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Archaeological research of three caves in the Tatra Mountains in 2019-2023

ABSTRACT

This publication discusses the results of the project, which explains the mysterious lack of any traces of the Palaeolithic in the Tatra Mountains. Research undertaken in recent years in three caves – Obłazkowa and Dziura in the Polish Tatra and Hučivá diera Cave in the Slovak Tatras – have shown the destruction of sediments in Polish caves. Only in the Slovak cave was it possible to discover and partially examine a camp of the Late Paleolithic people. This discovery leads to the conclusion that during the Bölling warming of the Pleistocene, hunters operated in this cave, hunting goats and processed carcasses of hunted animals on site.

KEYWORDS

Tatra Mountains, cave excavations, Late Palaeolithic, sediment damage

I. INTRODUCTION

Although the first scientific interest in Polish caves was primarily in the vicinity of Ojców and the Mnikowska Valley in the south of the Krakow-Częstochowa Upland, their main 19th-century researcher, Gotfryd Ossowski, also tried to include the Tatra caves in the research.

Both for him and his archaeological successors in the 1930s, these attempts ended with negative results (Jura 1954; Zwoliński 1955). For almost a hundred years, from the mid-nineteenth century, the object with which great hopes were placed to discover traces of human presence was the Magura Cave in Polish Tatras (Zwoliński 1955; Jura 1955). The result of the first overview and scientific visits to this cave was the acquisition of paleontologically significant animal bones, especially the cave bear (Eljasz 1870; Kiernik 1909). During one of the trips to the Magura Cave, painter St. Witkiewicz (the senior) found two bones "... which, in his opinion, bear traces of processing by primitive man." (Zwoliński 1955, 63).

Despite referring to the scientific authorities of the time, the bone and stone artefacts from the excavations undertaken over time in the Magura Cave were ultimately not confirmed. Thus, the topic of prehistoric settlement in the Polish Tatras has been closed to this day.

The recent research in the Tatra massif was caused by the unclear source situation regarding prehistoric settlements, especially from the Stone Age, which has persisted for over a hundred years (Jura 1955; Buławka, Kerneder-Gubała 2020; Brunswig, Valde-Nowak 2023).

The long-lasting mystery of such an early settlement of the Tatra Mountains has recently begun to be clarified. In the Belianske Tatras, in Hučiva Cave in Slovakia, traces of the settlement of a group of late-glacial hunters of the Magdalenian culture were discovered (Valde-Nowak, Soják 2018; Valde-Nowak *et al.* 2022). Parallel to the research in the Slovak part of the Tatra Mountains, two excavations were carried out in two different caves on the Polish side of the massif: Obłazkowa and Dziura. The results of these activities are described in this article (Fig. 1).

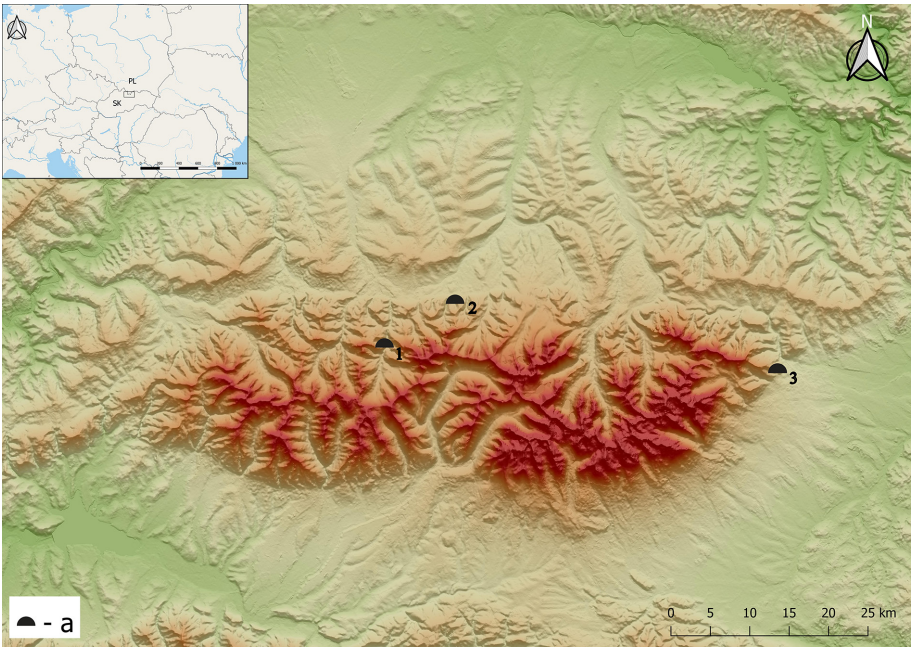

FIG. 1. Tatra map with marked caves (a) that were the subject of research: 1 - Obłazkowa, 2 - Dziura, 3- Hučiva Cave (layout by J. Skłucki)

II. METHODOLOGICAL BACKGROUND AND COURSE OF RESEARCH

The research was carried out in three cave objects in the years 2019-2023. Hučiva Cave was explored in 2019 and 2022[1], Obłazkowa Cave in 2022, and Dziura Cave in 2023.

These works were interdisciplinary in nature, subordinated to the questions posed in the National Science Center project "Stone Age Man in the Caves of the Tatras". This meant close cooperation between archaeologists, palezoologists and geologists during field work. At the analysis stage, the scope of interdisciplinary cooperation was expanded to include, among

1 At the time of writing this text, the next (2024), the third season of excavations in the Huciva diera Cave was beginning. The results of these works were not included in the article.

others, archaeobotanists and palynologists, paleogeneticists, sedimentologists and malacologists. The primary goal of the work was to ascertain the stratigraphy of the sediments and analyse any traces of settlement preserved in them, along with their natural context. Therefore, all three objects were included in the exploration, proceeding according to the same assumptions. Before starting the research, appropriate permits were obtained, necessary due to restrictions in force in the Tatra National Park. Special permits were also obtained to drive into protected areas by off-road car. The research was conducted by archaeology students and PhD students of the Jagiellonian University as part of the Summer School of Mountain Archaeology.

