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CHIPPED STONE INDUSTRIES OF THE LINEAR BAND POTTERY CULTURE SETTLEMENTS IN THE NOWA HUTA REGION

Sites of the Linear Band Pottery in the Nowa Huta region have furnished several assemblages of chipped stone implements belonging to 3 chronological phases. In sites Nos 12, 15 and 62 there is a complete sequence of pre-Notenkopf, Notenkopf and Želiezovce phases showing the evolution of technology and of the structure of retouched tools. This evolution has been analyzed as a dynamic process and also in respect of differentiation of the synchronous assemblages in the frame of the Middle (Notenkopf) and Late (Želiezovce) phases. In the assemblages of the pre-Notenkopf phase only few retouched tools and debitage occur. During the Notenkopf phase differences between assemblages appear which could be interpreted as functional or phyletic. In the Želiezovce phase richest assemblages occur, showing the spatial separation of subsistance activities and workshops. A greater variety of stylistic features in the debitage can be observed, as well as divergent structures of retouched tools which confirm the different origin of groups peopling the region of Nowa Huta during this phase: some groups seem to be the effect of the local evolution of the Notenkopf phase, other groups appeared due to the population shift from other regions.

INTRODUCTION

The Nowa Huta microregion between the rivers Vistula and Dłubnia is exceptional in that it has been extensively excavated revealing six large settlements of the Linear Band Pottery culture, part of which were settled during the two or three classical, phases of the development of this culture (Godlowska 1976). Studies of the horizontal distribution and chronological seriation based on the frequency of ceramic types, decorational motifs, and ceramic imports from other culture units permitted the distinguishing of three chronological phases on sites 62 (Mogiła) and 12, 15 (Bieńczyce), at least two phases on sites 17–20 (Pleszów), and one phase on site 55 (Mogiła). Finds from all those sites, yielded by features dated by ceramics, are the concern of this paper. The settlement on site 41 (Krzesławice) has been only fragmentarily investigated and left out from our considerations since homogeneous features of one phase could not be isolated (Buratyński 1968).

All the above-mentioned settlements represent intensive early neolithic and eneolithic settlement. Materials in the culture layers were almost invariably mixed, the layers themselves strongly eroded (including most of the post dwellings). Because of that the spatial distribution and connection between artefacts and dwellings have not been reconstructed in detail. The conclusions we have drawn are, therefore, incomplete, particularly as to the functional variability within settlements (zones of manufacturing activity).

Most of the discussed finds come from pits surrounding habitation feature. These are rubbish pits filling up during the exploitation of settlements and their dwellings. Ceramic material in the pits permits precise seriation chronologically significant (Godłowska 1982; Godłowska, Rook, Drobniewicz 1985). Unfortunately small number of artefacts has necessitated the combining of inventories of particular features within more general divisions into the pre-Notenkopf (Gniechowice + Zofipole), Notenkopf (Music-note) and Želiezovce phases.

The dynamic method of reconstruction of coring processes has been employed covering as well the classification of debitage, morphological-technological analysis of blades and retouched implements. Use-wear analysis could not be carried out limiting our conclusions regarding the functional variability of settlements.

I. RAW MATERIALS

The settlement microregion near Nowa Huta is situated in the centre the Kraków settlement region whose boundaries were defined by Lech (1981). Its attractiveness rested in favourable conditions of soil and climate nad rich resources of raw materials, primarily in the nearby flint deposits. They occur at a distance of ca 12–15 km in the Upper Jurassic limestone which forms the Kraków-Częstochowa Jurassic Plateau and the Kraków Gate. Besides the limestone beds numerous flint nodules were recorded in secondary local deposits formed as a result of the weathering of limestone (Kaczanowska, Kozłowski 1976; Lech 1981). Subsequently the flint was transported over a distance, deposited in the river gravels and utilized.

Since closest to settlements, the deposits in the Vistula valley and in the alluvial cones of its tributaries, notably the Dłubnia, must have been of primary importance for the area under discussion. But acc. to Tyczyńska (1968) materials from the alluvial cones contained a small number of flint nodules. Nevertheless, the studies so far of the neolithic flint inventories from the Nowa Huta area point to a fairly important role of raw materials from river gravels (Kaczanowska 1971).

Varieties of Jurassic flint constituted the basic raw material used throughout the Linear Band Pottery culture by the people inhabiting the Nowa Huta region. The high quality flint A was predominant (notably A_1), but the range of its deposits has not been precisely located. This flint is found over the whole of the Limestone Plateau except the Sowiniec Hillock. In the oldest settlements (site 12 – Bieńczyce and site 62 – Mogiła) dated to the Gniechowice-Zofipole phase (I) variety A was used in more than 90% of artefacts produced from Jurassic flint. Small proportions of other varieties have been recorded such as: raw materials from the eastern part of the Plateau (D) and from Iwanowice (B) where flint C is also found. It is thought, in view of the above, that the earliest population groups representing the Linear Band Pottery culture may have come to the Nowa Huta area from the north-east or west, bringing with them a supply of raw material supplemented from the nearby secondary deposits. Since the proportion of cores is fairly high (twice as high as in the inventories of the later phase on site 62 – Mogiła), this raw material must have been brought as nodules. Flint artefacts are not very numerous, possibly because the local deposits were not known to the inhabitants of this area. It has been established that already in this early phase contacts existed with the territories farther to the north-east where the Świeciechów flint occurred. Finds from Moravia (Kozłowski 1970) confirm the early exploitation of this raw material. So far investigations have not ascertained whether this flint was systematically used by the Linear Band Pottery culture population or by the contemporaneous Mesolithic people. Single finds of artefacts made of Świeciechów flint encountered in the earliest assemblages of the Linear Band Pottery culture bear witness to the importance of the Vistula valley for spreading new cultural trends, or even for migrations of early farming populations.

During the later phases of the Linear Band Pottery culture small amounts of raw materials from other territories are recorded to have flowed in. Their insignificant proportion points merely to contacts with fairly extensive areas, while the local Jurassic flint from the secondary deposits in the vicinity remains the basic raw material. During the Notenkopf phase the inventories of all the analysed sites show a drop in the proportion of variety A, with the noticeable increase in the raw material variety C. The latter occurrs on the Pleszów site whose beginnings fall at exactly this period. The participation of varieties D and B gros as well. Deposits of flint C concentrate in two spots: The Kraków Gate and in Iwanowice. It is likely that the increase in flint C proportion near Nowa Huta during the Notenkopf phase is linked with the start of the exploitation of the Olszanica settlement situated within the range of deposits of this raw material. This does not mean, however, that its presence can be explained by the exchange with the inhabitants of Olszanica, but that the Linear Pottery Band culture groups penetrated the areas containing deposits of this variety of flint.

Besides those areas, territories were penetrated between the middle Prądnik, and the upper and middle Kluczwoda, where next to raw materials variety A, flint variety B is found. It was probably collected from the gravels of the Dłubnia river which cuts into the deposits near Iwanowice. This is supported by the fairly frequent occurrence of flint B on site 55 (Mogiła), closest to the river. Flint B has also been recorded in the inventories from site 41 (Krzesławice) dated to the period from the Notenkopf to the Želiezovce phase of the Linear Band Pottery culture.

Besides Jurassic flint another raw material were used as well in the Notenkopf phase. Of interest is the presence of obsidian, although in small amounts

from 0.1 to 0.6%. It was supplied from a distance of ca 200 km, had no practical significance, pointing merely to links with the territories of eastern Slovakia and northern Hungary. Discoveries from Olszanica show that it was known in the Želiezovce phase (Milisauskas 1982) which indicates early contacts between Little Poland and eastern Slovakia, earlier than between eastern and western Slovakia (Pavúk 1970; Kaczanowska 1982).

On the other hand in Hungary numerous ceramic imports with Notenkopf decorations (Kalicz, Makkay 1977) are known from the territory of the so-called Alföld Linear Pottery culture (Szakalhat group). They bear witness to lively contacts between the eastern (Alföld) Linear Pottery culture and the western Linear Band Pottery culture. We may then expect to discover single finds made of obsidian also in the Linear Band Pottery culture in western Slovakia.

Contacts between the Nowa Huta region and the northern edge of the Świętokrzyskie Mountains have been confirmed by the presence of single artefacts made of chocolate flint (only 3%). This raw material played an important role in Kujawy during the Linear Band Pottery culture, whereas in Little Poland it was replaced by other raw materials primarily Jurassic flint.

Artefacts made of northern erratic flint, whose nodules are contained in the formations of the Riss glaciation, are widely distributed north of the discussed territory and give no clue as to the direction of contacts.

The Želiezovce phase did not introduce important changes in the raw material structure of the investigated inventories. Similar varieties of Jurassic raw materials were exploited, in almost the same proportions as in the previous phase. Obsidian occurred in slightly bigger amount, up to 1.6% (site 62 Mogiła). This does not mean a more intensive exchange with eastern Slovakia and northern Hungary since on other sites obsidian becomes even more rare, amounting to as little as 0.6% of the whole inventory in Olszanica (Milisauskas 1982). The frequency of obsidian as high as 25% on site 41 is exceptional, approaching that in the inventories of the Rzeszów region. At least part of Krzesławice inventories can be dated to the Želiezovce phase. But since chronological seriation of most assemblages could not be established, materials from this site have been omitted from our considerations.

II. ANALYSIS OF INVENTORIES OF THE PRE-NOTENKOPF PHASE

1. INVENTORY STRUCTURE

The inventory structure on sites of the early Linear Band Pottery culture in Nowa Huta is similar to that found on other settlement sites situated in the vicinity of deposits. Raw materials were worked predominantly within the boundaries of the settlement. Hence the perecentage of retouched tools is not very high and does not exceed 8–10%, while large quantities of flakes constitute up to 50% of the whole inventory. On site 62 and 12, 15 the general inventory structure is as follows:

	Site 62 (Mogiła)		Sites 12, 15 (Bieńczyce)	
	N	%	N	%
Cores	14	7.2	3	9.7
Flakes	121	62.6	15	46.9
Blades	40	20.7	11	34.3
Tools	18	9.3	3	9.7

The small size of the set of artefacts on sites 12, 15 precludes definite conclusions, but the data obtained from site 62 is similar. In both cases a relatively high proportion of cores is striking indicating that the settlers brought with them a certain amount of raw materials such as cores and pre-cores.

2. CORES

The investigated series contained 17 cores. They are strongly processed, usually small (length of the flaking face 26–60 mm). One initial cores has the flaking face 80 mm long. Single-platform examples with prepared platform predominate. Sometimes the platform had been rejuvenated (6 pieces). The high frequency of cores with prepared platforms is additionally evidenced by the presence of blades, mostly with prepared platforms. Two cores have platforms formed by a single blow, in three cases the platforms are unprepared. Flaking faces are usually flat, broad. Preparation covers one side. Some unpre-

pared specimens have also been found. Examples with natural platforms or platforms formed by a single blow, where the processing was less advanced, have incomplete preparation and longer flaking faces. In all likelihood, retrimming was more important in these cases than the preparation. Some cores were shortened during processing by detaching a thick flake which removed the distal end. To carry the processing further the changing of orientation was employed (2 examples). The first of the two specimens has two opposite flaking faces with the common striking platform. The second core has the flaking face on one side and the platform on the distal part of the initial core. Both pieces are small.

Cores in the advanced stage of processing were used as hammers (2 examples). Some cores are strongly worn and thermally damaged (2 examples).

3. FLAKES

Flakes are represented by 136 examples. They are medium-size: 21–78 mm long, 20–79 mm wide. The percentage of cortical flakes is relatively high. The frequency of particular types of scar-pattern of the dorsal part is as follows:

Cortical flakes	11	8.0%
Partially cortical flakes (up to 50% of dorsal side)	42	30.8%
Unidirectional flakes	46	33.8%
Flakes with the opposite direction of scars	3	2.2%
„ „ „ and the same direction of scars	7	5.1%
„ „ scars perpendicular to the flake axis	13	9.5%
„ „ „ parallel and perpendicular to the flake axis	2	1.4%
Flakes with bilateral scars	1	0.7%
„ „ multidirectional scars	1	0.7%
Others (characteristic examples)	5	3.7%
Undefined (damaged)	5	3.7%

The fairly high proportion of cortical or partially cortical flakes (the total number: 38.8) shows that tools were manufactured on the site partly from prepared cores. To compare: at the Lengyel culture workshop on sites 17–20 (Pleszów) cortical flakes amount to over 50% of all flakes, in the Sąspów workshops their ratio oscillates between 64.2 to 70.3%. On the strength of this comparison we can reasonably assume that a certain quantity of cores – not nodules – were brought to the site and subsequently subjected to intensive processing which can be inferred from the high perecenetage of flakes from retrimming and the changing of orientation (altogether 18.1%), whereas on sites 17–20 (Pleszów) it is less than 5%.

The frequency of platform types in the Mogiła assemblage is as follows:

Unprepared platforms	28	27.4%
Single blow platforms	24	23.5%
Prepared platforms	17	16.7%
Dihedral platforms	10	9.8%
Punctiform platforms	23	22.5%

Unprepared platforms are fairly numerous but the various types of prepared platforms dominate. Finds from the Sąspów workshop contain primarily unprepared platforms with the exception of workshop 1/1960 specializing in the manufacture of blades. There is a distinct ascendancy of unprepared platforms in the inventories at Iwanowice – both in those dated to the Modlnica phase and those linked to the Malice group (Dzieduszycka-Machnikowa, Lech 1976). Unlike materials from workshops close to extraction points in the inventories from settlements retrimming of cores during processing played an important role.

The fairly high ratio of punctiform platforms suggests that the pressure and splinter techniques were employed. Typical flakes were struck, as a result, with pronounced percussion waves on the ventral side. This has already been pointed out in the literature of the subject (Kaczanowska 1971).

Frequently flakes were retouched as tools. Of the total number of 21 tools seven were made on flakes i.e. 33%. Cortical flakes and flakes from the preparation or retrimming were used.

4. BLADES

The earliest phase of the Linear Band Pottery culture is represented by a small series of blades (51 specimens), mostly fragmentarily preserved. Site 62 (Mogiła) yielded only 14 whole blades i.e. 26.6% of the total. The proportion of blades is higher on sites 12, 15 (Bieńczyce): 7 blades – 63.6%. The difference is considerable. The small size of the Bieńczyce series prevents observation of regularities. Bla-

des are from 38 to 62 mm long, 12–25 mm wide. The average blade length in the series from site 62 is $\bar{x}$ = 45.9 mm with the standard deviation of 8.2 mm, the average width is $\bar{x}$ = 16.0 with the standard deviation of 4.2 mm. Specimens from sites 12, 15 have similar dimensions. Blades in the advanced stage of processing are predominant. This is reflected in the pattern of scars on the dorsal side:

Cortical blades	1	2.5%
Partially cortical blades	4	10.0%
Blades with unidirectional blade scars	31	77.5%
„ from double-platform cores	1	2.5%
„ with scars perpendicular to the axis	3	7.5%

The frequency of platforms types is as follows:

Unprepared platforms	3	13.6%
Single-blow „	1	4.5%
Prepared „	16	72.7%
Punctiform „	2	9.0%

Although the series is small we find that in comparison with the flake group there is a distinct drop in the proportion of pieces with unprepared and punctiform platforms. This suggests that the technique of the soft hammer or punch was employed. Increase in prepared platforms points to frequent application of rejuvenation when blades were being detached.

Among blade fragments proximal parts are in ascendancy. Blades were more often retrimmed by breaking the distal end or by removing the proximal part than they were on sites of the earliest phase of the Linear Band Pottery culture. In the investigated series the difference between the quantity of proximal and distal parts is not large. All the operations connected with core processing and tool manufacture must have been performed within the boundaries of the settlement, otherwise the proportions of particular blade fragments would have to display greater divergence. If the ready blanks have been brought to the settlements, they would have been first subjected to at least partial selection in the workshop.

5. RETOUCHED TOOLS

The analyzed material yielded relatively few tools (21 pieces). The frequency of particular types is as follows: end-scrapers 12, burins 2, truncations 5, side-scrapers and retouched flakes 2.

Majority of tools were found in the assemblage on site 62 (Mogiła). Three end-scrapers from sites 12, 15 (Bieńczyce) confirm the important role of this tool in the flint industry of the Linear Band Pottery culture. Their ascendancy over other tools has been recorded over the whole range of the Linear Band Pottery culture from Holand (Bohmers, Bruijn 1959) to Moldavia and in the northern zone of this culture in Kujawy (Czerniak 1980).

The group of end-scrapers contains mostly short and robust specimens on blades (8) and some on flakes (4). The front is invariably situated in the distal part of the blade, it is rounded or rounded and slightly oblique (asymmetrical 4), straight (2), less often denticulated (1) or S-shaped (1). The front angle is almost straight (5). Its height oscillates between 6 to 12 mm. The sides are unretouched, only in one case there is discontinous inverse retouch.

Flake end-scrapers include one double end-scraper with the low front and traces of use on the edge, two specimens with straight fronts, and one rounded end-scrapers. Traces of use on parts other than the front indicate that these tools were used on a variety of tasks.

The analyzed series contained two burins on blades, one being a single-blow transversal burin. Implements like this are known from other sites of the Linear Band Pottery culture (e.g. Šturovo) but may have been accidentally produced. The second example is a double angle burin at opposite ends of a blade. This type of tool is not generally found on sites of the Linear Band Pottery culture but is affiliated to the Lengyel culture. A possibility must be taken into account that this implement is a later intrusion, especially since it was not deeply stratified. It might, however, represent the Linear Band Pottery culture.

The group of truncations is represented by both single and double specimens. Of interest is the presence in the Mogiła assemblage of two double trapezoidal truncations, of which one is alternate with a finely retouched edge. Trapezoidal double truncations are sometimes regarded as characteristic for the later phases of the Neolithic. In the Nowa Huta series they occurred on site 62 (Mogiła – 2 examples) and sites 12, 15 (Bieńczyce). The truncations group contains besides an atypical transversal truncation, slightly thermally damaged, with inverse retouch.

One transversal side-scraper with a denticulated edge was recorded, and a lateral side-scraper.

Implements such as perforators, alternate perforators or trapezes are missing in the assemblage under consideration. These tools occurred on the site in Mohelnice. It seems that since the group of tools is not very numerous their absence may be accidental. It does not determine a separate character of assemblages in Little Poland, which, on the other hand, cannot be said to be identical.

III. ANALYSIS OF INVENTORIES OF THE NOTENKOPF PHASE

1. INVENTORY STRUCTURE

The Notenkopf phase of the Linear Band Pottery culture is represented by altogether 1254 flint finds from settlements features on site 62 (Mogiła) – 575 items, 17–20 (Pleszów) – 585 items, and 12, 15 (Bieńczyce) – 52 items. Because the series from Bieńczyce is small, it has been excluded from statistical calculations.

