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# Archaeological investigations at Bodrogkeresztúr-Henye

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## 1. Topography and the surrounding Palaeolithic sites
## Geographical endowments

The main features of the surface morphology of the Carpathian Basin were already established by the end of the Tertiary period. The special interior development of the basin, surrounded by the Carpathians and the interior volcanic arch was only modified by elevation and depression on local scale. The Basin is closed from three sides. Its special micro-climate is strongly influenced by its morphological position: more dry than could be expected on the basis of geographical co-ordinates. Also due to its basin morphology, certain bio-geographical insulation can be observed in its development (SOMOGYI 1982, 77.) The cca. 300 thousand square km area, beyond the above general statements, was probably dissected into several so far unknown "ecological niches" during the whole time span of the Pleistocene.

This relative isolation indicated by geomorphological and climatic data seem to be proved in the light of recent research at least for a restricted area and time span (by the end of the Pleistocene SÜMEGI 1996, 9) At the same time, this bio-geographical isolation cannot be traced in the Upper Palaeolithic, though it is well known that the dependence of Palaeolithic communities "on natural conditions and resources" were still all important. Quoting Hagen: "...nature has been the dominant partner and any examination of the relationship of man to nature will inevitably be a one-way affair" (HAGEN 1972, 10) More exactly: the Upper Palaeolithic population of the Northern third and the central region of the Carpathian Basin were, beyond doubt, participants or active agents of historical processes from the Interpleniglacial to the Würm maximum (using recently suggested terminology, the MUP = Middle Upper Palaeolithic period (MUSSI-ROEBROEKS 1996). Differences between the find material of Hungarian sites and those of the classical habitation zones of Palaeolithic cultures have been observed by most students of the period and tried to solve the problem by terminological tricks. Differences in the archaeological material can be explained, to our present knowledge, by the peripheral position of the Carpathian Basin compared to the tribal area of the great cultures. This could be further influenced by relative isolation in the Basin, the possible direction of contacts determined by geomorphological endowments etc. Accepting this theory, probably some retarded (?), surviving (?) cultures of the Transylvanian basin, "outliving their time" can also be explained by isolation determined by geographical factors.

To the East of the Danube-bend, the Northern stripe of Hungary is occupied by the Northern Mid-Mountain Range. Its Easternmost member is the Eperjes (Presov)-Tokaj Mts., known also in (erroneous) vernacular use as Zemplén Mts. This name is mainly applied for the parts lying to the South of the Szalánc (Slanec) path. This mountain range belongs to the innermost volcanic range of the young folded mountain system of the Carpathians. This area forms a transition between the High Carpathians and the Lowland (Alföld) in several aspects: morphology, climate, biological environment. Due to the intersection of the margin of the mountains with the lowlands, Alföld intrudes deep into the river valleys (PINCZÉS 1960, 1–2.). This paleogeographical fact had a favourable influence on the settlement strategy of Upper Palaeolithic communities, who were naturally most sensitive to versatile ecological challenges. This area was inhabited in all periods of the Upper Palaeolithic.

The Tokaj-Presov Mts. was formed as a result of several volcanic eruptions in the Miocene / Sarmatian period. It has different strike from that of other members of the North-Hungarian Mid-Mountain range, directed roughly North-South. Eruption centres, lying some 8–10 km from each other following the main strike of the mountain in a zig-zag line can be still recognised. Lava cones were typically dislodged by modern age quarries. (GYARMATI 1972) *(Fig.1.)*

Sulphurous springs of the area are slight reminiscences of the Miocene volcanic activity. The postvolcanic activity following the intensive eruption phases supplied the region – especially the southern border of the mountains – with a ring of silicites, prepared from the soft pyroclastic rocks during the Late Pleistocene. They served the prehistoric population a vast quantity of, mainly excellent raw material for tools. Silicic acid leached by thermal springs from the andesite (and rhyolite) was sedimented in volcanic cavities, clefts and lakes in the form of opal, chalcedony or jasper at different phases of the volcanic activity. E.g., in limnic quartzite, plant remains from the Sarmatian period or Pannonian age wood trunk can be found, equally. (PINCZÉS 1960, 16.)

The body of the mountain is rising suddenly from the flat surface of the Alföld. Its young, slightly eroded form recall, in spite of its relatively low altitude (5–700 m a.s.l.) real mountain forms.

The most ancient member of the mountain range is the eponym Tokaj (or, Kopasz [Bald]) Mt. It is standing separately, to the south of the main body of the mountains: an irregular volcanic cone of 512 m altitude, dissected by several dry valleys. Measured along the Holocene terraces of the rivers, Bodrog and Takta, its diameter is 5 km on the average. This cone is a decisive geological formation of the area. The Kopasz Mt. or Tokaj Mt. gave its name to the volcanic mountain range, the region as well as the wine.

It is separated from the main body of the mountains with a 5–6 km wide stripe of hills. These hills are some 300 m lower than the Kopasz Mt., and at least 100 m lower than the margin of the mountain, consisting of smaller rhyolite cones covered by thick Late Pleistocene loess. The highest point of the hills is Bodrogkeresztúr-Henye itself, at 198 m altitude.

*Archaeological topography*

Investigating the topography of Hungarian Upper Palaeolithic sites, certain tendencies can be observed in the spatial array of sites.

The earliest Upper Palaeolithic culture in Hungary, Aurignacian with split base bone points seems to be a short "cave episode" (perhaps serving as temporary hunting camps of the open-air sites known to the North and East of our borders; or, perhaps other ethnic groups?). Caves are objective endowments. It is an ideal habitation environment within the Bükk Mts., though at other places of Central Europe the Aurignacian population did not live in them. It is of certain importance that here again we imply a conscious choice on behalf of Palaeolithic people the reason of which is unknown to us. Both Aurignacian sites are caves at relatively high altitude, though in Bükk Mts. there are large, habitable caves at much lower altitude, in the level of the sole as well.

Topographical investigation can only lead to some general observations if the location of the settlement was arbitrarily selected by prehistoric people. The Hungarian open air Upper Palaeolithic sites belong culturally to the Gravettian entity, spanning over the Middle Upper Palaeolithic and the Late Upper Palaeolithic periods.

Certain differences were observed in the settlement strategy of the two periods. As the number of sites known is not too much, these differences should be treated as trends rather than laws. People of the MUP /older blade industry/, i.e. Pavlovian complex preferred to occupy multiple function strategic points, on elevations along the southern margin of the mid-mountain ranges, foothill slopes, terraces or hilltops 180–200 m altitude, on relatively permanent settlements. At the same time, both cultural phyla of LUP /Younger Blade Industry and Pebble Gravettian or Ságvárian hunting communities, respectively) seemed to occupy the whole territory of the Carpathian Basin. Their "ad hoc" settlements / sites were found, contrary to a long lasting geological "topos", i.e., there are no Palaeolithic settlements on Alföld), partly on loess covered Ice Age relict surfaces, 80–120 cm below the present surface (Jászság / Jazygian region), partly in embryonal soil horizons of typical loess sequences, several meters below the present (on the northern margin of Telecska-hills, Madaras). In the given time period of the Upper Palaeolithic, however, the endowments of the actual surface could always decisively influence the selection of the habitation area.

The temporal and spatial scale of geomorphological studies is rather large-scale compared to the needs of Palaeolithic research specialists. Still the reconstruction of the original surface morphology of a given settlement can be fairly successful.

The Henye hill and its immediate environs is surrounded by, from North and South by the mountains, from the East, river Bodrog, and from the West, the flatlands of the stream Takta. Knowing the selection criteria of the Gravettian entity, the site is ideal, about 190 m high above sea level, on a row of steep side hills: a typical multiple function, strategical scene. It is located at the meeting point of several ecological niches:

– in the immediate vicinity (western margin) of the area, a swampy flatland served rich and varied lacustrine and terrestrial fauna (leading element: Alces), without the danger of temporary floods

– to the south, the Alföld offered dry grassy steppe (leading faunal elements: *Mammuthus, Equus*)

– the Northern mountainous environment was less utilised for hunting, but this area is a rich source of variable stone tool raw materials (BIRÓ–PÁLOSI 1983, BIRÓ–DOBOSI 1991). In the first place, we find there one of the "obsidian centres" supplying the Carpathian Basin (probably even the areas beyond the Carpathians) with obsidian. This could be a decisive factor in the system of connections probably already in the Palaeolithic Period.

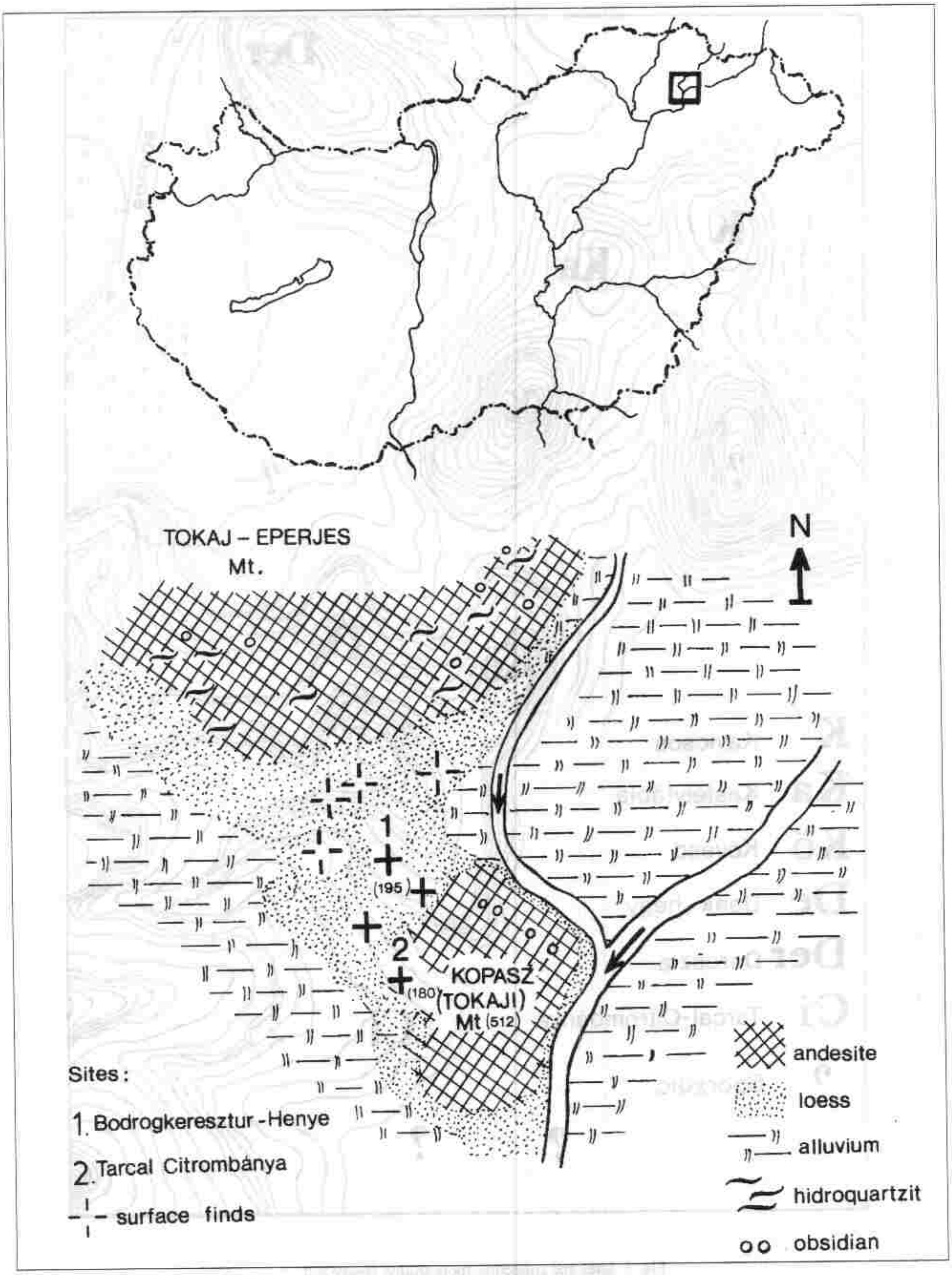



Fig. 2 The environs of Bodrogkeresztúr-Henye

20 pieces of flake, knapping debris ( 7 obsidian, 13 hydroquartzite)

Terézia-chapel – it is built on the hill next to Henye, belonging already to the administration of the village Tarcal. Some chipped stone objects are known from here as well. The Palaeolithic tools: found here (Pb 83/222) were probably washed out to the slope of the chapel-hill towards the village by erosion or turned out by deep ploughing for the vineyards. 10 worked flake, (3 obsidian, 7 hydroquartzite)

**Dereszla**-hill – the northern part of the modern village Bodrogkeresztúr completely fills the narrowing valley of the river Bodrog, houses stretching up, partly, to the eastern flanks of the Dereszla hill. This is an elevation with quite steep slopes, highest point at 162 m. a.s.l. The top of the hill was disturbed during the construction of a pumping station of the local water plants. Apart from finds from different other archaeological periods, Magdolna Hellebrandt found here on mammoth bones and chipped stone artefacts in the depth of 30–40 cm. (HELLEBRANDT—SIMÁN 1980, 88). The material of the 1982. field survey got into the Hungarian National Museum: Pb 83/239-261 *(Fig. 4. 1–5)*

Type distribution:

angular burin (hydroquartzite and obsidian) 2 pieces

truncated blade / atypical end-scraper, l piece

burin-edge or worked fragment 4 pieces (2-2 obsidian and hydroquartzite )

blade 8 pieces ( Prut silex, hydroquartzite, obsidian)

flakes, knapping debris 28 pieces (hydroquartzite, erratic flint, radiolarite, "stone marrow", hydroquartzite obsidian)

one borer and a small core-rabot from here are probably not Palaeolithic.

**Between Dereszla and Kavicsbánya dülő** (location cannot be defined more precisely, field survey by István Horváth during the 1963 excavations by László Vértes): Pb 64/495–498:

Type distribution:

2 blade and 8 mixed raw material fragments

Further collecting points are known from the foothill slopes along the Kopasz-Mt. To the North, along the road to Tokaj we find Bodrogkeresztúr – Brickyards, where two artefacts were collected by László Vértes from the sequence between two buries fossil soil layers:

Pb 64/480: obliquely truncated blade, retouched on both edges, from patinated hydroquartzite

Pb 64/481: atypical core, egg-shape hydroquartzite lump with flake negatives: seems somewhat older than the finds of the surrounding hill-tops.

To the South of Henye, in the vicinity of Tarcal, two collecting spots yielded considerable amount of material:

Tarcal-**Kövesd** Pb 87/23–34. *(Fig. 4. 6–14)*

Type distribution:

two flake scrapers (obsidian), high end-scraper (erratic flint), burin-edge core fragment, conical core, worked fragments (4 pieces), blade and blade-like flake (5 pieces), flake: 36 pieces (4 obsidian, 2 erratic flint and 30 hydroquartzite)

Tarcal-**Deák hill**: Pb 87/21–22: a beautiful end-scraper on blade made of hydroquartzite and l3 flakes (12 hydroquartzite, 1 obsidian.)

There were two more unidentified collecting spots at Tarcal, which could be any of the mentioned sites and / or new hill-tops as well:

Tarcal, half-way **between the Roman Catholic church and Henye** hill, collected during the excavation of Vértes: 3 flakes and a wide, short end-scraper on flake: Pb 64/499–501.

Tarcal, hill at the road bend, on the southern side towards Tarcal (above cemetery) 9 pieces of flakes were collected made of mixed raw materials during the 1982. excavation season:

Inv.nr.Pb 83/223

The mountain Kopasz itself is already above the altitude level preferred by the Gravettian entity MUP / (Pavlovian) population. Two objects marked as **"Kopasz Mt."** in the collection of the HNM could originate from anywhere..

A beautiful, arched silex blade chipped off from a core rim was donated to the HNM by I. Frits, student of pharmacology (DOBOSI 1975, 68), further on, M. Pécsi collected flakes at a more closely unidentified spot from layered loess over the uppermost fossil soil horizon in 1964.

The southern foothill regions were not systematically surveyed as yet, and no information is available on finds collected by others. The eastern slope of the Kopasz, however, is partly natural and partly artificial but altogether sloping very steep almost vertical till the Bodrog river. This wall is the famous **Lebuj-bend**, locality for perlite and "marekanite", pearl-like glass balls of a few mm. This side was formed artificially – partly, washed away by the Bodrog, partly disturbed by the road construction, with all possible Pleistocene sediments destroyed.

Sites on the Northern and Western foothill slopes belong already to the administrative custody of the village Tarcal.

On the northern slope, finds were collected by Gábor Gyombola on the **Deák hill** and the **Kövesd-hill** around the beginning of the 1980-ies. On these non can be that the Henye hill (198 m. a.s.l.) was surrounded by, on the lower hill-tops about 160 m altitude in a circle of cca. 1 km by satellite settlements.

Towards the North-west, **halfway between the Tarcal church and the Henye hill**, in the loess wall of a deep-cut road archaeological finds were found, an end-scraper and a burin. This datum cannot be specified more closely.

To the West, in the Tarcal – Brickyards, palaeontological excavations by Dénes Jánossy resulted in some obsidian- and silex artefacts (p.c. by D. Jánossy). Finds of uncertain stratigraphy were found in the covering loess of the Railway station quarry, some 200 m of it.

At **Tarcal-Citrombánya** ("Lemon quarry"), on Fekete-hill, details of an Upper Palaeolithic settlement were excavated. The pyroxene-dacite quarry was opened at a "side hill" of the Kopasz Mt., about the altitude of the Henye hill. The original surface was about 215–220 m a.s.l. The original surface could not be reconstructed due to earth works preceding the opening of the quarry. In the covering loess, E. Krolopp discovered archaeological finds in course of sampling for malacological investigations, that were later authenticated. Stratigraphical sequence: Pyroxene dacite is covered by 200–230 cm thick Late Würm loess, comprising two charred stripes in the length of some 26 m in the depth of 140–180 and 80–100 cm, respectively. The lower stripe is archaeologically sterile, the upper charred stripe is a cultural layer. Its clay is slightly loamy, the time of its deposition can be placed to some Late Würm interstadials (Laugerie-Lascaux?).

*Fauna:*
Vertebrates: *Equus, Rangifer* (JÁNOSSY 1975, 26.)
Mollusca: *Pupilla muscorum, Chondrula tridens* and *Bradybaena fruticum*, denoting relatively mild climate (KROLOPP 1975, 28.) The slightly loamy embryonal soil and the "mild" malacofauna mutually corroborate the chronostratigraphical position of the cultural layer.
*Anthrakotomy: Pinus cembra* (STIEBER 1975, 29.)
*Archaeological finds:* (DOBOSI 1975, 9–25.)
35 tools (end-scrapers, rabots, scrapers and retouched blades)
25 blade
314 flake
Dentalium and Vermetus "trinket snails"

The numerous collecting points are material proofs of the apparent attractions of the area in some periods of the Palaeolithic, notably in the Pavlovian period. One a few square km, an unparalleled settlement density, habitation centre came forth. Were these settlements indicated by the surface finds of identical age or not? And, if they were strictly contemporary, were there any rank order, functional, spatial or any other similarities or differences among them? These questions cannot be answered as yet.

According to the subjective opinion of the author, the hill-top settlements in the immediate vicinity of the site Henye were contemporary satellite settlements while on the slopes of the Kopasz Mt., settlements of younger age are also occurring (e.g. Tarcal-Citrombánya)

## 2. Research history of the site Bodrogkeresztúr-Henye

The earliest record in the inventories of the Hungarian National Museum regarding Bodrogkeresztúr-Henye is the entry 33/1948. **in the year 1920–21**. from the excavations of Jenő Hillebrand marked "mesolithikum". This excavation could be the campaign of Lajos Bella and Jenő Hillebrand in the Copper Age cemetery of Bodrogkeresztúr (BELLA 1923, 7.). Probably, Hillebrand who had by that time considerable practice in Palaeolithic excavations found this site in course of field survey. The Copper Age cemetery was excavated on the estates of count Ernest Széchenyi-Wolkenstein in the autumn of 1920, spring and autumn of 1921. A. E. van Giffen from Groningen took part on this excavation. K. Wollák informed us that during her study trip to the Netherlands in 1987, she came across "Mesolithic" finds from Bodrogkeresztúr in the university collection of Groningen. Thus we can justly suppose that the note in the Palaeolithic inventory book, "excavation by Jenő Hillebrand" relates not the Henye, but the Copper Age cemetery. In the publication of the site, however, no traces of finds from other (Palaeolitrhic or Mesolithic) period were mentioned

This inventory entry (and the stone tools) draw the attention of László Vértes to the site when he was revising the NE-Hungarian data in the Palaeolithic depository of the Hungarian National Museum.

**In the summer of 1963,** László Vértes entrusted Lajos Tóth, metallurgical engineer and private collector from Miskolc to perform field survey on the area. According to Tóth's data, there were surface Palaeolithic finds on Henye, the slope of the hill with the Terézia-chapel facing the Henye hill as well as on the Csengős hill (unidentified collecting spot). As the top of Henye hill was intended to be planted by vineyards,

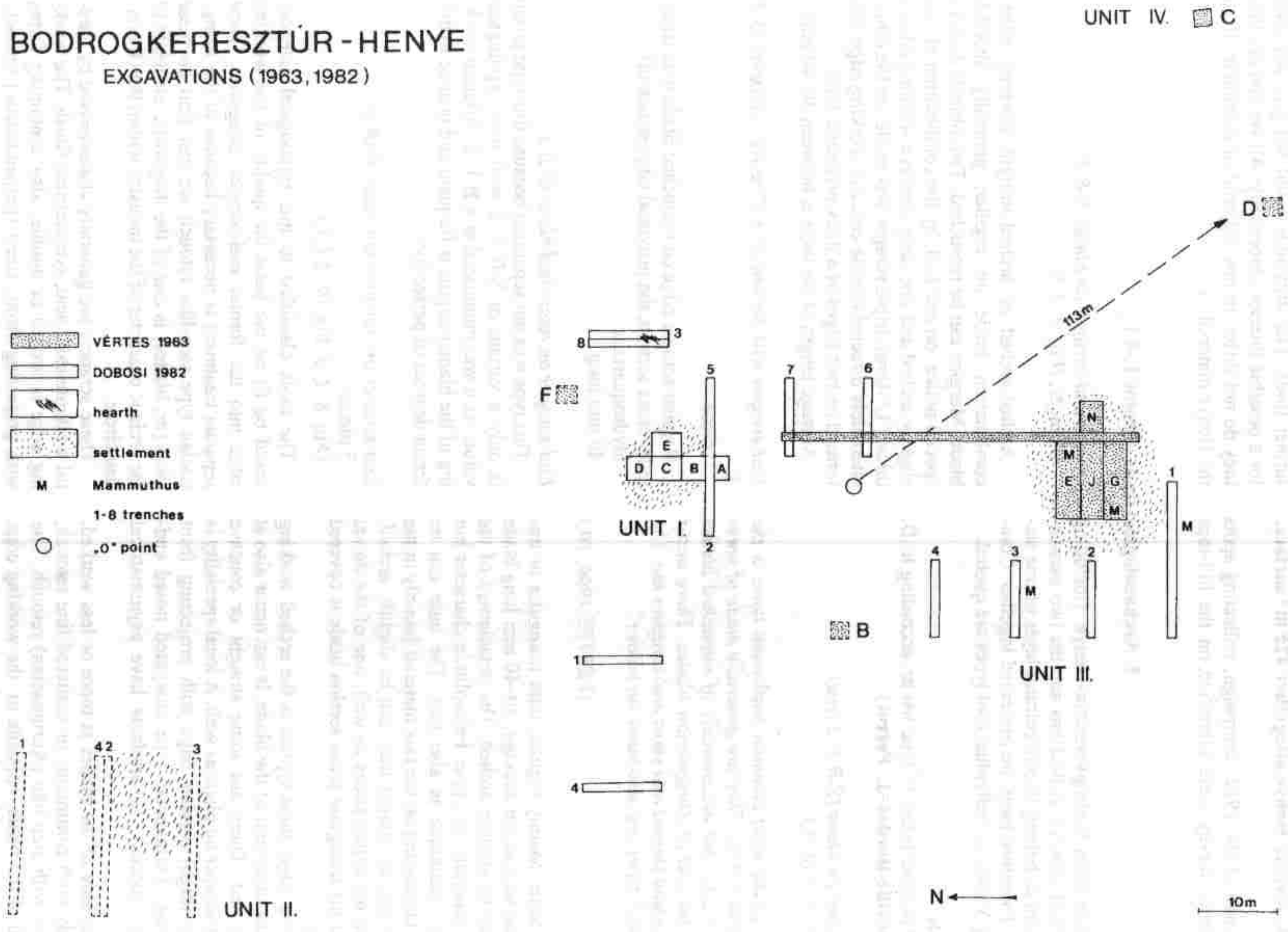
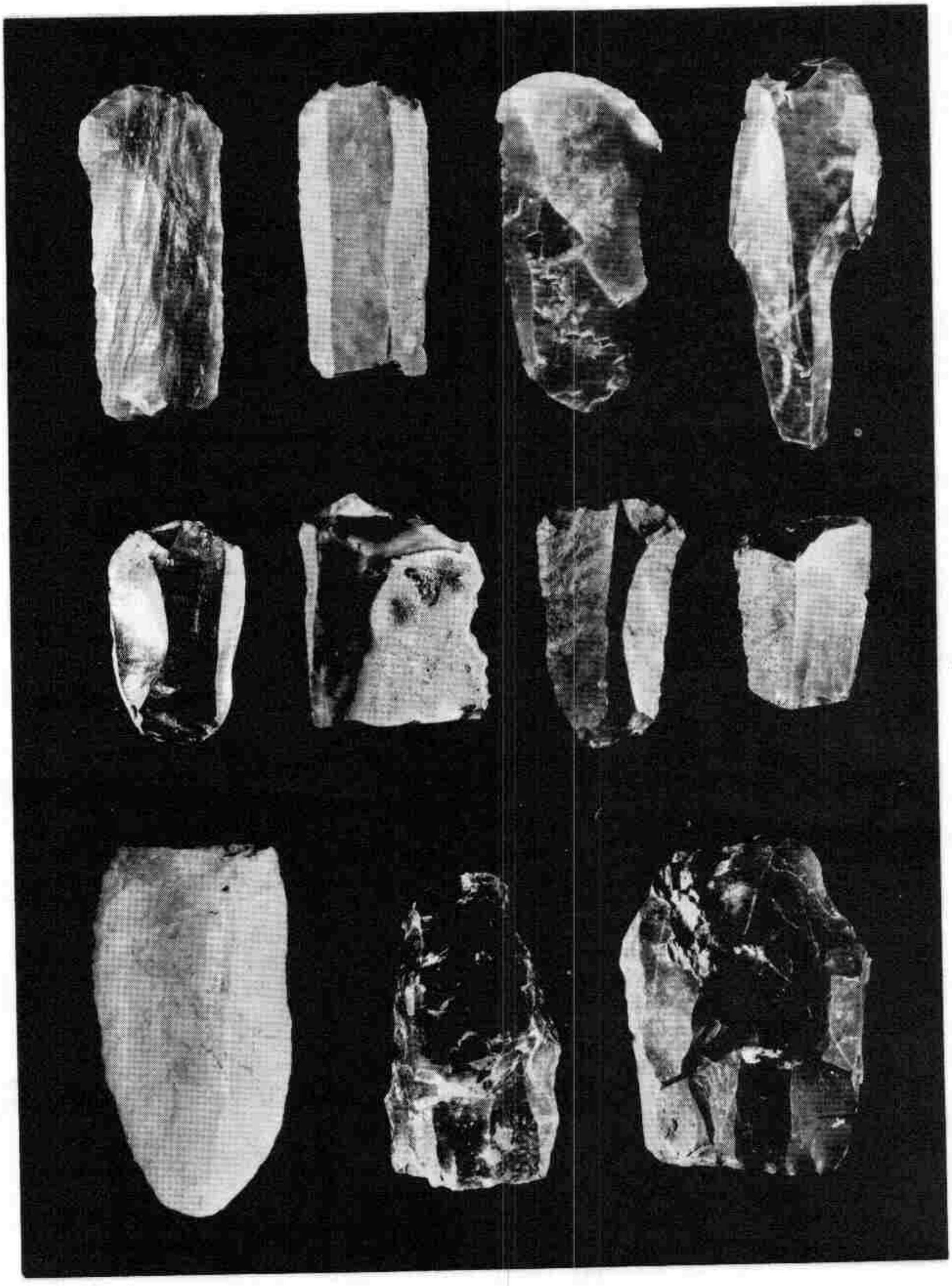
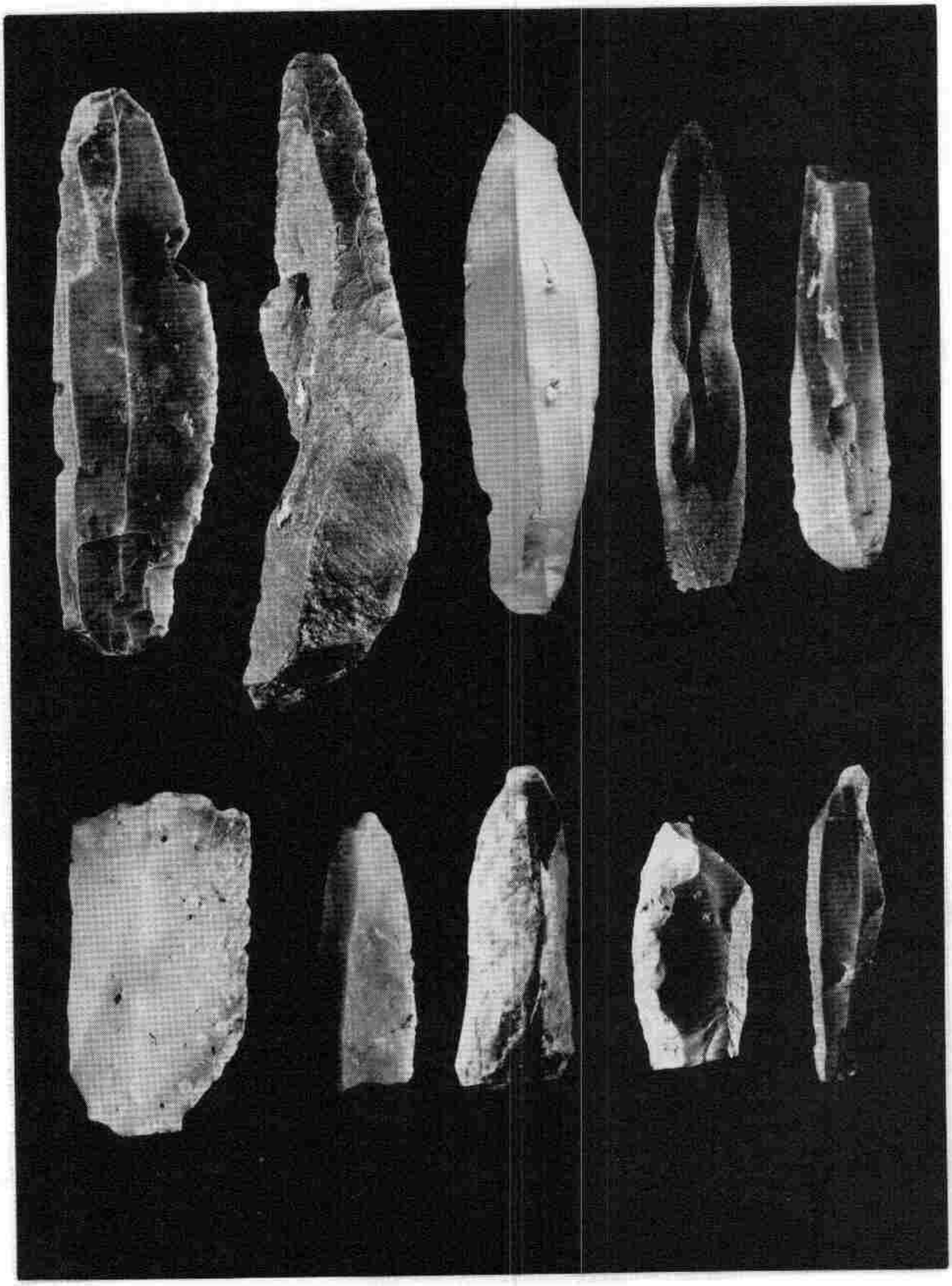



Fig. 5 Comprehensive site map of the excavations by László Vértes (1963) and Viola Dobosi (1982)



End-scrapers



Blades

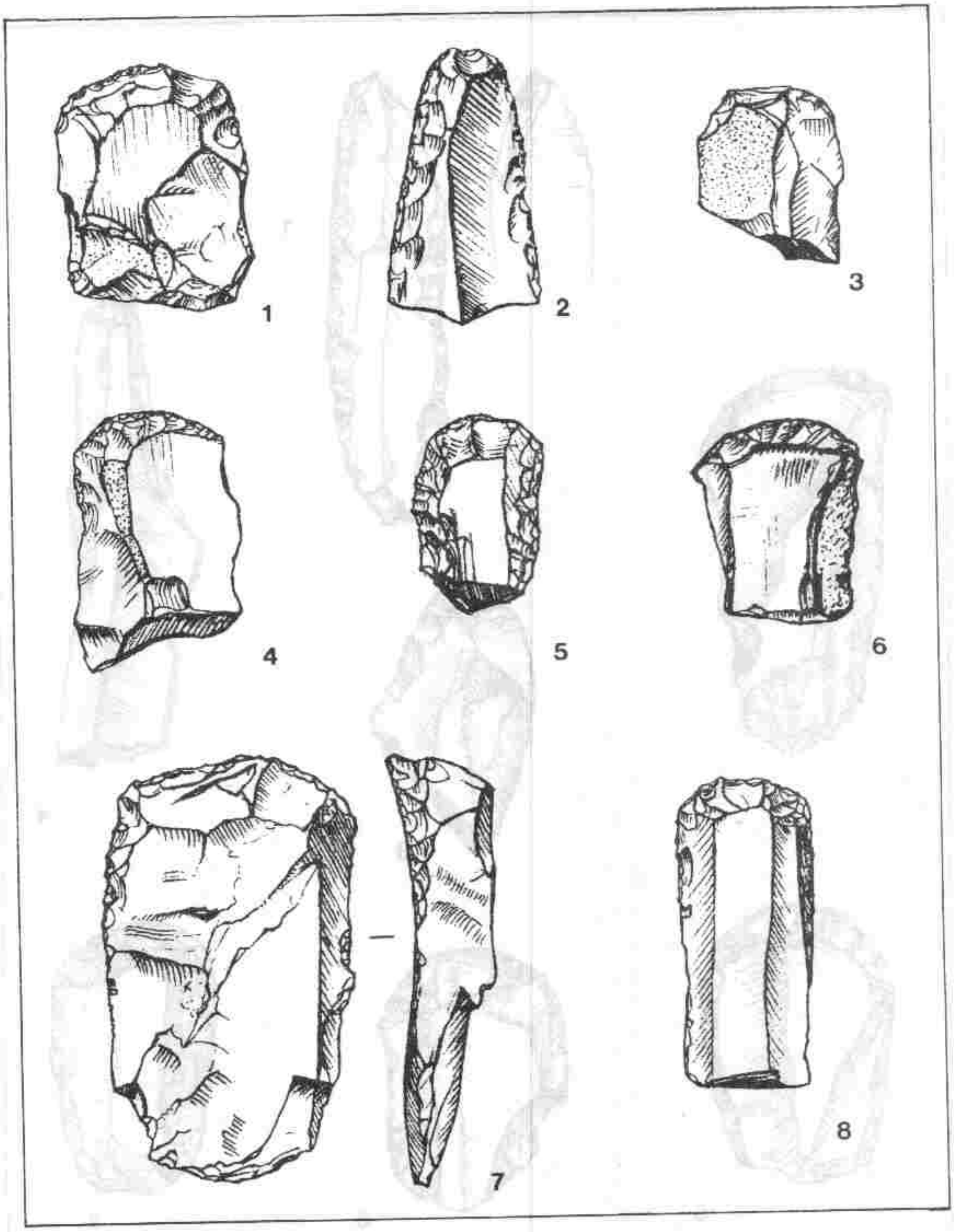



Fig. 6 End-scrapers on blade. Scale 1:1

*Fan-shape end-scraper (S-B 7)*
3 pieces *(Fig. 8. 7, 8)*

Made partly on already fan-shaped short, high flakes, partly on flakes made narrow at the proximal edge by retouch or strike-off. They are steep, slightly arched edge scraping tools.

Typically, they are about 30 mm long, wide flakes.

*End-scraper on flake (S-B 8)* 37 pieces
*(Fig. 9. 1, 2, 4, 5, Fig. 10. 6, 7, 8, Fig. 11. 2 ,5, 6)*

*"Flake scrapers are also frequent. But on the other hand the "aurignacoid" true caréné forms and the*

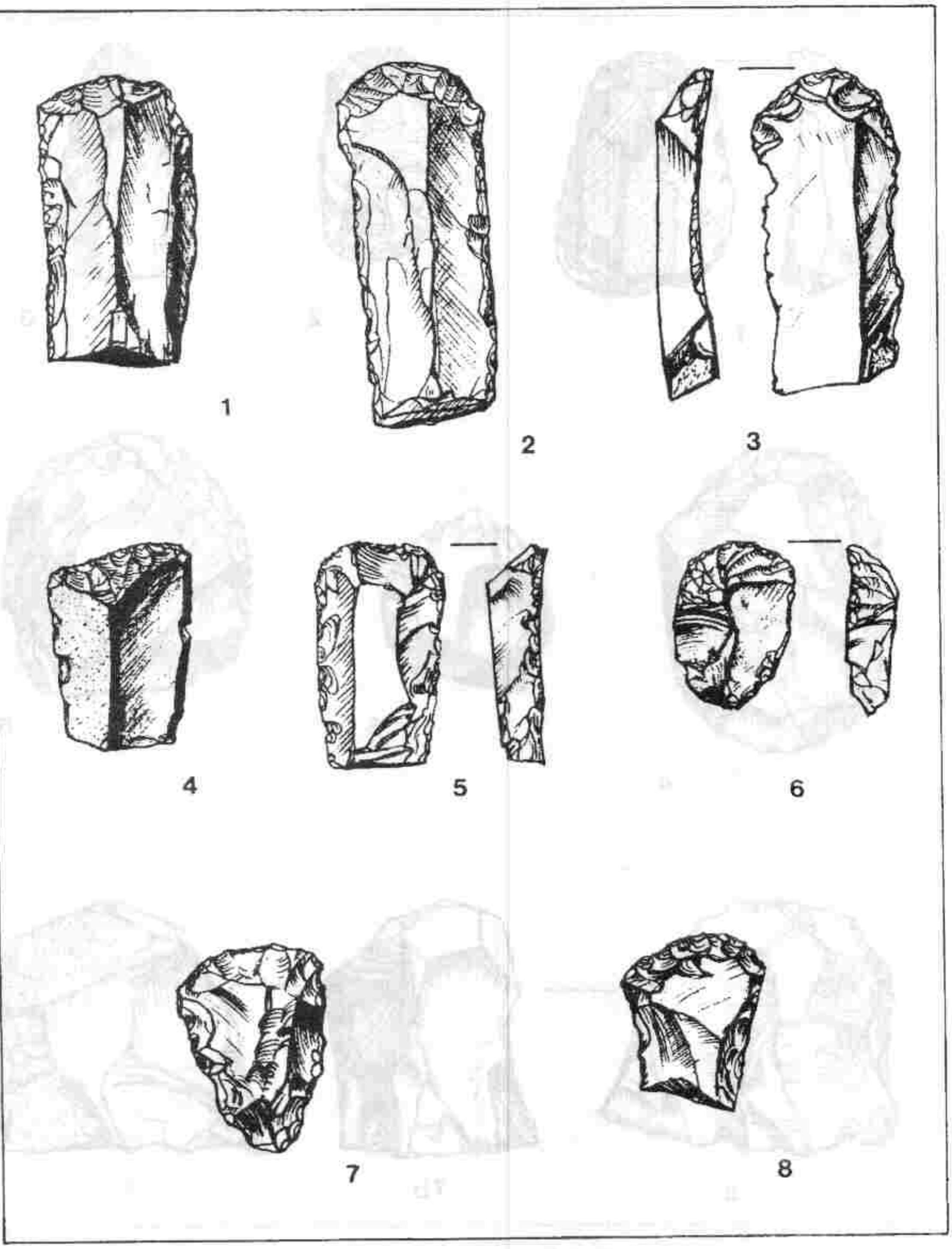



Fig. 8 End-scrapers on retouched blade, fan-shaped end-scrapers. Scale 1:1

Detachment of the flake can be of Upper Palaeolithic character, diédre and also clactonian as well. There are obliquely directed "déjeté" type flakes as well. Cross section is typically uneven, both in form and thickness.

Working edge: directed at variable parts of the base form, can be lobate, U-form, arched, elongated and in broken arch (ogival), straight (within the latter, perpendicular or oblique to the longitudinal axis of the flake).

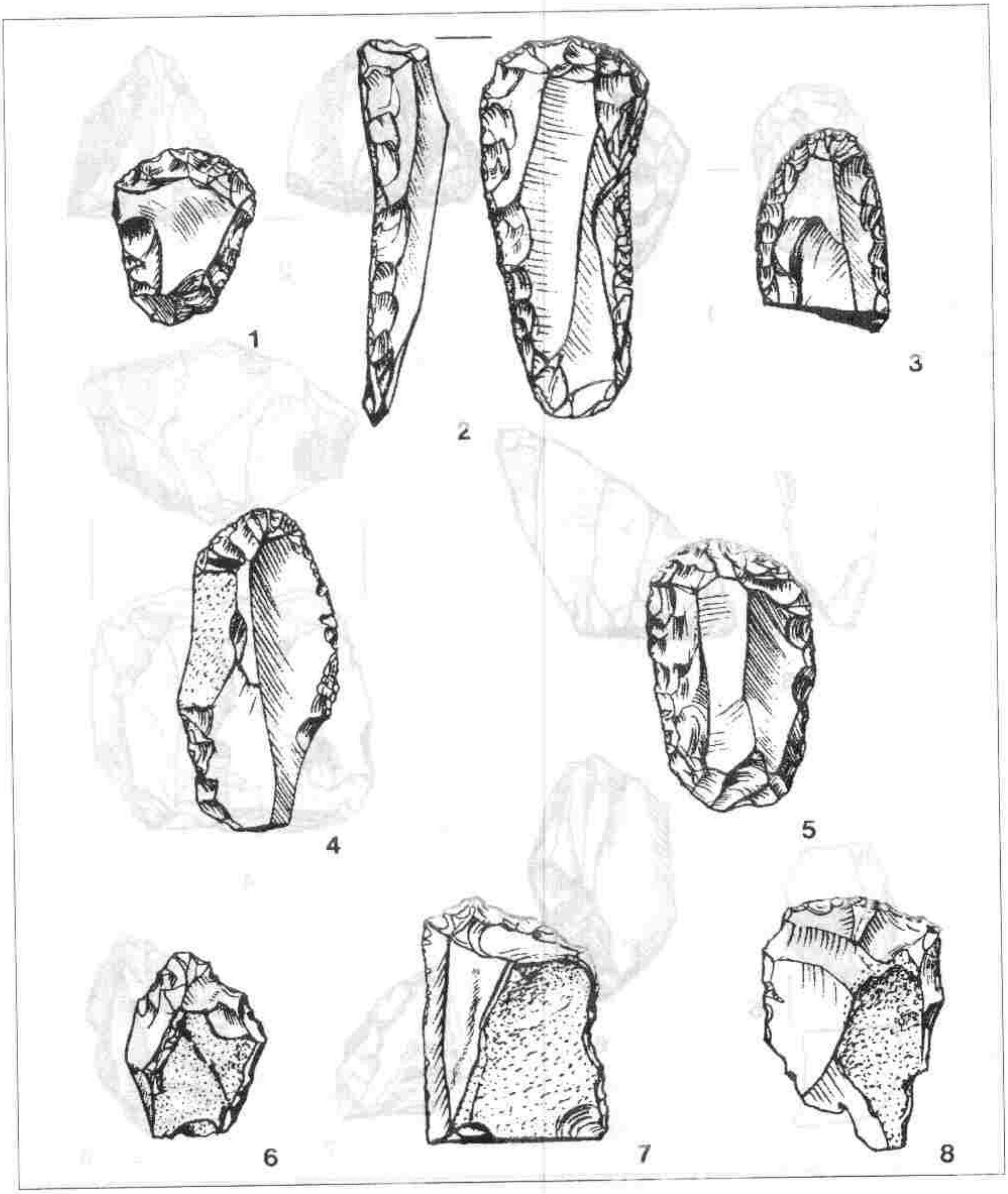



Fig. 10 End-scrapers on retouched blade, flake. Scale 1:1

edge is more strongly arched. It is not a characteristic type group, seems in most cases rather "ad hoc" solution: the otherwise naturally arched cleavage edge was worked by lobate retouch. It is possible that they served not scraper function. The flakes are high, the retouch is steep or linear, there are several items with steep / projecting front.

*Carenoid end-scraper (S-B 11-12)*

6 pieces *(Fig 11. 2, 6, Fig. 16. 6, 7, Fig. 23. 1 )*

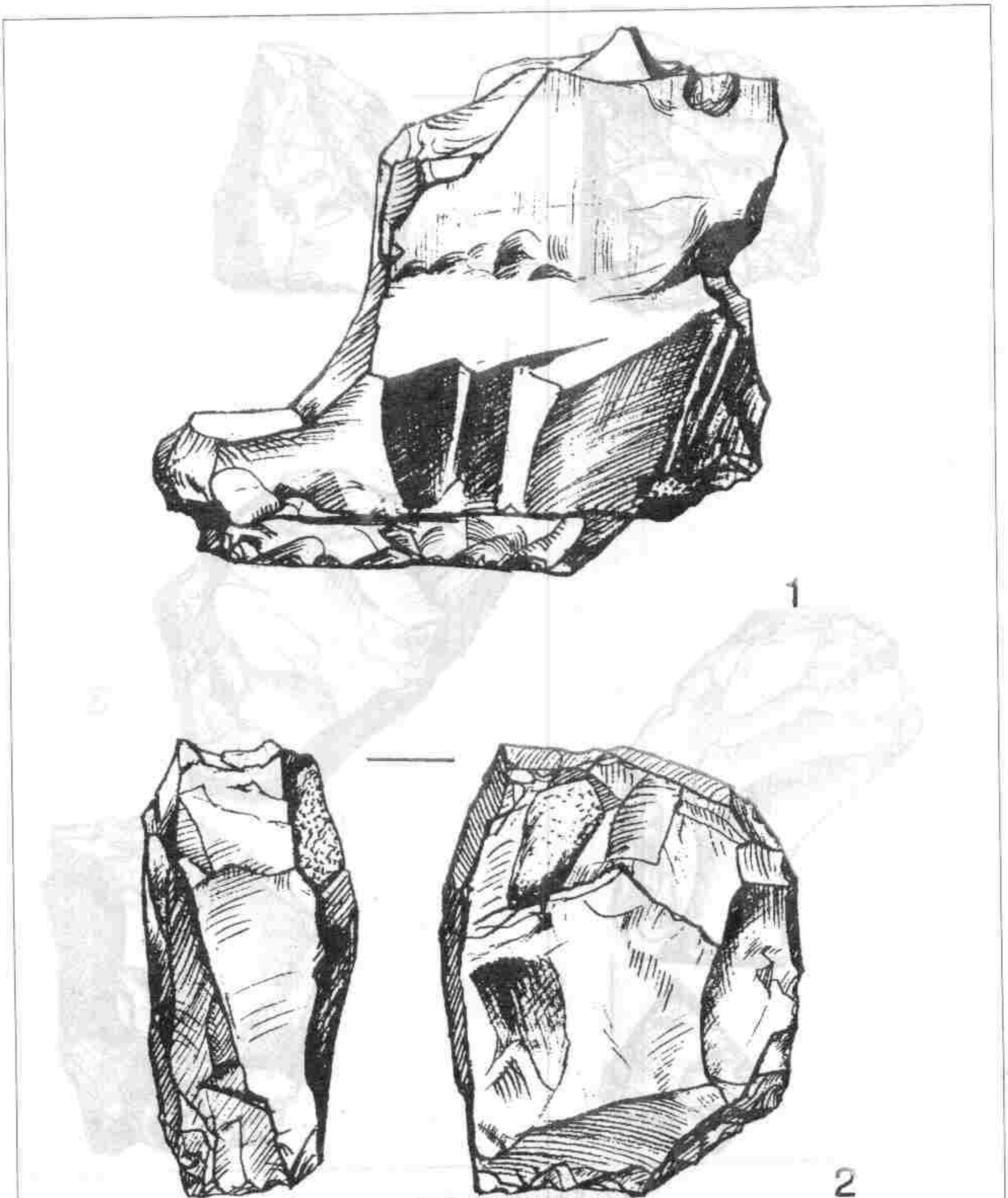



Fig. 12 Rabots (planes). Scale 1:1

find no carenoid type lithic industry. In this aspect, the lithic industry of Bodrogkeresztúr – Henye with this 6, not very typical carenoid end-scrapers is more "Aurignacian-like" than the stone tools of the real Aurignacian sites in Hungary.

*"..."Rabots" are very typical. They are also in most instances combined with burins doubled or may even have side-scraper edges. We find similar implement the Arka industry. There are giant forms too which are, however, still smaller than those of Arka. One of the characteristics of the Bodrogkeresztúr industry is the existence of the intermedial forms between the "rabot" and these carinate types of heavy burins."*

*(VÉRTES 1966, 10.)*

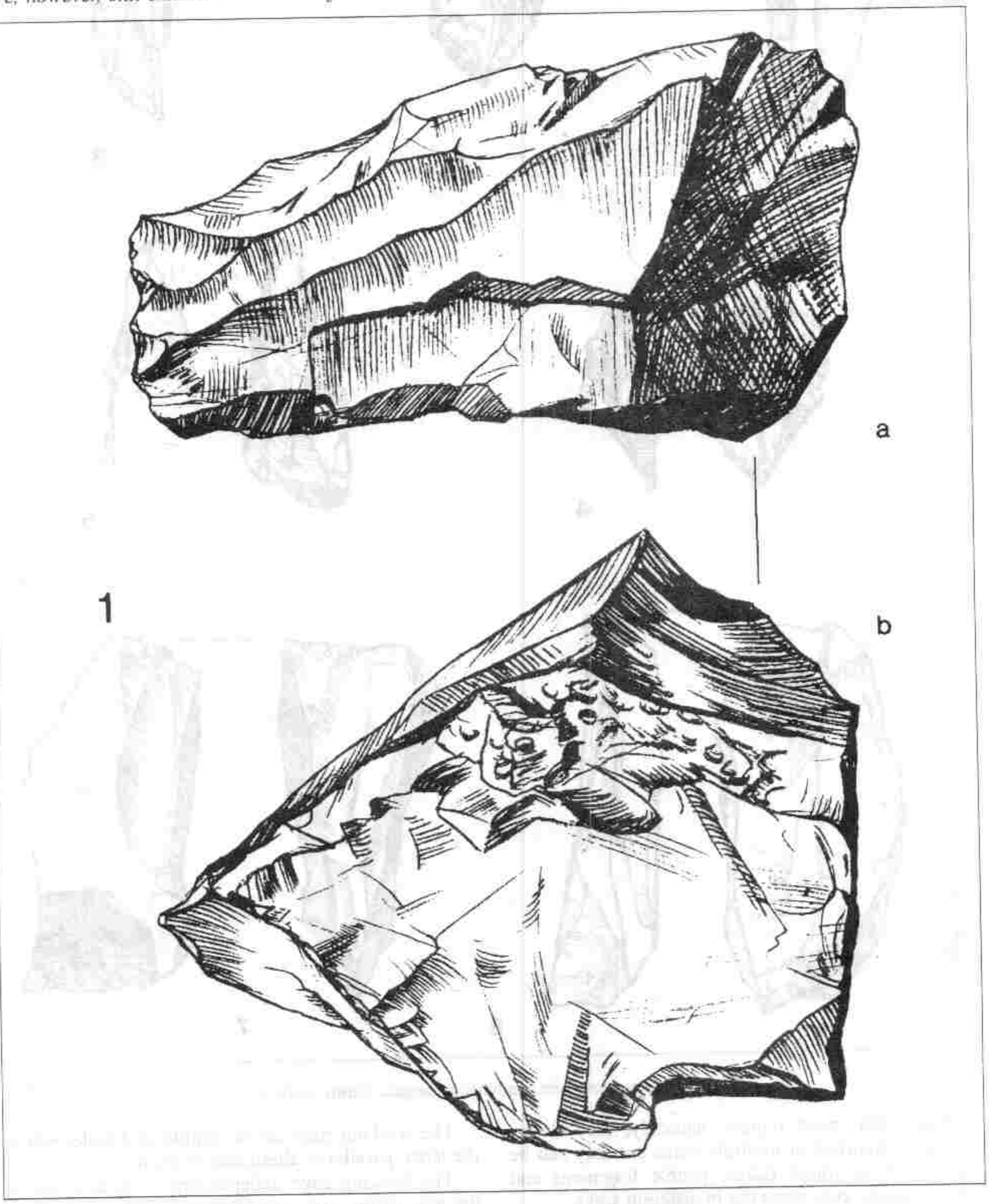



Fig. 14 Rabots (planes). Scale 1:1

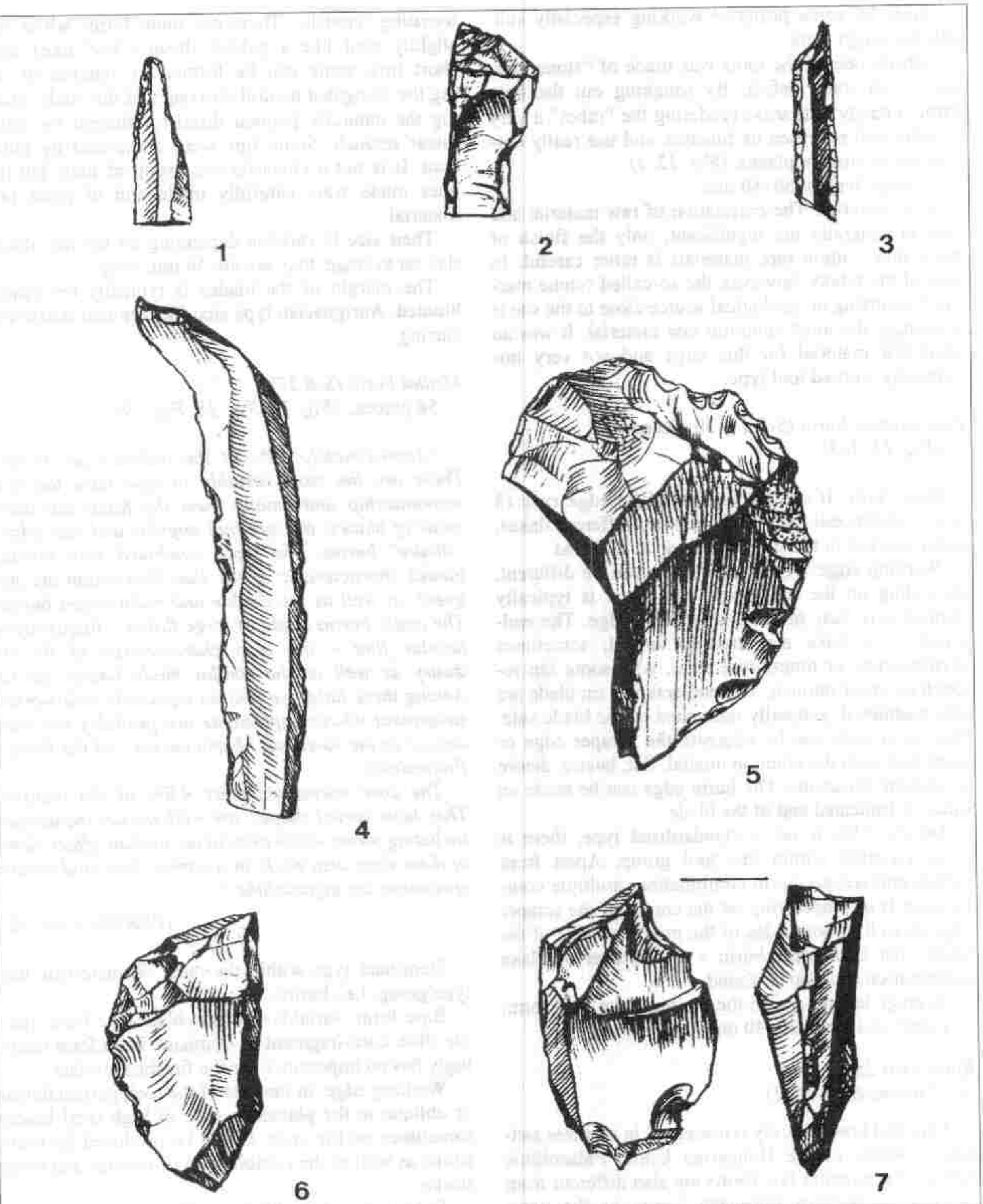



Fig. 16 Borers, end-scrapers, combined tools. Scale 1:1

The degree of the cutting edge is mainly less than 90°. If the rabot edge was formed on the basis of the core, the prepared core rim was thinned from the dorsal site by one blow.

