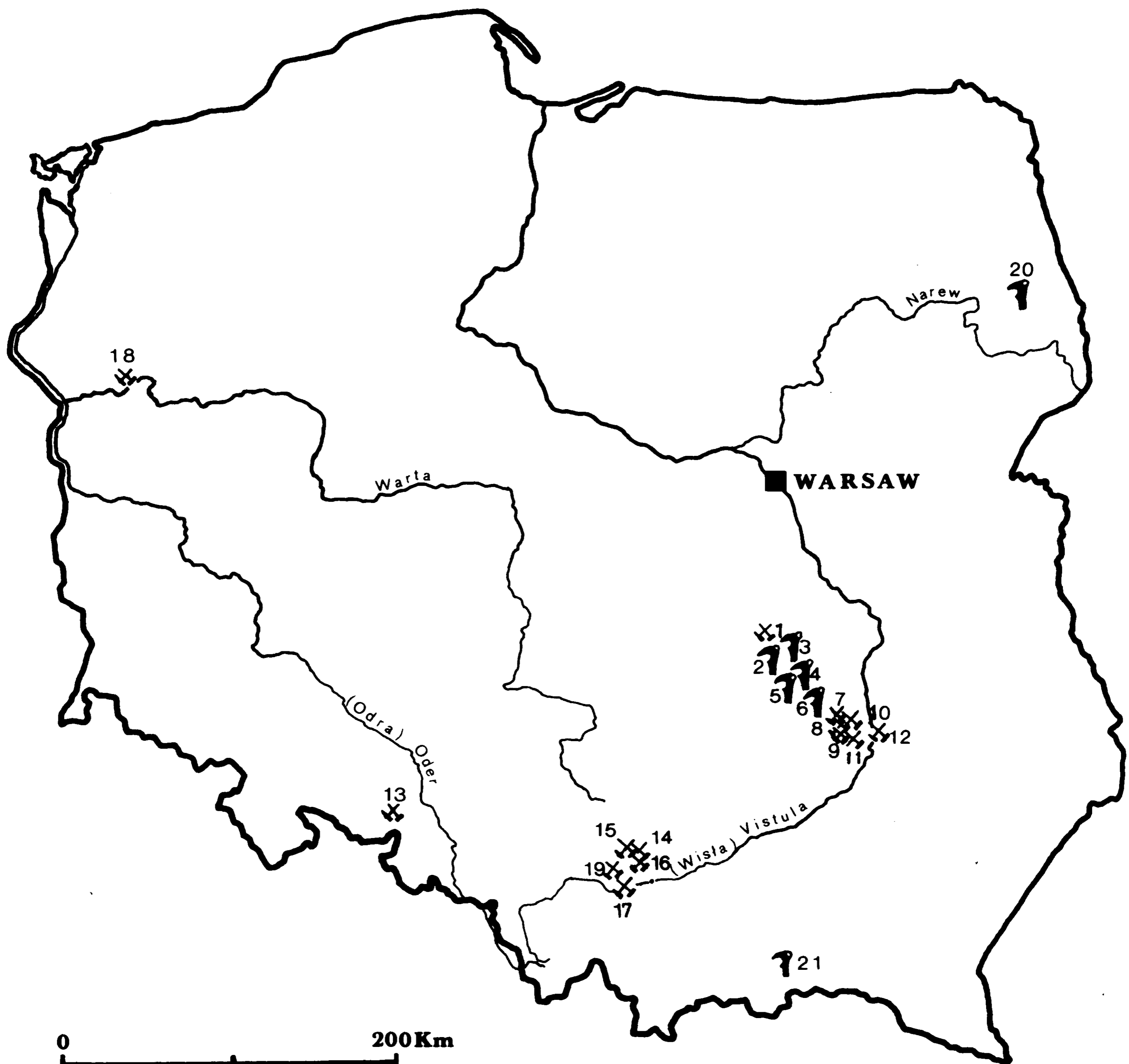


PL 5 Polany II, Radom Province

Tomasz Herbich, Jacek Lech

PL ISSN 0066-5924

<https://rcin.org.pl/dlibra/publication/242312>



PL Poland

PL 1 Orońsko

PL 2 Tomaszów

PL 3 Wierzbica

PL 4 Polany Kolonie II

PL 5 Polany II

PL 6 Krzemionki Opatowskie

PL 7 Ruda Kościelna

PL 8 Borownia

PL 9 Korycizna

PL 10 Gliniany

PL 11 Ożarów

PL 12 Świeciechów-Lasek

PL 13 Maków

PL 14 Jerzmanowice-Dąbrówka I

PL 15 Saspów

PL 16 Bębło

PL 17 Wołowice

PL 18 Gorzów Wielkopolski-Chwałęcice

PL 19 Brzoskwinia

PL 20 Rybniki

PL 21 Ropa

PL 5 POLANY II, RADOM PROVINCE

Tomasz Herbich and Jacek Lech

Site II near the village of Polany was presented by Maria Chmielewska in “*5000 Jahre Feuersteinbergbau*” (1980:583–6). In the following years the results of excavation work in the years 1971–1972 were analysed and further geophysical and archaeological studies were carried out (Chmielewska 1988; Herbich 1993).

The Polany II flint mine lies in the Iłża Foreland, near its border with the Radom Plain, several kilometres south-east of the flint mine at Wierzbica “Zełe”. It is located on land belonging to the village of Polany, Wierzbica commune, about 800 m north-west of the summit of a small hill 220 m above sea level, and about 1400 m from the first buildings in the village (Fig. 1). The mine is one of a group of centrally placed exploitation points of chocolate flint. It is the most south-easterly placed of the group (Schild 1971:29–30). The geographic co-ordinates of the site are $51^{\circ}15' N$, $21^{\circ}5' E$. The Iłża Foreland is part of the Mesozoic, north-eastern rim of the