Stone and other artefacts, bones, and plant microfossils were collected during the research after they had been tracked. The sediment was exposed in arbitrary layers (0.05 m or, depending on the debris fraction, exploration was carried out in 0.1 cm layers), maintaining a grid of quarters of meters (0.25 sq. m), which forms the basic excavation unit. The whole sediment was wet-screened on sieves with less than 1 mm mesh size. During field work, samples were taken for specialized tests. The rock floor was not reached in any part of the excavated caves.

III. MAIN RESULTS

The excavation campaigns carried out at individual cave sites will be discussed separately in the following order: Obłazkowa, Dziura, and Hučiva.

Obłazkowa Cave

Archaeological works in the Obłazkowa Cave in the Polish Tatra Mountains took place in September 2022. Obłazkowa Cave is 120 m long. Its entrance is located at an altitude of 1,098 m above sea level, about 130 m above the bottom of the Kościeliska Valley, in Raptawicka Turnia. Together with the neighboring Mylna Cave, it forms part of the Pawlikowski Cave system. The cave opening is spacious and measures 9 x 2 m (Fig. 2). The entrance chamber is relatively bright, leading to dark and narrow corridors.

Excavation research was carried out under the conditions specified in the permit of the Tatra National Park and in the ministerial decision. These conditions excluded the possibility of wet sieving of cave sediments on site. The number of samples taken, the spatial scope of the works and the number of

FIG. 2. Kościelisko, com. loco. Obłazkowa Cave. General view of the cave entrance in March 2022. Photo by P. Valde-Nowak

participants were also calculated restrictively. This significantly limited the research possibilities. Despite this, the exploration was carried out in detail, using small tools. The material collected in this way was additionally sorted and checked on site. After marking benchmarks using GPS measurements, establishing a meter grid inside the cave, two small excavations were marked out with a total area of 3 square meters: excavation 1 on meter A4 at the entrance to the cave and excavation 2 in meters D1-D2 (Fig. 3). The work was carried out using an arbitrary method, in layers 10 cm thick to a depth of 1 meter. The stratigraphy in both trenches is similar: 0-25 cm – a grey layer, 25-60 cm – a clay-dust layer, yellowish-brown, with a small amount of stones, 60-90 cm – a layer with a small amount of stones; some were pebbles in the initial phase of rounding, typical for water transport. Below 90 cm, there was a dark brown-olive layer of clay with fine gravel, which was very damp. From trench II, from layer 1, a fragment of a glass vessel from the turn of the 19th and 20th centuries was obtained, with decoration in the form of concentric

FIG. 3. Kościelisko, com. loco. Obłazkowa Cave. Plan of the cave with two trenches (a) and scattering of small bone fragments (b) and the place where a fragment of a glass vessel was found (c). Drawing by J. Skłucki

cuts in the shape of a "rosette"; from layer 2 – a bear's tooth (inventory no. 2/22); from layers 1-3, several small fragments of animal bones were extracted, but it was impossible to determine the species. All bones showed signs of polishing typical of water transport. Trench 1 did not yield faunal material or archaeological artefacts.

Two small indeterminate animal bones were selected for dating. The dating was carried out in Laboratory C14 in Poznań (Table 1). The calibration was made with the OxCal v4.4.2 software (Bronk Ramsey 2020; atmospheric data from Reimer *et al.* (2020).

The obtained results indicate mixed bone material from the beginning of the Upper Paleolithic. They cannot be related to human activity from such a distant period. The excavations were minor, in which the rock bottom

TABLE 1. Results of AMS dating of bone samples from the excavations in Obłazkowa Cave

Sample name	Lab. no.	BP Age	BCcal 68.3%	BCcal 95.4%	Remarks
Obłazkowa 11/22*	Poz-160803	40 000 ± 2 000	43 406- 40 286	47 791- 39 313	5%N 9.0%C, 4.6%coll
Obłazkowa 13/22	Poz-160804	30 900 ± 500	33 794 - 32 766	34 302 - 32 481	3.5%N 12.0%C, 10.6%coll

*may extend out of range of the method.

was not reached. It is therefore difficult to determine the thickness of the Obłazkowa Cave sediments in this place. Therefore, the question of the presence of undisturbed sediments at a much lower level, perhaps containing significant archaeological traces, remains open. A small fragment of a modern glass vessel, the only archaeological artefact from the conducted research, is a surprisingly modest result, considering the high precision of the search. The lack of a larger quantity of similar materials, or even modern garbage, single natural fragments of animal bones from the distant Interplenivistulian times, lying shallowly under the surface of the current fill, allows us to put forward a hypothesis about the remodeling of the upper part of the sediments, probably lowering their original level, as evidenced by traces on the southern wall of the chamber. These may indicate the former level of the ceiling of the alluvial deposit (Fig. 4). However, there is no information in the archives of the Tatra National Park about the remodeling of the cave floor. Important information about the excavation of various cave fills in the Polish Tatras was provided to one of the authors (PVN) in a telephone conversation on April 12, 2023, by a geologist specializing in Tatra cave research and speleologist: Prof. Wiesław J. Wójcik from the Museum of the Earth of the Polish Academy of Sciences in Warsaw. He claims that in the late 1940s and the following years, the Zwoliński brothers, after receiving a large state subsidy to open the Tatra caves to visitors, undertook extensive earthworks in the caves, destroying sediments. These works were carried out without appropriate documentation. The aforementioned trace was found on the wall of the entrance chamber of Obłazkowa Cave, a few meters from probe no. II, may indicate the removal of cave ceiling sediments. There is some source information stating that earthworks were carried out at the opening of the Obłazkowa Cave to create a convenient route for tourists to the Mylna Cave located next to Obłazkowa (Lewkowicz 2021, 244).