Retouch: primary working is rarely refined further by linear or marginal retouch. The working edge, in most cases is a lobate margin formed by chopper-retouch. Prepared raw material blocks / flake cores can

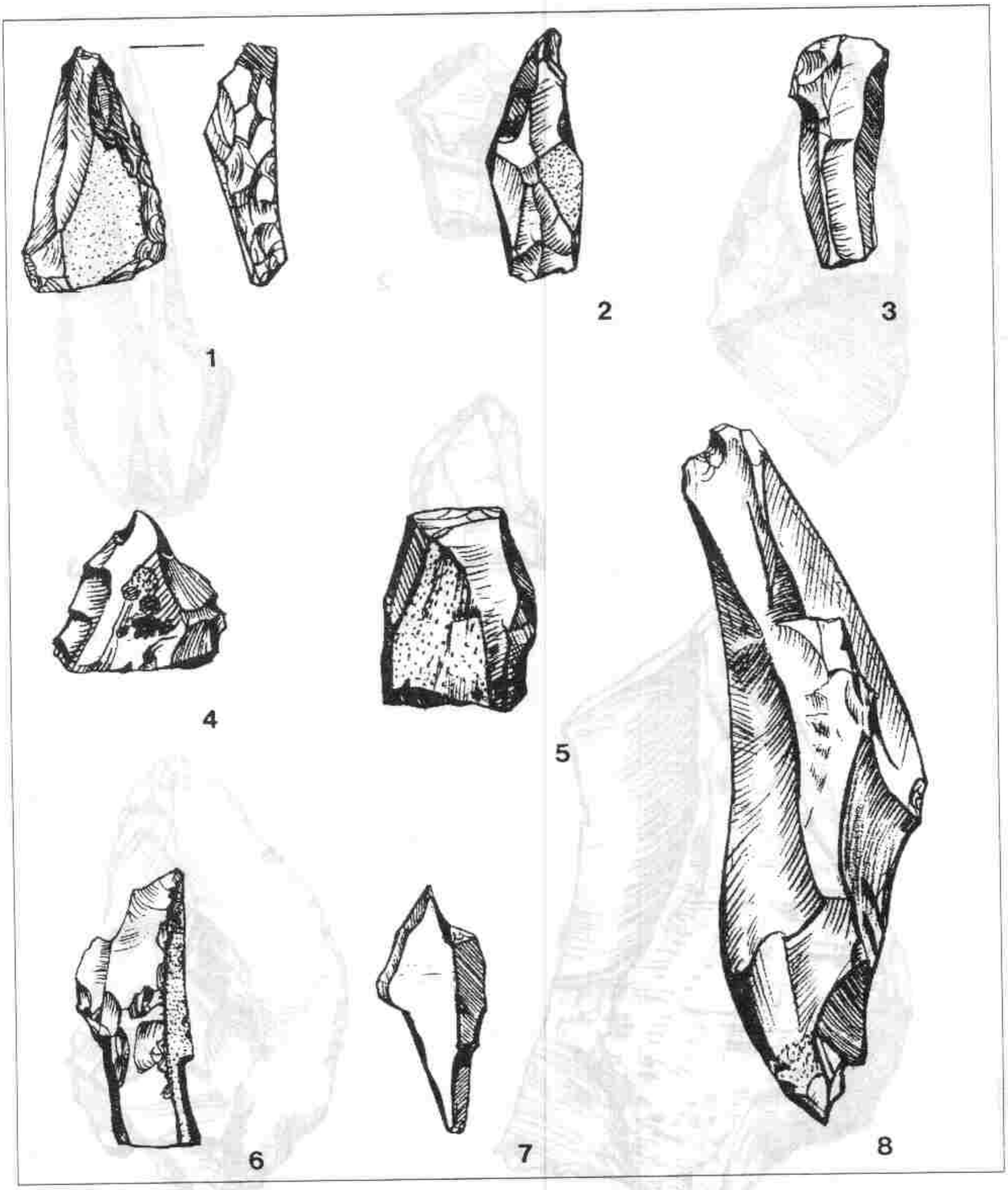



Fig. 17 Burins, combined tools. Scale 1:1

*Oblique burin (S-B 28)*
5 pieces, *(Fig. 20. 2, 7)*

Its separation is not justified as quite often the working edge of medial burins is also oblique compared to the ventral plane of the tool (i.e., in acute angle an not perpendicular). In the separation, the former classification of Vértes was followed, but this type has no statistical value.

In case of two tools classified to this group the burin-stroke was directed not from above towards the base but from the ventral plane towards the dorsal one.

The working edge is the part between the oblique detachment and the dorsal plane of the tool.

*Lateral burin (S-B 29)*
67 pieces, *(Fig. 20. 1, 3, Fig. 21, Fig. 22.)*

This is the most numerous group within the burins. It is characterised by variable base form and careful finish. The margin can be retouched, the end blown off. The burin edge can be formed by one stoke or angular as well.

There are some lateral burins made on the broken fragment of some other tools, with "ad hoc" character.

*Carenoid burin (S-B 32)*
9 pieces, *(Fig. 23. 4)*

The artefacts classified here differ essentially from the Aurignacian type. "Busqué" relates not the whole tool but only the way of production for the burin edge. The base form of these tools can equally be on plan-parallel silex sheet, core or core remnant, pebble fragment, wide flake or slender blade.

Occurs also combined with alternate scraper or other burin forms.

The working edge can be closed by a notch, but there is also a Brezillon's "burin busque sans encoche" on corticated obsidian slice. This type gives an archaic character to the industry but it is not a dominant feature.

*Burin on truncated blade (S-B 34, 35, 36, 37)*
14 pieces

Not very characteristic type group in low number.
Transversely truncated: 2 pieces
Obliquely truncated: 5 pieces,
Concavely truncated: 4 pieces,
Truncated in arch: 3 pieces,

Part of the types correspond to classical terminological criteria. Some of the tools with specially careful finish were made on more-or-less retouched flakes.

*Transversal burin (S-B 38, 39)*
12 pieces

Made usually on flake, sometimes by dorsal burin stroke at the proximal end of the flake. Shaping can be completed by linear retouch in full width or parts from the ventral side.

If the raw material was obsidian, amorc cage/decorticage flakes are frequent.

*Multiple burin (S-B 41)*
49 pieces, *(Fig. 22. 3, 4, 5, 7, 8)*

Most varied group, typical and nicely finished, outstanding from the rich set of burins. The separation of the group applied by L. Vértes:
twin form: made along two margins of the same end of the blade or flake
double: made opposite or vis-à-vis
combined with slightly arched scraping edge
has no typological significance.

Few pieces are combined with truncation. More frequently, multiple burins are formed on blades with struck-off end. Part of the multiple burins were made on thick prismatic base form: they were suitable for very robust, suitable for use with force.

Double pyramidal or prismatic forms: these base forms are characteristic of the site, more typical than multiple burins formed on flat blades or flakes. Some tools are of alternate edge, thick, suitable also for plane-like function. These tools were formed by traditional (though rather large) burin strokes,

Some multiple burins made on medial fragment of wide blades resemble Noailles-burins with the difference that retouch at the end of the blades is substituted by one stroke.

Analysing dimensions, these tools can be divided into two groups: traditional combined burins 30–40 mm long, prismatic, alternating edge combined burins with plane function belong to the macro-tools with average length of 60–70 mm.

*Core burin (S-B 43)*
34 pieces *(Fig. 24, Fig. 25)*

Due to the character of the raw material (hydrothermal silices of mainly banked occurrence), these tools were typically made on geometric base forms, raw material pieces in the shape of prismatic pyramids.

At Bodrogkeresztúr, core burin formed on pebble or geometrical base form with arched, wide medial working edge were typical:

– on one side of the burin, with long blade-shape, arched parallel strokes

– on the other side, the burin edge was thinned with some flat and wide scaled retouch

This type of working resulted in a "carenoid" or similar character.

Occasionally this type occurred in combination, most typically with scraper edge along the margin of the flake.

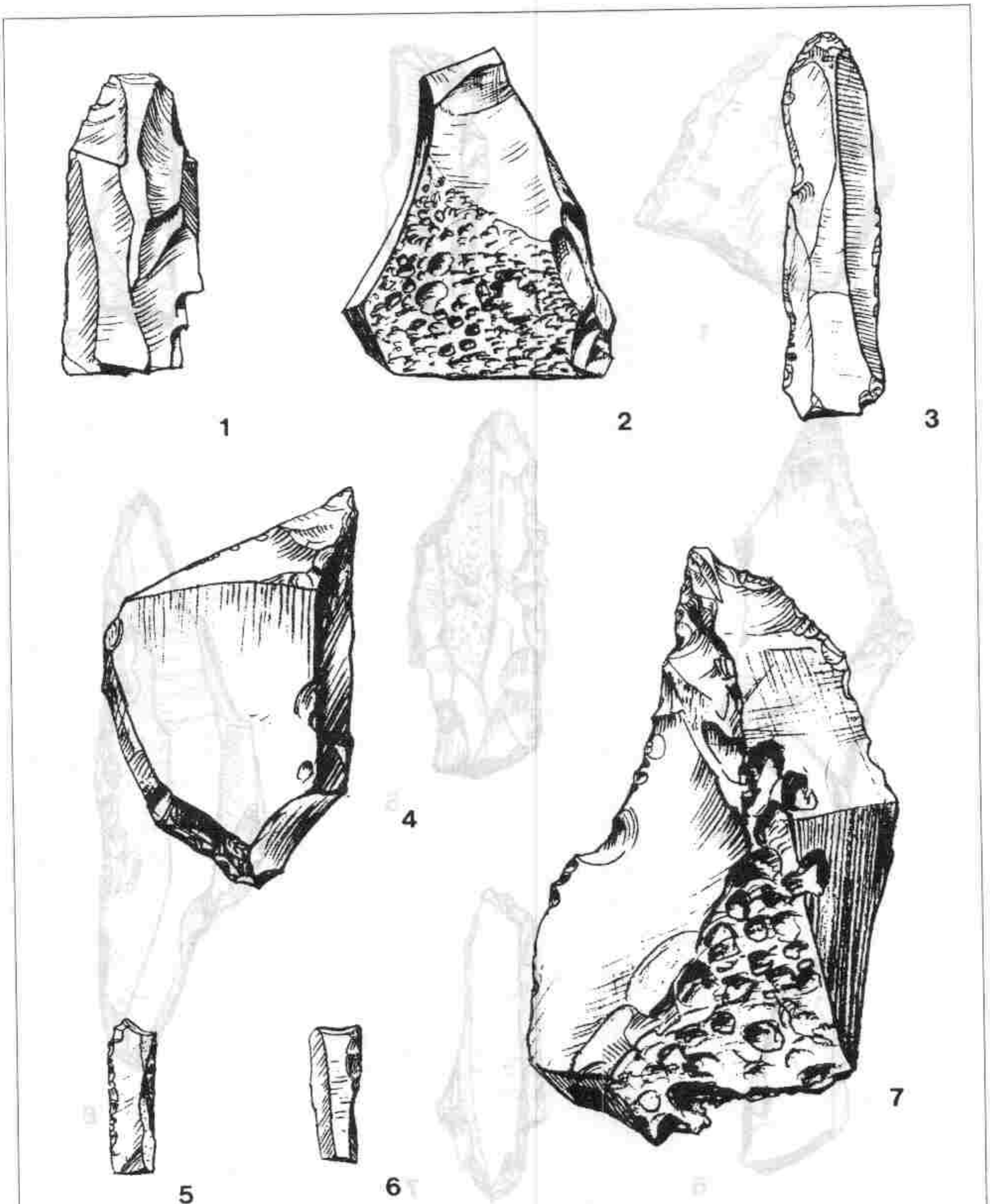



Fig. 20 Lateral and core burins. Scale 1:1

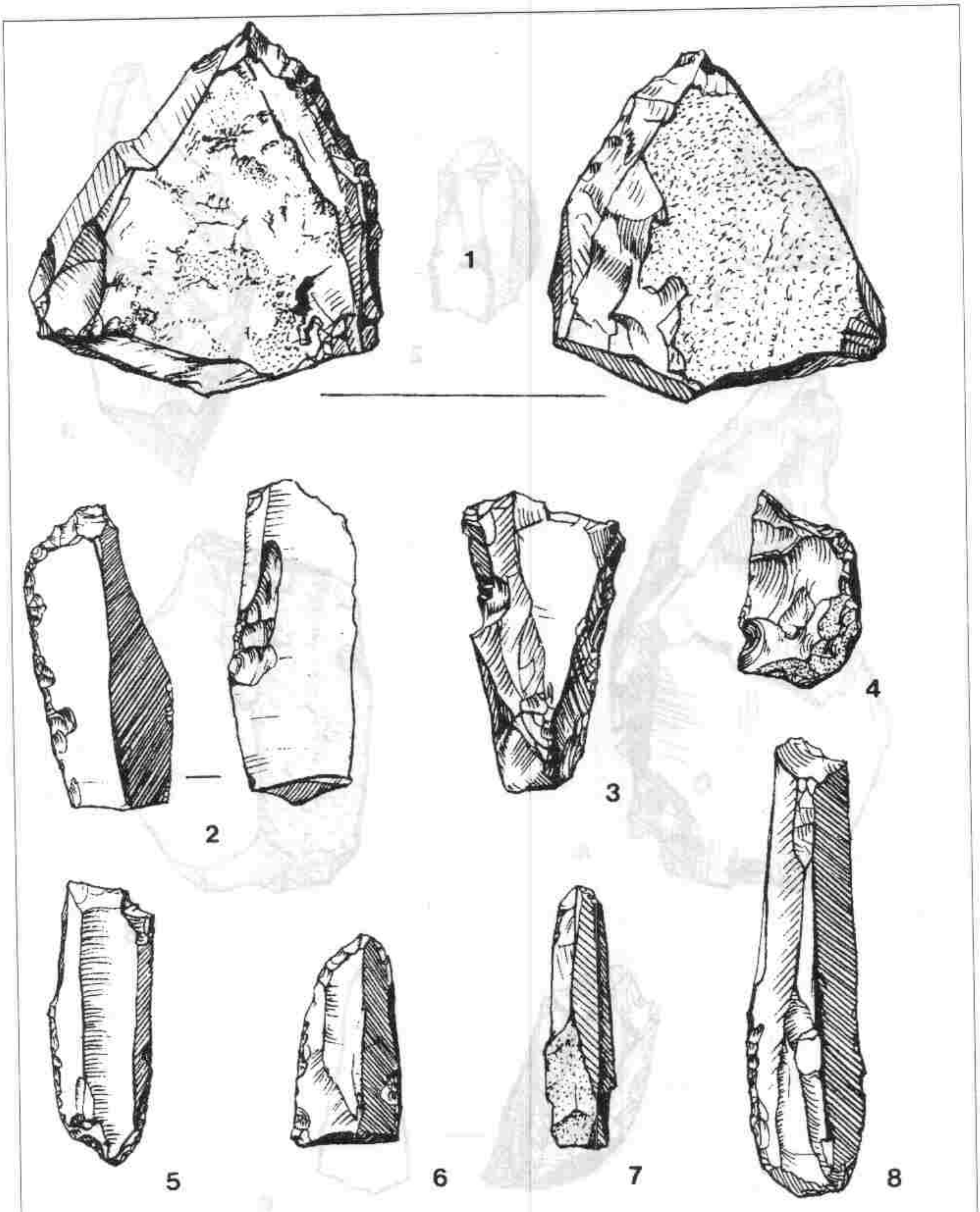



Fig. 22 Lateral, angular, flat burins. Scale 1:1

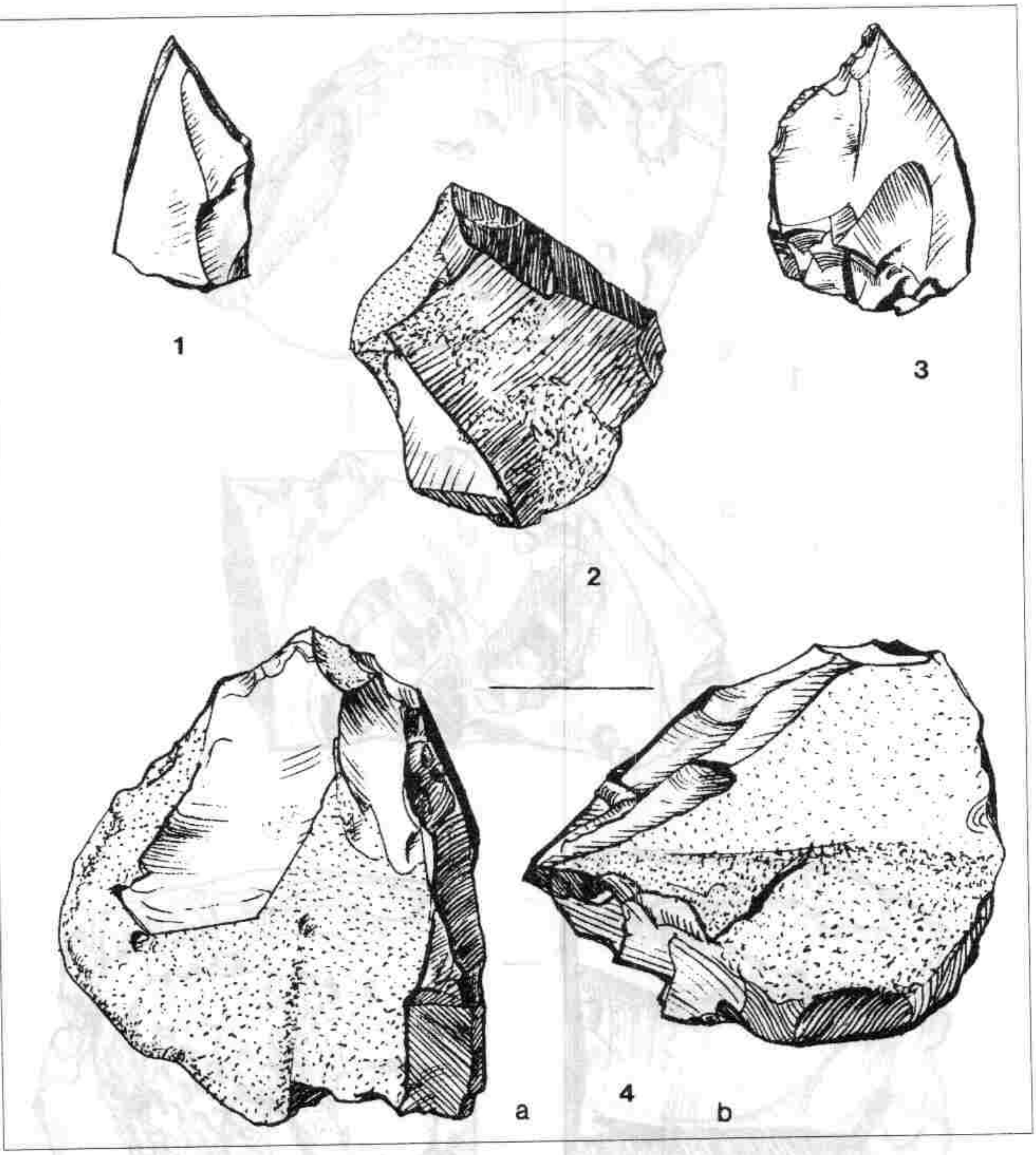



Fig. 24 Core- and multiple burins. Scale 1:1

Within the core burins, multiple burin-combination occurs frequently with variable burin edges (lateral, medial, angular, flat etc.).

*Flat burin (S-B 44)*
12 pieces

This tool type is not characteristic, fairly accidental. The burin edge is mostly blunt (60–70°), and the complete group has some atypical character. One of the tools (Pb 83/615) deserve special mentioning: slightly arched blade, covered on one side of the dorsal side by cortex, on the distal end, flat burin edge, on the ventral side,

combined with truncation on the dorsal side. At the base, on the back side oblique retouch: this piece is nearest to a Kostienki-knife from the whole assemblage. The "relation" is only in type and places of finish, the type however is only reminding to a Kostienki-knife and not actually identical with that.

*Blade points (S-B 46-47)*
26 pieces, *(Fig. 26)*

Exactly half of this tool group (13 pieces) consist of "pointes naturelles (Klingen mit natürlichen Spitze)", known also from Willlendorf. The pointed blades were functional without any further elaboration. Among the retouched blade points there are only 6 pieces which can be inserted into strict morphological type categories (according to the S-B list), i.e., they are close to the typological criteria of the Chatelperron-knife.

Among the other retouched blade point we can find tools formed partly or totally with marginal retouch, crested retouch, steep retouch on the proximal edge (hafting) as well. One of the tools deserve special attention: here, the proximal end of the blade was pointed. The retouch applied in the distal upper third of the right side looks like a "contra-á-cran!".

*Gravette points (S-B 48, 49)*
14 pieces, *(Fig. 27. 1, 3, 4, 5, 6, 7)*

Among the traditional blade points, Nrs. Pb 83/594 resembling Vachons, and Pb 83/710, resembling Krems type points can be specially mentioned.

In case of some Gravette-points, initial hafting can be observed. Some of the bases were truncated by steep retouch. In some cases, the tip of the blade point was flattened by accidental crested retouch, Retouch is sometimes not blunted but simply marginal. In other instances the slender blade with natural edge is only shaped to form and the retouch is not continuous.

*Shouldered-hafted tools (S-B 57)*
14 pieces

*"There are many retouched blades and we find a few Aurignacian-type ones too. The "pi'ece 'a cran" form is frequent and on certain blades even the point in addition to the area of the base is retouched, but the true "point 'a cran" is lacking."*

*(VÉRTES 1966, 10.)*

Typical á cran-forms, both of Eastern and Western European types are missing.

Due to the almost identical function, tools retouched from two sides (hafted) were counted here.

At the end of the blade (mainly on the distal, but sometimes on the proximal end) a shallow shoulder or hafting is formed on a short phase by steep retouch. This tang is so short that it could hardly correspond to this task: the part observed as hafting could serve other functions (e.g., steep truncation running at an acute angle to the base of the tool?)

Shouldering is not typical technological feature of the Bodrogkeresztúr industry.

*Backed blades (S-B 58, 59)*
27 pieces

This type can be further divided into the following groups:

– blade blunted on one side

– blade blunted on one side and retouched (perhaps with alternating retouch) on the other side

– blunted blade, transversally or more seldom, obliquely truncated on one or two end (Rechteckmesserchen). The retouch at the end of the blade can also be on the dorsal side.

– blunting starts from the ridge of the blade with triangular cross section

The average length of the complete blunted blades is about 30 mm. The transversally struck blades must have had a similar function to truncated blades, the natural cleavage surface of silex can give equally useful working surface as blunting.

*Truncated blades: (S-B 60-62)*
26 pieces

transversally truncated (S-B 60) 10 pieces
obliquely truncated (S-B 61) 12 pieces
concavely truncated (S-B 62) 4 pieces

Part of the tools assigned to these groups were primary truncated blades, the other part formed on broken tool remnants or wide flakes obtained in course of shaping a core, a straight, oblique or concave working edge formed by linear retouch.

Truncation is often accompanied by the accidental retouch of the margins. Among the truncated blades we find several with high crest, thick, trapezoid section, prismatic blades, i.e., definitely "heavy" tools, suitable for use by force.

*Blades retouched on one side (or retouched crest) (S-B 65)*
126 pieces

*"At our site blades having a so-called retouched crest are frequent. A part of these are surely not core edges."*

*(VÉRTES 1966, 10.)*

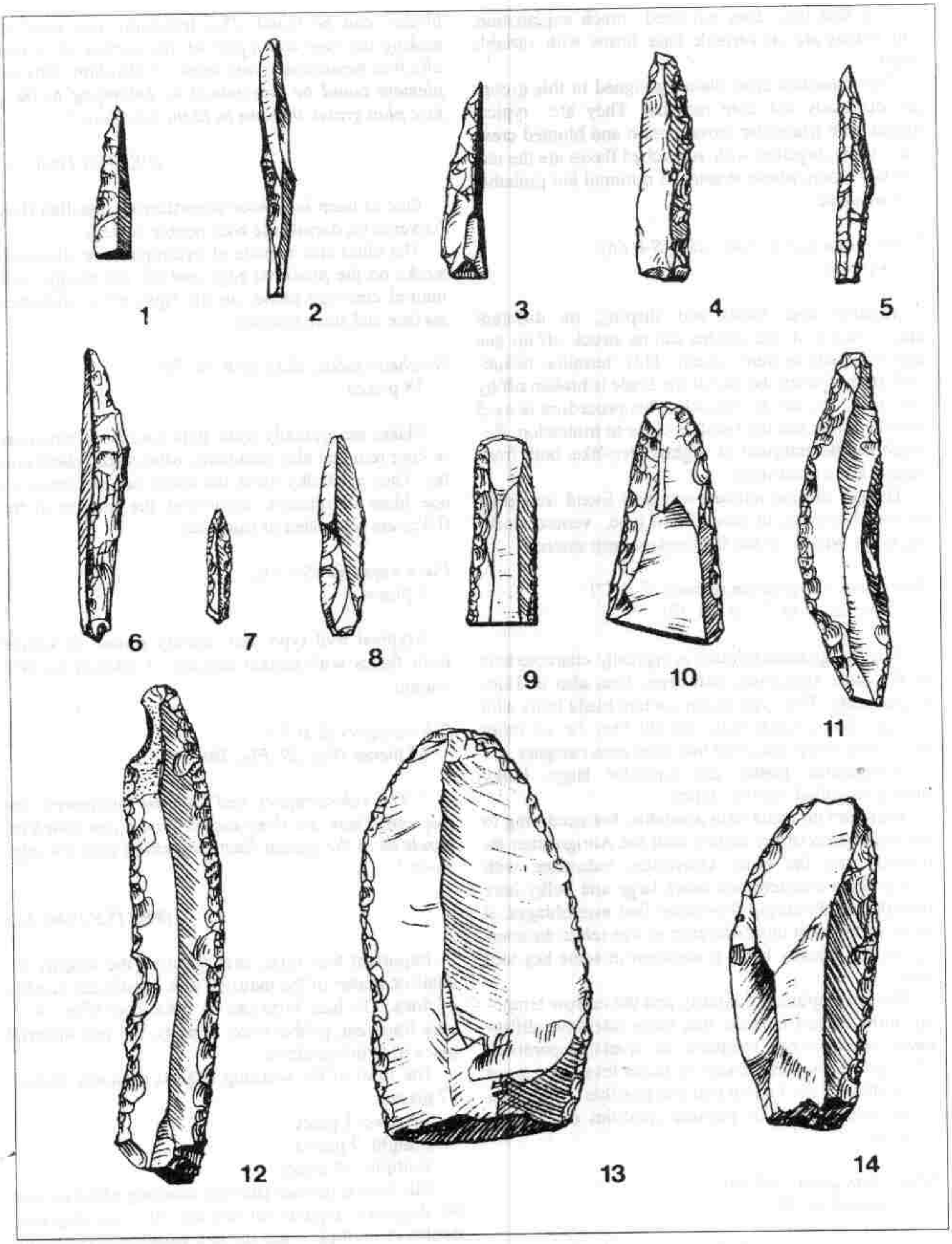



Fig. 27 Retouched blades and blade points. Scale 1:1

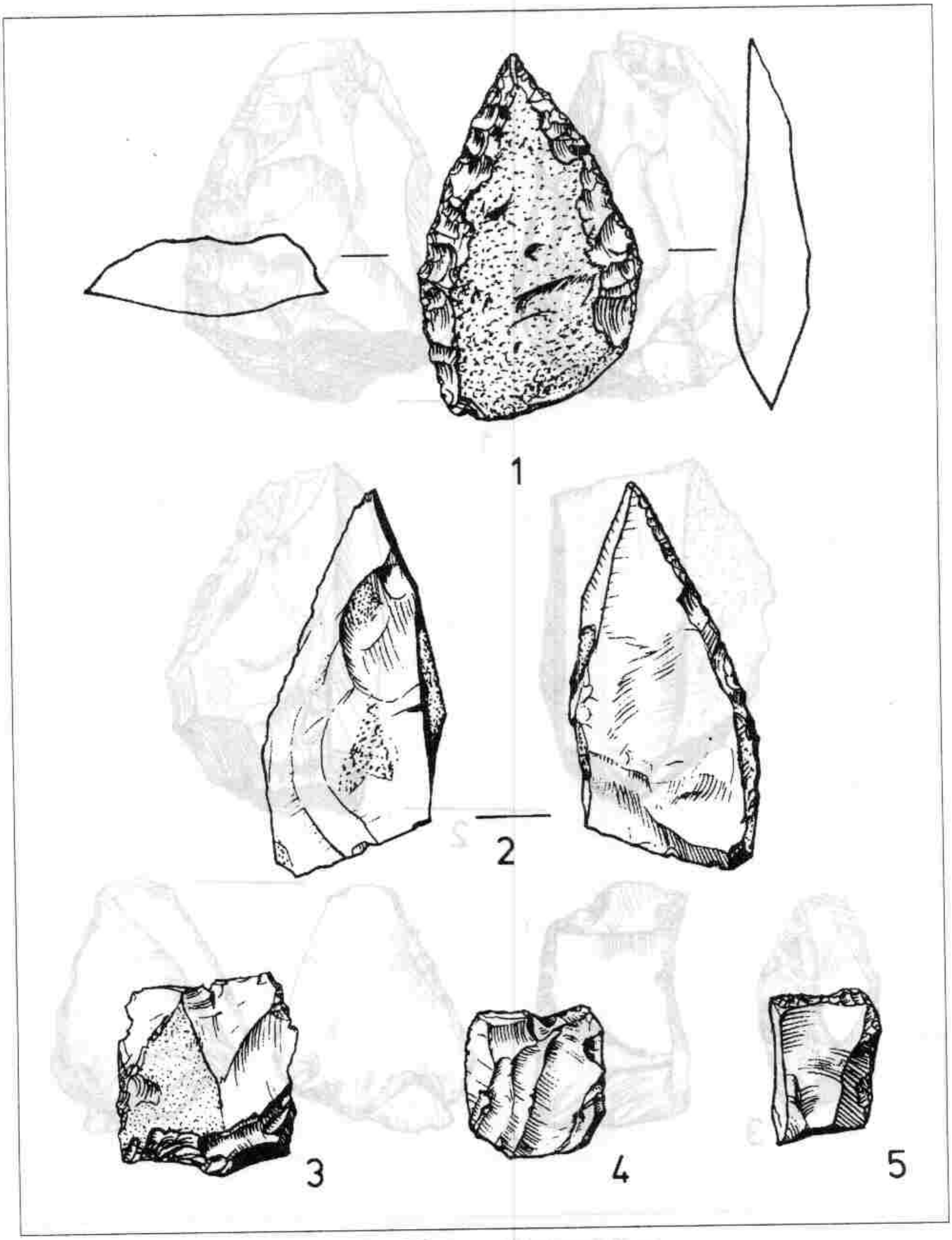



Fig. 28 Mousteroid point, piéce esquillée. Scale 1:1

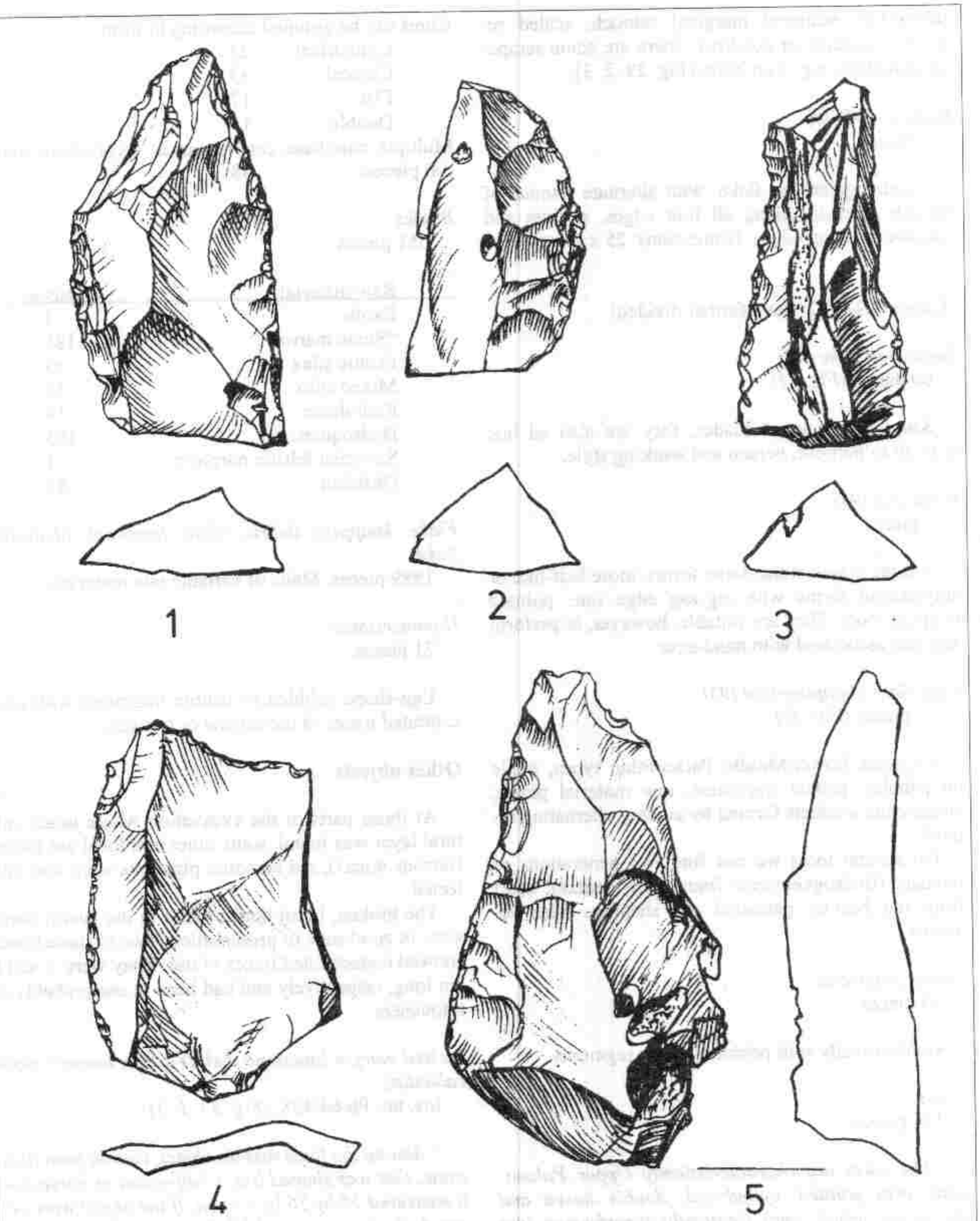



Fig. 30 Side-scrapers. Scale 1:1

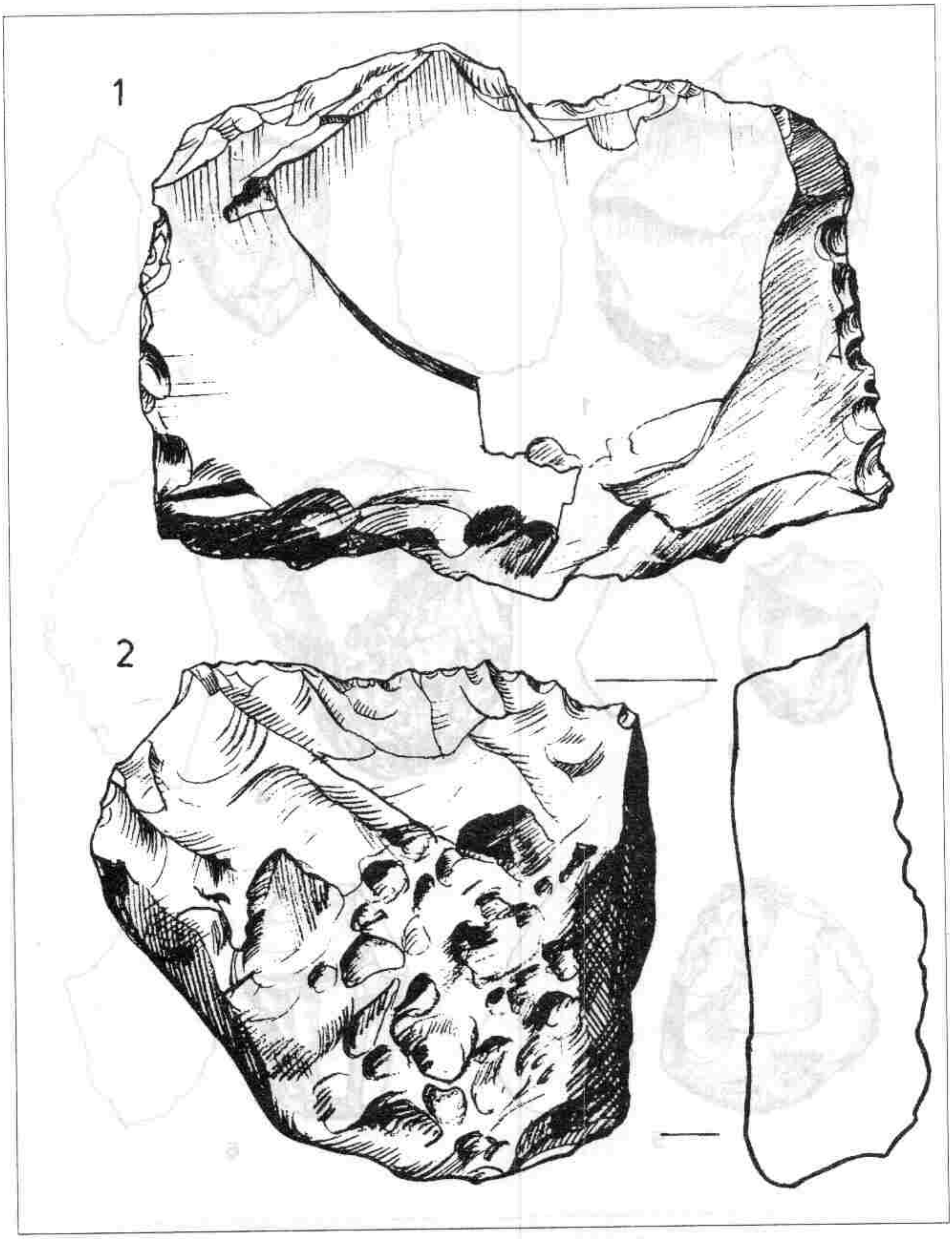



Fig. 31 Worked fragments. Scale 1:1

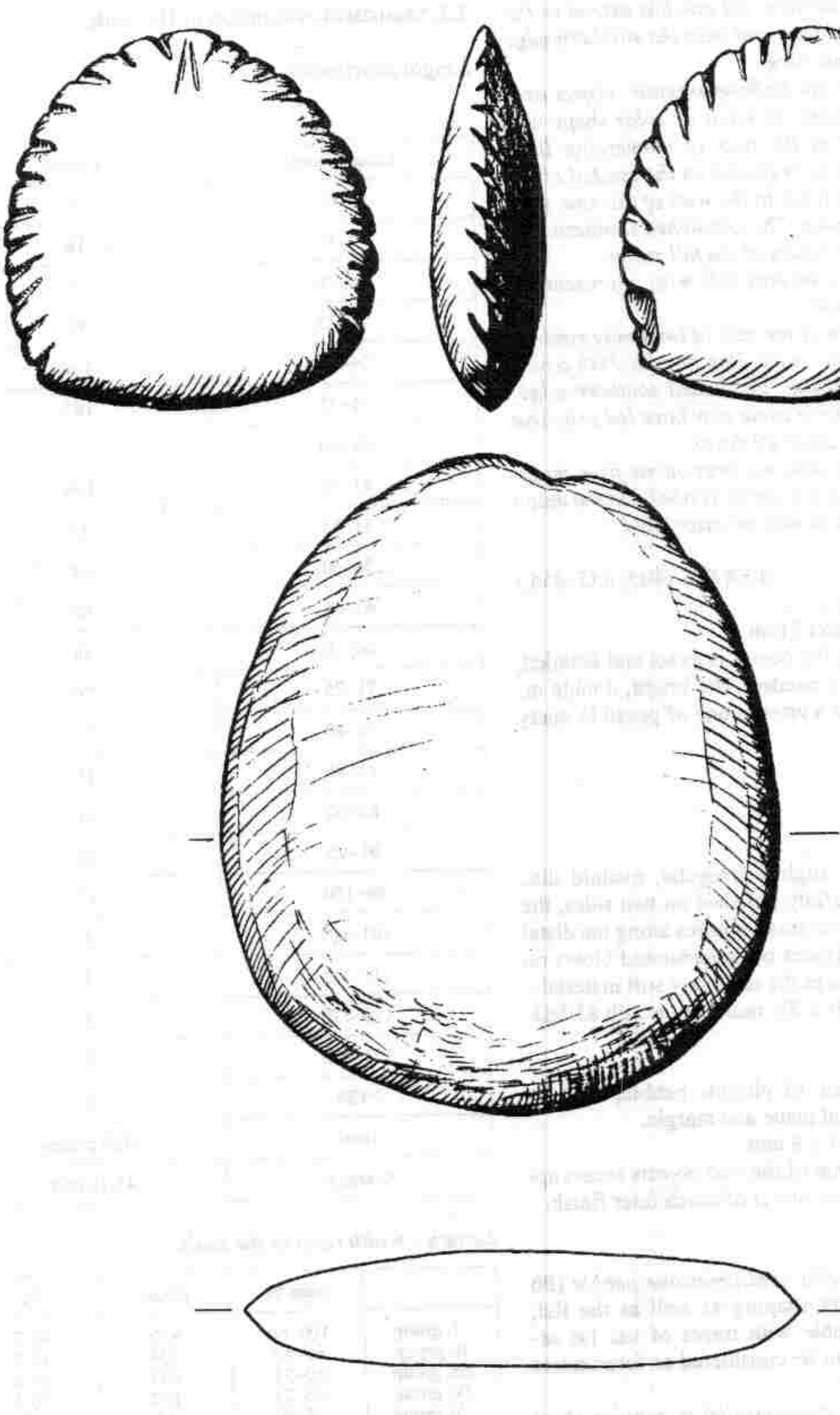


Fig. 33 Incised stone and serpentine disc. Scale 1:1

Bodrogkeresztúr-Henye is a classical blade industry, marked by the base forms of the type list and the number of the unworked regular blades. The numerous archaic tools made on flakes (e.g., side-scrapers) and the worked / geometrically broken pebble tools which do not fit in a blade industry modify the ratio numbers.

According to the calculations by Vértes, the length distribution of (a part of) the blades at Bodrogkeresztúr-Henye is as follows: (VÉRTES 1966, 12.)

| | |
|---|---|
| < 10 mm | 0 blades |
| 10–20 mm | 5 blades |
| 20–30 mm | 21 blades |
| 30–40 mm | 67 blades |
| 40–50 mm | 51 blades |
| 50–60 mm | 44 blades |
| 60–70 mm | 35 blades |
| 70–80 mm | 18 blades |
| 80–90 mm | 6 blades |
| 90–100 mm | 4 blades |
| Total | 251 blades |

Vértes separated 251 blades from the 1963. year excavation and performed statistical calculations on them.

In the last years of his scientific career, Vértes concentrated on the quantitative analysis of morphological criteria for lithic technology, shedding new light on the development of their makers.

He considered probability calculation a suitable tool for a mathematical expression of biological development of prehistoric people. For the characterisation of the stage of development he used a factor considered important by Vértes, i.e. the statistical distribution of tool length data. The proximity of the distribution curve to ideal, Gauss-type distribution was considered as a representation of plan and finish, by the mind planning the instrument and the more or less trained hand to fulfil the concept (VÉRTES 1968, 4–5.)

As a conclusion of his investigations, Vértes hypothesed a general tendency that the standardisation of the finds increase proportionally to the time elapsed as the assemblages grow younger. At the same time, adaptation to new raw materials is time-consuming and in the initial phase of adaptation, learning how to work a new material works against standardisation.

Maybe this is an explanation to differences in blade length distribution, in spite of the fact that traditional "transported" raw materials show high technological development skill. Significant differences between "transported" and "local" raw material working and utilisation was demonstrated by Vértes in course of the elaboration of the Arka-Herzsarét Upper Palaeolithic settlement (VÉRTES 1964/65).

### 3.3. Technology

Apart from generalities of an Upper Palaeolithic tool-producing technology, the following observations deserve special attention:

**Technological specialities due to the raw material applied:**

"Stone marrow", a thick platy-banked (tabular) local hydrothermal raw material was specially important for people of the Bodrogkeresztúr settlement. Consequently, and in the first place, among the artefacts made of this material, high crest, asymmetrical cross-section (often close to a right-angle triangle) were frequent.

Due to the natural cleavage of "stone marrow", the cores made of originally plan-parallel raw material plates are prismatic, with parallelogram cross-section.

On the surface, silex lumps of 3–4 cm diameter can be collected and was probably available in those days. Their use resulted in the production of shortish blade-like implements apart from the classical blade tools, partly covered by cortex, as slices and segments.

Calculating the average length in a traditional way can be therefore misleading because this smaller size group of implements is connected more to raw material than function. The banked hydrothermal silices available in the immediate vicinity of the site were mainly used for macro-tools. The close analogies of some rough "gigantolithes" could be found in the material of Arka-Herzsarét, lying topographically not very far but chronologically much younger. The proximity of the abundant raw material sources lead to a "lavishing" use of the local raw material, hydroquartzite.

**Striking platform**

Apart from the characteristic point-like striking platform there are also dièdre and clactonian (110–120°) and, sporadically worked striking platforms present in the material. The flakes are often oriented obliquely, in a "déjeté" fashion.

**Working edge**

Working edge occurs typically on the distal side, more rarely on the proximal end of the flake. Multiple working edges can be parallel, convergent, and some rough tools with alternate edge (axe-adze function).

**Retouch**

Most typical retouch type is direct, but inverse, alternating and bifacial retouch is also occurring. The most typical array of retouch is linear marginal, or

**Typological-technological observations**[2]

256 pieces of typical tools were analysed, selected from both excavations and the surface collections. The distribution of the selected artefacts, according to traditional archaeological typology is as follows:

108 end-scrapers
101 burins
11 end-scraper-burin combinations
11 rabots
17 blades
8 worked fragments

Raw material distribution:

203 pieces of mixed silices
53 pieces of obsidian

The aim of our investigations was to compare technical characteristics of recent tools and their hypothesed Palaeolithic equivalents. The fact that there are contradictions among the technical terms used for describing some artefacts and their actual function has been demonstrated recently by several traceological studies. *(Fig. 34)*

The basic process of tool-working and shaping is cutting (slivering): from the object to be shaped, smaller or bigger parts are trimmed off using different tools.

The most important condition of the success of work is the selection of working angle of the tool used depending on the hardness of the piece to be worked. The relation of the cutting edge angle of the tool and the hardness of the material to be worked by this tool is an axiom, which can serve as a suitable starting point for detecting the real function of the tools. Hardness of different materials is given by technical literature either as abrasive hardness (Mohs' scale) or resistance to pressure (Brinnel's hardness). Quite often, some individual experimental series are used as "etalon". For bone and antler, typically not their hardness but the bending strength is studied, because they are considered not as the object of the working procedure but as a tool or part of a composite tool.

The variety of indices found characterise different qualities of the material thus these values cannot be converted to each other. On our graphs, on the horizontal axis Mohs' hardness considered. As Mohs hardness is proportional to pressure resistance, Brinnel values were extrapolated.

The cutting edge angle of archaeological types was used to postulate the material worked by the tools. On the basis of analogy between archaeological types and recent tools, some modifications of the typology can be suggested.

We can observe the following on the graph of cutting edges:

1. The working edge of end-scraper inlays is suitable for making round sections and notches is best suited for working on wood and bone. Most of the cutting edges fell into the domain of hard wood-antler hardness. *(Fig. 34)*
2. Working edge of different categories of burins are more steep, the cutting angle bigger and the working edge shorter. *(Fig. 35)*

Higher angle indicated harder material to be worked: these edges could be adequate to work on fresh bone.

3. Obsidian tools of both type groups started with higher cutting edge angle: obsidian is more rigid, fragile and sotf than silex, by the application of pressure the cutting edge get injured more easily.
4. Working edge of tools made of obsidian were, by both type groups, in a significantly more narrow interval.
5. The incrementation of the angle of working edge is not evenly distributed. Disregarding casualties and the possibilities of mistakes it seems that the cutting edge was incremented, as a trend, in five-degree steps.

### 3.4. Comparison between traditional archaeological types and their recent equivalents *(Fig. 36.)*

The most typical Upper Palaeolithic type groups, end-scrapers and burins were, due to their high ratio in the lithic assemblage, probably the most typical working tools.

Using modern terminology, chisels are cutting(slivering) tools with one edge *(Fig. 37)*. The edge may have one or two planes, the line of the edge straight or arched line straight ones can be of right angle or oblique. The character of the working ability of the tool, the cutting angle is determined by the user how the chisel is held in the hand.

Chisels are grouped according to their application:

*Flat or carpenter's chisel* – this working tool correspond best, in archaeological typology, to "Meisselciseau-doloto". The working edge is in the dorsal-ventral plane of the tool, opposed to most implements called Chisels today, which are the descendants of is archaeological "Stichel-burin-rezec" and their derivatives: mortise chisel, plugging chisel, gouge or wedge chisel.

Wedge chisels occupy a considerably important place in the Palaeolithic tool kit as seen in their occurrence ratio. Its function is still the same as in the Palaeolithic period. The difference between a Palaeolithic and a modern wedge chisel (inv. nr.: Pb 64/456) is in the unworked interior triangular profile *(Fig. 37)*,

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[2] partial results published in DOBOSI—HOMOLA 1989, 37–57.

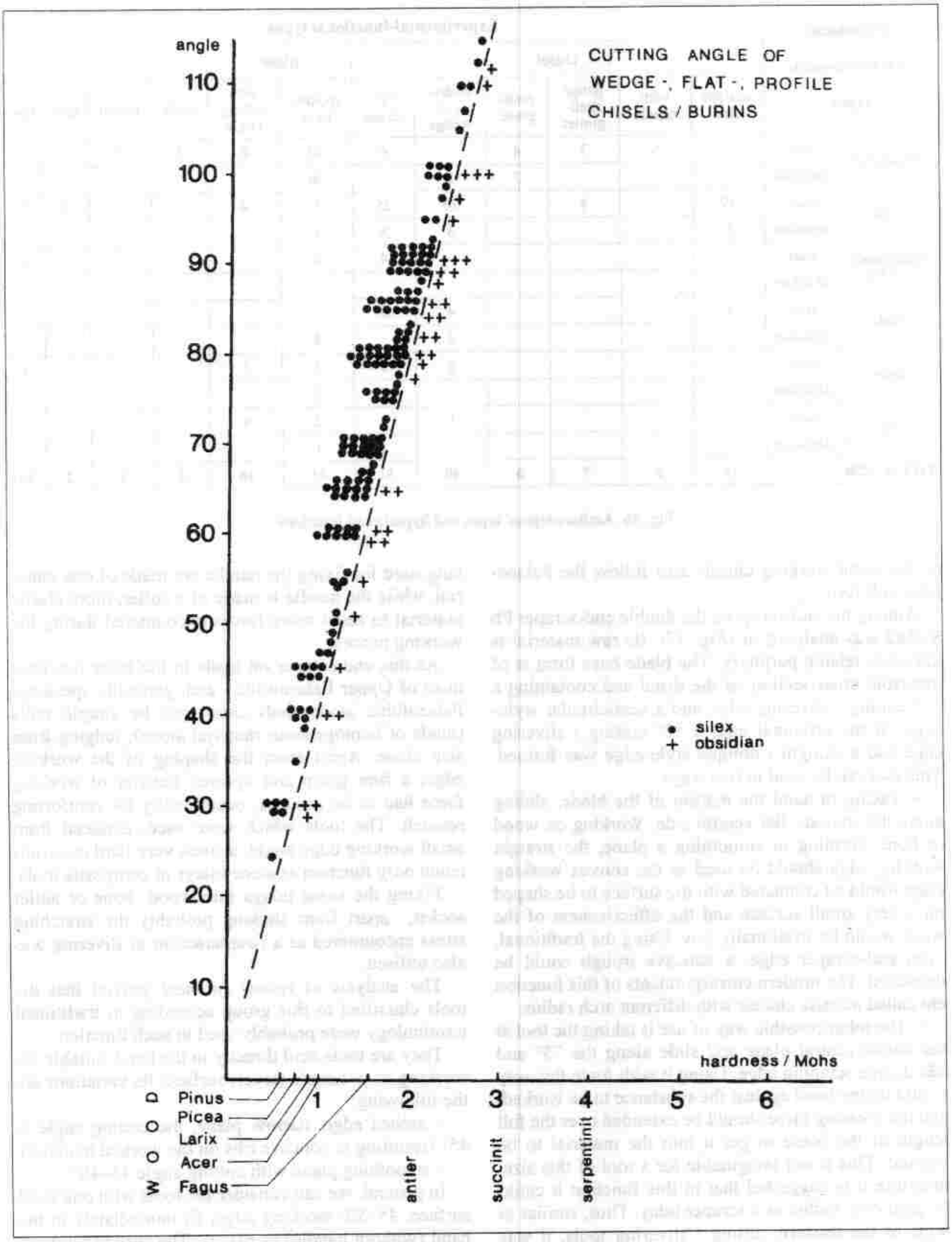


Fig. 35 Cutting edge of chisels – burins

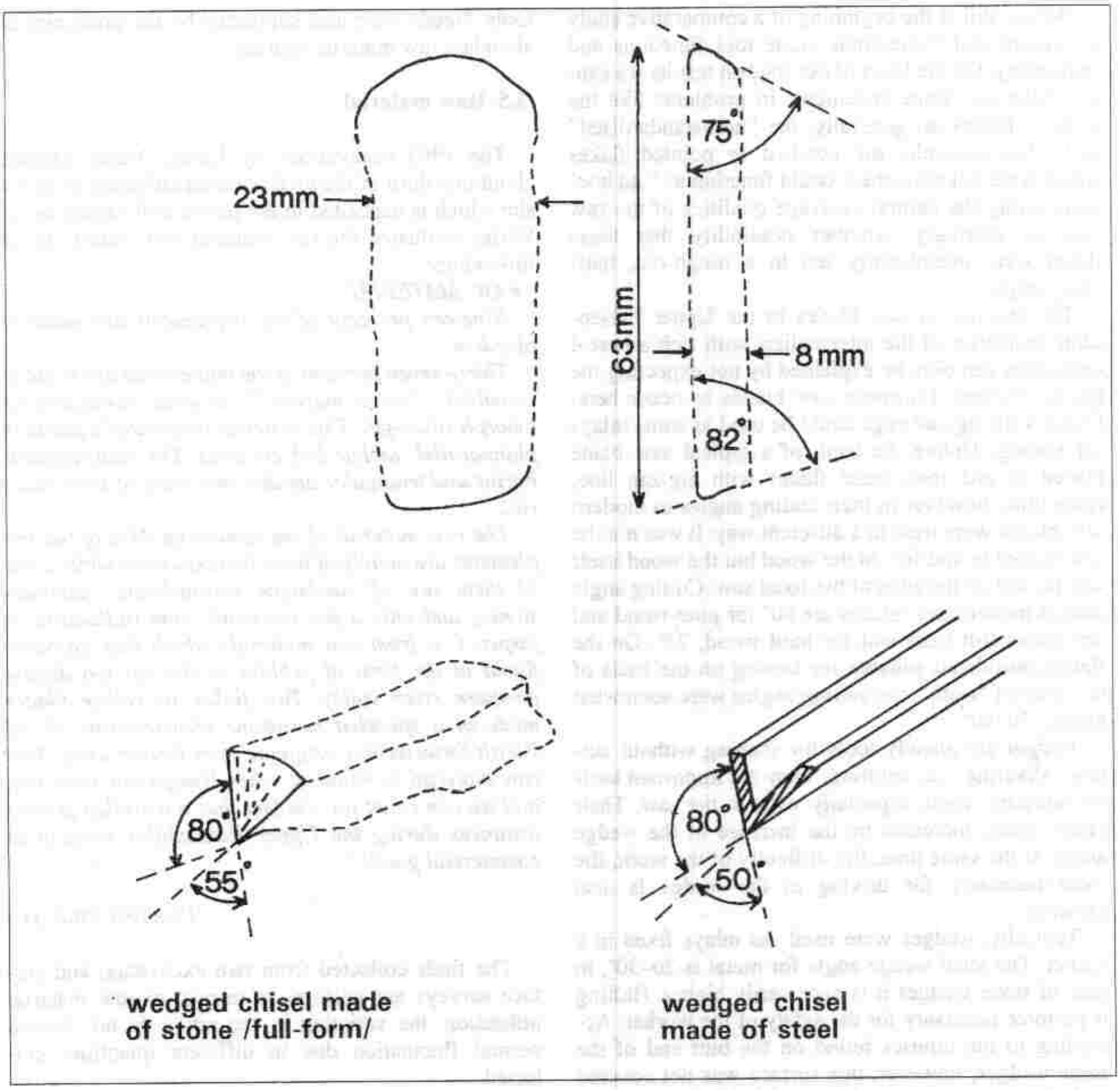


Fig. 37 Working edge angles of end-scraper and modern chisel

*Spoil shave blades* can be used for the final shaping of level and space curve surfaces. Their cutting angle is perpendicular to the back panel. In our case, the steeply/perpendicularly truncated blades or the "blown-off" blades can be considered as spoil-shave blades. This latter procedure simplified the rather longish process of retouch by a well directed blow – the result is an edge perpendicular to the ventral plane. In some cases it should be considered that the objects simply called "blade fragments" could be real tools.

*Style-knifes* are large hand tools used for several functions. To fulfil these tasks, variable working edges are used: arched or lobate, nosed or concave. Their general feature is a smooth base from where the cutting angles start from. In the Palaeolithic choice, mainly core rims, large retouched crested blades correspond to these criteria.

*Borers* do not belong to the typical tool kit of the Hungarian Upper Palaeolithic period.

Among the *non-retouched flakes*, however, series of objects can be found the unretouched lobate edge of which could be suitable for this function. The boring tip is symmetrical, edges meeting a pointed tip with a concave edge. After this, a small "side-peak" prevented the tool from sticking in; in the correct position, splinters can be also detached from the hole by the tool.

**The 100 m thick limnic sequence was accumlated in 1–10 meter deep basins fed by hot spring**

| > 5,0 | 2,0 - 5,0 | 0,0 - 2,0 | depth of water (m) |
|---|---|---|---|
| open water surface | marshy | marshy forest | vegetation |
| slow | medium | fast | extent of enterrement |
| very good | good | bad (delta type) | extent of sorting |
| bad | medium, changeable | very good | oxygene supply |
| dominant | changeable | siliceous | quantity of colloide material |
| quartzite, fine clay | sandy tufite, fine clay | sandy tufite conglomerate | charachteristic formation |

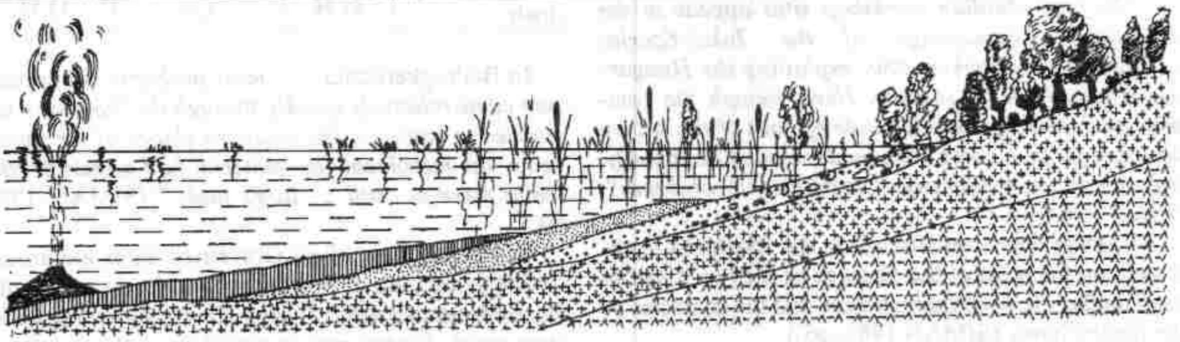

Fig. 38 Geomorphological scheme of the formation of limnic quartzite, reconstruction by Ernő Mátyás

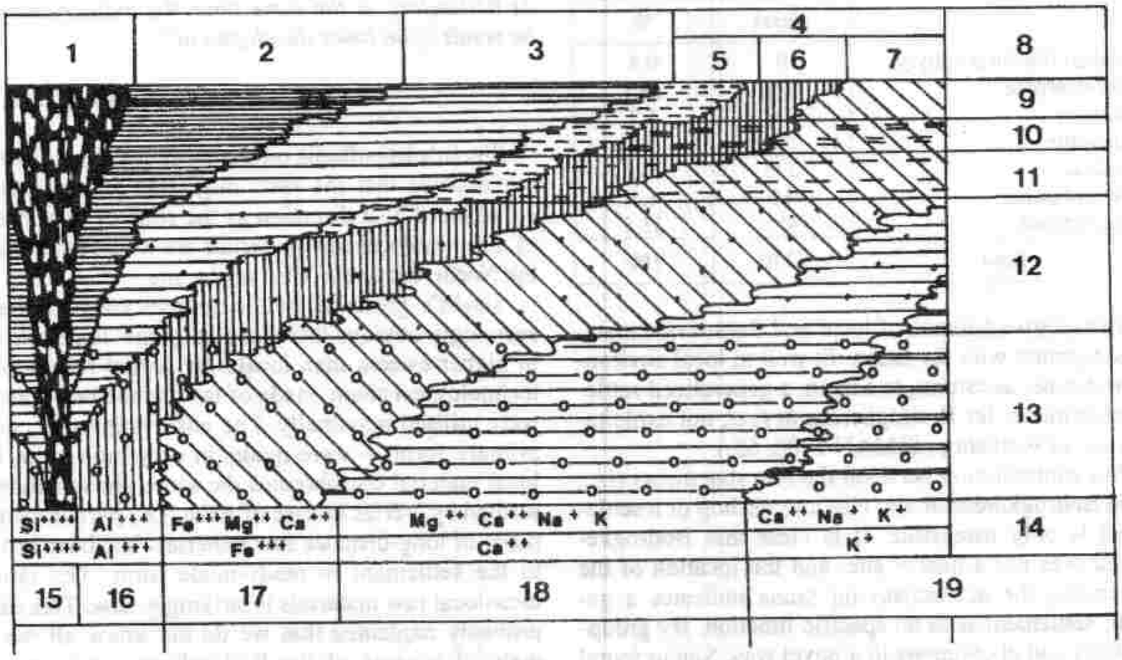


Fig. 39 Different phases of the silicification process, reconstruction by Ernő Mátyás

1. hidroquartzite, 2. thick layers of limnoquartzite, 3. slaty limnoquartzite, 4. fine clays, 5. siliceous silt, 6. kaolinite, 7. montmorillonite, 8. character of the sediment, 9. chemical, 10. pelitic, 11. fine sandy, 12. sandy, 13. gravel, 14. characteristic cations, 15. $SiO_2$, 16. kaolinite, 17. montmorillonite, 18. montmorillonite, allevardite, 19. mixed structure minerals + zeolites

during the Late Pleistocene. They can be collected on the surface even today. (p.c. by Ernő Mátyás). These hydrothermal raw materials were the closest sources of raw materials; they are not found on the site itself but the sources are within sight.