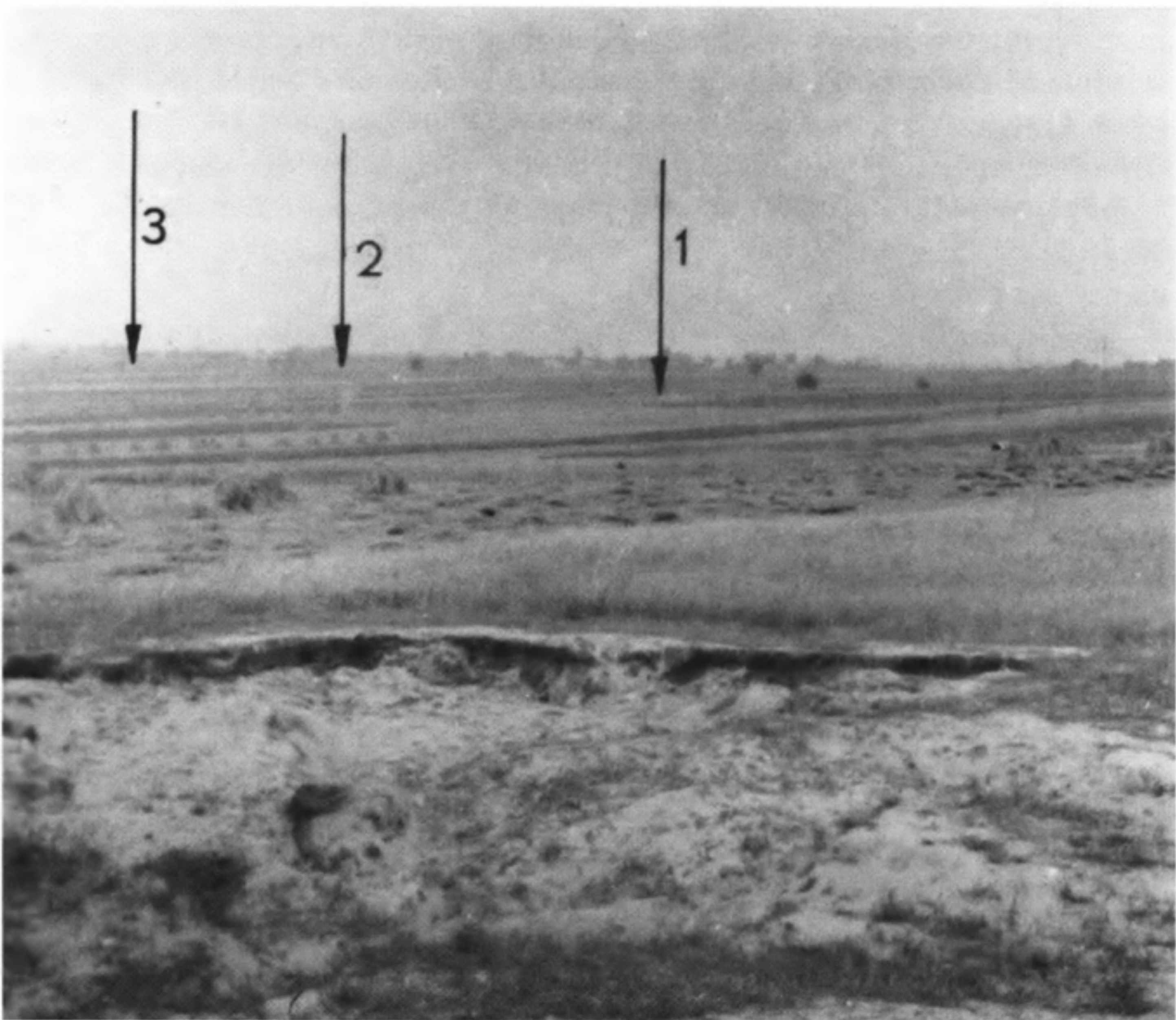


Fig. 1. The Iłża Foreland. Hill 220 m a.s.l. View from SE to NW: 1 — the flint mine Polany II (PL 5) and cutting II/72; 2 — the flint mine Polany Kolonie II (PL 4); 3 — the flint mine Wierzbica “Zełe” (PL 3).
Photo: J. Lech.

Palaeozoic range of the Świętokrzyskie (Holy Cross) Mountains. It lies north of the Kamienna River valley. This area is composed of Jurassic limestone and Cretaceous rocks and their weathering products, covered by boulder clays and Pleistocene sands. In the limestone rocks, under a cover of permeable sediments, karst development occurs, also visible on the surface. Awareness of this process was important for the first archaeological interpretation of the Polany II site. The landscape here shows little variety. In the Holocene it was originally covered with mixed forests growing on sands, with a predominance of pine.

The area in which chocolate flint occurred at archaeological sites associated with outcrops was a subject of interest for Stefan Krukowski, especially in the twenties and thirties (Krukowski 1920 and 1922; 1939). In 1968 a group of archaeologists from the

Institute for the History of Material Culture, Polish Academy of Sciences (now Institute of Archaeology and Ethnology), led by Romuald Schild, relating to the work done by Krukowski, undertook a new program of research of outcrops of chocolate flint and archaeological sites associated with them. It was the beginning of a wider program of excavations of mining and workshop sites in the area and of detailed studies into the mining and distribution of chocolate flint raw material in prehistoric times (Schild 1971:5–6, 1976, 1987).

The bifacial flint artefacts collected from the surface of site II in 1968 were described as almost symmetric, convex side-scrapers and on the basis of typology, state of preservation (striking white colour due to the deep patination of the specimens), and settlement pattern were dated to the early Würm. Polany II was seen as a camp-workshop site, situated at a place where flint occurred naturally. This was an important conclusion, since Polany II and the nearby Polany Kolonie II became in this way the two most northerly Middle Palaeolithic sites in Poland (Schild 1971:46–47 and 54–55). Due to these findings excavations of both sites, designated as Palaeolithic exploitation points of chocolate flint, were begun in 1971–1972.

The Polany II site was excavated by Chmielewska, in 1971 together with Jacek Lech and Jadwiga Mościbrodzka (Fig. 2), and in 1972 (during the first phase of excavations) with Lech and Hanna Młynarczyk. During both seasons excavations were carried out within trenches 10 x 2 m, so as to ascertain the character of the site, determine its stratigraphy and find Palaeolithic material *in situ* (Chmielewska 1972).

Krukowski's methods for excavating Palaeolithic and Mesolithic sand sites were used here. This precise and laborious method best served the objectives of these particular excavations which had been set on the basis of surface studies. The method favoured horizontal observations rather than vertical (Fig. 3). In 1972 it was used to explore, over a period of four weeks, a trench 80 cm deep. At this level only single flint artefacts were found in a depression. It was assumed that flint artefacts occurred in the sandy clay and sands which fill the sinks formed by the renewal of numerous old karstic features. Various bifacial specimens were distinguished such as foliated forms, similar to specimens found in the Middle Palaeolithic, post-Micoqian industries of Central Europe (Chmielewska 1972). Younger artefacts were also noticed, dated to the Holocene mainly by comparison with French sites (Chmielewska 1973). However, the possibility of a different dating and interpretation was considered, taking into account the similarity of the features to the open shafts of a mine in Sąpów, near Cracow discovered in 1970. Therefore, after finishing the Palaeolithic research program, it was decided to check the second hypothesis. In the second phase of the excavations in 1972, led by Lech, the method developed during the



Fig. 2. PL 5 Polany II flint mine, Radom Province. October 1971. Cutting I/71: 1 — Concentration 1 of limestone plates and flints in “karstic feature” — later filling of shaft no. 1; 2 — Concentration 2 in “karstic feature” — later filling of shaft no. 3. In the cutting standing R. Schild, on the outside M. Chmielewska and J. Mościbrodzka. Photo: J. Lech.

Sąspów excavations in 1970–1971 was applied here. The second phase of excavations showed that the old karstic features were in fact flint exploitation pits (Fig. 4) — primitive open shafts. In trench I/72 8 shafts were distinguished. The Palaeolithic flint tools turned out to be early roughouts of Late Neolithic and Early Bronze Age bifacial tools, including blades of axes and sickles in different stages of preparation (Chmielewska and Lech 1973). The new dating of the site, also based on typological assumptions, was confirmed by a radiocarbon date obtained at the Research Laboratory of the British Museum, from charcoal collected at the bottom of shaft no 1 (Lech 1981b:25 and 48). Until the excavations at the Wierzbica “Zełe” mine this was the youngest date for flint mining in Poland, approaching the



Fig. 3. PL 5 Polany II flint mine, Radom Province. July 1972. Cutting I/72 — view from south; 1 — Concentration 1 of limestone plates and flints in “karstic feature” — later filling of shaft no. 1; 2 — Concentration 2 in “karstic feature” — later filling of shaft no. 3. a, b — walls with control cross-sections. Photo: J. Lech.

upper limits assumed then for the occurrence of flint mining as such (Schild 1987:142).