The general inventory structure is as follows:

	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
Cores and pre-cores	26	4.5	30	5.1	11
Flakes	330	57.5	337	57.6	26
Blades	144	24.9	178	30.4	10
Tools	75	13.1	40	6.8	5
Total	575	100.0	585	99.9	52

The inventory structure in the Notenkopf phase does not differ from that of other sites situated in the direct neighbourhood of deposits – just as in the previous phase. Its characteristic feature is that raw materials were mostly worked within the settlement boundaries. For this reason the low frequency of retouched tools (sites 17–20 – 6.8%, site 62 – slightly higher 13.1%), while at the same time the ratio of flakes is very high (57.6%, 57.5% respectively), distinctly higher than that of other categories. A large number of cores, far exceeding that of unworked nodules, suggests that cores and pre-cores must have been brought to the site.

The investigated sites do not show in the Notenkopf phase the presence of materials whose nature would evidence specialized flint workshops.

2. CORES

The series contains 67 cores and 9 unworked nodules. The structure of this group on particular sites is represented in the table below:

	Sites			Total
	62	17–20	12, 15	
Unworked nodules	–	4	5	9
Pre-cores	2	–	1	3
Initial cores	5	–	–	5
Single-platform blade cores:				
with broad flaking face	3	7	–	10
conical	1	–	–	1
with narrow flaking face	1	6	–	7
sub-conical	1	–	–	1
Blade-flake cores, single-platform, residual	3	2	–	5
Blade cores with changed orientation	–	1	–	1
Microlithic blade cores	1	1	–	2
Flake cores:				
with changed orientation	–	4	–	4
single-platform	2	1	1	4
polihedral-spherical	1	–	–	1
discoidal	–	–	1	1
Core fragments	3	4	3	10
Splinters	1	–	–	1
Hammerstones on cores	2	4	5	11
Total	26	34	16	76

The inventories of the Notenkopf phase contained 43 cores with blade cores in ascendancy – 22 specimens (site 62 – 7; sites 17–20 – 15), next come flake cores (3.5 – respectively; sites 12, 15 – 2), and finally blade-flake cores (3.2 respectively). The remainder are initial cores and core fragments. The basic shape is a single-platform core with a slightly convex broad flaking face on the broader side of the flint nodule. On site 62 (Mogiła) out of ten cores three represented this type, on sites 17–20 (Pleszów) 7 out of 15. On site 17–20 the next well represented shape are single-platform cores with a narrow flaking face (6 examples). The remainder are some few discoidal and subdiscoidal cores. Blade blanks were also struck from thick flakes.

Majority of blade cores have prepared platforms, some are single-blow. Only four specimens on site 62 have no preparation on the platform preceding processing. Preparation covered sides or the back of the core removing, usually, the cortex or evening the natural surface, but crests are rare. Many cores have unprepared or even cortical sides and back. Similarly most of the core tips which are often damaged. The preparation of the described cores was not advanced. This is further confirmed by a very small

number of flakes from preparation and by the scar-pattern on the dorsal side of the blades. There are few wholly cortical blades: site 62 – 4.9% of all blades; sites 17–20 – none; partially cortical blades are more numerous: sites 62 – 13.9%; sites 17–20 – as much as 32.9%. This includes specimens from the broadening of the flaking face – 90% and 74.5% of all partially cortical blades. Different methods of retrimming were employed, the most common being the changing of orientation, and rejuvenation of platforms, evening of platform edges, shortening of cores by striking off special flakes which removed core tips. These methods are confirmed by the core and flake patterns.

Blade cores unsuited for processing had, usually, changed orientation or were of the blade-flake type. Flake cores were singleplatform, with changed orientation, dihedral, spherical and discoidal. They were typical flake cores as well transformed from blade cores. In their final form blade and flake cores were used as hammerstones (site 62 – 2, sites 17–20 – 4, sites 12, 15 – 3).

The described cores represent various stages of processing: from early through advanced, to almost complete. Five initial cores occur on site 62. They have only one or two scars. The largest is the group of fully processed cores, especially among blade cores, of which some could even now be used to detach blades (notably some cores from sites 17–20). Coring angles are acute or right, in one instance – site 62 – the angle is obtuse.

Cores from sites 17–20 were measured. They are 25 – 68 mm high, 22–53 mm broad, and 24–63 mm thick. The length of longest blade scars on cores is between 24 to 63 mm.

3. FLAKES

The Notenkopf inventories from the discussed sites contained 793 flakes: site 62 (Mogiła) – 330; sites 17–20 (Pleszów) – 337; sites 12, 15 (Bieńczyce) – 26. The frequency of this category is highest. The measurable attributes of specimens are following:

	Site 62		Sites 17–20	
	mm	x	mm	x
Length	9–75	33.7	13–83	35.7
Width	11–74	30.1	11–92	30.0
Thickness	3–30	8.7	3–21	7.5

Classification of the set in respect of the scar pattern on the dorsal side ascribed each flake to a particular stage in the dynamic reconstruction of core processing. The frequency of types of scar-pattern on the dorsal side is represented in the table below:

	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
Cortical flakes	41	12.4	20	5.9	1
Partially cortical flakes	67	20.3	88	26.1	7
Flakes with unidirectional scars	150	45.4	140	41.5	6
Flakes with opposite scars (on double-platform cores)	18	5.4	11	3.3	–
Flakes with scars perpendicular to axis	33	10.0	12	3.6	–
Flakes with perpendicular scars	17	5.1	45	13.3	1
Flakes with centripetal scars	3	0.9	–	–	–
Others (characteristic types)	1	0.3	11	3.3	–
Splinters	–	–	10	3.0	–
Undetermined	–	–	–	–	11
Total	330	99.8	337	100.0	26

The table shows the group of flakes with unidirectional scars to be dominant on both sites. These flakes come from the advanced stage of processing. Partially cortical flakes come next (20.3%, 26.1%) followed by flakes with perpendicular scars (13.3%) and finally cortical flakes (5.9%). The set of whole flakes with preserved proximal part has been classified in respect of paltform types:

Platform	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
Natural	81	28.0	54	18.4	–
Single-blow	69	23.9	66	23.0	5
Prepared	53	18.3	74	25.6	2
Dihedral	15	5.2	–		–
Cortical	–		33	11.4	2
Punctiform	71	24.6	61	21.2	6
Total	289	100.0	288	99.6	15

The exterior angle of finds from site 62 (Mogiła) have been measured: 10 flakes – acute angles, 67 – right angles, and 102 flakes have obtuse angles. Analysis of the flake set reveals some differences

between the two sites. A large number of flakes with natural platforms in the material from Mogiła (62), with the simultaneous high proportion of cortical flakes (12.4% – third group in respect of frequency) may suggest that on this site the entire flint processing took place on the settlement, and unworked nodules were brought to the site. The situation was somewhat different on sites 17–20 (Pleszów) where the proportion of cortical flakes is smaller by half (5.9%) than on site 62. The comparison suggests that we have to do in Pleszów with a different organization of production process.

4. BLADES

The Notenkopf phase features of the Linear Band Pottery culture on the investigated sites yielded altogether 332 blades: site 62 (Mogiła) – 144, sites 17–20 (Pleszów) – 178, sites 12, 15 (Bieńczyce) – 10 specimens.

The degree of preservation of blades from particular sites is represented in the table:

	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
whole blades	57	39.6	90	53.9	5
proximal parts	47	32.6	38	22.7	3
central parts	23	16.0	20	12.0	1
distal parts	17	11.8	19	11.4	1
indefinite	–	–	11	–	–
Total	144	100.0	178	100.0	10

Specimens preserved intact have been measured and their attributes broken down into classes of length, width and thickness. Averages and the standard deviation were calculated.

Length in mm	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
20–30	8	14.0	12	13.3	–
31–40	14	24.6	26	28.9	–
41–50	17	29.8	27	30.0	1
51–60	10	17.5	19	21.1	3
61–70	5	8.8	4	4.4	1
71–80	2	3.5	2	2.2	–
81–90	1	1.7	–	–	–
Total	57	99.9	90	99.9	5

Blade length ranges from 20–90 mm, with majority of specimens in the class 41–50 mm (site 62 – 29.8%, sites 17–20 – 30.0%). The average length of blade blanks corresponds to the metric classes: for sites 17–20 $x = 43$ mm, the standard deviation $s = 11.5$, for site 62 it is slightly higher $x = 44.3$ mm, the standard deviation $s = 13.0$ which can be accounted for by a larger number of blades over 60 mm long on this site.

The width of blade blanks ranges on the investigated sites from 10–36 mm. The distribution of width of specimens is presented in detail:

Width in mm	Site 62		Sites 17–20		Sites 12 15
	N	%	N	%	N
10–15	28	49.1	40	44.4	–
16–20	22	38.6	32	35.6	1
21–25	3	5.3	11	12.2	2
26–30	4	5.3	4	4.4	1
31–35	1	1.7	2	2.2	–
36–40	–	–	1	1.1	1
Total	57	100.0	90	99.9	5

On both sites blade blanks with the width in the class 16–20 mm show high occurrence (Mogiła – 49.1%, Pleszów – 44.4%), followed by specimens in the class from 16 to 20 mm (38.6%, 35.6%). On sites 17–20 more blades in the class 21–25 mm (12.2%) which is reflected in a slightly bigger average width $x = 16.5$ mm, the standard deviation $s = 5.6$, whereas for site 62 this value is 16.3 mm and the standard deviation $s = 5.0$.

Thickness of blades ranges from 2 to 16 mm (on site 62 one example – 34 mm), but this attribute is fairly varied on both sites.

Class	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
2	1	1.7	2	2.2	–
3	8	14.0	20	22.2	–
4	20	35.1	16	17.8	–
5	6	10.5	16	17.8	1
6	5	8.8	10	11.1	1
7	6	10.5	9	10.0	1
8	–	–	7	7.8	1
9	–	–	5	5.6	–
10	5	8.8	3	3.3	–
11	–	–	1	1.1	–
12	1	1.7	–	–	–
13	2	3.5	–	–	–
14	1	1.7	1	1.1	–
15	–	–	–	–	1
16	1	1.7	–	–	–
34	1	1.7	–	–	–
Total	57	99.7	90	100.0	5

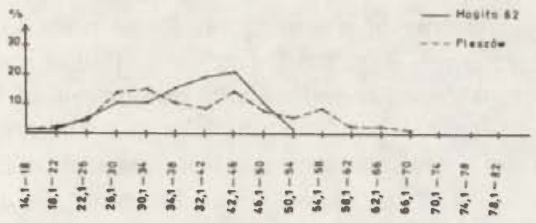

Fig 1. Width/length index of blades in Notenkopf phase of the Linear Band Pottery culture

The range of thickness for blades from site 62 (Mogiła) is shorter: 80.7% range from 2 to 7 mm, but most specimens in this group – i.e. 47.7% are 4 mm thick. The remaining blades – 19.3% range from 10–16 mm in thickness. In the case of blades from sites 17–20 (Pleszów) the range of thickness is bigger: from 2 to 11 mm, only one specimen stands apart being 14 mm thick. Blades from the latter sites (Pleszów) are thinner than those on site 62. The average for the two sites is, respectively, $x = 5.2$ with the standard deviation $s = 2$, and $x = 6.1$ mm, $s = 4.4$.

For the blade blanks diagrams have been drawn of indices of W/L ratios and T/W ratios. On both sites elongated blades with the index 14.1–22 are rare, while robust specimens predominate. On sites 17–20 they are moderately robust, with the index of 30.1–34 – 15.5%, followed by a group with the index of 26.1–30 and 42.1–46 – each 14.4%. A small number blade blanks occurred with indices: 34.1–38, 38.1–42, 46.1–50, 54.1–58. On site 62 the blade blanks are conspicuously robust with the predominant index.

The comparison of blade proportions from the investigated sites has shown that they are more homogeneous for the Mogiła materials (site 62), with a shorter range of the W/L index; between 14.1 to 54, of the T/W index: between 10.1 to 62. In the case of blades from Pleszów (sites 17–20) the range of the two indices is much larger: the L/W index ranging from 14.1 to 70, the T/W index between 10.1 to 90. These estimations show the occurrence of robust and very robust specimens which are absent on site 62. At the same time on sites 17–20 a fairly numerous group of elongated blades occurs with the W/L index ranging from 26.1 to 34 mm.

Besides wholly preserved specimens, blade fragments have been recorded constituting 59.2% of all blades on site 62 (Mogiła), and 46.1% on sites 17–20 (Pleszów). In the set of blade fragments proximal parts are predominant: site 62 – 54% of all fragments, sites 17–20 – 49.3%, often together with the central part, since the length of specimens is frequently as large as 46–59 mm. Blades with the broken off proximal part, or central parts of blades are distributed in similar quantities on both sites. Length of blade fragments suggests that blades were made straight rather than intentionally segmented. The most frequent operation was to break off the thin and recurved distal ends of the blade to obtain the transversal working edge of the tool. Sometimes, the thick proximal part was also removed. To obtain straight blades with approximately equal thickness both proximal and distal parts were broken off.

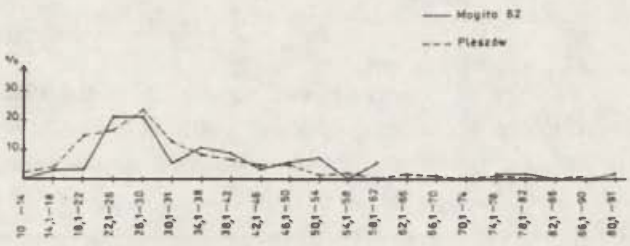

Fig. 2. Thickness/width index of blades in the Notenkopf phase of the Linear Band Pottery culture

Scar pattern on the dorsal side of blades distinguished the following types in the investigated set:

Blades	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
Cortical	7	4.9	–	–	–
Partially cortical	20	13.9	55	32.9	–
With unidirectional scars	107	74.2	105	62.9	9
With opposite scars	3	2.1	4	2.4	1
With perpendicular scars	7	4.9	3	1.8	–
Total	144	100.0	167	100.0	10

On both sites blades with unidirectional scars are distinctly dominant: site 62 (Mogiła) – 74.3%, sites 17–20 (Pleszów) – 62.9%, i.e. from the advanced stage of processing. There is a fair number of partially cortical blades including examples from the broadening of the flaking face by removing cortex from the sides: site 62 – 90%, sites 17–20 – 74.5% of all partially cortical blades. As we have already mentioned this seems to point to an early stage of core preparation when sides were shaped. Hence the very high proportion of blades laterally cortical, low of blades detouched after removing trimming blades.

The distribution of blade platforms is following:

Platform	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
Natural	8	7.7	11	8.6	–
Single-blow	20	19.3	27	21.1	2
Prepared	62	59.5	65	50.8	5
Dihedral	–	–	–	–	–
Cortical	6	5.8	3	2.3	–
Punctiform	8	7.7	22	17.2	1
Total	104	100.0	128	100.0	8

The low frequency on both sites of natural and cortical butts ascertains, just as in the case of cores, the procedure of preparing platforms prior to blade processing – a method which was almost invariably employed. From the high proportion of blades with prepared butts we may infer that the rejuvenation of core platforms was a frequent operation during blade processing. The inventory from sites 17–20 contains numerous blades with punctiform butts amounting to 17.2% of all butt types (third after single-blow and prepared types). In all likelihood this was the result of a more frequent use of the pressure technique.

5. RETOUCHED TOOLS

Features of the Notenkopf phase of the Linear Band Pottery culture yielded a total of 120 implements. The structure of this category on particular sites is as follows:

Retouched tools	Site 62		Sites 17–20		Sites 12, 15
	N	%	N	%	N
End-scrapers	48	64.0	11	27.5	4
Burins	4	5.3	2	5.0	–
Truncations	10	13.3	13	32.5	–
Retouched blades	2	2.7	10	25.0	1
„ flakes	4	5.3	2	5.0	–
Side-scrapers	5	6.7	–	–	–
Perforators	1	1.3	2	5.0	–
Alternate perforators	1	1.3	–	–	–
Total	75	99.9	40	100.0	5

Analysis of major tool classes shows that side-scrapers are represented by blade and flake specimens, with the former in distinct ascendancy: 33 examples on site 62 (Mogiła), 7 on sites 17–20 (Pleszów), and 15 (Bieńczyce), 4 flake examples respectively. They are generally single, only 5 double end-scrapers have been recorded. On both sites end-scrapers are short and robust. Average length of blades specimens on site 62 is $\bar{x} = 29.2$, on sites 17–20 $\bar{x} = 31.6$ with the average width $\bar{x} = 20.2$ and $\bar{x} = 21.1$. Flake end-scrapers are somewhat larger and thicker; two may be described as macroend-scrapers (on site 62 measuring $56 \times 35 \times 11$ mm, sites 17–20 – $55 \times 42 \times 14$ mm).

Fronts are mostly rounded, situated in the distal part of the blank. Oblique, straight or irregular undulated fronts occur but their frequency is lower. Front angles are acute, sometimes right. Their height is between 3–16 mm on site 62 with the average $\bar{x} = 7.1$ mm, on sites 17–20 between 5 to 15 mm, $\bar{x} = 8.4$ mm. Occasionally end-scrapers have intentional retouch or pseudo-retouch on the lateral edge. Majority of these tools are made on blanks with unretouched sides (site 62 – 41 examples, sites 17–20 – 11 examples).

The second group in respect of intensity of occurrence are 24 truncations. They are elongated, single or double trapezoidal. The latter are more numerous – 6 specimens, but on site 62 (Mogiła) the two types are equal in number. Truncations are usually oblique or straight, single truncations are retouched in the distal part of the blade. On site 62 an interesting double arched truncation was found. Truncations from site 62 do not have, except for one specimen with a retouched notch on the longer side, additional characteristics such as retouched lateral edges, whereas on sites 17–20 (Pleszów) 7 truncations have finely retouched lateral edges – probably pseudo-retouch. Part of truncations have intentional alternate retouch of the edge, flattish inverse retouch of the edge near the end, or steeply retouched notches. Use-wear analysis of the investigated material has not been carried out. Macroscopical examination showed typical gloss between the edge and the truncation, interpreted as wear traces left by reaping. The fact is worthy of notice that the tool group under consideration contained double trapezoidal truncations (notably site 62 – 2 examples, sites 17–20 – 1). This tool is considered to be typologically later, characteristic of the inventories of the Lengyel-Polgar complex.

Similarly as in other lithic inventories of the Linear Band Pottery culture, the examined Notenkopf phase material contains few burins. Four occurred on site 62 and two on sites 17–20. They are blade as well as flake specimens, among them two dihedral burins, two single-blow, one burin on a snap, and one truncation burin. With the exception of the truncation burin from site 62 which was formed by two blows, the remaining tools were produced by one burin blow.

The third group as to its intensity of occurrence are retouched blades: 2 on site 62, 10 on sites 17–20. They have fine direct retouch of the edge, alternate or two-sided. Two specimens have retouched notches – one with inverse, the other with alternate retouch. It is of interest that in the inventory on site 17–20 trimming blades and flakes removing distal parts of blade cores were retouched as tools.