The most special raw material used on the site is "stone marrow". Neither contemporary sites at the other side of the mountain (Megyaszó), nor younger settlements in the north-western neighbourhood (Arka) yielded comparable high ratio of this raw mate-

Raw material distribution of Bodrogkeresztúr– Henye archaeological material according to types (the extended type list contains, apart from the S-B list, the complete artefact type list):

| Types | pieces total | Erratic silex | other | radio-larite | exotic | hydro-quartzite | stone marrow | obsidian | Szele-tian f.p. | Quar-tzite |
|---|---|---|---|---|---|---|---|---|---|---|
| 1–2 | 75 | 10 | 11 | 4 | 1 | 21 | 2 | 23 | 3 | |
| 3 | 8 | | 2 | | | 3 | | 3 | | |
| 4 | 1 | | | | | 1 | | | | |
| 6 | 5 | 3 | | 1 | | | | 1 | | |
| 7 | 3 | | | | | | | 3 | | |
| 8 | 37 | 1 | 2 | | 1 | 16 | 6 | 11 | | |
| 9–10 | 9 | 1 | 2 | | | 5 | | 1 | | |
| 11–12 | 6 | 2 | 2 | | | 1 | 1 | | | |
| 13 | 7 | 3 | 1 | | | 3 | | | | |
| 16 | 19 | | 1 | | | 7 | 9 | 2 | | |
| 17 | 30 | 4 | 3 | 2 | | 13 | 3 | 5 | | |
| 23 | 15 | | 4 | 1 | | 3 | 3 | | 1 | |
| 27 | 58 | 11 | 6 | 3 | | 16 | 7 | 15 | | |
| 28 | 5 | 1 | | | | | 1 | 3 | | |
| 29 | 65 | 10 | 14 | 3 | | 15 | 11 | 12 | | |
| 32 | 9 | 2 | | | | 2 | 4 | 1 | | |
| 34 | 2 | 1 | | | | | 1 | | | |
| 35 | 5 | 1 | 2 | | | 1 | | 1 | | |
| 36 | 4 | | 1 | | | 1 | | 2 | | |
| 37 | 3 | 1 | | | | | 1 | 1 | | |
| 38–39 | 12 | | | 1 | | 4 | 3 | 4 | | |
| 41 | 49 | 11 | 13 | 2 | 1 | 7 | 9 | 4 | 2 | |
| 43 | 34 | 1 | 6 | 1 | | 6 | 11 | 9 | | |
| 44 | 12 | 3 | | | | 4 | 4 | 1 | | |
| 46–47 | 26 | 3 | | | | 6 | 16 | 1 | | |
| 48–49 | 14 | 8 | 3 | | | 2 | 1 | | | |
| 57 | 14 | | 3 | | | 3 | 3 | 5 | | |
| 58–59 | 27 | 10 | 4 | | 1 | 8 | 1 | 3 | | |
| 60 | 10 | | 4 | | 1 | 1 | 1 | 3 | | |
| 61 | 12 | 3 | 1 | | 2 | | 3 | 3 | | |
| 62 | 4 | 1 | | | | 2 | | 1 | | |
| 65 | 126 | 17 | 21 | 4 | | 37 | 27 | 20 | | |
| 66 | 24 | 3 | 5 | 2 | 1 | 10 | | 3 | | |
| 67 | 15 | 4 | 2 | 1 | | 7 | | 1 | | |
| 69 | 2 | | | | | 1 | | 1 | | |
| 74–75 | 18 | | 2 | | 1 | 2 | 7 | 6 | | |
| 76 | 9 | 2 | 2 | | | | 2 | 3 | | |
| 77 | 37 | | | | 1 | 14 | 14 | 7 | 1 | |
| 78 | 1 | | | | | 1 | | | | |
| hand-axe | 7 | | | | | 6 | | | | 1 |
| chopper-chopping-tool | 25 | | | 2 | 1 | 5 | 5 | 11 | | 1 |
| core | 157 | | 8 | 2 | 2 | 50 | 36 | 58 | 1 | |
| core base | 5 | | | | | 3 | 1 | 1 | | |
| geometrical pebble | 13 | | 3 | | | 1 | | 9 | | |
| hammerstone | 21 | | | | 5 | 2 | | | | 14 |
| blade, blade-fragment | 561 | 49 | 39 | 19 | 7 | 168 | 187 | 91 | 1 | |

ment. The original collecting place for the rock crystal could be among the numerous occurrences of the Eastern and Central Alps. These regions were free of permanent ice sheet during the interstadials (DOBOSI–GATTER 1996). This raw material is known to occur on all settlements of the Older Blade Industry of the Gravettian/Pavlovian settlement wave (Bodrogkeresztúr, Megyaszó, Hont-Parassa III) and practically, it is present in the whole Hungarian Upper Palaeolithic /Gravettian entity. Most frequently, rock crystal was found at the chain of Epipalaeolithic settlements near Pilismarót. Their occurrence indicates a systematical, though not frequent and not necessarily direct contact with the source areas.

Some pieces of so-called. "Tarpa silex" is also occurring among the Bodrogkeresztúr finds, classified by Pál Gyarmati as "összesült = baked" silicified rhyolite tuff (GYARMATI 1983, 17.). This light grey, compact rock can be easily recognised on the basis of characteristic resorbeated quartz crystal fragments. Archaeological material belonging to several archaeological periods was found at the outcrop, Tarpa hill from the wall of a small mould disturbed by sand quarry from a loessic sand (residual surface?). Most of the finds were made of this material there (DOBOSI 1983. 10–11). The exact geological source is unknown. The raw material might originate from the Bodrogkeresztúr rhyolite region rather than the small hyperstene andesitic ruined volcano at Tarpa; its occurrence at Bodrogkeresztúr is not surprising. The small extent of its use can be explained by the abundant presence of other, better raw materials. It seems that this raw material can be non-local at Tarpa. Though no typological or stratigraphical arguments are available, the temporal limits of the utilisation of this raw material might indicate that part of the Tarpa material was of Upper Palaeolithic (Pavlovian?) age.

The appearance of the Tarpa raw material in the older Upper Palaeolithic find assemblages of Bodrogkeresztúr (together with stone marrow, which has its primary geological outcrop in all probability at the southern margin of the Tokaj-Presov Mts.) the contemporaneity, or at least, the common raw material source utilisation of the two site groups can be supposed.

**Long distance raw materials**

Occurrence of source-specific raw materials falling in the category of regional or long distance raw materials in considerable ratio can be, to some extent, proof of certain control / ownership over the raw material sources.

In case of Bodrogkeresztúr, the known geological sources point at the North and the North-East. Characteristic and unique items include, e.g., felsitic porphyry from the Tatár-trough of the Eastern Bükk Mts., the characteristic Szeletian raw material known under many names. The dotted chert from Swieciechów can be located quite safely. The Eastern parts of the Polish Mid-Mountain range separated as Holy Cross Mts. served as the primary geological source of this very characteristic, small yellow dotted silex of good quality which has been found sporadically in the Hungarian material since the Middle Palaeolithic. In the material of Bodrogkeresztúr, at least 5 tools were made of this raw material (Pb 64/50, 65/1270, 66/65, 83/624, 809).

The minimal distance between the settlement and the geological sources, considering the route Bodrog-Ondava-Dukla pass -Wisloka-Wisla valley is 300 km, that is, far surpassing the daily movement, usual "action radius" of the community.

Another "long distance" raw material is the so called Erratic / Baltic flint. The name itself indicates the heterogeneity of the raw material, therefore its localisation is very "fuzzy". This type of silex can be collected in the terminal moraines, their primary source could be practically anywhere within the extended "ice-catchment area". Their closest generally accepted secondary collecting spots are at the terminal moraines deposited in the Riss period in Silesia, Special raw material collecting expeditions could have been directed to these regions (KOZŁOWSKI 1970, 8). Raw material classified as "Erratic" at Bodrogkeresztúr were, in all means, long distance goods, even in the case when the terminal moraines could be found more to the South than Silesia, as supposed by J. KOZŁOWSKI. We have no information on secondary geological sources of Northern flint within the Carpathian Basin. Comparative Erratic flint samples of the Lithotheca offer little help. The exact identification of the quite often heavily patinated and carefully worked artefacts is a task for the future.

In Simán's paper, some tools are supposed to belong to Baltic flint the raw material of which are not known either from inside the Carpathian Basin or from its environs (Pb 64/228, 474, Pb 83/921, 279). (SIMÁN 1990, 18.) The tools made of "Baltic flint" in Simán's view were carefully worked, small tools, probably brought ready-made from a former station.

Some tools were made of the so-called "Prut silex", i.e., a mainly graphite grey, silky lustre fine material with brownish translucent edges. Bulk of the tools of the Esztergom-Gyurgyalag Upper Palaeolithic site were made of this material (VARGA 1991, 269.). The utilisation of this material reached its heights, after the Upper Palaeolithic period, in the Copper Age (Bodrogkeresztúr culture), both in technology and quantities, appearing in graves as high prestige grave goods.

The upper reach of the river Prut where this raw material can be collected is about 400 km from our site. The immediate connection of the two regions are blocked by the Eastern Carpathian arch, reaching an average height of 2000 m altitude. The objects are the following: Pb 64.1.23, Pb 64/292, Pb 83/60, 565, 572,

**The horizontal and vertical position of the finds**

During the two excavation seasons – 1963. and 1982., respectively – several sections and trenches were opened on the top of Henye hill *(Fig. 5.)*.

In opening the excavation sections, the primary factor was the concentration of finds. Not all of the sections came up to expectations. This is especially true for the sections cut in 1982, because the official and amateur collecting activity spoiled much of the surface features. The seemingly disordered layout of sections and trenches therefore followed the surface morphological features and covered, approximately, the original (Palaeolithic) concentration of finds. For an easier orientation among the finds the introduction of certain "Units" (see: settlement units, *fig. 5.*) became necessary.

The observations made during the two excavations partly corroborated, partly completed each other.

Dividing the hilltop according to quarters, the geodetic spot height was used. Sections and exploring trenches were fixed relative to the spot height. Data on the intra-site topography were collected from the excavation registries.

Observations by László Vértes in 1963. were the following:

– finds were concentrated in an irregular patch around the geodetic point in a circle of cca. 20 m diameter,

– cultural layer was observed in the depth of 60–70 cm,

– just below the cultural layer, at 70–80 cm the underlying base rock, andesite was found,

– in the trenches, there were 30–40 cm mixed, disturbed soil containing sporadical finds in obviously secondary position,

– on the southern part of trench "A", immediately under the disturbed layer at 60 cm intact cultural layer was found. Ploughing did not reach that far,

– the material of the cultural layer (i.e., brownish loess) did not seem a filling for pits or artificially coloured area, much like if it were a fossil soil, also by its argilaceous touch, especially in sections H-F-D (1963),

– on the intact parts of trench "A" preserved in stripes, some silex and bones were found though not many

– there was a 60 cm deep ploughing on the are, cultural remains were intact only below this level,

– probably, the central parts of the settlement were destroyed by disturbances.

Information on the position of the cultural layer from 1982.:

– there were worked tools, flakes, fragments present in all profiles, in the disturbed loess as well as the ploughed soil,

– in the intact or only shallow ploughed sections there was a yellow, homogeneous loess layer free from concretions, its thickness varies between 10–20 cm,

– the cultural layer was on the border of this yellow typical loess and the underlying limy, whitish loess-like sediment. The boundary was not sharp and definite but gradual,

– the cultural layer itself was a brownish embryonal soil with humus and limy mycelia,

– 10–15 cm below the cultural layer a level saturated with loess concretions could be observed; under this, the andesite base rock followed.

The layer sequence, vertical array of finds were different in the different exploring trenches and sections. According to excavation experiences, not only the unevenness of modern disturbances and cultivation could be reconstructed but the relative and absolute depth of the cultural layer allow some conclusions on the original surface, form and relief of the hill as well.

Observations concerning the hill-top, 1982.:

– The Palaeolithic campsite was settled on the hilltop, at the supposed central parts, immediately over the andesite. Just in the periods preceding the formation of the settlement, considerable erosion must have been in operation: on the more protected slopes, original loess sediment can be found below the cultural layer including probably the sediments washed off from the slope.

The **North-East** of the geodetic point, there were two excavation units, section "F" from 1963 and trenches 3. and 8. connecting unit I. from 1982.

In section "F" (35–40 m to NE from the geodetic point, the surface is 1,90 m deeper) in the depth of 100–110 cm, burnt patches of cca. 10 cm thickness were found. No archaeological finds were found beside this hearth.

Base rock was found in the depth of 340 cm. In trenches 3–8., the same phenomenon was encountered in the depth of 130–140 cm, together with scattered settlement margin features, some flakes of stone and bone.

Archaeological features were not found in comparable depth at other places on the excavated hill-top. It was, in fact, not possible to reach that deep (base rock was appearing much higher, not deeper than 1 m). Finds and the terracotta-like thick burnt hearth patches were "in situ", found in their original place and not washed in/down by erosion.

The possibility of a second, deeper / older cultural layer was considered and subsequently rejected because:

– in these NE sections, no traces of cultural layer above the hearth level was observed (no direct superposition)

– The average depth of the cultural layer can be accepted as 70 cm; significant differences were only found in the hearth level of the north-eastern cleft. The loess covering the settlement surface by the end of sedimentation and the accumulation of the loess was probably much thicker (see the thickness of the cover sequences in the north-western sections). The lack of these sediments today indicate a strong denudation. The transformation of the surface, started in the Late Pleistocene was finished by intensive modern cultivation and deep ploughing, destroying the glacial sediments almost till the base rock.

– By the time of the Upper Palaeolithic habitation, the loess formation of the preceding periods had already levelled the andesite surface. The different depth the base rock from the current surface can be explained by this.

**Hearths**

On the surface of the excavated undisturbed settlement parts there were many, more or less scorched, burnt bone fragments found. Constructed hearths – deepened into the soil or built to any small degree – were not found during the two excavation seasons.

The "hearths" were found on the margin of the hypothesed settlement surfaces (find concentrations), associated with no finds at all or a very scanty number of finds. They were found in section "F" of Vértes's 1963 excavation and in trenches 3. and 8 in Unit I. of 1982. *(Fig. 40)*. These "hearths" were mainly irregular, more smutty than burnt patches with a minimal quantity of charcoal in bad state of preservation.

The hearth place in trench 3.–8. was heavily burnt, like terracotta in a depth of 10 cm. It was accompanied by only very poor material, just enough to signal the presence of the cultural layer.

Vértes mentioned palmful dark patches on the intact settlement surface found in the loess. These ashy patches were rare but marked the presence of the cultural layer even on the parts void of finds. Vivid red spots occurred in all sections, however these were independent of human activities being the weathering product of one type of the local rock.

**Archaeological observations regarding the fauna**

Apart from the palaeontological evaluation of the fauna, which was relatively rich and in adequate state of preservation, we could observe that limb bones and mandibles were fairly frequent within the material. The occurrence frequency of these two regions of the body depend on the way of utilisation of the booty.

The distribution of the bones is uneven on the settlement: probably, they were connected with the settlement patches / Units which could not be delineated precisely because of the modern disturbances.

Vestiges of mammoth were found on the southern part of the settlement.

Though the section or surface colour of the settlement surface did not suggest any artificial formation of the surface, i.e., pit, around the mammoth jawbones, the base level of the mammoth mandible was a definite walking level.

The features around the mammoth mandible were interpreted by Vértes in the followings:

"*Mammoth Mandible. The mandible of a mammoth was found in squares 1, 2, 4 and 5 of surface G. It lay in the yellow loessy material, undisturbed, approximately 80–90 cm below the surface (Fig. 41). Under it was an entirely sterile stratum 40 cm thick. The mandible lay with the teeth downwards, forming an angle of 340° to the north-east. The mandible was damaged near the roots of teeth. The roots of the teeth were exposed, otherwise it is well-preserved.*

*In the circle (with a radius of cca 1 meter which can be drawn around the mandible we found seven implements 22 unretouched blades, 3 hammer-stone fragments made of sandstone pebbles and 30 flint flakes on the same level. Among these a few rested on the bone. A part of the flint was lying on a slant as if the mandible had been in a shallow pit.*

*The excavation squares around the mandible of the mammoth were poor in bone finds. Generally speaking, few bones were found in the western section of the trenches. The single mammoth mandible in the shallow pit surrounded by hammer-stones, implements and flint waste was most likely to have been a sort of stool or anvil in a small workshop.*

*(VÉRTES 1966, 13.)*

**The state of preservation of the finds**

On the basis of archaeological experiences, the embedding sediment of the cultural layer of Bodrogkeresztúr-Henye resembled the classical loess of open air sites.

The Henye-hill loess is more suitable for the fossilisation of the fauna than the weathered volcanic soil in the interior valleys of the mountain. In the latter, organic remains were consumed with the exception of some tooth enamel plates (experiences by L. Vértes at Arka and K. Simán at Hidasnémeti).

On the Bodrogkeresztúr site, bones remained relatively completely. The difficulty is caused by the thick limy coating on the lower surface of the bones which could be detached only with part of the bone. This feature did not help much in recognising and preserving worked bones.

The stone tools found "in situ" within the cultural layer and, to some extent, also the surface finds were often covered with thick limy crust, sometimes 5 mm thick. For the precipitation of such a bulky lime coating, a lime-rich cover layer of at least 70 cm thickness as well as long eluviation period was needed.

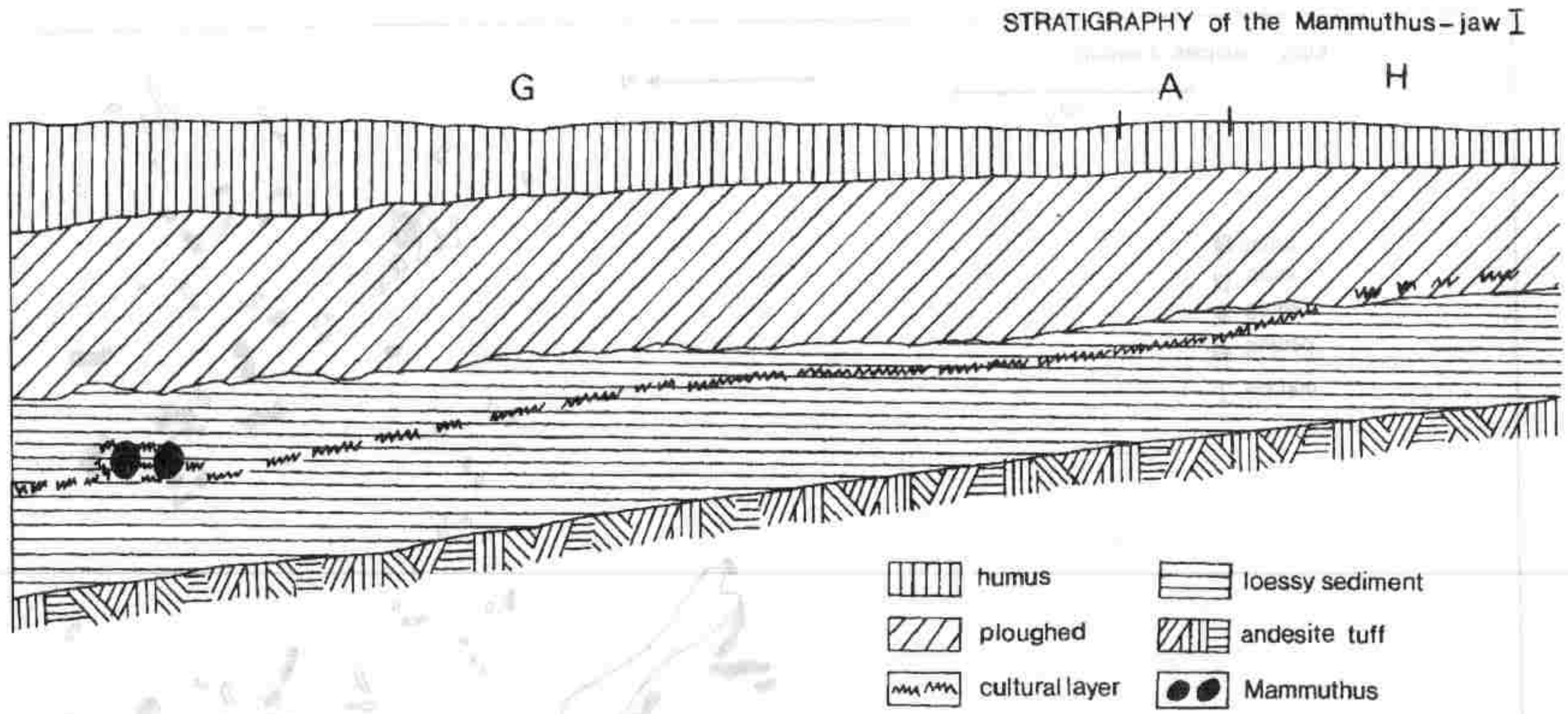


Fig. 41 Stratigraphical position of mammoth mandible (after Vértes L.)

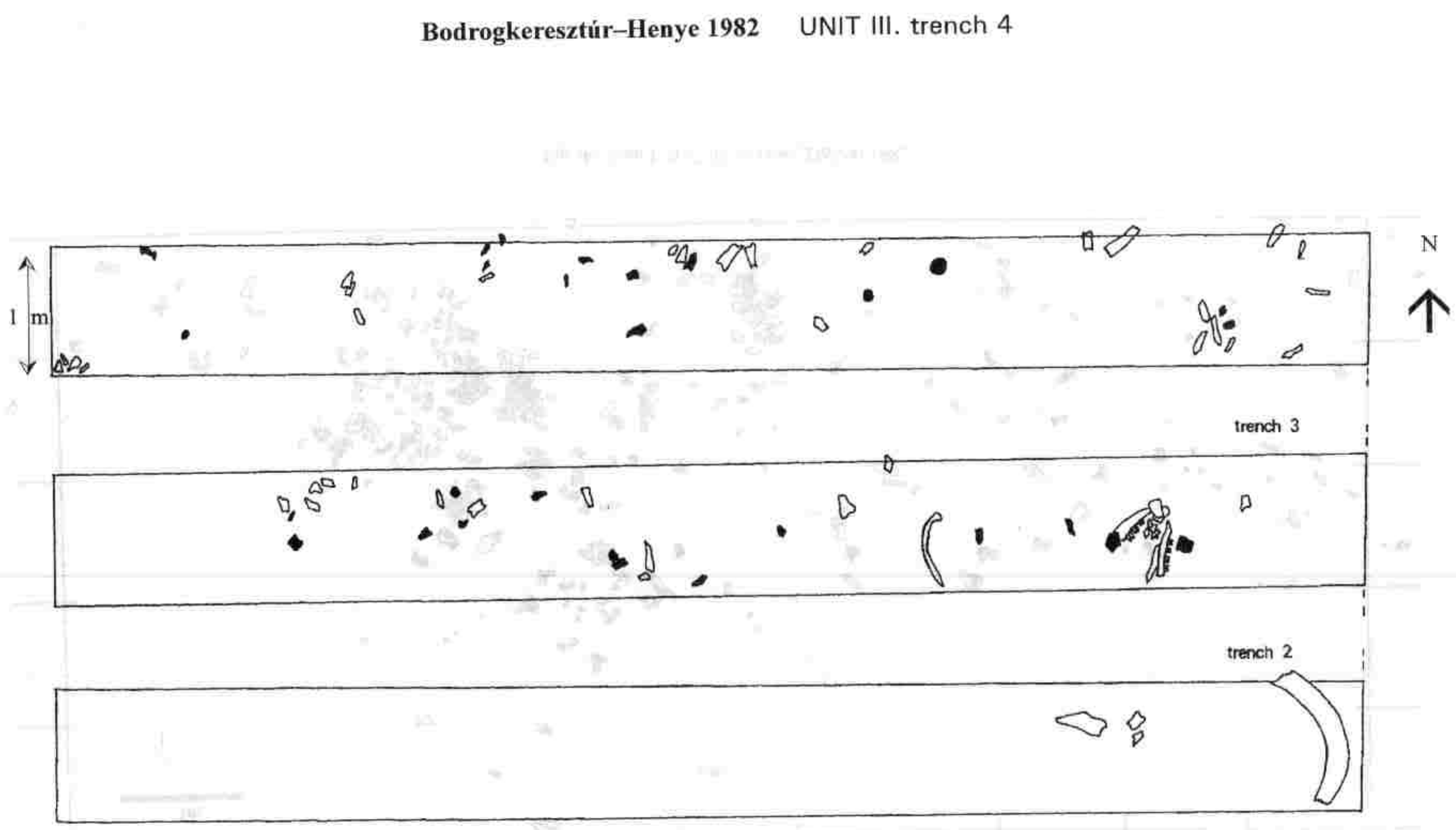


Fig. 43 Unit III surface plan, Dobosi 1982

**Bodrogkeresztúr–Henye 1982 UNIT II. trenches 2–4.**

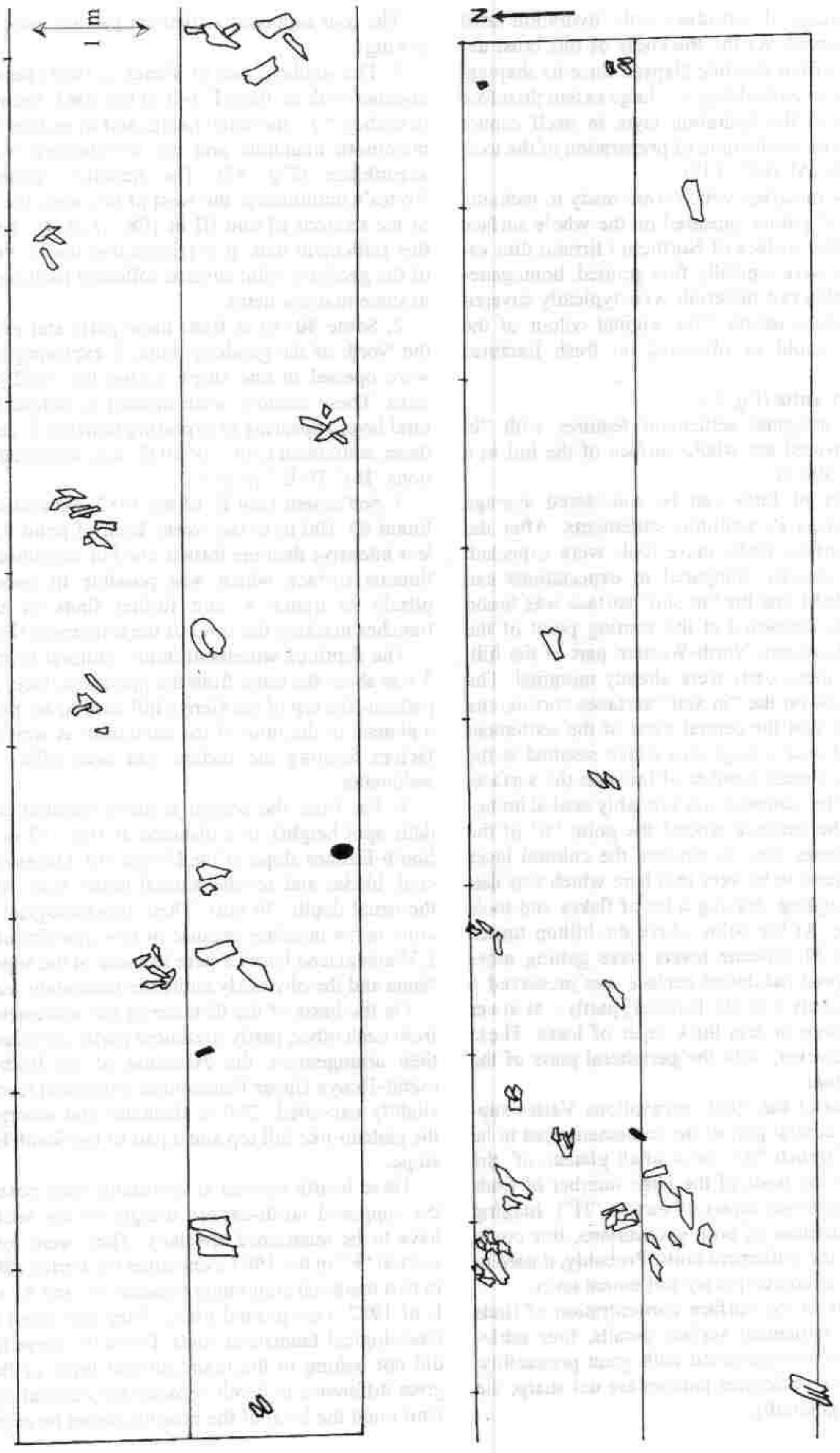


Fig. 45 Unit II, Dobosi 1982

given the few meters' distance between them. The difference is bigger than between the cultural layer and the current surface. These burnt patches can be even the traces of natural fire as well .

The two hearths were separated by a stripe void of finds (Unit I. trenches 5. and 7.) from the central areas of the settlement. The level of the base rock (andesite) here is about one meter deeper than in the neighbouring trenches. We can justly suppose that permanent camp fire was placed here, sheltered by a natural cleft or ridge (the soil was burnt in a thickness of 10–15 cm).

These find concentrations, settlement units exceeded the extent of usual tent bases generally found on temporary hunting-camps. The disturbances spreading the finds on the surface effected only the objects on the surface. In case of the "in situ" objects, the horizontal array and the identification of at least four contemporary settlement units corroborate the natural strategical importance resulting from the geographical position of Bodrogkeresztúr-Henye.

Though the specific settlement features that would prove a permanent / winter camp were missing and there were no traces of artificial constructions found, even in the "in situ" Bodrogkeresztúr-Henye was obviously more than a transitional camp-site used for one hunting season.

**Horizontal distribution of tools, half products and flakes**

Bodrogkeresztúr-Henye hill was more or less covered with finds around the geodetic spot height. The places where some concentration of finds were observed were opened by authenticating excavations. Thus approximately three settlement patches were delineated.

The exact position of the surface finds collected during several years cannot be identified any more. On the surface, agricultural cultivation of the soil reworked the finds coming from the three settlement units and spread them all over the plateau, covering up the (possible) barren stripes. The significance of observations concerning the settlement structure was not evident at the beginning of the excavations. The other reason why these considerations are only of informative value is also rooted in heavy disturbances: the size of the authentic, excavated cultural layer surface at the different settlement patches vary to a large extent.

The percentage distribution of different type groups collected from the surface and the different excavation units is given below:

| Type groups | Surface | Vértes 1963 Dobosi-unit III | Dobosi unit I | Dobosi unit II. |
|---|---|---|---|---|
| Tools | 17 | 15,8 | 18,2 | 23,2 |
| archaic elements | 2,8 | 2,4 | 3,4 | 1,7 |
| Blades | 14,4 | 11,9 | 18,7 | 9,1 |
| Flakes | 62 | 67 | 52,7 | 64,3 |
| Cores | 3,8 | 2,9 | 7,0 | 1,7 |

Vértes 1963 and Dobosi 1982 Unit III: mainly workshop character, low number of finished tools and many flakes: it could be a refreshing, resharpening place because the number of cores is also low

Unit I: among all settlement patches, most of the archaic tools were found here. The relatively high ratio of blades and cores indicate primary tool-producing workshop activity

Unit II: the highest ratio of finished tools was found here, especially that of burins which is double the value of the two other units. The number of half-products and cores is low.

The results are reliable in the basic tendencies: there were only minor differences within the type spectra of surface collected finds and the three find concentrations. The close values within the settlement patches of Bodrogkeresztúr-Henye indicate uniform functions.

The evaluation of the nearest analogy in all sense (topography, chronology, settlement features) Megyaszó-Szelestető gave significantly different data: ratio of tools is less than half here (7%), ratio of blades lower (5%) but the amount of flakes is much higher (over 80%)

At Bodrogkeresztúr, the statistics of surface finds did not show eminent values, surface collection can be considered as a representative sample.

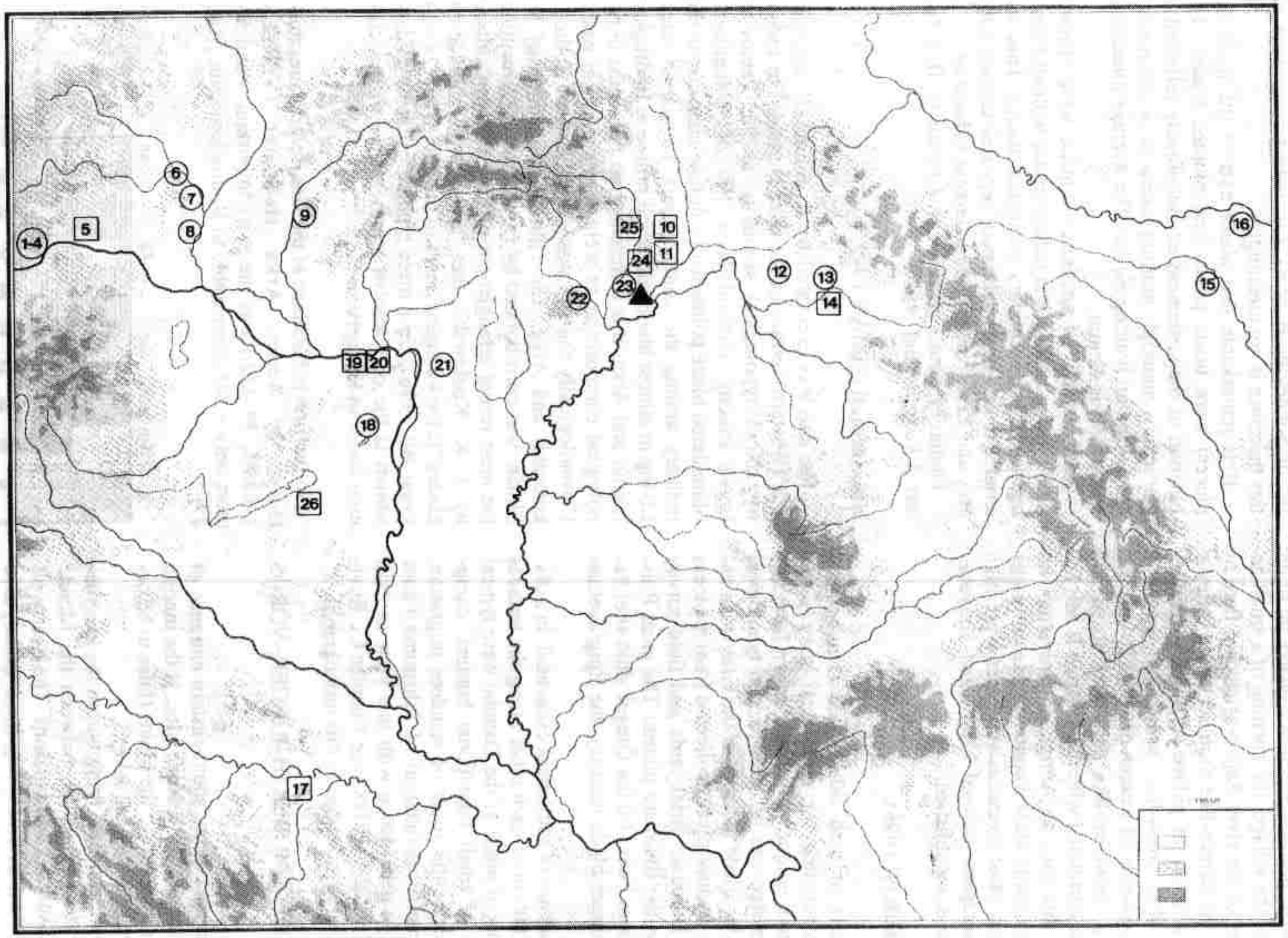


Fig. 46 Main upper Palaeolithic Sites in the Carpathian Basin
▲ Bodrogkeresztúr–Henye 1. Willendorf, 2. Aggsbach, 3. Krems, 4. Langenlois, 5. Grubgraben, 6. Dolní Věstonice, 7. Milovice, 8. Stillfried, 9. Moravany nad Vahom (Žakovska, Podkovica), 10. Kašov, 11. Cejkov, 12. Beregovo, 13. Korolevo, 14. Oas, 15. Mitoc, 16. Molodova, 17. Kadar, 18. Nadap, 19. Mogyorósbánya, 20. Esztergom, 21. Püspökhatvan, 22. Sajószentpéter, 23. Megyaszó, 24. Arka, 25. Hidasnémeti, 26. Ságvár

In spite of geographical proximity and the partly identical raw material basis the two sites *cannot be connected*

- in age
- in settlement function
- in raw material basis
- in technological criteria (i.e., size, thickness of tool base forms and different techniques resulting, partly, from different raw material basis)

Disregarding the different impression on the general image of the two industries, there are no significant differences between the type list of the two sites: moreover, the type distribution percentages are surprisingly similar.

Among the known Hungarian Upper Palaeolithic sites, the find material of only a few can be used for statistical calculations. These sites are: Megyaszó and Hidasnémeti from the Pavlovian /Old Blade industry, Ságvár and Mogyorósbánya from the Ságvárian / Pebble Gravettian, Esztergom and Arka from the Younger Blade industry / Epigravettian facies.

Comparison of type lists from Hungarian sites suitable for statistical evaluation

| Types after Sonneville-Bordes | | Bodrogkeresztúr | Megyaszó | Hidasnémeti | Ságvár | Mogyorósbánya | Esztergom | Arka |
|---|---|---|---|---|---|---|---|---|
| Code | type name | % | % | % | % | % | % | % |
| 1–16 | end-scrapers | 18 | 26,8 | 38,8 | 10 | 0,4 | 23,3 | 26,8 |
| 17–19 | end-scraper-burins | 3,3 | – | 2,7 | 4,2 | 0,4 | 1 | 0,01 |
| 20–26 | Borers | 1,7 | 1,7 | 2,7 | 3 | 2 | 1,8 | 1,7 |
| 27–44 | Burins | 29 | 21 | 23,8 | 20,2 | 2,2 | 20,1 | 21 |
| 45–50 | blade-points | 4 | 5 | 0,6 | 10,4 | 6,1 | 1,5 | 5 |
| 51–57 | Shouldered points | 1,7 | 1,4 | 1 | 0,1 | 0,7 | 2,3 | 1,4 |
| 58–68 | Retouched blades | 24 | 35,8 | 2,3 | 1,8 | 57,5 | 12,7 | 35,8 |
| 69–72 | Points | 0,2 | 0,2 | – | 0,05 | – | 0,5 | 0,2– |
| 74–76 | encoche, piéce esquillée | 3 | 0,4 | 1,6 | 5,9 | 0,2 | 5 | 0,01 |
| 77–78 | Side-scrapers | 4,2 | 7,4 | 4,3 | 3,0 | 1,7 | 1,8 | 7,8 |
| 79–83 | Geometrical Microliths | – | – | – | 2,7 | – | – | – |
| 84–91 | Microliths | – | – | 12,1 | 10,1 | 0,4 | 3,1 | – |
| 92 | Others | 10,3 | + | 28,5 | 18,4 | 26,9 | – | – |

In the category "others", we can find tools missing from the Sonneville-Bordes list, which are, however, decisive for the image of the industry (archaic types, hand-axes, pebble tools)

Esztergom: DOBOSI—KÖVECSES-VARGA 1991, 233–255.

Mogyorósbánya: DOBOSI 1992, 5–17.

Ságvár: CSONGRÁDI 1997, 17–44

In the comparison, sites of the Ságvárian / Pebble Gravettian are definitely detached from the type composition of Blade (Older and Younger) industries, i.e., Pavlovian and Epigravettian sites. This differentiation is present in all measurable criteria (average length, ratio of length/width, i.e. laminarisation)

The picture of the large-enough Hungarian Upper Palaeolithic sites, according the Otte's large categories, is the following: (1. and 2.: débitage and déchets contracted, OTTE 1981, 72.)

pared to Bodrogkeresztúr if data of their publication made it possible.

Finds of the younger settlement horizon were necessarily different. The exact definition, expression of these differences, however, contributed to finding the exact character of the Bodrogkeresztúr industry.

Sites, site groups were studied according to directions of possible contact. These supposed directions of contact were considered at different degrees of probability due to geographical endowments.

**North-West**

In the comprehensive study of J. Barta, several sites were enumerated without typological details as contemporary sites with Bodrogkeresztúr, mainly from the Vah valley, on both sides of the river:

Vlckovce, Nemšová, Nové Mesto. Further sites enumerated include Svodin, Sládeckovce and some cave sites of the White Carpathes.

The site complex Moravany along the river Vág has to be mentioned specially. (Palaeolithic sites of the eastern, left side of the asymmetrical Vág-valley /the foothill terraces of Považsky Inovec were published by HROMADA–KOZŁOWSKI 1995, 17) The older tool assemblages of the typologically-chronologically different sites show a lot of similarities to Bodrogkeresztúr, though their chronology is younger (BARTA 1965, Taf. 67). One of the base camps, Moravany nad Vahom - Podkovica, with Kostenki knife, served as a key site for the delineation of the origin and distribution of the Gravettian culture in the theory of M. Otte (OTTE 1990, Fig. 6.)

Dolní Věstonice is a key site for the Central European Gravettian cultural complex. The material of this classical site was published according to the Sonneville-Bordes–Perrot system (KLIMA 1963), thus it can be directly compared to Bodrogkeresztúr:

Comparison of type lists from Dolní Věstonice and Bodrogkeresztúr according to the Sonneville-Bordes–Perrot type list

| Type | Dolní Věstonice | Bodrogkeresztúr |
|---|---|---|
| | % | % |
| 1 | 6,55 | 9,2 |
| 2 | 1,77 | 9,2 |
| 3 | 0,52 | 1,0 |
| 4 | 0,42 | 0,1 |
| 5 | 0,20 | 0 |
| 6 | 0 | 0,8 |
| 7 | 0 | 0,3 |
| 8 | 2,2 | 4,6 |
| 9 | 0,05 | 1,1 |
| 10 | 0,31 | 1,1 |
| 11 | 0,05 | 0,7 |
| 12 | 0,2 | 0,7 |
| 13 | 0 | 0,9 |
| 14 | 0,1 | 0 |
| 16 | 0,1 | 2,3 |
| 17 | 2,2 | 3,7 |
| 18 | 0,05 | 0 |
| 19 | 0,31 | 0 |
| 20 | 0,05 | 0 |
| 23 | 1,25 | 1,8 |
| 24 | 0,10 | 0 |
| 25 | 0 | 0 |
| 26 | 0,15 | 0 |
| 27 | 3,09 | 7,1 |
| 28 | 2,0 | 0,6 |
| 29 | 2,56 | 8,0 |
| 30 | 5,87 | 0 |
| 31 | 1,61 | 0 |
| 32 | 0,85 | 1,1 |
| 33 | 0,05 | 0 |
| 34 | 1,94 | 0,2 |
| 35 | 1,61 | 0,6 |
| 36 | 1,68 | 0,5 |
| 37 | 0,2 | 0,4 |
| 38 | 0,31 | 1,5 |
| 39 | 0,31 | 1,5 |
| 40 | 0,87 | 0 |
| 41 | 1,1 | 6,0 |
| 42 | 0,35 | 0 |
| 43 | 2,35 | 4,2 |
| 44 | 1,62 | 1,3 |
| 45 | 1,31 | 0 |
| 46 | 1,40 | 3,2 |
| 47 | 1,89 | 3,2 |

As it is emphasised by J. Svoboda, the chronological position of Bodrogkeresztúr-Henye is unambiguous:

*"Position of Pavlovian at Pavlov (27 000–25 000 B. P.) and Predmostí (26 870±250 B. P.) is chronologically comparable to the mean dating of DV I and II, while at Stránská skála IIa we still found late Aurignacian in the corresponding stratigraphic level. The Gravettian settlement at Milovce seems to be slightly more recent (25 500–22 000 B. P.). Generally, the Pavlovian may be placed into longer time-span between 29 000–20 000 B. P.*

*Earlier phasis of the Moravian Pavlovian is contemporary with several Gravettian sites in the Carpathian Basin: Nemšová (28 570 ± 1345 B. P.), Slaninova Cave (27 950 ± 270 B. P.) and Bodrogkeresztúr-Henye (about 28 000 B. P.). In this eastern region, the lower Gravettian horizons still may appear in chernozem soil (the Mende soil). In South Poland and in Austria, the sites of Spadzista C2-layer IV and the Willendorf sequence, beginning with layer 5, fall in this same period".*

(SVOBODA 1991, 14.)

This chronological position is corroborated by the typological composition of Bodrogkeresztúr-Henye.

Different sites of the Pavlovian culture were compared several times and by several authors. One of these was compiled by K. Valoch, using the classical indices (VALOCH 1986/87, 60.). The values of Bodrogkeresztúr have been supplied accordingly:

| | Dolní Věstonice 3 | | | | Pavlov II 4 | Bodrog-keresztúr |
|---|---|---|---|---|---|---|
| | Partie Inférieure | amasd'os | Habitation I | Habitation II | | |
| N | 215 | 77 | 1338 | 416 | 388 | 812 |
| IG | 26,51 | 18,19 | 12,71 | 12,01 | 25,00 | 18,6 |
| IB | 35,55 | 32,47 | 29,07 | 37,98 | 45,62 | 35,9 |
| IR | 6,05 | 6,49 | 0,90 | 1,20 | 1,55 | 5,8 |
| ID | 15,81 | 12,99 | 37,67 | 19,95 | 12,11 | 11,9 |
| Ipf | | – | 0,30 | (0,24) | – | – |
| Couteau Kostenki | ? | – | (0,46) | (0,24) | ? | – |
| Lames appointes | 1,40 | 10,38 | 4,33 | 4,57 | 2,06 | 3,2 |
| IGA | 2,33 | – | 0,15 | – | 0,26 | 1,6 |
| IBA | 0,47 | – | 0,37 | 0,72 | – | 1,2 |
| N | 199 | 73 | 1259 | 385 | 341 | 634 |
| Composites | 8,04 | 8,22 | 6,27 | 8,05 | 13,78 | 21,8 |

In the essay of J. Kozłowski (1984), material of irrationally large geographical distances are ccompared to each other (Dolní Věstonice, Pavlov, Ostrava-Petrkovice, Corbiac; KOZŁOWSKI 1984, Table III.) for expressing essences of the cultural phyla / chronological levels.

Comparing statistical values presented here with their equivalents from Bodrogkeresztúr, evidently, comparable values were found only on the Moravian sites.

Whatever was said for Dolní Věstonice is valid for Pavlov and Ostrava-Petrkovice as well, that is:

- in the first place, they share negative evidence, i.e., the complete lack of certain type groups
- the presence of rabots and carenoid end-scrapers lend Bodrogkeresztúr an archaic character

The recently excavated South-Moravian settlements from the Pavlovian period (Milovice) represent a younger phase of the culture. The radiometric dates are around 25 kyear, which means a younger phase of the Interpleniglacial. From the archaeological point of view, the industry seems fairly archaic, with Aurignacoid character (OLIVA 1989, 112.).

*"Die geochronologische Stellung unseres Paläolithikums ist daher eindeutig: knapp über dem eigentlichen Stillfried B und in der beginnenden "letzen Kaltzeit" (Würm III). Der in unserem Profil auftretende gleyartige Horizont entspricht der "Gleyfleckenzone", die auch anderswo als über Stillfried B liegend beschrieben wird (FINK 1979, 79.). Vielleicht lässt er sich mit einer entsprechenden "Vermehrung des Wasserhaushalts", und lassen sich die doch leicht unterschiedlichen Schneckenfaunen in den Schichten 1-5 mit den möglichen Klimaoszillationen im Stillfried B erklären."*

(FELGENHAUER 1980, 26.)

The author did not see enough reason for adopting the Moravian name "Pavlovian" for the Lower Austria sites, gave priority to the name "Aggsbachian" introduced after J. Bayer in 1951. The eponym site is in Wachau, dated to the middle of the Würm II period (according to FELGENHAUER 1951, 261.)

*"Wir glauben, so Aggsbach innerhalb unserer engeren Heimat in die frühe Mitte des Würm II-Stadiales stellen zu dürfen und somit alter als Miesslingtal und jünger als Willendorf II/5 zu bezeichnen. In dieser zeitlichen Stellung bildet es mit eine der Stationen der Niederösterreichisch-Mährisch-Slovakischen Gruppe des östlichen Gravettien.*

*Den Terminus "Aggsbachien" glauben wir ablehnen zu dürfen – sowohl im Sinne einer eigenen Kultur als auch im Sinne eines zeitlich oder räumlich selbstandig gewordenen Typus."*

The main cultural layer of the eponym site of the Aggsbachian was dated around 25 kyear by C-14 method, parallel to the younger phase of the Pavlovian, i.e., the upper levels of Willendorf II though typologically and technologically it is different to some extent (with 50%, "flechette" and archaic forms).

The lower / Northern end of the Wachau is the region of Krems where the Danube leaves the mid-mountain environment and the widening Danube-valley is transsected by, from the North, the Wagram hills, from the south, the flattening slopes of the Vienna forest.

Krems itself is known for its numerous Gravettian sites. Recent excavations identified several more sites.

The publications available for the author were partly reappraisals of old excavations: the modest Gravettian material of Krems-Hundssteig, rich in microgravettes (hardly 50 tools that were closest to Willendorf II/5 according to the publication (HAHN 1972, 88.)

In course of her Central European activity, A. Montet-White encountered also the difficulties of working on poor assemblages – both in absolute quantity and quality (Bosnia: Kadar and Austria: little part of Grubgraben) – more exactly, where the find material could be accessed only in fragments or details. She was trying to fit Grubgraben material into the range of sites using the Sonneville-Bordes type list. Her grouping offered a more realistic approach though assemblages under 100 pieces should, as a rule, not be treated in the statistical evaluation (MONTET-WHITE 1990, 155)

Grubgraben belongs to the younger phase of the Gravettian culture. On the basis of the few tools published in drawings (MONTET-WHITE 1990, Fig. IX. 1–12.), the material is analogous with the material of the middle settlement waves of the Gravettian culture in Hungary.

The real significance of the Grubgraben material excavated and published by Montet-White lies in the unusually carefully documented settlement features, as Lower Austria is known to be very rich in archaeological finds from this period. Same as Grubgraben is much more than the published little details as I had the chance to see, thanks to the kindness of Prof. F. Brandtner.

The Early Gravettian tool kit of Langenlois, Kargl's Brickyards was found accompanied by a hut base (?) formed of mammoth bones and teeth and a tool producing workshop.

The site would deserve more attention, as far as the dwelling hut is concerned, but unfortunately I have no detailed information on the find material (HEINRICH 1974–1975, 16.).

Langenlois is so far the most westward point in the slightly arched, very long, east-west directed stripe of settlements extending over 1500–1800 km, characterised by the mammoth hut and, partly, the Kostenki-points.

**South-West**

The morphology of the southern parts of the Carpathian Basin is changing decisively only south of the Sava valley, by the rising northern fore-hills of the Dinarian Alps. The available scanty data may reflect low number of inhabitants in the Upper Palaeolithic and/or low efficiency of archaeological studies on the period. (DOBOSI 1967, 184–193.)

The best known site along the Southern bank of the river Sava is Kadar. (MONTET-WHITE et al. 1986), which has, at the same time, comparable lithic industry:

Comparing Bodrogkeresztúr to the Korolevo Upper Palaeolithic industry is not realistic, because

• the number of true tool types is very low within the assemblage

• over 90% of all artefacts were made of andesite

• the chronological position of both Upper Palaeolithic cultural layers rendered any statistical comparison unreal

(On the basis of the drawings, Korolevo II represents partly a Bábonyian type Middle Palaeolithic, partly transitional forms between Middle and Upper Palaeolithic forms like "Eger-culture". From the artefact inventory of Korolevo I some forms resemble Bodrogkeresztúr, as much as one can judge from the drawings. (GLADILIN-DEMIDENKO 1989 Fig. 19–20. USIK 1989, 179.)

The stratigraphical position of the sites was found "*... not fitting into the generally accepted chronology...*" by the authors (GLADILIN–DEMIDENKO 1989, 177.) They considered the Carpatho-Balkan region as a centre of the multi-rooted development leading from the Middle Palaeolithic to the Upper Palaeolithic cultures.

The topographical position of Korolevo practically invited a Palaeolithic habitation. The river Tisza enters the plains between Huszt and Nagyszőlős, in other words, it means a possible route for crossing the Carpathes along the Western Slopes of the Carpathian Forests, the Avas hills and Nagyszőlős with 800 m average altitude a.s.l., leading till the Tartarian pass.

Anyway, its stratigraphical position under the Brorup fossil soil needs further arguments (provided that Brorup/Ammersfoort is identical with Emiliani 5/c, i.e., the Mende base soil also in a Transcarpathian sense as stated by both Pécsi and Ringer (PÉCSI 1992, Fig. 10., RINGER 1988, 80–81.) In this case, the Korolevo I soil correspond the "acme" of Hungarian Middle Palaeolithic.

Reviewing the sites of the "Beregovo group" we can observe the following:

Their raw material utilisation, type distribution and tool producing technology and traditions are common. The most numerous assemblage is Beregovo I with 114 tools, the type distribution of which seems similar to Bodrogkeresztúr at least in ratios and its well documented stratigraphical position is also corresponding to that of Bodrogkeresztúr (as Tkachenko wrote: "*...in the lower part of pale-yellow loam 4 above the second paleosol Paudorf...*" TKACHENKO 1989, 214–216.)

The distance between the two sites is not more than 80-90 km. Most probably, they both belong to the same cultural phylum. This may well be true for the other localities belonging to the Beregovo-group, ranging along the southern margin of the Beregovo Mts. (Nagyhegy), which yielded, however, a low number of finds not suitable for a statistical evaluation (TKACHENKO 1989, 222.).

The Kostenki-Borsevo circle is already falling outside this essay. In the archaeological elaboration, the traditional method of hunting analogies by each type was not followed. There is, however, one exception:

László Vértes found an exact analogy of the obsidian mousteroid point from Bodrogkeresztúr *(Fig. 28. 1)* at Kostenki 15 (Gorodcovskaia) site (ROGACHEV 1982, Fig 58./2.).

This special industry is to some extent different from the general image of the Kostenki-type industries. At the same time, it is an eponym site for a facies, Gorodstovian within the Kostenki circle occurring at several points.

The distribution of the cca. 370 tools is quite specific, with 25% end-scraper, 30% piéce esquillée (!) and Chatelperron type blade points. According to chronological position, this facies belongs to the middle horizon of the culture, around 21 Kyear. (ROGACHEV–SINITZYN 1982, 162–171.)

The tools of Kostenki 15 are known to us only in diminutive drawings. Analogies of the forms were found in great number without implying immediate genealogical connections.

## Romania

Contemporary sites of the Romanian Upper Palaeolithic should be further divided into two geographical groups: inside and outside the Carpathian arch. In respect of Bodrogkeresztúr, basically the former region should be considered: marginal regions within the Carpathian Basin, Upper Palaeolithic sites from northwestern parts of Romania. This area is heavily dissected by river valleys, opening towards the West to the Szatmár plains. In the Upper Palaeolithic cultures of the region all phyla are present that were found on the foothill slope regions of the neighbouring countries, which are politically different now but the geomorphological, topographical conditions are absolutely identical with those of this region.

The Gravettian industries of the subsequent interstadial settlement waves can be obviously connected to the material of the settlements around Beregovo.

Though the available publications cannot be used for statistical evaluation, the sites of Bitiri's Gravettien I. phase (*"plus ancient"*), Calinesti and Turulung were obviously contemporary with Bodrogkeresztúr as "Post-Aurignacien" assemblages (BITIRI 1969, 530)

The early phase of the Gravettian culture in the Avas (Oas) region – according to the terminology used by Carciumaru, Ohaba interstadial– was found different from the Ságvárian by Chirica as well (CHIRICA

Moldavian culture flourishing along the Eastern slopes of the Carpathes.

**North**

Along the Southern, Hungarian margin of the Tokaj-Eperjes Mts. there were several Upper Palaeolithic settlements – among them, Bodrogkeresztúr. On the eastern margin of the northern parts of the mountains there were two large settlements, adjoining the Bodrog valley: Kasov and Cejkov.

The Kasov industry can be assigned to Epigravettian, one geochronological phase younger than Bodrogkeresztúr, settlement of the medium wave of the Gravettian population. It is a large and rich settlement with more than 4000 tools/artefacts.

