LOCATED IN THE IMMEDIATE VICINITY OF THE MINING EXPLOITATION FIELD IN KRZEMIONKI OPATOWSKIE, IN THE AREA OF SINKHOLES

Traces of Neolithic and Early Bronze settlement in the area of the sinkholes (Fig. 1) by the banded flint mines, neighbouring with the exploitation field in Krzemionki Opatowskie, were recorded during inspections and surface surveys conducted by S. Krukowski in the 20^s and 30^s of the 20th century. The material gathered included artefacts obtained from the local population and collected at his request (Krukowski 1939; Sałaciński and Sałacińska 2020). Close to the sinkholes, in addition to artefacts of domestic type, including FBC and GAC ceramic fragments (Bąbel 2015, 183-199). Neolithic flint processing workshops of the on-mine type were also discovered, in which roughouts and semi-finished products of axes were produced, having strict analogies to artefacts originating from the mining field (Figs 2: b, d, 3: a; Sałaciński and Sałacińska 2020, 361, figs 9-11). On a smaller scale there was

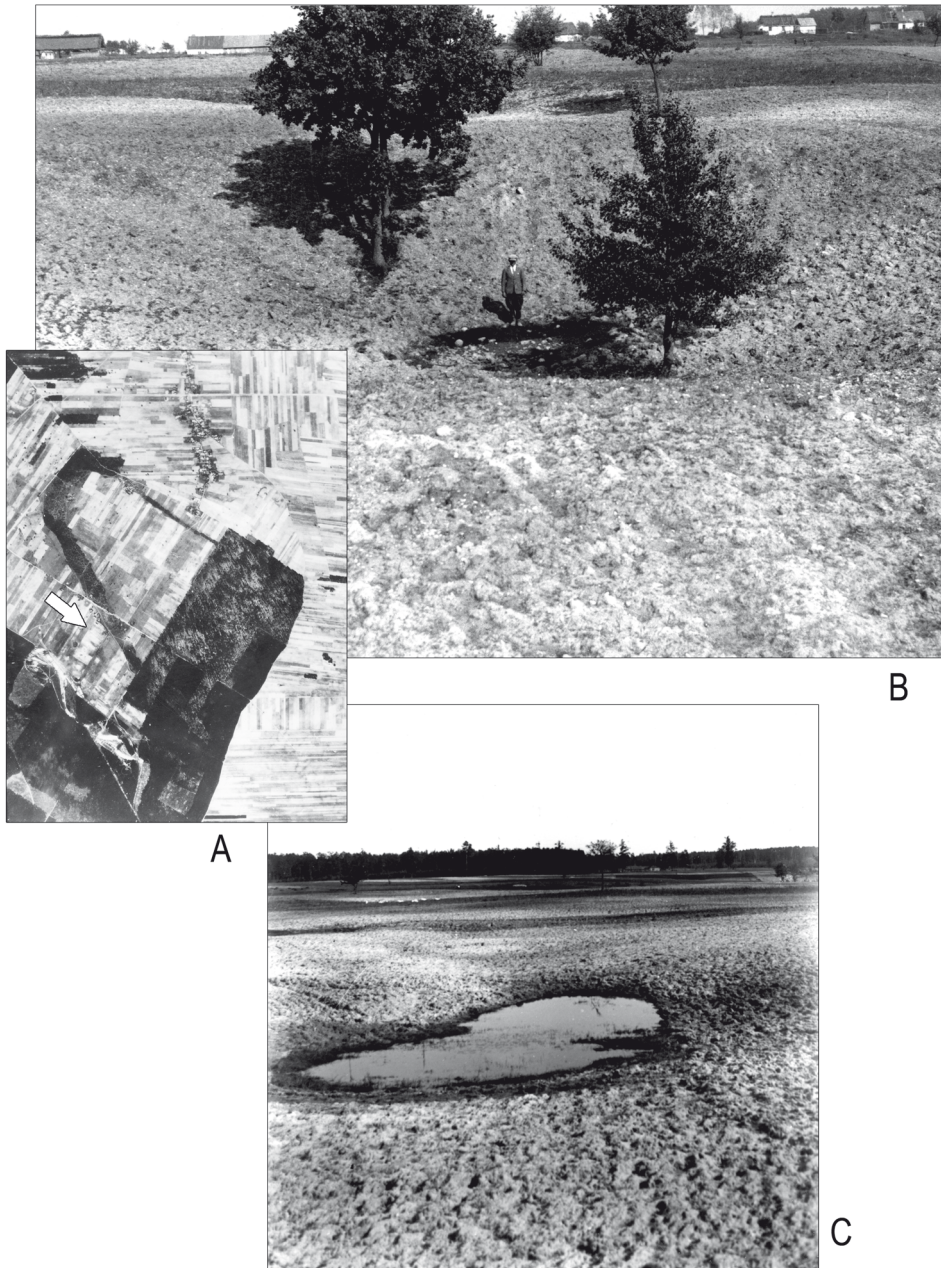


Fig. 1. Krzemionki Opatowskie, Ostrowiec Świętokrzyski district.

A – location of the exploitation field, aerial photo, the 1960s; B – the Kał Hutny Dół sinkhole in the 1930s;

C – the Kał Dwojak sinkhole in the 1930s.

Photo from the collection of the State Archaeological Museum in Warsaw

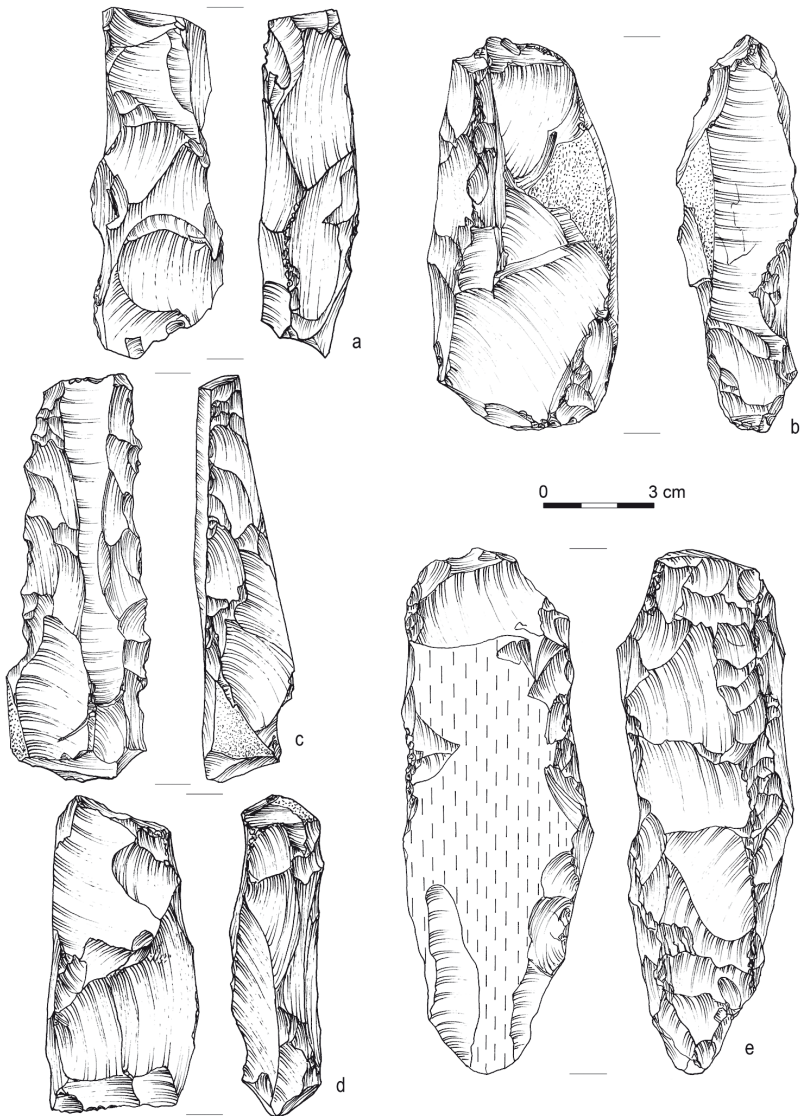


Fig. 2. Core forms of banded flint from encampments located at sinkholes: a – Krzemionki Opatowskie, Ostrowiec Świętokrzyski district, the Kał Plinik sinkhole, semi-finished product of a chisel with quadrilateral section, Globular Amphora culture; b – Krzemionki Opatowskie, Ostrowiec Świętokrzyski district, the Kał Chodnik sinkhole, semi-finished product of an axe with quadrilateral section, Funnel Beaker culture; c – Krzemionki Opatowskie, Ostrowiec Świętokrzyski district, the Kał Trojak sinkhole, semi-finished product of a chisel with quadrilateral section, Globular Amphora culture; d – Kały near Jelenia Góra (now part of the village of Sudół), Ostrowiec Świętokrzyski district, semi-finished product of an axe with quadrilateral section, Funnel Beaker culture/Globular Amphora culture; e – Kały near Jelenia Góra (now part of the village of Sudół), Ostrowiec Świętokrzyski district, pick, Globular Amphora culture. Drawn by B. Karch, graphic design by B. Sałacińska