Examination the Polany II site was resumed in 1985. In the years 1985–1987 Tomasz Herbich experimented with the electro-resistivity method of determining the area of a mine field (Fig. 5). The results obtained indicated that after years of trials the right method had been found. In 1988 excavations were carried out to confirm the results (Fig. 6). They were supervised by Herbich, with the participation of Krzysztof Misiewicz and Mirosław Mizera (Herbich 1993). Lech was a consultant. Two

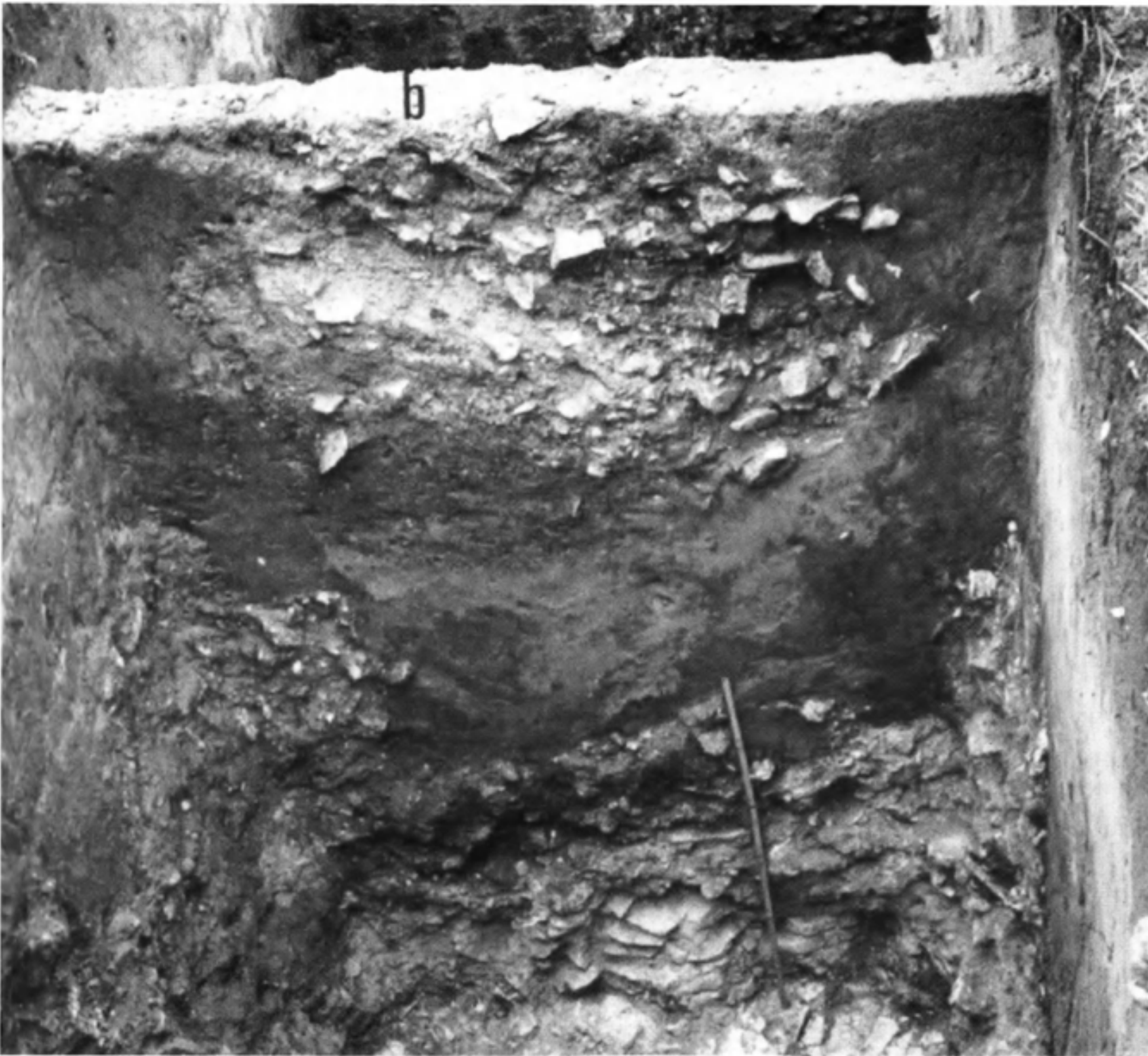


Fig. 4. PL 5 Polany II flint mine, Radom Province. August 1972. Cutting I/72. View from the north of the north wall of the control cross-section of the shaft no. 6 filling (see Fig. 3). Measure on the bottom 1 m. Photo: J. Lech.

trenches, covering together an area of 70 m², were dug in the central part of the site, near trenches I/71 and I/72, at the northern (trench I/88) and southern (trench II/88) borders of the hypothetical mine field (Fig. 5 and 6). Three new exploitation units were discovered (Fig. 7). At the southern edge of trench I/88 one shaft (3/88) was found (Fig. 8). In trench II/88 two exploitation units were found (1/88 and 2/88). The end one (1/88) was excavated (Figs 12–13). It was an exploitation pit, the most shallow and the oldest feature studied so far at the site. The excavations completely confirmed the accuracy of the electro-resistivity method in determining the area of a mine field (Fig. 7). At the same time charcoal was obtained from the fillings of the exploitation units, so that an important series of four radiocarbon determinations could be