*"Le niveau inférieur présente un habitat assez restreint (12 x 8 m) caractéris, par une industrie avec des traits gravettiens plus prononcés (aux d'outils à bord abattu 10,5%) et exécutée en grande partie avec du silex "nordique" provenant du Sud de la Pologne (54,4%). L'importation systématique du silex "nordique" à l'intérieur du bassin carpathique et du Danube moyen est un phénomène caractéristique..."*

*Le niveau supérieur, probablement postpléniglaciaire, d'après les données sédimentologiques, représente une industrie avec faible taux d'èléments à bord abattu, sans formes diagnostiques gravettiennes, mais largement dominée par les grattoirs et les burins. On y remarque certains éléments "aurignaciides" comme des grattoirs à front élévé, des burins carénoides; cèst un phénomène plus large dans certaines industries post-pléniglaciaires de l'Europe Centrale."*

(BÁNESZ et al 1992, 19.)

The geographically closest analogy to Bodrogkeresztúr was the site Cejkov in Slovakia, lying in a distance of cca. 50 km from Bodrogkeresztúr, in the other (Slovakian) part of the Tokaj-Eperjes obsidian-region.

The older level among the two cultural layers found here probably belonged to the Denekamp-period (BÁNESZ 1962, 758.; BARTA–BÁNESZ 1981, Fig. 1.) The main cultural layer of the site is the younger Gravettian horizon. On the basis of chronological data, the Cejkov interstadial probably corresponded to the older embryonal soil horizon of the Ságvár period. (BANESZ 1996, 7)

The older level, which would be more important in respect of Bodrogkeresztúr, has not been published in details as yet.

According to personal impressions of the author, the Cejkov industry is smaller, more, gracile than Bodrogkeresztúr.

Comparison with the site Kraków-Spadzista hits against double difficulties:

1. Bodrogkeresztúr-Henye did not belong to the Kostenkian culture like the statistically interpretable Site B, with mammoth bone hut.

2. The other side of the same difficulty: the probably closely related Pavlovian industry (Site C2 Level IV.) with its 24 pieces of tools were not adequate for comparison.

To demonstrate the essential difference between Bodrogkeresztúr and the Kostenkian industry from Kraków-Spadzista, the statistical comparison of the two sites were performed and presented below:

| Types | Kraków-Spadzista, B | | Bodrogkeresztúr | |
|---|---|---|---|---|
| | Pieces | % | Pieces | % |
| end-scrapers | 7 | 2,97 | 157 | 24 |
| Burins | 57 | 24,25 | 173 | 27 |
| combined tools | 1 | 0,42 | 16 | 2,5 |
| Truncations | 7 | 2,97 | 13 | 2,0 |
| Kostenki knives | 27 | 11,48 | – | – |
| ret. blades | 24 | 10,21 | 90 | 14,0 |
| Borers | 1 | 0,42 | 18 | 2,8 |
| Backed imp. | 36 | 15,31 | 32 | 5,0 |
| shouldered | 63 | 26,8 | 9 | 1,4 |
| retouched flakes | 12 | 5,1 | 60 | 9,3 |
| side/scrapers | – | – | 57 | 8,8 |
| Notched | – | – | 20 | 3,1 |

(KOZŁOWSKI–SOBCZYK 1987, 66/68.)

Disproportionate features arising from the comparison of the type list:

• dominance of culture specific types in Kraków (shouldered blades, Kostenki-knife)

• higher number of archaic types (side-scrapers, notched tools) at Bodrogkeresztúr justify the chronological position of the Kostenkian type industries and the Bodrogkeresztúr finds.

low representation of Hungarian sites can be reasonable, because this division is not valid for the Hungarian sites at that moment. In the most recent comprehensive work, he mentioned only five Upper Palaeolithic sites from Hungary (DJINDJAN–KOZŁOWSKI–OTTE 1999, 383).

OTTE 1980–81

M. Otte presenting the preliminary results of his Gravettian monograph mentioned only the Epigravettian sites from Hungary (Ságvár, Arka, Pilismarót, Szeged)therefore he wrote:

*D'une facon générale la plupart des sites gravettiens étaient contemporains soit de la fin de l'interstade de Stillfried B (= Arcy-Kesselt), soit du stade rigoureux suivant (portant ici le no III); certains vont jusqu"a l'oscillation tempérés correspondant à Laugerie-Lascaux. Les ensembles épigravettiens hongrois semblent plus récents encore.*

*D'après les dates radiocarbones disponibles, la période d'occupation gravettiene s'étend de 27000 à 20000 BC (sauf pour les sites hongrois) et l'on observe les occupations les plus anciennes en Basse-Autriche (Willendorf II/5) et en Podolie (Molodova V/X, IX).*

(OTTE 1980, 175.),

and classified the Hungarian sites summarily into the last group (Nr. 8) to the Epigravettian industries (OTTE 1980, 189.)

The large-scale comparison by M. Otte considered the tool kit of 21 Gravettian sites. (Mainz, Geissenklösterle, Brillenhöhle, Mauern, Bilzingsleben, Lubna, Revnice, Willendorf II/5–9, Aggsbach, Dolní Věstonice II, Pavlov II, Petrkovice, Mamutova, Wojcice, Krakow-Spadzista, Cejkov, Molodova V/VII) Among the sites studied, the number of artefacts were typically well under the range of Bodrogkeresztúr-Henye: exceptions to that were only Willendorf II/9, Aggsbach and Molodova V/VIII complex where the number of tools studied was adequately large. (OTTE 1981, 86.)

The type groups ("Types de vestiges, OTTE 1981, 73) specified by Otte were defined for Bodrogkeresztúr and the values were fit in the comprehensive table connecting several sites of the entity.

| Otte Types de vestiges | 1–2 debitage déchets doutils | A posteriori | Outils retouchés |
|---|---|---|---|
| Bodrogkeresztúr-Henye | 73,8% | 2,6% | 23,5% |
| Megyaszó | 84% | 9% | 7% |
| Willendorf II/6 | 71% | 1,6% | 27,45% |
| Pavlov II | 62% | 2,2% | 39% |
| Krakow-Spadzista | 59% | 10% | 31% |
| Dolní Věstonice II | 53% | 5% | 42% |
| Aggsbach | 50% | 1,3% | 49% |

The ratio of the groups separated by Ottecan be influenced by the extent of collection, the ratio of excavated surface compared to the total area of the settlement and the function of the of the settlement. Still, the observable tendencies seem to indicate an increase in tool production efficiency.

After the analysis of the tool-kits, the following observations could be made

• there is no connection with the Central European sites (Otte's Nrs. 1–5, comprising Mainz, Geissenkösterle, Brillenhöhle, Mauern, Bilzingsleben)

• sites 6–11 (Lubna, Revnice, Willendorf II/5, 6, 7, 8) and the Bodrogkeresztúr finds resemble most in the ratio of worked blades (Otte's type groups 4, 5, 12, 17 and composites)

• relation with Pavlov II is observed in the ratio of burins, percoirs and becs

• the ratio of end-scrapers in Mamutova cave and Bodrogkeresztúr was equally around 20–21%

• at Molodova V/VII, the ratio of lames appointes and encoche-tools were identical with Bodrogkeresztúr

the individual characteristics of Bodrogkeresztúr were mainly the negative features: Otte's type groups 6–9 (microliths, shouldered points) as well as types 14–15 (knives) were totally missing. The only "positive divergence" from the sites analysed by Otter were the high ratio of side-scrapers (4,6%) which could be explained by chronological arguments (archaic character) but also functional reasons (OTTE 1981, 87.)

The basic grouping was also kept in 1996 when connecting the Upper Palaeolithic sites of the Prut-Dniestr region to the Willendorf-Kostenki circle (OTTE et al. 1996, 213–226)

In 1989, M. GÁBORI argued for a chronological division of the Hungarian Upper Palaeolithic/Gravettian period. Within the three "*Zeithorizonte*" (between 30–27, 18–16 and 13–23 kyear, respectively) he did not separate cultural phyla (GÁBORI 1989)

G. GRIGORIEV AND O. SOFFER 1993 introduced a new category for marking a large group of sites: *Willendorf-Pavlov-Adveevo-Kostenki Archaeological Entity* (GRIGORIEV 1993, 52., SOFFER 1993, 45.). This unit was rather widely delineated in geographical and chronological sense and stand for a former phase of the so-called Eastern Gravettian technocomplex. Though traditional archaeological criteria seemingly did not have much influence on the events happening at the interior parts of the basin. The population surplus condensed in the Eastern forelands of the Carpathes – whether they had immediate contact with the more distant Eastern cultures or not – could advance towards the West by avoiding the high mountains towards the North (or, possibly, the South).

To answer the question whether the Upper Palaeolithic cultures appearing in the interior parts of the Carpathian Basin were of Eastern origin, independent of nomenclatorical considerations (i.e., to distinguish them from Western- and Central European cultures), the answer can only be given in two separate phases. Eastern, in a sense that the appearance of the Upper Palaeolithic cultures and Homo sapiens in this region can be explained from the East-South-East. Apart from the general Eastern origin, the population of the Carpathian Basin during the whole period of the UP, more exactly, the interstadial periods took place probably from north-western direction, the core area at Wachau-Pavlov region. The mutual and constant connection of the original population with the further-lying eastern cultures took place, most probably, to the North of the Carpathian arch along the corridor between the ridges of the high mountain range and the permanent ice sheet.

Another problem of nomenclature, the question of the so-called Ságvárian culture should also be raised here. Currently it seems probable that the LUP pebble-Gravettian (Ságvárian) was an independent facies of the above large cultural entity; however, it is a fairly enigmatic find assemblage. The latent development of Middle Palaeolithic pebble-working traditions, even their preservation over such a long period in spite of the complete anthropological and cultural basis needs further proofs. The origin and movement direction of the population cannot be described yet. It is not connected to Bodrogkeresztúr anyway. Let us state here again: the cultural name Ságvárian is still used in some Western European technical literature erroneously: it has no relevance for late backed blade industries in the Carpathian Basin (KOZŁOWSKI 1979, 42.). The second (medium) phase of the chronologically and typologically well separable three settlement horizons connected to the Gravettian entity is called *Ságvár period*. The eponym site of this period is the Ságvár Upper Palaeolithic settlement. Its contemporaneity with the Lascaux interstadial has been proved by V. Gábori-Csánk (GÁBORI–CSÁNK 1978, 11.). By the refinement of archaeo-stratigraphy the duration of this period was extended over the embryonal soil horizons containing the two cultural layers of the Ságvár settlement (in Hungarian loess profiles: h1 and h2) as well as the sedimentation of the 1 m thick loess layer in between them, corresponding to the Laugerie-Lascaux interstadials in western terminology and the intermittent little micro-stadial phase (DOBOSI–VÖRÖS 1987, 58). The older settlements of this geochronological phase can be connected to Ságvár site. That is, the so-called "pebble gravettian" (Ságvár, Madaras, Mogyorósbánya sites) constitute the Ságvárian culture in an archaeological sense. The unity of the find material serve adequate reason for separating this small group within the large Gravettian entity. Ságvár is one of the oldest known and certainly the most quoted Hungarian Upper Palaeolithic site (*Habent sua fata situum*: it may take several decades before one site becomes universally known among professionals). Inhabitants of the site were specialised on hunting horses (37 individuals) and reindeer (126 individuals; VÖRÖS 1982). Its two cultural layers, pole-post dwelling hut, pierced antler ("commanding stick") and the rich lithic inventory really distinguish Ságvár among the average of Hungarian Upper Palaeolithic sites (GÁBORI 1959). It was among the first Hungarian Upper Palaeolithic localities dated by radiocarbon method. The chronological – cultural identification of the site was not made easier by that in those day as the only comparable (Palaeolithic) C-14 date was known from the Istállóskő cave and the number of known Hungarian Upper Palaeolithic sites was only a fraction of those known today. Thus comparison was only possible to far-western, French data (GÁBORI–CSÁNK 1960, 128). For several decades, Ságvár was "**the**" open air Upper Palaeolithic site in Hungary. The generally spread – and mainly erroneously used – technical term "Ságvárien" can be attributed to its universal notoriety and its special character, recognised already by M. Gábori. M. Gábori and later V. Gábori–Csánk separated the finds of the southern region in Hungary and applied the term "Ságvár group" for it. The sites of the Danube bend region and the north-eastern parts of the country, were named as the "Pilismarót group" (GÁBORI 1968 186, GÁBORI–CSÁNK 1984) ). Following this, in the foreign archaeological literature the "Ságvárian group" became a synonym for Upper Palaeolithic cultures in the central parts of the Carpathian Basin denoting summarily and exclusively all Upper Palaeolithic features here (with the exception of the Aurignacian).

The period "framed" by the two cultural layers of the Ságvár settlement immediately following the small interstadial after Würm 3 maximum till the end of the Lascaux period seems in our interpretation rather a geochronologically well defined period (DOBOSI–VÖRÖS 1987, 58) which can be associated with (at least) two different cultures following different tool-working traditions.

• the cultural unit formerly called "pebble gravettian": the name Ságvárian is suggested for this, and only this unit, Moravia. Cultural effects, sometimes groups of people radiated from here towards the Rhine and the river Don. The latter direction, though chronological data seem to support the direction of the migration / invasion clearly, could not be a real migration taking into consideration the vast distances, the shortness of time and the richness of cultures unfolding on the Eastern territories. This period is fit into such wide spatial and temporal scales that it could be hardly summarised within one culture.

The most recent Upper Palaeolithic summary already divided this period into two parts. In the north-western corner of the great Central European base area (gravettien ancien d'Europe centrale) appeared a "Kostenki-episode", limited in time and space with hypothetical connection to the Kostenkian base areas (DJINDJIAN–KOZŁOWSKI–OTTE 1999, 206–207).

There must have been a certain base population the culture of which was coloured by the innovations overtaken or just the other way, which influenced the local appearances of the strong cultural expansion by their own traditions.

The Carpathian Basin is located to the south of the base area and the main expansion routes of the culture (mammoth-hut route): the most likely direction of the immediate or indirect spreading of cultural effects, the ice-free corridor to the south of the permanent ice sheet and to the north of the arch of the Carpathes, open till the river Don and even further on with no high mountains blocking the way.

Connection with the neighbouring Moravian territories could be realised through the north-western gate in the Danube valley, connecting Bodrogkeresztúr with the base areas of the culture. The same route might serve for the inflow of raw materials of Silesian (?) origin. This route along the Danube lead along the Danube-bend towards the foothill regions rich in raw materials. The foothill region of mountains in the central parts of the Carpathian Basin could not hold up the communication between areas. The river valleys running from North to South, which were often mentioned could only serve as raw material acquisition routes or traffic with the small brotherly communities (Slovakian sites): these rivers run inside the Carpathian watershed, and the main obstacle of contacts outside the Carpathes was just the presence of the high mountains.

The morphological endowments of the Central European orography, the effect of the Carpathian arch as a geographic factor on the direction and pace of the spreading of different cultures was studied by F. Djindjan in an inspiring lecture (DJINDJAN 1992.). This effect was immediate and strong: the closed range of the Eastern Carpathes set a limit to immediate eastern connections of Bodrogkeresztúr which was hard to surpass among interstadial circumstances and practically impassable among stadial conditions.

To the east of the Carpathian arch, taking advantage of the favourable conditions of the so-called Ukrainian Switzerland, the population was practically condensed and lived constantly further on, unfolding the Molodova culture in its full richness. In the development of these events, Bodrogkeresztúr had hardly any immediate role.

The possible connections between Molodova and Bodrogkeresztúr were observed first by Grigorjeva and Anikovich (GRIGORIEVA–ANIKOVICH 1990, 89.) Apart from the stone tools, the most striking common element is a carved rim biconvex discoid object, similar to the "moon calendar" of Bodrogkeresztúr. The presence of this special object at both sites, however is not adequate for proving direct contacts.

In spite of formal analogies, the sites of the middle phase of the river Prut can be connected more to the geographically neighbouring regions than to Bodrogkeresztúr.

The scenery of migrations in the Stillfried B – Paudorf – Maisieres interpleniglacial period can be located with great probability in the northern ice-free stripe. Probably this movement took place in both directions, though the absolute chronological data mainly point at movements from west to east. This statement is to some extent contradictory to accumulated evidence on the direction of spreading of faunal waves. The movements of different directions took place not necessarily at the same time horizon: the migration of surplus population from the Gravettian base areas towards the West could take a very short time within the period of the fauna movement.

Estimating density of population on the basis of the existing archaeological evidence it seems that during some thousands of years the cultures rooted in the Central European base area expanded into flourishing at the East Side of the Carpathian arch.

The Upper Palaeolithic sites within the interior river valleys of the Carpathian Basin opening towards the plain on foothill-, terrace or plateau geomorphological position represent two chronological phases. According to our present knowledge, Middle Upper Palaeolithic (MUP) sites with variable local cultural names (on the interior parts of the Carpathian Basin, Pavlovian or Gravettian Older Blade Industry) delineated the route of outflow from the base area towards the East (DOBOSI 1998, Fig. 2) Knowing the geomorphological endowments of the area, other directions of movement would be hard to imagine within the Carpathian Basin. This west-east movement in the northern stripe of the basin could be almost completely independent of the larger scale and more lasting connection between the large Central European Upper Palaeolithic cultural units, the route of which features (e.g., mammoth hut), not to speak of the art objects. There were only few elements found among the generally accepted criteria for estimating duration of settlement or population size. Most of the Hungarian sites were poor in finds and settlement features with ad-hoc types and scarcity of features. This can be explained by the lack of the base camps known from the neighbouring areas (east, west, north). Conclusions can be built upon, however, existing data only: the immediate Eastern connection of the Hungarian Gravettian culture cannot be accepted and it seems better to reside from classifying sites without adequate data into traditional cultural schemes.

The base area of the MUP / Gravettian entity shows a rich and most varied cultural image from the Lower Austrian loess regions till the Moravian basin, which can be classified into several cultural horizons. This area has been studied for over a century. The relevant technical literature is rich and accessible. Let us mention here only two recent summaries, a substantial catalogue edited by, and partly written by J. Svoboda (SVOBODA 1994) and a short but concise site catalogue from Austria (NEUGEBAUER–MARESCH 1995).

Starting from the Willendorf-Pavlov arch, we can survey the sites of the period in the Carpathian Basin. In Western Slovakia, close to the Pavlovian core area the MUP-LUP period was begrudgingly rich and varied. The valley of the river Vah (Vág) running by and large from north to south is transsecting variable soil types. Following its high-mountain origins, the middle phase of the river runs across wide loessy hills. This phase must have had a great ecological potential in the Late Pleistocene: a great variety of Upper Palaeolithic industries and typical, rich settlements are known from these regions. To mention some of them: Trenčianske Bohuslavice with regular, arched edge blade points, (BÁRTA 1988) Moravany-Podkovica, closest to the Pavlovian core areas, classical Kostenki points characterise MUP (VALOCH 1995, 604), and in the close vicinity, within a few kilometres, the leaf-point industry of Moravany-Dlha and a range of LUP Epigravettian settlements were excavated (Moravany-Žakovska, HROMADA 1995). At the entrance of the next valley in Považski Inovec, on the plateau over the river Nitra we can find another classical site, Nitra-Čermán, also with Kostenki-points (VALOCH 1995, 604).

From the range of settlements along both sides of the river Ipoly, those on the left side are better known (GÁBORI 1956). The concentration of finds here embrace within narrow spatial dimensions the complete periods of MUP and LUP. Towards the east, within the Kosice Basin in the valley of the river Hornad (Hernád)large and special sites of the LUP period are known: Kasov and Cejkov (BÁNESZ 1996).

The Upper Palaeolithic tools of the Korolevo multi-layered Palaeolithic complex were classified by the excavators of the site as *"new, well perceptible and expressive centre of early Upper Palaeolithic industries"* (GLADILIN–DEMIDENKO 1989, 177). The topographical position of Korolevo was stratigraphically favourable, corresponding to Older Gravettian traditions. Probably this favourable position accounts for its "versatile" character; in other words, the variable environment of the site was most attractive as landscape, too. It is true, however, that the site was wedged in the north-eastern corner of the Alföld. Consequently, the direction of possible contacts and the flow of innovation – information – raw material was limited. So far we do not know about similar old Upper Palaeolithic sites in North-East Hungary which could be connected with this cultural circle; moreover, we have no authentic contemporary site excavated on the regions geographically connected to the Transcarpathian area.

It seemed evident that the Korolevo Upper Palaeolithic industry with its unique chronological position, raw material use and typology should be compared to the Upper Palaeolithic settlements lying around Beregovo, known for several decades, some 20 km of the site Korolevo. In the opinion of V. I. Tkachenko who evaluated the sites around Beregovo, Korolevo and the settlements around Beregovo represent two independent Upper Palaeolithic groups in respect of chronological position and typological spectra (TKACHENKO 1989, 222). Condensing all sites around Beregovo on mere topographical grounds would not be necessarily justified. On the basis of their stratigraphical position, they can form a link in the chain of MUP system of cultural connections. In respect of geographical position, these sites form the easternmost elements of the large settlement wave running along the Carpathian Basin (DOBOSI 1998, 130)

Geographically, the Gravettian sites of the Oas region in Romania belong to this horizon (Boinesti, Somos, Calinesti). According to the authors BITIRI–SOCOLAN, these sites were dated to Würm 3. In their opinion, though they had a parallel development to similar age Eastern Gravettian groups, still they formed a special group of sites (*facies particulier*), the analogies of which could be found on Hungarian and Czechoslovakian sites (BITIRI–SOCOLAN 1966, 24). In a more recent publication, the chronological separation of the sites could also be accomplished: Turulung and Calinesti represent an older facies of the Gravettian culture while Boinesti and Somos I–II belong to a younger horizon (BITIRI 1969, 53). It would be very important to define these "particularities" exactly as this area used to be a passage towards the Transylvanian Basin, which is very deficiently known.

prising altogether 90% of all artefacts (DOBOSI et al. 1988), offering a special attractive character for the industry.

The Danube-bend region seemed to possess in all phases of human history the geographical energy to attract a dense network of population. During the MUP and LUP periods of the Upper Palaeolithic, a string of sites were settled here on a cca. 20 km long phase along both sides of the river. MUP is represented only sporadically among the soil layers of the Basaharc loess profile, serving as pedological key section. The early phase of LUP is represented by Mogyorósbánya, assigned to the Ságvárian culture while the range of Epigravettian settlements is situated between Pilismarót and Dömös. All three MUP sites were just sporadical, the Pebble-Gravettian Mogyorósbánya in itself, the Younger Blade or Epigravettian industries occurred in a chain of some 10 kms around Pilismarót.

### 6. Summary

Bodrogkeresztúr-Henye is a 195 m hill in North-Western Hungary at the margin of the Tokaj-Eperjes (Presov) mountain range. The Upper Palaeolithic site on top of the hill has been known for several decades. The find material accumulated mainly in the Hungarian National Museum[4] originated from two excavation campaigns and several official and private field surveys. Deep ploughing and planting of vineyards disturbed the sediments at some places till the base rock, including the Upper Palaeolithic cultural layer.

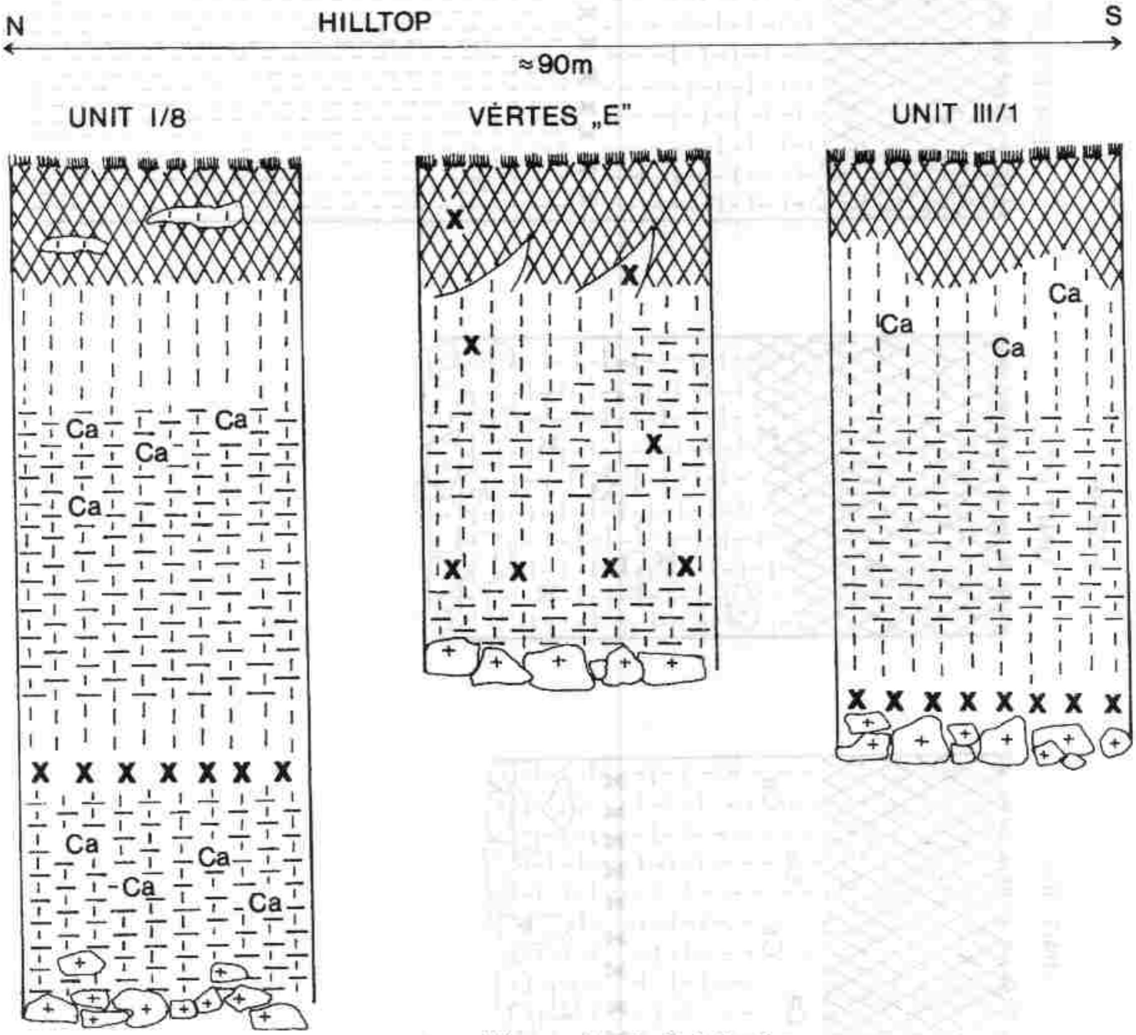


Fig. 48 Henye hilltop stratigraphy N–S direction

[4] A small part of the material is in Herman Ottó Museum, Miskolc

On the basis of the stratigraphy obtained during excavation experiences

• the Würm period relief of the hill must have been more uneven with higher relief energy

• the Late Pleistocene loess cover of variable thickness smoothed away these uneven surfaces

• the subsequent intensive climatic events re-arranged the actual surface to variable extent *(Fig. 48–49)*.

The archaeological material is uniform. It is in good accordance with Hungarian and Central-Eastern European analogies, the radiocarbon results and the fauna.

On the basis of areal extent and the quantity of the archaeological and palaeontological material, the Bodrogkeresztúr-Henye site was outstanding among the Hungarian Upper Palaeolithic sites. The finds allow us to postulate long lasting permanent and / or repeated stay of the **same cultural entity**. The criteria on the basis of which permanent settlements were separated in the Moravian Basin or along the river Don had been missing in the complete Hungarian Palaeolithic evidence; still, Bodrogkeresztúr-Henye was undoubtedly one of the most varied and complete Upper Palaeolithic sites in Hungary. The centre of habitation could be observed at several point of the plateau. Topographical "slip" may indicate chronological differences but the unity of the archaeological evidence clearly indicate that the complete find assemblage used to belong to the same archaeological culture.

Bodrogkeresztúr-Henye was an important site of the Older Upper Palaeolithic / Gravettian population wave which could be followed from Willendorf and the Pavlovian base areas till Molodova.

In the large sense, it was a member of the Willendorf-Pavlov-Avdeevo-Kostenki Entity, or, from another point of view, into the frames of the (Central European) Middle Upper Palaeolithic (MUP). The identity is understood more in the similarity of the ecological relations of the interpleniglacial or younger open-air settlements than specific (typological or other) analogies. For this, the presented framework is far too large in chronological as well as geographical sense.

Immediate typological connections were found within the interior margins of the Carpathian Basin as well as southern parts of Moravia. Bodrogkeresztúr used to exist to the east of the core area of the interpleniglacial backed blade industries, to the south of the hypothetical main spreading route of this culture.

The most likely route for the population of the interior areas of the Carpathian Basin is considered to be across the Danube valley (with adjacent hills and midmountain regions). Other routes might have also played minor roles, running towards the interior parts of the basin from the main communication road or the watershed (in the first place, the river Hernád and its tributaries). Immediate eastern-south-eastern connection with the regions outside the Carpathian basin are hard to postulate.

Leading finds of the culture like Kostenki knives, permanent above ground constructions/mammoth huts were missing from Bodrogkeresztúr and all the other contemporary Hungarian settlements. Art was represented in the form of incised rim polished discs. Well-known and spectacular "fossile directoire" finds were always emphatically considered in the cultural classification of sites. They are, in fact, adequate but not indispensable conditions for assigning sites into cultures. Supposing that the "people with mammoth huts" were a separate, somewhat younger episode of the Gravettian entity (DJINDJAN–KOZŁOWSKI–OTTE 1999, 207), the Hungarian sites could well be a more general, less typical and poorer representatives of the same culture. The geographical and chronological framework covered by the mammoth-huts could be to large for being filled out by one culture in the traditional archaeological sense. The possibility of other explanations – i.e., the construction of mammoth huts were specific not for the culture but the climate should also be considered. The hypothesis can be risked that the distribution stripe of mammoth huts coincided with the grassy tundra vegetation zone with no arboreal vegetation (JÁRAINÉ 1997, 9). The Carpathian Basin was situated to the south of this stripe, with its specific, more protected climate already in the steppe zone.

As we are getting closer in time, the amount of information is getting objectively more numerous. Our perception, however, multiplies it subjectively. It seems that the resultant tendencies do not favour integration in the Upper Palaeolithic. In the period of sensible separation we can count on a big mosaic of local communities built on each other replacing the traditional large cultural units of the Lower or Middle Palaeolithic period. The given territories, chronological frames could overlap to some extent.

The summary or part of features which could be investigated with archaeological methods included:

• selection of the place of settlement (close to rivers, on multi-purpose strategical points

• large system of connections (e.g., procurement of "long distance" raw materials)

• distribution of certain object carrying probably the same conceptual contents (polished serpentinite discs)

• type spectrum and analogies of types.

– These features set a common framework to the sites of this period. The above reconstruction of the Older Blade Industry / Pavlovian/MUP sites (position of the site Bodrogkeresztúr and its circle) within the Hungarian Upper Palaeolithic could be realised accordingly, on the basis of our present state of knowledge.

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# Hunted mammals from the Gravettian campsite Bodrogkeresztúr-Henye (Ne Hungary)

István VÖRÖS

## 1. Introduction

The Henye hill is situated between the so-called Hegyalja region lying along the Bodrog river at the SE margin of the Zemplén Mts. at 200–300 m altitude and the Tokaj (Kopasz) Mt., 515 m a.s.l.near Bodrog-keresztur village. In 1963, László VÉRTES excavated the Upper Palaeolithic settlement lying on the flat top of Henye hill. In 1982, Viola Dobosi continued work by sondage. In the two excavation seasons, altogether 423 $m^2$ was unearthed :

1963, VÉRTES 165 $m^2$
1982, DOBOSI 258 $m^2$

resulting in altogether 3589 pieces of stone, 1803 animal bones and 154 charcoal pieces

Animal bone remains of the 1963. excavation season were transported into the Palaeovertebrate Collection of the Hungarian Geological Institute (Since 1994, the collection belongs to the Geological Museum within the Hungarian Geological Institute. Inventory numbers: V.10974, 10976-77, 10979-10990, 10992.)

This part of the assemblage was investigated by Miklós KRETZOI (KRETZOI 1964a.); the "extract" of this work, i.e., the faunal list was published by László VÉRTES in his article on the site (VÉRTES 1966. 7):

*Table 1.*

| III. 63. A trench., E, J, G, H, C, D. sections | | |
|---|---|---|
| Equus | 94ps | 9⁺ MNI |
| Alces | 59 | 9 |
| Cervus | 1 | 1 |
| Bison | 5 | 1 |
| Mammuthus | 7 | 3 |
| Leo | 1 | 1 |
| Lepus | 1 | 1 |
| **TOTAL** | **168** | **26** |

+ in KRETZOI 1964, min. 10, but more

Animal bone remains of the 1982. Excavation were transported into the Quaternary Section of the Archaeozoological collection of the Hungarian National Museum.

There were remains of six big game species found at the Henye-hill settlement. Among them were five herbivores: *Equus sp., Alces alces (L.), Cervus elaphus L., Bison priscus* /Bojanus/, *Mammuthus primigenius* /Blumenbach/; a large carnivore, *Leo spelaeus* /Goldfuss/ and a medium fur game: *Lepus* sp. /europaeus Pallas/ *(Table 2.)*

The traces of the Upper Palaeolithic settlement on the SE plateau of the Henye hill could be observed on a surface of 250 x 75–80 m area. Excavations were performed on four areas (Unit I–IV) by archaeological sections (sec.) and trenches (tr.) *(Fig. 1.)*, which were further divided by a grid system into 1 $m^2$ ( =□ ) surfaces.

Occurrence of animal bones on the excavated surfaces is asymmetrical: sometimes they are concentrated, at other places, missing. Animal bones occurred on 36,4% of the total excavated surface (154 $m^2$ of 423 $m^2$): *(Fig.1.)*

| | TotaL area excavated ($m^2$) | Animal remains found ($m^2$) | Animal bone remains found (pieces) |
|---|---|---|---|
| Unit I. (1963, 1982) | 151 | 57 | 1083 |
| Unit II. (1982) | 80 | 28 | 212 |
| Unit III. (1963, 1982) | 184 | 61 | 474 |
| Unit IV. (1963) | 8 | 8 | 34 |
| **TOTAL** | **423** | **154** | **1803** |

On the Henye-hill, the surface of the andesite base rock is uneven and is sloping more than the current surface of the sediment deposited on it.

Observations made during excavation prove that the cultural layer of the upper Palaeolithic settlement, the contemporary walking level followed the surface of the base rock, i.e., it is running parallel to the andesite surface. Consequently, the thickness of the sediment overlying the cultural layer is alternating, getting thin on the top of the hill and more thick towards the slope. Due to viniculture practised on the hill, the covering layers were mixed several times at some places till the depth of 80–100 cm. Consequently, animal bones were also occurring in original position in the cultural layer, "in situ" as well as the present surface.

Distribution of animal bones according to excavation units was the following:

*Unit I. (Fig.2.)*

The Northern part of the centre of the Palaeolithic settlement: I.63. B, F sec., A tr. 1–15 m. Excavated surface 151 m$^2$, with 1083 pieces of animal bones found on 57 m$^2$ of the area *(Table 2.).*
No animal bones were found at I.63. B, F. sec., I.82. 1,4, and 5 tr.

Samples for C-14 analysis:
1. loessy charcoal (300 g) - I. 63. F. sec. 100–110–130 cm (from burn layer with charcoal, VÉRTES HNM Archives V. 94.1965.)
2. Equus bones - I. 82. B. sec. 4 □, I. 82. 7 tr.

Also from the profile of I.63. F sec., samples were collected for sedimentological analysis (VÉRTES HNM Archives V. 94.1965.) Results by D. Moldvay were published by L. VÉRTES (VÉRTES 1966. 7).

Fix depth data for the animal bones are the following:

| | |
|---|---|
| I.82.C. sec. "under humus" | –80 cm |
| 3. tr., S part | –130 cm |
| 3. tr. | –100, –110 cm |
| 6. tr. "in deep-ploughed soil" | –60, –80 cm |

*Unit II. (Fig.3.)*

NW part of the Palaeolithic settlement: I.82. 1–4 trs. Excavated surface 80 m$^2$, with 212 pieces of animal bones found on 28 m$^2$ of the area *(Table 2).*
Fix depth data for the animal bones are the following:

| | |
|---|---|
| I.81. tr. | –60, –70 cm |
| 4. tr. | –60, –70 cm |
| 2. tr. | –50, –70 cm |
| 3 tr. W part | –65, –70 cm |

*Unit III. (Fig. 4.)*

Southern part of the centre of the Palaeolithic settlement: III.63. A, tr. E, J, G, and H sec., III. 82. 1–4 trs. Excavated surface 184 m$^2$, with 474 pieces of animal bones found on 61 m$^2$ of the area *(Table 2).*
No animal bones were found at I.63. B, F. sec. I.82. 1, 4, and 5 tr.
Samples for C-14 analysis:
Equus bone - III. 82. 3 tr. W part, 7 □
Fix depth data for the animal bones are the following:

| | |
|---|---|
| III.63.H. sec. "disturbed layer" | –80, –90 cm |
| E sec., E part | –60, –80 cm |
| E sec. 2–3 □ | –100 cm |
| G sec. 2, 5 □ | –80 cm(Mammuthus mandible) |
| III.82.1. tr. 5 □ "disturbed humus", | –80 cm (Mammuthus molar) |
| 2. tr. 6 □ | –90, –100 cm (Mammuthus tusk fragm.) |
| 3. tr. 9 □ | –80, –90 cm |
| 4. tr. 3–4 □ "disturbed humus" | –80 cm |

*Unit IV. (Fig.1.)*

SE edge of the centre of the Palaeolithic settlement: IV.63. C, D sec. Excavated surface 8 m$^2$, with 34 pieces of animal bones found on all 8 m$^2$ of the area. No other archaeological material was found here. The material inventorised as "stray finds" in the Palaeovertebrate Collection of the Hungarian Geological Institute as well as some unmarked pieces from the site correspond to the quantity and description and excavation observations by VÉRTES, which said for the D sec: many horse, mammoth, Megaloceros ... (Old settlement)... (HNM Archives V. 94. 1965.). Among the provenance of palaeontological finds, the A tr. and all sec.-s are found with the exception of D. and C. sec-s. Probably, we can identify D. sec. With "stray finds" and unmarked finds with C. sec.
Fix depth data for the animal bones are the following:

| | |
|---|---|
| IV.63.C. sec. "disturbed layer" | –20 cm (Mammuthus molar) |
| D sec., "cultural layer in original position" | –70 cm |

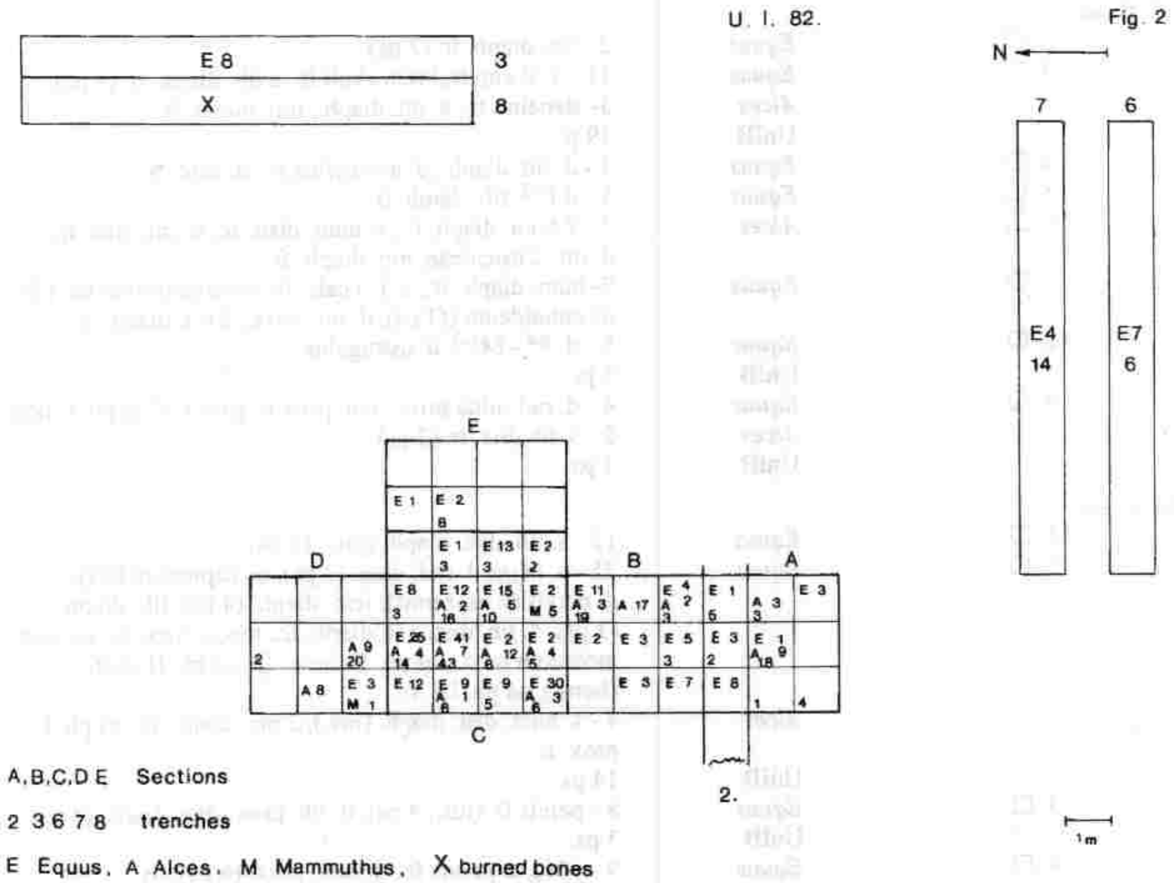


Fig. 2 Bodrogkeresztúr-Henye, Unit I. 82. Bone distribution among the species

## 2. Description of the big animal remains – topographical distribution

### *2.1. Unit I. (Fig. 2.)*

I. 82. A. sec.

| | | |
|---|---|---|
| 1. ☐ | UnIB (unidentified bone) | 1 p. (piece) |
| 2. ☐ | *Equus* | 1 - os sesamoideum dist. fr. |
| | *Alces* | 9 - s. rad. prox. med. fr (4 ps), 3 carpus fr., mc. diaph. fr. (2 ps) |
| | UnIB | 18 ps. |
| 3. ☐ | *Alces* | 3 -2 scapula fr., mc. diaph. |
| | UnIB | 3 ps. |
| 4. ☐ | UnIB | 4 ps. (2 burnt) |
| 6. ☐ | *Equus* | 3 - rad. diaph. fr. (2 ps), os capitatum ($C_3$) |

I. 82. 2.tr. (parts between A sec. 1-3 ☐ and B. sec. 7-9 ☐)

| | | |
|---|---|---|
| 1. ☐ | *Equus* | 4 - tib. diaph. fr. (4 ps) |
| 2. ☐ | *Equus* | 3 - tib. diaph. fr. (3 ps) |
| | UnIB | 2 ps. |
| 3. ☐ | *Equus* | 1 - M sup fr., |
| | UnIB | 5 ps. |

| | | | |
|---|---|---|---|
| | | *Alces* | 5 - 2 mc. prox fr., d. mc.dist.. fr., tib. dist. fr., os malleolare fr. |
| | | UnIB | 10 ps (2 burnt). |
| | 10. □ | *Equus* | 30 - s. brain skull fr., s. $I^{1-2}$, d. $I^3$, scapula fr. (11 ps), rad. prox. fr., s. os pisiforme ($C_a$), pelvis fr. (juv., 3 ps), s. fem. prox. fr., tib. prox.fr. (burnt), tib. diaph. fr., s. calc., 2 $mp_{2/4}$ fr., s. os ph. I. ant. – post., d. os ph I. ant., os ph. I. prox fr. |
| | | *Alces* | 3 - d. mt. prox. diaph., d. mt. dist. fr. (2 ps). |
| | | UnIB | 6 ps. |
| | 11. □ | *Equus* | 2 - os ph. I. post. lat. fr., os ph. I. distr. fr. |
| | | *Alces* | 4- d. tib.diaph..fr. (4 ps). |
| | | UnIB | 5 ps. |
| | 12. □ | *Equus* | 2 - s $P^4$, s $M^3$ |
| | | *Mammuthus* | 5 - corpus mandibulae fr (5 ps) |
| I. 82. C. sec. "strayfinds" | | | |
| | | *Equus* | 29 - I inf. fr., 4 M inf. fr., corpus mandibulae fr., s. ram. mandibulae (burnt), hum. distr.fr., rad. prox. med. fr., 3 pelvis fr., fem.diaph.. fr., (4 ps), 3 tib. prox. diaph. fr., tib. diaph. fr. (3 ps), 3 mp. dist.fr., $mp_{2/4}$ prox. fr., 2 os sesamoideum prox., os ph. II. prox fr. (burnt) |
| | | *Alces* | 5 - rad. prox. fr., fem.diaph. (2 ps), 2 os ph. I. dist. fr. |
| | | *Bison* | 1 – s.tib.dist. |
| | | *Mammuthus* | 7 – tusk aboral terminal piece (2 ps), praemaxilla fr. (5 ps) |
| | | UnIB | 284 ps (154 bone grit, 130 "bone morsels") 25 burnt, |
| I. 82. E. sec. | | | |
| | 2. □ | *Equus* | 1 – d. os ph. I. ant. |
| | 4. □ | *Equus* | 1 - mp.diaph. fr. |
| | | UnIB | 3 ps. |
| | 5. □ | *Equus* | 2 – scapula fr., hum.diaph. fr. |
| | | UnIB | 8 ps. |
| | 7. □ | *Equus* | 13 - d. $I^{1-2}$ (juv.), d. $P^{3/4}$, s. $P_{3/4}$, fem.diaph. (8 ps), os ph II. prox.fr. |
| | | UnIB | 3 ps (burnt). |
| | 10. □ | *Equus* | 2 - mp.diaph. fr. (2 ps). |
| | | UnIB | 2 ps. |
| I. 82. E. sec. "during excavation" | | | |
| | | *Equus* | 7 - hum. dist. diaph., astragalus fr., 2 $mp_{2/4}$ fr., 2 os ph. I. diaph. fr., os ph. II. dist. fr. |
| | | *Alces* | 1 P sup. (germ). |
| | | *Bison* | 1 d $M_{1-2}$. |
| | | UnIB | 57 ps (19 burnt). |
| I. 82. D. sec. | | | |
| | 2. □ | UnIB | 2 ps. |
| | 4. □ | *Alces* | 8 - 3 costa fr. , s. tib. dist. (2 ps), tib. diaph. (3 ps). |
| | 7. □ | *Equus* | 3 - s. pelvis fr. (juv., 2 ps), tib. diaph. (burnt). |
| | | *Mammuthus* | 1 - tooth lamella fr. |
| | 8. □ | *Alces* | 9 - 2 vert. lumba. fr., 3 costa fr., tib. diaph. (3 ps), mc. prox. diaph. |
| | | UnIB | 20 ps. |

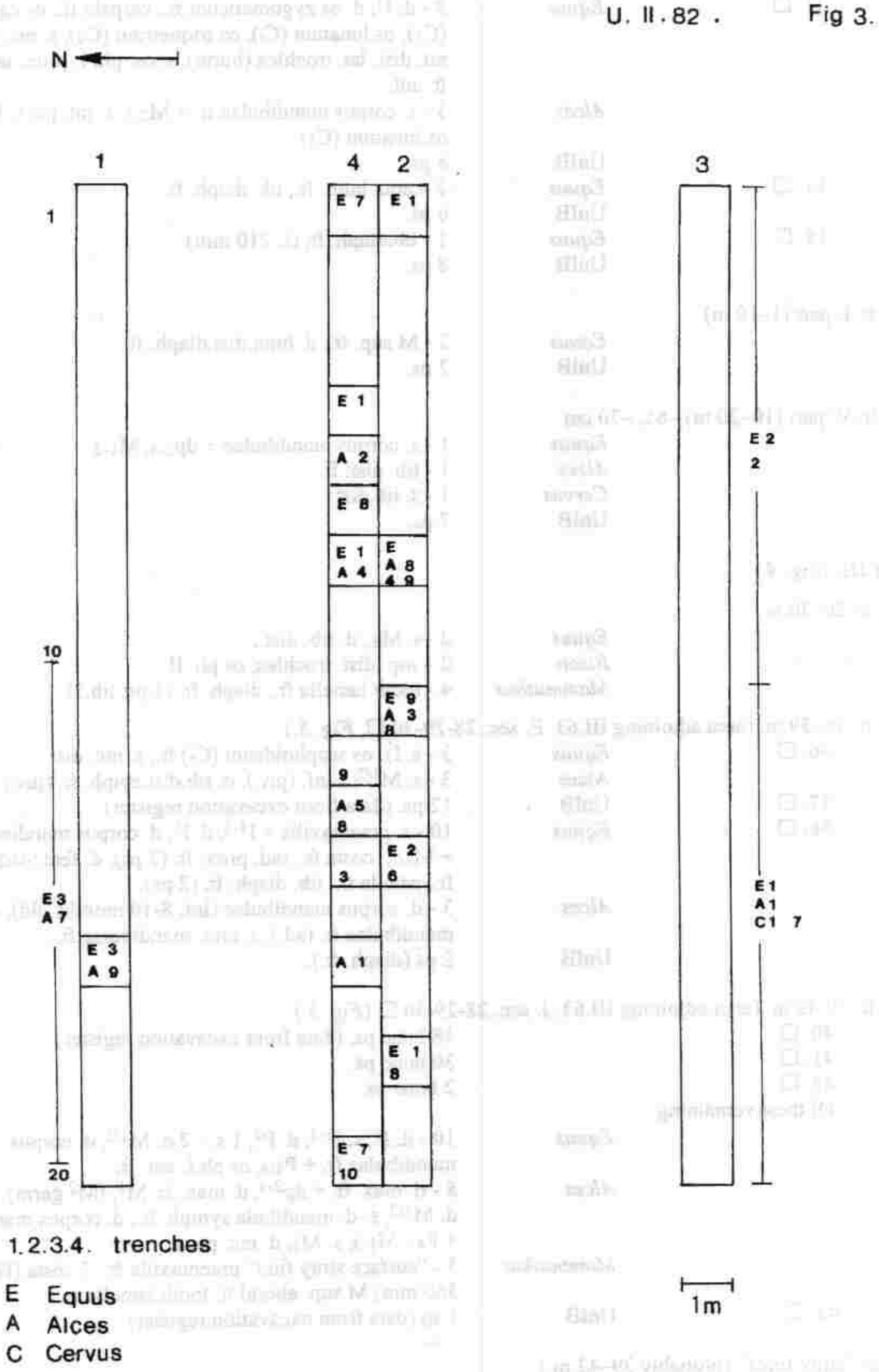


Fig. 3 Bodrogkeresztúr-Henye, Unit II. 82. Bone distribution among the species

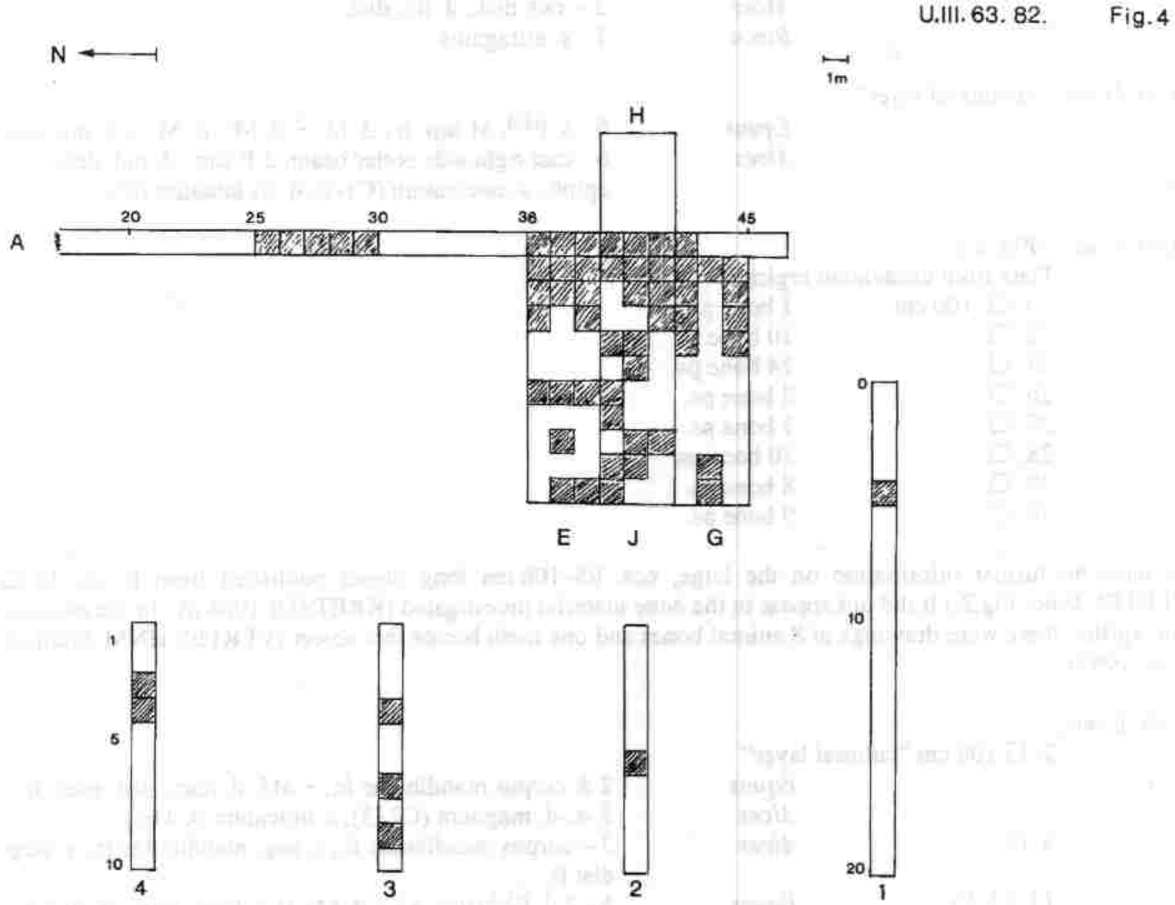


Fig. 4 Bodrogkeresztúr-Henye, Unit III. 63., 82. Animal bone distribution

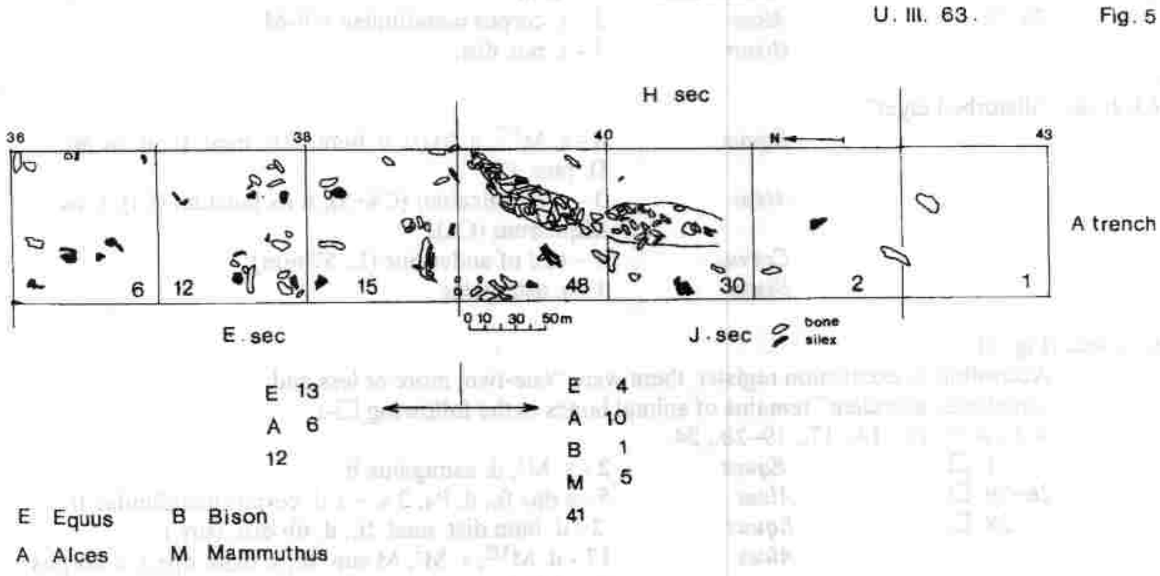


Fig. 5 Bodrogkeresztúr-Henye, Unit III. 63. "A" tr. Bone distribution among the species.
Completed a fter Vértes 1966, Fig. 3.