On site 62 (Mogiła) one atypical perforator on retouched blade and one flake perforator were found, on sites 17–20 (Pleszów) two flake perforators. The cusps of these tools are weakly distinguished, in the case of flake perforators projected laterally. When the cusp was made in the proximal part of the blank, a convex bulb was removed by flat retouch.

Four retouched flakes occurred on site 62 and two on sites 17–20. They are medium-size, robust, with fine retouch on the edge, one flake on site 62 has steep denticulated retouch.

Side-scrapers are present only in the inventory of site 62, where in respect of frequency they come third after end-scrapers and truncations. Two are transversal, two transversal-lateral and one example is lateral. The tools are fairly large, from 45 to 93 mm in length, 46 to 81 mm in width, robust, with flattish retouch extending onto the surfaces, in three instances denticulated.

Analysis of statistical-typological structure of tools from both sites together shows a situation typical of the Notenkopf phase of the Linear Pottery Band culture i.e.: a very high occurrence of end-scrapers – 51.3%, the proportion of truncations smaller by half – 20%, retouched blades – 10.4%. Other tools are poorly represented: retouched flakes and burins – 5% each group, side-scrapers – 4.3%, perforators – 2.6%, atypical perforators – 0.9%. However, conspicuous difference occur between the two sites. On site 62 end-scrapers – 64.0% show higher occurrence than truncations – 13.3%, side-scrapers – 6.7%, or burins and retouched blades – 5.3% each, finally retouched flakes – 2.7%. The distribution of tools is diametrically different on sites 17–20. Here the highest occurrence have truncations – 32.5%. However only slightly higher, than that of end-scrapers – 27.5%. Third come retouched blades – 25%, then burins, perforators and flakes – 5% each group. Side-scrapers are missing.

IV. ANALYSIS OF INVENTORIES OF THE ŽELIEZOVCE PHASE

1. INVENTORY STRUCTURE

During the Želiezovce phase considerable oscillations of indices of major tool classes can be observed pointing to high functional variability of investigated sites. The total number of artefacts from all sites and their percentages are presented below:

Site	Cores		Flakes		Blades		Tools		Total
	N	%	N	%	N	%	N	%	
17–20	2	2.59	36	46.75	13	16.99	26	33.76	77
55	25	15.33	69	42.33	35	21.47	34	20.58	163
62	16	3.81	249	59.42	118	28.16	36	8.59	419
12, 15	38	9.09	260	62.05	76	18.13	43	10.52	417

The table shows that sites 17–20 (Pleszów) in the Želiezovce phase was a typical settlement where the exploited inventory consisting of blades and blade tools was brought to the site from outside. Processing within the settlement was limited to several cores.

Site 55 is also a settlement, but with a greater number of cores (percentage of cores is exceptionally high which suggests the storing of cores suitable for further processing). The amount of debitage and blades should correspond to processing of 4 or 6 cores whereas this site yielded as many as 25 specimens. Tool percentage is high and typical of settlements where completed implements were brought from outside.

The other sites: 62 (Mogiła) and 12, 15 (Bieńczyce) are also settlement sites situated in the vicinity of deposits, with core processing, beginning from pre-core stage, carried out on the site. Percentages of all major tool classes mutually correspond viz.: frequency of cores suggests that debitage constitutes all of flakes from preparation carried out *in situ*, while the proportion of blanks and tools corresponds to the number which would have been obtained from cores processed *in situ*. A structure like this has been experimentally obtained and showed only several (3) per cent of cores, 50–60% of debitage, and 20–30% of blades and blades tools together. On the other hand, the tool frequency of 8–10% is consistent with settlement sites where raw material was processed *in situ*, and located in the vicinity of deposits. This has been corroborated by a number of Palaeolithic and Neolithic sites (Kozłowski 1980).

The structure of site 62 and 12, 15 is fairly close

to that in the pre- and Notenkopf phases of the Linear Band Pottery culture from Mogiła and Bieńczyce. Significant differences occur only on sites 17–20 and 55, where the total number of flint artefacts is smaller and percentages of tools are high (20 and 33%). The selective character of the inventory must have ensued from the separation of zones of initial processing of raw materials from zones where blanks and tools were used i.e.: from the advancing specialization of production.

2. CORES

The described series is made up of the total of 81 cores, core fragments and specimens used as hammers. The general structure of this group of artefacts is as follows:

	Sites				Total
	17–20	62	12, 15	55	
Unworked nodules	–	–	7	3	10
Pre-cores	–	1	1	–	2
Initial cores	–	4	1	4	9
Single-platform blade cores:					
with broad flaking face	1	3	–	3	7
conical	–	2	–	1	3
with narrow flaking face	–	2	1	–	3
with carinated flaking face	–	–	1	–	1
Blade-flake single-platform cores (residual)	–	–	3	–	3
Blade cores with changed orientation	–	–	2	–	2
Microlithic blade cores	–	1	–	3	4
Flake cores:					
with changed orientation	–	1	–	–	1
single-platform	–	–	4	1	5
with converging flaking faces	–	–	1	–	1
polihedral-spherical	–	–	6	–	6
discoidal	–	–	3	–	3
Core fragments	1	1	3	5	10
Splinters	–	1	–	2	3
Hammers on cores	–	–	5	3	8
Total	2	16	38	25	81

The table reveals significant differences in the core structure on particular sites. Cores in the early stage of processing together with unworked nodules occur with almost equal frequency (22–30%) on all the sites except on sites 17–20 (Pleszów). Cores in the advanced stage of processing, on the other hand, are most numerous on site 62 (Mogiła). This group is composed of cores representative for the Linear Band Pottery culture viz.: single-platform blade cores with the broad, slightly convex flaking face and a prepared platform, microlithic cores with the broad flaking face. The highest occurrence of flake cores has been recorded on site 12, 15 (Bieńczyce). It is likely that these are residual cores from the above-mentioned types of blade cores, notably those which were not conical. If this hypothesis is correct then the core structure on sites 12, 15 reflects a much more advanced processing of cores than on other sites of the Želiezovce phase.

On site 62, which is our special concern, the percentage of cores (15.33) is exceptionally high, the component of initial cores is fairly large (but without typical flaking faces – 29%), and typical blade cores in the advanced stage of processing are abundant (28%). The remainder are core fragments from processing, splinters and hammerstones on cores. A structure like this offers a twofold explanation of the increased core frequency on the site: 1 – the storage of unworked or partially processed cores as a convenient form of raw material from which to obtain blades, 2 – frequent fracture of cores during processing due to faults in the material.

The reconstruction of dynamic aspects of lithic raw materials processing distinguished three stages in the processing of cores:

1. The initial stage when the platform and the flaking face were prepared, possibly also sides and core back, or core processing was commenced without initial preparation. The collection contained only two typical pre-cores with lateral trimming edges on the pre-flaking face (uni- and bilateral). Unworked nodules or cores in the initial stage of processing, occasionally typical pre-cores, were brought to the site.

2. The stage of advanced processing when blades were struck from cores – mostly single-platform with the broad flaking face. The platforms were prepared, or at least single-blow. Sometimes cores had preparation on the back, sides or the distal end. The length of cores is between 50–60 mm, occasionally 80 mm. Blade-flake specimens are rare in this stage of processing (only sites 12, 15 – Bieńczyce).

3. The final stage of processing when blades were further processed to obtain subdiscoidal forms (the flaking face was made broader covering the sides or possibly the core back), or by changing the orientation blades and flakes were struck simultaneously producing flake cores polihedral-spherical or discoidal.

The presence of microlithic blade cores on sites 55, 62 (Mogiła) alongside cores for typical blades is noteworthy. Morphologically cores for bladelets

correspond to typical blade cores with broad flaking faces. It should be added that on site 63 (Mogiła) the microlithic core for bladelets was made on a small obsidian nodule, whereas on site 62 all microlithic cores were flint.

Some waste from coring indicate that procedures such as striking off trimming blades, shortening of cores by removing the distal end, rejuvenation of platforms were not employed often. As a result the number of blade cores weakly processed was large, or in the final stage of processing cores were transformed to flake specimens. The former situation can be observed on site 62 and 55, the latter on sites 12, 15 (Bieńczyce). We may infer that the level of technique of flint processing in the Linear Band Pottery culture was not very high. The knappers did not know how to correct certain technical features of cores so as to obtain blades until the final stage of processing was reached.

3. FLAKES

The frequency of flake classes distinguished in respect of types of dorsal side is as follows:

Flakes	Sites 17–20		Site 55		Site 62		Sites 12, 15	
	N	%	N	%	N	%	N	%
Cortical	4	12.9	9	13.0	25	10.0	16	6.1
Partially cortical	5	16.1	13	18.8	35	14.0	62	23.8
With unidirectional scars on the dorsal side	16	51.6	25	36.2	85	34.3	73	28.0
With opposite scars (on double-platform cores)	–	–	3	4.3	10	4.0	5	1.9
With scars perpendicular to flake axis	2	6.4	9	13.0	19	7.6	20	7.7
With perpendicular scars	–	–	–	–	12	4.8	7	2.6
With centripetal scars	–	–	–	–	6	2.4	–	–
Special (from trimming edges and tips)	2	6.2	–	–	9	3.6	–	–
Splinters	–	–	–	–	–	–	1	0.3
Flake fragments	2	6.4	10	14.4	48	19.2	76	29.2
Total	31	99.6	69	99.7	249	99.9	260	99.6

The table shows that although quantitative distribution of flakes varies, percentages stacked along the list of flake types are strikingly uniform. For example: oscillations in the percentage of flakes from initial preparation are small (24.0 on site 62 – Mogiła, 31.8 on site 55 – Mogiła), secondly, percentages of cortical flakes in this group are almost the same (from 6.1% on site 12, 15 – Bieńczyce, to 13.0% on site 62).

Percentages of flakes from the more advanced core processing with unidirectional scars are also uniform (28.0 to 37.2%). The inventory on sites 17–20 (Pleszów) is an exception since these flakes amount to 51.6% which means that the role of initial processing of raw material locally was insignificant. The distinct increase in the proportion of flakes with perpendicular scars on the dorsal side (28.9%) on sites 12, 15 correlates with a higher occurrence of flake cores with changed orientation from the final stage of processing. Proportions of flakes with centripetal or perpendicular scars on site 62 are more varied which can be accounted for by the presence of preparation on cores, both initial and rejuvenated during processing. Moreover, there is a higher occurrence on this site of special types of flakes (from trimming edges and core tips) and platforms.

Platform types reflect methods of core preparation. The table presents frequencies of platform types on particular sites taking into account only wholly preserved platforms:

Platforms	Sites			
	17–20	55	62	12, 15
Single-blow	7	17	41	65
Natural or cortical	6	6	31	43
Formed by several blows	5	9	37	51
Dihedral	–	2	9	11
Punctiform	9	7	57	73
Total	27	41	175	243

If we take into account the differences in the occurrence of flakes with the proximal part broken off, then – as the table shows – no significant fluctuations are found in the distribution of particular platform types. The slightly higher occurrence of single-blow platforms on sites 12, 15 (Bieńczyce) is probably resultant from the frequently employed change of orientation of flake cores whose number is distinctly bigger on this site.

Generally, the Želiezovce phase shows a conspicuous dominance of prepared platforms over unprepared (the latter amount to 8.6–19.3%). From the low percentage of unprepared platforms it can be reasonably assumed that part of operations connected with initial core processing was carried out outside settlements. This is reflected by a relatively small percentage of cortical flakes (6.1–13.0%).

From among measurable atributes of flakes the exterior angles were studied on two sites:

	Sites 12, 15		Site 62	
	N	%	N	%
90°	73	46.7	21	52.4
100°	44	28.2	9	22.5
110°	16	10.2	4	10.0
120°	18	11.5	5	12.5
130°	5	3.2	1	2.2
Total	156	99.8	40	99.6

The above results confirm the homogeneous character of coring technique on the two investigated sites, pointing to a relatively low proportion of obtuse angles which are associated with the early stages of coring.

4. BLADES

The Želiezovce phase yielded a series of 242 blades including 117 whole specimens. The lowest percentage of intact blades is on sites 17–20 – Pleszów (23.1%), the highest on sites 12, 15 – Bieńczyce (61.8%).

Particular parts of blades have been preserved in various proportions which may be the indication of intentional breakage of some fragments for further processing or use. The proportions of blade parts on the Želiezovce sites are as follows:

Part	Sites			
	17–20	55	62	12, 15
distal	1	1	14	2
central	4	3	30	3
proximal	4	8	24	11
Total	9	12	68	16

The table shows that on site 55 (Mogiła) and sites 12, 15 (Bieńczyce) the preserved proximal parts of blades are twice as numerous as middle and distal fragments. Just the opposite, the richest series of blades on site 62 (Mogiła) contained predominantly middle parts of blades. The sample from sites 17–20 is too small to be statistically significant, though the number of proximal fragments lowest on all the sites is interesting. Such distribution may have resulted from the processing of distal parts of blades into tools (this, however, is not supported by the number of implements made on distal fragment was broken off. On site 62, however, blades inserts for combined tools which were not discarded when the settlement was abandoned. Middle fragments may have been used in the same way. At the same time, their smaller number may suggest that the proximal part was longer and only distal fragment was broken off. On site 62, however, blades were broken into three parts, but both distal fragments as well as – to a lesser extent – proximal ones are absent.

The length of blades oscillates from 20 to 80 mm, with the average length from 40.7 to 49.5 mm. The distribution of blades according to classes of length is as follows:

Length in mm	Sites			
	17–20	55	62	12, 15
10–20	–	–	2	–
21–30	–	2	5	2
31–40	2	5	10	11
41–50	–	7	11	20
51–60	1	6	9	13
61–70	–	1	4	1
71–80	–	1	2	2
Total	3	22	43	49

As we can see in the table the most numerous are blades from 50–60 mm long. No conspicuous differences between sites are observed.

Width of blades oscillates between 10 to 40 mm, with the average between 16.0 to 19.1 mm. Blade distribution in the classes of width is presented below:

Width in mm	Sites 17–20		Site 55		Site 62		Sites 12, 15	
	N	%	N	%	N	%	N	%
10–15	5	38.5	7	20.5	3	2.7	20	26.3
16–20	3	23.0	20	58.8	32	28.8	40	52.6
21–25	5	38.4	7	20.5	52	46.8	10	13.1
26–30	–	–	–	–	18	16.2	3	3.9
31–35	–	–	–	–	5	4.5	2	2.6
36–40	–	–	–	–	1	0.9	1	1.3
Total	13	99.9	34	99.8	111	99.9	76	99.8

The table shows that the differences in blade frequencies in classes of width on particular sites are more pronounced. Narrow blades (up to 20 mm) are more frequent on site 55 (Mogiła) and sites 12, 15

(Bieńczyce; altogether 79.3 and 78.9%), whereas on sites 17–20 (Pleszów) and 62 (Mogiła) blades whose width is more than 20 mm are in majority.

The distribution of blade thickness is more uniform oscillating from 2 to 9 mm, only on site 62 some blades are thicker (11–14 mm) resultant from the more advanced core processing on this site, where in the final stage blade-flakes are obtained. The distribution of blades in classes of thickness is as follows:

Thickness in mm	Sites 17–20		Site 55		Site 62		Sites 12, 15	
	N	%	N	%	N	%	N	%
2	–	–	1	2.9	7	6.5	–	–
3	4	30.7	5	14.7	18	16.8	11	14.4
4	5	38.4	10	29.4	29	27.1	25	32.8
5	1	7.6	8	23.5	15	14.0	17	22.3
6	2	15.3	3	8.8	18	16.8	5	6.5
7	1	7.6	5	14.7	8	7.4	8	10.5
8	–	–	2	5.8	4	3.7	3	3.9
9	–	–	–	–	1	0.9	4	5.2
10	–	–	–	–	1	0.9	1	1.3
11	–	–	–	–	2	1.8	–	–
12	–	–	–	–	1	0.9	–	–
13	–	–	–	–	2	1.8	–	–
14	–	–	–	–	1	0.9	2	2.6
Total	13	99.6	34	99.8	107	99.5	76	99.5

All the sites yielded at least 10% of cortical blades which is the consequence of employing initial preparation of pre-cores more often than in the earlier assemblages. Because the flaking faces of cores are distinctly convex the cross-section of blades is trapezoidal. The technological feature ensuing from frequent preparation of core platforms is the conspicuous dominance of prepared blade butts. Thus on site 62 prepared platforms constitute 60.1% of all platforms, while unprepared and punctiform platforms come next (11.1%).

5. RETOUCHED TOOLS

The examined sites yielded relatively small series of retouched implements. The numerical data of their occurrence on particular sites can only be approximate: the total number of retouched tools on all sites is 139 specimens:

Tools	Sites 17–20		Site 55		Site 62		Sites 12, 15	
	N	%	N	%	N	%	N	%
End-scrapers	10	38.4	9	26.4	13	36.1	25	58.1
Burins	1	3.8	2	5.8	5	13.8	2	4.6
Truncations	5	19.2	2	5.8	3	8.3	2	4.6
Backed pieces	–	–	–	–	1	2.7	–	–
Retouched blades	7	26.9	2	5.8	3	8.3	4	9.3
Retouched flakes and side-scrapers	3	11.5	11	32.3	4	11.1	7	16.3
Combined tools	–	–	–	–	2	5.5	–	–
Perforators	–	–	2	5.8	5	13.8	2	4.6
Pic-like tools	–	–	2	5.8	–	–	1	2.3
Denticulated blades with gloss	–	–	4	11.7	–	–	–	–
Total	26	99.8	34	99.4	36	99.6	43	99.8

When we proceed to look into the morphology of particular tool classes the highest of all frequency of end-scrapers is conspicuous, oscillating from 26.4 on site 55 (Mogiła) to 58.1% on sites 12, 15 (Bieńczyce). The latter index is representative for the Linear Band Pottery culture.

The ratio of flake to blade end-scrapers on particular sites is following:

	Sites			
	17–20	55	62	12, 15
Blade end-scrapers	7	6	8	17
Flake end-scrapers	3	4	5	8

Blade end-scrapers are both slender and robust, but the former specimens are more numerous. In respect of shape of fronts most specimens are convex symmetrical (sites 17–20 – 4 examples, site 55 – 5, site 62 – 5, sites 12, 15 – 8). Some end-scrapers have straight symmetrical fronts, undulating, irregular, nosed or "shouldered" (à *epaulement*) fronts. On sites 17–20 (Pleszów) one specimen occurred with a high front. Blade end-scrapers have, as a rule, unretouched sides, whereas among flake end-scrapers occasional examples are found with retouch on one side.

There are sporadic examples of end-scrapers with inverse retouch near the front (site 55 – a

specimen resembling St. Sourd end-scrapers, and one flake example on site 62), denticulated flake end-scrapers (3 examples on sites 12, 15), and end-scrapers with straight retouch on the base resembling a truncation (flake specimen on site 62 and one blade example on sites 12, 15).