FIG. 4. Kościelisko, com. loco, Obłazkowa Cave. General view of the interior of the chamber during excavations. Black arrows show the alleged trace of removed sediments visible on the wall. Photo by J. Skłucki

Dziura Cave

In September 2023, archaeological research was carried out in Dziura Cave in the Ku Dziurze Valley in the Polish Tatra Mts. This was another attempt to explain the archaeological potential of caves located in the northern part of the Tatra massif on the Polish side. The above-described result of Obłazkowa's research resulted in the transfer of the archaeological initiative to a place with different topographic characteristics, to the easily accessible Dziura Cave, located on the edge of the Tatras (Polish Caves PIG PIB). In September 2022, a 3 x 2 m test excavation was made there, at the cave threshold (Fig. 5). The exploration of sediments was carried out to a depth of about 1 m. Such dimensions of work were strictly defined in the TPN permit. The arrangement of clay-rocky layers was not consistent with the topography of the terrain within the terrace in front of the cave. Furthermore, the content and nature of the

FIG. 5. Zakopane, com. loco, Dziura Cave. Archaeological excavation at the cave threshold during works in 2023. Photo by P. Valde-Nowak

sediments themselves did not confirm their natural arrangement. No archaeological artefacts, bones or contemporary rubbish were found in the entire excavation, which could be expected in the near-surface layers of the so-called tramp, which is practically absent in Dziura Cave. On this basis, a secondary arrangement of sediments was found, which indicates that earthworks were carried out in Dziura Cave, like Obłazkowa, as part of the activities of the team led by Stefan Zwoliński. As a result of this activity, an extensive and leveled terrace in front of the cave and a wide access path, convenient for tourists, shaped into steps, was created. The documentation of these works, preserved in the Archives of the Tatra Museum, unfortunately does not provide detailed information on the extent to which the earthworks in the cave chamber covered the terrace; however, an analysis of the traces preserved to this day inside the chamber indicates that this was an activity carried out on a very large scale (Fig. 6). It is possible to recognize the still legible terrace arrangement, which was created during the process of removing unnecessary masses of earth from

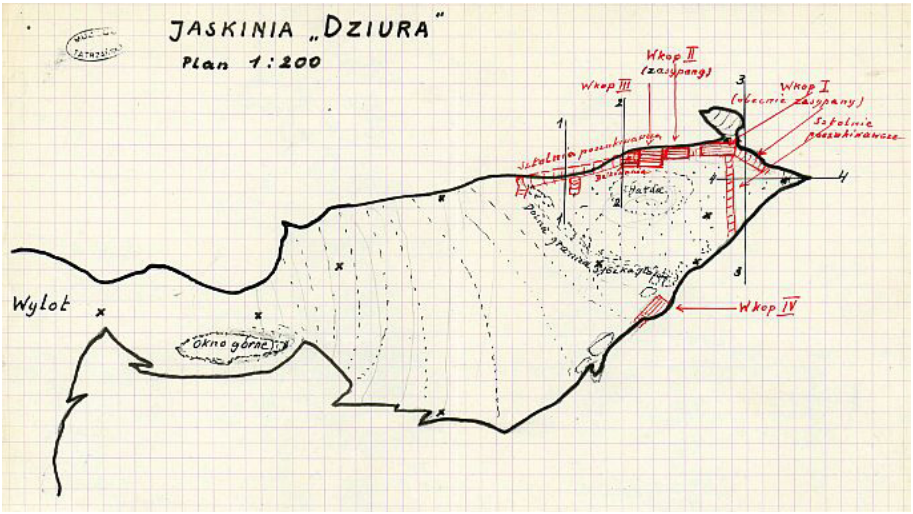

FIG. 6. Zakopane, com. loco, Dziura Cave. Plan of the cave made by S. Zwoliński with marked excavations from 1953. Archives of the Tatra Museum

the interior of the chamber upwards, towards the opening, to safely continue speleological reconnaissance in the deepest part of the chamber and at the cave walls. Tree trunks have survived in the cave chamber to this day, which were used to support and stabilize the bases of the heaps being created (Fig. 7). In the cave, near the logs, there are also the lower parts of the tree trunks with a root system, which probably additionally stabilized the heaps against sliding. In the notes in the reports submitted by Stefan Zwoliński on the activities in Tatra caves in August 1953, one can come across elements illustrating the scale of earthworks in Dziura Cave, as well as the use of wooden structures to support the heaps:

"The work is very difficult because digging into the loose rubble requires the use of a complicated system of shoring and installing artificial vaults made of beams supporting the sliding mountain of rubble. To this day, a trench of approx. 12 m in length has been dug along the wall and approx. 7 m has been dug into the rubble area." (Zwoliński 1953a).

In another place in the report from November of the same year on the work in the hole we read:

"The excavated material is deposited in this place outside of large blocks, (…) which again forces the use of strong retaining beams supporting the removal of rubble into the constantly deepening excavation." (Zwoliński 1953b).

FIG. 7. Zakopane, com. Loco, Dziura Cave. Cave chamber with visible wooden structural elements supporting the spoil heaps during S. Zwoliński's work. Photo by P. Valde-Nowak

This type of activity disturbed extensive parts of the cave fillings. Its main goal was to uncover any existing corridors and open the cave facilities to the growing tourist traffic. Unfortunately, this was done for many years and without proper documentation. This led to the irreversible destruction of significant volumes of silt deposits and the original stratigraphic system.

Hučiva diera Cave

Hučiva diera Cave in the Belianske Tatras in Slovakia lies within the boundaries of the High Tatras-Tatranská Kotlina (Poprad district) in the Prešov region in Slovakia (Fig. 8).

The cave with a total length of 16 m is located at an altitude of 936 m on a rock cliff on the Southern slope of Kobylí Vrch (1109 m) in the Belianske Tatry Mountains near the "Sparkling Spring" (Rausch Quelle) (Bella *et al.* 2018). A portal entrance of a triangular shape with a base of approx. 4 m

FIG. 8. General view of the Belianske Tatras from the side of the village of Lendak with the approximate location of the Hučiva Cave (arrow) in the Kobylí vrch massif (1109 m). In the background, Łomnický Peak (2634 m). Photo by P. Valde-Nowak

and more than 2 m in height is a relic of a horizontal (phreatic) cave passage, with a length of 10 m. At the cave passage end, where the site of the excavated archaeological profile is located, the cave ceiling sharply rises becoming a vertical chimney. The narrow chimney is blocked by rocks and soil in its upper parts, which prevents it from opening to the surface. The signs of frost weathering are documented by rock debris and gravitational breakdown, accumulated at and near the archaeological site. The detachment surfaces of the rock breakdown are currently obliterated by weathering and dissolution by seepage water. If this had been open at the time of human use of the cave, it could have ventilated the smoke of the fireplace.