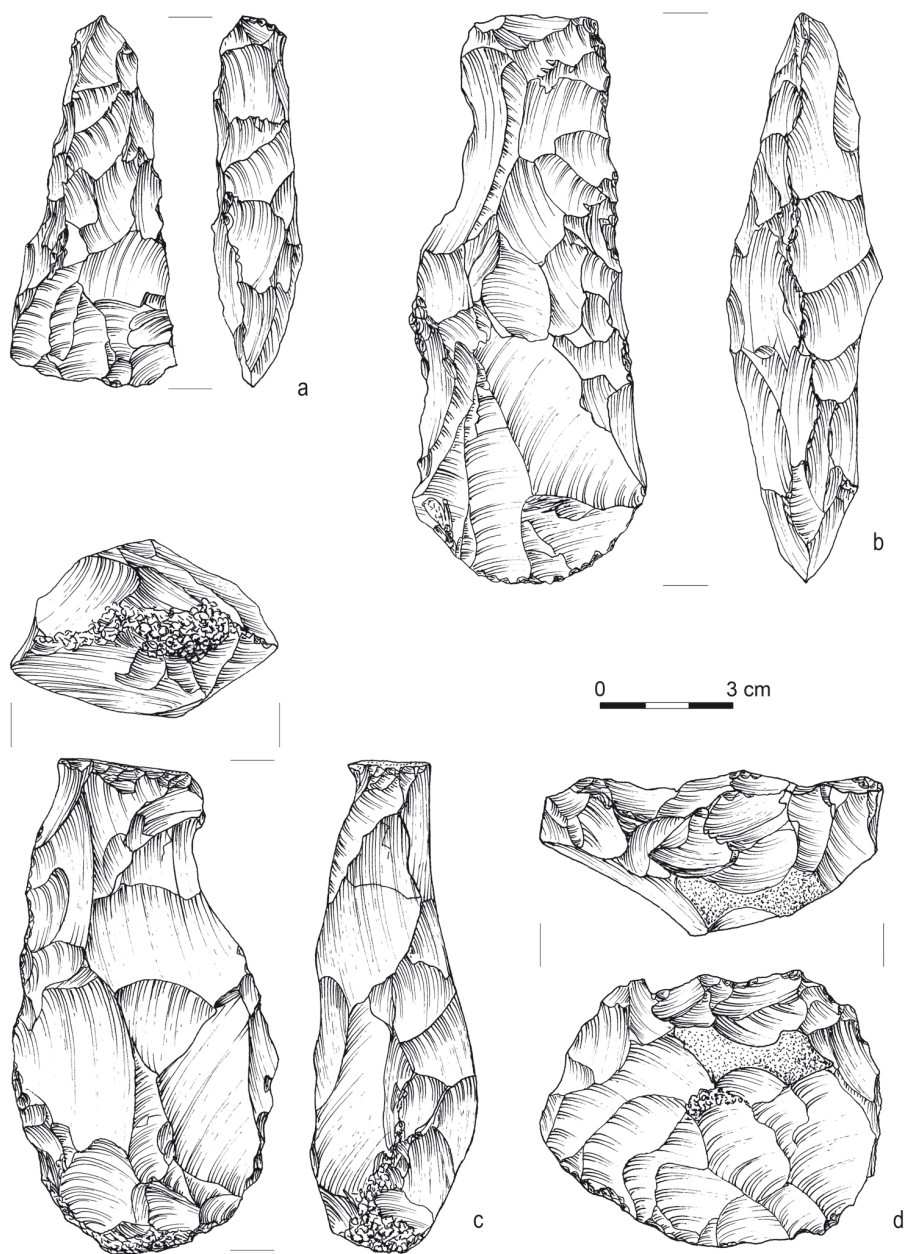


Fig. 3. Krzemionki Opatowskie, Ostrowiec Świętokrzyski district, the Kał Wielki Lej Krasowy or Kał Wielki Dół sinkhole), core forms of banded flint from an encampment located at the sinkhole: a – semi-finished product of an axe with quadrilateral section, Funnel Beaker culture/Globular Amphora culture; b – semi-finished product of a bifacial axe, Mierzanowice culture; c – hoe, Mierzanowice culture; d – flake core, Mierzanowice culture. Drawn by B. Karch, graphic design by B. Sałacińska

evidence for the production of chisel-forms (Fig. 2: a, c; Sałaciński and Sałacińska 2020, 361, figs 12, 13). The close relations with the nearby mines are also confirmed by the mining tools distinguished in the materials from the camps situated by the sinkholes – flint wedges and picks made of banded flint material (Fig. 2: e; Sałaciński and Sałacińska 2020, 364, fig. 17).

Among the tools made of banded flint, both from mine fields and from sinkholes, hoes were also distinguished (Fig. 3: c). They functionally served as digger-tools to work in the upper parts of the shafts and digging up waste heaps to obtain flint chunks. They are dated to the Early Bronze Age and are associated with the MC (Sałaciński and Sałacińska 2020, 364, 367, figs 9: a, 19: a, 20). The semi-finished products of bifacial axe blades are also associated with the MC (Fig. 3: b; Sałaciński and Sałacińska 2020, 361, 364, figs 14, 15) and small cores intended for obtaining flakes for the production of arrowheads (Fig. 3: d; Sałaciński and Sałacińska 2020, 371, figs 21: a, 23).

In the years 1986-1988, Marek Zalewski from the Team for Research on Prehistoric Flint Mining of the State Archaeological Museum in Warsaw conducted excavations near one of the sinkhole called by the archaeologists 'Kał Cebuli' or 'Kał Smużek', located south-west of the border of the mining field. One of the main goals of this work was an attempt to define the connections between the camp and the mines. The analysis of the historic material obtained from the research shows that all production steps of the flint axes of the FBC or the GAC have been produced here, from the initial stage – raw nodules, rough outs, massive cortical flakes, through shaping – scar flakes of several series, to the finishing stages of axe blades – fragments of grindstones (Zalewski 1996).

The workshop-type material discovered at the sinkholes are a testimony to the stages of processing of banded flint in the camps. Excavation research in the area of Kał Cebuli confirmed the findings of S. Krukowski about the great importance of natural water reservoirs in sinkholes for the camp of Neolithic and Early Bronze miners exploiting banded flint in nearby mines (Zalewski 1996, 359, 373; Sałaciński 1997, 23).

In the times of operation of the mines in Krzemionki Opatowskie, not only rough outs and semi-finished axes reached the miners' home settlements, but also, although on a much smaller scale, fragments of flint nodules (concretions) used for other types of products, *e.g.* cores, blade-and-flake blanks and ultimately retouched tools (Sałaciński 1989). The production of semi-finished axes of banded flint on a mass scale was also carried out in flint processing workshops at settlements of the FBC, *e.g.* in Podgrodzie, Ostrowiec Świętokrzyski district (Krzak 1966; Balcer 1975, 185), and above all at the site on Gawroniec Hill in Ćmielów, Ostrowiec Świętokrzyski district (Krukowski 1939, 89; Balcer 2002, 130-145).

Apart from the traces of encampment within the mine area and at the sinkholes neighbouring the mining field, B. Balcer distinguished the mother settlement, the production settlements and the users' settlements (Balcer 1975, 30).

SETTLEMENTS OF THE FUNNEL BEAKER CULTURE IN THE NORTHERN PART OF THE SANDOMIERZ UPLAND

The Sandomierz Upland, especially its northern part (Fig. 4), is considered a settlement base for the population of the FBC that exploited banded flint in the mines in Krzemionki Opatowskie (Krukowski 1939, 84-97; Wiślański 1979b, 246-248; Balcer 1975, 247; Kruk 1980, 105).

This finding is supported by the results of the analyses carried out by Hanna Kowalewska-Marszałek on the Neolithic settlement, which indicate that the Sandomierz Upland is an area of compact, intensive settlement of the FBC (*e.g.*, Kowalewska-Marszałek 2018;

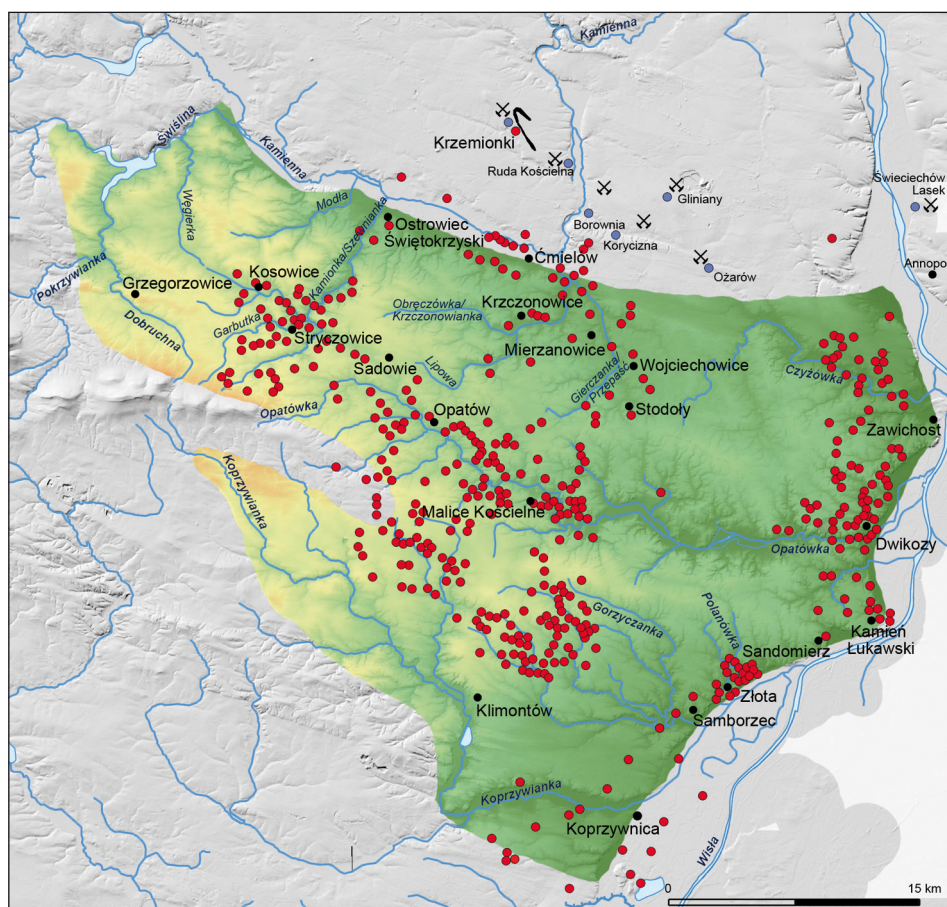


Fig. 4. Sandomierz Upland. Maps of the distribution of settlement points of the Funnel Beaker culture. Based on: Balcer 1971, Fig. 1; Bąbel 2015, Fig. 174; Kowalewska-Marszałek 2019, Fig. 1: a, source: digital terrain model Head Office of Geodesy and Cartography. Graphic design by B. Sałacińska, W. Gruzdź

2019, further literature there). The settlement network of this culture is characterised by high uniformity, as well as a preference for regions with similar environmental conditions. The distribution of settlement points is divided into three latitudinal zones: northern, central and southern. Larger concentrations of settlements of the FBC are visible over the upper Gorzyczanka river, the upper Kamionka river, in the Opatówka river basin and in some sections of the Vistula escarpment (around Złota, the area between the Pepper Mountains north of Sandomierz and Zawichost). In the central-western zone, as well as in the northern zone, the most common are large settlements, usually characterised by a high intensity of use. Medium-sized settlements predominate in the central-eastern part. A special category are the so-called upland settlements: situated in places with natural defensive values, including in Stryczowice, site 1, Ćmielów, Gawroniec site, Grzegorzowice, Diabli Piec site, Nikisiałka Duża, site 1 (Kowalewska-Marszałek 2018, 320; 2019, 120-127, 132, figs 1: a, 2: a).