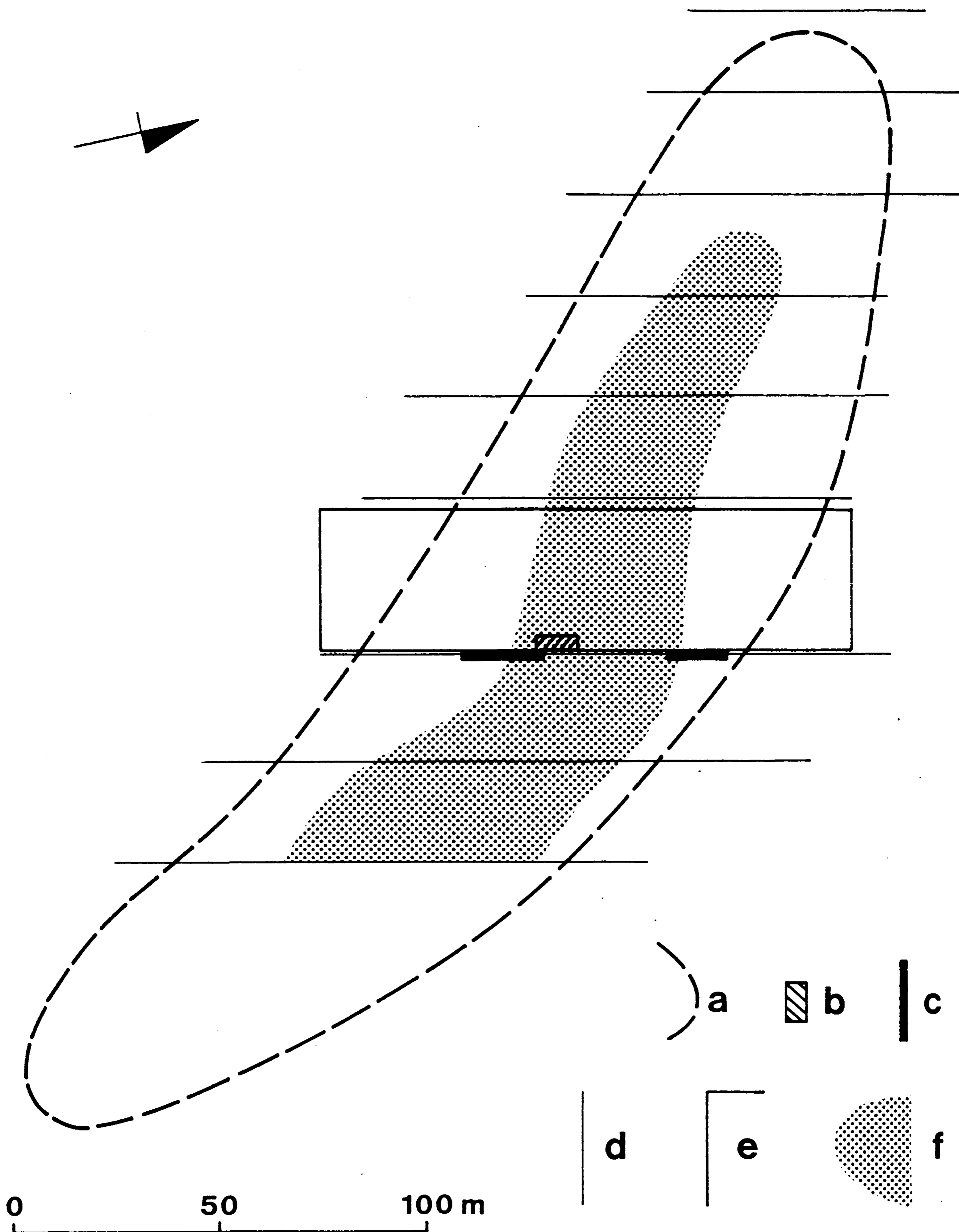


Fig. 5. PL 5 Polany II flint mine, Radom Province. The general map of the site: a — the boundary of the spread of flint artifacts on the surface; b — the cuttings from 1971—1972; c — the cuttings from 1988 verifying the resistivity survey results; d — the lines of resistivity sounding; e — the area of profiling; f — the extent of the mine field according to the results of the resistivity survey. After T. Herbich



Fig. 6. PL 5 Polany II flint mine, Radom Province. August 1988. The cuttings from 1988 verifying the resistivity survey results — view from the south in the direction of the village: a — cutting I/88; b — cutting II/88; 1 — shaft no. 1/88. Photo: J. Lech.

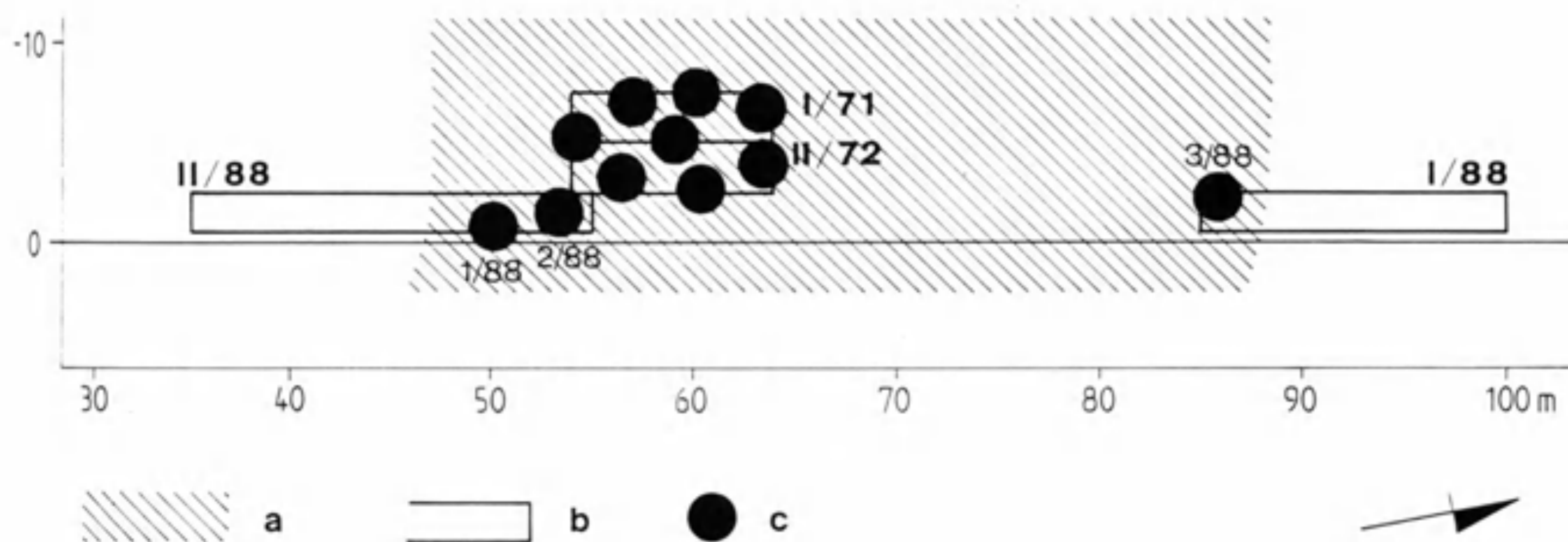


Fig. 7. PL 5 Polany II flint mine, Radom Province. The archaeological verification of the resistivity survey: a — the extent of the mine field suggested by the results of resistivity profiling; b — archaeological cuttings; c — shafts. After Herbich.

obtained from the Berlin Laboratory (by Dr Jochen Görtsdorf), providing a more complete view as to the absolute dating of the mine.

In the natural stratigraphy of the site under the topsoil (at present plough land), there is a layer of sands mixed in varying degrees with boulder clay (Fig. 8). These also contain a small amount of gravel derived from northern rocks. At a depth of 110–150 cm there is a layer of eluvial (karstic clay) with flint nodules and limestone rubble. Its thickness varies, usually between 80–100 cm. Under the layer of eluvial clay there is a very weathered Upper Jurassic platy limestone from the Kimmeridgian. Its upper surface in parts contained flint concretions of a larger size than the eluvial clay. This level of flint was also exploited.

In the eluvial clay there was a preponderance of oval, flat and pancake-shaped nodules, small and medium sized, measuring at most 20 cm in diameter. The nodules extracted from the surface of the limestone were larger and several centimetres thick. The surrounding cortex, hard and even, has a thickness from approximately 1 mm to more than 1 cm, depending on the nodule and place. The flint from Polany has a uniform siliceous mass and a deep dark brown colour with some varieties. It is medium transparent with a waxy surface. This raw material has an excellent fissile quality but this is limited by natural cracks, mainly thermal (see Schild 1971:7 and 45; Lech 1981b:12; Chmielewska 1988:158).

At present all traces of the original landscape of the mine field have disappeared, levelled by ploughing. The only evidence that a mine and workshops existed here are the industrial and natural flint specimens lying on the surface and a few limestone slabs and rubble. The area of site II at Polany, as suggested by the distribution of industrial flints, was estimated by Chmielewska (1988:143) to be approximately 1.25 ha, and by Herbich to be approximately 1.7 ha (Fig. 5:a). The mine field Polany II itself was much smaller, but could have had an area of several thousand square metres, if calculated using Herbich's electro-resistivity method.