The Institute of Archaeology of the Slovak Academy of Sciences in Nitra and the Institute of Archaeology of the Jagiellonian University in Krakow undertook the first rescue works (because of speleological damaging by unknown persons in the past) in 2019, which was continued as systematic work in 2022 (Soják & Valde-Nowak 2019; 2021; Soják *et al.* 2019; Valde-Nowak *et al.* 2022) and in July 2024. Sediments were examined in two excavations. One of them was located in the entrance opening, where the entrance grate was

to be installed, in 2020. So far, sediments have been examined on an area of approximately 20 square meters to a depth of 250 cm. The rock floor was not reached in any part of the excavation.

The work to date has helped ascertain the stratigraphy. The profile has nine main clay-rubble layers, with layer 6 having variants. The top layers 1-4 were formed in the Holocene. Layer 1 is modern footfall and the remains of a speleologists' heap. Two Slovak State coins and a cartridge from World War II were found there. Layers 2-3 contain sparse modern ceramic material, which can be related to the 17th century. Layer 4 is transitional. Palaeolithic artefacts were extracted from layers 5-8, but their main deposit is layer 6a, constituting traces of a large hearth. Layer 9, silt and clay of dark yellow colour, sterile both archaeologically and paleontologically, most probably formed in the LGM (Fig. 9).

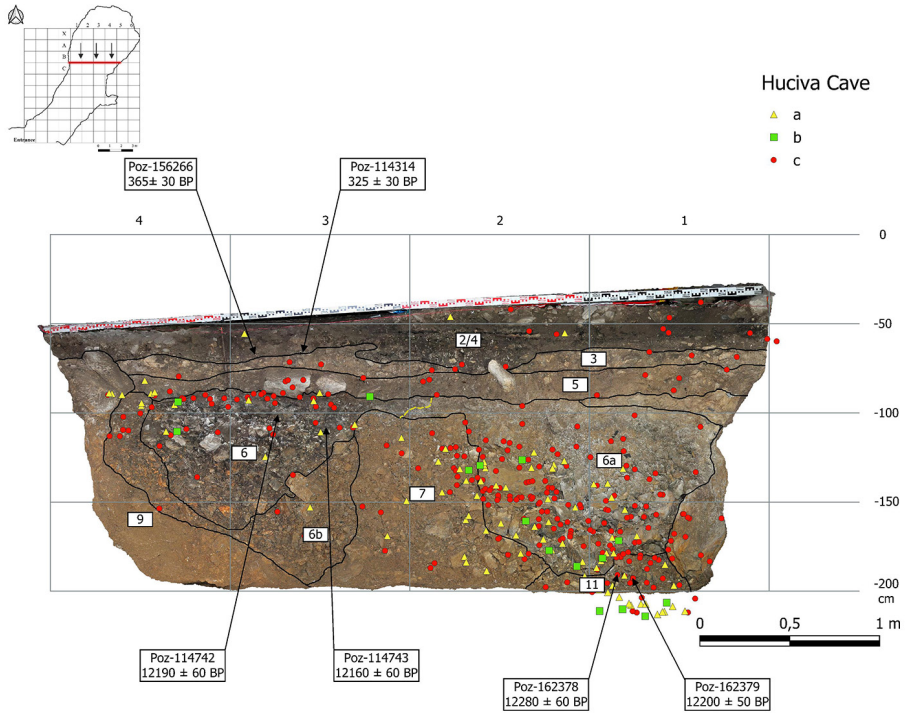

FIG. 9. High Tatras-Tatranská Kotlina, Poprad district, Hučivá Cave. Cross-section of cave sediments (stand 2022) with numbered layers, a scatter of stone artefacts (a), burnt stone artefacts (b), animal bones (c), and the position of samples for AMS dating. Layout by J. Skłucki

Two AMS dates were obtained from charcoal from the fireplace: 12 190±60 BP (Poz-114742: 12 316–11 896 Cal BC, at 95.4% confidence) and 12 160±60 BP (Poz-114743: 12 260–11 868 Cal BC, at 95.4% confidence). An ibex mandible was also found in this fireplace, resulting in 12 160±60 BP (Poz-126122: 12 270–11 860 Cal BC). From pit 6b adjacent to the fire, two further dates were obtained from charcoal: 12 280±60 BP (Poz-162378: 12 542–12 108 Cal BC, at 95.4% confidence) and 12 200±50 BP (Poz-162379: 12 367–12 065 Cal BC, at 95.4% confidence), indicating synchronicity with the fire, which is additionally confirmed stratigraphically. A slightly earlier date was obtained from a horse's jaw, found outside the excavation in the deeper part of the cave, protruding from unexamined sediment: 12 400±50 BP (Poz-154006: 12 920–12 258 Cal BC, at 95.4% confidence). All these data points towards the Bölling interstadial (GI 1e).

A sample of charcoal comes from the high cultural layer no. 2, which gave a late medieval/modern date, consistent with the characteristics of the fragments of pottery found there: 365±30 (Poz-156266: 1453–1635calAD, at 95.4% confidence).

As a result of the two seasons of work, 812 stone artefacts have been discovered. In terms of raw materials, the inventory is in some cases difficult to determine due to patina. Some of the artefacts were made of radiolarite (77,83%), but there are artefacts from raw materials such as various flints from Polish territory and Volhynia (19,95%), limnosilicite from Middle Slovakia or the borderland between Northern Hungary and Slovakia (Kaminská 2014), as well as the hornstone of the Stranska Skala (at least one piece) type from the Moravia area (Bartik *et al.* 2019).

The share of different varieties of flints are as follows: Krakow-Jurassic 41, chocolate 26, Bircza flint 11, Cretaceous from Volhynia 4, undetermined 80. Flint from Bircza must be present, which we can now treat as a good indicator of Magdalenian in its eastern province.

The conditions in the cave significantly impacted the state of preserving the siliceous rock surface. Most isolated flints have a deep, white patina. Their texture can also be substantially transformed. To a small extent, this also applies to some specimens made of steel-grey or green radiolarite. Additionally, the proximity of fire influenced the change in the original characteristics of flint products. Many specimens show traces of "welding" and burning, which results in a change in the gloss, texture, and damage to the rock structure.