Combined tools are represented by only two combined end-scrapers – burins on site 62. One of these is a short end-scraper – single-blow burin, the other a combined flake end-scraper – dihedral lateral burin. Traces of burin blows on these tools are in all likelihood connected with the method of treating the base to be set in the haft, or with unintentional pressure on this part of the implement.

Burins occur in greatest number on site 62 (Mogiła) – 5 examples, and are represented by : 2 lateral single-blow burins (one on a splinter, the other on chunk), two blade burins on a snap, and one truncation burin on an obliquely retouched blade. On sites 17–20 (Pleszów) one truncation burin on an irregular bladelet was found, while on site 55 (Mogiła) two transversal burins, including one flat with multiple facets. Two transversal burins come from sites 12, 15 (Bieńczyce): one flake example, double, polihedral, and one blade example on a retouched notch on the blade side. Almost all specimens mentioned above (except for the truncation burin on site 62) are single-blow or burins on a snap and do not have surfaces intentionally prepared for burin blow (or blows). It is questionable, therefore, whether these specimens are intentional burins or whether they were produced as a result of pressure applied during use.

The frequency of the group of truncations undergoes marked oscillations: from only 4.6% on sites 12, 15 and 5 on site 55, up to as much as 19.2% on sites 17–20. The biggest series of truncations on sites 17–20 comprises as many as three double truncations (two asymmetrical, and one asymmetrical with some sort of a tang – a cran), which seems fairly unusual for the Linear Band Pottery culture. This may perhaps suggest that these truncations are a later, eneolithic addition – although the assemblages in which they are found do not contain later ceramic intrusions. The remaining truncations from sites 17–20 are single (one damaged example is oblique, and one is convex with a strongly rounded truncated end resembling a blunted back formed by opposite retouch). These specimens too diverge markedly from the truncations commonly found in the Linear Band Pottery culture and could be a middle eneolithic addition, although the archaeological context is to the contrary.

Truncations of different character are found on site 62 (Mogiła): one finely retouched, transversal, on a bladelet, one convex, and one concave rather atypical. Site 55 (Mogiła) yielded two oblique single truncations, and sites 12, 15 (Bieńczyce) a double trapezoidal and an oblique single truncation. These specimens do not differ from the types well-known which occur in the Linear Band Pottery culture. Only one backed piece is found representing the Želiezovce phase: this is a narrow bladelet with a straight blunted edge, more like palaeolithic specimens (site 62).

The frequency of retouched blades also shows strong oscillations from 5.8% on site 55 up to 26.9% on sites 17–20 (Pleszów). It is usually equal to the frequency of truncations. The biggest series known from sites 17–20 comprises blades with fine inverse or alternate retouch (5 examples), and notched blades (2 examples). Site 62 yielded besides blades with fine inverse discontinuous retouch (2 examples), and one with fine semi-steep retouch resembling flechettes. On site 55 retouched blades are fine with direct retouch of one side, whereas on sites 12, 15 they are elongated with fine direct continuous retouch.

The frequency of the group of retouched flakes is uniform (11–16%) with the exception of site 55 (Mogiła), where the index of occurrence for these tools is as high as 32.3%. On this site flakes are predominant with straight lateral or transversal edges with fine semi-steep retouch, direct or inverse, and specimens with retouched notches usually transversal.

Of interest is the presence on site 62 (Mogiła) of a typical side-scraper, double, lateral, bi-convex, and some sort of a reclette with inverse retouch. On site 17–20 (Pleszów) were found: a double lateral-transversal side-scraper and a lateral side-scraper on a cortical flake, a sub-rectangular flake scraper with retouch on the dorsal and ventral sides. Simple retouched flakes and two raclettes with retouch in the distal part occurred on sites 12, 15 (Bieńczyce).

The frequency of occurrence of perforators varies: they are absent on sites 17–20; on site 55 and 12, 15 their index is 4.6 and 5.8, on site 62, however, as high as 13.8. This includes: 4 slender blade perforators (one inverse), one flake perforator retouched round almost its whole circumference and one double perforator, possibly a type on a tanged point. It has alternate retouch in the distal part and simple in the proximal part, one side is retouched along its whole length.

Pic-like tools recordeed on site 55 (2 examples), and sites 12, 15 (1 example) deserve special attention. They are all made on chunks, with triangular

cross-section. One example has retouch on both sides, and one specimen has three sides retouched representing a typical "Triedre" (site 55, pit 167). The second tool from site 55 is fractured, the distal part has not been preserved.

Generally, the inventories of retouched implements from the Želiezovce sites under discussion are considerably varied:

1. The inventory with the average index of end-scrapers and higher of truncations and retouched blades (sites 17–20 – Pleszów).

2. The inventory with high index of end-scrapers and low of truncations (sites 12, 25 – Bieńczyce).

3. The inventory with a low index of end-scrapers and higher of retouched flakes and side-scrapers (site 55 – Mogiła).

4. The inventory with an average index of end-scrapers and higher of burins and perforators, partly also of retouched flakes (site 62 – Mogiła).

On the above evidence it has been ascertained that during the Želiezovce phase almost every site of this culture displays a different statistical-typological structure.

V. EVOLUTIONAL AND DISCRIMINATING TENDENCIES IN THE DEVELOPMENT OF LITHIC INDUSTRIES OF THE LINEAR BAND POTTERY CULTURE IN THE NOWA HUTA REGION

1. INVENTORY STRUCTURE

The inventory structure on sites of the Linear Band Pottery culture in the Nowa Huta region had undergone certain modifications from the earliest (pre-Notenkopf) to the latest (Želiezovce) phase of this culture. A complete analysis of quantitative relations between particular major categories is impeded by the fact that not all of the phases of this culture are represented on each of the examined sites. Especially poor are the inventories of the earliest phase precluding their full analysis. During this phase the processing of lithic materials seems to have been carried out within the two settlements (sites 12, 15 – Bieńczyce; site 62 – Mogiła). This is corroborated by the low proportion of cores which does not exceed 10%, the dominance of the flake group amounting to more than 50% of the whole inventory, and a relatively low proportion of blades and tools. A structure like this is typical of sites where the whole production process took place – starting from the core preparation until a tool had been manufactured. In comparison with the later phases of the Linear Band Pottery culture a slightly higher index of cores is observed on site 62. The quantitative distribution of flakes, blades and tools suggests that 8–20 cores were worked, while 14 specimens were found on the site. This phenomenon can be explained in the following way:

1. A group of settlers came to the site bringing with them a supply of raw material such as nodules or cores. This hypothesis has been confirmed by the analysis of the raw material structure of the lithic inventory.

2. Because the knappers were not particularly well-skilled in the processing of lithic materials, or the raw materials were of poor quality, cores were frequently discarded.

Remains of a Notenkopf settlement were identified on three sites: 62 (Mogiła), 12, 15 (Bieńczyce)

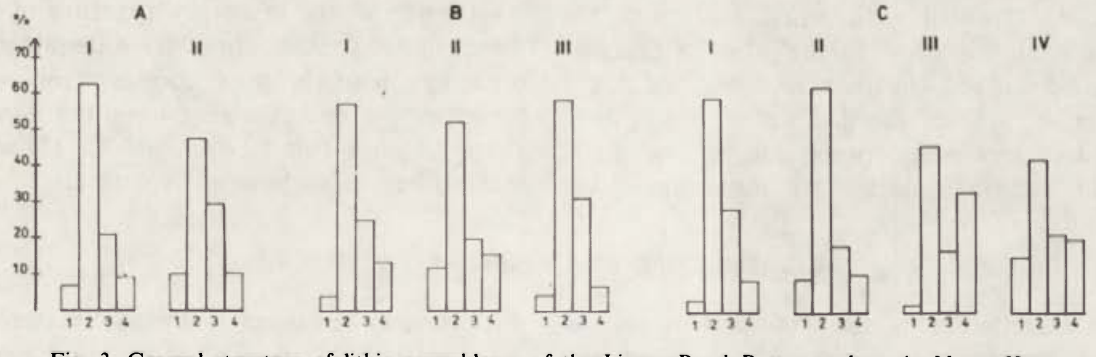

Fig. 3. General structure of lithic assemblages of the Linear Band Pottery culture in Nowa Huta

A – pre-Notenkopf phase, B – Notenkopf phase, C – Želiezovce phase; I – Mogiła, site 62, II – Bieńczyce, sites 12 and 15, III – Pleszów, sites 17–20, IV – Mogiła, sites 53 and 55: 1 – cores, 2 – flakes, 3 – blades, 4 – retouched tools

and 17–20 (Pleszów). This phase saw a certain growth of settlement, its population had a better knowledge of their environment and, consequently, a more thorough orientation as to raw materials deposits. However, the inventory structure remained relatively little modified. On site 62 the index of cores and flakes dropped, while that of blades and tools became higher pointing to improvement in the technical skill of a flint worker and a regular supply of better quality lithic raw materials. Similar conclusions have been arrived at on the evidence of analysis of lithic raw materials. The inventory structure on sites 12, 15 is similar to that from site 62: with a dominance of flakes and low proportion of cores, followed by blades and tools. It may reasonably be assumed, therefore, that the whole of the flint processing took place on the site.

The inventory structure of a comparatively numerous series of finds from the settlement on sites 17–20 is somewhat different. The blade index exceeds 30%, while tools are poorly represented. The index of blades and tools together is similar, however, to the data computed in this way for other sites. It, therefore, seems that blades on sites 17–20 were produced within the settlement, but fewer were processed into tools than on the remaining sites. Blades on this site contain some relatively elongated blades. It was this group that was not used to manufacture tools contributing to the increased index of blades on sites 17–20.

The most conspicuous modifications in the inventory structure of the settlements under discussion were recorded during the Želiezovce phase. Some settlements emerge (site 55 – Mogiła; sites 17–20 – Pleszów) where flint processing was limited, and tools were used manufactured either outside the living areas, or produced from cores brought to the settlement. There were other settlements, besides, where the whole operational sequence of flint processing was carried out (site 62 – Mogiła; sites 12, 15 – Bieńczyce). In this way we seem to have to do with two types of settlements: 1 – with the whole production process taking place within the settlement territory; from the working of nodules of raw materials to the manufacture of tools; 2 – specialized centres where processing of raw materials on the settlement itself is less important, flakes are less than 50% of the whole inventory, while the ratio of blades and tools is high. Changes like this may have been induced by the growth of settlement in a given microregion and the ensuing differentiation of functions of settlements within one economic unit. The evolution of the lithic industry, more intensive in the later chronological section of the Linear Band Pottery culture may have consituted another stiumulus for modifications. If this were the case then we would have to assume that these settlements were not contemporaneous but belonged to two separate chronological horizons: earlier when the process of separation of the production site from the settlement had not commenced, and a later horizon when such a separation was accomplished. Analysis of the inventory structure in isolation tends to reveal the dependency of the first type viz. the functional differentiation. The temporal factor is of importance here since functional differentiation advanced in time.

The new settlement set up on site 55 is distinct by the high ratio of tools in the inventory (20%) with almost the same proportion of blades confirming the manufacture of blades outside the settlement. At the same time a high ratio of cores has been found. The recorded number of cores should correspond to about 300 flakes, 120 blades and 60 implements. Since these groups are much less numerous, especially flakes which are four times less numerous, it may be inferred that part of the examined cores constituted reserves of raw material. However, the collected raw materials were not stored in one place as a depot. Secondly, the examined artefacts contain specimens made from flint from river gravels. On this evidence, we may reasonably assume that raw material was randomly gathered in the course of economic activities in the vicinity of the Vistula or the Dłubni rivers. Specimens whose suitability for further processing was tested by applying several blows were then brought to the settlement.

Analysis of the inventory structure of the settlements under consideration has ascertained that the organization of the production system on some of the sites did not change during the Linear Band Pottery culture (site 62 and sites 12, 15) whereas on some others it underwent evolution.

2. CORES, CORE PROCESSING AND DEBITAGE

When an attempt is made to determine the evolutional features of core processing within the framework of the defined horizons it should be stressed that the differences between these horizons are primarily restricted to the raw materials economy and the allocation of operational sequences to flint extraction sites or particular settlements, but there is little variation in the core processing itself.

A hypothesis may be put forward that during the Linear Band Pottery culture the coring technique on sites of this culture in the Nowa Huta region underwent little modifications both in respect of the dynamic aspect of core preparation and processing as well as core morphology.

The reconstruction of core processing in its dynamic aspect has ascertained that on all the sites the preparation was insignificant (limited to the evening of irregularities of surfaces of flint nodules and, as a rule, to the preparation of platforms), and the stage of pre-core prior to coring is rarely present. The core processing proper was restricted to the working of single-platform blade cores which in the final stage were transformed into blade-flake cores with changed orientation, further into flake cores of various types: single-platform, 90 degree, discoidal or polihedral-spherical. With the exception of the oldest horizon standardized microlithic blade cores occurred which were not then transformed into flake cores.

Turning to the detailed analysis of morphological features of cores considerable similarities can be seen in particular phases as shown in the table below:

	Phase		
	I	II	III
Blade cores:			
single-platform with the broad flaking face	14	10	7
subdiscoidal	1	2	3
single-platform with the narrow flaking face	–	7	3
carenoidal	–	–	1
microlithic	–	2	4
Blade-flake cores with changed orientation (residual)	2	4	2
Flake cores:			
single-platform	–	4	5
changed orientation	–	4	1
with converging flaking faces	–	–	1
discoidal and subdiscoidal	–	1	3
polihedral-spherical	–	1	6

The numerical distribution of cores presented in the table does not permit to estimate the frequency of consecutive morphological core variants for each site, but it does point to the basic convergence in the occurrence of these variants, notably in the Notenkopf and the Želiezovce phases. Little variety in blade cores in phase I may be caused by the small size of the sample. Lack of flake cores in this phase, on the other hand, may be the consequence of economical use of raw materials or the demand for exclusively blade blanks with standardized measurable attributes. In the later phases flake blanks obtained in the final stage of core processing, are used both as unretouched tools as well as blanks for retouched tools.

Let us now proceed to discuss operational sequences on particular sites. The locational continuity of sequences can be estimated on the basis of cores and debitage. From the point of view of stages of processing the frequency of cores on particular sites is as follows:

Phase	Site	Unworked nodules	Pre-cores	Blades			Flake
				initial	fully processed	flake, residual	
I	62	–	–	–	12	2	–
	12, 15	–	–	–	3	–	–
II	62	–	–	5	7	3	3
	17–20	4	–	–	15	2	5
	12, 15	5	1	–	–	–	2
III	55	3	–	4	7	–	1
	62	–	1	4	8	–	1
	17–20	–	–	–	1	–	–
	12, 15	7	1	1	4	3	14

The above table shows that during phase I cores in the stage of full blade processing occur primarily. It can be assumed that a certain number of cores was brought to the site already initially prepared, which were used until the blade stage was accomplished and then discarded. In phase II two types of core structure are found:

1. With initial processing, full blade processing and the final stage (site 62 – Mogiła).

2. Without initial stage, only with the stage of full and final processing (sites 17–20 – Pleszów). It is of interest that simultaneously unworked nodules occur which were brought to the site but were not subjected to processing.

In phase III two types of core structure are observed:

1. With all the stages of processing well-represented, particularly the final flake processing (sites 12, 15 – Bieńczyce).

2. With the initial stage of processing and full blade processing, but with a small proportion of residual cores (sites 55 and 62 – Mogiła).

To draw conclusions from the changes in core structure calls for analysis of the frequency of particular groups of debitage, particularly the debitage from the earliest and initial stage (cortical and partially cortical flakes), and from the final stage to this stage belong flakes with perpendicular scars, especially in the case of the discussed material with only occasional flakes from initial preparation of flaking faces. The structure of debitage groups in respect of their placement in the core processing is as follows:

Phase	Site	Cortical flakes	Partially cortical	Unidirectional without cortex	Opposite without cortex	Perpendicular
I	altogether	8.0	30.8	33.8	7.3	11.6
II	62	12.4	20.3	45.4	5.4	15.1
	17–20	5.9	26.1	41.5	3.3	16.9
III	55	13.0	18.8	36.2	4.3	13.0
	62	10.0	14.0	34.1	4.0	12.2
	17–20	12.9	16.1	51.6	–	6.4
	12, 15	6.1	23.8	28.0	1.9	31.5

A general tendency can be observed for a smaller proportion of flakes from the initial stage (cortical and partially cortical), which is expressed in the following seriation: Phase I: 38.8%; Phase II: site 62 – 32.7%, sites 17–20 – 32.0%; Phase III: site 55 – 31.8%, sites 12, 15 – 29.9%, sites 17–20 – 29.0%, site 62 – 24.0%. Such a seriation seems to reflect the diminished proportion of initial preparation as the Linear Band Pottery culture developed and initial stages of operational sequences were transferred to workshops situated near lithic deposits.

The seriation of debitage from the initial stage of processing is reflected by the changes in the proportion of flakes with cortical or unprepared platforms on each site. Their ratio is distinctly higher on sites of phase I and II, dropping in phase III, similarly as the ratio of cortical or partially cortical flakes (%):

Phase	Site	Unprepared platforms	Single-blow platforms
I	altogether	27.4	23.5
II	62	28.0	23.9
	17–20	18.4	23.0
III	17–20	19.3	22.6
	12, 15	12.7	31.5
	62	12.4	16.4
	55	8.6	24.6

At the same time variability of proportions of all platform types reveals modifications of structure discriminating between operational sequences on particular sites within horizons.

On the other hand, considerable oscillations can be observed on particular sites in the ratio of cortical to partially cortical flakes, corresponding – to some-extent – to the core structure. The oscillations may reflect the functional specialization of particular sites, representing stages of operational sequences. In this way during the Notenkopf phase the facies with cores in the initial stage of processing (site 62 – Mogiła) is characterized by a high occurrence of cortical flakes (12.4%), whereas in the facies without initial cores (sites 17–20 – Pleszów), the percentage of cortical flakes is smaller by half (5.9%). Simultaneously both facies with initial cores show a fairly high occurrence of flakes with perpendicular scars (site 62 – 15.1 and sites 17–20 – 16.9%).

During the Želiezovce phase the facies abounding in cores from all stages of processing (sites 12, 15 – Bieńczyce) contains a smaller percentage of cortical flakes (6.1%) but has a very high ratio of flakes with perpendicular scars (31.5%) corresponding to the exceptionally high proportion of flake cores. The second facies with initial cores and cores in the stage of complete processing, but without the final stage (sites 55 and 62 – Mogiła) has a higher ratio of cortical flakes (10.0 and 13.0%) and lower of flakes with perpendicular scars (12.2 and 13.0%).