Assessing the extent of a mine field is an important aspect of the study of prehistoric flint mining. The problem becomes especially difficult when no traces of the original mining landscape survives, as in the case of the Polany II flint mine. The basic method applied to determine the exact size of the area of mining activity was an analysis of the distribution of worked flints on the surface. However, this method is deceptive: it has been proven many times that the defined boundaries of the site thus produced overstepped the extent of the mine field (Lech 1981a:45–54, 1981b:38–9; Schild 1985:93–4 and 203). Any attempt to solve the problem needs very extensive excavations which would be both costly and time consuming. In such a situation attention was paid to different physical methods, above all to geophysical ones (Sieveking *et al.* 1973; Budziszewski 1986; Pattantyus 1986; Bussemaker 1988; Herbich 1992, 1993).

The shafts uncovered were directly next to each other. The fills of the features often cut into one another (Chmielewska 1988:147–56). The closeness of the shafts led to a considerable mixing of the material lying above the limestone, within the borders of the mine field. The fills consisted of a mixture of boulder and eluvial clays, sand and limestone rubble (Fig. 4, 8, and 9).



Fig. 8. PL 5 Polany II flint mine, Radom Province. Cutting I/88. Cross-section of the shaft no. 3/88 — view from north. Grid of 1 m squares. Scale near the bottom — 20 cm. Photo: J. Lech.

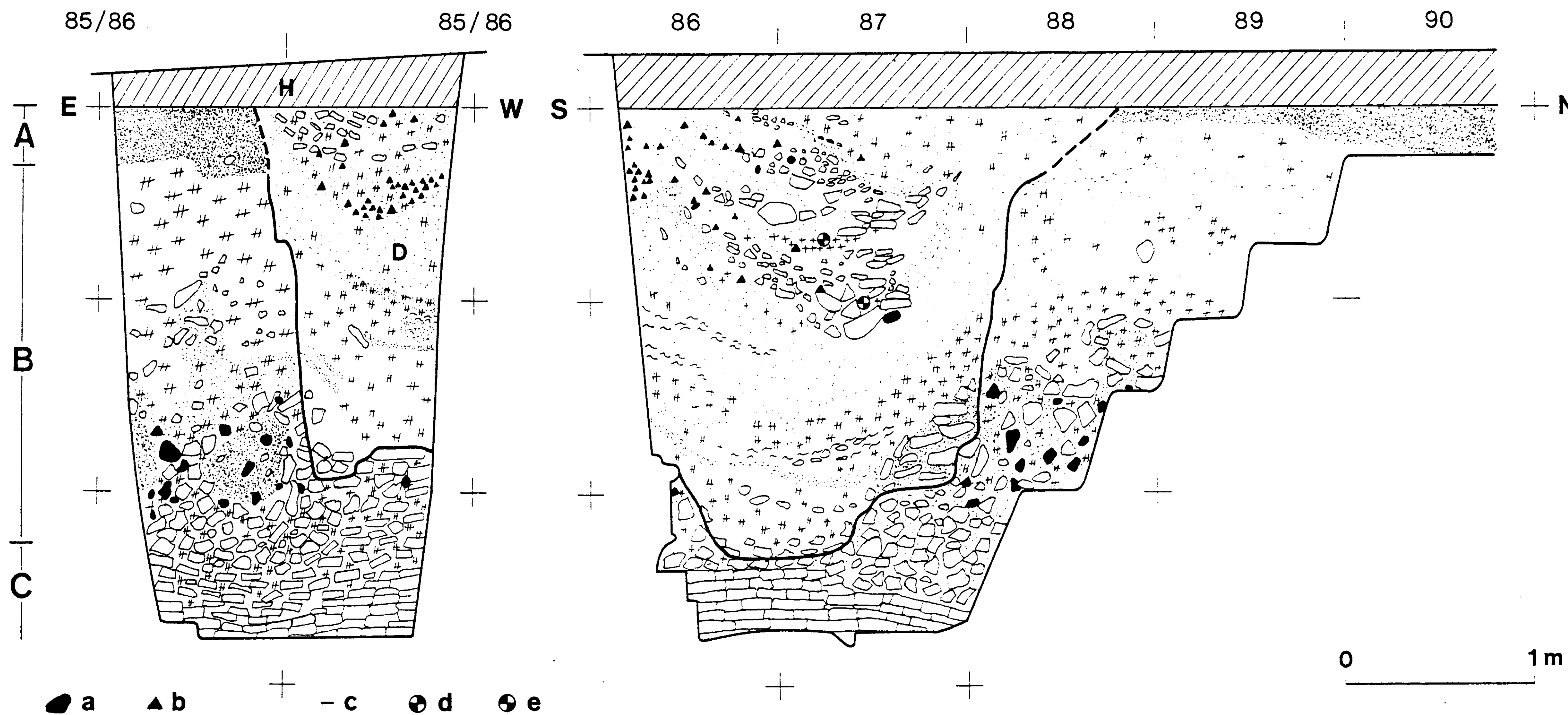


Fig. 9. PL 5 Polany II flint mine, Radom Province. Cutting I/88. The cross-sections of the south and west walls with shaft no. 3: a — natural flint nodules; b — worked flints; c — scattered pieces of charcoal; d — for measurement Bln-4173; e — for measurement Bln-4174.

The close packing of shafts meant that the mine field could be treated as a zone of disturbed layers when compared to the area around. An assessment of the extent of this zone could lead to an estimation of the mine field extent. This observation determined that multi-level resistivity prospecting should be applied. This was composed of geoelectrical soundings, allowing us to observe stratigraphy and multilevel profiling, which enabled us to trace the changes of resistivity of layers at different depth (Weymouth 1986:318-41; Scollar *et al.* 1990:307-74).

The analysis of the electro-resistivity soundings following on lines set across the site (Fig. 5:d) indicated that within the area of undisturbed geological layers (high resistivity sand, low resistivity clays and limestone) there is a zone of homogenous resistivity throughout all levels. The shafts uncovered during previous excavations (Fig. 3, 4, 5:b, 7) lie within this zone. This suggested that the homogeneity reflected mining-related disturbances within the natural sequence of layers and the extent of the homogeneity could correspond to the boundaries of the mine field.