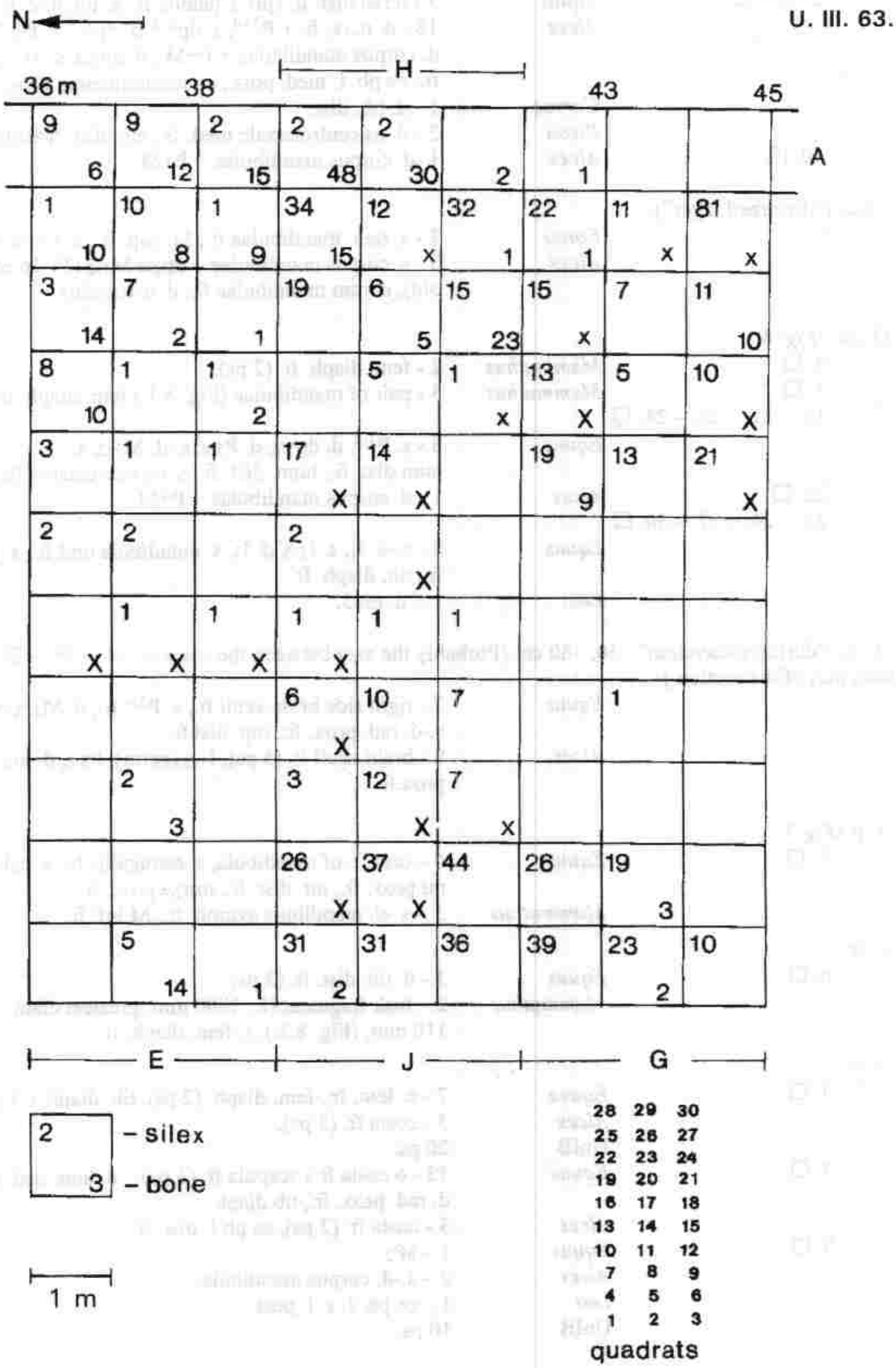


Fig. 6 Bodrogkeresztúr-Henye, Unit III. 63. E-J-G sec. Animal bone and silex distribution

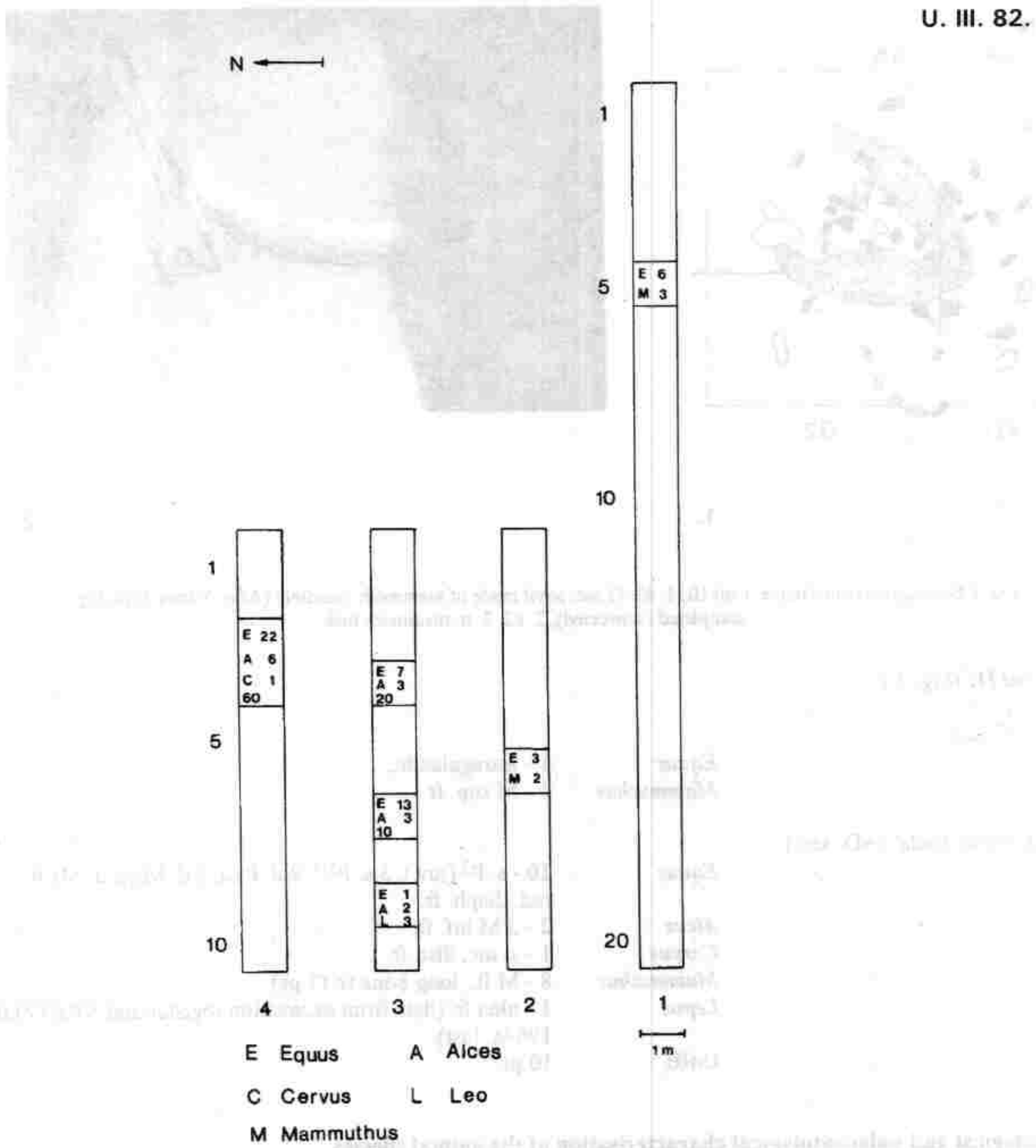


Fig. 7 Bodrogkeresztúr-Henye, Unit III. 82. 1–4. Bone distribution among the species

III. 82. 4. tr

| | | |
|---|---|---|
| 3.–4. □ | *Equus* | 22 - s. $M_3$ fr., costa fr. (8 ps), c. hum.fr. (2 ps), d. hum.dist., d. pelvis fr., caput. fem. fr., fem. diaph. (3 ps), tib. diaph. (5 ps). |
| | *Alces* | 6 - costa fr. (4 ps), scapula fr. (2 ps). |
| | *Cervus* | 1 - antler tine |
| | UnIB | 60 ps. |

| | | | | |
|---|---|---|---|---|
| 15 isolated upper incisives | | | | |
| 7 | $I^1$ | 2 sin. – | 5 dext. | |
| 4 | $I^2$ | 1 sin. – | 3 dext. | |
| 3 | $I^3$ | | 3 dext.; | 1 $I^{1/3}$ fr. |
| 21 isolated upper premolars | | | | |
| 5 | $P^2$ | 2 sin. – | 3 dext. | |
| 1 | $P^3$ | 1 sin., | | 1 $dp^3$ sin. |
| 11 | $P^{3/4}$ | 6 sin. – | 5 dext. | |
| 3 | $P^4$ | 1 sin. – | 2 dext. | |
| 30 isolated upper molars | | | | |
| 4 | $M^1$ | 2 sin. – | 2 dext. | |
| 2 | $M^2$ | 1 sin. – | 1 dext. | |
| 5 | $M^{1/2}$ | 2 sin. – | 3 dext. | |
| 7 | $M^3$ | 4 sin. – | 3 dext.; | 12 M fr. |
| 12 mandibulae | | | | |
| 4 corpus mandb. | | 1 sin. – | 1dext. | |
| 2 mandibula lower edge, fr. | | | | |
| 3 mandibula oral fr. | | | | |
| 3 ram mandib. fr. | | 2 sin. – | 1 dext. | |
| 8 isolated lower incisives | | | | |
| 3 | $I_1$ | 2 sin. – | 1 dext. | |
| 1 | $I_2$ | 1 sin. – | | |
| 3 | $I_3$ | 2 sin. – | 1 dext.; | 1 I fr. |
| 13 isolated lower premolars | | | | |
| 3 | $P_2$ | 2 sin. – | 1 dext. | |
| 9 | $P_{3/4}$ | 2 sin. – | 7 dext.; | $dp_{3/4}$ 1 sin |
| 28 isolated lower molars | | | | |
| 11 | $M_{1/2}$ | 2 sin. – | 9 dext. | |
| 1 | $M_2$ | 1 sin. | | |
| 8 | $M_3$ | 5 sin. – | 3 dext.; | 8 M fr. |

*Trunk region*
1 vert. cervicalis fr.,
21 costa fr.

*Fore limbs*
15 scapula fr.
24 humeri
- 4 prox. epiph. 1 sin. (juv.)
- 12 diaph. — 4 dext.
- 8 dist. epiph. 2 sin. – 2 dext.

33 radiis
- 15 prox. epiph. 4 sin. – 3 dext.
- 16 diaph.
- 2 dist. epiph. — 2 dext.

2 ulna fr. (olecranon) — 2 dext.
8 carpals - 3 os capitatum $C_3$, os triquetrum $C_u$, os pisiforme $C_a$, os lunatum $C_i$, os scaphoideum $C_r$, carpals fr.
10 metacarpals
- 1 prox. epiph.
- 2 diaph.
- 7 dist. epiph. 5 sin. – 2 dext.

*Hind limbs*
22 pelvic (pars acetabuli, corpus o., ilii, ala o. ilii) 4 sin. – 8 dext.

42 femur
- 8 prox. epiph. 3 sin. – 1 dext
- 30 diaph.
- 4 dist. epiph.

2 patella fr.
96 tibia
- 3 prox. epiph.
- 81 diaph. 1 sin. – 9 dext
- 12 dist. epiph. 3 sin. – 9 dext.

18 tarsale
- 7 astragalus 2 sin. – 3 dext.
- 6 calcaneus 4 sin. – 2 dext.
- 2 os naviculare $T_c$, os cuneiforme lat. $T_3$, 2 os cuboideum $T_{4+5}$

8 metatarsale
- 2 prox. epiph. 1 dext.
- 3 diaph.
- 3 dist. epiph. 1 dext.

17 metapodial /mc/mt/ diaph.fr.

*Phalanges*

| | |
|---|---|
| 14 os ph.I. | 5 ant. – 4 post.; (7 complete, 2 prox., 3 diaph., 2 dist. pieces) |
| 12 os ph.II. | 3 ant. –2 post.; (5 complete, 5 prox., 2 dist. pieces) |
| 2 os ph.III.-fr. | |
| 4 os sesamoideum | 3 prox. 1 dist |

Anatomical division of *Equus* remains within the camp site are presented on Table 3.

### 3.1.2. Teeth

For the exact classification of the Henye hill horses, their relationship, chronology and species evolutionary level they should be compared to *Equus* finds from other well known and documented Upper Pleistocene sites. For the comparison, primary and characteristic dimensions of fossil material, teeth and postcranial bones can be used.

Skulls were cracked and destroyed, with only 66 pieces of isolated upper teeth remaining.

Among the 23 incisors (15 sup. - 8 inf.) there were no deciduous ones. 3 of the incisors are not worn yet. Dimensions of juv. and ad. upper incisor crowns are presented below in mm:

| | $I^1$ | | | | $I^2$ | | | | $I^3$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Width | 16,5 | 19 | 19,5 | 20 | 17 | 18,1 | 21 | 21 | 17 | 18 | 19,5 | 20 |
| Sag. L | 9 | 11 | 12,2 | 12 | 10 | 11,1 | 10 | 12 | 10 | 13 | 12 | 13 |
| | juv. | | | | juv. | | | | juv. | | | |

Canine (C) is absent from the campsite of Henye hill.

The Henye-hill horses can be characterised well on the basis of 29 upper and 41 lower cheek teeth and teeth fragments *(Table 4–5)*.

*Height of the teeth*

Dimensions of cheek teeth, e.g. height depend on the species-evolutionary level and the age of the individual.

G. Nobis (NOBIS 1971. 7.) assigned the height of teeth into three abrasion levels, taking into consideration abrasion of the teeth with the advance of age:

| Abrasion levels | Age | Height of the teeth (mm) | |
|---|---|---|---|
| | | Upper | Lower |
| A.I. | From after the appearance of the permanent teeth till 6[th] years of age | 75 < | 60 < |
| A.II. | 7–16 years | 75–55 | 60–40 |
| A.III. | After 17. years | <55 | <40 |

Height of the tooth was measured from the bifurcation of the roots to the upper grinding surface (or top) of the tooth.

Upper teeth from Henye hill:

| | NOBIS categories | | |
|---|---|---|---|
| | A. I. | A. II. | A. III. |
| $P^2$ | 1 | | - |
| $P^{3/4}$ | 5 | 4 | 2 |
| $M^{1/2}$ | 8 | 2 | – |
| $M^3$ | 2 | 2 | 1 |

Upper teeth height (mm)

| | juv. | | | | | | subad. | | | ad. | | | mat. | | sen | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P^2$ | | | | | | | | | | 75 | | | | | | | | |
| $P^{3/}$ | | 96 | | | | 85 | 83 | | | 75<br>75 | | 64 | | 60<br>60 | 58 | | 54 | 45 |
| $M^{1/}$ | 98 | | 90<br>90 | 88 | 86 | 85<br>85 | | 80 | 76 | | | 65<br>65 | | | | | | |
| $M^3$ | | | | | | 85 | | | | 75 | 66<br>66 | | | | | 55 | | |

Average height of the upper teeth in A. I. was 83,87 (n = 16), 98–75 mm; in A.II., 63,00 (n = 8) 66–58 mm.
Average height of upper teeth (in mm):
$P^{3/4}$ (n = 9) 72,89 96–58
$M^{1/2}$ (n = 10) 82,30 98–65

*Table 5.* Bodrogkeresztúr–Henye., Dimensions of the lower cheek teeth of *Equus* (measured at the occlusal surface; in mm)

| | $P_2$ | | | | $dp_{3/4}$ | | $P_{3/4}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 33,4 | 34,0 | 36,6+ | 38,0 | 33,0 | 35,0 | 29,0 | 30,0 | 30,0 | 31,0 | 32,0 | 32,5 |
| 2. | 18,2 | 15,0 | 17,5 | 17,5 | 16,5 | 15,5 | 19,0 | 18,1 | 18,5 | 19.0 | 21,4 | 20,0 |
| 3. | 28,0 | 35,0 | 50,0 | 58,0 | | | | 84,0 | | | | 60,0 |
| 4. | 6,07 | 5,10 | 6,38 | 6,67 | 5,45 | 5,25 | 5,51 | 5,43 | 5,55 | 5,89 | 6,72 | 6,50 |
| | sen | mat | | | | | | | | | | |

| | $P_{3/4}$ | | | | $M_{1/2}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 33,0 | 35,0+ | 35,0 | | | 26,5 | 27,0 | | 27,0 | 27,0 | 27,8 | 28,0 |
| 2. | 17,0 | 18,0 | 18,0 | 22,0 | 15,5 | 19.0 | 17,0 | 17,1 | 18,0 | 16,5 | 17,9 | 16.0 |
| 3. | 50,0 | 40,0 | 60,0 | | | | | | | | | |
| 4. | 5,61 | 6,30 | 6,30 | | | 5,04 | 4,60 | | 4,86 | 4,48 | 4,97 | 4,48 |

| | $M_{1/2}$ | | | | | | | | $M_3$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 28,0 | | 28,1 | 28,1 | 28,5 | 33,0 | 34,0 | 35,0 | 33,0 | | 33,0 | 33,5 |
| 2. | 17,0 | 17,5 | 19,0 | 17,5 | 16,0 | 18,5 | 18,0 | 16,1 | 13,5 | 14,0 | 16,5 | 15,0 |
| 3. | 52,0 | | | 75,0 | | 95,0 | 90,0 | 80,0 | 78,0 | 47,0 | 58,0 | |
| 4. | 4,76 | | 5,34 | | 4,56 | 6,10 | 6,12 | 5,64 | 4,46 | | 5,45 | 5,03 |
| | | | | | | | | | | mat | | |

| | $M_3$ | | | | |
|---|---|---|---|---|---|
| 1. | 34,0 | | 36,5 | 36,5 | |
| 2. | 15,0 | 15,0 | 13,5 | 15,0 | |
| 3. | | 60,0 | 56,0 | | 70,0 |
| 4. | 5,10 | 4,93 | 5,48 | | |

1. legnth, 2. breadth, 3. height, 4. occlusal surface measure ($cm^2$), + = germ (not yet erupting; the tooth crown was still sunk down in the alveolus)

Cheek teeth belonging to abrasion stage A.I. are characterised by, beyond question, great hypselodonty. This feature corresponds well to large vaulted facial skull, high maxilla (e.g., horse skull from Pilismarót-Basaharc, VÖRÖS 1990a). The corpus mandibulae is wide and high. The fast abrasion of teeth in stage A.II. shows that the resistivity of enamel to contemporary vegetal nutrients was low. In the case of this *Equus* form, the inadequate hardness of the enamel is "compensated" by, for the teeth exposed to fast abrasion, by hypselodonty.

The differences in the height size of teeth is also influenced by the status of the tooth – i.e., milk teeth or permanent teeth. The row of teeth of three juv./subad. individuals show the differences well (height of teeth in mm):

| | P2 | P3 | P4 | M1 | M2 | M3 | Age (years) | Unit |
|---|---|---|---|---|---|---|---|---|
| inf. | 50[1] | 40[1] | 60[1] | 90 | 80 | | CCa. 2 years | II.83. 3. tr. |
| sup. | 75 | | 85 | 90<br>86 | 90<br>88 | 75[2] | 2–2,5<br>3–3,5 | I.82. 3. tr.<br>I.82. B sec. 8. □ |

[1] germs permanent teeth under the deciduous teeth
[2] unworn (without abrasion surface)

*Length and breadth of teeth*

The length and breadth size of the crown – tooth column – determine, apart from the absolute dimensions of the teeth, the formation of the chewing surface, the "useful area" of the tooth as well. W. Reichenau (1915, 105–) draw attention to the phe-

*Table 7.* cont. (2)

| Teeth/Site | length | | | breadth | | | Protocon length | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | x | min-max | n | X | min-max | n | x | min-max |
| $p^{3/4}$ | | | | | | | | | |
| **Bodrogkeresztúr** | 12 | 31,95 | 29,6–35,0 | 8 | 30,43 | 29,0–32,0 | 9 | 14,45 | 11,5–17,0 |
| Pilismarót-Bh[1] | 5 | 33,00 | 32,0–33,5 | 5 | 31,50 | 30,5–33,0 | 5 | 13,90 | 12,4–18,5 |
| Pilisszántó II.[2] | 5 | 21,90 | 30,0–34,0 | 5 | 29,00 | 26,0–33,0 | 5 | 16,40 | 14,5–17,5 |
| Kiskevély[3] UL | 4 | 29,42 | 27,0–32,0 | 4 | 29,25 | 27,0–31,0 | 4 | 14,23 | 13,0–15,0 |
| LL | 2 | | 32,0–33,0 | 2 | | 28,5–33,0 | 2 | | 13,0–15,0 |
| Madaras[4] | 5 | 30,22 | 25,1–33,5 | 4 | 29,12 | 25,5–31,5 | 4 | 15,00 | 9,5–18,0 |
| Pilisszántó I.[5] | 4 | 30,28 | 25,0–32,6 | 4 | 27,07 | 25,5–29,0 | 3 | 14,00 | 12,5–16,5 |
| Nadap[6] | 5 | 29,06 | 27,0–33,5 | 3 | 26,67 | 26,0–28,0 | 4 | 14,12 | 13,5–14,5 |
| Ságvár[7] | 11 | 29,01 | 25,6–31,0 | 11 | 27,12 | 25,8–29,0 | 14 | 13,12 | 11,3–15,0 |
| Combe Grenal[8] | 73 | 30,28 | 27,0–33,5 | 67 | 28,33 | 26,0–28,0 | 72 | 13,79 | 11,0–18,0 |
| Solutré[8] | 20 | 28,60 | 26,5–31,0 | 19 | 27,40 | 23,2–30,0 | 20 | 13,54 | 12,0–15,7 |
| Willendorf II.[9] | 2 | | 29,3–29,5 | 2 | | 29,5–31,0 | | | |
| Tilde[10] | 37 | 30,80 | 26,8–35,3 | 38 | 28,80 | 24,7–33,4 | 36 | 14,69 | 11,5–17,2 |
| Sandalja II[11] E-F | 8 | 29,10 | | 5 | 27,60 | | | | |
| G-H | 22 | 31,00 | | 15 | 28,00 | | | | |
| Temnata[8] V. | 9 | 29,48 | 27,7–31,4 | 8 | 29,26 | 28,0–31,8 | 9 | 27,7–31,4 | 11.4–16,9 |
| Bacho Kiro[12] | 15 | 27,10 | 24,5–28,8 | 13 | 28,30 | 25,9–31,0 | | 24,5–28,8 | |

*Table 7.* cont. (3)

| Teeth/Site | length | | | breadth | | | Protocon length | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | x | min-max | n | X | min-max | n | x | min-max |
| $M^{1/2}$ | | | | | | | | | |
| **Bodrogkeresztúr** | 10 | 30,25 | 26,0–33,0 | 10 | 27,91 | 26,0–30,0 | 9 | 14,26 | 12,0–16,0 |
| Pilismarót-Bh[1] | 6 | 29,08 | 28,5–30,0 | 6 | 30,21 | 29,5–31,0 | 6 | 15,20 | 13,0–18,0 |
| Pilisszántó II.[2] | 2 | | 23,2–31,0 | 2 | | 26,5–30,0 | 2 | | 12,0–16,0 |
| Kiskevély[3] UL | 4 | 26,17 | 25,0–27,2 | 4 | 28,12 | 27,0–29,0 | 4 | 13,5 | 10,0–15,5 |
| Madaras[4] | 3 | 24,04 | 22,8–26,1 | 2 | | 24,1–28,1 | 2 | | 10,7–15,5 |
| Pilisszántó I.[5] | 2 | | 24,4–25,0 | 1 | | 28,0 | | | |
| LL | 2 | | 28,5–29,0 | 2 | | 28,0–31,5 | 2 | | 13,0–15,0 |
| Nadap[6] | 6 | 27,36 | 23,5–29,5 | 5 | 27,20 | 25,5–28,5 | 6 | 13,21 | 12,0–15,0 |
| Ságvár[7] | 15 | 25,22 | 24,4–27,0 | 15 | 27,12 | 25,8–29,0 | 14 | 13,12 | 11,3–15,0 |
| Combe Grenal[8] | 71 | 26,82 | 23,0–30,0 | 60 | 26,93 | 24,5–29,5 | 72 | 14,13 | 11,0–17,0 |
| Solutré[8] | 23 | 25,99 | 24,5–29,0 | 20 | 26,15 | 24,0–29,5 | 22 | 14,39 | 13,0–16,9 |
| Willendorf II.[9] | 2 | | 25,0–26,5 | 2 | | 27,0–28,0 | | | |
| Tilde[10] | 16 | 29,4 | 26,4–34,1 | 16 | 26,90 | 23,7–29,2 | 16 | 14,60 | 12,7–16,9 |
| Sandalja II[11] E-F | 12 | 27,10 | | 9 | 26,50 | | | | |
| G-H | 16 | 28,40 | | 13 | 26,50 | | | | |
| Temnata[8] V. | 7 | 27,70 | 23,5–32,5 | 7 | 27,51 | 25,0–30,0 | 7 | 14,78 | 13,7–15,9 |
| Bacho Kiro[12] | 9 | 23,40 | 21,8–24,5 | 7 | 25,50 | 24,5–27,0 | | | |

*Table 8.* cont. (3)

| Teeth/Site | length | | | breadth | | |
|---|---|---|---|---|---|---|
| | n | x | min-max | n | X | min-max |
| $M_{1/2}$ | | | | | | |
| **Bodrogkeresztúr** | 13 | 29,08 | 26,5–35,0 | 16 | 17,28 | 15,5–19,0 |
| Kiskevély C. UL[2] | 2 | | 26,7–27,0 | 2 | | 17,5–19,6 |
| LL | 2 | | 28,5–30,0 | 2 | | 18,0–20,5 |
| Nadap[4] | 7 | 28,57 | 25,5–34,0 | 6 | 15,68 | 13,0–17,5 |
| Pilisszántó II. Rsh.[1] | 3 | 28,10 | 27,3–29,0 | 3 | 18,40 | 18,0–20,5 |
| Ságvár[5] | 11 | 25,46 | 23,6–27,0 | 10 | 16,80 | 15,0–19,3 |
| Madaras LL[3] | 2 | | 23,0–25,0 | 2 | | 13,0–15,5 |
| Combe Grenal[6] | 124 | 27,78 | 21,5–33,0 | 122 | 15,67 | 13,0–18,0 |
| Solutré[6] | 27 | 27,10 | 24,6–29,5 | 26 | 14,54 | 12,7–16,0 |
| Tilde C $T_1$[7] | 21 | 31,70 | 26,6–36,2 | 21 | 16,30 | 14,8–18,2 |
| Sandalja II C. E-F[8] | 3 | 26,7 | | 3 | 14,5 | |
| G-H | 8 | 27,3 | | 7 | 14,7 | |
| Temnata C.[6] | 7 | 27,40 | 25,3–29,0 | 7 | 16,11 | 15,0–17,2 |
| Bachoi Kiro C.[9] | 11 | 25,5 | 24,0–28,6 | 13 | 15,5 | 13,8–16,8 |

*Table 8.* cont. (4)

| Teeth/Site | length | | | breadth | | |
|---|---|---|---|---|---|---|
| | n | x | min-max | n | X | min-max |
| $M_3$ | | | | | | |
| **Bodrogkeresztúr** | 6 | 34,42 | 33,0–36,5 | 8 | 14,68 | 13,5–16,5 |
| Kiskevély C. UL[2] | 1 | 34,0 | 34,0 | 1 | 15,0 | 15,0 |
| LL | 2 | | 37,0–38,0 | 2 | | 17,0–18,0 |
| Madaras ML–LL[3] | 2 | | 34,0–36,0 | 2 | | 13,0–13,6 |
| Nadap[4] | 1 | 34,0 | 34,0 | 1 | 14,0 | 14,0 |
| Ságvár[5] | 14 | 32,15 | 29,0–34,0 | 12 | 14,15 | 12,0–16,0 |
| Pilisszántó II. Rsh.[1] | 1 | 30,0 | 30,0 | 1 | 13,0 | 13,0 |
| Combe Grenal[6] | 48 | 33,48 | 30,0–38,0 | 48 | 13,93 | 12,0–16,0 |
| Solutré[6] | 9 | 31,92 | 28,5–35,5 | 9 | 13,71 | 12,5–15,5 |
| Tilde C $T_1$[7] | 3 | 31,70 | 29,2–33,5 | 3 | 14,1 | 13,6–14,4 |
| Sandalja II C. E-F[8] | 3 | 33,9 | | 3 | 13,2 | |
| G-H | 3 | 31,2 | | 3 | 12,2 | |
| Temnata C.[6] | 8 | 34,53 | 32,5–36,0 | 7 | 14,87 | 13,3–15,6 |

1. VÖRÖS 1986b. 37; 2. VÖRÖS 1994. 2–3.; 3. VÖRÖS 1989. Tabl. 2.; 4. VÖRÖS 1988b. Tabl. 3.; 5. VÖRÖS 1982. Tabl. 2.; 6. DELPECH–GUADELLI 1992. Tabl. 36–42.; 7. RIEDEL 1980. 32–33. Tabl. I.; 8. FORSTEN 1990. Tabl. 2.; 9. FORSTEN 1982. Tabl. 1.

tooth with narrowing wall towards the tooth neck can occur as individual variation. The facial skull (maxilla) of the horses with "prismatic" teeth and the corpus of the mandible, however, had to be more robust. The deposition of layers of tooth cement is less significant in case of the upper teeth while it is considerable on the labial side of the lower teeth.

The dentition, tooth size of the Henye hill *Equus* finds correspond to the large mesodont horses of the Upper Pleistocene W 1–2 period (*Tables 7.–8.*). One item, a sup. $M^{1/2}$ (A.I.) differs from the rest of the Henye hill *Equus* finds in its small dimensions (26 x 26 Pch. 14 mm) (*Table 4.*).

*Occlusal (or grinding) surface in square centimetres*

The above dental parameters, i.e. the product of length and breadth can give the "useful" chewing area of the tooth. This is the surface where the animal, during nutrition, grinds vegetal food. Dimensions of the occlusal (or grinding) surface on the cheek teeth are given below in square cms for the *Equus* finds at Henye:

| Lower teeth - $P_3$-$M_2$ | | | |
|---|---|---|---|
| | Site | mean | n |
| A.III. | Ságvár | 4,53 | 28 |
| | Nadap | 3,66 | 2 |
| | Madaras Lower Level | 3,56 | 3 |

+only $P_{3/4}$

The dimension of the grinding surface Henye hill horses, both for the upper and lower teeth, is typically large medium -medium value: for the upper $P^3$-$M^2$, the average is 8,96, while that of the lower $P_3$-$M_2$ is 5,44. The dimensions and average of the grinding surface P3 - M2 of the Henye hill horses show great similarity to Equus teeth at Tilde near Triest: sup. 8,48 limit 6,99–11,22; inf. 5,13 limit 4,48–7,0 (RIEDEL 1980. 36) The grinding surface average of *Equus achenheimensis* is somewhat higher: sup. 9,75 limit 8,6–10,9, inf. 5.7 limit 4,6–6,3; that of *Equus remagensis* sup. cca. 8,0 and *Equus solutreensis* sup. cca. 8,05 inf. cca. 5,3 are a little lower than those of the horses of Henye (RIEDEL 1980. 36, NOBIS 1971. 39, 41, MUSIL 1968 a.).

*Protoconus length (in mm)*

| | n | mean | min-max. |
|---|---|---|---|
| $P^{3/4}$ | 9 | 14,50 | 11,5–17,0 |
| $M^{1/2}$ | 9 | 14,25 | 12,0–16,0 |
| $M^3$ | 4 | 13,78 | 11,1–16,0 |

The mean value of $P^3$/$M^2$ Pc length average of the *Equus* finds at Henye hill is 14,35 mm.

*Table 10.* Comparison of occlusal surface (in $cm^2$) of lower teeth of *Equus* from similar chronological perios sites in Hungary

| Kiskevély C. LL[3] | | | n | mean | min-max. |
|---|---|---|---|---|---|
| | A.I.-II. | $P_3$-$M_3$ | 6 | 6,17 | 5,1–6,7 |
| | | $P^{3/4}$ | 4 | 6,42 | 6,3–6,7 |
| | | $M_{1/2}$ | 2 | | 5,1–6,2 |
| **Bodrogkeresztúr-Henye** | | | | | |
| | A.I.-III. | $P_3$-$M_2$ | 22 | 5,44 | 4,4–6,7 |
| | A.I.-II. | $P_{3/4}$ | 9 | 5,98 | 5,4–6,7 |
| | A.I.-III. | $M_{1/2}$ | 13 | 5,07 | 4,4–6,1 |
| | A.III. | $M_{1/2}$ | 1 | 4,48 | 4,4 |
| Pilisszántó II. Rsh.[4] | | | | | |
| | A.I.-II. | $P_3$-$M_2$ | 8 | 5,43 | 5,0–5,9 |
| | | $P_{3/4}$ | 5 | 5,59 | 5,2–5,9 |
| | | $M_{1/2}$ | 3 | 5,15 | 5,0–5,2 |
| Madaras ML-LL[2] | | | | | |
| | A.I.-II. | $P_{3/4}$ | 5 | 5,04 | 4,4–6,0 |
| | A.III. | $P_{3/4}$ | 1 | 4,0 | 4,0 |
| | | $M_{1/2}$ | 2 | | 2,9–3,8 |
| Nadap[6] | | | | | |
| | A.I.-II. | $P_3$-$M_2$ | 11 | 4,98 | 4,3–5,9 |
| | | $P_{3/4}$ | 7 | 5,14 | 4,6–5,9 |
| | | $M_{1/2}$ | 4 | 4,68 | 4,2–5,2 |
| | A.III. | $M_{1/2}$ | 2 | | 3,3–3,9 |
| Kiskevély C. UL[3] | | | | | |
| | A.I.-II. | $M_{1/2}$ | 2 | | 4,7–5,2 |
| Ságvár[7] | | | | | |
| | A.III. | $P_3$-$M_2$ | 28 | 4,53 | 3,5–6,7 |
| | | $P_{3/4}$ | 18 | 4,67 | 4,7–6,7 |
| | | $M_{1/2}$ | 10 | 4,28 | 3,5–5,2 |

2. VÖRÖS 1989. Table 2.; 3. VÖRÖS 1994. Table 3.; 4. VÖRÖS 1986b. 37.; 6. VÖRÖS 1988b. Table 2.; 7. VÖRÖS 1982. Table 3.

Investigating the extreme values of the tooth dimension range we find that by relatively constant higher values, the variation of the lower values is very large (*Tables 7-8*).

"Macrodontous" teeth, dominant in the Middle Upper Pleistocene, can be found still, though rarely (e.g., Madaras, Ságvár). The teeth of the latter period are more hypselodon, the walls of the prismatic crown are parallel. Their size is hardly decreasing, even by abrasion stage A. III. Such forms are *Equus* from Bodrogkeresztúr-Henye (*Table 4–5.*) and those of sediments under layer C-6 in Kůlna Cave. These are medium size horses, dentition assigned to the form *E. scythicus* (MUSIL 1990, Tabl. 2., 7., 14., 33., 41., 47).

One of its last occurrences is known from the Dryas II. period, from layer VIII. of Kniegrotte (MUSIL 1974. Tabl. 2–23).

The evaluation and interpretation of the lower values of tooth dimension is more difficult. "Microdontous" teeth found on the sites can originate from real "small" teeth as well as "senilis" (A.III.) horses. To decide this question is no problem in an assemblage of optimal distribution. If the "microdontous" teeth came forth only from A.III. stage, it is not knowable if they originated from small teeth or just remains of "pyramidal" teeth. In case when the same layer yielded "macrodontous" A.III. teeth as well, the difference is evident the form *Equus* II. "small horse" and E. /A./ cf. hydruntinus was separated on this basis at several Hungarian Upper Palaeolithic sites (Ságvár, Nadap, Madaras, Pilisszántó I.–II. Rockshelters). Let us note that these "microdontous" teeth appear quite often with totally abraded grinding surface, worn deep till the roots (Madaras: VÖRÖS 1989. Fig. 2. 2–7., Pilisszántó II. Rockshelter: VÖRÖS 1986. b. Fig. 4.4., Nadap: VÖRÖS 1988. b. 34.). They show that their enamel was less hard and resistant to contemporary vegetal nutrients.

Horses with "senile" microdontous teeth appear in Hungary at Madaras Lower Layer and the Medium Layer of the Pilisszántó I. Rockshelter during the WII/III interstadial (VÖRÖS 1989, 1987 c.).

On some sites, though in low number, there were small and small medium size teeth found as well. One example was found at Henye hill; one dext. $M^{1/2}$ (82. II. 4. tr. 1. □, *Table 4.*)

The presence of real microdontous small horses during the Late Upper Pleistocene is marked, apart from the *asinien*, by the *Equus* tooth find of the North Bulgarian Bacho Kiro Cave (W II/III interstadial, FORSTEN 1982. Tabl. I.) as well as the afore mentioned Kniegrotte Cave VIII. from the Dryas II. period, where microdontous teeth were found also in Abrasion stage I. (MUSIL 1974. 2–23).

All Bodrogkeresztúr-Henye teeth belonged to the large medium category with the exception of the one small medium piece. Tooth remains from small size *Equus* and *Asinus* were missing from this Upper Palaeolithic campsite.

### 3.1.3. Postcranial skeleton elements

72,8% (352 pieces) of the *Equus* finds from the Henye site were postcranial bone remains (*Table 3.*). This is the highest number on the Upper Palaeolithic sites in Hungary, but due to its fragmentary character, only 11,0% could be measures.

The osteometrical data of the bones, measured according to the methods published by J. U. DUERST (1926.) and A. van den DRIESCH (1976.) are presented on *Table 11.*

*Table 11.* Bodrogkeresztúr–Henye. Measurement of postcranial bones of *Equus* (in mm)

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| Radius | | | | | | | |
| | – | 95 | – | – | 56 | – | – |
| | – | – | – | – | 50 | 35 | – |
| | – | – | – | – | 48 | – | – |
| | – | – | – | – | – | – | 51,5 |
| Metacarpus | | | | | | | |
| | – | – | – | 61 | – | 30 | 42 |
| | – | – | – | 58 | – | 28 | 40 |
| | – | – | – | 58 | – | 24,5 | 40ˣ |
| | – | – | 40 | 56 | – | 26,5 | 41 |
| | – | – | – | 56 | – | – | 40 |
| Tibia | | | | | | | |
| | – | – | – | 90 | – | – | 56 |
| | – | – | – | 90 | – | – | 55 |
| | – | – | – | 85 | – | – | 53 (juv.) |
| | – | – | – | 80 | – | – | 52 |
| | – | – | – | – | – | – | 54 |
| | – | – | – | – | – | – | 52 |
| | – | – | – | – | – | – | 52 |
| | – | – | – | – | – | – | 50 |
| Metatarsus | | | | | | | |
| | – | 60 | – | – | 54 | – | – |
| | – | – | – | 53 | – | 28 | 40 |
| Os phalangis I. | | | | | | | |
| ant. | 97 | – | 38 | 54 | – | 21 | 30 |
| | 91 | – | – | – | – | – | – |
| | 90 | 64 | 41 | 55 | 41 | 22 | 28 |
| | – | – | 41 | – | – | 23 | – |
| | – | – | 39 | 50 | – | 21 | 24 |
| post. | 92 | – | – | – | – | – | – |
| | 91 | – | 40 | 52 | 43 | 22 | 28 |
| | 85 | – | 36 | 46,5 | – | 18 | 27 |
| Os phalangis II. | | | | | | | |
| ant. | 47 | 65 | 56 | 61 | 35 | 26 | 30 |
| | 46 | 64 | 54 | 59 | 35 | 25 | 30 |
| | – | – | – | – | 35 | – | – |

*Table 12.* cont.

| **Os ph. I. ant+post length** | **n** | **mean** | **min-max.** | **diameter** | **n** | **mean** | **min-max.** |
|---|---|---|---|---|---|---|---|
| Bodrogkeresztúr-Henye | 6 | 91,0 | 85,0–97,0 | | | | |
| Kiskevély C. UL[1] | 17 | 86,5 | 78,0–92,0 | | | | |
| LL | 7 | 91,0 | 87,0–100 | | | | |
| Pilisszántó II. Rsh.[3] | 1 | 88,0 | 88,0 | | | | |
| Pilisszántó I. Rsh.[4] | 1 | 80,0 | 80,0 | | | | |
| Achenheim[6] | 39 | 93,8 | 88,0–101 | | | | |
| Kůlna C.[7] | 2 | | 91,2–91,6 | | | | |
| Tilde C. $T_1$[8] | 24 | 90,1 | 86,0–95,0 | | | | |
| **prox. breadth** | | | | | | | |
| Bodrogkeresztúr-Henye | 1 | 64,0 | 64,0 | | | | |
| Kiskevély C. UL[1] | 17 | 60,6 | 53,0–64,0 | | | | |
| LL | 7 | 65,4 | 62,0–67,0 | | | | |
| Pilisszántó II. Rsh.[3] | 1 | 62,0 | 62,0 | | | | |
| Pilisszántó I. Rsh.[4] | 1 | 60,0 | 60,0 | | | | |
| Achenheim[6] | 37 | 63,6 | 58,0–72,5 | | | | |
| Kůlna C.[7] | 2 | | 55,2–63,9 | | | | |
| Tilde C. $T_1$[8] | 21 | 61,7 | 55,0–69,0 | | | | |
| **diaph. breadth** | | | | | | | |
| Bodrogkeresztúr-Henye | 6 | 39,2 | 36,0–41,0 | | | | |
| Kiskevély C. UL[1] | 17 | 38,4 | 36,0–41,0 | | | | |
| LL | 7 | 42,4 | 40,0–45,0 | | | | |
| Pilisszántó II. Rsh.[3] | 1 | 39,5 | 39,5 | | | | |
| Pilisszántó I. Rsh.[4] | 1 | 35,0 | 35,0 | | | | |
| Achenheim[6] | 39 | 41,9 | 37,5–47,0 | | | | |
| Tilde C. $T_1$[8] | 23 | 40,2 | 36,5–44,9 | | | | |
| **dist. breadth** | | | | | | | |
| Bodrogkeresztúr-Henye | 5 | 51,5 | 46,5–55,0 | | | | |
| Kiskevély C. UL[1] | 17 | 50,6 | 45,5–53,0 | | | | |
| LL | 7 | 54,4 | 51,0–57,0 | | | | |
| Pilisszántó II. Rsh.[3] | 1 | 49,5 | 49,5 | | | | |
| Pilisszántó I. Rsh.[4] | 1 | 48,0 | 48,0 | | | | |
| Kůlna C.[7] | 2 | | 47,7–50,9 | | | | |
| Tilde C. $T_1$[8] | 23 | 48,6 | 45,0–51,9 | | | | |
| | | | | | | | |
| **Os. ph. II. ant+post length** | | | | | | | |
| Bodrogkeresztúr-Henye | 4 | 47,0 | 46,0–48,0 | | | | |
| Kiskevély C. UL[1] | 8 | 44,4 | 42,0–47,0 | | | | |
| LL | 7 | 48,3 | 46,0–51,0 | | | | |
| Pilisszántó II. Rsh.[3] | 1 | 45,0 | 45,0 | | | | |
| Pilisszántó I. Rsh.[4] | 1 | 41,0 | 41,0 | | | | |
| Combe-Grenal[9] | 2 | | 39,0–39,0 | | | | |
| Solutré[9] | 25 | 38,6 | 35,5–42,6 | | | | |
| Achenheim[6] | 14 | 41,0 | 38,0–47,5 | | | | |
| Tilde C. $T_1$[8] | 15 | 40,9 | 37,5–44,4 | | | | |
| Kůlna C.[7] | 2 | | 50,0–55,9 | | | | |
| Temnata C.[9] | 1 | 43,9 | 43,9 | | | | |
| **prox. breadth** | | | | | | | |
| Bodrogkeresztúr-Henye | 5 | 61,7 | 55,0–65,0 | | | | |
| Kiskevély C. UL[1] | 8 | 56,8 | 53,0–60,0 | | | | |
| LL | 7 | 62,2 | 59,0–62,0 | | | | |
| Pilisszántó II. Rsh.[3] | 1 | 58,0 | 58,0 | | | | |

| Würm III | Mc | Mt |
|---|---|---|
| Szeged-Öthalom | 141,3 | |
| Pilisszántó II. Rockshelter | 135,5–142,4 | |
| Solutré[1] | 128,5–145,3 | 127,4–145,0 |
| W. II/III–III | | |
| Kiskevély Cave UL | 138,6–144,0 | 137,5–140,2 |
| Willendorf I.[2] (cca.) | | 138,6 |
| Würm II/III–II | | |
| **Bodrogkeresztúr-Henye** | **(cca) 147,0–152,0** | **146,0–152,0** |
| Remagen[1] | 140,2–154,6 | 141,3–157,3 |
| Tilde Cave[1] $T_1$ | 144,5–150,9 | 146,1–150,9 |
| Achenheim UL[1] | 149,3–160,0 | 150,0–158,4 |
| Achenheim LL | 148,0–155,2 | 154,6–165,8 |
| Würm I–II | | |
| Kiskevély Cave LL | 148,8 | 147,2–155,8 |
| Risovaca[3] | 151,4–153,5 | 143,4–154,5 |

(1. RIEDEL 1980. Fig. 1., 2., 2. THENIUS 1959. 160., 3. RAKOVEC 1965. Tabl. 27-28.)

The average height of the Henye *Equus* is cca. 146,0 cm. It is similar to that of the Tilde Cave $T_1$ horses 146,5 cm, (*E. remagensis*) and can be considered intermediate between the larger form *of E. achenheimensis* and the small *E. "germanicus" – E. solutréensis*.

### 3.1.4. Character and definition of the Henye horses

The *Equus* remains from the Henye hill can be classified on the basis of different features and dimensions into two groups: absolutely dominant large medium size horses (dentition, skeletal bones) and sporadically occurring small medium size horses (dentition, skeletal bones).

The dental dimensions of the large medium size horses are between the forms *E. achenheimensis* and *E. remagensis*. Width dimensions of the postcranial bones suitable for analysis as well as os Ph.I. agrees well with the form *E. mosbachensis – E. achen heimensis* and larger than *E. "germanicus" – E. solutréensis*.

The large *E. achenheimensis* described from the lower loess layers of Achenheim (20 c/d–20a, NOBIS 1971.) probably appeared already in the Riss period. In Hungary, the occurrence of *E. achenheimensis* is known from the Hungaria Hill Cave at Dorog (JÁNOSSY—VÖRÖS 1987.) The reason why the *Equus* of Dorog was only marked "cf." here is that in the chronologically closed material, the dimensions of large Equida bones can be different in a mosaic-like pattern from the typical *E. achenheimensis*.

The dimensions of the Dorog *Equus* hum. dist. agree with those of *E. mosbachensis* (PRAT 1968., NOBIS 1971. 1981.), the mc-mt length dimensions with those of the short form of *E. mosbachensis*; however, the epiphyses and the diaphyses are wider. At the *E. achenheimensis*, mc-s are shorter and more narrow while at *E. steinheimensis*, mc-s are smaller (PRAT 1968., NOBIS 1971.). Among the mt-s, longer pieces occur as well. Dimensions of the tib. dist. agree with the smaller form of the *E. mosbachensis*, and the dimensions of *E. achenheimensis – E. steinheimensis* (PRAT 1968., NOBIS 1971. 1981.).

The large Equid from Dorog has large mesodont dentition, longer and wider bones that the Central-European *E. achenheimensis* – a typical steppe form. Its latest occurrence is known from Pilismarót– Basaharc brickyards (s.l. W I–II, VÖRÖS 1990a.).

The medium large *E. remagensis.* (SKORKOWSKI 1933) forms in a way a transition between the large form of *E. achenheimensis* and the small forms of *E. "germanicus" – E. solutréensis*.

In the Late Lower and Middle Würm, the names *E. piveteaui* (PRAT 1968.), the *E. remagensis.* (remagenensis) (SKORKOWSKI 1933.) and *E. scythicus* (RADULESCO–SAMSON 1962.), *E. latipes* (GROMOVA 1949.) are used partly for zoogeographical distinction and, partly, as chronospecies names.

The large medium size *Equus* finds from Bodrogkeresztúr–Henye belong geologically as well as phylogenetically to this large circle. Conventionally it can be identified with the Central-European chronospecies *E. remagensis*. A. Riedel identified the horses from Tilde Cave $T_1$ with the Upper *Würm E. "germanicus"* or rather *E. remagensis* chronospecies, noting that they comprise some more archaic (Riss?) forms as well (RIEDEL 1980. 73).

The Equid material of the Kiskevély Cave Lower Layer can be also classified here, which is, on the basis of its osteology, a forest living form. The large $P^2$ (dimensions: 45 x 36 mm, VÖRÖS 1994. 31. Fig. 6.1., Tab. 3.) found together with remains of A. hydruntinus in the lower level of the Kiskevély Cave belongs to *E. mosbachiensis* (REICHENAU 1901.). Knowing the layer sequence and excavation methods applied in the Kiskevély Cave (DOBOSI–VÖRÖS 1994.) this view can be supported.

The collective name for the small bulky Equid dominating in Europe in the Upper Würm, mainly in its second half is *E. germanicus* chronospecies: *E. gallicus* (PRAT 1968.), *E. "germanicus"* (NEHRING 1884.), *E. solutreensis* (NOBIS 1971.), *E. ferus* (BODDAERT 1785,. on the basis of the interpretation of G. NOBIS 1971. 51). Apart from the "local" names used for the small Equidae on the given geographical region, any other species / subspecies assignation (e.g. E. ferus ssp., E. caballus ssp., E. przewalski ssp.) seem more of a taxonomical-phylosophical category than osteological, zoogeographical facts.

Conventionally, the small size horses have an mc shorter than 225 mm, mt 270 mm and os ph.I. shorter

*Fore limbs*
6 scapula fr.,
4 humerus
3 diaph.,
1 dist. trochlea sin.
12 radius
6 prox. epiph. 2 sin.,
4 diaph.
2 dist. epiph. 2 sin.
1 ulna (olecranon) fr. sin.
16 carpale
3 os magnum $C_{2+3}$, 4 os hamatum + uncinatum $C_{4+5}$ 1 os scaphoideum $C_r$, 3 os lunatum $C_i$, 2 os triquetrum $C_u$, 3 carpale fr.
15 metacarpal
5 prox. epiph. 1 sin. - 1 dext.,
8 diaph.,
2 dist. epiph. 1 sin - 1 dext.

*Hind limbs*
5 femur diaph.,
33 tibia
13 diaph.,
20 dist. epiph. 6 sin. - 12 dext.
1 os malleolare
5 tarsals
2 astragalus dext.
1 calcaneus dext.
1 os centrotarsale dext., 1 os unciforme int. - lat., $T_{2+3}$ dext.,
19 metatarsal 4 sin. - 8 dext.
10 prox. epiph. 1 sin. - 5 dext.,
5 diaph., 1 sin. - 1 dext.,
4 dist. epiph. 2 sin. - 2 dext.
12 metapodia (mc/mt) diaph. fr.

*Phalanges*
5 os ph. I.
1 os ph. II.
1 os sesamoideum prox.

The anatomical distribution of *Alces* remains is presented on *Table 13.*

*Table 13.* Bodrogkeresztúr-Henye. Anatomical distribution of the Alces remains on the hunting station (Number of specimens)

| Unit | I. | | | | | II. | | | | III. | | | | | | | IV. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Section | D. | C. | E. | B. | A. | | | | | H. | | E. | J. | G. | | | D. | |
| Trench | | | | | | 1. | 4. | 2. | 3. | | A. | | | | 4. | 3. | | |
| antler | | | | | | | | | | 1 | | | | | | | | 1 |
| brain skull | | | | | | | | | | | | | | 5 | | | | 5 |
| facial skull | | | | | | | | | | | 2 | | 1 | | | | | 3 |
| P sup. | | | 1 | | | | | 1 | | 2 | | | 6 | 1 | | | | 11 |
| M sup. | | | | | | | | | | | 2 | | 6 | | | | | 8 |
| mandb. | | | | | | 1 | | 1 | | | 6 | 4 | 9 | 1 | | 2 | | 24 |
| P inf. | | | | | | | | | | | | | 7 | | | | | 7 |
| M inf. | | | | | | | | | | | 1 | | 1 | | | | 2 | 4 |
| I inf. | | | | | | | | | | | 1 | | 1 | 1 | | | | 3 |
| verteb | 2 | | | | | | | | | | | | | | | | | 2 |
| costa | 6 | | | | | 1 | 3 | | | | | | | | 4 | 5 | | 19 |
| stenebra | | | | 1 | | | | | | | | | | | | | | 1 |
| scapula | | | | | 2 | | | | | | | 2 | | | 2 | | | 6 |
| hum dph | | 1 | | 2 | | | | | | | | | | | | | | 3 |
| dt | | | | 1 | | | | | | | | | | | | | | 1 |
| rad px | | 1 | | | 4 | | | | | | | | 1 | | | | | 6 |
| dph | | 4 | | | | | | | | | | | | | | | | 4 |
| dt | | | | | | | | | | 1 | 1 | | | | | | | 2 |
| ulna | | | | | | | | | | | | | 1 | | | | | 1 |
| carpal | | | | | 3 | | 4 | 1 | | 2 | | 6 | | | | | | 16 |
| mc px | | 2 | | | | | 1 | | | | 1 | | | 1 | | | | 5 |
| dph | 1 | 4 | | | 3 | | | | | | | | | | | | | 8 |
| dt | | 1 | | 1 | | | | | | | | | | | | | | 2 |
| fem dph | | 5 | | | | | | | | | | | | | | | | 5 |
| tib dph | 6 | 6 | | | | | 1 | | | | | | | | | | | 13 |
| dt | 2 | 3 | | 2 | | 8 | | 1 | 1 | | 2 | | 1 | | | | | 20 |
| malleo | | 1 | | | | | | | | | | | | | | | | 1 |
| astg. | | | | | | | | 1 | | | | | 1 | | | | | 2 |

*Table* con.
Lower teethrow length (measured at alveol, in mm)

| | P-M | P | M | $M_3$ |
|---|---|---|---|---|
| | 1. | 2. | 1. | 2. |
| dp | | 50 | | |
| dp | | 66 | | |
| dp | | 67 | | |
| | – | | 91 | 38 |
| | 166 | 67 | 95 | 40 |
| | – | 68 | | 38 |
| | – | 71 | | |
| | 173 | 72 | 97 | 40 |
| | – | 73 | | |
| | 172 | 77 | 99 | 40 |
| | – | 77 | | |

1. length, 2. breadth

The only antler piece found is a right side cast beam: the diameter of the rose is 230 mm, the diameter of the stem is 175 mm.

Skull fragment is known only from Unit III. 63. 3 secs., one parietale (broken to 5 pieces) and fragments of 3 maxilla dext. *(Table 13.)* The length of milk-praemolars of the *Alces* calves were:

upper 60–65 mm,
lower 50– 66–67 mm.

The dimensions of Late Upper Pleistocene *Alces* teeth and rows of teeth are fairly uniform *(Table 16, Table 17)*. The differences in the extreme values of the tooth crown size limit is caused by individual age and sexual dimorphism, typical of the Artiodactyls.

The few measurable bones of *Alces* from Henye correspond to both Upper Pleistocene (THENIUS 1959. 153., JÁNOSSY 1964. 144; as well as Hór-valley and Istállóskő Cave specimens) and recent Eastern European elk (TOPÁL—VÖRÖS 1984., GROMOVA 1960. 99., 111).

*Table 15.* Bodrogkeresztúr-Henye. Measurement of postcranial bones of *Alces* (measured at crown, in mm)

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| Humerus | – | – | – | 92 | – | – | – |
| Radius | – | 79 | – | – | 45 | – | – |
| | – | – | – | 74 | – | – | 48 |
| Metacarpus | – | – | – | 44 | – | – | – |
| | – | – | – | – | – | – | 40 |
| | – | – | – | – | – | – | 42 |
| Tibia | – | – | – | 79 | – | – | 58 |
| | – | – | – | 82 | – | – | 60 |
| | – | – | – | – | – | – | 54 |
| | – | – | – | – | – | – | 56 |
| | – | – | – | – | – | – | 58 |
| | – | – | – | – | – | – | 60 |
| Metatarsus | – | – | – | 67 | – | – | 41 |
| | – | – | – | 77 | – | 40 | 48 |
| Os ph.I. | 77,5 | 35 | 27 | 33,5 | 45 | 23,5 | 26 |
| | – | 34 | – | – | 38 | – | – |
| Os ph.II. | – | 30 | – | – | – | – | – |

| | 1. | 8. | 9. |
|---|---|---|---|
| Astragalus | 78 | 52 | 48 |
| | 82 | 54 | 45 |
| Calcaneus | 168 | 54 | – |
| Magnum | 40 | 35 | 25 |
| Uncinatum | 40 | 32 | 27 |
| | 47 | 32 | 26,5 |
| Triquetrum | 54 | 28 | 43 |
| Lunatum | 45 | 33 | 34 |
| | 48 | 35 | 36 |

*Table 17.*

| **Lower teethrow length** | **P-M** | | |
|---|---|---|---|
| **Bodrogkeresztúr–Henye** | 3 | 170,4 | 166,0–173,0 |
| | **Pm** | | |
| **Bodrogkeresztúr–Henye** | 7 | 72,2 | 67,0–77,0 |
| Nagymaros[4] | 1 | 68,0 | 68,0 |
| | **M** | | |
| **Bodrogkeresztúr–Henye** | 4 | 95,5 | 91,0–99,0 |
| Nagymaros[4] | 1 | 98,0 | 98,0 |
| Babja C.[2]j. | 1 | 99,0 | 99,0 |

1. RAKOVEC 1956. 2.; 2. POHAR 1985. Tabl. 11–12.; 3. MALEZ 1963. 126.; 4. MOTTL 1942b. 54.; 5. VÖRÖS 1986b. 37.

### 3.2.3. Occurrence of Alces alces in the Upper Pleistocene of the Carpathian Basin and its environs

According to general opinion, *Alces* alces shows in "ice-free" Europe chronologically and regionally discontinuous occurrence patters during the Upper Pleistocene (Würm) period.

Its widest distribution can be placed to the last interglacial (Eem) and the following Prae- and Early Würm periods. In the Middle and Late Upper Pleistocene (W II–III period) which is in the focus of interest due to the *Alces* finds at Henye , the occurrence of *Alces* alces was restricted to certain periods or regions.

***Hungary*** *42 localities*

In Hungary, remains of *Alces* are known from 46 Pleistocene localities. It appearance can be connected to two faunal stages.

The first is the Middle Pleistocene Biharian faunal stage, of which the earliest occurrence of *Alces* is known:

Lower Biharian substage, Osztramos 2. *Alces* group (JÁNOSSY—KORDOS 1977. 43.)

Upper Biharian substage – Tarpa hill *Alces* sp. (together with *Trogontherium*, JÁNOSSY—VÖRÖS 1979. Nr. 468), Solymár-Ördög Cave A/7a, *Alces latifrons, Alces brevirostris* (KRETZOI 1946 a., VÖRÖS 1985., 1988 a.), Győrújfalu *Alces latifrons* (JÁNOSSY—KROLOPP 1994.).

The second is the Upper Pleistocene Utrechtian faunal stage in which the number of sites with *Alces* alces is tenfold: 42 localities. With the exception of the last third of the faunal stage (Würm III), *Alces* is present though with variable intensity.

Varbó faunal phase 1 site, Prae-Würm
Lambrecht Cave, Layer IV–V (JÁNOSSY 1964. 148)
Subalyuk faunal phase 3 sites, Lower Würm
Kiskevély Cave, Layer 4. (VÖRÖS 1994.)
Lambrecht Cave, III. (JÁNOSSY 1964. 148)
Poroszló, Tisza river bed (JÁNOSSY—VÖRÖS 1979. Nr. 486)

Szeleta faunal phase 11 sites Würm I.
Büdöspest Cave, upper (6) greenish grey layer and lower (dark grey) culture layer (5–3.) (KADIĆ 1934. 64, MOTTL 1941. 15),
Herman Ottó Cave, 2. layer (KADIĆ 1916. 10, ÉHIK 1916. 25)
Szelim Cave, 3. "C" layer (VÉRTES 1965.345)
Fegyvernek, Tisza bed (JÁNOSSY—VÖRÖS 1979. Nr. 497)
Kiskunfélegyháza – Brickyard (fauna: *Arvicola terrestris, Panthera spelaea,* large *Equus* "abeli", *Cervus elaphus, Megaloceros giganteus, Sus scrofa* (BENDA 1929. 268–270 JÁNOSSY—VÖRÖS 1979. Nr. 449–450)
Rába bed, Ikrény (JÁNOSSY—VÖRÖS 1979. Nr. 6)
Ságvár – "sand with concretions" under the loess (GAÁL 1933a., VÖRÖS 1982.)
Szolnok-Tisza bed (JÁNOSSY—VÖRÖS 1979. Nr. 501)
Tiszakécske-Tisza bed (JÁNOSSY—VÖRÖS 1979. Nr. 521)
Tiszasüly-Tisza bed (JÁNOSSY—VÖRÖS 1979. Nr. 491)
Vezseny-Tisza bed (JÁNOSSY—VÖRÖS 1979. Nr. 515)

Istállóskő faunal phase 27 sites, Middle Würm, W II, W II–III.
Istállóskő Cave, III. (JÁNOSSY 1955 160, VÖRÖS 1984.).
Jankovich Cave, upper yellow layer, rich in microfauna (Hillebrand 1919. 9, fig. 3.)
Kiskevély Cave 3. layer (MOTTL, 1941 17, VÖRÖS 1994.)
Peskő Cave, grey layer, "sample nr. 12." (HIR 1990., Table 1.):
Pilisszántó II. Rock Shelter ML., 7. layer (VÖRÖS 1986 b.)
Solymár-Quarry, cleft filling (KUBACSKA 1927. VÖRÖS 1988 a. Tabl. 4.)
Szelim Cave, $B_2$ layer (GAÁL 1935., MOTTL 1941. 15)
Tarkő Rock Shelter, Block II upper "2" (JÁNOSSY 1976. 15., Tabl. II/C.)