3. BLADE BLANKS

A series of a total of 625 blades has been obtained: phase I – 51 examples, phase II – 332, phase III – 242. The numerical distribution in the phases on each site is highly irregular:

Sites	Phase I	Phase II	Phase III
62 (Mogiła)	40	144	118
12, 15 (Bieńczyce)	11	10	76
17–20 (Pleszów)	–	178	13
55 (Mogiła)	–	–	35
Total	51	332	242

In all the phases parts of blades were preserved in various proportions which resulted from their intentional breaking to use only certain parts for processing into tools. The dominance of proximal fragments over other blade parts ascertains that this operation consisted in breaking off the recurved distal part. Materials from the Notenkopf phase are a good example, where the length of proximal fragments is up to 46–49 mm. The Želiezovce series from site 62 (Mogiła) departs from the standard model. On this site blades were in all likelihood broken into three sections which is evidenced by the

ascendancy of middle sections of blades over others. We have to do here with the modification of the method of retrimming of blades: in phase I and II by breaking off distal parts, in phase III both distal and proximal in order to obtain blades with a straight edge.

The measurable attributes of blades are fairly uniform in particular phases and do not show drastic changes. The dimensions of blades (in mm) are presented below:

	Phase		
	I	II	III
Length	38–62	20–90	20–80
Width	12–25	10–36	10–40
Thickness	?	2–16	2–9

In phase II and III the most numerous are blades with the length of 30–60 mm, width 10–25 mm and thickness 2–7 mm. The averages ($\bar{x}$) for each attribute are also similar in all the phases:

	Phase		
	I	II	III
Length in mm	45.9	43.0–44.3	40.7–49.5
Width „	16.0	16.3–16.5	16.0–19.1

It is difficult on the basis of these data to draw definite conclusions as to the tendency of measurable attributes of blades to increase. Certainly, this tendency is observable in the Želiezovce phase, though, on the other hand, the average length of blades in the pre-Notenkopf phase is higher than in the Notenkopf phase, and higher than the average from some of the Želiezovce sites.

Scar-pattern on dorsal parts of blades has been obtained for phases I and II. The percentages are as follows:

Blades	Phase		
	pre-Notenkopf	Notenkopf	Želiezovce
Cortical	2.5	2.3	1.9
Partially cortical	10.0	24.1	14.3
with unidirectional scars	77.5	68.2	79.8
with opposite scars	2.5	2.3	3.9
with perpendicular scars	7.5	3.2	–

When the above data are compared it is noticeable that during the Notenkopf phase the ratio of blades from the advanced stage of core processing drops, while that of partially cortical examples goes up, notably those with cortex preserved on the sides which is connected with the broadening of the flaking face by removing cortex from core sides.

The frequency of types of blade platforms in percentages is as follows:

Platforms	Phase		
	pre-Notenkopf	Notenkopf	Želiezovce
Unprepared	13.6	8.2	12.8
Single-blow	4.5	20.2	17.1
Prepared	72.7	54.7	51.2
Diédre	–	–	–
Cortical	–	3.9	4.2
Punctiform	9.0	12.9	14.7

Prepared platforms are in ascendancy. There are no significant differences between sites within each phase. Comparison of the frequency of prepared and single-blow platforms is noteworthy. In the Notenkopf phase the ratio of prepared platforms is slightly lower in comparison to the previous phase, while the ratio of single-blow platforms grows indicating that rejuvenation of core platforms was often performed.

4. RETOUCHED TOOLS

Lithic materials of the Linear Band Pottery culture contained altogether 280 retouched implements whose numerical distribution in particular phases is very irregular. Even less uniform is the distribution on sites within particular phases viz.:

Sites	Phase		
	I	II	III
62 (Mogiła)	18	75	36
12, 15 (Bieńczyce)	3	5	43
17–20 (Pleszów)	–	40	26
55 (Mogiła)	–	–	34
Total	21	120	139

The typological-statistical structure of tools in consecutive phases is as follows:

Tools	Phase					
	pre-Notenkopf		Notenkopf		Želiezovce	
	N	%	N	%	N	%
End-scrapers	12	57.1	63	52.5	57	40.1
Burins	2	9.5	6	5.0	10	7.2
Truncations	5	23.8	23	19.2	12	8.6
Backed pieces	–	–	–	–	1	0.7
Retouched blades	–	–	13	10.8	16	11.5
Retouched flakes and side-scrapers	2	9.5	11	9.2	25	18.0
Combined tools	–	–	–	–	2	1.4

Tools	Phase					
	pre-Notenkopf		Notenkopf		Żeliezovce	
	N	%	N	%	N	%
Perforators and atypical perforators	–	–	4	3.3	9	6.5
Pic-like tools	–	–	–	–	3	2.1
Denticulated blades with gloss	–	–	–	–	4	2.9
Total	21	99.9	120	100.0	139	99.0

The table shows that with the evolution of the Linear Band Pottery culture the frequency of end-scrapers and truncations had a declining tendency. Burins do not exhibit seriation. Their ratio drops in the Notenkopf phase, increasing slightly in the Żeliezovce phase. The group of retouched flakes and eliezovce phase. The group of retouched flakes and side-scrapers shows a uniform frequency in phases I and II, in phase III their ratio is almost twice as high. Retouched blades are missing in phase I, their ratio is slightly higher in phase III than in phase II. In the Żeliezovce phase the tool kit is enriched by pic-like tools and denticulated blades with high-gloss. Combined tools are present. Our observations have been somewhat invalidated by the fact that when the frequency of tools is broken down to particular sites oscillations within each phase become apparent.

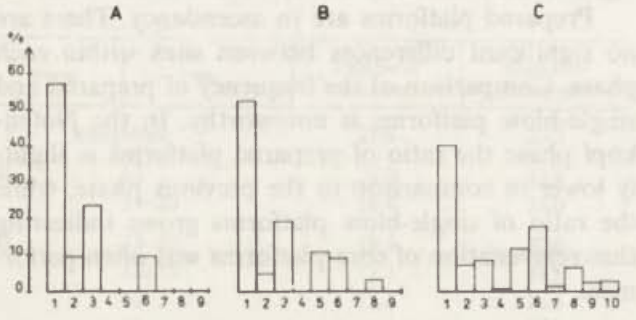

Fig. 4. Major tool categories in the Linear Band Pottery culture sites from Nowa Huta region

A – pre-Notenkopf phase, B – Notenkopf phase, C – Żeliezovce phase; *1* – end-scrapers, *2* – burins, *3* – retouched truncations, *4* – backed pieces, *5* – retouched blades, *6* – retouched flakes and side-scrapers, *7* – combined tools, *8* – perforators, *9* – pic-like tools, *10* – denticulated blades

Blade end-scrapers dominate in all the phases over flake examples. They are short and robust with unretouched sides. Located as a rule in the distal part of blades the fronts are slightly rounded, besides a small number of oblique, straight and undulating fronts is present, in the Żeliezovce phase also nosed end-scrapers.

Combined tools are found only in the Żeliezovce phase. Burins are not numerous, majority are single

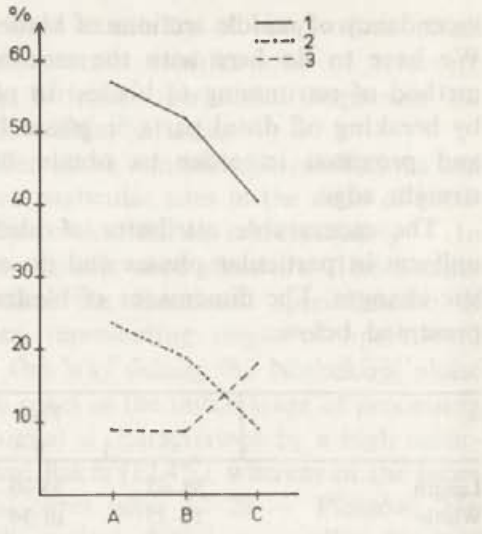

Fig 5. Frequency of some selected major tool categories from different phases of Linear Band Pottery culture

A – pre-Notenkopf phase, B – Notenkopf phase, C – Żeliezovce phase; *1* – end-scrapers, *2* – retouched trunctions, *3* – retouched flakes and side-scrapers

burins and burins on a snap, i.e. specimens whose surfaces had not been intentionally prepared for burin blows and which may have been produced accidentally.

Truncations group is morphologically uniform in consecutive phases, more elongated than end-scrapers. They are usually oblique, straight, sometimes atypical arched examples. Exceptionally interesting is the occurrence in all the phases of trapezoidal double truncations, the form which in accordance with the hitherto existing conceptions, was typical of the inventories of the Lengyel-Polgar complex. It seems, that within the context of the examined materials the double trapezoidal truncations may be acknowledged to be – if not typical – at least present from the earliest phases of the Linear Band Pottery culture. This is born out by the occurrence of this tool on sites of the Linear Band Pottery culture in region of Lublin (Zakościelna 1981).

Retouched blades are missing from the oldest phase. In the Notenkopf and Żeliezovce phases they occur as a third group amounting to 10.8% and 11.5% of the total of implements. Within each phase inventories on particular sites display different ratio of retouched blades (similarly truncations). In the Notenkopf phase these implements make up from 2.7% on site 62 (Mogiła) up to 25% on sites 17–20 (Pleszów), in the Żeliezovce phase from 5.8% on site 55 (Mogiła) to 26.9% (on sites 17–20). Majority of specimens have fine direct retouch on the edge, alternate or bilateral.

Retouched flakes and side-scrapes are uniformly distributed in the earliest and the Notenkopf phases

making up 9.5% and 9.2% of the total. In the Želiezovce phase their occurrence is high amounting to 18.0% of all tools, which makes them the second group after end-scrapers. These implements have fine retouch of the edge, semi-steep inverse or direct, sometimes with notches.

All the phases contain side-scrapers: lateral, transversal, or lateral-transversal.

Perforators and atypical perforators are represented only in the material from the Notenkopf phase – 2.5%, and the Želiezovce phase – 6.5%. Their frequency on particular sites varies. In the Notenkopf phase on site 62 and 17–20 it is 2.6% and 5%. In the Želiezovce phase there are none on sites 17–20; on site 55 and 12, 15 (Bieńczyce) their index is 4.6 and 5.8%, on site 62 as high as 13.8%. Both elongated blade perforators as well as flake ones are present. Their points are weakly distinguished.

Pic-like tools are noteworthy in the inventory of the Želiezovce phase. They are represented on site 55 (2 specimens), and 12, 15 (1 example). All are made on chunks and have triangular cross-section. Two tools are retouched on two sides, one example on three sides.

Use-wear analysis has not been carried out for the material under discussion. Macroscopically a characteristic gloss is observable on the tip of most truncations and on some unretouched blades, on the latter especially in the Želiezovce phase. This indicates that part of the blades were used as unretouched tools for reaping.

VI. SYNCHRONOUS AND DIACHRONOUS RELATIONS BETWEEN SETTLEMENTS OF THE LINEAR BAND POTTERY CULTURE IN THE LIGHT OF LITHIC INDUSTRIES

The most general conclusion drawn from the foregoing analysis of lithic industries of the Linear Band Pottery culture is that no major differences exist between particular culture phases which had been distinguished on the basis of the seriation of ceramic types. Technological features, style of debitage, and frequency of groups of retouched tools did not essentially change throughout phases confirming the findings so far reported in literature (Kozłowski 1970; Kaczanowska 1971; Kaczanowska, Lech 1977; Lech 1979; 1982; Balcer 1983).

With the exception of the series obtained at Mohelnice – Czechoslovakia (where perforators are found, high frequency of blades and retouched flakes was recorded), materials from the sites of the earliest phase in the Nowa Huta region are the oldest known inventories of the Linear Band Pottery culture. Indices of occurrence of tool groups in the materials from phase I (pre-Notenkopf) are loaded with a large standard error resulting from the small size of the series and are not statistically significant.

The inventory structure of phase I suggests that the people of the Linear Band Pottery culture who set up first settlements in this microregion brought with them from north-west and west, a supply of partially worked nodules of raw materials and, subsequently carried out the whole processing sequence (coring, production of blanks, tool manufacture) within the settlement. The small size of the sample from sites 12, 15 (Bieńczyce) precludes a comparison of the two early settlements.

Looking into the inventory structure in all the cultural phases a tendency is apparent for progressing specialization which dissociated sites dealing with initial processing and sites where blades were manufactured and processed into tools. This tendency is reflected in the diminishing ratio of initial cores and debitage (flakes and blades) from the early stage of processing. Parallel to this overall trend marked dissimilarities between sites are observed in the Notenkopf and the Želiezovce phase.

During the Notenkopf phase the role of initial processing is smaller on sites 17–20 (Pleszów), while on site 62 (Mogiła) almost the complete sequence of processing is well-represented. Other divergencies concern the ratio of blades – distinctly higher on sites 17–20, next the lower ratio of retouched tools on site 62. It is likely that this modest number of retouched tools on site 62 was compensated by slender blades used as unretouched tools. It should be mentioned that elongated blades functioning as retouched implements were found as well on site 48 (Mogiła) affiliated with the Malice group (Kaczanowska, Kozłowski 1971).

The indices of both blades and tools together for site 62 and sites 17–20 are nearly identical, therefore, the same quantity of nodules must have been used to obtain equal quantities of end-product i.e. blades and retouched tools – if we decide to regard them as a final outcome. They were, however, used in different ways. Dissimilarities between the two sites are further apparent in the frequency of tool groups. On site 62 the index of end-scrapers is high,

low of truncations, while side-scrapers, retouched flakes and burins occur with higher frequency, finally the index of retouched blades is low; on sites 17–20 the index of end-scrapers is low, truncations and retouched blades show high occurrence, no side-scrapers are found.

The following interpretations of differences between the two sites are plausible:

1. The link between the two sites was that of a base – site 62 (Mogiła) – and a filial settlement – sites 17–20 (Pleszów).

2. The dissimilarities reflect functional differentiation of the two settlements inhabited by the same population.

3. They are due to genetic-cultural differences between the local population (from the previous phase) inhabiting site 62 and the new settlers who at that time founded the settlement on site 17–20.

The first hypothesis is invalidated by the evidence of the balance of cores, debitage and blanks on site 62 demonstrating that a surplus of blades could not have been produced which would tally with the number of specimens from sites 17–20. Moreover, the structure of raw materials worked on site 62 is somewhat different than on sites 17–20 where the raw material type C is more frequent.

The second hypothesis is supported by the aforesaid differences in the occurrence of typological groups assuming that the compatibility between functions and morphological tools groups has been established. Additional argument in favour of functional differentiation is the surplus of unretouched blades in comparison to the number of tools on sites 17–20. Its inhabitants must have pursued activities which required tools such as simple blades functioning most likely as cutting tools (knives?). This is corroborated, besides, by the higher than on other sites ratio of retouched tools of the sort that can be used on similar tasks (truncations-retouched blades – 57.5%). Verification of the hypothesis about functional origin of divergence between inventories from sites 17–20 and 62 would call for use-wear examination of retouched and unretouched tools. Moreover, certain discrepancies in the proportions of raw materials present conflicting evidence; nor does the hypothesis account for the absence of the initial stage of raw materials processing on sites 17–20.

The third hypothesis explicates adequately discrepancies in raw materials structure and in the frequency of major tool classes resting, however, on the assumption that the differences are treated as a reflection of various technological traditions but are not identified with specific functions. To explain absence of the initial stage of processing on sites 17–20 it must be assumed that the group settling the site had a different system of raw material supply and its technical skill was more specialized.

In the light of the data presented above the last hypothesis seems to be most feasible viz. the differences between settlements on site 62 and 17–20 are of genetic nature. The population on the first settlement was derived from groups occupying this settlement in the early phase of the Linear Band Pottery culture, whereas the population on site 17–20 migrated to this region only in the Notenkopf phase.

In the Želiezovce phase the settlements expand to four. Their systems of raw materials supply and economy are unlike, also different are the percentages of retouched tools. On sites 17–20 (Pleszów) and 62 (Mogiła) these aspects of inventories resemble traits of the Notenkopf phase on the same settlement, and are probably the continuation of local traditions. Different characteristics of the inventory on site 55 (Mogiła) may have arisen from the fact that the site was settled by a new population group. The inventory on sites 12, 15 (Bieńczyce) from the Želiezovce phase does not lend itself to interpretation since the lithic materials from the Notenkopf phase on this site are poorly represented. The genetic explanation of dissimilarities between inventories of the Želiezovce phase is supported by the variability of indices of major tool classes in this phase, which goes beyond the framework of functional variability and seems to have derived from the polyphyletic genetic relations between assemblages. Of importance are the discrepancies in the indices of end-scrapers (low – up to 30%, medium – 30–40%, and high – more than 50%), and their covariance with the frequency of truncations, perforators and retouched flakes. Regretfully, the series of retouched tools were small and the solutions offered in this place are only the working hypotheses which have to be tested by means of examination of the horizontal distribution of artefacts on well-documented settlements, with well preserved habitation structures. A possibility cannot be excluded that the diverse indices of frequency of tool groups reflect allocation of a variety of artefacts to various parts of a given settlement or habitation structures. If such were the case then it is not the sum total of artefacts on a site that should be compared, but artefacts from particular features or their sections. Experience so far of better preserved habitation structures of the Linear Band Pottery culture has confirmed homogeneous horizontal distribution of retouched implements. Discrepancies concern prima-

rily the general technological structure of assemblages (relations of debitage, blanks and implements).

In the Želiezovce phase the raw materials structure too displays differences: more uniform on site 55 and 62 (Mogiła), it is diverse on sites 17–20 (Pleszów). On the two latter sites alongside flint variety A, flint B, C, D, E and G occur which are not all found on sites 12, 15 (Bieńczyce) and 62.

To sum up, the distinctive feature of the Želiezovce phase is the progressing specialization of the process of production of lithic artefacts. This might be reflected either in the emergence of workshops in the vicinity of deposits of Jurassic raw materials, or in the presence of workshops peripheral to settlements basing on the raw materials supplied from the deposits. The presence of workshops like this in the territory of the Kraków Częstochowa Jurassic Plateau already in the Linear Band Pottery culture was suggested by J. Lech (1981). But it is quite likely that near some settlements, notably site 62, specialized workshops of this type may have operated. This question requires further detailed study impeded by the fact that flint finds from the culture layer, especially debitage, are difficult to date or ascribe to a major settlement phase. For example, near the Hospital on site 1 (Mogiła), outside the area taken up by Neolithic settlement features, remains were found of flint processing such as debitage and four flint depots (Kozłowski 1961; Kaczanowska 1981), but which unfortunately cannot be precisely dated. Although initially J. K. Kozłowski suggested that the depots might be ascribed to the Linear Band Pottery culture, we are inclined now to believe them later, possibly middle-eneolithic. In such a situation we cannot as yet identify the zones of flint processing which would correspond to the Želiezovce phase on site 55 (Mogiła).

The analysis presented in this paper has led us to conclude that essential similarities of all aspects of lithic industry persist in a given settlement throughout all the phases of its occupation. On the other hand, each new settlement was, in all likelihood, set up by a new population group coming from outside. These settlements show the biggest differences in comparison with the remaining settlements. The patterns we have recorded may be specific for the Nowa Huta microregion only. It should be born in mind, besides, that the final confirmation of our hypothesis requires to employ use-wear analysis and knowledge of detailed horizontal distribution of lithic artefacts within each site.