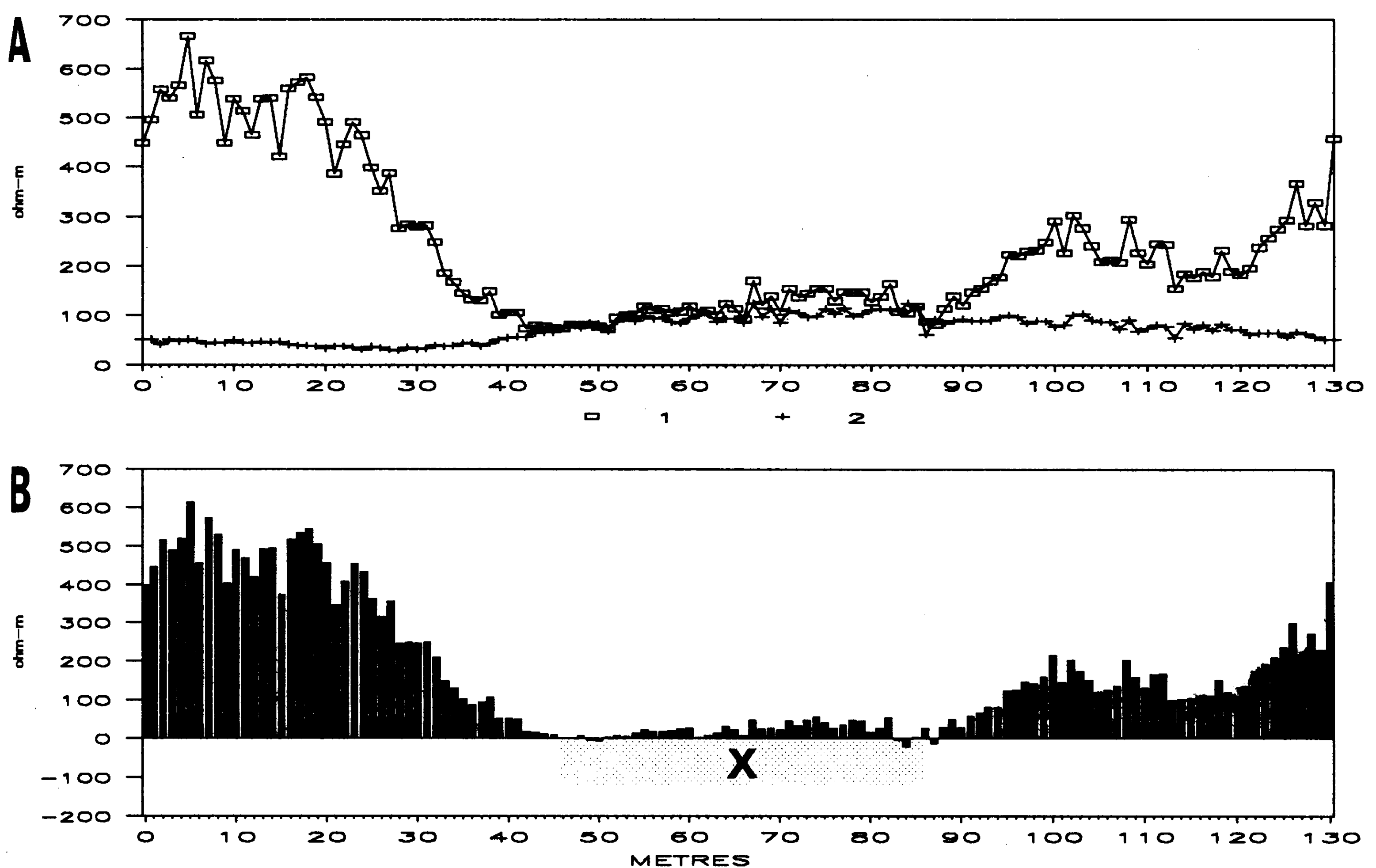


Fig. 10. PL 5 Polany II flint mine, Radom Province. The resistivity profile, line 5. A. The curves of two-level profiling: 1 — the shallow level (AB = 4 m); 2 — the deep level (AB = 14). B. The diagram of the difference between resistivity values of the shallow and the deep level: x — the zone of homogeneous resistivity.

The following procedure was applied: after a sounding which produced a general picture of the extent of the homogeneity, the part of the site in which the presence of shafts had been confirmed by excavation was chosen for more detailed prospecting. A two-level profiling was applied (Fig. 5:e, 10). The two levels made it possible to observe changes of resistivity at two different depths, the latter being the high resistivity surface layer (visible within the area of the undisturbed sequence of layers) and the top of the limestone. Since the purpose of the profiling was to establish the borders of the zone of homogeneous resistivity, no absolute values of resistivity at individual levels of the prospection were analysed, but the difference between the values at both levels was observed (Fig. 10:B, 11). The intersection points of the curves on the graphs of

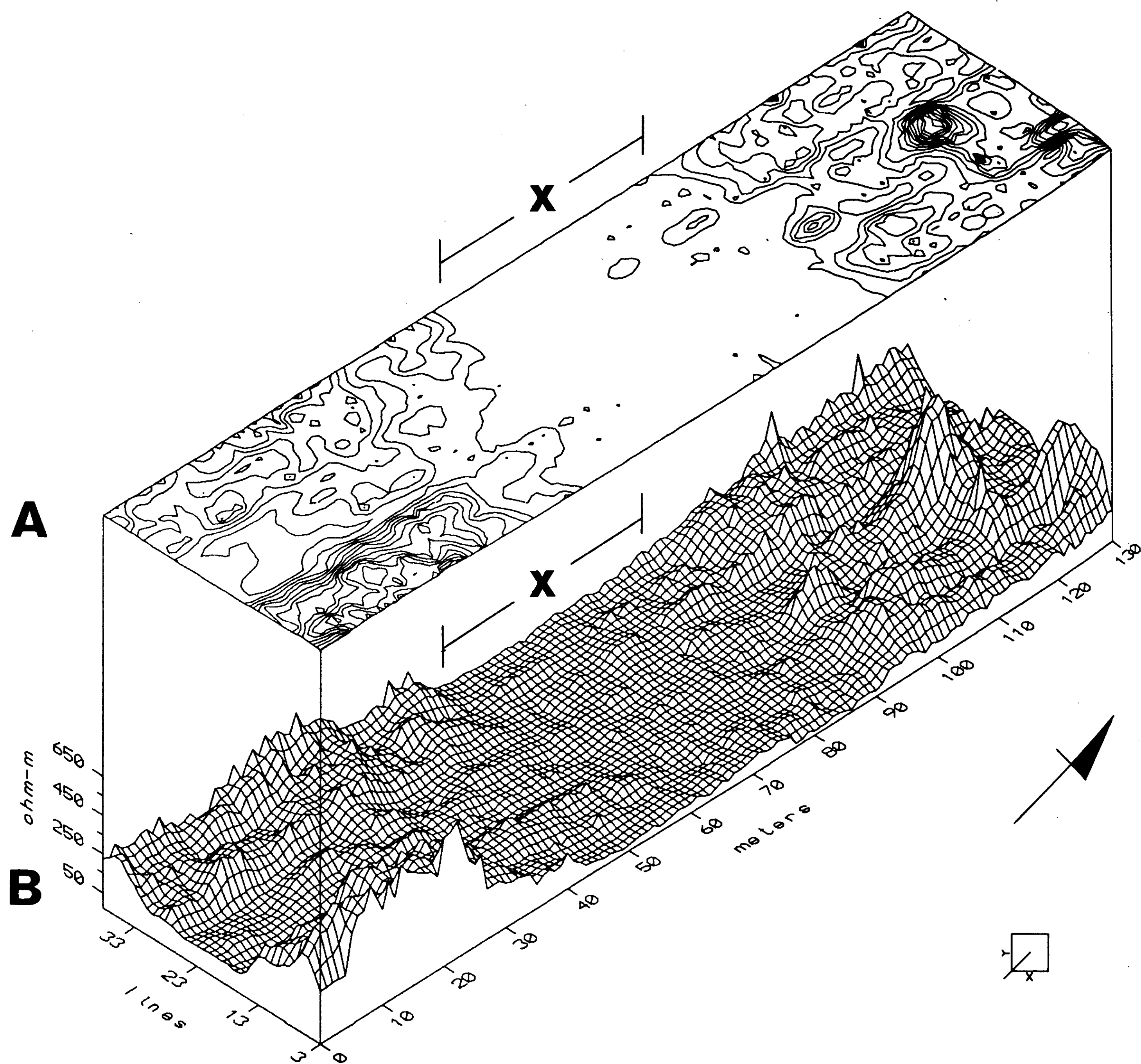


Fig. 11. PL 5 Polany II flint mine, Radom Province. Map (A) and three-dimensional model (B) of the difference between resistivity values of the shallow ($AB = 4$ m) and the deep level ($AB = 14$ m) of profiling:
 x — the zone of homogeneous resistivity.

the changes of resistivity (Fig. 10:A) were interpreted as boundary points for the mine field; in this way were treated the extreme points of the zone of values below or equal to zero on diagrams of difference between values at both levels (Fig. 10:B, 11).