Among this remarkable blade industry, 3 cores, 108 flakes (without chips), 162 blades and 103 tools were found. The cores are in an extremely exploited

form. Despite this, it still represents blade technology. All cores represent single platform cores with changed orientation. One of the cores is shaped like a tablet made most probably on the big flake. It is preserved in an extremely exploited form (Fig. 10: 1). Another can be considered a micro-form with signs of a conical shape and is in a very advanced stage of use (Fig. 10: 2). The third can document traces of repeated unsuccessful separation of chips in the form of the so-called hinge (Fig. 10: 3). When assessing the technology used by core users, its high technical level must be emphasized. The core angle has been successively improved as evidenced by the negatives on the striking platform. A soft hammer was commonly used. Blades often confirm the formation of en éperon butts. Splintered bulbs on blades and bladelets are also confirmed. The maximum use of these specimens is impressive.

The most characteristic tools are points (Fig. 11). Some of them resemble shouldered points (Bohmers 1956; Maier 2015), as well as specimens like the massive Creswell triangles (Stapert 1985). One item can be considered as double truncations called Cheddar points (Barton *et al.* 2003). There are also perforators, including a badly worn specimen with a twisted Zinken sting. Oblique truncations are also present. It is also essential that the backed bladelets are visible.

The statistics in a tool group can be presented as follows: projectile points 31, burins 6, truncated pieces 17, combined (end scraper + fine perforator) 2, perforators and borers 20, retouched blades 18, backed bladelets 9, end scraper 1, notched tools 1.

One shell was discovered at Hučiva Cave in the 2022 season (Fig. 12: 4). It is a fossil Miocene shell of *Tiaracerithium pictum* (de Basterot 1825), perforated with two holes made similarly (results of the analysis carried out by Dr. A. Kurzawska)[2].

The inventory includes an awl (Fig. 12: 1) and two bone needles (Fig. 12: 2-3) prereserved in two fragments. There was also a tool made of lynx bone, which was worked intensively so that the tip was blunt, indicating permanent impacts. Also noteworthy is a series of parallel cuts that give the impression of notation (Fig. 12: 5). Bone needles are a relatively common find in the inventories of the Magdalenian culture (d'Errico *et al.* 2018).

2 An almost identical specimen, also perforated with two holes, was found in the 2024 season.

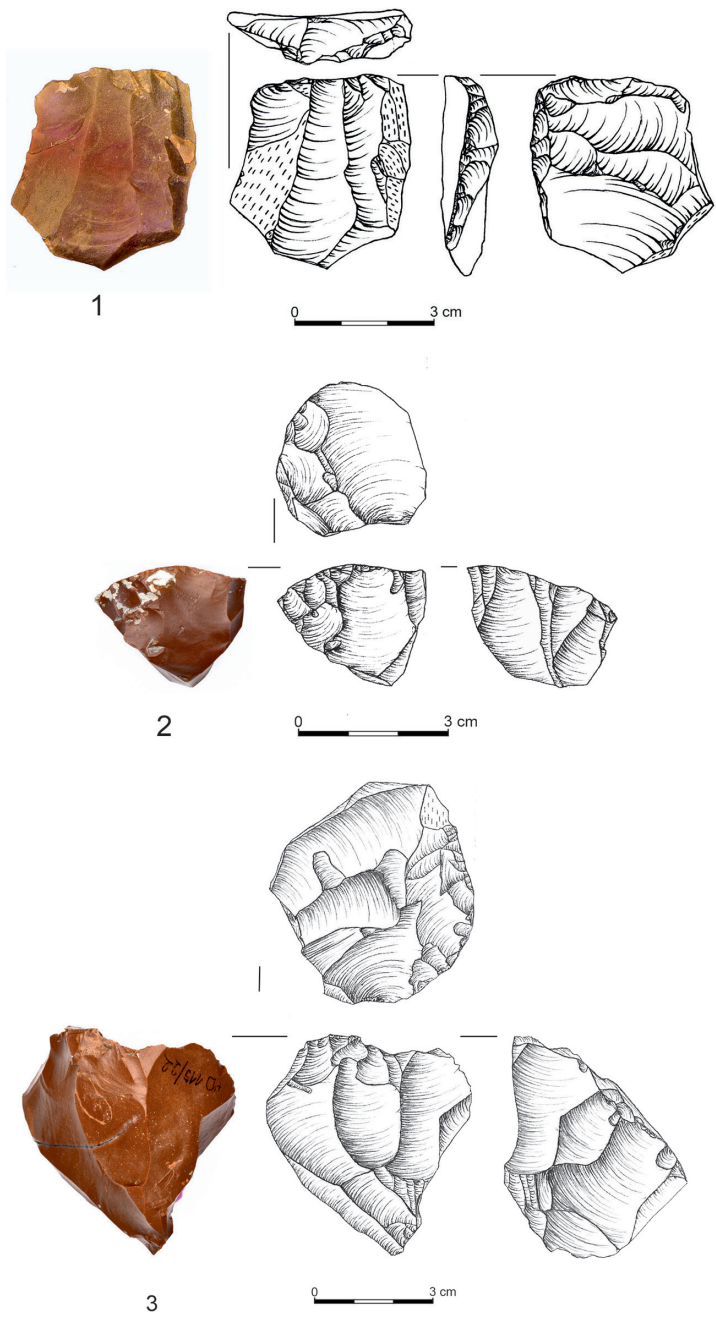

FIG. 10. High Tatras-Tatranská Kotlina, Poprad district, Hučivá Cave. Cores made of radiolarite. Drawings by J. Chowaniak, photo by J. Skłucki