Translated by Krystyna Bławat

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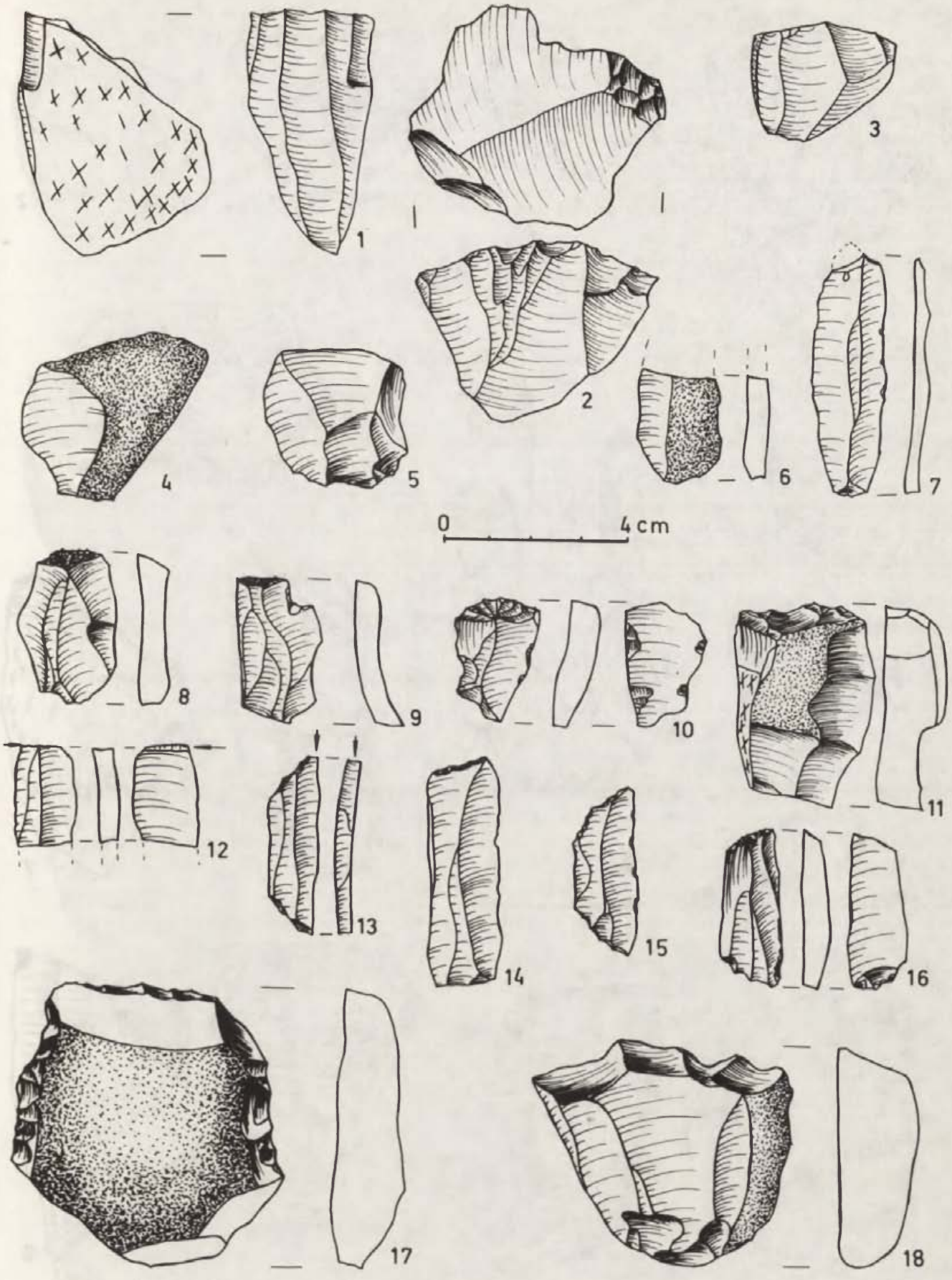
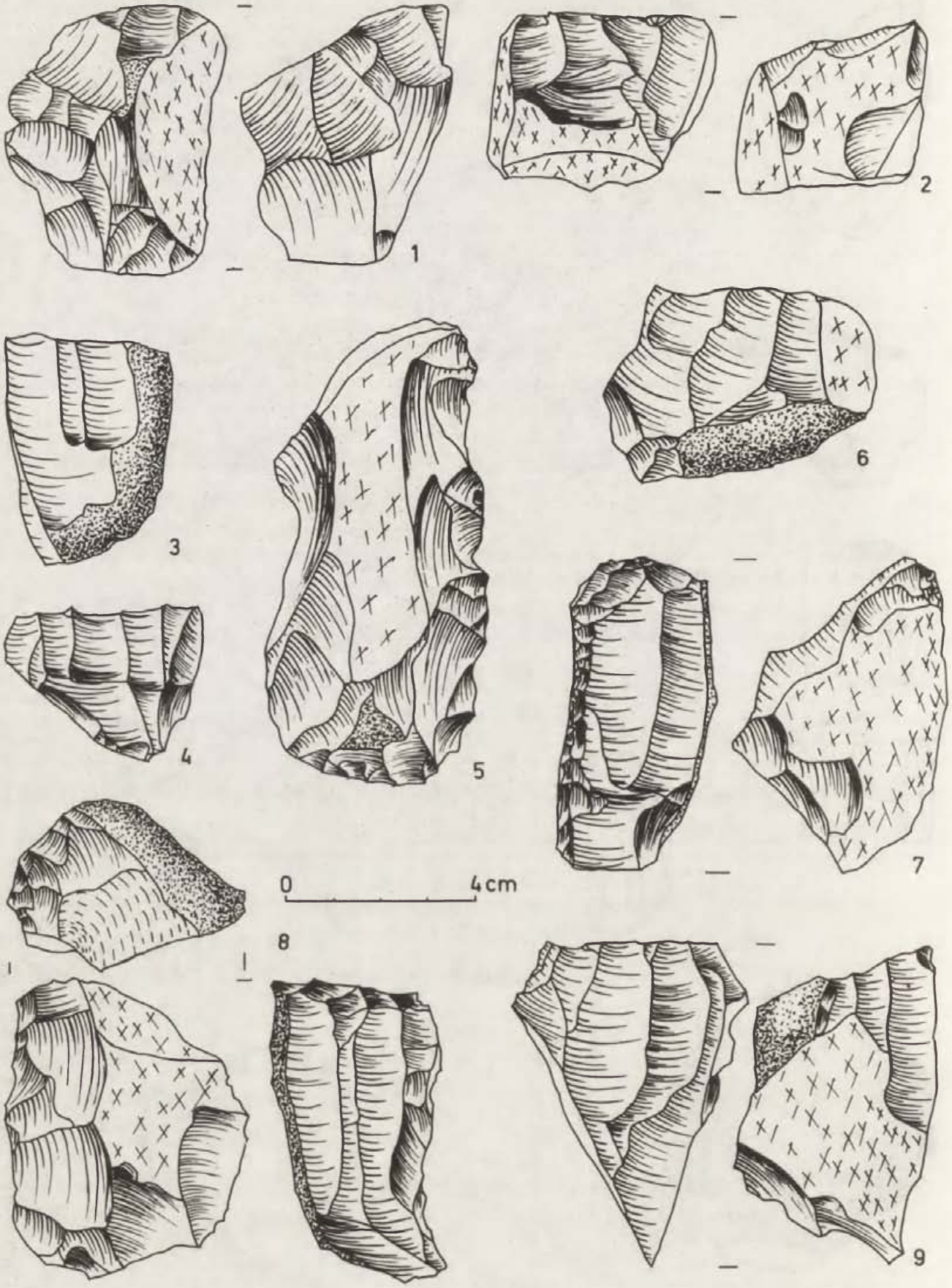


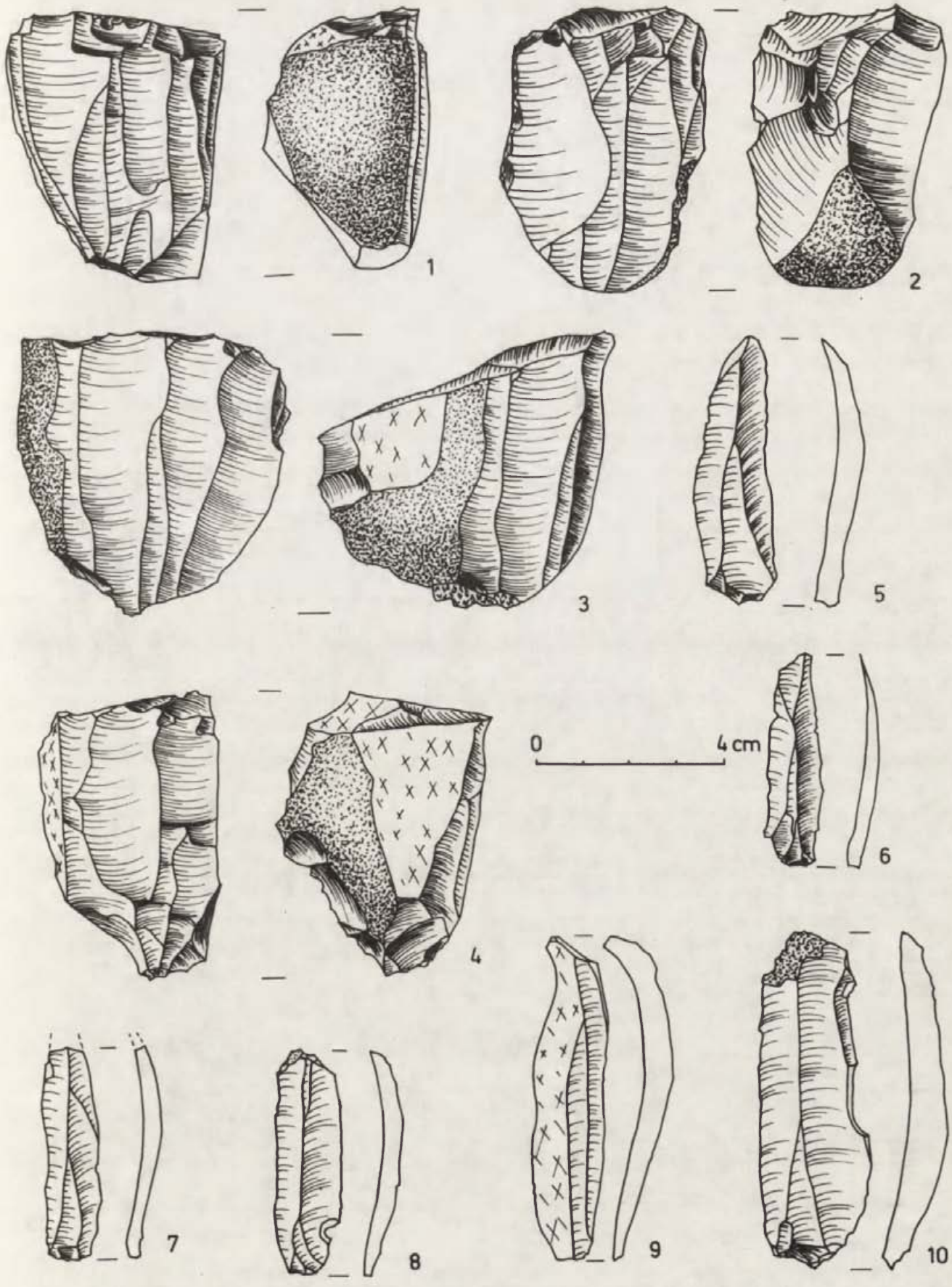
Pl. I. Oldest (Ib) phase of the Linear Band Pottery culture. Mogiła, site 62

1–5 – cores, *6, 7* – blades, *8–11* – end-scrapers, *12, 13* – burins, *15, 16* – retouched truncations, *17, 18* – side-scrapers



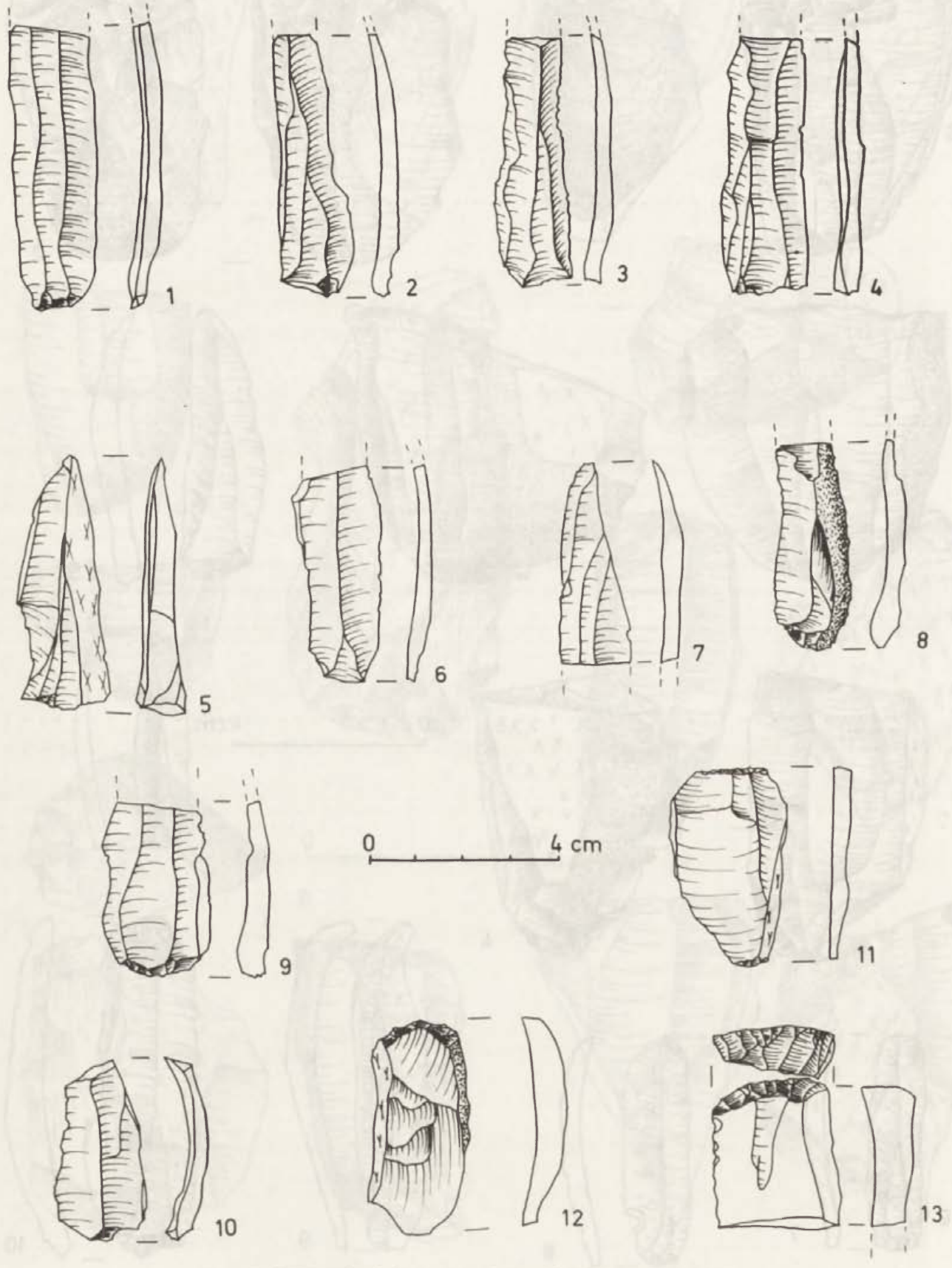
Pl. II. Notenkopf phase of the Linear Band Pottery culture

1, *5* – pre-cores, *2–4*, *6–9* – cores (*1–6* – Mogiła, site 62; *7–9* – Pleszów)



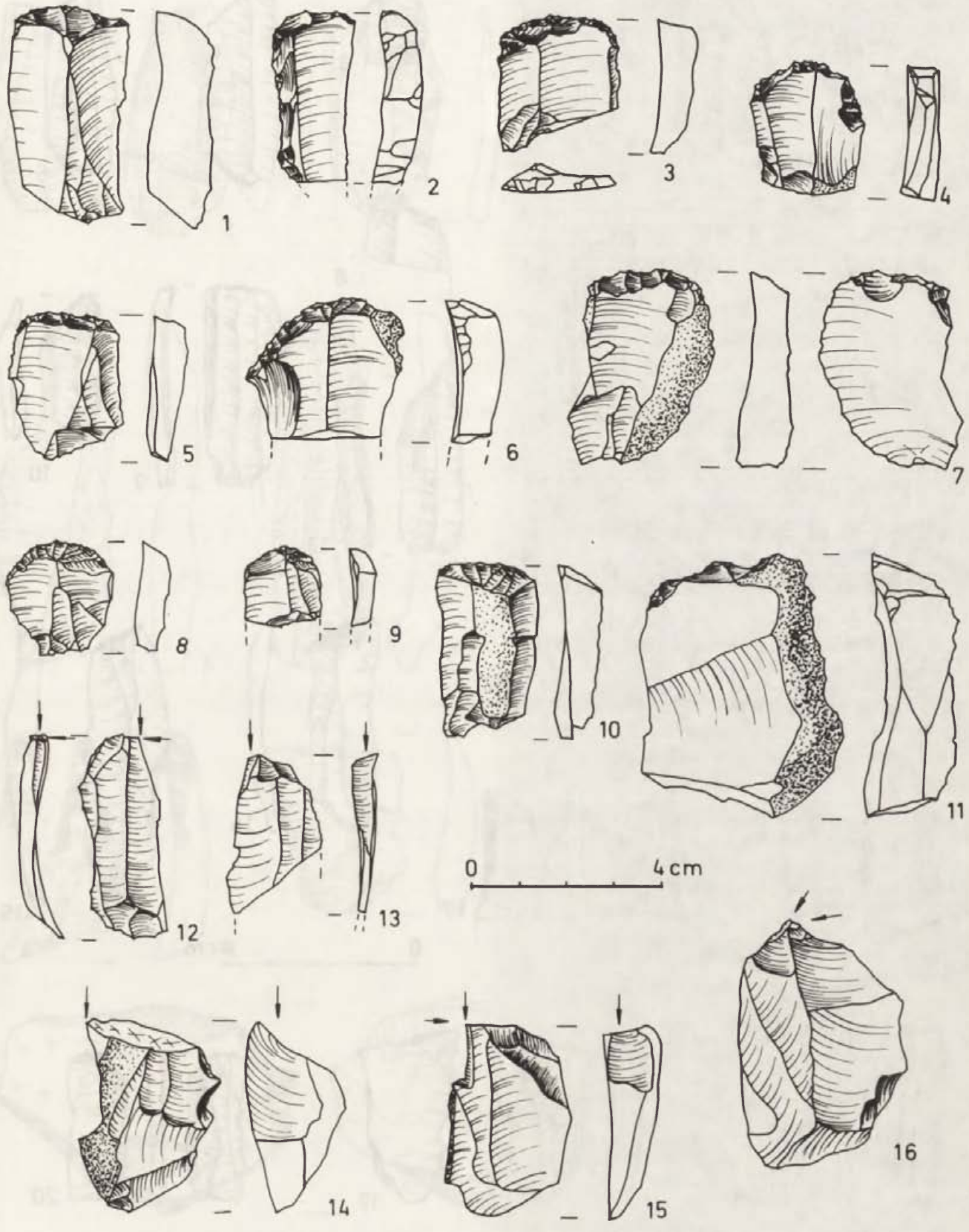
Pl. III. Notenkopf phase of the Linear Band Pottery culture. Pleszów