According to H. Kowalewska-Marszałek, the settlement of the FBC in the northern and central part of the Sandomierz Upland may be related to the exploitation and processing of flint raw materials: banded and Świeciechów flints, the outcrops of which are located north and north-east of the Upland (Kowalewska-Marszałek 2019, 127).

The mother settlement of the miners from Krzemionki Opatowskie on the Gawroniec Hill in Ćmielów, Ostrowiec Świętokrzyski district

The mother settlement of miners from Krzemionki Opatowskie, according to S. Krukowski, was located at the site on Gawroniec Hill in Ćmielów (Krukowski 1939, 84-97). The settlement is situated on a loess hill on the northern edge of the Sandomierz Upland, in the Kamienna river valley, which separates the upland from the Iłża Forehills (Fig. 5). The river bed is located approximately 1 km from the settlement.

The site was discovered by an amateur archaeologist, Zdzisław Lenartowicz (Lenartowicz 1922), in the years 1928-1939, it was surface tested by S. Krukowski (Sałaciński 1982; 1989). Open-area excavation research was carried out in the years 1947-1961 (six seasons) by Zofia Podkowińska, and one campaign by Zygmunt Krzak (Podkowińska 1950; 1952; Krzak 1963). During the research, 255 pits were discovered, 245 have been explored.

The connections of the settlement of the FBC in Ćmielów with mining activities and processing of banded flint were emphasised by S. Krukowski, Z. Podkowińska, Z. Krzak and B. Balcer (Krukowski 1939, 84-97; Podkowińska 1950, 165; 1952; Krzak 1962; Balcer 2002, 161-162). Flint products were produced there on a mass scale, above all semi-finished products of axe blades with quadrilateral section were finished there (Figs 6, 7; Balcer 2002, 88). According to S. Krukowski, each year seasonal teams of miners and helpers were sent to the mines in Krzemionki Opatowskie, and the crews were provisioned. There had to be also a market place, most often in the fall (after the grain harvest), where



Fig. 5. Ćmielów, Gawroniec site, Ostrowiec Świętokrzyski district.

A – view of the site, photo M. Bogacki, photo from the collection of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski; B – view of the site, east side, 1982, photo S. Sałaciński; C – view of the site, 2019, photo B. Sałacińska

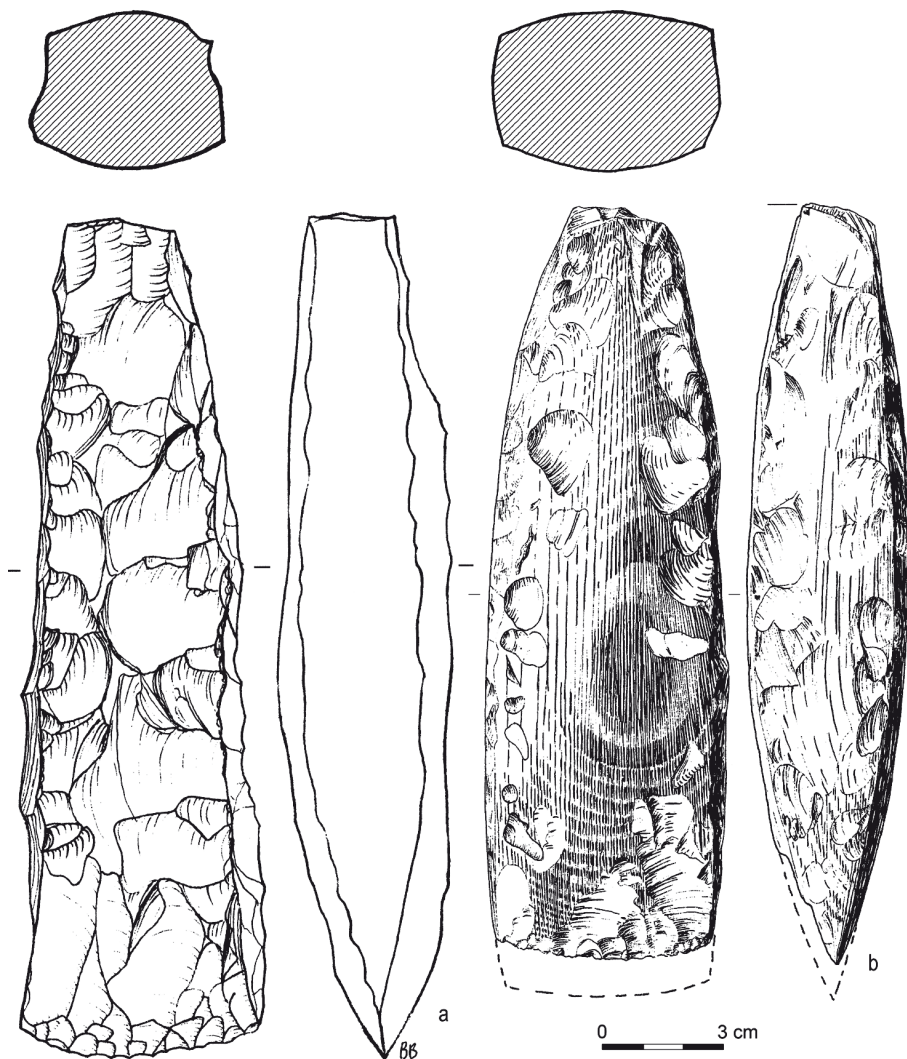


Fig. 6. Ćmielów, Gawroniec site, Ostrowiec Świętokrzyski district.
The biggest banded flint axes of the Funnel Beaker culture (a) and the Globular Amphora culture (b).
After Balcer 2002, fig. 34

a barter trade took place and various agricultural products were obtained from the inhabitants of various villages in exchange for flint products and flint raw material (Krukowski 1939, 105-107). In addition, the commercial importance of the settlement in Ćmielów has been demonstrated by Kazimierz Krysiak, who claimed that the remains of young individuals, which are present in large quantities among animal bones, were obtained during

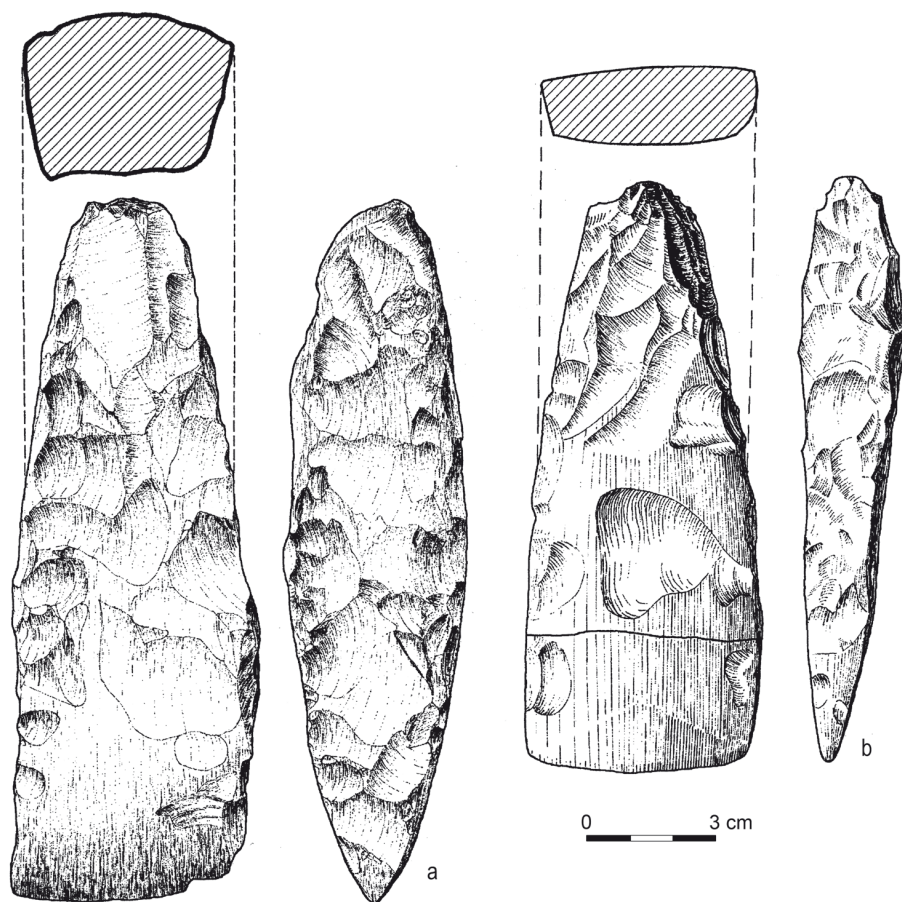


Fig. 7. Ćmielów, Gawroniec site, Ostrowiec Świętokrzyski district.
Axes of banded flint of the Funnel Beaker culture. After Balcer 2002, fig. 35: a, b

the exchange of goods (Krysiak 1950, 166; Podkowińska 1950, 131). K. Krysiak believed that it was a fact worth emphasising that a large number of deer antlers, with a negligible proportion of the bones of these animals, also testifies to their imported origin (Krysiak 1952, 243, 244). However, he did not take into account that they may have come from collecting shed antlers (Sałaciński 1982, 13).

Bogdan Balcer argued that the large number and type of production residues discovered at the Gawroniec site in Ćmielów indicate that the banded and Świeciechów flint came from independent exploitation. He considered the settlement at the site on Gawroniec Hill to be a model production site (Balcer 2002, 147). He believed that the connections between the settlement in Ćmielów and the deposits of the Świeciechów raw material

were of greater importance than with the nearby of the banded flints ones. This was because most of the cores, blades and blade retouched tools from this settlement are made of the Świeciechów raw material (Krukowski 1939, 89, 91; Balcer 2002, 130). Both raw materials could be obtained by opencast methods. Within the mining field in Krzemionki Opatowskie, banded flint was mined in area of shallow pit and niche mines, on the outside part of the band of outcrops. More controversially, B. Balcer does not rule out the use of the more labour-intensive method of underground mining in the stall units at the end of the existence of the Gawroniec settlement in Ćmielów or after its collapse (Balcer 2002, 130).