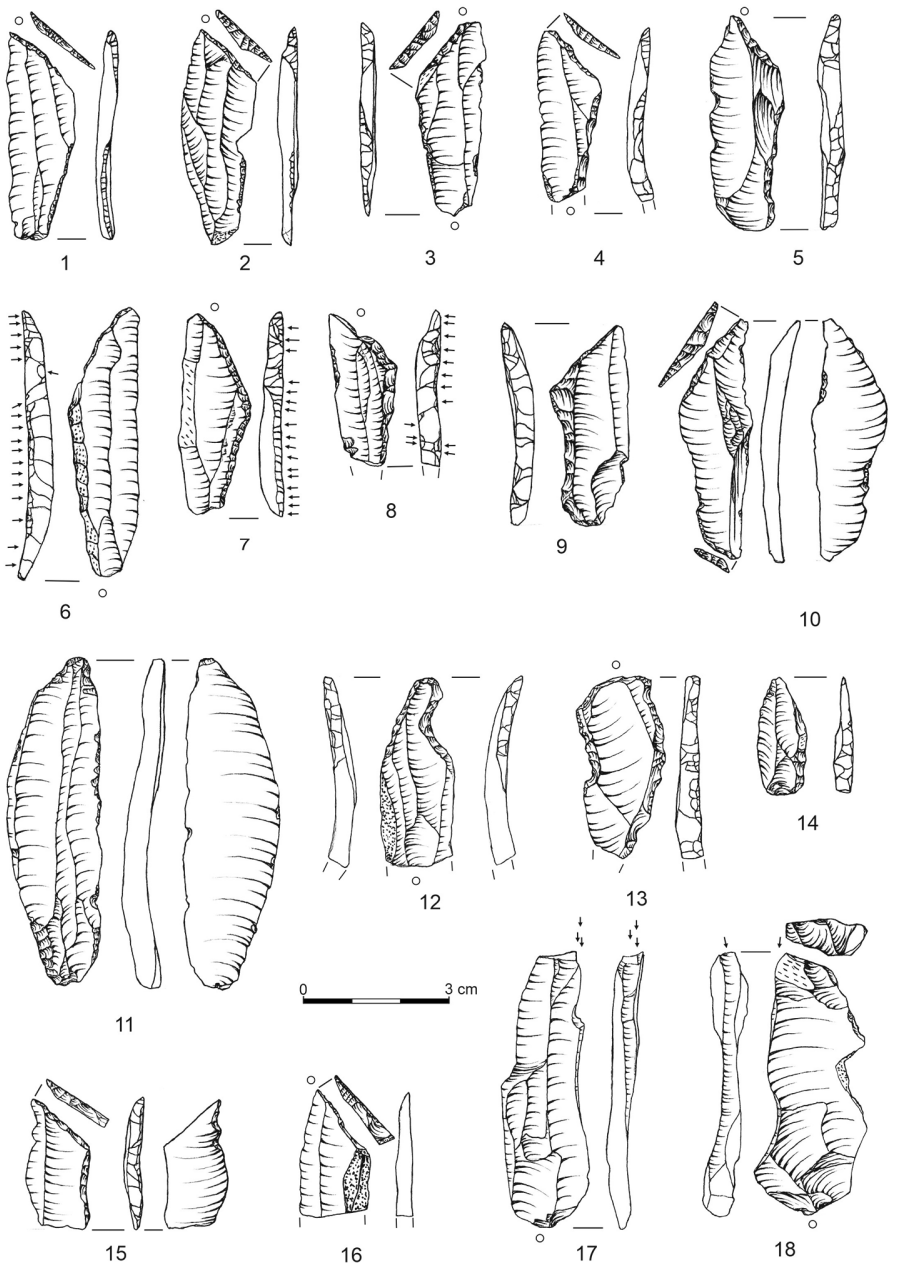

FIG. 11. High Tatras-Tatranská Kotlina, Poprad district, Hučivá Cave. Selected stone artefacts: 1–3, 6–9 Cresswell points, 4–5 shouldered points, 10 Cheddar point, 11, 13–14 perforators, 12 Zinken, 15 borer, 16 truncation, 17–18 burins. Drawings by J. Chowaniak