To check the interpretation two trial cuttings were excavated at the borders of this zone (Figs 5–7). The three shafts that were found formed the outer edges of the mine field and corresponded exactly with the borders of the homogeneous resistivity zone (Fig. 7). The excavations also identified the high resistivity layer. This was composed of a layer of glacial sands, overlaying a layer of boulder clay. The sand, 0.2 to 0.5 m thick was covered with humus. In the area disturbed by the shafts this layer occurred only in some places, and sand was mixed with the shaft fills (Herbich 1993).

The result of geophysical surveys at Polany II shows that electro-resistivity can successfully be used to estimate the extent of a mine field composed of shallow surface



Fig. 12. PL 5 Polany II flint mine, Radom Province. Cutting II/88 (see Fig. 6): a — filling of exploitation pit 1/88; b — cross-section of the natural geological sediments near the border of the mine field. Scale 20 cm.

Photo: J. Lech.



Fig. 13. PL 5 Polany II flint mine, Radom Province. Cutting II/88 (see Fig. 6). Lower part of the exploitation pit no. 1/88 filling (see Fig. 14). In the bottom natural platey limestone. Scale 20 cm. Photo: J. Lech.

pits or open shafts. This method which was applied at a range of mining sites on the north-east fringe of the Świętokrzyskie Mountains (Herbich 1992, 1993) could have a much wider application, especially for sites with a similar lithostratigraphic situation.

After rejecting a Palaeolithic date for the site, the flint material was attributed on the basis of appearance and morphology to the Late Neolithic and Early Bronze Age — the Corded Ware Culture and Mierzanowice Culture. It is also possible that the earliest exploitation of the Polany II deposits can be associated with the Globular Amphora Culture, for the site yielded a carefully polished flint axe blade of striped flint characteristic of these communities, from the Krzemionki Opatowskie mine. The first radiocarbon date obtained for the site (BM-1235) also indicated the possibility that the deposit was exploited by people of the early Trzciniec Culture. The series of radiocarbon dates from the laboratory in Berlin confirms these chronological boundaries. In two cases the dates are a little later and in two distinctly earlier than the BM-1235 date:

Shaft No. 3/1988 (Figs 7–9)

Bln-4173 1450 ± 70 bc — depth 0.5–0.7 m below topsoil

Bln-4174 1500 ± 90 bc — depth 0.9–1.0 m below topsoil

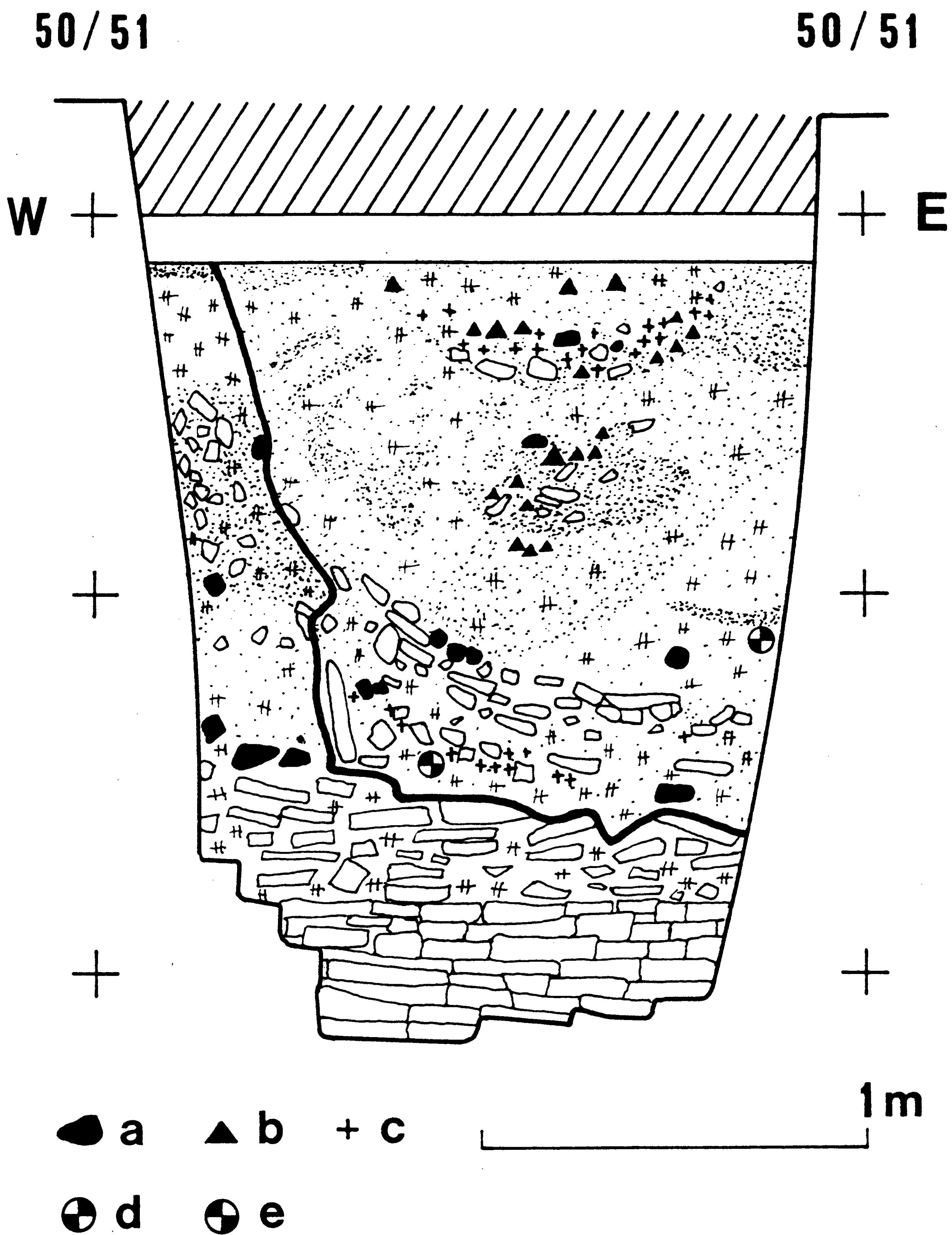


Fig. 14. PL 5 Polany II flint mine, Radom Province. Cutting II/88 (see Fig. 6). Cross-section of the exploitation pit no. 1/88 filling (see Fig. 13) — north wall: a — natural flint nodules; b — worked flints; c — scattered pieces of charcoal; d — for measurement Bln-4175; e — for measurement Bln-4176.

Shaft No. 1/1972 (Fig. 7)

BM-1235 1541 ± 81 bc — from bottom of the shaft.

Shaft No. 1/1988 (Fig. 7 and 12–14)

Bln-4175 1800 ± 80 bc — depth 0.9–1.1 m below topsoil

Bln-4176 1740 ± 80 bc — depth 1.4 below topsoil

These dates are contemporaneous with the younger phase of the Mierzanowice Culture distinguished by Baczyńska (1993) when studying the settlement and cemetery at Szarbia, Kielce Province. The dates need to be calibrated to get a result in calendar years. In the calibration ranges for 63.8% of confidence level obtained by a calibration program (Stuiver and Reimer 1986) with a ten-year calibration curve, the chronology of the mine at present is as follows: 2310–2030 and 1870–1610 cal BC. According to Dr Jochen Görtsdorf (letter to J. Lech of 3.04.1992) nearly the same result was obtained with the calibration program C.I.O. Groningen Radiocarbon Code (Plicht and Mook 1987).