**Bodrogkeresztúr - Henye**

Dunaszekcső, loess (JÁNOSSY—VÖRÖS 1979. Nr. 298 )
Füzesabony – gravel quarry (JÁNOSSY—VÖRÖS 1979. Nr. 342)
Füzesabony – sand quarry (JÁNOSSY—VÖRÖS 1979. Nr. 343)

Matjaževe kamre layer 3., (BRODAR—OSOLE 1979. 143. Nr. 11.).

Middle Würm: W II-II/III.: Parska Golobina , layers 3–4. (BRODAR—OSOLE 1979. 147. Nr. 27 Gravettian),

Late Upper Würm – end of W III – Bölling interstadial: Babja jama Cave layer 5 (Epigravettian, POHAR 1985.), Lukenjska Jama Cave layer 4. (Epigravettian, POHAR 1983.), Matjaževe kamre layer 2. (Epigravettian, RAKOVEC 1975. Tabl. 1.), Županov Spodmol layer 2. (Epigravettian, RAKOVEC 1975. Tabl. 1.).

On the NW part of the Balkan peninsula – the foothill region of the Eastern Alps – *Alces* occurred since the beginning of the Würm period. The migration of Upper Pleistocene *Alces* to Slovenia and Croatia came from the north-west, from the direction of the Eastern Alps (RAKOVEC 1956., MALEZ 1972. 177, MALEZ 1986. 107).

Their further distribution towards the South is dated for the W III. stadial.

The age of the *Alces* remains from the Sava valley is uncertain; their dating to the Holocene period, exclusively, probably has to be revised (RAKOVEC 1956., MALEZ 1972.).

*Alces* remains described from "heavily mixed" mammalian fauna, dated to the interstadial periods "Bölling and Alleröd", following the W III stadial maximum as well as the "Oldest, Older and Younger Dryas", with no *Equus* at all (POHAR 1997.)

***Northern Italy** 10 localities*

In the Upper Pleistocene *Alces* occurred on the continental zoogeographical region – from Alps to Bologna: in W Liguria (1 site), N Lombardia (1 site), Veneto (6 sites) and Friuli Venezia Giulia (2 sites) (MINIERI et al. 1995. Tab. 1.).

Sites (Nr. taken from MINIERI et al. 1995.):

Grotta di Grimaldi (5.); Alluvioni Pavesi (15.); Grotte di S. Bernandino (20); Riparo Tagliente (23.); Grottina Azura (locality of Grotta di Paina, Epigravettian, (BARTALOMEI et al. 1988. Tab. 1. In: POHAR 1997. 156.); Grotte del Broion (25.); Grotta di Trene (26.); Ponte di Veja (31.); Cave di Ca'Negra (40.), Tilde C. (W II.–II/III. near Gabrovizza – earlier names: La grotta del'Alce, Losova jama, RIEDEL 1980.).

Apart from the s.l. Middle Würm Grotta di Grimaldi (W I/II.) and Alluvioni Pavesi as well as Tilde Cave near Triest dated to the second part of the Würm Glaciation, the other seven sites can be dated to the Late Pleistocene / Holocene transitional period (very end of the Würm glaciation (MINIERI et al. 1995., MASSETI et al. 1995., RUFFO 1995. Fig. 10.).

***Lower Austria** 3 localities*

E. Thenius remarked the followings concerning the elk finds of Willendorf V (Würm II/III ?): *Alces* was occurring only rarely in young Pleistocene sediments and enumerated three sites (Rixdorf, Klinge bei Cottbus, Dürnten ). From other layers of Würm, it was not known but a large *Cervus* form was found "instead" (THENIUS 1959. 82., 151–153., 167.)

***Czech Republic** 9 localities*

In Morava region, *Alces* remains were published from three localities: Kůlna Cave, layers 11.a.-7 R/W – W II/III and layer 5 (end of W III.), Magdalenian (MUSIL 1969. 10–17.), Předmosti W II.–W II/III. (ABSOLON—KLIMA 1977. 73.) and Šipka (Štramberk), end of W III., Magdalenian (MUSIL 1958. 25.).

Four other sites were mentioned in connection with the fossil *Alces* finds of the Northern Bohemian Zechovice II. stone quarry and Novy druh u Volyné: Suchomast, Sudslavic, Trmic and Josefova (ŽELIZKO 1923. 250–251., 264–265.).

***Poland** 21 localities*

In the catalogue of K. Kowalski on Pleistocene mammals in Poland, published in 1959, 59 localities with *Alces* finds were enumerated. The author used mainly old reference data and remarked that most of the *Alces* finds were Holocene and a closer dating of the Pleistocene finds was impossible (KOWALSKI 1959. 39., 237.). On the basis of other Upper Pleistocene species found on the sites with *Alces* 21 localities proved to be Pleistocene with great certainty (KOWALSKI 1959. Cat. 171–176.). In the followings, the number after the sites is Kowalski's catalogue number.

Three localities from Northern Poland: Elbląg (18.), Grupa (25.) and Minięta (21.) from the Early Upper Pleistocene. On localities 18. and 25., Alces was found together with Megaloceros.

From the southern margin of South-Poland, 18 localities with *Alces* are known:

From the Sudet Mountains in Upper and Lower Silesia, 7 sites: Brzeg Dolny (32.), Chorzów (40.), Dzierzno (39.), Maslów (34.), Radochów (38.), Strzegom (37.), Witków (1.).

From the region of Kraków-Wielun Upland, 11 sites:

Bęblo, Bęblowska Cave (43.), Czulów, Matką Boską Cave (51.), Potoczkiem Cave (52.), Murek Cave (53.), Maszyce, Maszycka Cave (46.), Mników, Milaszówce Cave (49.), Kochanka Cave (50.), Piekary, Galoska Cave (48.), Sąspów, Koziarnia Cave (42.), Wierzchowie, Wierzchowska Cave (44.), Mamutowa Cave (45.).

*Table 18.* Distribution of *Alces* in the Würm and Holocene period (site number)

| Period | St | Pleistocene | | | Holocene | |
|---|---|---|---|---|---|---|
| | | W I. | W II–II/III–III | End of W III | Praehist. | Hist. |
| Poland | 18 | | | | 58 | 35 |
| Moldavia West Ukraine | 11 | 4 | 2 | 4 | 49 | 7 |
| Bohemia | 6 | | | | | |
| Moravia | 3 | | 2 | 1 | 1 | |
| Slovakia | 3 | | | | 2 | |
| Austria | 3 | | 1 | | | |
| Hungary | 38 | 11 | 27 | | 2 | |
| Roumania | 17 | | 4 | 1 | 38 | |
| Bulgaria | 2 | | 2 | | | |
| Yugoslavia | 3 | 1 | | 1 | | |
| Croatia | 12 | 3 | 4 | | | |
| Slovenia | 7 | 2 | 1 | 4 | 4 | |
| Northern Italy | 10 | | 2 | 7 | | |

For references, see chapter 3.2.3.

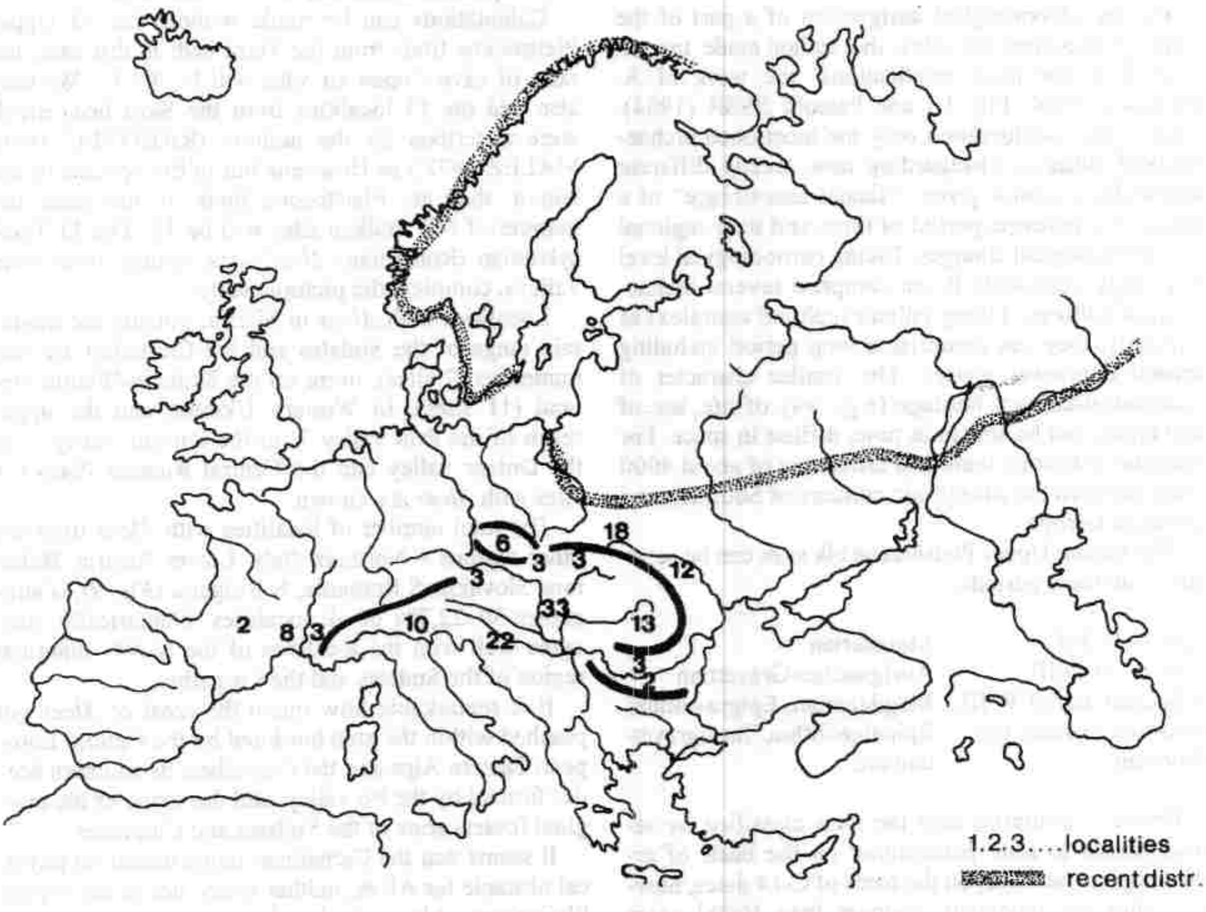


Fig. 9. Topographical distribution of *Alces alces* during the Upper Pleistocene in Europa

Moravia, Northern Bohemia and Slovakia form a sort of faunistical transitional zone between the Carpathian Basin and the South-Polish region. It could not be "by chance" that in the Late Upper Pleistocene, elk turned to be a "mountainous forestal species" not only in Central Europe, but also in the distant Caucasus (BARYSHNIKOV 1982.).

According to our present state of knowledge, the southernmost known occurrence of *Alces* in Europe during the Late Upper Pleistocene was found in the Crvena Stijena Cave, in Crna Gora at 43° latitude, in the Prut-Dniestr valley, at 48° latitude while in the Don valley, it is over 51° latitude.

In Hungary, *Alces* appeared in the Varbó and Subalyuk faunal phase of the Utrechtian fauna stage, became common in the Szeleta faunal phase (11 localities) and frequent by the Istállóskő faunal phase, when the number of known occurrences exceeds the double of the former period (27 sites). By the time of the Würm III maximum (beginning of Pilisszántó faunal phase) *Alces* disappeared from the Hungarian fauna.

### 3.2.5. Holocene occurrences of Alces (*Fig.10*)

In the transitional period between the Late Pleistocene / Holocene, *Alces* accumulated along the Western margin of the Alps and advanced along the Eastern side of the Carpathes towards the North, North-East. Elk reached the northern limit of its recent occurrence during the Preboreal – Atlantic phase, during some 2–3000 years *(Fig. 10)*.

*Northern part of Sweden - 64 localities* (IREGREN 1983. Tab.4.1.12.).

Mesolithic 2, Mesol-Neolithic 6, Neolithic 11, Mesol-Neol-Bronze-Iron 10, Neol-Bronze-Iron 26, Bronze-Iron 9 sites.

*Eastern Balticum – 57 localities* (PAAVER 1965. Tab. 67).

| | |
|---|---|
| Early Holocene | 2 sites |
| Middle Holocene | 12 sites |
| Late Holocene | 43 sites (Tab. 67). |

(In the Fig. 41 different data were given by PAAVER 1965. )

| | | |
|---|---|---|
| Early Holocene | 7000–3000 BC | 12 sites |
| Middle Holocene | 2000 BC | 13 sites |
| Late Holocene | second half of Ist Millennium BC – Ist Millennium AD | 20 sites |
| | IInd Millennium AD | 20 sites |

*Western Balticum (Denmark) – 15 localities*

| | |
|---|---|
| Late Glacial "Alleröd" 3 sites | (AARIS-SORENSEN 1993. Tab. p. 30., FISCHER 1993. 56.) |
| Mesolithic 12 sites | (till the end of the Atlantic period) (JARMAN 1972. Appendix 1.) |

*Germany - 2 localities*

| | |
|---|---|
| Mesolithic 2 sites | (JARMAN 1972. Appendix 1.) |

*Poland - 93 localities*

"Holocene"38 sites, (KOWALSKI 1959. Catalogue 171–176.):

Mesolithic 1, Neolithic 6, Bronze 1, Iron-Roman 12, Medieval 35 sites (WYROST 1994. Tab. 5. 119–120., 149–150.).

*Western part of Switzerland – 73 localities*

(CHAIX—DESSE 1981., Annexe 1.2.1., HESCHELER—KUHN 1949. 264., 282., 507., 516.):

Mesolithic 3, Neolithic 23, Neol-Iron 10, Bronze 3, Iron-Roman 6, "Holocene" 18, unknown 10 sites.

*France – 8 localities*

(CHAIX—DESSE 1981., Annexe 1.2.1.,):

Mesolithic 4, Neolithic 4.

*Morava - 1 locality*

"prehistoric / Iron Age" + mixed of Pleistocene species,( MUSIL 1969. 10–11.).

*Slovakia - 1 locality*

Jablunka peat (Orava county), "prehistoric", (SZALAY 1916. 6.).

*Hungary - 2 localities*

"prehistoric" (Bélavári berek =grove, near Heresznye, Somogy county, (SÁRKÖZY 1916. 247–248).

Copper Age (Tiszaluc-Sarkad, VÖRÖS 1987 a.).

*Slovenia - 4 localities*

Mesolithic 2, Bronze 2 (RAKOVEC 1956., 1975. Tab. 1., MALEZ 1972., POHAR 1983., BRODAR-OSOLE 1979. 136.).

Remains of Alces from the Sava valley, flowing across several countries were found at 12 sites, considered Holocene (RAKOVEC 1956., MALEZ 1972.).

*Romania - 38 localities*

"Postglacial" 9, Neolithic 4, Bronze 5, "Holocene" 10, unknown 10 sites (CZIER—JURCSÁK 1987. 618–622).

*Western parts of Ukraine and Moldavia - 86 localities*

Mesolithic 3, Neolithic 16, Bronze- Iron 4, Iron 22, Roman 6, Medieval 7, "Holocene" 28 sites.

(PIDOPLICHKO 1956., CALKIN 1966., TRINGHAM 1969., LUCIUS 1969–70., TELEGIN 1985. Tab 3. 135.)

At the beginning of the Mesolithic period, a fast migration can be observed from the Late Glacial refugia of the mountainous parts of the Carpathes and the Carpathian Basin towards the North-East and the East, getting gradually slower (W part of Switzerland, France, Denmark, Poland, Eastern Balticum, W Ukraine and Moldavia).

In the Neolithic and Aeneolithic period, *Alces* was still frequent in Western parts of Switzerland and Western Ukraine.

During the Bronze Age generally described as cool and humid, the Central European occurrence of *Alces* decreased to minimal. Later on, during the Iron Age / Celtic /Roman period they were appearing again on the territory of Switzerland, Morava, Poland and W-Ukraine. In Western Ukraine, during the 8-2 century BC, *Alces* was found on 22 sites from the Skythian period. The occurrence frequency of elk on the Central Russian Plain changed in a very interesting way: from NE to SW, their number was decreasing. While at the forested NE parts and the Orlov – Kursk forestal steppe elk formed 19–26% of the fauna, while *Cervus* was either missing or occurring in very low quantities (1.5%). At the same time, in the region of the Dniepr-Ingulce and the lower reach of the Southern Bug, the ratio of *Alces* was only 1.5% while they were completely missing from Moldova. Ratio of *Cervus* at the latter territories reached 26,5%, in Moldova, even 51% (CALKIN 1966., 59., 86–87., Fig. 35., Tab. 77).

In the historical periods, *Alces* was known in large numbers during the 9–10th century AD in the Eastern Baltic countries, in Poland and to some lesser quantities in W-Ukraine and Moldova (PIDOPLICHKO 1956, CALKIN 1962., PAAVER 1965., WYROST 1994.)

Summarising the chronodinamical changes in the areal of Alces we can conclude the followings:

During the Upper Würm period, *Alces* in Europe was a typical submountainous animal living in the Eastern Alps – Circum-Carpathian zone. Its occurrence was also noted to the North of the Pyreneans (Tarn, Garonne-valley, DESBROSSE—PRAT 1974. 151) and to the South of the Lower Danube (N Bulgaria, KUBIAK—NADACHOWSKI 1982., DELPECH—GUADELLI 1992).

In the Upper Pleistocene, the areal of *Alces* was disjunct. The closest neighbour to the East from the Central European areal was located in the Caucasus. After the withdrawal of the polar ice cover, *Alces* migrated slowly towards the North, North–East from the region of the E Alps and the Carpathes; the areal of *Alces* in the Caucasus remained isolated.

In the boreal / subboreal zones of our days, *Alces* can be considered as an allochtonous element of the fauna.

The present areal of elk generally characterised by great vagility (mobility) can be divided into several parts. In the summer period, they reach the forestal tundra, otherwise they prefer the deciduous forests in and around the watercourses. They are migrating seasonally to different habitats according to the availability of nutrients.

Compared to its recent seemingly continuous areal we can observe intensive long distance migration of *Alces* with long term SW, S expansion throughout prehistory, historical ages and modern times (HEPTNER et al. 1966. 283, BRIEDERMANN 1982. 99., TOPÁL—VÖRÖS 1984 with further references). Taking into consideration data from the past 200 years the observer gets the feeling that the current boreal areal of *Alces* became conserved as a result of natural (faunistical) and artificial (antropogeneous) factors together; from time to time, elk tries to "break through" these frames. The reason for these areal expansions are not really known: it can be a result of environmental, climatic and / or population dynamical motives. Anyway, the environmental factors of the milder climatic zones do not mean for *Alces* a pessimal habitat, with the exception of human interference.

In Europe *Alces*, having a more universal distribution in the Upper Pleistocene R-W, Early W periods, can be found only in the refugia along the mountain ranges during the W II–III period (submountainous range, basins, Pyrenees-Western Alps, Eastern Alps-Carpathes, further Caucasus. To answer the question, where this species used to stay in the "elkless" periods, further faunistical studies, mainly site chronology are necessary. Was it "no elk" or "no hunter" on the area?

### 3.3. Cervus elaphus maral (Gray 1850)

5 remains - 3 individuals

There were relatively few remains of *Cervus* found on the Upper Palaeolithic campsite Bodrogkeresztúr-Henye , altogether 5 pieces. The anatomical distribution of these are given below:

| | |
|---|---|
| antler tine piece (L. 57 mm) | III.63. E Sec. 2. □ |
| antler tine piece (L. 85 mm) | III.82. 4 tr. 3–4. □ |
| s. mc dist. fr. (juv.) | III.63. D Sec. "strayfind" |
| d. tibia dist. piece | III.63. J Sec. 27–30. □ |
| s. tibia dist. piece | II.82. 3 tr. W |

### 3.4. Bison priscus ssp

10 remains - 7 individuals

There were altogether 10 pieces of *Bison* remains on the Upper Palaeolithic campsite Bodrogkeresztúr-Henye hill. The anatomical distribution of these are given below:

d. M1/2 (l. 37, br. 19, h. 50 mm) I.82. E Sec. "during cleaning"

| | |
|---|---|
| hum.dist. fr. | III.63. D sec., 19-22-25-28. ☐ |
| s. mc dist. | III.63. E sec., 24. ☐ |
| s. tib. dist. | I. 82. C sec."surface" |
| s. astragalus | III.63. E sec., 2. ☐ |
| s. astragalus | III.63. A tr. 38–42. ☐ |
| d. centrotarsale | III.63. J sec. 27–30. ☐ |
| metapodium dist. fr. | III.63. J sec. 27–30. ☐ |
| metapodium dist. fr. | III.63. A tr. 26–30. ☐ |
| os ph. II. | III.63. A tr. 26–30. ☐ |

*Table 20*. Comparison of *Bison* bone dimensions of Bodrogkeresztur and other UP sites (in mm)

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| Tibia dist. | | | | | | | |
| **Bodrogkeresztúr** | – | – | – | **90** | – | – | **60** |
| Willendorf I.[1] | – | – | – | 98,5 | – | – | – |
| Willendorf V.[1] | – | – | – | 91 | – | – | – |
| Metacarpus dist. | | | | | | | |
| **Bodrogkeresztúr** | – | – | **55** | **90** | – | **31** | **44** |

| | 1. | 2. | 3. |
|---|---|---|---|
| Astragalus | | | |
| **Bodrogkeresztúr** | **95** | **69** | **58** |
| | 97 | 68,5 | 55 |
| Kiskevély Cave 3–4 | 93 | 60 | 52 |
| Willendorf I.[1] | 92,5–94,0 | 61,0–62,2 | |
| Babja jama[2] | 92,5 | 64,2 | 55 |
| Moravska z.[2] | 95,2 | 63,8 | 56 |

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| Os phalangis II. | | | | | | | |
| **Bodrogkeresztúr** | **50** | **37** | **28** | **29** | – | **28** | **35** |
| Kiskevély Cave 3-4 | 51 | 40 | 31 | 31 | 38 | 28,5 | 33,5 |
| | 52 | 37 | 29 | 32 | 43 | 28,5 | 36 |
| Willendorf I.[1] | 57 | 42 | – | 34 | 45 | – | 38 |

1. THENIUS 1959. 158., 2. POHAR 1985.

The measurable bones of *Bison* at Bodrogkeresztúr (6 pieces) used to belong to male individuals, the humerus, the two metapodium fragments and the os ph. II. are smaller.

*Bison* represented the most frequent element of the Upper Pleistocene herbivorous fauna in Hungary. Its dominance maximum was reached during the Szeleta and the Istállóskő faunal phases (Appendix, *Table II* with 35-35 sites.).

Without the horn core, the determination of the subspecies cannot be realised directly. The *Bison* bone dimensions of the Bodrogkeresztúr agree best with the dimensions measured at the Amvrosievka kill site (983 individuals, 78 209 bone pieces identified, Pidoplichko 1956. 113., 20–21 000 BP) which was classified as short-horn *Bison priscus Mediator* Hilzheimer form (KROTOVA—BELAN 1993. 137–138.).

According to our present knowledge, *Bison* priscus was known to occur still in the Bajót faunal phase. During the Holocene, another form of *Bison* is encountered, *Bison bonasus,* more precisely *B. bonasus hungarorum* KRETZOI (= Caucasian form, KRETZOI 1946 b, VÖRÖS 1987 b.). Finds are known from the Neolithic and Celtic periods as well as the early medieval times.

Recent archaeological excavations on the Great Hungarian Plain yielded very large size *Bison* mc-s, from Mesolithic (Jásztelek I.) and Middle Neolithic (Szarvas 1.) sites, located along river valley terraces, the size of which exceeded those of known fossil *Bison* in Hungary. *(Table 21).* The presence of large *Bison* in the Holocene can be explained in two ways: either they can be considered "surviving" *B. priscus* at the beginning of the Holocene (or bonasus males?), or they were simply of Pleistocene age . There were also other instances of this: e.g. at Tiszaluc-Sarkad 1989., 431 Sec. W. 1–2 spade levels, fragments of mammoth pelvis (parts of acetabulum) were found in a Copper Age pit, as a collected, "rarity" together with bones of domesticated animals. Currently, physical methods are applied to decide the problem.

*Table 21.* Comparison of *Bison* bone dimensions of Bodrogkeresztúr and other Pleistocene and Holocene sites (in mm)

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| **Pleistocene** | | | | | | | |
| **Bodrogkeresztúr** | – | – | **55** | **90** | – | **31** | **44** |
| Bervavölgyi Rsh.[1] | 235 | 90 | – | 90 | – | – | – |
| Istállóskő Cave | 230 | 75 | 42,5 | 75 | 45 | 28 | 39 |
| Bronz Cave (Pilis mts) | 226 | 77 | 45 | 79 | 48 | 28 | 42 |
| Budapest, Corvin sq. | – | 80 | 56 | – | 48 | – | – |
| Kreuzberg[2] | 221 | 83 | 51 | 85 | – | 30 | – |
| Amvrosievka[3] (male) | 214,5–246 | 75–93 | 45,4–58 | 83,5–98 | | | |
| (female) | 213–246 | 67,5–81,5 | 39,5–51 | 70,5–81 | | | |

found during the construction of the railway by the end of the l9th century. The mammoth remains were transported to the Hungarian Royal Geological Institute; the teeth belonged to juvenile, prae-adultus and adultus animals. The taphonomy of the whole setting recall a typical flood catastrophe, similar to the conditions encountered at Visonta K-II open-cast mining site where remains of Arch. meridionalis were found in 1983 (FODOR—VÖRÖS 1990.).

At 8 localities – in 6 Caves (Aggtelek-Baradla, Berva, Diósgyőr-Tapolca, Lambrecht, Subalyuk, Szeleta Caves) and at 2 open-air sites (Bodrogkeresztúr, Mátraderecske) the mammoth was obviously present as hunted pray.

On the 146 Northern Hungarian sites altogether some 180–200 mammoth individuals were found. Of these, we have information of the age group of 80 individuals given below:

neonatus 2, infantilis 4, juvenilis 17, post-juvenilis 7, prae-adultus 5, adultus 25, senior adultus 20.

It is interesting to compare the mammoth finds from Northern Hungary to the South-Polish material (KUBIAK 1965.) as well as the evidence found on the Předmosti mammoth-hunter's campsite (MUSIL 1968 b. in GUENTHER 1977.):

| Regio | young | adult | senior |
|---|---|---|---|
| Northern Hungary (individual %) | 37,5 | 37,5 | 25 |
| Southern Poland (pieces %) | 25 | 25 | 50 |
| Předmost (pieces %) | 63 | 18,5 | 18,5 |

It is surprising that in the more or less random sample from Northern Hungary only half of all individuals reached sen. adultus / maturus age than in Southern Poland. What could be the reason for this widely different mortality? It is not possible to answer this question as yet without exact chronological and sedimentological analyses. The following observation may serve as a contribution to the problem: young individuals occurring dominantly in river valleys (JÁNOSSY—VÖRÖS 1979. Abb.2.) at the bottom of loess bunches over fossil soil horizons. The young animals were probably victims of unfavourable natural conditions.

At the Předmost mammoth hunters' campsite the large number of young individuals reflect, similar to hunted mammoth fauna in Hungary, specialisation on mammoth calves and young animals. The same can be observed at Tata and Bodrogkeresztúr as well.

*Table 22.* Dimensions of mammoth teeth (in mm)

| | Mandible $M_2$ | | M sup. fr. | Lm | d. $mM^2$ |
|---|---|---|---|---|---|
| | s. | d. | | | 43 |
| tooth l. | 190+ | 185+ | | | 31 |
| tooth br. | 73 | 72 | 81 | | 30 |
| tooth h. | 110 | 105 | 150 | | 43 |
| gs l. | 90 | 115 | | | 6 |
| gs ln. | 9 | 11 | | | 6 |
| ln. | 16+ | 14+ | 4+ | | |
| Index | 10 | 11 | | | |
| lth | 6 | 5,6 | 7 | 6 | |
| eth | 1,4 | 1,5 | 1,3 | 1,4 | |

+ fragmented, incomplete piece

gs l.:length of the grinding surface, gs: ln. lamella number of the grinding surface, ln. lamella number, lth:lamella thickness, eth: enamel thickness, Index: number of lamellae in 100 mm

On the basis of the thickness of the tooth lamella (5,6–7 mm) and that of the enamel (1,3–1,5 mm) this form can be assigned to the so-called "jung primigenius" type, i.e., the evolved *Mammuthus primigenius* form (KRETZOI et al. 1982. Tabl. 2.)

Dimensions of the mandible: maximal breadth 490, length 440 mm, The height of corpus mandibulae is 154, its width is 123 mm. The interior width of the symphysis is 80, its height is 88 mm. The distance between the lingual margin of the two $M_2$-s is 90 mm.

In the Carpathian Basin the ancestral form of the taxon *Mammuthus primigenius* probably appeared already in the upper substage of the Biharian faunal wave. At the Castle Hill of Buda, in the localities 5. and 9. Országház str., remains of M. primigenius were found in limy silt "in loess-like porous calcareous clay layer" containing antiquus (!) (KADIĆ 1939., VÖRÖS 1991 a, 1983 c. Tabl. 1.).

During the Upper Pleistocene, M. primigenius is still a typical element in the Istállóskő phase of the Utrecht faunal wave (found at 4 Cave- and 36 open-air sites, see Appendix Tabl. III.). Subsequently, it is disappearing from the fauna.

On the Palaeolithic settlements younger than 18–20000 BP the occurrence of mammoth seems to be related not with the hunting activity but collecting (VÖRÖS 1991b., 1998.). The smooth surface of large mammoth bones, mandibles were used on living floor, or carved, split for artefacts or parts of artefacts. At Szob-Ipolypart, femur diaphysis (GÁBORI 1969. 6., Taf. I. 1–2), at Esztergom-Gyurgyalag, tibia (VÖRÖS 1991b. Fig. 1.) was used for local activities.

50%, 384 pieces – found in Unit I., 35,5% (272 pieces) in Unit III; 11, 3% (87 pieces) in Unit II and 3,2% (24 pieces) in Unit IV. *(Table 23.).*

Bone accumulation is highest in unit I.; less than half in Unit II and Unit II and in Unit IV., there is an order of difference in bone density.

Investigating bone distribution in the different units, we find the followings:

| Unit | I. | | II. | | III. | | IV. | | I–IV. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pieces | % | pieces | % | pieces | % | pieces | % | pieces | % |
| Determined | 384 | 35,5 | 87 | 41,0 | 272 | 57,4 | 24 | 70 | 767 | 42,5 |
| UnIB | 699 | 64,5 | 125 | 59,0 | 202 | 42,6 | 10 | 30 | 1036 | 57,5 |
| Total | 1083 | 100,0 | 202 | 100,0 | 474 | 100,0 | 34 | 100,0 | 1083 | 100,0 |

UnIB: Unidentified bone

### *4.2. Qualitative distribution*

*4.2.1. Distribution of the remains by species*

92,2% of the decisive bone remains (707 pieces) used to belong to two species while the rest 7,8% (60 pieces) belong to five species *(Table 24.).*

The two most imported hunted big game for the Bodrogkeresztúr-Henye Upper Palaeolithic hunters were horse and elk. The frequency of horse remains were 63%, those of elk 29,2%. The frequency of the accessory game was strikingly low, mammoth 5,5%, bison 1,4%, red deer 0,6%, cave lion 0,2% and rabbit 0,1% (Table 24.).

Bone remains belonging to different species were unevenly distributed on the settlement. There were important quantitative differences observed (Table 23.). Remains of the two main game were found in all four units but their accumulation frequency was different within the settlement.

58,8% of all horse remains (284 pieces) were found in Unit I.; 29,5% (142 pieces) in Unit III; 9,5% (46 pieces in Unit II and 2,2% (11 pieces) in Unit IV.

Among the 224 pieces of elk remains 43,3% (97 pieces) were found in Unit III.; 38% (85 pieces) in Unit I.; 17,8% (40 pieces) in Unit II and 0,9% (2 pieces) in Unit IV (Table 23.).

It can be concluded from the data that horse dominated in Unit I – the occurrence of elk here was 20% lower. At the same time, *elk* dominated in Unit III where ratio of horses was 14% lower.

Among the two main big game, the distribution of ***elk*** is more even on the settlement: difference between Unit I and III is only 5% while the same value was almost 30% for the horse. In the modest bone material of Unit II., horse remains slightly surpassed that of elk while its frequency was slightly less than half of those (Table 23.).

Among the accessory game, mammoth and red deer occurred in 3-3 units (mammoth: Unit I.–III.–IV.; red deer: Unit II.–III.–IV.); *bison* occurred in two units (Unit I.–III.) while cave lion (Unit III.) and rabbit (Unit IV.) in one.

Examining the units of the settlement separately for the distribution of bones *(Table 24.)*, the frequency of the two main big games differs according to the quan-

*Table 24.* Bodrogkeresztúr–Henye. Distribution of the animal species in the units (Number of specimens, % in unit, minimum number of individuals

| Unit | I | | | II | | | III | | | IV | | | I–IV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | pieces | % | MNI | pieces | % | MNI | pieces | % | MNI | pieces | % | MNI | pieces | % | MNI |
| Equus | 284 | 74,0 | 20 | 46 | 52,8 | 10 | 142 | 52,4 | 18 | 11 | | 2 | 483 | 63,0 | 50 |
| Alces | 85 | 22,1 | 9 | 40 | 46,0 | 5 | 97 | 35,8 | 19 | 2 | | 1 | 224 | 29,2 | 34 |
| Mammuthus | 13 | 3,4 | 1 | | | | 20 | 7,4 | 7 | 9 | | 2 | 42 | 5,5 | 10 |
| Bison | 2 | 0,5 | 2 | | | | 8 | 3,0 | 5 | | | | 10 | 1,3 | 7 |
| Cervus | | | | 1 | 1,2 | 1 | 3 | 1,1 | 2 | 1 | | 1 | 5 | 0,6 | 4 |
| Leo | | | | | | | 2 | 0.3 | 2 | | | | 2 | 0,2 | 2 |
| Lepus | | | | | | | | | | 1 | | 1 | 1 | 0,1 | 1 |
| Total identified | 384 | 100 | 32 | 87 | 100 | 16 | 272 | 100 | 53 | 24 | 100 | | 767 | 100 | 108 |
| unidentified (UnIB) | 699 | | | 125 | | | 202 | | | 10 | | | 1036 | | |
| Total | 1083 | | | 212 | | | 474 | | | 34 | | | 1803 | | |

Table 25. Bodrogkeresztúr–Henye. Topographical distribution of *Equus* remains

| Location | Head | | | Trunk | | Fore leg | | | | Hind leg | | | | Terminal bones of feet | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Unit I. '82** | | | | | | | | | | | | | | | |
| D. sec. 7□ | | | | | | | | | | | | | | | |
| C. sec. 1□ | | | | | | | | | | pelv | | tib | | | |
| C. sec. 2□ | | | tooth | | | | | rad | c | pelv | fem | tib | mt | ph.II.-III. | |
| C. sec. 3□ | | | | | | | | | | pelv | | tib | | | |
| C. sec. 4-5□ | antler | mdb | tooth | | | | hum | rad | mc | pelv | fem | tib | c/mt | ph.II. | |
| C. sec. 6-8□ | | mdb | tooth | | | | hum | rad | | pelv | fem | tib | mt | ph.I-II. | |
| C. sec. 9-12□ | | mdb | tooth | | | | hum | rad | | pelv | fem | tib | mp | ph.I-III. | |
| C. sec. 7-10-11□ | skull | mdb | tooth | | | scp | hum | rad | c | pelv | fem | tib | t/mp | ph.I. | |
| E. sec. 2□ | | | | | | | | | | | | | | ph.I. | |
| E. sec. 5-4-7-10□ | | | tooth | | | scp | hum | | | | fem | | t/mp | ph.I/II. | |
| B. sec. 2□ | | | | | | | | | | | | tib | | | |
| B. sec. 3□ | skull | | tooth | | | | | | | | | tib | | | |
| B. sec. 4-5□ | | | tooth | | | | | | | | | tib | t | | |
| B. sec. 7-8□ | | max | | | | | hum | | | | | | t/mt | | |
| B. sec. 9□ | | | | | | | | rad/ulna | | | | | | ph.I. | |
| 2. tr. 1-3□ | | | | | | | | | | | | tib | | | |
| A. sec. 2□ | | | | | | | | | | | | | | | sesam. |
| A. sec. 6□ | | | | | | | | rad | c | | | | | | |
| 3. tr. | | | tooth | rib | | | | | | | | | | | |
| 6. tr. | | | | | | | | | | | | tib | t/mp | | |
| 7. tr. | | | | rib | vert | | | | | | | | | | |
| **Unit II. '82** | | | | | | | | | | | | | | | |
| 1. tr. 16□ | | | | | | | | | mc | | | | | | |
| 4-2. tr. 1-1□ | | | | rib | | | | rad | | | | | | ph.I. | |
| 4. tr. 5□ | | | | | | | | | | | | tib | | | |
| 4. tr. 7□ | | | | | | | | rad/ulna | | | | | | | |
| 4-2. tr. 8-8□ | | | tooth | | | | | | | pelv | fem | | | | |
| 2. tr. 11.□ | skull | | tooth | | | | | | c/mc | | | | mt | ph.I. | |
| 2. tr. 14.□ | | | | | | | hum | | | | | tib | | | |
| 2. tr. 18.□ | | | | | | | | | | | | tib | | | |
| 4. tr. 20.□ | | | | | | | | | | | fem | tib | | ph.II. | |
| 3. tr. E | | | tooth | | | | hum | | | | | | | | |
| 3. tr. W | | mdb | | | | | | | | | | | | | |
| **Unit III. '63** | | | | | | | | | | | | | | | |
| H. sec. | | | tooth | | | | | | mc | | | | | | |
| A tr. 26-30.□ | | | tooth | | | | | | | | | tib | | | |
| A tr. 37.□ | | | tooth | | | | | | | | | | | | |
| A tr. 39.□ | | max/mdb | | rib | | | | rad | c/mc | | fem | tib | | | |
| A. tr. 40-42.□ | | | tooth | | | | | | | | | | | ph.I. | |
| E. sec. 2.□ | | mdb | | | | | hum | | | | | | | | |
| E. sec. 13-15.□ | | | tooth | | | | hum | | | | | tib | | | |
| J. sec. 1.□ | | | tooth | | | | | | | | | | t | | |
| J. sec. 27-28-30.□ | | mdb | tooth | | | | hum | | | | | tib | | | |
| G. sec. 19-28.□ | | mdb | tooth | | | | hum | rad | | | | tib | t/mp | | |
| G. sec. 21-30.□ | skull | | | | | | | | | | | | | | |
| **Unit III. '82** | | | | | | | | | | | | | | | |
| 1. tr. 5.□ | | mdb | | | | | | | | | | | t/mr | | |
| 2. tr. 6.□ | | | | | | | | | | | | tib | | | |
| 3. tr. 7.□ | | | | rib | | scp | hum | rad | | | | tib | | | |
| 3. tr. 9.□ | | | tooth | | | | | | | | | | | | |
| 4. tr. 3-4.□ | | | tooth | rib | | | hum | | | pelv | fem | tib | | | |

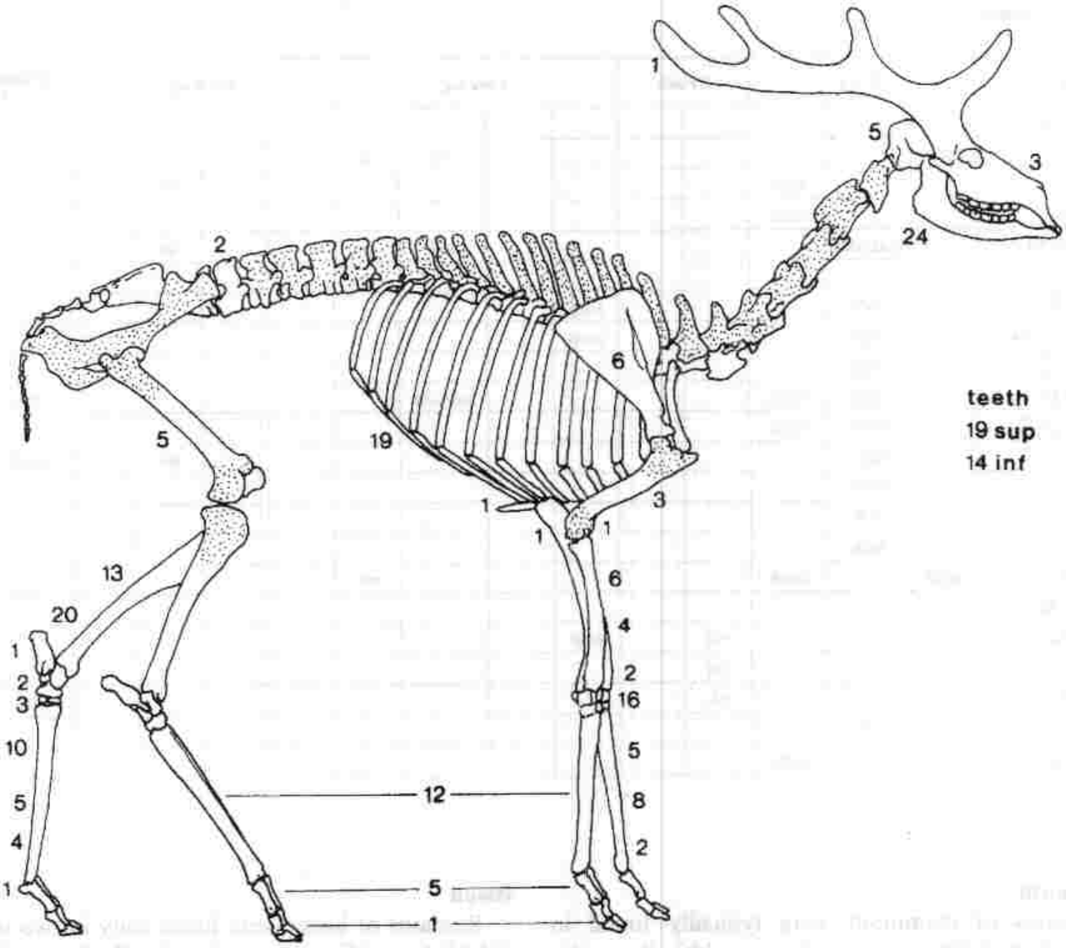


Fig. 12. Bodrogkeresztúr–Henye. Anatomical distribution of *elk* bones

*Table 26.* Bodrogkeresztúr–Henye. Topographical distribution of *Alces* remains

| **Location** | **Head** | | | **Trunk** | | **Fore leg** | | | | **Hind leg** | | | | **Terminal bones of feet** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Unit I. '82** | | | | | | | | | | | | tib | | | |
| D. sec. 4☐ | | | | rib | | | | | mc | | | tib | | | |
| D. sec. 8☐ | | | | rib | vert | | | | | | | tib | | | |
| C. sec. 2☐ | | | | | | | hum | | mc | | | | | ph.l. | |
| C. sec. 4-5-6☐ | | | | | | | | rad | mc | | | tib | mt | | |
| C. sec. 8-9☐ | | | | | | | | rad | mc | | fem | tib | mt | | |
| C. sec. 10-11☐ | | | | | | | | | | | fem | tib | mt | ph.l. | |
| E. sec. | | | tooth | | | | | | | | | | | | |
| B. sec. 3-6-9☐ | | | | | stenebra | | hum | | mc | | | tib | mt | | |
| A. sec. 2-3.☐ | | | | | | scap | | rad | c/mc | | | | | | |
| **Unit II. '82** | | | | | | | | | | | | | | | |
| 1. tr. 16☐ | | mdb | | rib | | | | | | | | tib | mp | | |
| 4. tr. 6☐ | | | | | | | | | | | | tib | mp | | |
| 4-2. tr. 8-8☐ | | | tooth | | | | | | c | | | tib | t/mt | | |
| 2. tr. 11.☐ | | mdb | | | | | | | c | | | | mt | | |
| 2. tr. 13.☐ | | | | rib | | | | | | | | | mp | | |
| 2. tr. 16.☐ | | | | | | | | | mc | | | | | | |
| 3. tr. W | | | | | | | | | | | | tib | | | |

ger-bone (os ph. I.) of the terminal bones *(Table 31)*. The split mt was found in Unit III.63.G. sec. 21–24, 27–30 □, the os ph.I. was in Unit III. 82.3 tr. 9 □.

**Rabbit**

The only and lost *rabbit* bone (ulna fragment) belonged to the meaty limb region. *Rabbits* were typically exploited as source of meat and hide.

bones of possible "pilferers" of the nearby (?) butchering site (hyena, wolf, fox etc.) found. Collecting micro-mammals is a question of excavation technique. At Bodrogkeresztúr, collection of micro-facies was not practised; the presence of rodents on the site in either its active or inactive phase was documented on the surface of the bones (KRETZOI 1969 b.).

Table 27. Bodrogkeresztúr–Henye. Individual number of animals in the excavation units

| Unit | I. '82. | | | | | | | | II. '82. | | | | III. '82. | | | | | III. '82. | | | | IV. '63. | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Section** | **D.** | **C.** | **E.** | **B.** | | **A.** | | | | | | | **H.** | | **E.** | **J.** | **G.** | | | | | **C.** | **D.** | |
| **Trench** | | | | | **2.** | | **3.** | **6.** | **1.** | **4.** | **2.** | **3.** | | **A.** | | | | **1.** | **2.** | **3.** | **4.** | | | |
| Equus | 1 | 7 | 1 | 5 | 2 | 2 | 1 | 1 | 1 | 4 | 4 | 1 | 1 | 5 | 2 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 50 |
| Alces | 1 | 4 | 1 | 2 | | 1 | | | 1 | 1 | 1 | 1 | 2 | 4 | 3 | 6 | 2 | | | 2 | 1 | | 1 | 34 |
| Mammuthus | | | | | | | | | | | | | | 2 | 1 | | 2 | 1 | 1 | | | 1 | 1 | 10 |
| Bison | | 1 | 1 | | | | | | | | | | | 2 | 2 | | 1 | | | | | | | 7 |
| Cervus | | | | | | | | | | | | 1 | | | 1 | 1 | | | | | | | 1 | 4 |
| Leo | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | 2 |
| Lepus | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| Total | 2 | 13 | 3 | 7 | 2 | 3 | 1 | 1 | 2 | 5 | 5 | 3 | 3 | 13 | 9 | 11 | 8 | 2 | 2 | 4 | 2 | 2 | 5 | 108 |

*Table 28.* Bodrogkeresztúr–Henye. Individual number, age distribution and amount of usable meet of hunted animals

| Age group | | adultus | | subadultus | | juvenilis | | infantilis | |
|---|---|---|---|---|---|---|---|---|---|
| | MNI | MNI | meat | MNI | meat | MNI | meat | MNI | meat |
| Equus | 50 | 40/200 | 8000 | 9/15 | 1350 | 1/80 | 80 | | |
| Alces | 34 | 24/150 | 4050 | | | 5/80 | 400 | 2/50 | 100 |
| Mammuthus | 10 | 9/500 | 4500 | | | 1/100 | 100 | | |
| Bison | 7 | 7/200 | 1400 | | | | | | |
| Cervus | 4 | 3/100 | 300 | | | 1/60 | 60 | | |
| Leo | 2 | 2/60 | 120 | | | | | | |
| Lepus | 1 | 1/2 | 2 | | | | | | |
| Total | 108 | | 18372 | | 1350 | | 640 | | 100 |
| Total amount of useable meat: | | | | | | | | | 20462 kg |

## 5. Hunting-gathering strategies at Bodrogkeresztúr UP campsite

All the 1803 pieces of bones found in the excavated area of Bodrogkeresztúr-Henye hill could be classified as cultural or archaeozoological finds. Animal bones of all the seven species come from animals killed in hunting. These were *horse, elk, mammoth, bison, red deer, cave lion and rabbit*.

Cast antler of elk, red deer tines and mammoth tusks were also collected.

Local small mammals were not found among the species of the open air site, neither were the

### *5.1. Species used as food*

The minimal number of individuals (MNI) determined on the basis of the hunted bone remains found at Bodrogkeresztúr-Henye hill is 108. The areal distribution of the individuals belonging to certain species – more precisely, parts of their body – is demonstrated on (Table 27). Most species 6 and maximal number of individuals (44) was observed in Unit III. 63. Five species were present represented by one individual each in Unit IV. 63. D. sec. Apart from 29 individuals of the two main big game (*horse* and *elk*) there were 1 mammoth and 2 bisons in Unit I. 82. In Unit II. 82.,

*Table 30.* Bodrogkeresztúr–Henye. Distribution of hunted animnals according to body regions (pieces, %)

| species | | head A | | trunk B | | fleshy limb C | | dry limb D | | fingers E | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | pieces | pieces | % | pieces | % | pieces | % | pieces | % | pieces | % |
| Equus | 483 | 132 | 27,3 | 22 | 4,6 | 222 | 46,0 | 75 | 15,5 | 32 | 6,6 |
| Alces | 224 | 66 | 29,5 | 22 | 9,8 | 39 | 17,4 | 90 | 40,2 | 7 | 3,1 |
| Mammuthus | 42 | 25 | | 2 | | 15 | | – | | – | |
| Bison | 10 | 1 | | – | | – | | 8 | | 1 | |
| Cervus | 5 | 2 | | – | | – | | 3 | | – | |
| Leo | 2 | | | | | | | 1 | | 1 | |
| Lepus | | | | | | 1 | | | | | |

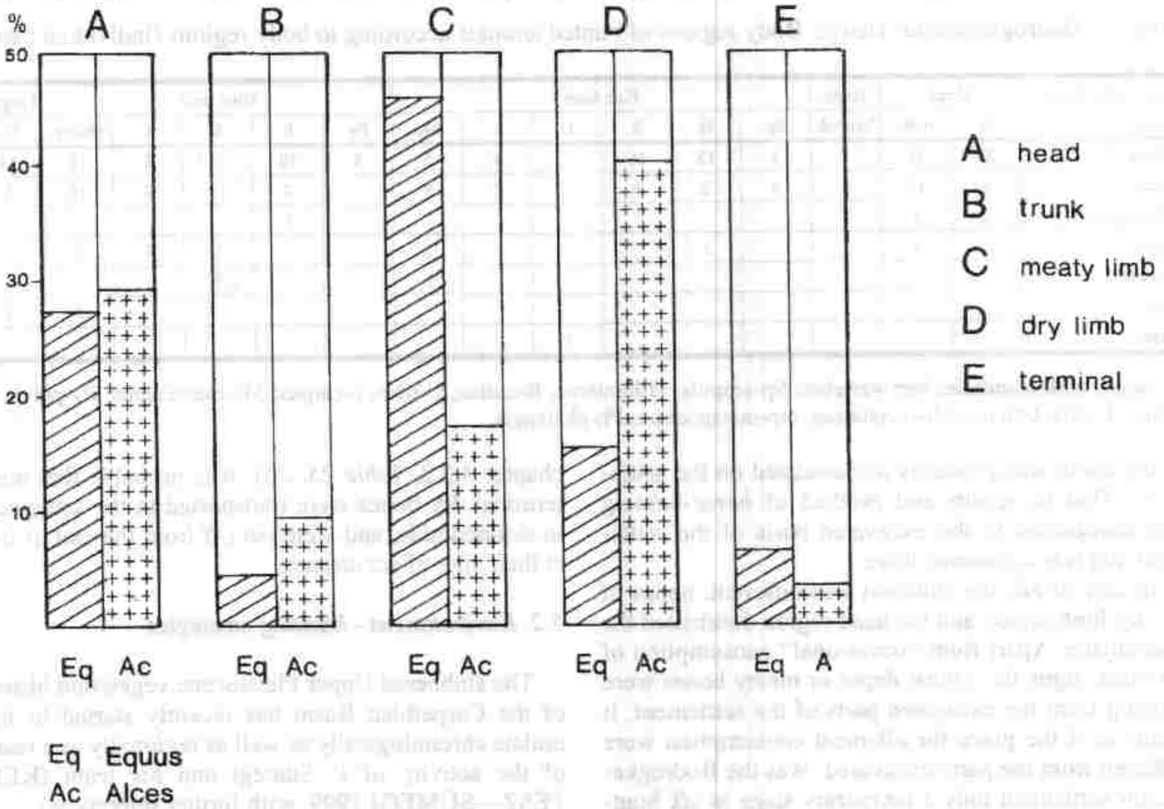


Fig. 13. Bodrogkeresztúr–Henye. Distribution of *horse* and *elk* remains according to body regions (%)

was observed in the ratio of meaty limb region versus dry limb region (Table 30): while 46% of *horse* remains was belonging to the meaty limb region, only 17,4% of *elk* bones came from the same body region. To present the same phenomenon from the other side, while the dry-limb region constituted only 15,5% of total *horse* bones, the same ratio was 40,2 for *elk*.

It means that the meaty – dry regions of the two main game showed adverse tendencies and, consequently, utilisation *(Fig 11–12)*.

What primary conclusions can be drawn from the above data?

The two large herbivores were of different milieu and habit; these animals could not be hunted in the immediate vicinity of the settlement. This is further corroborated by the apparent lack of trunk bones. The total number of trunk bones found comprise 3 vertebrae and 40 rib fragments and one stenebra *(Table 29,30)*; these bones altogether would not be enough for the reconstruction of the vertebral column of one animal – not to speak of 84 individuals (50 *horses* and 34 *elks*).

Both big game had been butchered at the hunting site. The hide was stripped off there, too. It is interesting to note that for the artylodactilous *elk*, 7 pharoszló, Szolnok) opposed to *mammoth* (47), woolly rhinoceros (19), *bison* (19) and Cervidae (Megaloceros 19, *elk* 13, red deer 8, JÁNOSSY—VÖRÖS 1979.).

The more variable was the zonality of the vegetation, the more mobile the large herbivores could be, so much the more species with different milieu could be found in a given region. By the study of the faunal remains, mixed species assemblages of widely different areal could be reconstructed.

The landscape structure of the Carpathian Basin was much more variable than the Western European territories or the Central Russian Plain in the Late Upper Pleistocene. Consequently, it is essentially different from a faunistical point of view as well.

All the faunal remains of big game at the Upper Palaeolithic open air site Bodrogkeresztúr-Henye, with the possible exception of *elk* and red deer antler pieces came from animals killed in hunting.

The species composition of the hunted animals was poor, typically reflecting antropogeneous selection.

The Upper Palaeolithic hunters were specialised on the kill of two large herbivores, *horse* and *elk*. 92,2% of the animal bones which could be identified (707 pieces) and 77,8% of the hunted individual game (84 individuals) used to belong to these two big games. The rest of the bones (7,8% - pieces) were distributed among 5 species - *mammoth, bison, red deer, cave lion* and *rabbit*, altogether 24 individuals (Table 24.). The hunting strategy of the Upper Palaeolithic hunters was generally based on four main big games (*horse, bison*, red deer and reindeer; GAMBLE 1986. 106). At Bodrogkeresztúr, of all hunted herd animals *horse* was absolutely dominating (63% of all bone pieces, 46,3% of all individuals) and the occurrence of *bison* and red deer was low (1,9% of pieces, 10 of individuals, *Table 28*). Reindeer was missing from the fauna due to faunistical reasons.

*Elk* served as an alternative resource for Palaeolithic hunters (GAMBLE 1986. 106., 109.). At Bodrogkeresztúr it was the second most frequently occurring hunted game (29,2% of all pieces, 31,5% of all individuals).

This is not surprising as the faunal dominance of *elk* was reached during the Istállóskő faunal phase (64,3%, App. Table VII.)

The mobility of big game and their tendency to form herds is different. Apart from the *resident* red deer, the other big games – *mammoth, bison, horse* and *elk* – are *migratory* species. The aggregation potential at set seasons of the year is *high* at the *bison*, *medium* for *mammoth, horse* and red deer and *low* for the *elk* (GAMBLE 1986. 105., Tabl. 3.10). It is interesting to note that Gamble classified *elk* to residental species.

The living space of Upper Pleistocene large mammals, their characteristic milieu was not necessarily identical to those of the species living today. We can say, conventionally, that *horse* was a steppe element, bison steppe or forest-steppe element, red deer characteristic of the forest while mammoth seemed to tolerate a wide range of environments. *Elk* generally indicated a marshland environment but it is also known that in summer elk rather avoided marshy environment because of the insects (STURDY—WEBLEY 1988. 263.) Knowing the *elk* distribution data in the Upper Pleistocene-Early Holocene (*Tables 18, Fig. 9–10*) it is difficult to recognise today's peripheral taiga belt. It is known, however, that elk would break out towards the south from time to time (TOPÁL—VÖRÖS 1984, with further references).

The basic environmental motive for the movement, seasonal migration of large herbivores is always winter food; obstacle being thickness of snow layers and the extent of flood covered areas during spring-time.

The Upper Palaeolithic hunters at Bodrogkeresztúr would chase hunted around the Zemplén-Hegyalja hills, close to the local floodplains of the rivers Hernád-Takta-Bodrog-Tisza and in the gallery forests. Single or herding animals were probably captured by collective hunting by a pack. The actual hunting weapons could be identified by functional analysis of the stone implements. Former "bone" (antler, mammoth-tusk) points of the Aurignacian hunters were missing from Bodrogkeresztúr. Bow and arrow are "long-distance" kill weapons penetrating deeply into the body, injuring / stopping the animal, and can be lethal in fortunate cases (FRAYER 1981). Probably, tilting spear must have been in use as well, by the help of which the injured animal could be killed at close range.

The consumption of horse meat, its storage was dominant in U. I. 82 C sec. and its vicinity, sec. B-E. *(Fig. 2.)*. Further meaty parts were found at U.II.82. 4-2-3 tr. *(Fig. 3.)* and U.III.63. A tr. E-J-G sec *(Figs. 5–6)*.

The "occasional consumption" of *elk* meat took place, interestingly, at the same place where the depot of *horse* meat was found, i.e., U.I. 82 C-B-A sec. as well as U. III. 63 E sec.