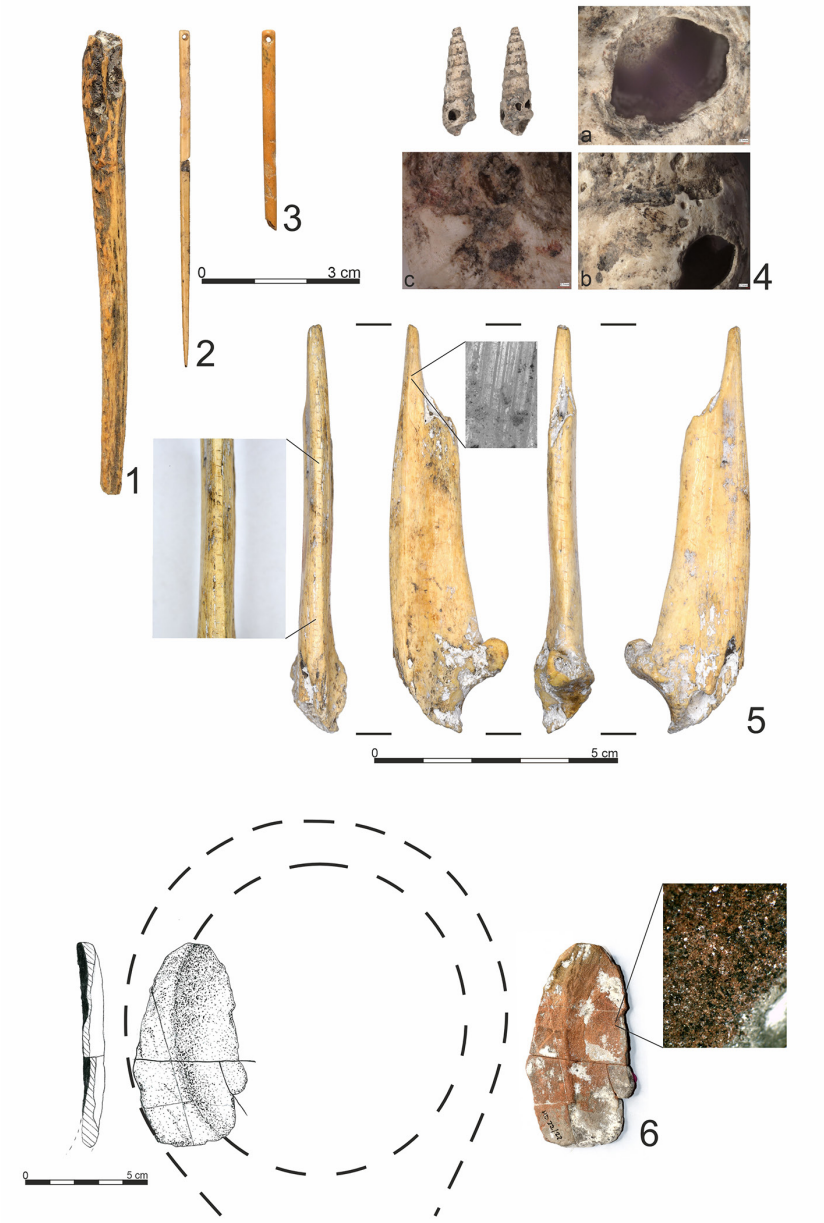

FIG. 12. High Tatras-Tatranská Kotlina, Poprad district, Hučivá Cave. Bone tools, shell ornament, and sandstone lamp. 1 awl, 2-3 bone needles, 4 shells of personal ornament, 5 a strongly polished bone tool (piercer or awl) with a visible series of parallel diagonal cuts, 6 refitted fragments of sandstone lamp. Drawings by J. Chowaniak and U. Bąk, photographs by A. Kurzawska and J. Skłucki

Two refitting fragments of sandstone found in the Hučivá diera focal layer require separate attention. They can be interpreted as a lamp (Fig. 12: 6). This stone undoubtedly comes from somewhere else, and its reddish colour may be the result of thermal transformation. Small traces of an unspecified organic substance were found on the walls. Stone objects found in the Magdalenian context, known as candle lamps, are also an integral element of this culture on Polish territory, e.g. Ćmielów (Paczkowski 2020; Paczkowski, Przeździecki 2021) and Wilczyce (Kowalski 2014). During the 2019 excavation season, five pieces were collected and ascertained initially as ochre lumps (results of the analysis carried out by Dr. Julia Kościuk-Załupka).

All layers yielded animal bones and teeth, but most of them were found in cultural layers 6 and 6a as well as layer 5. Remains belong to mammals (over 25 taxa have been determined) and birds (more than 15 species) were supplemented by less numerous amphibians and very scarce snails. In total, almost 500 remains of small and large mammals and almost 370 bird bones were identified at the species or genus level (results of the analysis carried out by Prof. A. Nadachowski and his team).

Among larger mammals that could have been hunted by the Magdalenian people, bone fragments and teeth of the Alpine ibex (*Capra ibex*) predominate in the fossil assemblages of cultural layers 6, 6a, 6b, and layer 5, and numerous cut marks are present on some of the bones. The remains of wild horses (*Equus ferus*) were less numerous, and traces of exploitation were also less frequent. Chamois (*Rupicapra rupicapra*) and red deer (*Cervus elaphus*) were also identified, aurochs (*Bos primigenius*) were represented by single specimens only. Remains of carnivores are represented by the brown bear (*Ursus arctos*), red fox (*Vulpes vulpes*), lynx (*Lynx lynx*), and at least four species of mustelids (*Mustelidae*). The most abundant remains belong to brown bears.

The studied sediment from the Hučivá diera cave was characterized by very low pollen frequency (50-280 including terrestrial AP and NAP pollen on the surface of 10 microscopic slides) and, at the same time, a low taxonomic diversity of sporomorphs, among which only 36 taxa (including 9 cryptogams taxa) were determined (results of the analysis carried out by prof. A. Wacnik). Based on the taxonomic composition and frequency of the main pollen morphological types, two pollen sections were distinguished in the diagram.

The older pollen representing the Late Glacial was characterized by a predominance of Scots pine *Pinus sylvestris* type pollen and Norway spruce *Picea abies* (up to 14%), as well as a very high frequency of herbaceous plant pollen.

The younger pollen zone represents the Holocene, revealing a completely different picture of vegetation.

The charcoal and wood were strongly degraded, vitrified, often penetrated by calcareous plastic sinter and rarely exceeded 2 mm in size. This hindered the taxonomic determination, resulting in intermediate (e.g. *Salix/Populus*) and probability determination (cf. *Juniperus*) or wider taxon category (e.g. d*eciduous*, *coniferous*) (results of the analysis carried out by prof. M. Hajnalova).

IV. DISCUSSION

Attempts to identify traces of Palaeolithic man in the caves of the Tatra Mountains at the end of the 19th and the beginning of the 20th century as mentioned above were unsuccessful (Jura 1955). The problem of the penetration of Palaeolithic hunters into the areas of alpine relief in the Carpathians is closely related to the difficult access to these areas in the coldest phases of the Pleistocene (Kłapyta *et al.* 2015; Makos 2015) and affected the availability of game animals (Horaček *et al.* 2015).

The three cave features selected for excavation represent different variants of location. Obłazkowa and Hučiva Diera are located deep in the Tatra massif at a similar height. The Dziura is located much lower and close to the border of the Tatra massif. Unfortunately, both caves on the Polish side did not provide information that is significant from an archaeological point of view in terms of traces of prehistoric settlement. This does not mean that the presence of such traces should be ruled out. The many years of activity, especially of Stefan Zwoliński, which was destructive from an archaeological and broader scientific perspective, are cast in a disastrous light. The research carried out has therefore the positive aspect of dispelling hopes for the possibility of conducting effective searches for prehistoric settlements in Tatra caves. The work described here had to be undertaken to form an opinion on the destruction to which cave sediments were subjected on the Polish side. On the Slovak side, the situation is better, as shown by the results of the work in Hučiva diera Cave. However, here too the activity of cavers and speleologists led to the destruction of some cultural settlements.