Based on radiocarbon dates, the operation of the settlement of the FBC at the Gawroniec site in Ćmielów covers the period of approx. 3500-3200 BC (approx. 2865-2625 bc) (Balcer 2002, 15).

Specialised teams of miners from the settlement at the Gawroniec site in Ćmielów could reach the area of banded flint deposits in Krzemionki Opatowskie in two ways – on foot through the forest areas of the Kamienna river valley, along well-worn trails, or by foot and by water using the Kamienna river. The raw flint material was initially worked in the mines and then transported to the mother village. There were also places of multi-staged processing, but the scale of processing at such points was not large (Balcer 2002, 155, 161).

Finds of banded flint raw material in the FBC in the form of axe blades and their fragments occur within a radius of 250 km from the deposits, mainly, however, near the mines, on the Sandomierz Upland. In other loess parts of the Lesser Poland Upland and on the fringes of the West-Volhynian Upland, the proportion of banded flint in the assemblages is already small (Balcer and Kowalski 1978).

Settlement of the Funnel Beaker culture in Stryczowice, Ostrowiec Świętokrzyski district

One of the settlements that is linked to the extraction of banded flint in Krzemionki Opatowskie is the settlement of the FBC in Stryczowice, site 1. The site is located in the Sandomierz Upland, on the plateau of the loess upland, between the Garbutka and the Kamionka rivers (Fig. 8). It was discovered in 1970 by Jerzy Tomasz Bąbel (Bąbel 1975, 539). The excavations were carried out in the years 1976-1985 (with breaks for 7 seasons) on behalf of the State Archaeological Museum in Warsaw by Anna Uzarowicz-Chmielewska. Over 17 ares were examined, including 32 settlements features (Uzarowicz-Chmielewska and Sałacińska 2013, 239; further literature there). In the artefacts of banded flint (234 specimens), 12 axes with quadrilateral section were identified (Fig. 9: b-d), partially polished with various degrees of functional damage (Sałaciński 2013, 260). Most of the features were interpreted as various types of economic pits of a storage nature, they certainly had different roofings, three features were described as water tanks. The site in Stryczowice can be associated with multi-path settlements of chaotic development and irregular shape with a zonal arrangement of buildings (Uzarowicz-Chmielewska and Sałacińska

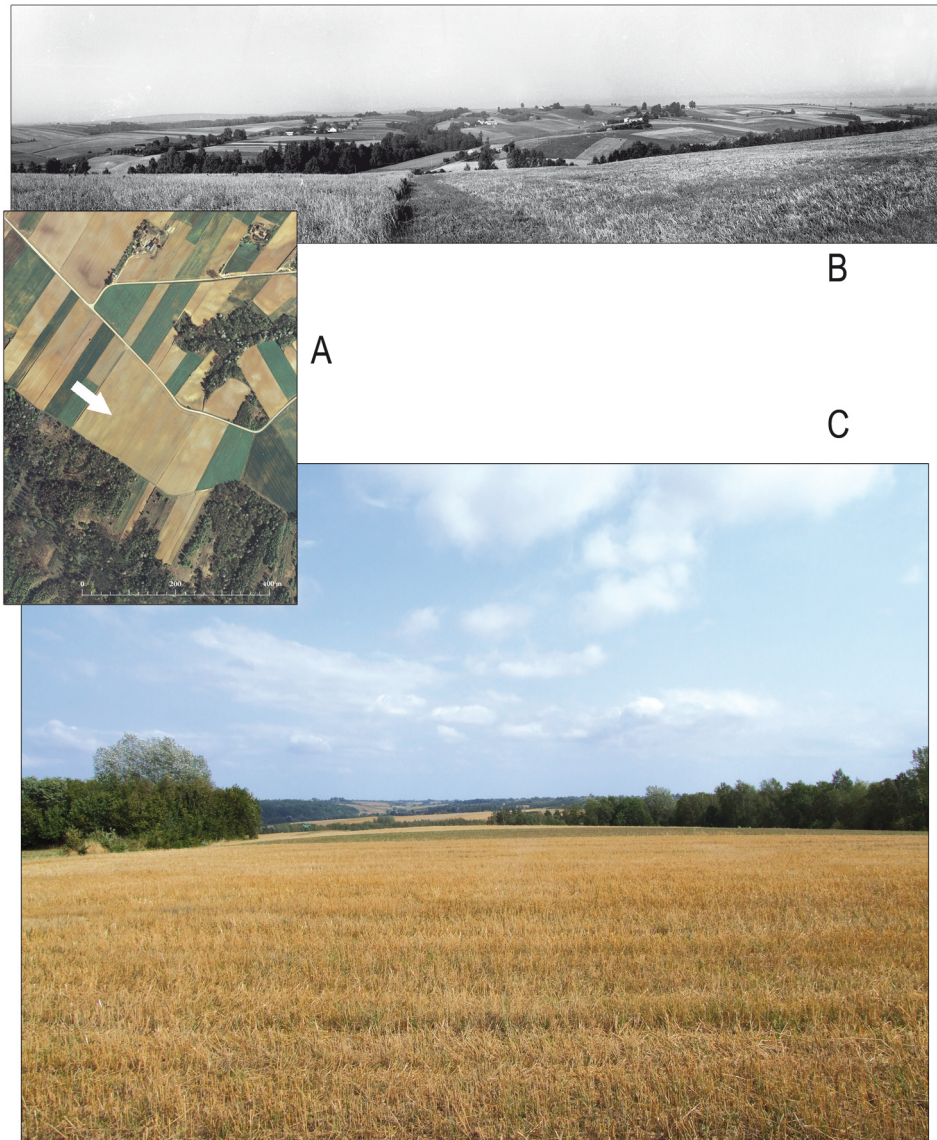


Fig. 8. Stryczowice, site 1, Ostrowiec Świętokrzyski district. A – orthophotomap of the vicinity of the site, source: digital terrain model Head Office of Geodesy and Cartography, after Uzarowicz-Chmielewska and Sałacińska 2013, fig. 3; B – the view from the site at Stryczowice to its surrounding area, 1983, computer image processing R. Sofuł, photo from the collection of the State Archaeological Museum in Warsaw, after Uzarowicz-Chmielewska and Sałacińska 2013, fig. 5; C – view of the site, 2017, photo B. Sałacińska

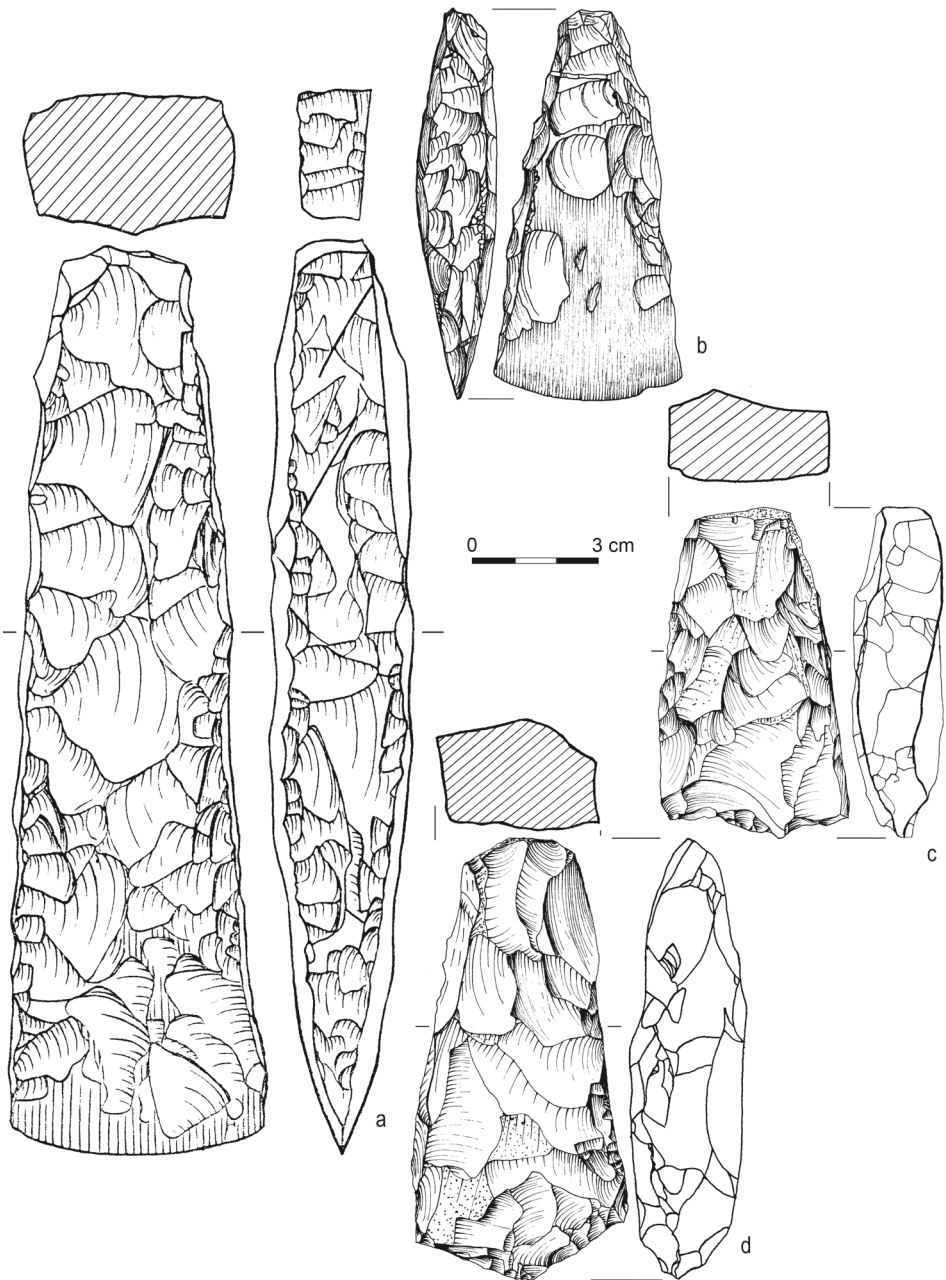


Fig. 9. Axes of banded flint, Funnel Beaker culture.