Meaty bones of *bison* and red deer were not found on the excavated parts of the settlement (*Tables 29–30*). 80% of both *horses* and *elk* hunted were adultus individuals indicating developed hunting technique and organised hunting strategies. On the Upper Palaeolithic sites Ságvár and Nadap, head region (in the first place, teeth) dominated among horse bones, followed by the dry limb parts (Table 32). At the same time, the material of the reindeer hunters campsite show different character: Pilismarót-Pálrét was a kill- and depot site, Ságvár a transient campsite, while

### *5.3. Chrono-biostratigraphy*

The lithic material of the Bodrogkeresztúr campsite used to belong to the Upper Palaeolithic Early Gravettian / Pavlovian entity, , which can be dated chronologically to the second half of the Istállóskő faunal phase (W II/III., Stilfried B interstadial). The 7 hunted mammals found on the site may occur any time with the exception of the end of the Late Pleistocene. The terminus ante quam for the site is the Szeletian phase (with *Megaloceros*) and the post quam is the Pilisszántó faunal phase without *Alces* and *Mammuthus*. The large *Equus remagensis*, known so far from the Late Lower-Middle Würm was an "archaic" element in the fauna, but the typical small-medium size *horse* of the Upper Würm, *E. "germanicus"* was also present. The large *Cervus elaphus maral*, *Bison priscus* ssp. with mediator bone dimensions and *Mammuthus* were, in this case, indifferent chronospecies. Their presence, however, was important for the ecological provenience of the fauna. *Elk*, red deer and *bison* were forestal species; among the *horses*, the large form was probably of forestal area and the small-medium size form typical of the steppe region.

The Kopasz Mt. of Tokaj is a member of the Zemplén-Hegyalja, protruding towards the South like a peninsula. It was and has always been in the junction of human and animal routes. On the basis of the reconstruction of the environment of the Kopasz Mt. and its environs (KERTÉSZ—SÜMEGI 1999. 72.-) we know that the Northern side of the mountain facing the Henye hill was covered in humid temperate periods by forest composed dominantly of spruce (Picea). On the north-eastern side of the Kopasz Mt. which had special surface morphology, a mixed forest refugium was formed (KERTÉSZ—SÜMEGI 1999.) by the Ságvárian chronological stage (DOBOSI—VÖRÖS 1987. Tabl. 8.).

At the feet of the Kopasz Mt., faunal elements from extreme areals could be found together: this was documented for example at the site Tokaj-Csurgókút 4a (20 000 BP) where extremely steppean elements, *Allactaga* and *Sicista* species where found (KORDOS—RINGER 1991. 527.). Allactaga was not known before from the Upper Pleistocene. Similar alien element of the fauna immigration previously was Alpine marmot known from north-eastern confines of Debrecen (KRETZOI 1954b.), the Pilismarót loess sequences (JÁNOSSY—VÖRÖS 1979. Nr. 164.) as well as the lower, light brown layers of the Bervavölgy rock shelter in the Bükk Mts. (MOTTL 1938 a. 32–33. Fig. 10).

The immediate surroundings of Bodrogkeresztúr-Henye yielded the following macro-mammal localities from the Würm period:

– Bodrogkeresztúr – *Mammuthus primigenius* (JÁNOSSY—VÖRÖS 1979, Nr. 428.)

– Bodrogkeresztúr-Dereszla, Site 3., –30 –40 cm deep *Mammuthus primigenius* (HELLEBRANDT 1980, 88, with archaeological finds)

– Bodrogkeresztúr – Lebuj tavern, from loess *Mammuthus primigenius* (KOCH 1900.)

– Tokaj – Kopasz Mt. *Cervus elaphus fossilis* (KOCH 1900.)

– Tokaj – Patkó quarry *Ursus arctos* (JÁNOSSY—VÖRÖS 1979, Nr. 424.)

– Tokaj – Bodrog interfluvial region, from loess *Mammuthus primigenius, Coelodonta antiquitatis* (VÖRÖS 1980, JÁNOSSY—VÖRÖS 1979, Nr. 422.)

– Tarcal – Brickyards, from loess *Mammuthus primigenius* (VÖRÖS 1980.)

– Tarcal – Citrombánya, from loess *Mammuthus primigenius, Ursus spelaeus, Rangifer tarandus* (VÖRÖS 1980, JÁNOSSY—VÖRÖS 1979, Nr. 421.); on the Palaeolithic settlement, *Equus* sp., *Rangifer tarandus* (JÁNOSSY 1975, 26).

## 6. Summary

1. From the 423 m$^2$ excavated surface on the site Bodrogkeresztúr-Henye, 1803 pieces of animal remains were collected. Species found included 6 big games: *Equus, Alces, Cervus, Bison, Mammuthus* and *Leo* as well as *Lepus*.

2. *Equus* was most frequent on the site (63%): the specimens found belonged to, with the exception of one small medium tooth and 5 postcranial bones to the large medium size range. Withers height estimated was 146–152 cm. The large medium form horse could be identified with Central European *E. remagensis*, the small medium form with the chronospecies *E. "germanicus"*. The decrease of size experienced in Late Upper Pleistocene Equidae could be attributed, apart from the effect of the deterioration of environmental conditions (cold, arid climate) to the appearance of migrating small *Equus* forms in Europe.

3. *Alces* (occurrence frequency 29,2%). Tooth and bone dimensions of the Bodrogkeresztúr *Alces* agree well with Late Pleistocene and recent Eastern European *Alces* dimensions. In the Upper Würm period, *Alces* is typical submountainous species in the Eastern Alpean – Circumcarpathian region in Europe. It was also registered North of the Pyreneans and south of the lower reach of the river Danube. The areal of the Central European *Alces* was shifted following the slow withdrawal of the ice sheet to the North, North-East. Its current boreal distribution was formed as a

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quoted, sometimes inaccurately, completed at some places by data from D. Jánossy and M. Kretzoi – again without references.

The publication of the comprehensive monograph by D. Jánossy (JÁNOSSY1979.) became necessary due to the correlation efforts based on the faunistical, bio- and sediment stratigraphical research of the 60-ies and the 70-ies. Its title is: "A magyarországi pleisztocén tagolása a gerinces faunák alapján" [The division of the Hungarian Pleistocene on the basis of the vertebrate faunas]. Late Würm faunas and fauna lists of Palaeolithic sites were omitted from the volume due to conceptual considerations (referring to the monograph by Vértes (1965.), (JÁNOSSY 1979. 8) The fauna lists of further 533 Hungarian localities where less than 10 species were found, the so-called sporadic sites were also omitted from the volume (JÁNOSSY—VÖRÖS 1979.).

There is still no comprehensive catalogue on the Upper Pleistocene fauna or its localities. This can be the reason for some misinterpretations, like the mistaken faunistical, biostratigraphical assignment of some faunal assemblages as turned out later: see, e.g., Lovas (DOBOSI—VÖRÖS 1979.) or Jankovich cave (GÁBORI—CSÁNK 1993.).

Dealing with macro-mammals, the author cannot aim at completing this gap fully. At the same time it became indispensable to compile at least a basic site catalogue of macro-mammals. These species were, at the same time, the most important big games for prehistoric man. Species names published in technical literature – knowing the different reliability and source value – had to be taken as published. These data cannot be altered till the actual revision of the animal remains is accomplished. Where revision has been already completed, results of these were also used. Species of Bovidae (*Bos* and/or *Bison*) were treated together, which is an acceptable compromise within the aims of the present work. In the future, the existing evidence of Bovid, Cervid species have to be examined again. It occurs quite often that assignation of species to *Cervus elaphus*, C. "maral" and *Megaloceros* is not correct. Taking this into consideration as well, the author believes that further corrections may modify the image on Upper Pleistocene herbivorous fauna in the Carpathian Basin, but the main trends will not change essentially.

Among the 15 macro-mammal species analysed, 2 are top predators (carnivores) and 13 herbivores:

*Leo spelaeus (Goldfuss)*
*Crocotta spelaea (Goldfuss)*
*Sus scrofa L.*
*Capreolus capreolus (L.)*
*Cervus elaphus. L.*
*Cervus "maral" Ogilby*
*Alces alces (L)*
*Dama dama(L)*
*Megaloceros giganteus (Blumenbach)*
*Rangifer tarandus(L)*
*Bovidae (Bos/Bison)*
*Asinus hydruntinus (Regalia)*
*Equus ssp*
*Coelodonta antiquitatis (Blumenbach*
*Mammuthus primigenius (Blumenbach).*

The studied Upper Pleistocene, Würm faunas and localities were assigned to the following faunal phases:

SÜTTŐ – uncertain, belonging to s.l. R-W;
VARBÓ – prae-Würm;
SUBALYUK – Lower Würm;
SZELETA – Middle Würm;
ISTÁLLÓSKŐ – Upper Würm as well as
PILISSZÁNTÓ – before the Würm III cold max.
BAJÓT, – following the W III maximum.

Among the faunal phases of the Upper Pleistocene in Hungary, Tokod phase has to be annulled because its type faunas are older species assemblages (JÁNOSSY—VÖRÖS 1985, 1987, GASPARIK 1993, 1998.). The chronological assignment of the open-air sites was performed on the basis of the so-called type species .

Sites

I. SÜTTŐ FAUNAL PHASE

**1. Csákvár cave, Vértes Mts.**

Side branch – upper part of yellow layer (mixed): *Dama*. Also occurring: *Crocotta, Sus, Capreolus, Cervus, Bison sp., Equus, Coelodonta* (KRETZOI 1954 a. 43–44).

**2. Süttő - Diósvölgy quarry**

In the cleft: *Leo, Crocotta, Sus, Capreolus, Cervus, Bovidae, Equus* (KORMOS 1925. 165). Later on, Jánossy identified the site with clefts Süttő 1., 2 and 4 (JÁNOSSY 1979. 118. Fig. 29).

Süttő 6/3. reddish brown layer: *Dama* (JÁNOSSY 1979. 118)

Süttő 8. *Crocotta* (JÁNOSSY 1979. 118)

Süttő 9. *Cervus, Bos* seu *Bison, Equus* (JÁNOSSY 1979. 120)

**3. Subalyuk cave, Bükk Mts.**

Lower layer complex:

1. high red layer: *Leo, Crocotta, Cervus, Bos, Equus, Coelodonta.*

2. high red layer with breccia: *Leo, Cervus, Equus, Coelodonta.*

**/10./ Pörgölhegy (Szárazgerence) cave, Bakony Mts.**

IV. yellow layer: *Megaloceros, Rangifer, Bison, Mammuthus.*

III. grey layer: *Sus, Capreolus, Cervus, Cervus* cf. maral, *Rangifer.*

II. reddish brown layer: *Capreolus, Cervus sp., Megaloceros, Rangifer,* "*Ovibos*" (=small *Bison*, according to I. VÖRÖS), *Asinus, Equus, Coelodonta* (VARRÓK 1955. 493–494).

**/3./ Subalyuk cave, Bükk Mts.**

Upper layer complex:

7. greenish grey layer: *Crocotta*

8. yellowish brown layer: *Crocotta, Cervus sp. "maral", Bos, Coelodonta, Mammuthus*

9. greenish yellow layer: *Leo, Crocotta, Cervus, Cervus sp. "maral", Rangifer, Bos, Equus, Coelodonta, Mammuthus.*

10+12 dark grey layer: *Leo, Crocotta, Cervus, Cervus sp. "maral", Bos, Equus, Coelodonta.*

11+14 light brown layer: *Leo, Crocotta, Cervus, Cervus sp. "maral", Megaloceros, Rangifer, Bos, Bison, Equus, Mammuthus* (MOTTL 1938c. 211–216).

**15. Érd - Parkváros,** Middle Palaeolithic site

Lower and upper layer complex: *Leo, Crocotta, Cervus, Megaloceros, Rangifer,* "petit Bovid" (? *Ovibos*, small *Bison* according to I. VÖRÖS.), *Bison, Asinus, Equus, Coelodonta.*

Also occurring in the lower layer complex: *Mammuthus*, in the upper layer complex: *Sus* and *Rangifer* too (KRETZOI 1968 a., 77–90. Tables on pp. 62–63).

**16. Poroszló,** Tisza river bed

*Alces, Megaloceros, Bison, Asinus, Equus, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 486).

**17. Tata, Porhanyó quarry, Middle Palaeolithic site**

KORMOS's excavation (1909)

In loess: *Leo, Bison, Mammuthus* (KORMOS 1912. 16, 20).

"In rock clefts": *Crocotta, Sus, Cervus, Megaloceros, Equus, Coelodonta* (KORMOS 1912. 23–25).

From the travertina: *Crocotta, Megaloceros, Asinus, Equus, Coelodonta, Mammuthus,* (KORMOS 1912, 22–23., KRETZOI 1964b. 116., 119.).

Vértes's excavation (1958–59), *Sus, Cervus,* ? *Megaloceros, Bos* seu *Bison, Asinus, Equus, Coelodonta, Mammuthus* (KRETZOI 1964b. 121–122).

IV. SZELETA FAUNAL PHASE

**18. Arnóckő cave, Bükk Mts.**

2. light brown layer: *Leo, Cervus, Megaloceros, Bison, Equus* (KADIĆ—MOTTL 1938. 51), *Cervus elaphus* f. *major* (MOTTL 1940. 1911).

**19. Balla cave, Bükk Mts.**

Rear part of cave, greyish-greenish layer: *Leo* ?, *Sus, Rangifer, Bos sp.* (HILLEBRAND 1912. 765)

(Lower) greenish grey layer: *Leo, Crocotta, Capreolus, Megaloceros, Rangifer, Bison, Equus* (MOTTL 1938b. 37., 1941. 14).

**20. Ballavölgy rock shelter, Bükk Mts.**

Yellowish brown layer: *Crocotta, Cervus, Megaloceros, Rangifer, Bison. Cervus* is missing at MOTTL (1941. 18), completed by M. KRETZOI in VÉRTES 1965. 283.

**21. Berva cave, Bükk Mts.**

2. light brown layer: *Crocotta, Cervus sp. (elaphus major, maral ?), Megaloceros, Bison, Equus, Mammuthus* (KADIĆ—MOTTL 1938. 20, MOTTL 1940. 1905, 1941. 13). *Cervus* os ph. II. is correctly os ph. I. (KADIĆ—MOTTL 1938. 19–20).

**22. Bervavölgy rock shelter, Bükk Mts.**

1. light brown layer: *Crocotta, Sus, Capreolus, Cervus, Megaloceros, Rangifer, Bos, Bison* (MOTTL 1936. 151, MOTTL 1938a. 34, later only *Bison* MOTTL 1940. 1910, 1941. 13), *Equus, Coelodonta.*

**23. Büdöspest cave, Bükk Mts.**

6. greenish grey layer: *Cervus, Alces, Megaloceros, Rangifer, Bison, Equus, Coelodonta, Mammuthus* (KADIĆ 1934. 64).

5. upper (dark grey) culture layer: *Crocotta,* "large" *Cervus, Alces, Megaloceros, Rangifer, Bos* seu *Bison, Bison, Equus, Coelodonta* (KRETZOI 1927, KADIĆ 1934. 64, MOTTL 1938b. 49)

3. lower (dark grey) culture layer: *Leo, Crocotta, Cervus, Alces, Megaloceros, Rangifer, Bos* seu *Bison,* (KRETZOI 1927, later *Bos* KADIĆ 1934. 64 and *Bos, Bison* MOTTL 1938b. 49, 1941. 15), *Equus, Coelodonta. Cervus* is only mentioned by KRETZOI (1927), missing from the publications of Kadić and Mottl.

**/1./ Csákvár cave, Vértes Mts.**

Main branch – light brown layer: *Leo, Crocotta, Cervus* (pierced "pearl tooth", canine), *Megaloceros, Rangifer, Bison, Equus,* (KADIĆ—KRETZOI 1927. 4–5).

**34. Balatonszabadi** - Sáfránykert
In the bottom of a high loessy-sand wall, 108 m. a.s.l. in loose sand: *Megaloceros, Bison, Equus, Coelodonta, Mammuthus* (KADIĆ 1911. 9).

**35. Barcs**
*Megaloceros, Coelodonta* (JÁNOSSY—VÖRÖS 1979. Nr. 69).

**36. Csepel - gravel quarry, Danube valley**
*Megaloceros, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 212).

**37. Csongrád environs, Tisza river bed**
*Cervus, Megaloceros, Bos, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 527).

**38. between Csongrád and Szegvár, Tisza river bed**
*Sus, Cervus, Megaloceros, Bos,* (JÁNOSSY—VÖRÖS 1979. Nr. 529).

**39. Danube river bed,** without closer locality
*Megaloceros, Bos* seu *Bison, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 265).

**40. Endrőd**
*Megaloceros, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 462).

**41. Eger**
*Megaloceros, Bison* (JÁNOSSY—VÖRÖS 1979. Nr. 361).

**42. Ercsi**
*Megaloceros, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 246).

**43. Fegyvernek, Tisza river bed**
*Cervus, Alces, Megaloceros, Bison, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 497).

**44. Gyoma**
*Megaloceros, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 461).

**45. Hatvan** - Brickyard, gravel layer
*Megaloceros, Bison, Equus, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 324).

**46. Jászberény** - sand quarry beside lime deposit
*Megaloceros* (JÁNOSSY—VÖRÖS 1979. Nr. 440).

**47. Királykút** spring, cleft
*Megaloceros, Equus, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 367).

**48. Kiskunfélegyháza** - Brickyard
"under the level of forest soil": *Leo, Sus, Cervus, Alces, Megaloceros, Equus,* (BENDA 1929. 268–270., JÁNOSSY—VÖRÖS 1979. Nr. 449–450).

**49. Nagymaros,** loess
*Megaloceros, Equus, Mammuthus* (data by M. KRETZOI in VÉRTES 1965. 357.).

**50. Nógrádverőce** - Brickyard, loess
*Megaloceros, Equus, Mammuthus* (MOTTL 1942b. 48-49).

**51. Pásztó**
*Cervus, Megaloceros* (JÁNOSSY—VÖRÖS 1979. Nr. 311).

**52. Pókaszepetk, forest sand quarry**
*Megaloceros* (JÁNOSSY—VÖRÖS 1979. Nr. 62.).

**53. Pilismarót-Basaharc,** Brickyard
Upper loess complex: *Equus*.
In loess between two layers of loam: *Megaloceros, Bison, Equus, Mammuthus*.
Lower thick loam layer: *Cervidae ind., Bison, Coelodonta, Mammuthus* (MOTTL 1942b. 52, VÖRÖS 1990a. 8. Fig. 1.).

**54. Rába river bed,** Győr environs
*Alces, Megaloceros, Rangifer, Bison, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 6).

**55. Sajókazinc,**
*Megaloceros, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 386).

**56. Ságvár** –in "sand with concretions", under loess
*Alces* (GAÁL 1933a., VÖRÖS 1982. 45).

**57. Szeged** environs, **Tisza river bed**
*Megaloceros, Bos, Bison, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 531).

**58. Szob** – Brickyard, loess
*Megaloceros, Equus* (VÖRÖS 1998).

**/27./ Kecskésgalya cave, Bükk Mts.**

Hall. 2. yellow layer: *Bison, Equus* (KADIĆ 1940. 219, MOTTL 1940. 1902).

**/5./ Kiskevély cave Pilis mts**

3. yellow layer, *Leo, Cervus, Rangifer, Bison, Equus, Coelodonta* (MOTTL 1941. 17).

4/3. layer: *Cervus, Alces, Bison, Equus, Coelodonta* (VÖRÖS 1994. Fig. 8.Tabl. 2.).

**75. Lökvölgyi cave, Bükk Mts.**

In main hall: *Leo, Crocotta, Cervus, Bison* (MOTTL 1938b. 38., 1940. 1913, 1941. 12).

**76. Orfű, Spring cave, Mecsek Mts.**

*Cervus, Equus, Coelodonta, Mammuthus* (VÉRTES 1954. 21).

**77. Perpác cave, Bükk Mts.**

Light brown layer: *Crocotta, Rangifer, Bos* seu *Bison* (KADIĆ 1940. 210).

**78. Peskő cave, Bükk Mts.**

3. red - brick red layer, rich in microfauna: *Leo, Crocotta, Capreolus, Cervus* f. *major, Rangifer, Bison, Equus, Coelodonta* (ÉHIK 1914. 194, KADIĆ 1935. 51, MOTTL 1940. 1915, 1941. 16, 1944. 13–16).

4. greenish grey layer (erroneously mentioned as greenish brown by MOTTL 1941. 11): *Leo, Crocotta, Cervus* f. *major, Rangifer* (KADIĆ 1935. 51, MOTTL 1941. 11, 1942a. 95)

5. dark brown layer: *Crocotta, Sus, Capreolus, Cervus* f. *major, Rangifer, Bison, Equus* (4–5. layer MOTTL 1940. 1918, 1944. 9–22). Mentioned large deer and small *Bison* (MOTTL 1944. 11.).

J. Hír performed an authentication excavation of the so-called "Vértes's section" (HIR 1990., Table 1.):

| | | |
|---|---|---|
| 4. grey layer: | in samples 7, 9, 11, 13: | Cervidae |
| | in sample | 12: *Alces* |
| 5. brown / dark brown layer: | | |
| | in sample | 16: Cervidae |
| | in sample | 18: *Crocotta.* |

**79. Petényi cave, Bükk Mts.**

Lower brown layer: *Crocotta* (VÉRTES 1956. 4).

**80. Pilisszántó I. rock shelter Pilis Mts.**

Lower layer complex: $D_6$ brownish grey + $D_7$ greyish brown layer: *Leo, Crocotta, Cervus "maral", Rangifer, Bison, Equus, Coelodonta, Mammuthus* (KORMOS 1915. 328–329, VÖRÖS 1987c. Tabl. 1–2) Pierced deer "pearl tooth" (caninus),( KORMOS 1915. Table XXIII. 8.).

**81. Pilisszántó II. rock shelter Pilis Mts.**

7. light grey layer (in the middle): *Leo, Crocotta, Alces, Bos, Bison, Equus, Coelodonta* (VÖRÖS 1986b. 35, Tabl. 1).

**82. Remete Lower cave, Budai Mts.**

12. rusty brown layer "c": *Cervus* (JÁNOSSY 1953. 420, 1979. 152).

In the 11. yellow loessy layer "b" the *Coelodonta* find belongs to this phase in age as well.

**83. Solymár** - Quarry, in cleft, **Budai Mts.**

Red-brown layer: *Leo, Crocotta, Capreolus, Cervus, Alces, Equus, Coelodonta* (KUBACSKA 1927. 63–64, VÖRÖS 1988a. Tabl 4 B/1).

**/33./ Szelim cave, Gerecse Mts.**

4–5. (upper) yellow "B" layer:

5. $B_1$ layer: *Rangifer, Coelodonta* (GAÁL 1935. 55).

4–5. $B_{1+2}$ layer: *Crocotta, Cervus, Cervus can. asiat., Cervus maral, Alces, Rangifer, Equus, Coelodonta, Mammuthus* (Data by, JÁNOSSY in VÉRTES 1965. 345).

4. $B_2$ layer: *Crocotta, Rangifer Alces, Equus, Coelodonta, Mammuthus* (GAÁL 1935. 54–55, MOTTL 1938b. 45, 1941. 15).

The marking of layer $B_2$ as Upper or Lower is erroneous (VÉRTES 1965. 345), it should be correctly marked as layer B upper= $B_1$; layer B lower= $B_2$, respectively.

**/13./ Tarkő rock shelter, Bükk Mts.**

Block II. upper "2" brown layer: *Capreolus, Cervus cf. elaphus, Alces, Equus.*

Block II. lower "3" brown layer: *Capreolus, Cervus, Rangifer, Bison.*

Block IIIa. upper "4" yellowish layer: *Leo, Cervus cf. elaphus, Rangifer, Bison.*

Block IIIa–b+V. (= KADIĆ 1944. 79), "6" yellowish grey layer: *Leo, Crocotta, Cervus, Bison.*

Block VII. "9" layer: *Leo, Cervus, Bison* (JÁNOSSY 1976. 11–17, Tabl. II/B-C. *Cervus* of Block VII. is missing from Tabl. II/C).

**84. Abaújszántó,** gravel

*Rangifer, Equus, Coelodonta, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 419).

**85. Bodrogkeresztúr - Henye hill, Upper Palaeolithic settlement**

*Leo, Cervus "maral", Alces, Bison, Equus, Mammuthus.*

**115. Pilismarót,** loess
*(Marmota), Cervus, Rangifer, Equus, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 164).

**116. Pilismarót-Öregek dűlő, Upper Palaeolithic site**
*Alces, Rangifer, Equus, Mammuthus* (MOTTL 1942b. 53–54).

**117. Polgár, Tisza river bed**
*Alces, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 482).

**118. Rákóczifalva, Tisza river bed**
*Bison, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 510).

**119. Romhány,** in cavity of Triassic limestone
*Cervus, Alces,* (JÁNOSSY—VÖRÖS 1979. Nr. 278).

**120. Sirok**
*Bison, Equus, Coelodonta* (JÁNOSSY—VÖRÖS 1979. Nr. 338).

**121. Szajol, Tisza river bed**
*Bison, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 500).

**122. Szendehely**
*Leo, Cervus, Equus, Coelodonta,* (JÁNOSSY—VÖRÖS 1979. Nr. 282).

**123. Szob** - beyond Kálvária, upper sandy part of gravel
*Cervus can. asiat., Rangifer, Mammuthus* (KÉZ 1934. 14).

**124. Sződliget**
*Bison, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 195).

**125. Szolnok - Sárnyak, Tisza river bed**
*Alces, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 503).

**126. Szolnok - Sokorú, Tisza river bed**
*Alces* (JÁNOSSY—VÖRÖS 1979. Nr. 508).

**127. Tiszalök -Rázom puszta**
*Alces* (JÁNOSSY—VÖRÖS 1979. Nr. 478).

**128. Tiszalök** - Dam construction, **Tisza river bed**
*Bison, Coelodonta, Mammuthus* (VÉRTES 1954. 19).

**129. Tószeg cliff, Tisza river bed**
*Alces, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 512).

**130. Vác-DCM,** loess
*Bison, Equus, Mammuthus* (VÖRÖS 1998.).

**131. Verseg - Kertekalja, Upper Palaeolithic settlement**
*Rangifer, Bison, Equus, Mammuthus* (VÖRÖS 1991c. 88–89).

**132. Visegrád - Hamzsabég**
*Cervus, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 170).

**133. Zebegény**
*Cervus, Rangifer, Equus, Coelodonta,* (KOCH 1900. 548, 550, JÁNOSSY—VÖRÖS 1979. Nr. 175).

**134. Zebegény - Kálvária hill,** loess
(without exact layer assignation): *Cervus can. asiat., Bison, Equus, Mammuthus* (GAÁL 1933b. 130, VÖRÖS 1998).

**135. Zirc-Cuha stream**, loess
*Bison, Mammuthus* (JÁNOSSY—VÖRÖS 1979. Nr. 29).

## VI. PILISSZÁNTÓ – VII. BAJÓT FAUNAL PHASES

**136. Alsó Szinva** (Cave over the "lower spring" of Szinva stream) **Bükk Mts.**
*Cervus* (JÁNOSSY—VÖRÖS 1979. Nr. 366).

**137. Baits cave, Gerecse Mts.**
Yellow, "b" layer: *Cervus can. asiat.*
Lighter yellow, "c" layer: *Leo, Rangifer* (GAÁL 1929. 4–6).

**/19./ Balla cave, Bükk Mts.**
Front part, (upper) yellow layer: *Capreolus, Rangifer, Bos sp.* (=*Bison*) (HILLEBRAND 1912. 780).

**/22./ Bervavölgy rock shelter, Bükk Mt.**
2. yellow - light yellow layer: *Crocotta, Capreolus, Cervus* (f. *major*), *Equus* (MOTTL 1938a. 26, MOTTL 1940. 1909).

**138. Bivak cave, Pilis Mts.**
Pleistocene upper 1. (yellow) layer: *Sus, Cervus, Rangifer.*

**153. Tarcal - Citrombánya, Upper Palaeolithic settlement**
*Rangifer, Equus* (JÁNOSSY 1975. 26).

**154. Ságvár, Upper Palaeolithic settlement**
*Rangifer, Equus* (VÖRÖS 1982.).

**155. Szeged - Öthalom, Upper Palaeolithic settlement**
*Rangifer, Bison, Equus* (VÖRÖS 1987b. 89, Tabl. 1.).

**156. Vác-Csipkés, Upper Palaeolithic settlement**
*Rangifer, Equus* (VÖRÖS 1998.).

**157. Zebegény-Kálvária hill,** Erzsébet str. 25 (currently, Szőnyi I. str. 23), **Upper Palaeolithic settlement**
In the bottom of the 14 m high loess wall, from the cultural layer: *Rangifer, Ovibos, Equus* (GAÁL 1933b, VÖRÖS 1998.).

On the 157 sites, altogether 241 layers / levels were separated, assigned currently into 180 chronological "units". Among these 180 units there are 2 clefts, 75 caves and 103 open air sites.

The biostratigraphical division of site types: *(Tables I–III)*

| Faunal phase | Sites total | Cave sites | Open air sites |
|---|---|---|---|
| SÜTTŐ | 3 | 3[1] | |
| VARBÓ | 11 | 11[2] | |
| SUBALYUK | 9 | 6 | 3 |
| SZELETA | 55 | 17 | 38 |
| ISTÁLLÓSKŐ | 70 | 18 | 52 |
| PILISSZÁNTÓ-BAJÓT | 32 | 22 | 10 |

1: cleft, 2: calcareous tuff

| Frequency of species on the 180 Upper Pleistocene sites | Species | Number of sites | Percentage fo sites |
|---|---|---|---|
| 1. | Bovidae | 103 | 57,3 |
| 2. | Equus | 92 | 51,2 |
| 3. | Cervus | 88 | 48,9 |
| 4. | Mammuthus | 84 | 46,7 |
| 5–6. | Rangifer / Megaloceros | 66<br>66 | 36,7<br>36,7 |
| 7. | Coelodonta | 63 | 35,0 |
| 8. | Crocotta | 49 | 27,3 |
| 9. | Alces | 42 | 23,4 |
| 10. | Leo | 38 | 21,2 |
| 11. | Sus | 26 | 14,5 |
| 12. | Capreolus | 18 | 10,0 |
| 13. | Asinus | 10 | 5,6 |
| 14–15. | Ovibos / Dama | 2<br>2 | 1,2<br>1,2 |

*Table I.* Carnivore and herbivore macro-mammals on Upper Pleistocene localities (Tables I–III)

SÜTTŐ FAUNAL PHASE 3 sites

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Csákvár c | | | C | Sus | Cp | Cv | D | | | Bi | | E | Coel | |
| 2. | Süttő (cleft) | | L | C | Sus | Cp | Cv | D | | | BsBi | | E | | Mamm |
| 3. | Subalyuk c. L | | L | C | Sus | | Cv | | | | Bs | | E | Coel | Mamm |

VARBÓ FAUNAL PHASE 11 sites

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| /1./ | Csákvár c | Hx | | C | Sus | Cp | Cv | | Mg | | Bi | As | E | Coel | |
| 4. | Diósgyőr-Tapolca c | Hx | | C | Sus | | Cv | | Mg | | BsBi | | E | Coel | Mamm |
| 5. | Kiskevély c. 5. | Hx | | C | | | | | | | | | | | |
| 6. | Kiskőhát | Hx | | | | | Cv | | | Rg | Bi | | E | Coel | |
| 7. | Lambrecht c IV–V | Hx | L | C | Sus | Cp | Cv | A | Mg | Rg | Bi | As | E | Coel | Mamm |
| | | | | | | | | | | | | | | | |

## SZELETA FAUNAL PHASE 17 caves + 38 open air site = 55 sites (con.)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46. | Jászberény | | | | | | | | Mg | | | | | | |
| 47. | Királykút | | | | | | | | Mg | | | | E | | Mamm |
| 48. | Kiskunfélegyháza | | L | | Sus | | Cv | A | Mg | | | | E | | |
| 49. | Nagymaros | | | | | | | | Mg | | | | E | | Mamm |
| 50. | Nógrádverőce | | | | | | | | Mg | | | | E | | Mamm |
| 51. | Pásztó | | | | | | Cv | | Mg | | | | | | |
| 52. | Pókaszepetk | | | | | | | | Mg | | | | | | |
| 53. | Pilismarót-Basaharc | | | | | | | | Mg | | Bi | | E | | Mamm |
| 54. | Rába bed | | | | | | | A | Mg | Rg | Bi | | | Coel | Mamm |
| 55. | Sajókazinc | | | | | | | | Mg | | | | | Coel | Mamm |
| 56. | Ságvár | | | | | | | A | | | | | | | |
| 57. | Szeged Tb | | | | | | | | Mg | | BsBi | | | Coel | Mamm |
| 58. | Szob | | | | | | | | Mg | | | | E | | |
| 59. | Szolnok Tb | | | | | | Cv | A | Mg | Rg | BsBi | | E | Coel | Mamm |
| 60. | Szolnok-Pv. Tb | | | | | | | | Mg | | Bi | | | Coel | Mamm |
| 61. | Szolnok-Zagyva bed | | | | | | | | Mg | | | | | | Mamm |
| 62. | Tiszadada Tb | | | | | | | | Mg | | Bi | | | | Mamm |
| 63. | Tiszafüred Tb | | | | | | Cv | | Mg | | Bi | | | Coel | Mamm |
| 64. | Tiszakécske Tb | | | | | | | A | Mg | | Bi | | | | |
| 65. | Tiszasüly Tb | | | | | | Cv | A | Mg | | Bi | | | | Mamm |
| 66. | Tiszaszőlős Tb | | | | | | | | Mg | | Bi | | | Coel | Mamm |
| 67. | Tiszaug Tb | | | | | | | | Mg | | BsBi | | | | Mamm |
| 68. | Tiszaug Tb | | | | | | Cv | | Mg | | Bi | | | | Mamm |
| 69. | Vác-Alsó, Csipkés | | | | | | | | Mg | | | | | Coel | |
| 70. | Vezseny Tb | | | | | | | A | Mg | | | | | | Mamm |
| 71. | Zalaegerszed II. By | | | | | | | | Mg | | Bi | | E | Coel | Mamm |

## ISTÁLLÓSKŐ FAUNAL PHASE 18 caves + 52 open air sites = 70 sites

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72. | Aggtelek | | | | Sus | | Cv | | | Rg | | | E | Coel | Mamm |
| /24./ | Görömbölytapolca c | | | C | | | Cv | | | Rg | BsBi | | | | |
| 73. | Háromkúti Rs. | | | C | | Cp | Cv | | | | | | | | |
| 74. | Istállóskő c V-I. | | L | C | Sus | | Cm | A | | Rg | Bi | | E | | |
| /26./ | Jankovich c | | | | | | | A | | Rg | | | E | Coel | |
| /27./ | Kecskésgalya c | | | | | | | | | | Bi | | E | | |
| /5./ | Kiskevély c 4/3 | | L | | | | Cv | A | | Rg | Bi | | E | Coel | |
| 75. | Lókvölgyi c | | L | C | | | Cv | | | | Bi | | | | |
| 76. | Orfű | | | | | | Cv | | | | | | E | Coel | Mamm |
| 77. | Perpác | | | C | | | | | | Rg | BsBi | | | | |
| 78. | Peskő c 3–5 | | L | C | Sus | Cp | Cm | A | | Rg | Bi | | E | Coel | |
| 79. | Petényi c | | | C | | | | | | | | | | | |
| 80. | Pilisszántó I. Rs. | | L | C | | | Cm | | | Rg | Bi | | E | Coel | Mamm |
| 81. | Pilisszántó II Rs. 7. | | L | C | | | | A | | | BsBi | | E | Coel | |
| 82. | Remete Lower c | | | | | | Cv | | | | | | | Coel | |
| 83. | Solymár quarry | | L | C | | Cp | Cv | A | | | | | E | Coel | |
| /33./ | Szelim c B | | | C | | | Cv/m | A | | Rg | | | E | Coel | Mamm |
| /13./ | Tarkő Rs II–III., V., VII. | | L | C | | Cp | Cv/m | A | | Rg | Bi | | E | | |
| 84. | Abaújszántó | | | | | | | | | Rg | | | E | Coel | Mamm |
| **85.** | **Bodrogkeresztúr** | | **L** | | | | **Cm** | **A** | | | **Bi** | | **E** | | **Mamm** |
| 86. | Badacsony | | | | | | | | | | Bi | | E | Coel | Mamm |
| 87. | Dunaföldvár | | | | | | | | | | Bi | | | | Mamm |
| 88. | Dunaszekcső | | | | | | | A | | | | | | | |
| 89. | Esztergom | | | | | | | | | Rg | Bi | | | Coel | Mamm |

PILISSZÁNTÓ-BAJÓT FAUNAL PHASES 22 caves + 10 open air sites = 32 sites (con.)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| /23./ | Büdöspest c 7. | | | | | | Cv | | | Rg | Bi | | E | | |
| /74./ | Istállóskő c VI | | | | | | | | | Rg | | | | | |
| /26./ | Jankovich c II. | | | | | | | | | Rg | | | | | |
| 139. | Királykút c | | | C | | | | | | | | | | | |
| /5./ | Kiskevély c 2. | | | | | | | | | Rg | | | E | | |
| 140. | Kőrös c | | L | | | | | | | | | | | | |
| 141. | Lillafüred Rs | | | | Sus | | Cv | | | | | | | | |
| 142. | Óhuta | | | | | | | | | Rg | Bi | | | | |
| 143. | Orfű-Sk | | | C | | | | | | | Bi | | | | |
| 144. | Ölyveskő c 2–3 | | L | | | | | | | Rg | | | E | | |
| /78./ | Peskő c 2. | | | | | | | | | Rg | Bi | | E | O | |
| /80./ | Pilisszántó I Rs. UL | | /L/ | /C/ | Sus | | Cm | | | Rg | Bi | | E | | |
| 145. | Rejtek I. Rsr | | | C | Sus | | Cv | | | Rg | Bi | | | | |
| /82./ | Remete Lower c 11. | | | | | | Cv | | | | Bi | | | | |
| 146. | Remetehegy Rs | | | C? | | | | | | Rg | BsBi | | E | | |
| /32./ | Szeleta c | | | | | | | | | Rg | | | E | | |
| 147. | Vaskapu c 2–3. | | | | | | | | | Rg | Bi | | | | |
| 148. | Arka | | | | | | | | | Rg | Bi | | E | | |
| 149. | Esztergom-Gyurgy. | | | | | | | | | Rg | | | E | | |
| 150. | Nadap | | | | | | | | | Rg | Bi | | E | | |
| 151. | Pilismarót-Diós | | | | | | | | | Rg | | | E | | |
| 152. | Pilismarót-Pálrét | | | | Sus | | | | | Rg | Bi | | | | |
| 153. | Tarcal | | | | | | | | | Rg | | | E | | |
| 154. | Ságvár | | | | | | | | | Rg | | | E | | |
| 155. | Szeged-Öthalom | | | | | | | | | Rg | Bi | | E | | |
| 156. | Vác-Alsó Csipkés | | | | | | | | | Rg | | | E | | |
| 157. | Zebegény-Kálvária | | | | | | | | | Rg | | | E | O | |

*Abbreviations:*
Hx Hystrix, L Leo, C Crocotta, Sus, Cp Capreolus, Cv Cervus elaphus, Cm Cervus "maral", A Alces, D Dama, Mg Megaloceros, Rg Rangifer, Bi Bison, Bs Bos, Bov Bovidae, As Asinus, E Equus, Coel Coelodonta, Mamm Mammuthus, O Ovibos, Tb-Tisza bed, Zb-Zagyva bed, By-Brickyard, c cave, Rs rock-shelter, U Upper, L Lower

*Table II.* Species frequency of the Upper Pleistocene faunal phases (180 sites with carnivore and herbivore macro-mammals – number os sites)

| Faunal phase | Sites total | Species analysed | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | C | Sus | Dm | Cp | Ce | Cm | A | Mg | Rg | As | E | B | O | Cl | Mm |
| SÜTTŐ | 3 | 2 | 3 | 3 | 2 | 2 | 3 | | | | | | 3 | 3 | | 2 | |
| VARBÓ | 11 | 3 | 5 | 5 | | 5 | 9 | 1 | 1 | 4 | 3 | 2 | 7 | 7 | | 5 | 2 |
| SUBALYUK | 9 | 6 | 5 | 5 | | 3 | 7 | 2 | 3 | 8 | 4 | 8 | 9 | 8 | | 8 | 8 |
| SZELETA | 55 | 12 | 15 | 4 | | 2 | 19 | 6 | 11 | 54 | 13 | | 23 | 35 | | 24 | 34 |
| ISTÁLLÓSKŐ | 70 | 11 | 14 | 4 | | 4 | 23 | 9 | 27 | | 21 | | 31 | 35 | | 24 | 40 |
| PILISSZÁNTÓ-BAJÓT | 32 | 4 | 7 | 5 | | 2 | 5 | 4 | | | 25 | | 19 | 15 | 2 | | |
| **Total** | **180** | **38** | **49** | **26** | **2** | **18** | **66** | **22** | **42** | **66** | **66** | **10** | 92 | 103 | 2 | 63 | 84 |

*Abbreviations:*
L Leo, C Crocotta, S Sus, Dm Dama, Cp Capreolus, Ce Cervus elaphus, Cm Cervus "maral", A Alces, Mg Megaloceros, Rg Rangifer, As Asinus, B Bovidae (Bos, Bison), E Equus, O Ovibos, Cl Coelodonta, Mm Mammuthus

stantly till the Pilisszántó faunal phase (3,4–16,5%); woolly rhinoceros remained fairly stable (8,75–9,8%).

Apart from the two giant herbivores, mammoth and woolly rhinoceros, the two top-predators, cave lion and hyena, the frequency distribution of the remaining 11 species shows more differentiated changes *(Table V. Fig. 2.)*. *Cervus*, *Bovid* and *Equus* were present in nearly equal (15%) percentage throughout the Upper Pleistocene. Their slight increase (with 5–8%) took place in different periods: *Cervus* in Varbó and Istállóskő, *Bovid* earlier in Szeleta and *Equus* later, only in the Istállóskő faunal phase reached frequency values over 20%.

The rare *Sus* can be traced throughout the Upper Pleistocene. Its about 10% frequency in the Varbó – Subalyuk faunal phases decreased to one quarter by the Szeleta – Istállóskö phases (cca. 2,5%), raising again, surprisingly, by the Pilisszántó phase (6,5%).

*Asinus* is present only in the Varbó (4,6%) and Subalyuk (14,2%) faunal phases. It is interesting that according to the shape of the graphs *(Fig. 1–2)*, Asinus advanced in the fauna not "on expense of" s.l. steppean elements *Equus* and / or Bovidae but *Megaloceros* and forestal *Cervus*. *Ovibos* appeared only in the fauna by the end of the Late Upper Pleistocene.

Among the herbivore large mammals, seemingly *Cervidae* are most sensitive for environmental changes *(Table VI. Fig. 3.)*. Their frequency was changing, or they left the area of the Carpathian Basin. *Dama* occurred, according to our present state of knowledge, only in the Süttő faunal phase.

The rare roe deer *(Capreolus)* can be traced throughout the whole Upper Pleistocene: its occurrence is highest at the beginning (Varbó, 21%) than, decreasing gradually, reaching lowest value in the middle phase (Szeleta, 2,0%) Similar to *Sus*, its frequency is raising again by the two upper phases (Istállóskő, 4,7%, Pilisszántó, 5,6%).

The abundant *Cervus* is constantly present. It shows relative decrease (by 10–13%) only in the Szeleta (23,8%) and Pilisszántó-Bajót (25%) phases.

On the graph, (Fig. 4., Table VI) the forms *C. elaphus* (6a) and *C. "maral"* (6b) forms are represented separately. The occurrence of the latter variety, if the determination of the species is adequate, is raising throughout the Upper Pleistocene.

*Alces* appeared in the Varbó phase (4,3%), represented by 10% in the Subalyuk and Szeleta phases, reaching triple value in the Istállóskő phase (32,2%).

*Megaloceros* appeared also in the Varbó phase (17,4%), than increasing intensively tripled by the Szeleta faunal phase (51,4%). Occurrence of *Alces* is low till the maximum occurrence of *Megaloceros* in the Szeleta phase. By the disappearance of Megaloceros, *Alces* reached its maximum frequency (32,2%, Istállóskő phase). It is interesting to note that among the species studied, the ones which reached an outstanding species dominance value in a given faunal phase are missing from the fauna of the next phase.

*Rangifer* is constantly present, significant from the beginning of the Upper Pleistocene (Varbó 13, 0%, Subalyuk 14,8%, Szeleta 12,4%). Its quantity doubled in the Istállóskő phase (25,0%). By the end of the Late Upper Pleistocene (Pilisszántó-Bajót phase, 69,8%) reached absolute dominance within the Cervidae and also between the Quaternary macro-mammals in general (*Table IV. V.)*.

The chronological distribution of Upper Pleistocene species is demonstrated on *Table VII.* and *Fig. 4.*, respectively. This figure can present well the characteristic species in the given faunal phases as well as their changes in dominance.

Summarising macro-mammalian species of the Upper Pleistocene in large scale faunal phases is only a first step in faunistical analysis. Differences among the faunal phases show the main directions and tendencies of global climatic changes. At the same time, they cover up chronological and regional differences within the faunal phase. The study of these factors is the task of further research.

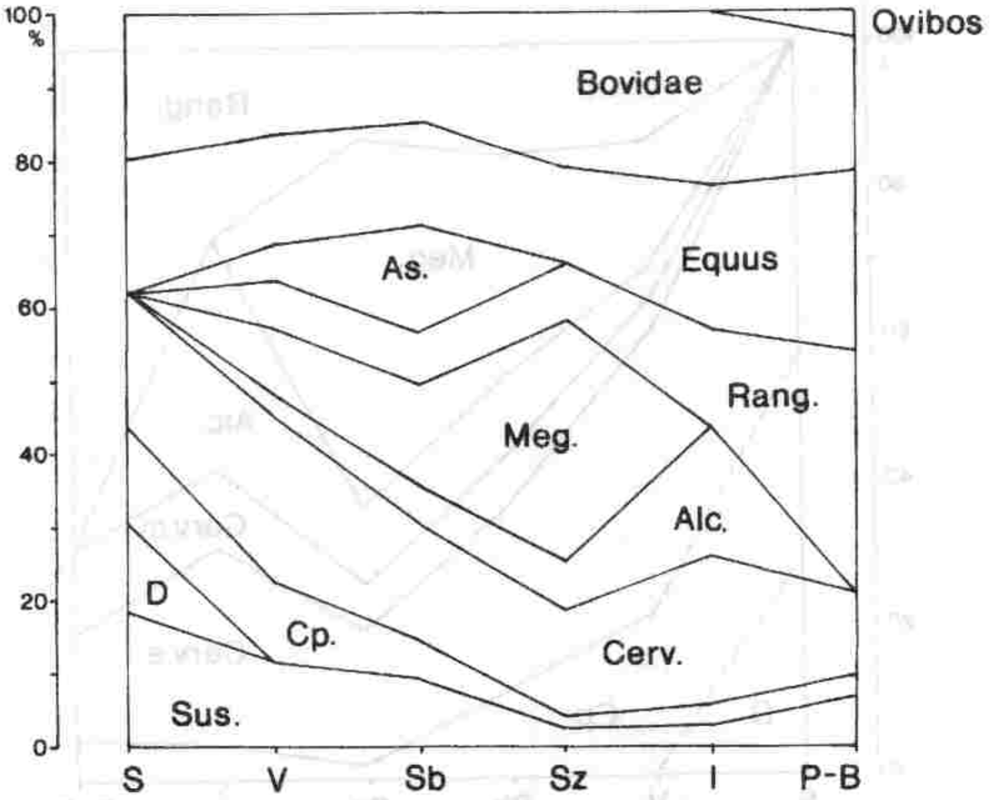


*Fig. 2.* S: Süttő, V:Varbó, SB: Subalyuk, Sz: Szeleta, I:Istállóskő,. P-B: Pilisszántó-Bajót phaunal phases
Mamm.: Mammuthus, Coel.: Coelodonta, As.: Asinus, Rang.: Rangifer, Meg.: Megaloceros, Alc.: Alces, Cp.: Capreolus, D.: Dama, Cerv: Cervus:

*Table V.* Species frequency of the Upper Pleistocne faunal phases in percentages (180 sites with herbivore macro-mammals, 11 species)

| Faunal phase | Species analysed | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sus | Dm | Cp | Ce/m | A | Mg | Rg | As | E | B | O |
| SÜTTŐ | | | | | | | | | | | |
| Sites | 3 | 2 | 2 | 3 | | | | | 3 | 3 | |
| % | 18,7 | 12,6 | 12,6 | 18,7 | | | | | 18,7 | 18,7 | |
| VARBÓ | | | | | | | | | | | |
| Sites | 5 | | 5 | 10 | 1 | 4 | 3 | 2 | 7 | 7 | |
| % | 11,3 | | 11,3 | 22,7 | 2,3 | 9,0 | 6,8 | 4,6 | 16,0 | 16,0 | |
| SUBALYUK | | | | | | | | | | | |
| Sites | 5 | | 3 | 9 | 3 | 8 | 4 | 8 | 8 | 8 | |
| % | 9,0 | | 5,4 | 16,1 | 5,4 | 14,2 | 7,3 | 14,2 | 14,2 | 14,2 | |
| SZELETA | | | | | | | | | | | |
| Sites | 4 | | 2 | 25 | 11 | 54 | 13 | | 23 | 35 | |
| % | 2,4 | | 1,2 | 15,0 | 6,5 | 32,4 | 7,8 | | 13,8 | 20,9 | |
| ISTÁLLÓSKŐ | | | | | | | | | | | |
| Sites | 4 | | 4 | 32 | 27 | | 21 | | 31 | 35 | |
| % | 2,6 | | 2,6 | 20,8 | 17,5 | | 13,6 | | 20,2 | 22,7 | |
| PILISSZÁNTÓ-BAJÓT | | | | | | | | | | | |
| Sites | 5 | | 2 | 9 | | | 25 | | 19 | 15 | 2 |
| % | 6,5 | | 2,6 | 11,6 | | | 32,5 | | 24,6 | 19,5 | 2,6 |

*Abbreviations:*
Dm Dama, Cp Capreolus, Ce/m Cervus elaphus / "maral", A Alces, Mg Megaloceros, Rg Rangifer, As Asinus, B Bovidae (Bos, Bison), E Equus, O Ovibos

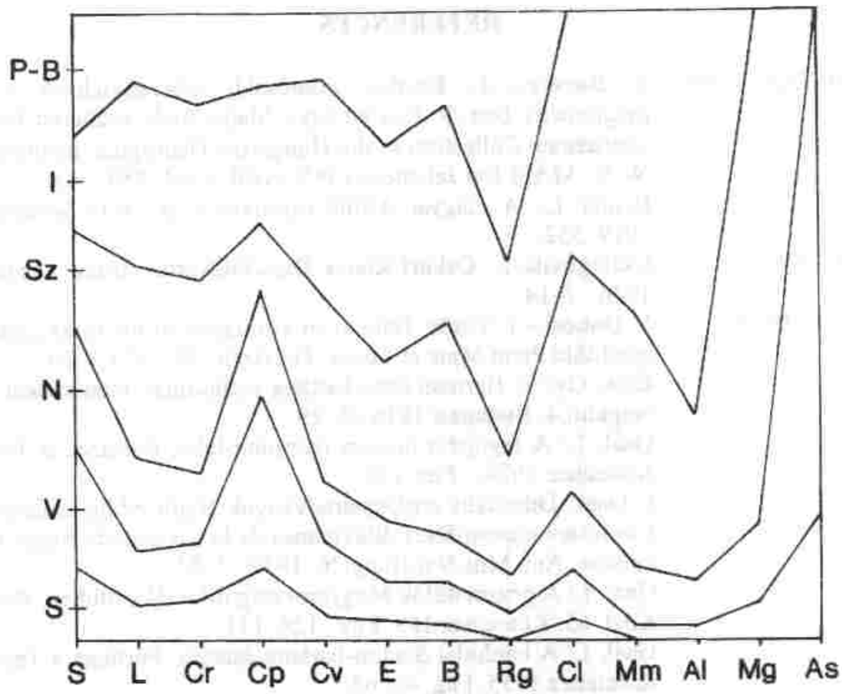


*Fig.4.* S: Süttő, V: Varbó, SB: Subalyuk, Sz: Szeleta, I: Istállóskő,. P-B: Pilisszántó-Bajót phaunal phases
S Sus, L Leo, C Crocotta, Cp Capreolus, Ce/m Cervus elaphus / "maral", E Equus, B Bovidae (Bos, Bison), Rg Rangifer, Cl Coelodonta, Mm Mammuthus, A Alces, Mg Megaloceros, As Asinus, Dm Dama, O Ovibos

*Table VII.* Chronological division of the Upper Pleistocene species in percentages (180 sites, 15 species)

| Faunal phase | Species analysed | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sus | L | C | Cp | Ce/m | E | B | Rg | Cl | Mm | A | Mg | As | Dm | O |
| SÜTTŐ | | | | | | | | | | | | | | | |
| Sites | 3 | 2 | 3 | 2 | 3 | 3 | 3 | | 2 | | | | | 2 | |
| % | 11.6 | 5.3 | 6.2 | 11.1 | 3.4 | 3.2 | 2.9 | | 3.2 | | | | | 100 | |
| VARBÓ | | | | | | | | | | | | | | | |
| Sites | 5 | 3 | 5 | 5 | 10 | 7 | 7 | 3 | 5 | 2 | 1 | 4 | 2 | | |
| % | 19.2 | 7.9 | 10.2 | 27.8 | 11.3 | 7.6 | 6.8 | 4.6 | 8.0 | 2.4 | 2.3 | 6.1 | 20.0 | | |
| SUBALYUK | | | | | | | | | | | | | | | |
| Sites | 5 | 6 | 5 | 3 | 9 | 9 | 8 | 4 | 8 | 8 | 3 | 8 | 8 | | |
| % | 19.2 | 15.8 | 10.2 | 16.6 | 10.3 | 9.8 | 7.8 | 6.0 | 12.8 | 9.5 | 7.2 | 12.1 | 80.0 | | |
| SZELETA | | | | | | | | | | | | | | | |
| Sites | 4 | 12 | 15 | 2 | 25 | 23 | 35 | 13 | 24 | 34 | 11 | 54 | | | |
| % | 15.4 | 31.5 | 30.6 | 11.1 | 28.4 | 25.0 | 34.0 | 19.8 | 38.0 | 40.5 | 26.2 | 81.8 | | | |
| ISTÁLLÓSKŐ | | | | | | | | | | | | | | | |
| Sites | 4 | 11 | 14 | 4 | 32 | 31 | 35 | 21 | 24 | 40 | 27 | | | | |
| % | 15.4 | 29.0 | 28.5 | 22.3 | 36.3 | 33.8 | 34.0 | 31.8 | 38.0 | 47.6 | 64.3 | | | | |
| PILISSZÁNTÓ–BAJÓT | | | | | | | | | | | | | | | |
| Sites | 5 | 4 | 7 | 2 | 9 | 19 | 15 | 25 | | | | | | | 2 |
| % | 19.2 | 10.5 | 14.3 | 11.1 | 10.3 | 20.6 | 14.5 | 37.8 | | | | | | | 100 |
| **TOTAL** | | | | | | | | | | | | | | | |
| **Sites** | **26** | **38** | **49** | **18** | **88** | **92** | **103** | **66** | **63** | **84** | **42** | **66** | **10** | **2** | **2** |
| % | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** |

*Abbreviations:*
S Sus, L Leo, C Crocotta, Cp Capreolus, Ce/m Cervus elaphus / "maral", E Equus, B Bovidae (Bos, Bison), Rg Rangifer, Cl Coelodonta, Mm Mammuthus, A Alces, Mg Megaloceros, As Asinus, Dm Dama, O Ovibos

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# Loess- and Palaeopedestratigraphical Data on the Bodrogkeresztúr-Henye Upper Palaeolithic site

Árpád Ringer

The Middle Danube Basin is one of the regions in Europe where surface loess cover is very important. The North-Eastern Hungarian parts within the basin are specific for their variable, generally shallow loess-like sediments which comprise, however, so-called "typical loess sequences" only rarely (PÉCSI 1993).

One of these most remarkable occurrences is located just in the Bodrogkeresztúr basin and the Kopasz Hill at Tokaj, in the vicinity of the Henye Palaeolithic settlement.

Opposed to the rich and significant archaeological and palaeontological evidence, the stratigraphical potentials of the site are relatively modest.

According to the study trench of the Henye hill excavated in 1982, the volcanic base rock is overlain by loessy cover in a layer of some ten cms thickness. The division of the sediments, however, is clear and uniform along the complete surface analysed. Starting from the surface downwards, under the Holocene soil we can find a loess layer followed by a palaeo-pedocomplex divided into several parts, overlying the bedrock.

The typical and suitably thick layer sequence of the site was sampled from the Western wall of trial trench nr. 8 (1982). In the following, the division of this section is presented *(Fig. 1., Table 1.)*:

*Table 1.* Granulometrical characteristics of the layers at the Bodrogkeresztúr–Henye Upper Palaeolithic site

| Nr. Of sample | $CaCO_3$ % | H % | Grain size distribution mm Ø gr % | | | | | | | | | A % | I % | L % | H % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0,002 > | 0,002–0,005 | 0,005–0,01 | 0,01–0,02 | 0,02–0,05 | 0,05–0,1 | 0,1–0,2 | 0,2–0,5 | 0,5 < | | | | |
| 1. | 0,86 | 0,65 | 20,56 | 7,56 | 6,77 | 18,81 | 35,53 | 10,70 | 0,31 | 0,15 | 0,67 | 26,12 | 25,58 | 35,53 | 11,83 |
| 2. | 4,72 | 0,21 | 20,11 | 8,35 | 6,95 | 15,69 | 22,64 | 8,85 | 1,20 | 0,82 | 15,19 | 28,46 | 22,64 | 22,64 | 26,06 |
| 3. | 6,43 | 0,21 | 22,4 | 8,12 | 7,68 | 17,26 | 34,59 | 9,15 | 0,36 | 0,28 | 0,32 | 34,16 | 24,94 | 30,59 | 10,11 |

A: Clay I: Loam L: Loess H: Sand

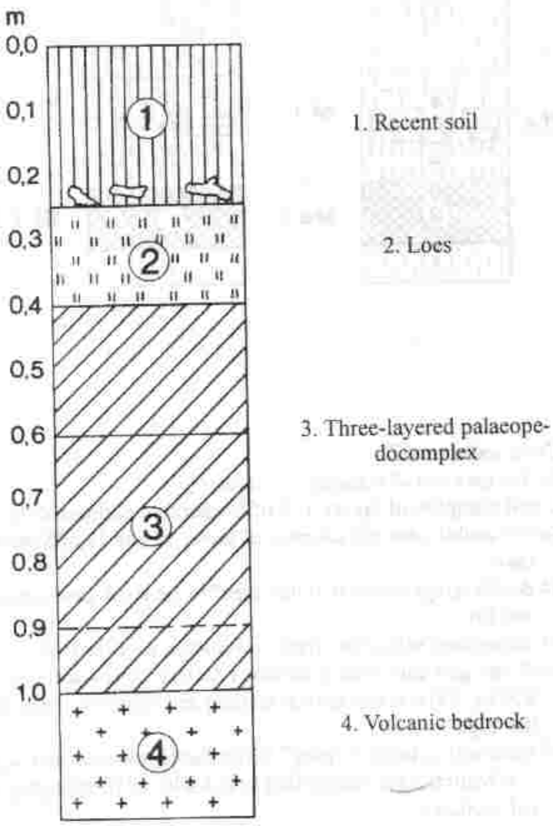


*Fig. 1.* Stratigraphical sequence of the Henye-hill Upper Palaeolithic site

1. 0,0–0,25 m. Shallow skeletal soil of brownish grey colour with anthropogene interferences. At the usual depth of 0,2 m, the base level of ploughing mixture connected with cultivation of the ground is observable. No traces of deep ploughing were found here (Table 1, Sample 1).
2. 0,25–0,40 m Greyish yellow, slightly loamy sandy loess (A[1]=28,46%, H[2]=26,06%, L[3]=222,64%). Concretions of calcium-magnesium carbonate indicate that large, (upper) parts of the loess were eroded prior to recent soil formation processes. The habit of these concretions is probably due to secretion from large bunches of loess and not leaching of the original Holocene (forest) soil (Table 1, Sample 2.)
3. 0,4–1,0 m. Palaeopedocomplex comprising several members. Only the first soil horizon was suitable for sampling (Table1, Sample 3.). This is a light brownish grey soil, comprising the archaeological

[1] A „agyag", clay fraction
[2] H „homok", sand fraction
[3] L „lösz", loess fraction

The palaeopedocomplex contained a Middle Palaeolithic /Upper Palaeolithic. transitional industry, over this, an Aurignaco-Gravettian industry could be observed. The series is closed by a younger Upper Palaeolithic horizon (RINGER, 1993 73–77, figs. 13–14).