1–4 – cores, *5–10* – blades



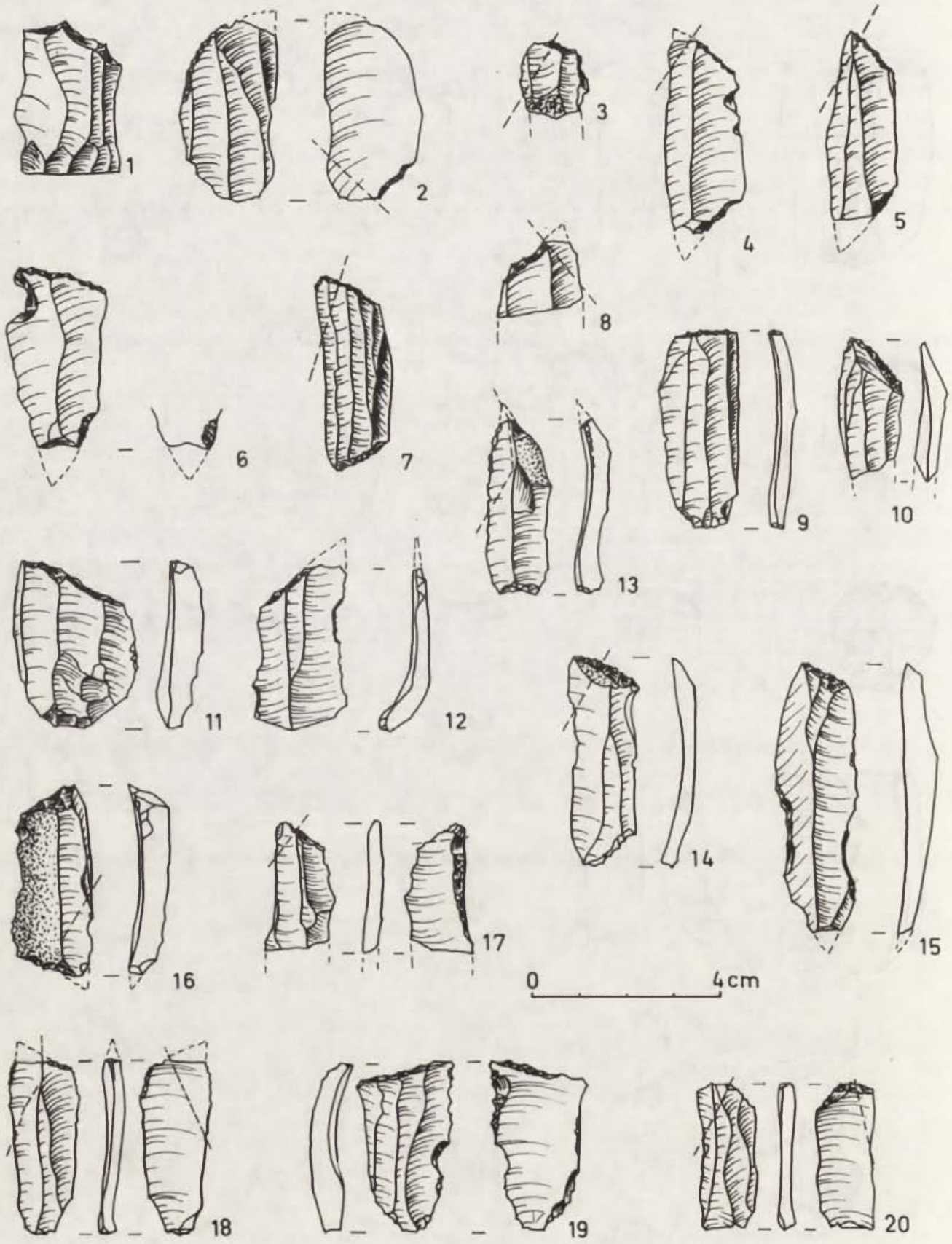
Pl. IV. Notenkopf phase of the Linear Band Pottery culture

1-10 – blades, *11-13* – end-scrapers (*1-10* – Plesków; *11-13* – Mogiła, site 62)



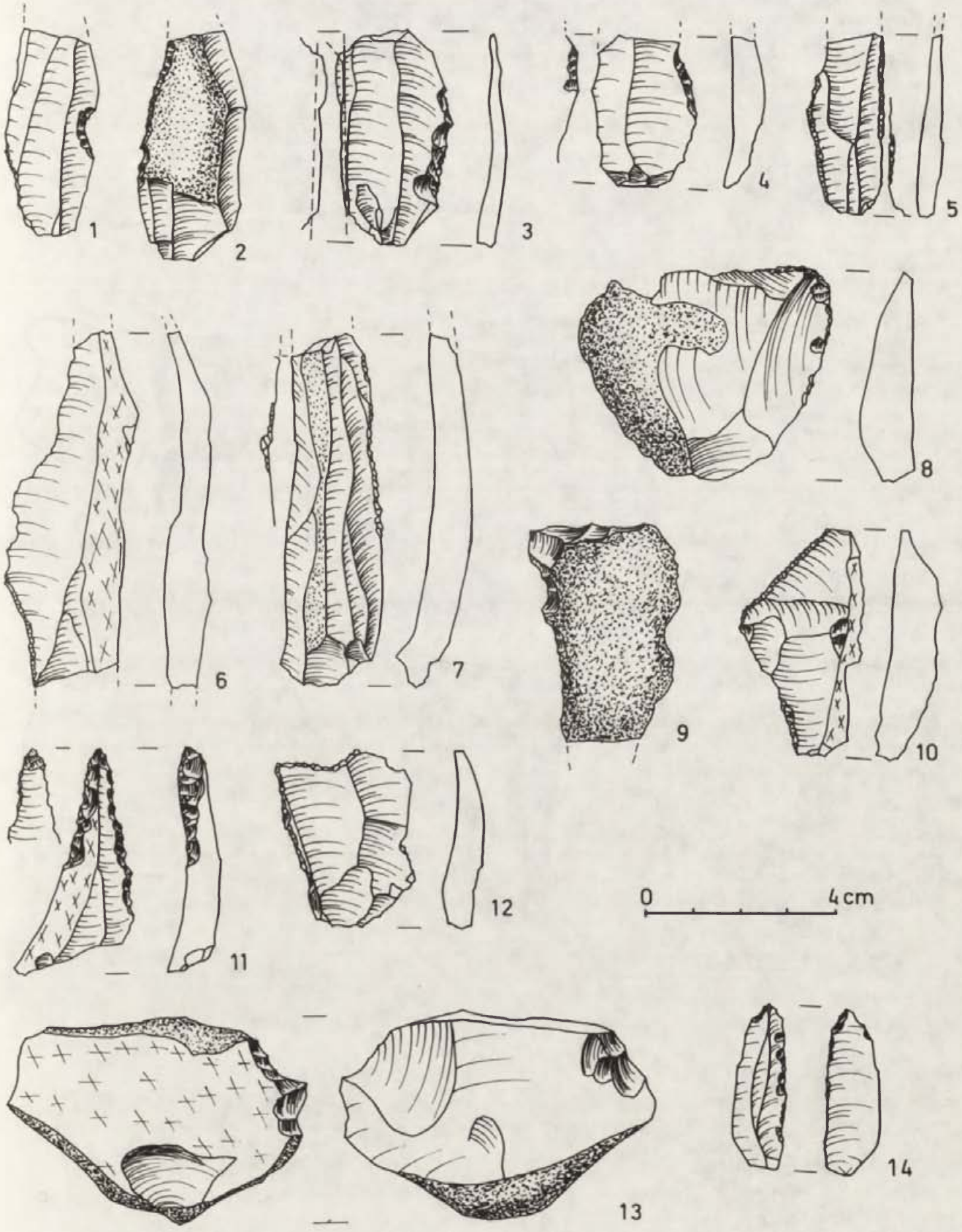
Pl. V. Notenkopf phase of the Linear Band Pottery culture

1–11 – end-scrapers, *12–16* – burins (*1–13* – Pleszów; *14–16* – Mogiła, site 62)



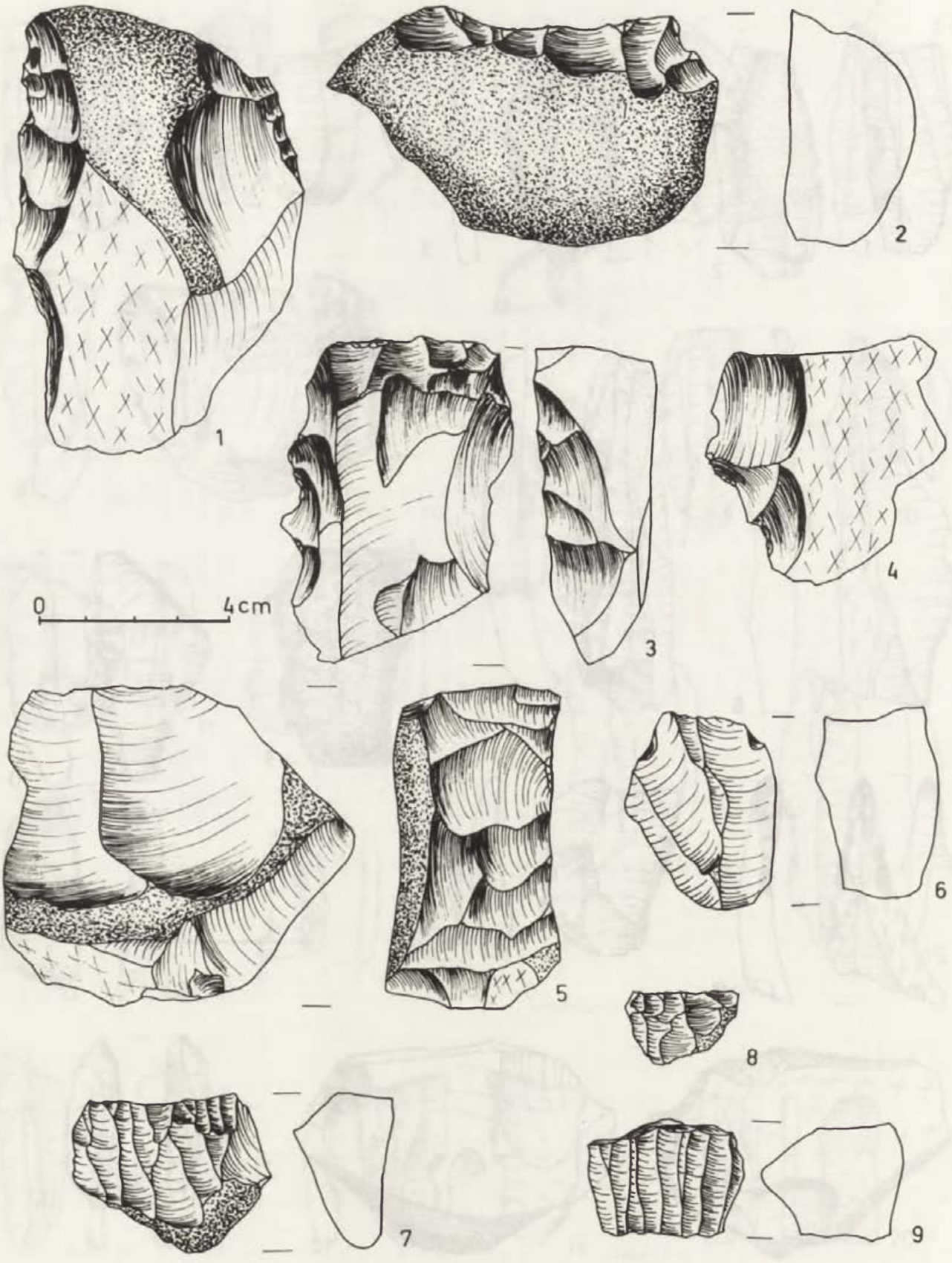
Pl. VI. Notenkopf phase of the Linear Band Pottery culture. Retouched truncations

1–8 – Mogiła, site 62, 9–20 – Pleszów

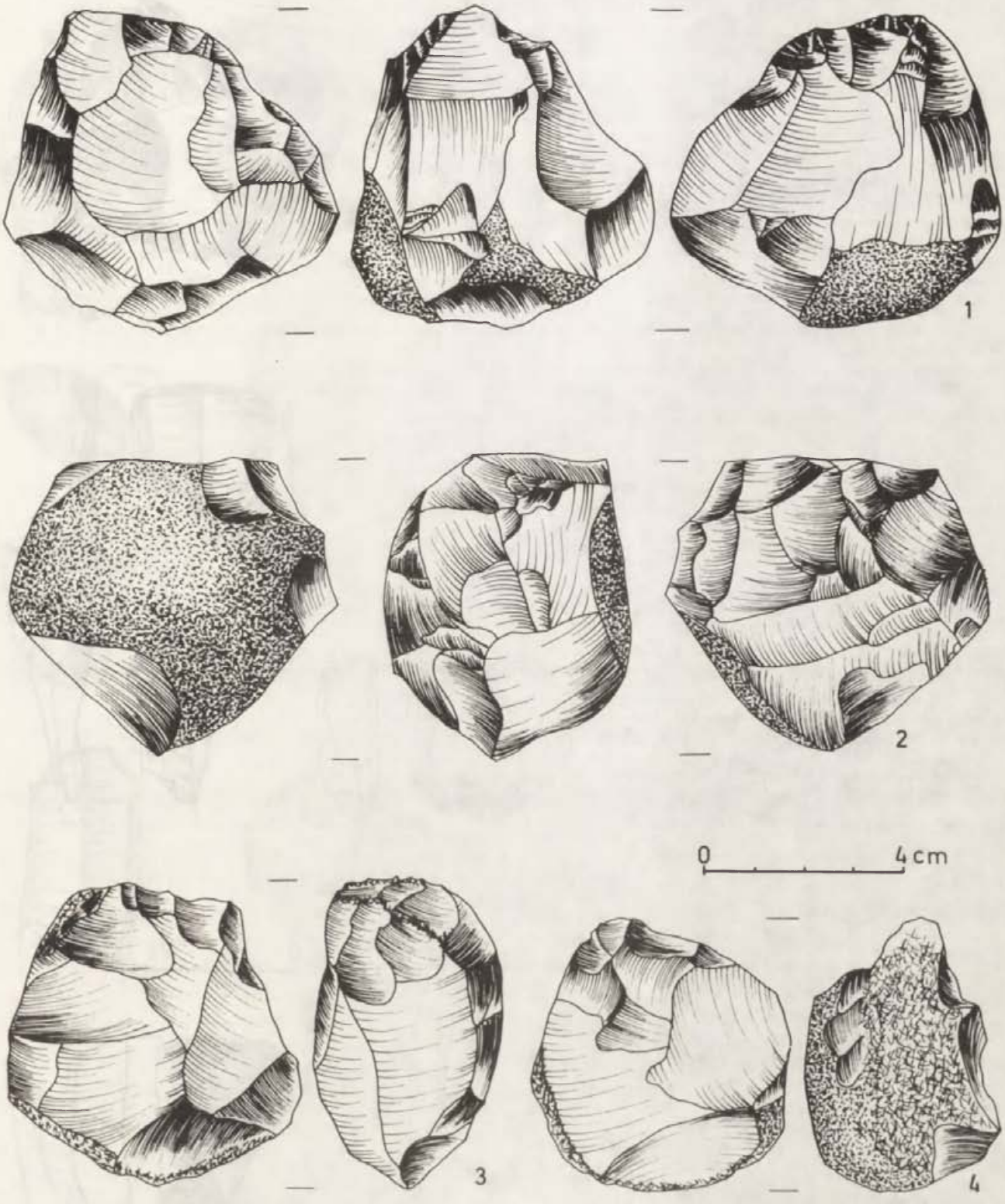


Pl. VII. Notenkopf phase of the Linear Band Pottery culture

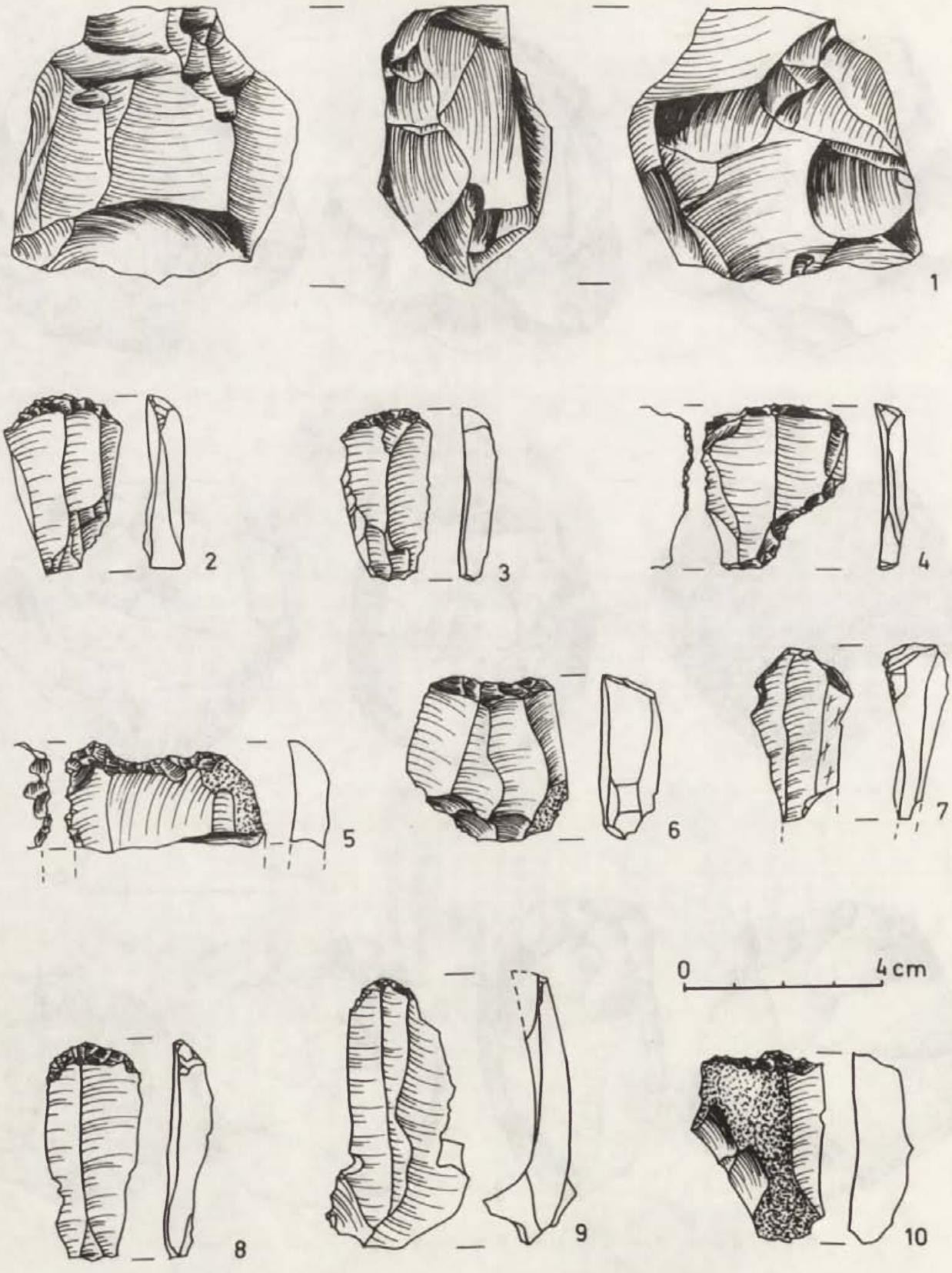
1–7 – retouched blades, *8–10* – retouched flakes, *11*, *12* – perforators, *13*, *14* – alterned perforators (*3–7*, *10–12* – Pleszów; remaining – Mogiła, site 62)