A – Ostrowiec Świętokrzyski, site 1, Ostrowiec Świętokrzyski district, after Balcer 1983, fig. 21: 13;

b–d – Stryczowice, site 1, Ostrowiec Świętokrzyski district,
after Uzarowicz-Chmielewska and Sałacińska 2013, Figs 29: 1, 2, 149: 4

2013, 223-227). One of the research hypotheses has connected the settlement with the mines in Krzemionki Opatowskie. The mere presence of products of banded flint is not, however, automatic evidence of such relationships. The above assessment may be confirmed by the discovery of a stone pick made of gabbro, which could have been used as a mining tool (Uzarowicz-Chmielewska and Sałacińska 2013, 214, fig. 195). Similar stone picks were discovered in Krzemionki Opatowskie (Borkowski *et al.* 1989, fig. 26). However, this is a single piece of circumstantial evidence in assessing the above hypothesis.

The acquired assemblage of vessel ceramics shows high homogeneity and should be associated with the classical phase of the south-eastern group of the FBC (Uzarowicz-Chmielewska and Sałacińska 2013, 229-232). According to P. Włodarczak, the obtained radiocarbon dates may indicate that the material from Stryczowice is contemporary to the younger dated assemblages from Ćmielów. Their age can most likely be estimated at around 3520-3310 BC, that is the late sub-period of the classical phase, synchronised with the BR III A stage (Włodarczak 2006, 42).

Settlement of the Funnel Beaker culture in Ostrowiec Świętokrzyski, Ostrowiec Świętokrzyski district

Another site of the FBC settlements identified by excavation is the settlement in Ostrowiec Świętokrzyski, site I. The site is located on the northern edge of the Sandomierz Upland, on a loess headland, on the Kamionka river, close to its confluence with Kamienna river. The excavations were carried out in 1942 by Konrad Jażdżewski and Kazimierz Salewicz. During the research, copious Neolithic material was discovered, among other things, a settlement of the FBC functioned here (Fig. 9: a). Ceramics and flint artefacts related to the GAC and the MC were also discovered. A unique find is the vessel of the FBC with an ornament interpreted as a schematic representation of a four-wheeled cart (Uzarowiczowa 1975; Uzarowicz-Chmielewska 1978).

SETTLEMENTS OF THE GLOBULAR AMPHORA CULTURE IN THE NORTHERN PART OF THE SANDOMIERZ UPLAND

The problem of the settlement model at the time of existence of the GAC, related to the extraction of banded flint, according to B. Balcer, has not been resolved definitively and reliably. The production of axe blades from banded raw material within this culture and the distribution of polished specimens over a distance of over 600 kilometres and the stabilisation of the settlement, indicate the enormous importance of deposits, mining and processing in the life of these communities (Bąbel 2015, 145).

The region of the right tributaries of the Kamienna river – Kamionka, Obręczówka and Gierzanka rivers is treated as a settlement base for the population of the GAC (Fig. 10)

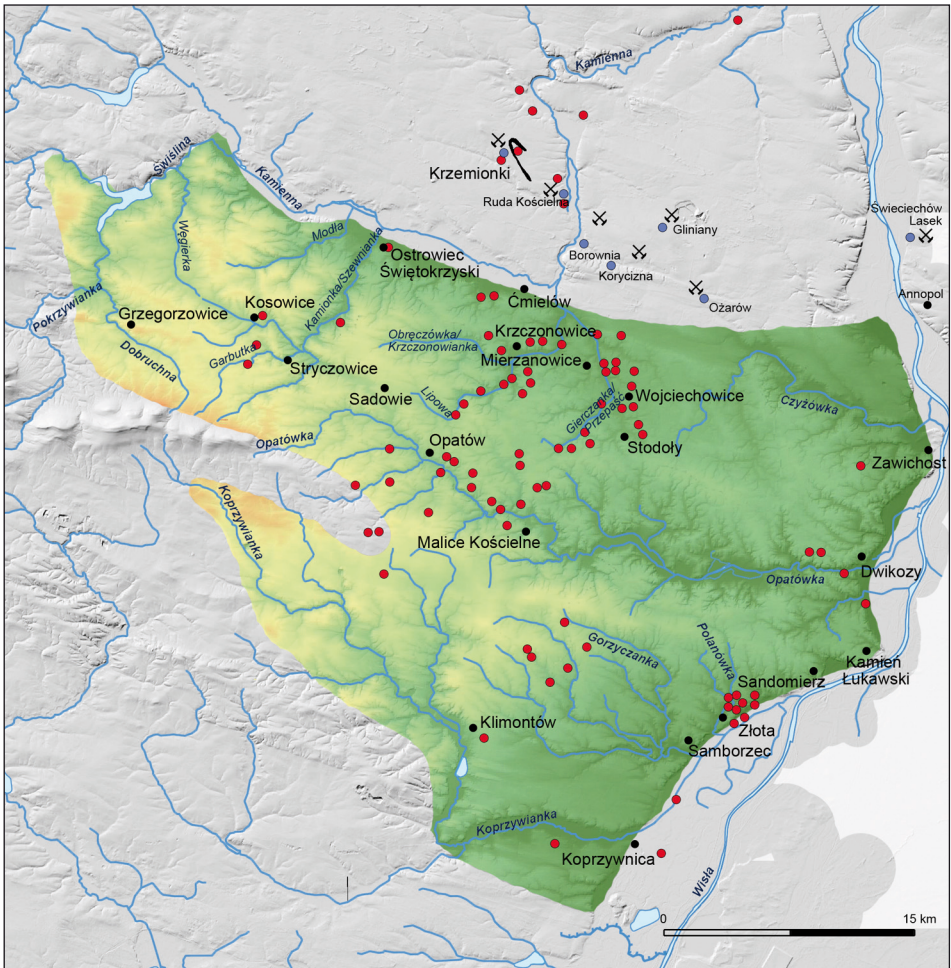


Fig. 10. Sandomierz Upland.

Maps of the distribution of settlement points of the Globular Amphora culture.

Based on: Balcer 1971, fig. 1; Bąbel 2015, fig. 179; Kowalewska-Marszałek 2019, fig. 1: b, source: digital terrain model Head Office of Geodesy and Cartography.

Graphic design by B. Sałacińska, W. Grużdź

exploiting banded flint in the mines in Krzemionki Opatowskie (Kowalewska-Marszałek 1986, 13, 20, map 4; 2019, 127-139; Jedynak 2009, 166).

According to H. Kowalewska-Marszałek the compact range of occurrence of the settlement of the GAC is confined to the north-western part of the Sandomierz Upland, from the Kamionka river in the west to Gierczanka river in the east, and to the tributaries of the upper and central Opatówka river in the south. Small concentrations of sites are also visible

on the upper reaches of Gorzyczanka and Polanówka rivers in the area of Złota, Sandomierz district. In the eastern and southern part of the Upland, only single sites of this culture can be found (Kowalewska-Marszałek 2019, 127-130, figs 1: b, 2: b).

The intensive exploitation of banded flint in the middle and late section of the Neolithic and in the Early Bronze Age undoubtedly required the existence of a settlement base in close proximity of the mines of this raw material. There is much evidence that this role was played primarily by the Sandomierz Upland, which was the natural context of the functioning of the flint mines located in the area of Krzemionki Opatowskie (*e.g.*, Krukowski 1939, 84-97; Balcer 1975, 247; Wiślański 1979b, 246-248; Kruk 1980, 105; Kowalewska-Marszałek 2019, 132).

A detailed analysis of the settlement of the Middle and Late Neolithic fully confirms the thesis about the significant role of the Sandomierz Upland as a settlement base for the banded flint mines in the Krzemionki region. Taking into account all the analysed features of the settlement network of this area, it can be concluded that the relationship with the banded flint mines is more pronounced in the case of the GAC. This is evidenced primarily by the clear concentration of sites of this culture in the northern part of the Upland, in close proximity to the outcrop of this raw material, in the absence of similar concentrations in other regions. There is no such clear accumulation of sites within the FBC, and large settlements of this culture (*e.g.*, Ćmielów, Gawroniec site, Stryczowice, site 1) show a partial relationship with the processing of banded flint (Balcer 2002, 147; Sałaciński 2013; Kowalewska-Marszałek 2019, 132).

Settlement of the Globular Amphora culture in Mierzanowice, Opatów district

One of the studied sites of the GAC is the settlement in Mierzanowice, located on the Sandomierz Upland, in the Gierczanka river valley. The excavations were carried out by K. Salewicz in 1936 (Salewicz 1939) and in 1957 by Aleksander Gardawski and Jacek Miśkiewicz (Gardawski and Miśkiewicz 1958).

The site in Mierzanowice is considered to be a large, stabilised village of farmers and breeders. K. Salewicz mentioned the discovery of dug-out dwellings there. Alongside the features sunk into the ground, there were probably above-ground buildings with lumps of construction daub with impressions of wooden logs and reeds (Salewicz 1939). The investigators, A. Gardawski and J. Miśkiewicz, confirmed the existence of buildings of such a character. They discovered several large pits with circular outlines, and three of them were forming a compact complex, similarly as in the settlements of the FBC (Gardawski and Miśkiewicz 1958).

K. Salewicz stated on the basis of ceramics that in the case of the GAC we are not dealing here with its pure form, but with its transitional stage to the Złota culture, which he called the Early Złota culture (Salewicz 1939).

The site of the GAC in Mierzanowice is certainly one of the permanent settlements of this culture in the Sandomierz Upland. This is shown by the ownership of deposits and also evidence of mining and processing specialisations. During the existence of the GAC, one settlement was inhabited by a dozen or so people at the same time. The extent of the settlements was to be influenced by the subsequent stages of settling (Balcer 1963, 99-142; 2012, 137, 138; Bąbel 2015, 144, 145).

Settlement of the Globular Amphora culture in Kosowice, Ostrowiec Świętokrzyski district

One site of the GAC in the Kamionka river valley recognised by excavation is the settlement in Kosowice. It was discovered during a surface survey by J.T. Bąbel in 1970. It is situated within the Sandomierz Upland, at the culmination of a loess hill, which slopes south towards the left tributary of the Kamionka river (Bąbel 1975, 553). In 1972, J. T. Bąbel and K. Kowalski conducted test excavations on the site. In one of the trenches, 10 pits were discovered, and seven have been explored (Bąbel and Kowalski 1975, 307).