This palaeopedocomplex with three members could be paralleled with the interstadials Hengelo + Arcy-Stillfried B + Kesselt in Western European young Pleistocene chronostratigraphy (Fig. 2.).

On the basis of evidence discussed in other parts in this monograph (C-14 date and archaeological analysis by Dobosi) as well as the soil sequence presented above we can connect the cultural layer to the top member of the three-layer palaeopedocomplex, around the period of Stillfried B + Kesselt Interstadials.

The settlement must have been lying in the loess forming the substratum of soil, which turned to soil only later. This is demonstrated by the fossilisation of the palaeontological material which could not have been accomplished in a soil. Thus the age of the settlement can be placed with highest certainty at the cooler climatic phase between the interstadials Stillfried B + Kesselt.

The raw material type spectrum is also typical for this period. While on other Gravettian sites, felsitic quartz porphyry is seldom occurring, especially typical Gravettian forms made of this material are rare, these occur in considerable amounts at the Henye-hill industry. According to personal experiences of the author, Gravette points and microgravettes made of felsitic quartz porphyry were also found in the Sajószentpéter aurignaco-gravettian collection, in the palaeosoil MS2 correlated with Stillfried B (RINGER 1993, fig. 15) in layer 2 of the Diósgyőr-Tapolca cave paralleled with this soil type on the basis of the original documentation of A. SAÁD (GAÁL—SAÁD 1935), as well as the layers 4. and 5. of the Szeleta cave (KADIĆ 1916).

This characteristic "Early Gravettian" horizon can be connected with, most probably, a narrow horizon of time around the interstadials Stillfried B + Kesselt. Probably the Henye hill Palaeolithic settlement can be bound to this phase.

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# Stratigraphical and palaeoecological investigation of the fossil soil comprising Upper Palaeolithic tools at Bodrogkeresztúr- Henye

P. Sümegi—E. Rudner—I. Beszeda

## *Introduction*

Between 1988 and 1994, several sampling was performed on the loess areas at the Kopasz-Hill of Tokaj and its environs for palaeontological, Quaternary geological, stratigraphical and palaeoecological investigations. Apart from artificial and natural outcrops (deep roads, cellar cuts, walls of brickyards, slide walls, grape plantations), boreholes and excavated trenches were also made. Most of the latter were deepened at the plateau Dereszla and Henye at Bodrogkeresztúr, because there were no natural outcrops available on either sites.

The sondage deepened at the Henye-plateau near the spot height opened a fossil soil layer. This soil layer was dark brown, slightly carbonatic, containing burnt charcoal, bone morsels, small fragments of quartzite and obsidian. It was settled over a base of Upper Sarmatian rhyolite effusive body in loessic sediments. The development of the fossil soil was considerably varied. Its thickness was about 2–4 cm depending on local geomorphological conditions. On its surface, a recent soil layer was formed, probably already in the Holocene. Due to the position of the recent soil horizon, the fossil soil layer is intersected by roots of the recent vegetation. At the same time, the contemporary and recent animal and vegetal effects (bioturbation etc.) and human interference (felling of the forests, ploughing, grazing, plant cultivation etc.) the recent and the fossil soil got completely mixed at several places. Due to erosion of the recent soil layer, fossil soil is located immediately under the present surface. In spite of this, the recent and fossil soil layers could be clearly distinguished macroscopically in the sections deepened till the base rock, both on the plateau and the side of the hill.

Investigations were aimed at the date and conditions of formation of the fossil soil and its lithological, stratigraphical connections with other fossil soil sections opened at other locations around the Kopasz-hill of Tokaj.

## Experimental methods

In each 5 cm layer of the geological sections, grain size composition was determined by aerometric hydrometry (VENDEL 1959).

From the level of the fossil soil, some 5 kg material was collected for Quaternary malacological analysis. The studied sample proved to be sterile in respect of Molluscs. At the same time, it contained significant amount of charcoal which was suitable after special cleaning procedure for radiocarbon analyses. Charcoal pieces had to be cleaned from recent roots which were intersecting the fossil wood. Without cleaning these young organic components would distort the measurement results. The measurements were made aiming at dating the fossil soil. Radiocarbon measurements were performed by E. Hertelendi and co-workers in the Light Element Isotope Laboratory of the Debrecen Nuclear Research Institute of the HAS according to the methods described by HERTELENDI et al. 1989.

Results are given below:

| Site | Depth | Age | $^{13}C$ (PDB) | Laboratory code |
|---|---|---|---|---|
| Bodrogkeresztúr–Henye | 0,5–0,6 | **26 318 ± 365 years BP** | 25,96 | deb-2555 |

The measurements were made in 1993. No calibrated dates are available as yet, so the above data should be interpreted accordingly

Apart from the radiocarbon analysis of the charcoal, it was suitable also for anthracotomical (xylotomical, histological) analysis.

On the basis of histological analysis of the charcoal remains we can determine the species it originates from. Such studies can help in reconstructing former local vegetation.

After macroscopic and binocular stereomicroscopic selection and taxonomical determination, AMRAY scanning electron microscopic analyses were made for a more detailed analysis of the histological marks (wood and phloem elements, thickening, resin canals) on tangential, radial longitudinal and transversal fracture surfaces (SZÖŐR et al. 1992, RUDNER 1994). This analytical series aimed at reconstructing the former arboreal vegetation, its composition and do it the best possible way by the help of histological marks.

Different taxonomic monographs were used (GREGUSS 1972; SCHWEINGRUBER 1978, 1990) as well as technical literature on arboreal anatomy. Identifying plants on the basis of histological marks can be difficult, sometimes impossible on the species level (BARTHOLIN 1979).

Charcoal was separated from 5 kg sediment by silting. Sieve aperture was 0,4 mm, the residuals were

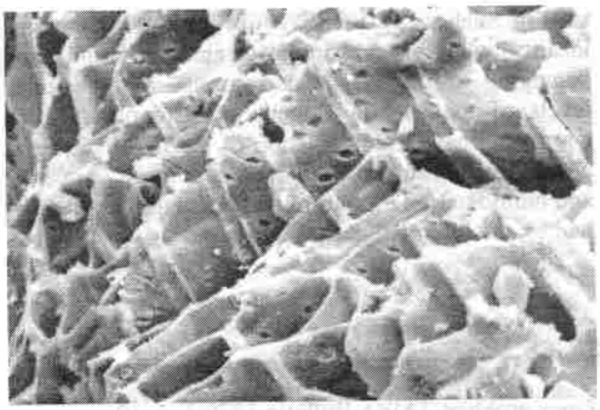

Fig. 4. Scanning electron micrograph tangential and radial fracture surfaces of *Picea* sp. charcoal from the Bodrogkeresztúr fossil soil (Magnification: 605x)

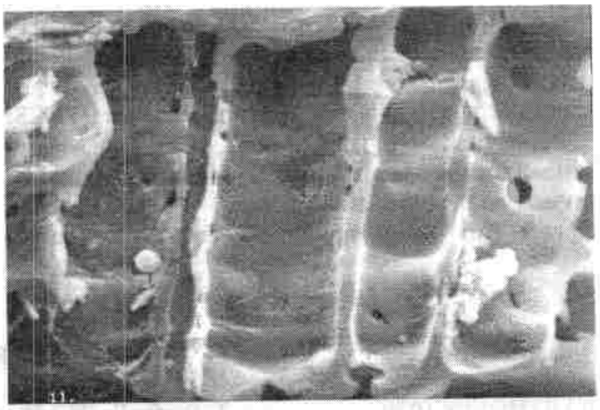

Fig. 7. Scanning electron micrograph radial fracture surface of *Picea* sp. charcoal from the Bodrogkeresztúr fossil soil (Magnification: 1320x)

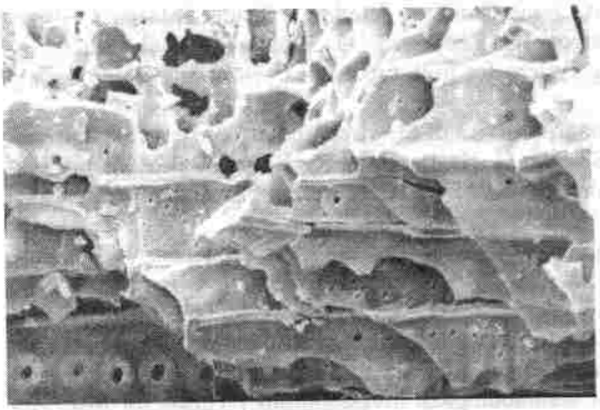

Fig. 5. Scanning electron micrograph radial fracture surface of *Picea* sp. charcoal from the Bodrogkeresztúr fossil soil (Magnification: 422x)

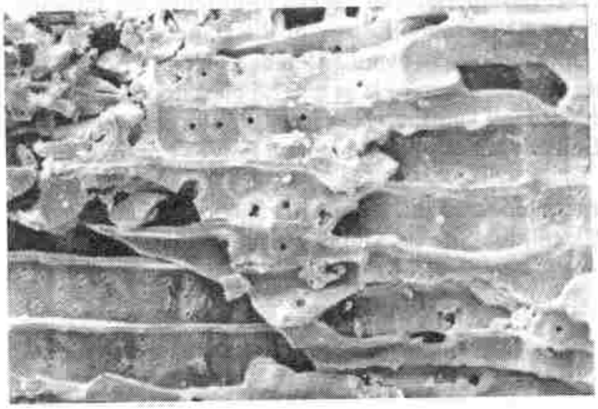

Fig. 6. Scanning electron micrograph radial fracture surface of *Picea* sp. charcoal from the Bodrogkeresztúr fossil soil (Magnification: 360x)

pine forest but a steppean taiga or a taiga with steppean elements in the time of the formation of the fossil soil. The recent ecological demands and resistivity of *Picea* type forests (NIKOLOV–HELMISARI 1992) is characterised by tolerating well long and cold winters and able to live in short, but long day-lit vegetation periods. Compared to *Larix* species, they require milder climate but more cold than members of the *Pinus* genus. *Picea* type forests are typically. formed on leached acidic podsol type soil. Currently, members of the *Picea* genus are spread on the Northern hemisphere, in temperate and cold climatic zone; in Europe, the plains of the Northern parts and the mountainous regions of the central parts of the continent. *Picea* species are also spread in the Carpathians, between the altitude 600 and 1900 meters; moreover, a "*Picea* belt" has also developed between 1000–1500 meters altitude.


**Summary**

At the Henye plateau, a fossil soil horizon was opened (sondage by the authors) which was formed on loess some 26.000–27.000 years ago and from a vegetation dominated by arboreal plants of *Picea* type, in a forestal steppe environment. These data show good agreement with former chronological data on the Bodrogkeresztúr-Henye site (GEYH et al. 1969) and anthracotomical investigations on charcoal (STIEBER 1968), supposing the formation of a *Larix-Picea* type taiga here 26.000–32.000 years ago (GXO-195: 28.700 $\pm$ 3000 BP). Scanning electron microscopical studies could further refine the composition of the vegetation described before.

The fossil soil opened at Henye-plateau can be paralleled, from a lithostratigraphical point of view, by the younger levels of the Mende Upper Soil complex

## Instrumental analysis I.:

# The Carpathian sources of raw material for obsidian tool-making.

(Neutron activation and fission track analyses on the Bodrogkeresztúr-Henye Upper Palaeolithic artefacts)

G. Bigazzi—K. T. Biró—M. Oddone

*Abstract*

The characteristics of the Carpathian obsidians have been analysed by fission track dating method and by instrumental neutron activation analysis. Chemical analyses and geological dating techniques together discriminate the sources of the Tokaj Mountains (Carpathian I, II) from other sources located in the Mediterranean and in Anatolia. Although part of the original primary sources cannot be located today, the best quality glass preferentially used by prehistoric man for tool-making comes in all probability from Eastern Slovakia. Prehistoric exploitation of the Tokaj obsidian sources started in early times, and the Upper Palaeolithic site Bodrogkeresztúr-Henye had a remarkable role in this process.

### *Introductory notes*

In the Mediterranean basin and adjacent regions, obsidian was widely used by prehistoric men for tool-making. Thus the identification of natural sources of obsidian artefacts provides archaeologists a peculiar opportunity of detecting trade routes and cultural interactions. Two factors make obsidian an ideal material for provenance studies: (1) this volcanic glass was recognised in the form of lava flows, domes or as a component of pyroclastic products in distinct volcanic regions and (2) its physical and/or chemical properties appear distinctly characteristic of the place of origin. For these reasons, provenance studies of obsidian artefacts are among the most popular archaeometrical research subjects.

Two potential factors may form an obstacle in obsidian provenance studies: (1) surface morphological changes (natural or produced by more recent human activities) may have made inaccessible some ancient sources and (2) prehistoric man may have exhausted some occurrences.

Among the several approaches used for characterisation and provenancing volcanic glass, chemical analysis of the major element and/or trace elements appears the most popular technique for connecting artefacts with natural sources.

Since the routine application of fission track dating (FT), several authors have shown that age and track densities are efficient, source specific discriminants of obsidian (SUZUKI, 1969; DURRANI et al., 1971; ARIAS RADI et al., 1972; BIGAZZI and BONADONNA, 1973; WAGNER et al., 1976). Application in different geographical areas such as Japan (SUZUKI, 1969), Europe (ARIAS RADI et al. 1972; ARIAS et al., 1986; BIGAZZI et al. 1990), Latin America (MILLER and WAGNER, 1981; BIGAZZI et al. 1992) proved the potentials of this method.

More recently BIGAZZI et al. (1986, 1993a) showed that the combination of different techniques based on independent parameters, such as the trace element composition by instrumental neutron activation analysis (INAA) and FT dating, is an efficient diagnostic tool, especially in case of ambiguous source identification.

The archaeometric significance of obsidian greatly contributed to stimulate scientists to study the potential natural sources and to refine analytical techniques. Therefore, especially in the last 20 years provenance studies of obsidian artefacts yielded solid results in several sectors of earth sciences.

This work reports on the results of an interdisciplinary approach, combination of INAA and FT dating, applied to samples from Hungary and Slovakia in order to characterise the Carpathian obsidians and compare them with the potential natural sources located in the Mediterranean and in Anatolia.

### *Potential obsidian sources in the Mediterranean and adjacent regions*

Since the early sixties several authors studied the natural potential sources of the obsidian prehistoric artefacts in the Mediterranean and surrounding areas (Fig. 1). The data-set (location, stratigraphy, chemical and physical properties) related to the Italian, the Aegean and the Carpathian occurrences and the documentation of their prehistoric use have reached considerable results. In contrast, knowledge on the occurrences located in Anatolia is still inadequate, especially in its western and eastern territories (KELLER and SEIFRIED, 1990; ÖZDOGAN, 1996).

In the following, the well known Mediterranean obsidians will be just mentioned. Some details will be and Cankiri (N and NE of Ankara). KELLER and SEIFRIED (1990) reported on an unknown source called "Galata-X". Homogeneity of age (KELLER et al., 1996) with Yaglar and Sakaeli and geographical location (south side of the Galatean massif), suggest that Galata-X was within the same volcanic complex.

*Central Anatolia.* The main sources located in Cappadocia, in the Aksaray-Nevsehir-Nigde triangle are the best known in Turkey. These are the large caldera along the Acigöl-Nevsehir road (Acigöl obsidians) and the Göllü Dagi rhyolithic volcano (Çiftlik obsidian, after the name of the town located a few km S-SW from Göllü Dagi). Recently, BIGAZZI et al. (1993b) published detailed geological maps for these two areas and geochronological data by FT dating.

The Acigöl obsidians have been stratigraphically distinguished by ERCAN et al. (1989) in two groups:

(1) Bogazköy obsidians – these are located on the caldera wall (and then predate its collapse) N of the Acigöl-Nevsehir road 7–8 km E of Acigöl and 1–2 km SE of Bogazköy. They include the "*WTHD source*" (white tuff north of Hotamisdag of KELLER and SEIFRIED, 1990). According to them, this occurrence corresponds to the Acigöl source described by RENFREW et al. (1966) and Fornaseri et al. (1977). Keller and Seifried's "*SE Bogazköy obsidian*" also belongs to this group.

(2) Taskesiktepe obsidians – these are several obsidian flows located in the domes inside the caldera: the Kocadag (or Hotamisdag) dome, E of Karacaören village, and the Güney Dagi and Korudag domes, in the west side of the caldera (BIGAZZI et al., 1993b)

The Çiftlik obsidians (more properly "Göllü Dagi" obsidians) are several flows which outcrop 1 km N, between 1 and 2 km S-SW and 4 km NW of Kömürcü village and 1 km E of Bozköy village.

Although not all the mapped sources have been analysed, the available data-set on Acigöl and Çiftlik obsidians seems to be rather adequate.

Other sources in Central Anatolia are located SW of Catköy village (few km N of the Acigöl caldera), in the Nenezi Dagi dome (BATUM, 1975), E of Bekarlar village, between Acigöl and Çiftlik, and in the Hasan Dagi volcano, SW of the Çiftlik town.

*Eastern Anatolia* – Large volcanic areas bear obsidian in this region. Classical sources, introduced in the literature since the 60's (RENFREW et al., 1966, 1968; DIXON et al., 1968) and revisited by ERENTÖZ and KETIN (1974) and FORNASERI et al. (1977) are Kars, Bingöl, Nemrut Dagi and, more recently, Sarikamis, Erzincan (Bas 1979), Süphan Dagi and Ziyaret / Meydan Dagi. Other sources recently surveyed are Erzurum, Pasinler and Mus (ERCAN et al. 1996; BIGAZZI et al., 1997). A short description following an ideal arc from E to W, SW and E is given below.

Kars – This name, introduced by Renfrew et al. (1966), is used by Ercan et al. (1996) for several obsidian beds located S of Digor village (40 km SE of Kars) and N of Kagizman (50 km S-SE of Kars). Other obsidian occurrences were recognised 10 km SW of Kars. Relationship between Renfrew's and Ercan's *Kars obsidian* is not clear.

Sarikamis – A volcanic field bearing several obsidian beds extends from ~ 15 km to ~ 35 km S-SE of Sarikamis, along the Sarikamis-Karakurt road. A detailed map is now available (ERCAN et al., 1996; BIGAZZI et al., 1997). KELLER and SEIFRIED (1990) quote also an obsidian occurrence W of Sarikamis.

Rize – Obsidian beds associated to tuffs were recognised near the Ikizdere village, 30 km S of Rize (TANER, 1977).

Pasinler – This name, introduced by ERCAN et al. (1996), refers to a sequence of outcrops in tuffs in volcanic cones, near the Tizgi village (NW of Pasinler). In a similar stratigraphic sequence, obsidian beds were recognised near Erzurum and Erzincan:

Erzurum – At Tabya Dagi and Kibletepe, near Tambura village, ~ 20 km SW of Erzurum and, very recently, ~ 20 km SE of Erzurum (ERCAN et al., 1996).

Erzincan – At Degirmentepe and Boztepe, few km E of Erzincan (BAS, 1979).

Bingöl, Solhan - A large volcanic field bearing obsidians is located in the Bingöl-Solhan-Karliova triangle. Their knowledge and documentation is rather poor: ÖZDOGAN (1996) and M. C. CAUVIN (personal communication) refer of frequent obsidian occurrences that they surveyed along the Bingöl-Solhan road. No detailed geological map of the area is available as yet.

Mus – These are new sources, located ~ 30 km NE of Mus (near the Mercimekkale village) and NW (near Yaygin village) of Mus.

Finally, the best known obsidian sources in Anatolia are located in the Quaternary volcano series along the coast of Lake Van. Important obsidian beds were documented by several authors in Nemrut Dagi, Süphan Dagi and Meydan Dagi (called also Ziyaret Dagi) volcanoes (RENFREW et al. 1966, 1968; DIXON et al. 1968; INNOCENTI et al. 1976, 1980; FORNASERI et al. 1977). Several maps are available; recently, new maps were prepared by ERCAN et al. (1996) and BIGAZZI et al., (1997).

*Western Anatolia.* This is a rather unknown region with regard to obsidian occurrences. Ercan et al. (1996) quote 10–15 cm thick obsidian beds in Neogene deposits near the Alanyurt train station (7 km E of Kütahya) and thin beds intercalated with perlites in

The Carpathian sources yielded relatively small amount of volcanic glass useful for tool-making compared to other sources of the Mediterranean area. Still they have great importance because these are the unique natural sources of obsidian present in Central Europe and, altogether in Mainland (Continental) Europe. It means that before regular sea-faring, this was the only obsidian source region available for European Palaeolithic communities (BIRÓ 1984).

The Carpathian sources were mentioned, mainly through archaeological evidence in the classical studies by optical emission spectroscopy performed by Renfrew and co-authors (RENFREW et al. 1966), based on archaeological material (Edelény-Borsod-Derekegyháza). Later on, provenance studies were supported by source collected evidence in the late seventies, by a British team using neutron activation analyses (WILLIAMS—NANDRIS 1977, WILLIAMS-THORPE 1984) as well as Hungarian research, using main component analyses by AAS (Biró 1981) and later EDS – XRF (BIRÓ—POZSGAI 1984, BIRÓ et al. 1986, BIRÓ et al. 1988). At the end of the 80's the obsidian sources of the region were surveyed by a Hungarian–Slovakian–Italian campaign, which was planned to get new geochemical and geochronological evidence on the obsidian sources of the Mediterranean and the Anatolian sources. Results were briefly reported in BIGAZZI et al. (1990). The Carpathian obsidian sources can be basically divided into two regional / chemical groups, in the southern part of the Tokaj Mountains (Mád, Erdőbénye, Tolcsva villages) and to the North of the Hungarian / Slovakian border (Viničky, Mala Bara: in the vicinity of archaeological sites Cejkov and Kašov). The primary separation of Carpathian I (Slovakian) and Carpathian II (Hungarian) obsidian has been suggested by O. Williams; BIRÓ et al. (1986) discovered further sub-groups within the Hungarian material. Most recently, new subgroups seem to emerge within the Slovakian obsidian sources as well (TÓTH et al. 1999). The geochronological study confirmed the existence of substantial differences in age as well as chemical properties between the main groups Carpathian I. and II.

Usually obsidian occurs in association with rhyolite flows (rhyodacites). Two main rhyolite bodies extending south of the Telkibánya-Nagybózsva line and North of the Erdőbenye-Tolcsva line, respectively, were recognised in the Tokaj Mountains. Several smaller rhyolite occurrences are scattered through the region. SZÁDECZKY (1886) described obsidian outcrops still existing in his time.

Due mostly to human activities since prehistoric times, obsidian fragments are scattered everywhere in the rhyolite areas. Bands of agricultural ground showing rich concentration of obsidian pebbles (size up to 5–10 cm) are located few hundred meters NW as well as SW of Tolcsva, S of Erdőbénye and E of Mád at Kakashegy.This source is closest to Bodrogkeresztúr; at the same time, it is the richest and most accessible source within Carpathian II (Hungarian) obsidians. Similar secondary geological occurrences were observed in Slovakia at Mala Bara and Viničky. These are interpreted as remains of original outcrops of obsidian horizons.

In conclusion, the Carpathian obsidian source region experienced radical changes in the last ten thousand years: the original outcrops bearing raw material useful for tool-making were heavily exploited. Prehistoric exploitation contributed to a great extent to the scarcity of large obsidian nodules. Already Szádeczky concluded at the end of the last century that the good quality glass of many prehistoric artefacts was not represented on the existing outcrops and that the sources containing the best material for tool-making had been exhausted by prehistoric men.

### *Fission track dating of volcanic glass: an alternative method for provenance studies of obsidian artefacts*

Glass is among the most suitable materials for FT dating: its importance has been recently reconfirmed, because glass is the only datable phase of many tephra (WALTER, 1989). As a matter of fact, FT dating gave a solid contribution to tephrochronological studies (see, for example, WESTGATE, 1989). Moreover, although due to relatively low uranium content of natural glass (usually between 2–3 pPM up to 30 pPM) low track densities can be accumulated in short times, large surfaces can be prepared for track counting in obsidian. Therefore, FT dating can be applied to few thousand year old samples under favourable conditions. Recently BIGAZZI et al. (1993b) have shown the potentiality of FT dating of obsidian for reconstructing chronostratigraphy in very young volcanic areas.

Due to low stability of fission tracks in glass over geological times, the spontaneous tracks are usually partially annealed. FT ages are in this case minimum ages (called "apparent ages"), unless a technique for correcting thermally lowered ages is applied. STORZER and WAGNER (1969) and STORZER and POUPEAU (1973) proposed the "size correction method" and the "plateau method", respectively.

The first technique is based on estimate of track density loss by track size measurements. The spontaneous to induced (assumed as undisturbed reference tracks) track size ratio is related to the partial annealing amount of the spontaneous tracks and to the corresponding track areal density decreasing.

*Table 1.* Fission Track dating of Carpathian obsidian

| Sample | $\rho_s$ | $N_s$ | $\rho_I$ | $N_I$ | $\Phi$ | $D_s/D_I$ | C.F. | App. Age | Age (+/- 1σ) |
|---|---|---|---|---|---|---|---|---|---|
| *Zemplin hills* | | | | | | | | | |
| PM 86/1 | 25,000 | 1,439 | 821,000 | 2,352 | 5.63 | 0.81 | 0,69 | 10.52 | 15.13 +/- 0.79 |
| PM 86/2-1 | 27,000 | 636 | 1,144,000 | 1,377 | 7.18 | 0.77 | 0.63 | 10.43 | 16.56 +/- 1.22 |
| PM 86/2-2 | 27,400 | 1,075 | 900,000 | 1,091 | 5.44 | 0.81 | 0.69 | 10.18 | 14.76 +/- 0.90 |
| 2h 250 °C | 25,700 | 1,115 | 549,000 | 998 | 5.44 | – | – | – | 15.64 +/- 0.68 |
| PM 86/3-1 | 13,800 | 1,195 | 575,000 | 1,527 | 7.18 | 0.74 | 0.60 | 10.61 | 17.83 +/- 1.13 |
| 2h 250 °C | 10,500 | 1,097 | 279,000 | 1,258 | 7.18 | – | – | – | 16.64 +/- 0.69 |
| PM 86/3-2 | 14,800 | 1,275 | 463,000 | 1,238 | 5.44 | 0.77 | 0.63 | 10.85 | 17.22 +/- 0.96 |
| PM 86/4-1 | 28,400 | 667 | 978,000 | 1,096 | 5.44 | 0.79 | 0.67 | 9.69 | 14.46 +/- 0.95 |
| 2h 250 °C | 28,400 | 1,233 | 602,000 | 1,477 | 5.44 | – | – | – | 15.75 +/- 0.65 |
| PM 86/4-2 | 26,900 | 633 | 1,229,000 | 1,384 | 7.18 | 0.82 | 0.71 | 9.66 | 13.71 +/- 0.82 |
| *Tokaj Mts* | | | | | | | | | |
| PM 86/10-2 | 7,890 | 365 | 430,000 | 648 | 5.63 | 0.77 | 0.63 | 6.35 | 10.16 +/- 0.78 |
| PM 86/11-1 | 8,630 | 195 | 444,000 | 472 | 5.63 | 0.82 | 0.71 | 6.76 | 9.59 +/- 1.10 |
| PM 86/12 | 5,570 | 412 | 358,000 | 637 | 5.63 | 0.73 | 0.58 | 5.38 | 9.35 +/- 0.71 |
| 2h 250 °C | 6,400 | 390 | 242,000 | 865 | 5.63 | – | – | – | 9.15 +/- 0.56 |
| PM 86/12a-2 | 8,890 | 411 | 478,000 | 720 | 5.63 | 0.77 | 0.62 | 6.44 | 10.38 +/- 0.77 |
| PM 86/15 | 7,700 | 214 | 394,000 | 744 | 5.63 | 0.86 | 0.79 | 6.54 | 8.27 +/- 0.69 |
| PM 86/16 | 6,300 | 439 | 385,000 | 680 | 5.63 | 0.78 | 0.65 | 5.68 | 8.80 +/- 0.68 |
| 2h 250 °C | 7,000 | 548 | 282,000 | 805 | 5.63 | – | – | – | 8.58 +/- 0.48 |
| PM 86/19 | 9,280 | 242 | 376,000 | 402 | 5.44 | 0.88 | 0.81 | 8.25 | 10.18 +/- 0.91 |

*Table 2.* Fission Track dating of obsidian artefacts from the Carpathian area

| Sample | $\rho_s$ | $N_s$ | $\rho_I$ | $N_I$ | $\Phi$ | $D_s/D_I$ | C.F. | App. Age | Age (+/- 1σ) |
|---|---|---|---|---|---|---|---|---|---|
| ***Bodrogkeresztúr–Henye*** | | | | | | | | | |
| BO-1 | 33,600 | 1,513 | 34,900 | 3,082 | 0.165 | 0.74 | 0.59 | 908 | 16.70 +/- 1.50 |
| 2h 250 °C | 32,700 | 1,473 | 19,100 | 1,167 | 0.165 | 1.00 | – | – | 17.40 +/- 1.80 |
| BO-2 | 4,400 | 111 | 8,200 | 91 | 0.165 | 0.87 | 0.79 | 5.7 | 7.21 +/- 1.90 |
| *Cejkov* | | | | | | | | | |
| PM 86/5-1 | 37,100 | 1,282 | 964,000 | 1,384 | 5.44 | 0.86 | 0.77 | 12.86 | 16.71 +/- 1.08 |
| 2h 250 °C | 31,900 | 1,110 | 654,000 | 1,192 | 5.44 | – | – | – | 16,33 +/- 0.68 |
| PM 86/5-2 | 37,300 | 1,380 | 1,069,000 | 1,228 | 5.44 | 0.85 | 0.76 | 11.66 | 15.45 +/- 1.10 |
| PM 86/5-3 | 38,700 | 1,262 | 1,047,000 | 1,196 | 5.63 | 0.85 | 0.76 | 12.78 | 16.81 +/- 0.95 |
| PM 86/18 | 36,300 | 1,105 | 875,000 | 1,109 | 5.44 | 0.91 | 0.86 | 13.88 | 16.14 +/- 1.02 |
| *Kašov* | | | | | | | | | |
| PM 8 | 30,500 | 1,489 | 413,000 | 1,351 | 2.44 | 0.86 | 0.68 | 10.78 | 15.85 +/- 0.97 |
| 4h 270 °C | 23,800 | 299 | 223,000 | 1,628 | 2.44 | – | – | – | 15.82 +/- 1.07 |
| *Tarcal* | | | | | | | | | |
| PM 86/9-1 | 4,260 | 197 | 1,029,000 | 1,147 | 5.44 | 0.29 | 0.09 | 1.38 | 16.30 +/- 2.30 |
| PM 86/9-2a | 33,900 | 941 | 1,007,000 | 1,155 | 5.63 | 0.87 | 0.79 | 11.65 | 14.75 +/- 0.86 |
| PM 86/9-2b | 38,700 | 1,075 | 1,059,000 | 1,218 | 5.63 | 0.87 | 0.69 | 12.24 | 15.49 +/- 0.88 |
| PM 86/9-3 | 33,700 | 1,247 | 1,064,000 | 1,218 | 5.44 | 0.80 | 0.68 | 10.59 | 15.69 +/- 1.03 |
| 2h 250 °C | 26,800 | 1,166 | 566,000 | 1,031 | 5.44 | – | – | – | 15.84 +/- 0.68 |
| PM 86/9-4 | – | – | 501,000 | 371 | 5.44 | – | – | – | – |
| *Mád-Kakas hegy* | | | | | | | | | |
| PM 86/10-1a | 6,900 | 319 | 888,000 | 1,159 | 5.44 | 0.39 | 0.16 | 2.60 | 16.20 +/- 1.80 |
| | 76 | 28 | | | | 1.00 | | | 0.0286 +/- 0.0050 |

*Table 3.* (con.)

| Source | FT app. age (Ma) | FT form. age (Ma) | $\rho_s$ [cm$^{-2}$] | $\rho_I$ [cm$^{-2}$] (x10$^3$) | Reference |
|---|---|---|---|---|---|
| **E. Anatolia** | | | | | |
| Kars–Digor | 2.4 | 3.0 | 4,600 | 110 | (6) |
| Kars | 3.6 | 4.0 | 8,000 | 160 | (6) |
| Sarikamis | 2.3–3.9 | 3.6–5.0 | 4,800–6,800 | 95–120 | (6) |
| Pasinler | 3.5–5.0 | 6.1–6.6 | 12,000–15,000 | 185–210 | (6) |
| Erzurum | 5.1 | 6.9 | 9,000 | 100 | (6) |
| Bingöl | 0.7–4.0 | 4.6 | 1,800–11,200 | 75–170 | (6) |
| Mus | 2.0 | – | 2700 | 80 | (6) |
| Nemrut Dagi | 0.024 | – | 65 | 170 | (6) |
| Süphan Dagi | 0.068 | – | 75 | 65 | (6) |
| Meydan Dagi | 0.06–0.70 | 0.60–0.90 | 200–1500 | 135–185 | (2), (6) |

Nevertheless, the present status of knowledge of the sources located in Anatolia does not allow to definitively exclude existence of an outcrop with characteristics recalling the Central European raw material yet. Several occurrences from that region are not represented in Table 3. Presence of obsidian with Carpathian ages appear incompatible with geological evidence in Northern, Central and Eastern Anatolia. The chronology of the volcanic rocks located in Western Anatolia is still full of blanks: so, the mentioned interaction may be possible although highly unlikely. At the same time, Carpathian obsidians are essentially different from other ages in the Mediterranean region.

(2) The artefacts excavated from loess at Cejkov (samples PM 86/5) represent a homogeneous group constituted by very clear glass pieces showing a high track density and a relatively low annealing amount of spontaneous tracks in relationship with their age. The artefacts PM 86/9-2a and PM 86/9-2b also belong to this group. BO-1, PM 86/9-1, PM 86/9-3 and PM 86/17-2 show very similar induced track density (proportional to U content), and originated probably from the same source. The only difference is a higher annealing amount, which may have been produced due to different environmental conditions in the last thousand years. The unusually high annealing amount of PM 86/9-1 is more consistent with a recent thermal event than anomalous room temperature of the source.

Three artefacts, PM 86/12a-1, PM 86/17-1 and PM 86/18 (collected on a hill 500 m from Cejkov, and reported together with the artefacts from that excavation in Table 2), constitute a further homogeneous group characterised by a slightly lower U-content and by unusually low annealing amount. PM 8, which shows a higher annealing amount, belongs probably to the same group.

Quality of glass, age and U-content indicate that the sources corresponding to these two groups of artefacts are (more properly, were) located in the Slovakian parts of the Tokaj-Prešov Mts.; their characteristics slightly differ from those of the geological samples shown in Table 1.

(3) Two artefacts only, BO-2 and PM 86/9-4, are consistent with a Southern Tokaj Mountains source. The induced track density only was determined on the last one, due to presence of a high concentration of microliths which prevented a reliable identification of the spontaneous tracks. This is a common feature for most geological samples from the Carpathian II (Hungarian) sources.

(4) Artefacts PM 86/17-4 and PM 86/17-5 differ from the remaining artefacts of Table 2. Good quality of glass and U-content point to the Slovakian parts of the Tokaj-Prešov Mts.; but they yielded younger ages.

(5) Two artefacts have very interesting analytical data. Sample PM 86/10-1a shows a bimodal size distribution of spontaneous tracks (Fig. 4a). Such a distribution is found very rarely (see, for example, MILLER and WAGNER, 1981) and indicates that the artefact experienced a strong thermal event during its history. The accident produced a consistent annealing amount of pre-existing tracks (the "small" tracks in Fig. 4a). Tracks formed afterwards (the "large" tracks in Fig. 4a) remained undisturbed and show normal sizes after etching. Counting both types of tracks (Table 2.), it was possible to calculate a "geological" age (formation age) and an "archaeological age" for the artefact. The resulting "archaeological age" is Upper Palaeolithic, fits well to absolute chronological dates on the Bodrogkeresztúr Upper Palaeolithic site. This piece, found at Mád-Kakashegy was both macroscopically and analytically identified as coming from the Carpathian I (Slovakian) sources; the "archaeological age" measured (0.0286 +/– 0.0050 Ma, i.e. 28.6 kyear B.P.) allows us, with just a little bit of fiction, associate it with the people of the Bodrogkeresztúr-Henye site who might have lost it while surveying for obsidian (Carpathian II) at the Mád-Kakashegy source region.

## *Application of INAA to Carpathian obsidians*

Samples from the same obsidian beds and most of the artefacts studied by the FT method were analysed by INAA in the Radiochemistry Laboratory of the Department of General Chemistry of the University of Pavia.

About 10 g (when available) from each sample were ground, powdered (≤100 mesh) and homogenised. Three randomly collected subsamples (from 0.1 up to 1.0 g in weight) from each sample investigated were submitted to homogeneity tests (JAFFREZIC, 1976). The variance analysis of the results, assumed as an evaluation of sample variability, showed that the aliquots of ~150 g are quite homogeneous and representative of the investigated obsidians.

Since most computer γ-ray data reduction codes proved to be very reliable especially when both samples and reference standards have similar a spectral shape as well as relative intensities, it is generally recommended to use a standard analogous in chemical composition to the samples to be analysed. NIST SRM 278 "Obsidian Rock" standard of the National Institute of Standards & Technology (NIST) was used for quality control.

Rare earth elements (La, Ce, Nd, Sm, Eu, Gd, Tb, Dy, Tm, Yb and Lu) and Sc, Fe, Rb, Cs, Ta, Th and U were determined. Samples of 300 mg in weight were irradiated with neutrons for 2 hours in the University of Pavia Triga Mark II reactor at a thermal flux of approximately $1 \times 10^{12}$ n cm $^{-2}$ s $^{-1}$. Induced activity was measured by γ-ray spectrometry with a Ge hyper pure detector coupled to a multichannel analyser-computer system, 2 days after the end of irradiation for Dysprosium determination. Afterwards, the samples were irradiated again for 25 h in the same conditions. Induced activity was measured 3, 10, 20 and 60 days after the end of the second irradiation. Nuclear data of investigated elements are reported in Table 4.

*Table 4.* Nuclear data of the investigated elements

| Element | Half-life of radionuclide formed | | Energy of measured γ-ray, keV |
|---|---|---|---|
| La | 140 La | 1.68 d | **1595,487** |
| Ce | 141 Ce | 33 d | **145** |
| Nd | 147 Nd | 11.1 d | **91,531** |
| Sm | 153 Sm | 1.96 d | **103** |
| Eu | 152 Eu | 12.2 y | **344,1408** |
| Gd | 153 Gd | 242 d | **98** |
| Tb | 160 Tb | 73 d | **879** |
| Dy | 165 Dy | 2.38 h | **95** |
| Ho | 166 Ho | 30 y | **80,810** |
| Tm | 170 Tm | 129 d | **84** |
| Yb | 169 Yb | 32.6 d | **198** |
| Lu | 177 Lu | 6.75 d | **208** |
| Sc | 46 Sc | 83.9 d | **888,1120** |
| Fe | 59 Fe | 45.1 d | **1098,1292** |
| Rb | 66 Rb | 18.6 d | **1077** |
| Cs | 134 Cs | 2.07 y | **795** |
| Ta | 182 Ta | 115.1 d | **1221** |
| Th | 233 Pa | 27 d | **311** |
| U | 239 Np | 2.35 d | **278** |

The NIST-SRM 278 "Obsidian Rock" (Table 5) and aqueous solutions of the above mentioned elements were also irradiated as reference standards.

*Table 5.* Iron (%) and trace elements (μg/g) abundance of NIST-SRM 278 "Obsidian Rock"

| Element | This work | Previous |
|---|---|---|
| La | 34.6 +/– 0.4 | 31.91 |
| Ce | 65.1 +/– 0.2 | 62.22 |
| Nd | 33.10 +/– 0.02 | 331 |
| Sm | 5.74 +/– 0.03 | 5.72 |
| Eu | 0.83 +/– 0.04 | 0.842 |
| Gd | 5.47 +/– 0.05 | 5.32 |
| Tb | 1.04 +/– 0.03 | 1.02 |
| Dy | 6.49 +/– 0.04 | 6.11 |
| Ho | 1.21 +/– 0.04 | 1.213 |
| Tm | 0.35 +/– 0.01 | 0.353 |
| Yb | 4.49 +/– 0.04 | 4.52 |
| Lu | 0.94 +/– 0.01 | 0.732 |
| Sc | 5.41 +/– 0.03 | 5.12 |
| Fe | 1.49 +/– 0.06 | 1.412 |
| Rb | 128.9 +/– 8.0 | 127.52 |
| Cs | 5.41 +/– 0.03 | 5.52 |
| Ta | 1.31 +/– 0.06 | 1.22 |
| Th | 13.1 +/– 0.09 | 12.42 |
| U | 4.56 +/– 0.04 | 4.582 |

Iron and trace element contents of the analysed Carpathian obsidians are shown in Tables 6–8; individual data are the average of three or more independent determinations. Precision of most element contents resulted around 4%, excepted for Holmium, Terbium and Lutetium (precision between 15 % and 24 %) whose abundance is quite low. Accuracy may be evaluated by comparing the determined and certified or previously published abundances for NIST-SRM 278 "Obsidian Rock" as reported in Table 5; a general agreement within experimental errors can be observed.

In order to find similarities among the investigated samples, a dimension reduction was applied to trace element abundances, using pattern recognition procedures by computer processing with the help of the BMDP statistical package (Engelman, 1990). The data-set of previously analysed obsidians from the Mediterranean Basin and Anatolia was also included.

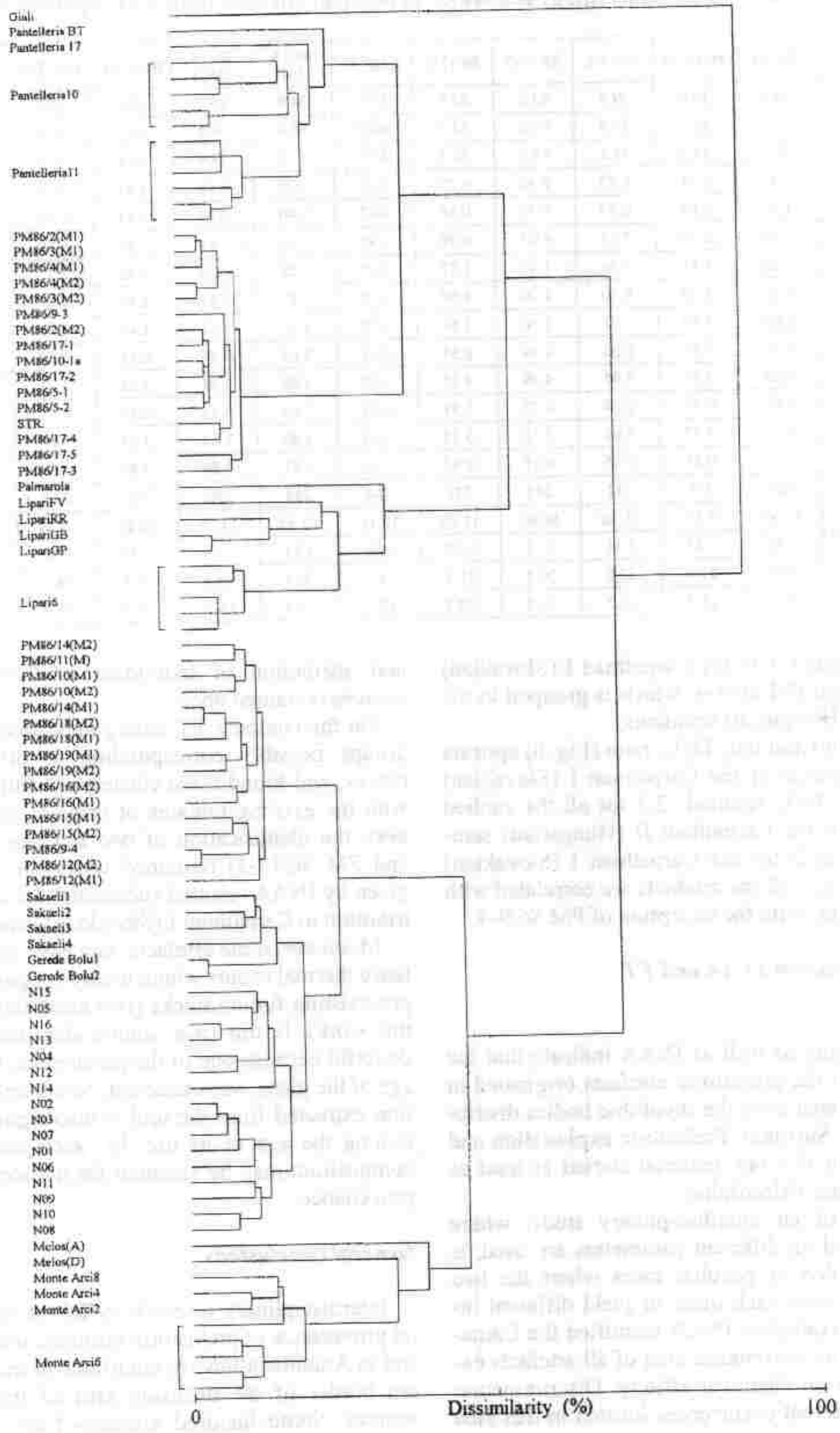


Fig. 5. Dissimilarity dendrogram produced by the BMDP (Engelman, 1990) data reduction statistical process using the Ce, Nd, Eu, Gd, Tb, Ho, Cs, Yb and Ta contents. Italian, Aegean and Anatolian obsidians are shown also. N01-N16: obsidians from Central Anatolia (N01-N03 and N07: Bogazköy obsidians; N04-06, N08-N11: Taskesiktepe obsidians; N12-N13, N16: Çiftlik obsidians; N15: Nenezi Dagi). Çankiri Orta and Gerede Bolu: obsidians from Northern Anatolia.

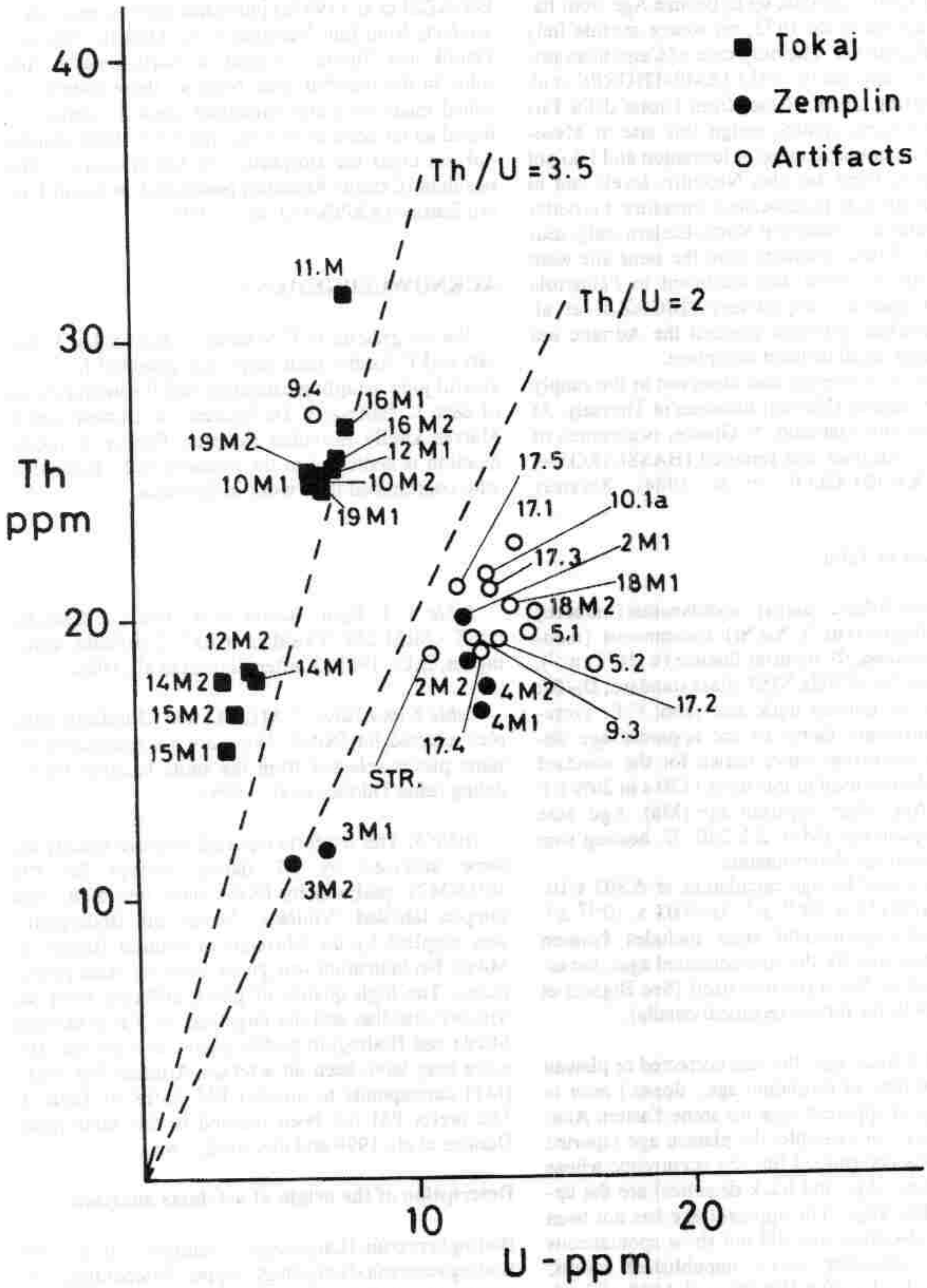


Fig. 6. The obsidians collected in the Tokaj Mountains (Carpathian I (Slovakian) and Carpathian II (Hungarian) sources) from the beds interpreted as remains of original occurrences (full circles) appear fully discriminated in a Th-U diagram. All artefacts (open circles), excepted PM 86/9-4, are attributed to Carpathian I (Slovakian) obsidians. STR: see explanation to Table 8. The prefix PM 86 has been omitted in this figure.

samples collected as surface findings on a hill ~ 500 m from Cejkov.

Kašov. supplied by L. Bánesz

Tarcal. Samples collected in the archaeological site Tarcal-Citrombánya?. Supplied by E. Mátyás.

Mád-Kakas-hegy. Sample PM 86/10-1a was collected as surface finding at the same locality of samples PM 86/10. Its shape and characteristics of the glass revealed that this piece was an "imported artefact".

Tolcsva. Artefact PM 86/12a-1 was collected at the sampling locality PM 86/12, and its history is the same as of artefact PM 86/10-1a. Artefacts PM 86/17 were collected as surface findings in a agricultural ground along the Tolcsva-Erdőhorváti road (on the eastern side), ~ 1 km north of Tolcsva. The quality of the glass indicate that the pieces were not related to the Tolcsva source area.

Streda nad Bodrogom. Supplied by V. de Michele; see footnote to Table 8.

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## Instrumental analysis II.

# Ion beam analyses of artefacts from the Bodrogkeresztúr-Henye lithic assemblage

K.T. Biró—Z. Elekes —B. Gratuze


### *Abstract*

In frames of a collaboration project between the Hungarian National Museum and the Institute of Nuclear Research, Debrecen (ATOMKI[1]), ion beam analytical techniques were used for provenancing geological and archaeological samples of

a, obsidian

b, radiolarite

c, control samples of various other local materials (limnic quartzite, "stone marrow").

PIGE and PIXE methods were used for analysis in the ATOMKI; additionally, LA-ICP was used for the analysis of obsidian samples in Orléans, France.

Identification of obsidian samples proved to be effective as known for several analytical techniques already; analysis of radiolarite samples represent preliminary state of research with a lot of open questions. Details of results on geological source areas and efficiency of characterisation are given elsewhere (Elekes et al. 2000a, 2000b, Biró et al. in press).

In this paper, the data relevant to the Bodrogkeresztúr Upper Palaeolithic site are presented.


### *Method*

The investigations were mainly carried out using non-destructive ion beam techniques, namely Particle Induced Gamma-ray Emission (PIGE) and Particle Induced X-ray Emission (PIXE) methods. Utilizing a novel Clover-Ge-BGO system the determination of light elemental composition via the detection of gamma-rays could be made with extremely low detection limits because of the high Compton-suppression factor. The minor and trace constituents of the samples were studied employing common PIXE technique. The results achieved by ion beam methods were compared and contributed with the data obtained with Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS).

### *Objectives of the study*

The collaboration project between ATOMKI and HNM, with participation in other international programs (COST, IGCP-442, GHPCP) aims at using ion beam analysis techniques for the study of archaeological artefacts. Several themes are investigated, among them two are relevant to the monograph on the Upper Palaeolithic site Bodrogkeresztúr-Henye: obsidian studies and radiolarite analyses. Both of these themes included the study of authentic, source collected reference samples, aiming at a good coverage of the possible geological sources of the prehistoric people as well as archaeological material for comparison and provenance study. Details of these studies are presented elsewhere (obsidian: ELEKES et al. 2000b, radiolarite: ELEKES et al. in press). Archaeological samples in both themes included material from Bodrogkeresztúr-Henye site, and we could use this example as an example of succesful source identification (ELEKES et al. 2000a.). The method is also working the other way round: these results are suitable to characterise the local, regional contacts of the site.

### *Samples analysed*

The material analysed from Bodrogkeresztúr is presented on Fig.1. Samples were selected from the flakes/chips of the settlement, on macroscopical basis. All of the studied flakes are in the collection of the Hungarian National Museum, inventorised under Pb 64/363. For the analyses, a small piece of the flake was taken from the flakes: control material will be stored in the Lithotheca collection.

*Obsidian (Fig.1/4–7):*

**363A** – Bodrogkeresztúr-Henye. Pb 64/363 (a): small decortication flake with hydrated cortex. Deep black, non-transparent. Macroscopical classification: Carpathian II T (Tolcsva) obsidian

**363B** – Bodrogkeresztúr-Henye. Pb 64/363 (b) small flake, deep black with lighter stripes, non-transparent. Macroscopical classification: Carpathian II T (Tolcsva) obsidian

**363I** – Bodrogkeresztúr-Henye. Pb 64/363 "kárpáti 1"– small chip, transparent grey. Macroscopical classification: Carpathian I (Slovakian) obsidian

[1] OTKA T 025771

"Radiolarite", PIXE (ppm)

| Sample | Si | P | S | Cl | K | Ca | Ti | V | Cr | Mn |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bk-1 rariolarite** | 465600 | <1600 | <160 | 238,6 | 2323 | 674,7 | 544,1 | 29,5 | 19 | 10,4 |
| **Bk-2 radiolarite** | 470700 | <1600 | <160 | 380,5 | 1807 | 344 | 86,49 | 23 | 19 | 9,5 |
| **Bk-3 radiolarite** | 491500 | <1600 | <160 | 2205 | 2784 | 1097 | 416,6 | 35 | 27 | 62,58 |
| **Bk-4 stone marrow** | 357800 | <1600 | <160 | 3564 | 34900 | 1848 | 591,3 | 113,9 | 36,91 | 73,81 |
| **Bk-5 limnic quartzite** | 475800 | <1600 | <160 | 2381 | 375,8 | 1384 | 27 | 68 | 51 | 10,5 |
| **Sample** | **Fe** | **Co** | **Ni** | **Cu** | **Zn** | **As** | **Rb** | **Sr** | **Y** | **Zr** |
| **Bk-1 radioralite** | 608,3 | 10,93 | 4,761 | 7,714 | 7,535 | 5,064 | 6,49 | 28,94 | <7 | <7 |
| **Bk-2 radiolarite** | 786,2 | <12 | <5 | 9,648 | 2,5 | <2,5 | 7,168 | 26,97 | <7 | <7 |
| **Bk-3 radiolarite** | 13420 | <12 | <5 | 13,16 | 9,765 | 6,218 | 21,98 | 42,55 | 32,43 | <7 |
| **Bk-4 stone marrow** | 5263 | <12 | <5 | 45,73 | 32,12 | 9,218 | 115,3 | 19,45 | 40,2 | 43,25 |
| **Bk-5 limnic quartzite** | 100,1 | 5,837 | 4,593 | 4,433 | 4,637 | 20,36 | <5 | 29 | <7 | <7 |

Radiolarite, as well as other siliceous raw materials have been only sporadically investigated by geochemical methods. Part of the studies were only semi-quantitative (KOZŁOWSKI et al. 1981); others not representative in quantity of material (nr. of sources compared to known occurrences, as well as nr. of pieces studied from the individual sources: BIRÓ–PÁLOSI 1986). Existing evidence has been collected in the volumes of Lithotheca (BIRÓ–DOBOSI 1991, BIRÓ–DOBOSI–SCHLÉDER 2000). The authors performed special studies for source determination of radiolarites within the Carpathian Basin (ELEKES et al. in press; BIRÓ et al. in press) and concluded that further data are needed for reliable source identification.

Stone marrow and limnic quartzite samples were mainly separable – on the basis of their very high / very low K, Rb content from the radiolarite samples. Former geochemical analysis of hydrothermal siliceous raw materials (BIRÓ et al. 1984, BIRÓ 1986, VICZIÁN 1986) proved a great variability within the hydrothermal/limnic siliceous rocks, therefore we cannot aim at exactly identifying the source of these rocks on the basis of chemical composition. However, they are distinctly separable from the radiolarite group.

### *Conclusions*

- Ion beam analytical techniques can be applied with promising results on archaeological lithic material.
- Obsidian – as a raw material with large archaeometrical cognisance and chemically distinctively different composition per source can be effectively characterised by the applied methodology (PIGE/PIXE; LA-ICP-MS)
- Radiolarite is a more difficult problem: chemical composition less distinct, archeometrical, geochemical data rare, while source areas are mor numerous geographically and formation period much longer than that of obsidian.
- Though on very small number of samples, radiolarites could be separated from siliceous raw materials of other (postvolcanic) origin
- Our results for Bodrogkeresztúr mainly contributed to characterisation of the local- mesolocal raw materials.

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