Pl. VIII. Notenkopf phase of the Linear Band Pottery culture (*1–4*) and Želiezovce phase (5–9). Mogiła
4 – side-scrapers, 5 [illegible] – cores (5 – site 62, [illegible] – site 55)

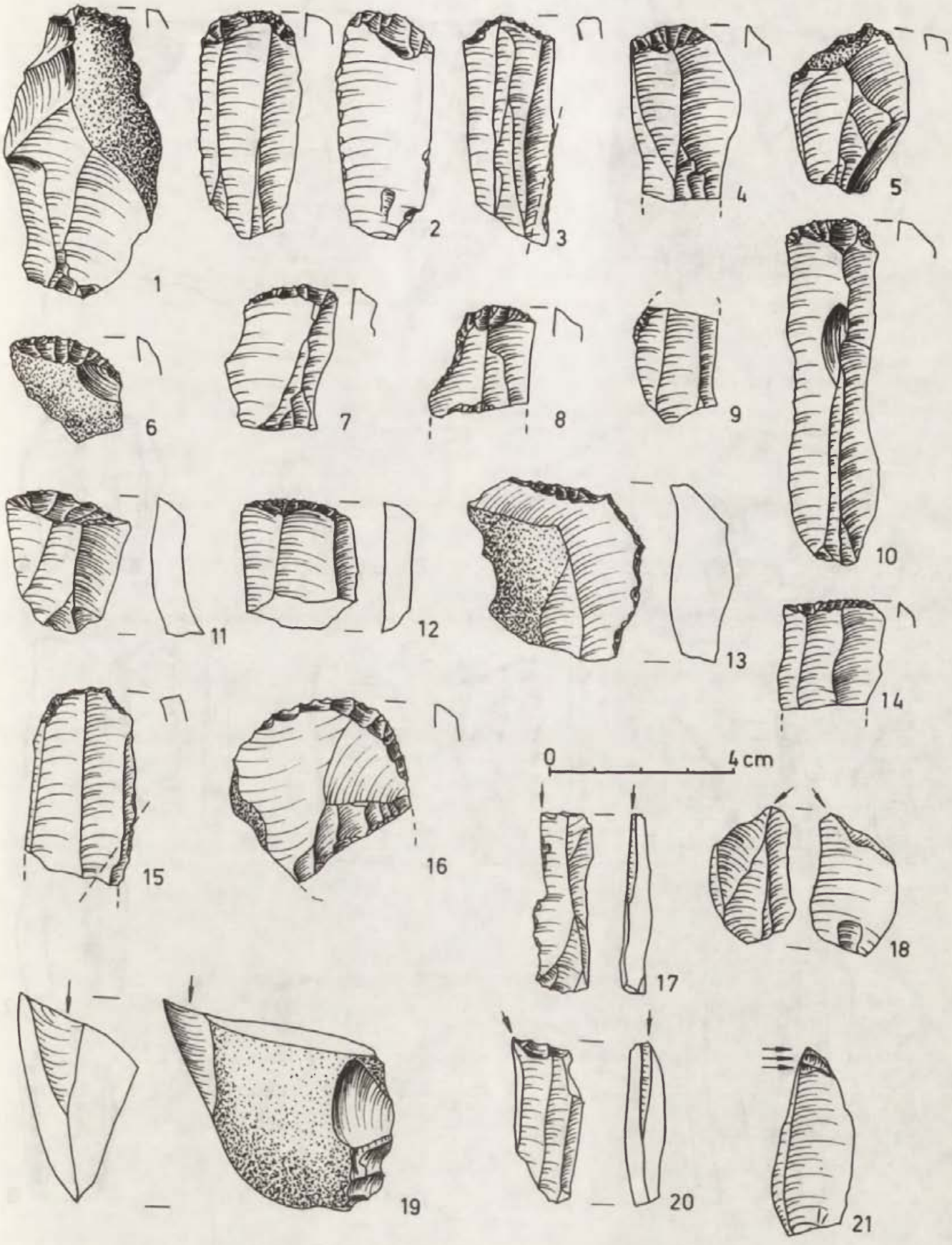


Pl. IX. Želiezovce phase of the Linear Band Pottery culture. Cores. Bieńczyce, site 12



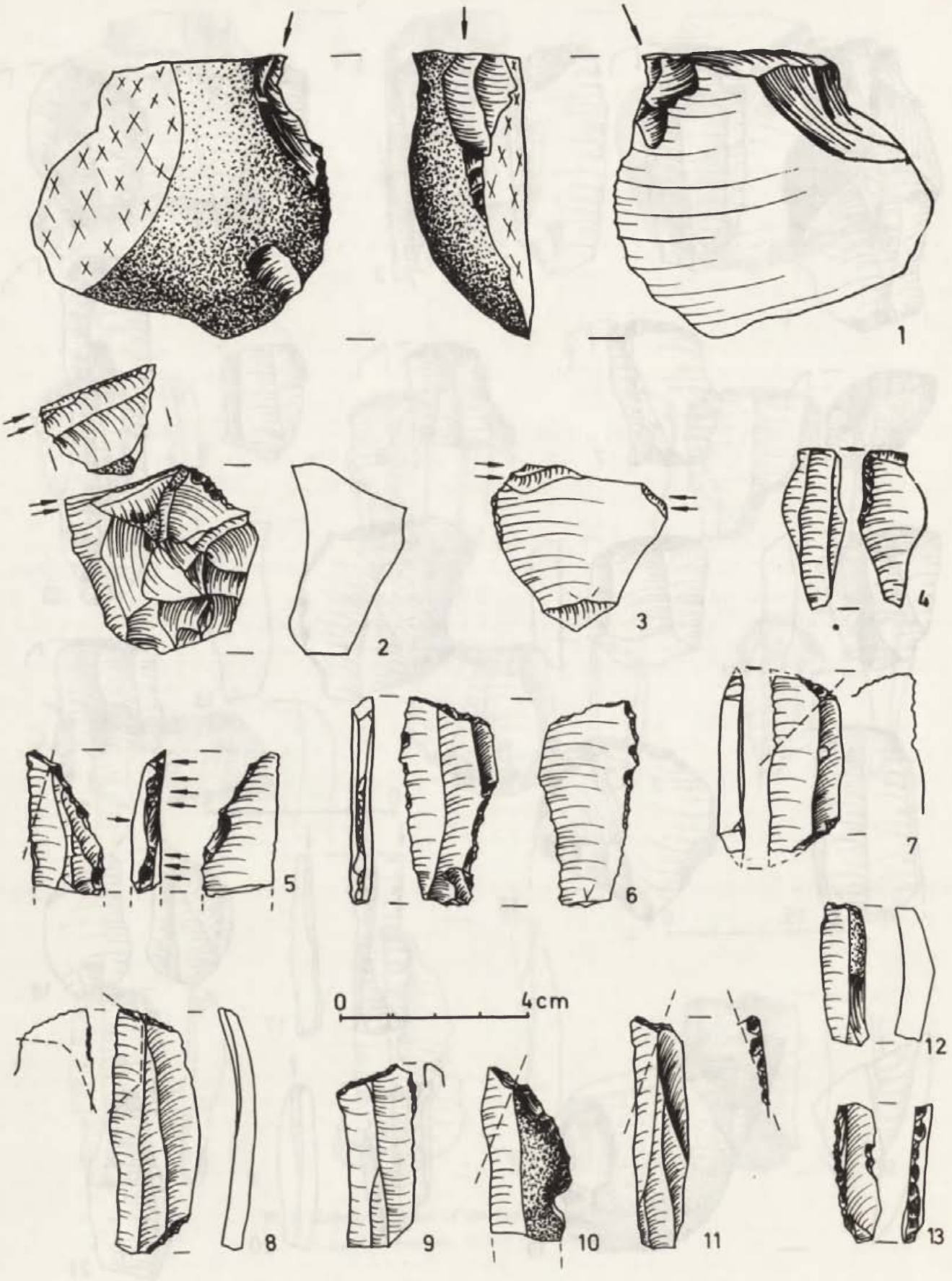
Pl. X. Želiezovce phase of the Linear Band Pottery culture

1 – core, (Bieńczyce, site 12), *2–10* – end-scrapers (Pleszów)



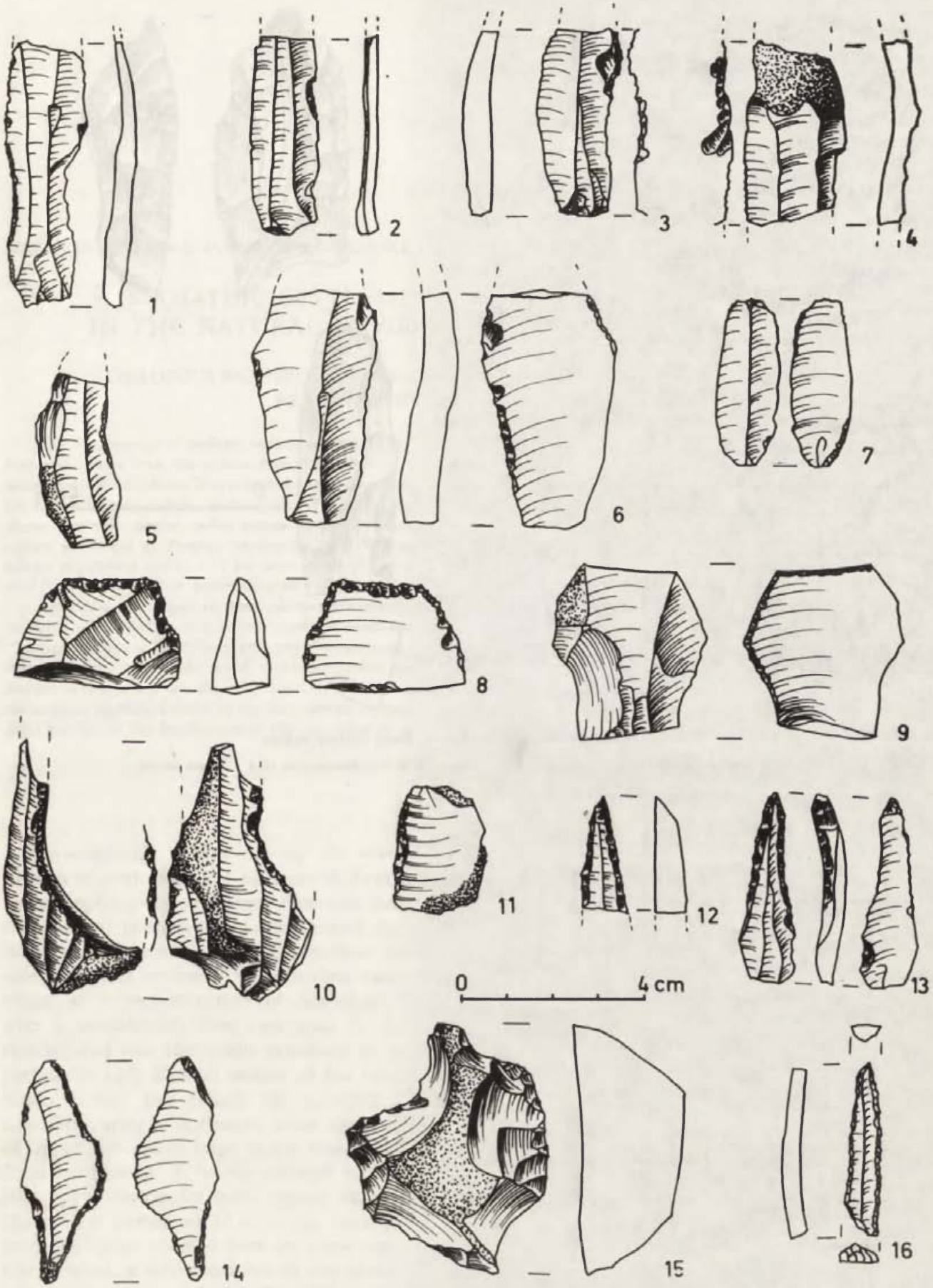
Pl. XI. Želiezovce phase of the Linear Band Pottery culture

1–16 – end-scrapers, *17–21* – burins (*1–9, 18, 21* – Mogiła, site 55, *11–13, 15, 16, 19, 20* – Mogiła, site 62, *10, 14* – Bieńczyce, site 2, *17* – Pleszów)



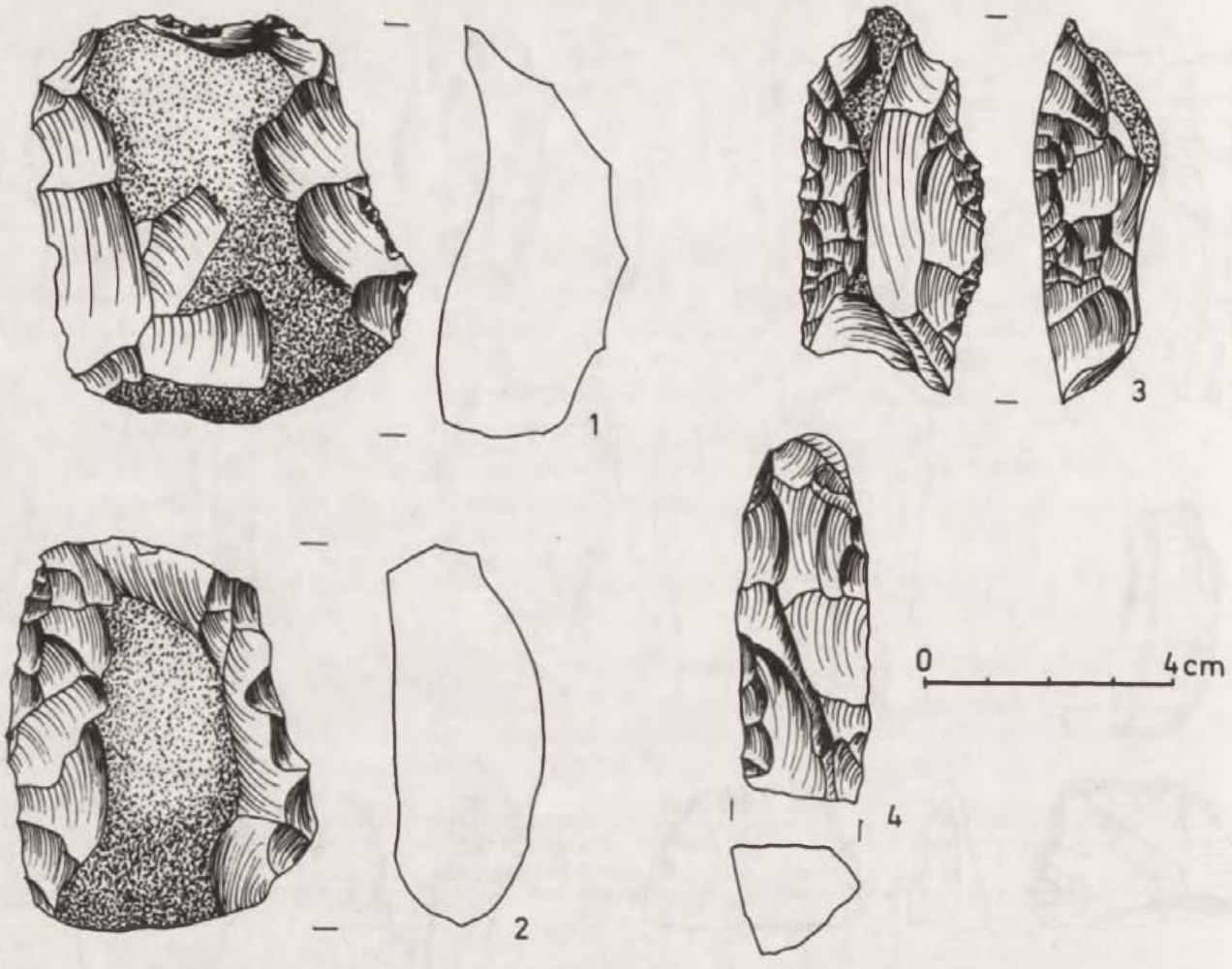
Pl. XII. Želiezovce phase of the Linear Band Pottery culture

1–4 – burins, *5–12* – retouched truncations, *13* – backed implement (*1*, *2*, *11–13* – Mogiła, site 62, *3*, *4* – Bieńczyce, site 12, *9*, *10* – Mogiła, site 55, *5–8* – Pleszów)



Pl. XIII. Želiezovce phase of the Linear Band Pottery culture

1–7 – retouched blades, *8*, *9*, *11* – retouched flakes, *10* – retouched flake removing, tip of the core, *12–16* – perforators (*1–4*, *8*, *10*, *11* – Pleszów, *5* – Mogi a, site 55, *6*, *7*, *9*, *12–16* – Mogi a, site 62)



Pl. XIV. Želiezovce phase of the Linear Band Pottery culture

1, *2* – side-scrapers, *3*, *4* – pic-like tools (*1* – Pleszów, *2* – Mogiła, site 62, *3* – Bieńczyce, site 12, *4* – Mogiła, site 55)