The obtained historic material is dominated by richly ornamented pottery fragments, characterised by a high homogeneity. Among flint artefacts, relatively few specimens of banded raw material were distinguished, including one flake from a polished axe blade. The most interesting is a semi-finished product of chisel with quadrilateral section – a typical tool in the production inventories of the GAC (Bąbel and Kowalski 1975, 308-312, fig. 18: o). Analogous forms are quite common in the workshop-type materials from the mine area in Krzemionki Opatowskie (Sałaciński 2000, 285, fig. 1; Bąbel 2015, fig. 143: b, 149: b).

All the tested pits and ceramics from the surface of the site belong to the GAC. J.T. Bąbel and K. Kowalski claim that it was a permanent settlement of this culture. The whole ceramic material is similar to the specimens from Mierzanowice. The authors concluded that both sites represent the same chronological horizon, *i.e.* the first quarter of the second millennium BC (Bąbel and Kowalski 1975, 314).

Settlement of the Globular Amphora culture in Krzczonowice, Ostrowiec Świętokrzyski district

Another site of the GAC identified by excavation is the settlement in Krzczonowice, located in the northern part of the Sandomierz Upland, on a loess headland that cuts deep into the valley of the right tributary of the Obręczówka river. The site was discovered during surface survey in the early 1970s by K. Kowalski from the State Archaeological Museum in Warsaw. In 1996 and 1997, it was verified during surface survey carried out as part of the Archaeological Picture of Poland (AZP) campaign by the research team of the Institute of Archaeology of the Maria Curie-Skłodowska University in Lublin.

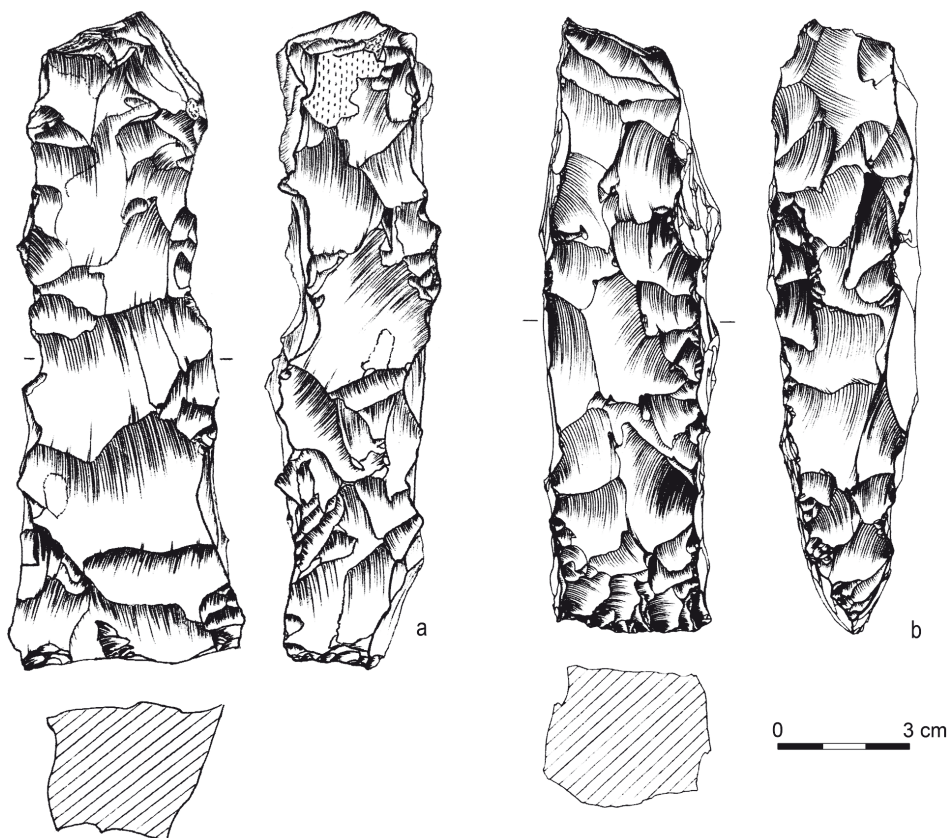


Fig. 11. Krzczonowice, site 63, Ostrowiec Świętokrzyski district. Semi-finished products of chisels with quadrilateral section of banded flint, Globular Amphora culture. After Jedynek 2009, figs 4, 5

In 2006, rescue excavations were carried out by Artur Jedynek and Kamil Kaptur from the Museum and Archaeological and Natural Reserve “Krzemionki”, the Branch of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski. The work covered an area of 2.1 ares. 11 features were discovered, including 10 farm pits and a skeleton grave. In one of the features a depression in the bottom was explored, which is most probably the place where the pit roofing or the communication ladder support was attached (Jedynek and Kaptur 2008, 23, fig. 1). The original find is a deposit of four half-products of banded flint, two of chisels with quadrilateral section (Fig. 11) and two of axes with quadrilateral section (Fig. 12). Based on the presence of historic material on the surface, it was found that the settlement occupied an area of approx. 1 hectare. The concentration of features of the GAC was uneven, their size and stratigraphic system, as well as the number of artefacts in fills, suggest the longer lasting of the settlement. The analysis of flint artefacts showed

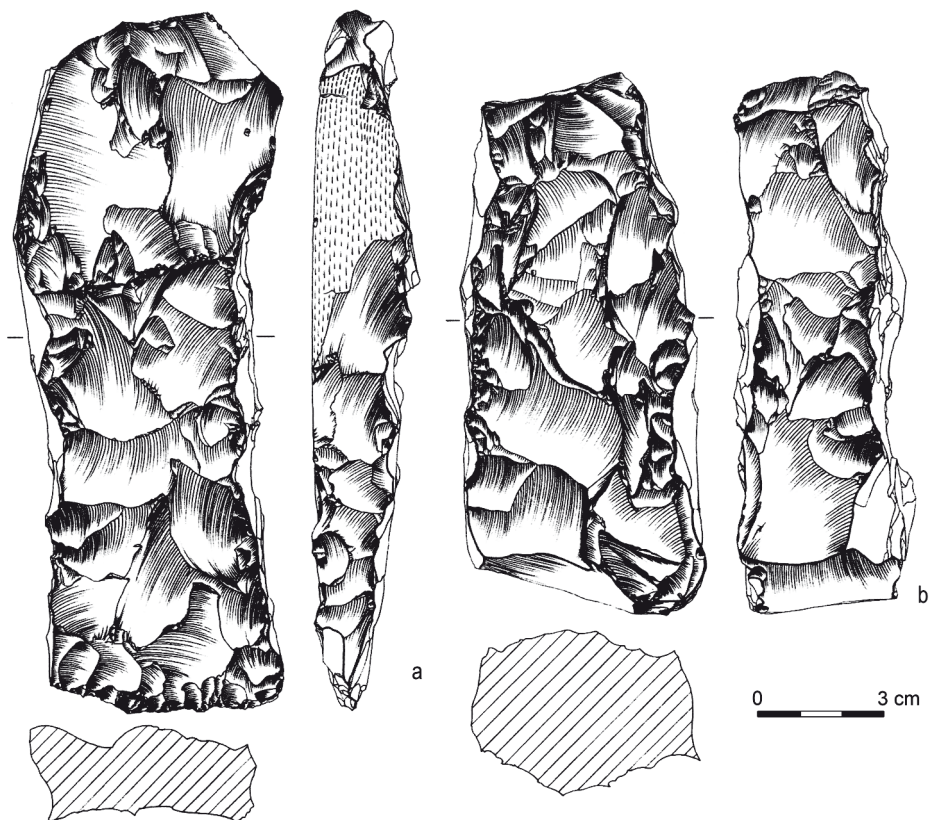


Fig. 12. Krzczonowice, site 63, Ostrowiec Świętokrzyski district.
Semi-finished products of axes with quadrilateral section of banded flint, Globular Amphora culture.
After Jedynek 2009, figs 6, 7

that the site featured materials typical for the home facies – a large percentage of tools (Jedynek and Kaptur 2008, 19, 25, fig. 3). Further excavation research would allow us to obtain evidence of the connections between the inhabitants of the settlement and the area of exploitation of this raw material, situated north of the Kamienna river valley. Dating ceramics using the thermoluminescence method put its age at the years 2716-2069 BC (Jedynek and Kaptur 2008, 20).

Settlement of the Globular Amphora culture in Ostrowiec Świętokrzyski, Ostrowiec Świętokrzyski district

One of the sites of the GAC in the Kamienna river valley, on the northern edge of the loess Sandomierz Upland, is the Globular Amphora settlement in Ostrowiec Świętokrzyski.

It is located in the south-eastern part of the city called Górki. It was examined in 1958 by Janusz Kuczyński during rescue excavations, during which he discovered nine pits of the GAC (Kuczyński 1960).

RELATIONSHIPS OF NEOLITHIC SETTLEMENTS WITH THE BANDED FLINT MINES IN KRZEMIONKI OPATOWSKIE IN THE LIGHT OF SURFACE SURVEY, SOUNDING AND RESCUE EXAMINATION

Z. Krzak was a pioneer in conducting systematic surface surveys in the Sandomierz Upland. He conducted numerous investigations in the 1950s, 60s and 70s. He also conducted test excavations at selected sites. Z. Krzak conducted mainly research in the Kamienna river basin and in the north-eastern part of the Sandomierz Upland, including along the right-bank tributaries of the Kamienna and the upper Opatówka rivers (Krzak 1961; 1962; 1993). In 1959, he investigated the areas of banded flint mines in Krzemionki Opatowskie, Borownia, Ostrowiec Świętokrzyski district, and Korycizna, Opatów district, and recognised many settlement sites. Among the discovered sites, more than 20 were Neolithic sites, mainly associated with the FBC. Some of the discovered settlements exhibited an industrial character and connections with the nearby Neolithic and Early Bronze banded flint mines in Krzemionki Opatowskie, Ruda Kościelna, Ostrowiec Świętokrzyski district, Borownia and Korycizna, the “chocolate” flint mines in Gliniany, Opatów district, and the Ożarów flint mines in Ożarów, Opatów district (Krzak 1961).