In the nearer and farther environs of the mine there are no traces of settlements connected with the cultures mentioned above. The Iłża Foreland is mainly covered with sands, gravel and boulder clay from the Pleistocene. It was unsuitable for farming. The area around the mine was beyond the zone of permanent farming settlements but it may have been visited seasonally in times when animal herding was the mainstay of the economy, as was the case at the time when the mine was being exploited. The nearest region with permanent settlements of this period is to be found on the loess covered Sandomierz Upland, on its border with the Iłża Foreland, *i.e.*, about 50 km south-east of the Polany mine. A second was on the Nałęczów Plateau, about 60 km to the east. Settlements in these areas, belonging to the Globular Amphora and Mierzanowice Cultures, used among other varieties also chocolate flint (Balcer 1963, 1977:197 and 206; Lech 1987:114–29; Budziszewski 1990).

The shallow open shafts at Polany II could have been exploited by two or more miners over a period of several days. The primeval forest covering the area meant that much exertion had to go be expended dealing with tree roots, though these also strengthened the walls of the shafts. One shaft could yield up to several hundred flint nodules but only some of these could be utilized (Chmielewska 1988:172). The distribution of chocolate flint, and the Polany II variant, spread beyond the borders of the settlement regions mentioned above. But it seems that in this period communities usually obtained their supply of flint independently and the role of exchange diminished, compared with the situation found at times during the Neolithic and Eneolithic. Nevertheless, it may be assumed that chocolate flint reached further south and east through exchange. In the Szarbia settlement mentioned earlier, it made up

9.4% of the 383 specimens analysed there in 1982. It came from different mines of chocolate flint, including the Polany mine. These are, however, only the first results. It is a paradox that research into flint mining in the Early Bronze Age in the Vistula Basin is more advanced than our knowledge of the settlement, social structures and exchange systems at this time.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Dr Ian H. Longworth and Mr Richard Burleigh from the British Museum and Dr Jochen Görsdorf from Deutsches Archäologisches Institut, Arbeitsbereich Ur- und Frühgeschichte for carrying out analyses of the charcoals from the Polany II mine. We are also grateful to Ms Barbara Baczyńska from the Institute of Archeology and Ethnology, Polish Academy of Sciences for making material from Szarbia available for analysis.

REFERENCES

- Baczyńska, B. 1993. *Cmentarzysko kultury mierzanowickiej w Szarbi, gm. Skalbmierz. Studium obrządku pogrzebowego*. Kraków.
- Balcer, B. 1963. Osada kultury amfor kulistych na stanowisku 1 w Mierzanowicach, pow. Opatów. *Materiały Starożytne* 9:99–142.
- 1977. Osada kultury mierzanowickiej na stanowisku 1 w Mierzanowicach, woj. tarnobrzeskie. *Wiadomości Archeologiczne* 42(2):175–212.
- Budziszewski, J. 1990. Uwagi o możliwościach porównywania kujawskich i małopolskich inwentarzy krzemienych kultury amfor kulistych. In *Kultura amfor kulistych w rejonie Kujaw*, A. Cofta-Broniewska (ed.), 205–24. Poznań.
- Burleigh, R. and K. Matthews, British Museum natural radiocarbon measurements XIII. *Radiocarbon* 24(2):151–70.
- Chmielewska, M. 1972. Polany II, pow. Szydłowiec. In *Informator Archeologiczny. Badania 1971*, 18–9. Warszawa.
- 1973. Badania stanowiska Polany II w pow. Szydłowiec, w 1971 r. *Sprawozdania Archeologiczne* 25:29–37.
- 1980. PL 5 Polany, Fundstelle II, Wojw. Radom. In *5000 Jahre Feuersteinbergbau. Die Suche nach dem Stahl der Steinzeit*, G. Weisgerber, R. Slotta, J. Weiner (eds), 583–6. Bochum.
- 1988. The Early Bronze Age flint mine at site II, Polany, Radom District. *Przegląd Archeologiczny* 35:139–81.
- Chmielewska, M. and J. Lech 1973. Polany, pow. Szydłowiec. Stanowisko II. In *Informator Archeologiczny. Badania 1972*, M. Konopka (ed.), 40. Warszawa.
- Herbich, T. 1992. Wyniki badań elektrooporowych na obszarze kopalń krzemienia w Krzemionkach (rejon tzw. magistrali). In *Materiały krzemionkowskie 1*, J. Jaskanis (ed.), 95–117. Warszawa.
- 1993. The method of estimation of the extent of the mining field of flint mines through observation of the arrangement of surface layers. *Archeologia Polski* 38(1):23–35.
- Krukowski, S. 1920. Pierwociny krzemieniarskie górnictwa, transportu i handlu w holocenie Polski. Wnioski z właściwości surowców i wyrobów. *Wiadomości Archeologiczne* 5:185–206.

- 1922. Pierwociny krzemieniarskie górnictwa, transportu i handlu w holocenie Polski. Wnioski z właściwości surowców i wyrobów. Część II. *Wiadomości Archeologiczne* 7:34–57.
- 1939. Paleolit. In *Prehistoria ziem polskich*, z. 1. Kraków. Encyklopedia Polska PAU, Vol. 4, cz. 1, dz. 5.
- Lech, H. and J. 1984. The prehistoric flint mine at Wierzbica “Zełe”: a case study from Poland. *World Archaeology* 16(2):186–203.
- Lech, J. 1975. O konieczności ochrony prahistorycznych kopalń krzemienia. Uwagi i postulaty. *Wiadomości Archeologiczne* 40(2):139–48.
- 1981a. *Górnictwo krzemienia społeczności wczesnorolniczych na Wyżynie Krakowskiej: koniec VI tysiąclecia — 1 połowa IV tysiąclecia p.n.e.* Wrocław.
- 1981b. Flint mining among the early farming communities of central Europe. *Przegląd Archeologiczny* 28:5–55.
- 1987. Z badań nad górnictwem krzemienia społeczności rolniczych Europy Środkowej. Relacje przestrzenne kopalń i osad. *Acta Archaeologica Carpathica* 26:93–137.
- Plicht, J. van der and W.G. Mook 1987. Automatic calibration of radiocarbon dates. In *2nd International Symposium: Archaeology and 14C*. Groningen.
- Schild, R. 1971. Lokalizacja prahistorycznych punktów eksploatacji krzemienia czekoladowego na północno-wschodnim obrzeżeniu Gór Świętokrzyskich. *Folia Quaternaria* 39:1–61.
- 1976. Flint mining and trade in Polish prehistory as seen from the perspective of the chocolate flint of Central Poland. A second approach. *Acta Archaeologica Carpathica* 16:147–77.
- 1987. The exploitation of chocolate flint in central Poland. In *The human uses of flint and chert. Proceedings of the fourth international flint symposium held at Brighton Polytechnic 10–15 April 1983*, G. de G. Sieveking and M.H. Newcomer (eds), 137–49. Cambridge.
- Schild, R., H. Królik and M. Marczak 1985. *Kopalnia krzemienia czekoladowego w Tomaszowie*. Wrocław.
- Stuiver, M.P. and P. Reimer 1986. A computer program for radiocarbon age calibration. *Radiocarbon* 28-2B:1022–30.