The research carried out by Z. Krzak in the Kamienna river valley has produced interesting results in the form of discoveries of settlements and encampments of the FBC. In some settlements, including in Grójec and Podgrodzie, both within the Ostrowiec Świętokrzyski district, Z. Krzak distinguished settlement parts with flint processing workshops. An interesting settlement in Podgrodzie, situated on the Kamienna river on the western edge of a loess hill, was cut by numerous ravines and created, hard-to-reach promontories. In one of them, a part of the site with flint processing workshops was located. The site produced fragments of vessels belonging to the FBC. The flint artefacts were made of several types of raw material. The main component was flakes of various sizes made of banded flint, which were produced by the finishing of semi-finished products of axe blades with quadrilateral section. A lot of fragments of repaired polished axes and semi-finished products of axes with quadrilateral section (some were reused as pestles) and retouched flake tools were also discovered within the settlement (Krzak 1961; 1962, 32-34).

Another site, discovered during the surface prospecting by Z. Krzak and surveyed, is located in Skąła, now it is part of the town of Ćmielów, Ostrowiec Świętokrzyski district. The site is located on the edge of a sandy and rocky ground moraine, on the right bank of the Kamienna river. Z. Krzak found traces of settlements there: pits and postholes from

a wooden structure. The obtained pottery fragments represented two cultures – the FBC and the CWC (Krzak 1962, 37, 38).

In Smyków, Ostrowiec Świętokrzyski district, Z. Krzak accidentally discovered a FBC settlement pit located on the dune on the edge of the right terrace of the Kamienna river, with pottery fragments of FBC together with flint artefacts of several raw materials – the Świeciechów, banded and “chocolate” flint (Krzak 1962).

In 1960, in the Kamienna river valley – in Piaski Ćmielowskie and Przepaść (both sites are now located in the part of the town of Ćmielów, Ostrowiec Świętokrzyski district), Z. Krzak discovered camps where banded flint was processed on an *ad hoc* basis (Krzak 1962, 39-44). The collected material was dominated by the production waste from semi-finished axe blades (Balcer 1975, 185). In Piaski Ćmielowskie, the camp of the FBC was located on the left, accumulation terrace of the Kamienna river. Z. Krzak located there the outlines of settlement pits and traces of posts. Among the discovered flint artefacts, mainly flake tools, banded flint was the dominant material (Krzak 1962, 39, 42).

According to B. Balcer, the production camps were the predecessors of the later large settlements where banded flint was processed on a larger scale, and they come from older periods, when agriculture was not yet dominant. They could also be satellite settlements of groups periodically remaining outside the area of their mother settlements or they are traces of settlement after the fall of great upland settlements (Balcer 1975, 185, 186).

In 1960, Z. Krzak conducted research in the area of the alleged route connecting the industrial settlements of the FBC on the Kamienna river with similar settlements on the Vistula river. The starting point was, on the one hand, the settlement at the Gawroniec site in Ćmielów, and, on the other, an analogous settlement: the Zbrza Wielka site in Zawichost, Sandomierz district. The settlement of the FBC on the Gawroniec site in Ćmielów is one of the largest ones, using banded flint from Krzemionki Opatowskie, and the settlement of the FBC at the Zbrza Wielka site in Zawichost is among similar ones, primarily using the Świeciechów raw material, exploited in Świeciechów, district Kraśnik, from which artefacts were also found in Ćmielów. The above-mentioned settlements are situated 25 km apart in a straight line, separated by a loess upland, cut by numerous streams flowing into the Kamienna river on one side, and into the Vistula and Opatówka rivers on the other. He discovered numerous Neolithic and Early Bronze sites – settlements and cemeteries of the FBC, including Cieszków, Opatów district, of the GAC – Podgajcze, Opatów district (Krzak 1962).

In 1969, Z. Krzak, together with Iwona Kupczyk, also conducted surface survey in the basin of the upper Opatówka river, from its sources to the village of Nikisiałka Mała. Opatówka flows out of the Holy Cross Mountains Range and is a left tributary of the Vistula. The study area is adjacent to the Jeleniowskie Range on the south-west. The catalogue attached to the publication contains information on 67 sites, 36 of which were considered Neolithic, including 17 FBC and 4 GAC sites. Few characteristic forms were distinguished among the obtained historic materials of the FBC made of banded flint, *e.g.* flakes chipped

from polished axes in Zochcin, Zochcinek, Nikisiąka Mała, all within Opatów district, and a hammer made of an axe with quadrilateral section from Wąworków, Opatów district. Artefacts belonging to the GAC, including those made of banded material, are few. In Nikisiąka Duża, Opatów district, apart from flakes, a fragment of a half-product of an axe with quadrilateral section was discovered in the flint inventory (Krzak 1993).

In the late 1960s and early 1970s, further surface surveys in the right-bank tributaries of the Kamienna river in the analysed part of the Sandomierz Upland were carried out by K. Kowalski and J. T. Bąbel. In 1969, K. Kowalski carried out a survey in the basin of the Obręczówka river, which is part of the basin of the Kamienna river. He recorded 43 previously unknown sites, dated mainly to the Neolithic (Kowalski 1975b). In 1970, J. T. Bąbel carried out surface research in the Kamionka river basin, focusing on the location of Neolithic and Early Bronze sites. He discovered and verified 125 settlement points (Bąbel 1975). In 1983, J. T. Bąbel carried out surface research in the Gierzanka river basin, in the area of Mierzanowice and Wojciechowice, both localities in the district of Opatów (Bąbel 1985).

Systematic surface research in the Sandomierz Upland in the 1980s, 1990s and in the first decade of the 21st century, as part of the Archaeological Picture of Poland (AZP) project, was conducted by Barbara Bargieł, Marek Florek, Jerzy Libera, Anna Zakościelna (Institute of Archaeology, of the Maria Curie-Skłodowska University in Lublin), Janusz Budziszewski (then the Institute of Archaeology of the University of Warsaw), Hanna Kowalewska-Marszałek (Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Warsaw), Sławomir Sałaciński (State Archaeological Museum in Warsaw), Szymon Orzechowski (then the Provincial Office for the Protection of Monuments in Kielce), Tadeusz Wichman, Ryszard Naglik (Archaeological Museum in Krakow), Urszula Jedynak and Artur Jedynak, Kamil Kaptur (Archaeological Museum and Reserve "Krzemionki", Branch of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski). The above-mentioned surface studies focused on the area of some districts – Ostrowiec Świętokrzyski and Opatów, intensively inhabited in the Neolithic period, with a clear predominance of FBC sites. Each sheet of the Archaeological Picture of Poland survey contains several hundred settlement points, including camps and larger settlements. Their concentrations were noted especially in the communes of Ćmielów and Opatów, and on a smaller scale – in the commune of Ożarów. Flint processing workshops of the FBC were discovered in Opatów district. During his surface research in the 1980s, S. Sałaciński located in the vicinity of Ćmielów several settlements of the FBC, quite extensive, with household materials and a large number of flint artefacts similar to those discovered at the site on Gawroniec Hill in Ćmielów. They formed a settlement network of considerable importance in spatial and economic systems. B. Balcer treated this information sceptically, sustaining the uniqueness of the settlement on the Gawroniec Hill in Ćmielów (Balcer 2002, 161). S. Sałaciński's opinions partially confirm the results of rescue excavations, carried out in 2016-2017, preceding the construction of the Ćmielów ringroad. In the limited

belt of the development, Edmund Mitrus discovered and explored part of the FBC settlement in Brzóstowa, site 25, Ostrowiec Świętokrzyski district (31 features, 1,100 pottery fragments, 141 flint artefacts, 134 animal bones), and settlements of the FBC in Ćmielów, site 80, Ostrowiec Świętokrzyski district (4 features, 37 pottery fragments, 2 flint artefacts, 18 bones).

Sławomir Sałaciński dealt with the settlement base of the banded flint mines in Krzemionki Opatowskie in the Stone Age in the Kamienna river basin (Sałaciński 1986). In 1987, S. Sałaciński with M. Zalewski conducted surface research in the vicinity of the village of Stodoły, Opatów district. The research covered the edge of the loess hill and its slope falling towards the narrow valley of Gierczanka river, which is the left tributary of the Obręczówka river (the right tributary of the Kamienna river). The site, which was the object of detailed penetration, was defined as a large, homogeneous settlement of the GAC, and this is something that is rare on the scale of the entire settlement of this culture. The issue of the size and the alleged multi-phase nature of the settlement in Stodoły and its possible connections with banded flint mines has been raised many times in the literature. Their existence was to be proved by finds of artefacts produced of this raw material (among other works Wiślański 1979b, 278). During the surface research, the focus was on finding possible processing places of the banded flint, determining their character (phases of production processes) and possible connections with the mines in Krzemionki Opatowskie. The historical material was found in a large area, stretching about 600 m along the valley, in a strip about 100 m wide. Compact clusters of artefacts have been distinguished within this zone; zones of occurrence of artefacts of the FBC, the GAC and the CWC were highlighted. There were also traces of the later settlement of the Mierzanowice, the Lusatian and the Przeworsk cultures (Zalewski and Sałaciński 1996).

The material discovered during surface studies allow for the determination of two main settlement phases. The oldest traces of the presence of human groups date back to the Middle Neolithic and are related to the FBC, they have been discovered over the entire surface of the site. Artefacts of the MC mark the next phase of settlement. In addition, material confirming the use of the site by the population of the GAC were also located, but they were assessed as of short duration. In connection with the above, the opinions functioning in the literature on the homogeneity and the size of the GAC settlement were questioned. During the described research, no traces of flint processing were found on the site's surface. The presence of banded flint artefacts only confirms the existence of direct or indirect contact with the mines in Krzemionki Opatowskie. Moreover, S. Sałaciński and M. Zalewski stated that in the case of the GAC, the scheme: mines – production settlements and user settlements, formulated for the FBC by B. Balcer, should not be automatically transferred to this period too. The conclusions were based solely on the results of surface studies, and therefore require further verification (Zalewski and Sałaciński 1996).

In the years 2004-2006, Artur Jedynek, Urszula Jedynek and Kamil Kaptur carried out surface surveys to identify prehistoric and later settlements north and west of the middle

and lower reaches of the Kamienna river in the Iłża Forehills, in the context of exploring the settlement base of the mine complex in Krzemionki Opatowskie. In the studied area, sites from the Neolithic and the Early Bronze Age are quite numerous. In the immediate vicinity of the exploitation field in Krzemionki Opatowskie, a large number of flint processing workshops were discovered, among other places in the area of the village of Sudół (Sudół, site 17, Ostrowiec Świętokrzyski district) and traces of flint work (Sudół, sites 11, 15, 19-21, Ostrowiec Świętokrzyski district), in the area between the village of Magonie and the Ostrowiec Świętokrzyski – Bałtów highway and the northern arm of the exploitation field in Krzemionki Opatowskie. No remains of large settlements have been discovered in the immediate vicinity of the mines. Settlement related to the FBC was registered in the Kamienna river valley, below the village of Skarbka, including Skarbka, site 26, Pętkowice, site 12, Okół, site 20, all in the Ostrowiec Świętokrzyski district (Jedynak *et al.* 2008).

The collection of the State Archaeological Museum in Warsaw includes loose Neolithic finds from the Sandomierz Upland and the Iłża Forehills. They were obtained in the pre-war period of the 20th century, and even from the 19th century. Some of them are made of banded flint and are linked to, among others, the FBC and the GAC. The rich inventory of the FBC comes from the localities of Grzegorzowice and Grzegorzowice-Zagaje, Ostrowiec Świętokrzyski district, including numerous polished axes with quadrilateral section and their fragments. A stone axe with a knobbed shaft-hole and fragments of ceramics, mainly of the FBC (Kowalski 1975a). The collection of flint materials from the collection of the State Archaeological Museum in Warsaw – 644 artefacts, was created by Aneta Sierosławska with S. Sałaciński's substantive consultation (Sierosławska 2012). Some of these materials come from the Diabli Piec site in Grzegorzowice-Zagaje, Ostrowiec Świętokrzyski district, from the FBC settlement (now administratively within the village of Czajęcice), dug up by amateur Józef Budzisz in 1940-1942. This site is located on a loess headland with heavily undercut slopes, on the edge of the Dobruchna river valley, separating the Sandomierz Upland from the Wilkowski Depression in the northern part of the Holy Cross Mountains mesoregion.

Axeheads of the GAC were distinguished, among other places, in material from Jelenia Góra, Lemierz, Stoki Stare (2 half-products), all within the Ostrowiec Świętokrzyski district, which are located in the immediate vicinity of Krzemionki Opatowskie on the Iłża Forehills, as well as in the material from Malice, Podgajcze, Tomin, Zawady, all within the Opatów district, located in the Sandomierz Upland (Kowalski 1975a).

A FEW SYNTHESISING REMARKS

The relationships of the Neolithic flint mining, including the production of banded flint, with the settlement have been the subject of research of many prehistorians, some of them treated this issue briefly, for others it constituted a very serious aspect in their analyses.

Synthetic studies on the Neolithic economic foundations have repeatedly pointed to the nature of the complex of banded flint mines in Krzemionki Opatowskie as the central mining centre, important for the development of flint working and mining. The importance of FBC settlements located in the immediate vicinity of the loess Sandomierz Upland was also emphasised, especially for the Gawroniec site in Ćmielów, primarily as the mother-settlements of the miners involved in the exploitation of banded flint and as production centres of banded flint products, which also participated in the development of long-distance exchange (Tabaczyński 1970, 276-282; Wiślański 1979a, 286-291; 1979b, 249-250; Kruk 1980, 51; 2008, 72).

Janusz Kruk deals with settlement phenomena in the Neolithic period, which were shaped under the influence of a number of natural (environmental) and cultural conditions (among others Kruk 1973). According to J. Kruk, the land-take process was based on the selection of suitable habitats. The main reasons for the development of spatial forms of settlement should be sought in the set of cultural processes, especially in the structure of the economy. J. Kruk dealt with the reconstruction of the forms of gaining control over the environment by the communities of Neolithic cultures. The appearance of the FBC resulted in substantial changes in forms of the mastery of the natural environment. The studied sites showed a tendency to occupy higher areas. They were located at the fringes of the high plains, on average 30-60 meters above the plains of the river accumulation (Kruk 1973, 11, 99).

The results of the analysis of the structure of settlement clusters suggest the possibility of the existence of close connections between permanent central settlements and the traces of temporary residence deployed in their wide surroundings. The loess areas were taken over by the FBC tribes probably at the end of the Atlantic period, around 3000 BC (Kruk 1973, 180). The nature of the encampments is different than that of the great loess villages. Among them are encountered both short-term places of stay and semi-permanent settlements that could have exist for one economic season, for example, in summer (Kruk 1973, 212).

Tadeusz Wiślański was an outstanding researcher of the Neolithic settlement issues. Among the loess settlements of the FBC he distinguished three categories – large, medium and small ones. The large ones were established only on highlands, the medium ones also preferred higher points, but sometimes they were located in valleys. The most common site type were small camps occupying *e.g.* high plains. The extensive loess settlements were multi-phase and they did not always cover the entire area of multi-hectare hills at the same time. As a rule, they did not exceed 25-40 households. Medium-sized settlements with 15 homesteads and smaller villages composed of several houses prevailed (Wiślański 1979b, 208-210).

According to T. Wiślański, individual mines in the depression of the terrain on the north-eastern slopes of the Holy Cross Mountains had connections with extensive mining and production villages. An open question is how the inhabitants of these villages were

procuring the necessary half-products. They could wander to the outcrops themselves and produce them there in situ. The mediation of the inhabitants of large loess production estates or camps associated with them also seems probable (Wiślański 1979b, 249).

Regarding the culture of GAC, the oldest complexes were confined, according to T. Wiślański to the lowland areas, but they quickly took over the loess zone as well. The spread of settlement of this culture shows some similarities to the FBC. T. Wiślański distinguished two categories of settlements – seasonal camps and permanent settlements, which, however, are rare. Extensive late-phase settlements on the loesses of the Sandomierz Upland (*e.g.*, Mierzanowice, Stodoły, Złota) were multi-phase and showed connections with the flint-bearing basin. Permanent estates were located on the hills, closer to water reservoirs than the encampments. Various types of pits with different functions were discovered there – garbage dumps, cellars, granaries, furnaces. The most common form of settlement were seasonal camps. They occurred both in the lowlands and in loess areas. They were often short-term staging points (Wiślański 1979a, 277-280).

In common use were axes and chisels with the entire surface carefully polished, made mainly of banded flint material. There was a specialisation in mining and flint processing in the GAC, which started in the Holy Cross Mountains region of the FBC. In the GAC, banded flint products were distributed en masse throughout the basin of the Vistula and Oder rivers, reaching Moravia and Saxony. During this period, the popularity of this raw material was at its peak. The GAC developed a far-reaching mining and production specialisation, bringing significant benefits. Mass export of banded axes took the form of a far-reaching exchange, especially downstream along the Vistula (Wiślański 1979a, 286, 290-291).

The intensive exploitation of banded flint in the middle and late section of the Neolithic and in the Early Bronze Age undoubtedly required the existence of a settlement base in the close proximity of the mines of this raw material. There is much evidence that this role was played primarily by the Sandomierz Upland, which was the natural context of the functioning of the flint mines located in the area of Krzemionki Opatowskie (*e.g.*, Krukowski 1939, 84-97; Balcer 1975, 247; Wiślański 1979b, 246-248; Kruk 1980, 105; Kowalewska-Marszałek 2019, 132).

One of the most important analyses for determining the significance of the FBC and GAC settlements in the Sandomierz Upland are the studies of the settlements of these cultures conducted by H. Kowalewska-Marszałek. They showed that the Sandomierz Upland is an area of compact, intensive settlement of the FBC. The settlements of the FBC in the northern and central part of the Sandomierz Upland may be related to the exploitation and processing of flint raw materials: banded and Świeciechów flints, the outcrops of which are located north and north-east of the Upland (Kowalewska-Marszałek 2018, 320; 2019, 120-127, fig. 1: a, 2: a).

The compact range of occurrence of the settlement of the GAC, on the other hand, is confined to the north-western part of the Sandomierz Upland, from the Kamionka river in

the west to Gierczanka river in the east, and to the tributaries of the upper and central Opatówka river in the south. Taking into account all the analysed features of the settlement network of this area, it can be concluded that the relationship with the banded flint mines is more pronounced in the case of the GAC. This is evidenced primarily by the clear concentration of sites of this culture in the northern part of the Upland, in close proximity of the raw material's outcrop, in the absence of similar concentrations in other regions. There is no such clear accumulation of sites within the FBC, and large settlements of this culture (*e.g.*, Ćmielów, Gawroniec site, Stryczowice, site 1) show a partial relationship with the processing of banded flint (Balcer 2002, 147; Sałaciński 2013; Kowalewska-Marszałek 2019, 127-130, 132, fig. 1: b, 2: b).

CONCLUSIONS

The article outlines the issues related to the settlement base of the Neolithic banded flint mines in Krzemionki Opatowskie. The focus was on the central Kamienna river basin in the region of the Sandomierz Upland and the Hża Forehills, and on two cultures: the FBC and the GAC. It is assumed that the population of the first of them began to exploit the raw flint material by digging shallow pit shafts (up to a depth of approx. 2 m) and pit-niche shafts (of approx. 4 m in depth), while the communities of the second one dug deeper stall-pillar mines (depth up to approx. 6 m) and chamber mines (depth up to approx. 9 m). In the area of the exploitation field, especially in its north-eastern part and adjacent regions (clusters at sinkholes), fragments of pottery from both of the above-mentioned cultures and a few from the Early Bronze MC, which extracted flint in Krzemionki Opatowskie, occasionally digging Neolithic backdirt heaps were found. They were described as traces of the on-mine and next-to-mine settlement.

In the article, we have tried to outline the issues related to the settlement base of the invaluable Neolithic complex of banded flint mines in Krzemionki Opatowskie, which was of great importance in the life of the community, especially those of the FBC and the GAC. The production of artefacts from this raw flint material influenced the development of internal and intergroup contacts. These products can be found in Poland's territory as well as beyond our border.

The above-mentioned issues have been mentioned in previous publications on Krzemionki Opatowskie. This article attempts to integrate the information on the above-mentioned topic. The full synthesis of knowledge about the settlement base, against a broad background, is a task for a separate large study.

Acknowledgements

We would like to thank Marek Florek from the Delegation in Sandomierz of the Świętokrzyskie Voivodship Monument Conservator for providing unpublished informa-

tion about the results of rescue excavations carried out before the construction of the Ćmielów ringroad.

We would like to thank Artur Jedynak and Kamil Kaptur for providing illustrative materials from the collections of the Historical and Archaeological Museum in Ostrowiec Świętokrzyski.

We would like to thank Andrzej Leligdowicz for translating the text.

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