When assessing the current modest prehistoric discovery potential of the Tatra mountain group, we can recall the occasional finding of Stone Age artefact from the Polish Tatras: e.g. a flint core from the Kondratowa Valley (Tunia 1977) and the Slovak Tatras, a copper axe from Velka Studena Dolina

(Novotna 1973), Hallstatt period pottery and bronze items from Dúpnica Cave, located in the Western Tatras, in the Sielnicka valley (Šimková 2014), as well as multicultural discoveries of extremely intense Neanderthal settlements and early Homo sapiens at the foot of the Tatra Mountains (Valde-Nowak 1991; Valde-Nowak *et al.* 2003). Another important clue, encouraging us to look for traces of Palaeolithic hunters' activity in the Tatra Mountains, was the discovery of lithic artefacts: a blade and a fragment of the core in the village of Witów at the mouth of the Chochołowska Valley, near Siwa Polana, and thus on the very border of the Tatra National Park. The author of this discovery recognized these traces as the Late Palaeolithic (Rydlewski 2006). In the vast sub-Tatra valley of Orava-Nowy Targ, also known as Podhale, hunting camps of the Magdalenian population have been successive registered for years (Valde-Nowak 1991). However, they had no equivalent in the Tatra Mountains themselves, from which no Palaeolithic traces were known until the discovery of Hučiva Cave.

Looking at the inventory of stone artefacts from Hučiva Cave, it is worth emphasizing the extremely reduced workshop section. Only three cores found in a very used form are a document of significant limitations in the possibility of restoring the inventory by its users. The spectrum of raw materials is also clearly shown by a distinct group of flint tools, i.e. from raw materials brought from far away. Since all three found cores are made of local radiolarite and not flint, it can be concluded that the flint blades are the remains of the original hunters' equipment with which they came to the Tatra region, which was then renewed using local raw materials, especially radiolarites.

The features of the series of stone points are extremely peculiar. It is not easy to find references to them in the inventories from the general eastern Magdalenian area (Bobak, Połtowicz-Bobak 2018). We do not know them from the Moravia (e.g. Kapustka *et al.* 2023) and a few Slovak sites that are considered Magdalenian (Valde-Nowak *et al.* 2007; Kaminská. 2014, 288–296).

Due to differences in concepts in terms of terminology and typology of these types of blades, the following clarifications are necessary. We can refer to Campbell's (1977) proposal to pay attention to specimens that are close to shouldered points but are different from them. These are Creswellian points (Campbell's AC l type).

Organizing the current terminology leads to the conclusion that the inventories related to the Creswellian tradition are dominated by specimens generally similar to shouldered points, but without a separate notch, creating a concave outline in this part of the entire shape, as we can see in Hamburgian

shouldered points (Burdukiewicz 1987; Weber 2009; 2012; Kabaciński & Sobkowiak-Tabaka 2012) and also, although occurring rarely, shouldered points of a Magdalenian type, e.g. in Etzdorf (Pasda 2018) and Petersfels (Albrecht 1979; Maier *et al.* 2020) and some Swiss sites, like Schweizersbild (Höneisen & Peyer 1994).

Typical shouldered points of the A2 type by J. M. Burdukiewicz (1987) have also been distinguished in the Hučivá diera Cave inventory, although less numerous than typical Cresswell blades.

We are faced here with the classic problem of understanding the Magdalenian-Hamburgian relationship, in which the participation of shouldered points is a primary element. Without entering this discussion, it should be recalled that the key element for distinguishing Hamburgian Magdalenians is the lack of retouched bladelets in the Hamburgian complexes (Weber 2012, 28). The presence of truncated bladelets in the Hučiva inventory is one of the strong indicators of the Magdalenian affinities of the findings. Apart from the incidental appearance of a single mite in the inventory from Krucza Skała, Kamienna Góra distr., a specimen similar to the Cresswell blade type, although it was not named as such (Cyrek *et al.* 2020), and a slightly larger series of shouldered points in Magdalenian context from Wrocław Żerniki (Burdukiewicz *et al.* 2013), we have practically no other references from the East Magdalenian area: Moravia and Poland. We can also recall two findings from the 19th-century excavations, mentioned several times in research but never associated with the typology of finds with Creswell features: a Creswell blade from Na Łopiankach Cave, Kraków distr., and a Cheddar point from Na Gaiku Cave, Kraków distr., (Collections of the Archaeological Museum in Kraków).

It is also worth mentioning the site of Rydno II/59, Skarżysko Kamienna distr., where an oblique and straight double half-back was discovered (Schild *et al.* 2011, 124-125 fig. 103). Many years ago, this type of point was recorded in the inventory from the foothills of the Tatra Mountains, namely from the site Podczerwone in Podhale, Nowy Targ distr.. included in the Magdalenian culture. Years later, it turned out that there were more traces at the foot of the Tatra Mountains that did not fit the Polish image of the Magdalenians. First, the site of Sromowce-Wyżne „Kąty", Nowy Targ distr., should be mentioned (Valde-Nowak 1991), with a large inventory and at least one Creswell point made of chocolate flint. Ongoing excavations in Obłazowa Cave (western entrance) in Nowa Biała, Nowy Targ distr., also yielded a small inventory of double half-backed forms like Cheddar points (Valde-Nowak *et al.* 2018). Blades of this

last-mentioned type are not known from Magdalenian settlements in Moravia and eastern Germany. They are concentrated in the southeastern part of the British Isles and the Netherlands (Barton *et al.* 2003). A single case is known from southern Germany from the Hohle Fels Cave (Taller *et al.* 2012).

The archaeological material from Hučivá diera Cave, in addition to typological references to the Creswell sites, contains elements known from the Magdalenians in Switzerland (Sedlmeier, J. 2015). It is about techno-assemblage E (Leesch *et al.* 2012; Nielsen 2016), which slightly precedes the settlement in Hučivá diera.

The Alpine ibex is a mountain species that in the late Pleistocene occurred first around the Alps and on the rocky coasts of the Mediterranean Sea. Alpine ibexes were victims of specialized hunting by people of the Magdalenian (Gauvrit Roux 2022) and Epigavettian people (Fiore *et al.* 2001). Currently, *Capra ibex* does not occur in the Tatra Mountains.

The overall assessment of the obtained inventory leads to obvious conclusions that we have traces of the operation of a specialized group of hunters in this cave, focused especially on hunting and butchering the hunted ibex on site. The chimney at the end of the chamber, just above the hearth, points to conscious planning of the camp space. This provided effective ventilation when using fire. Without this, the large fireplace at the back of the cave could not have been used (Kedar *et al.* 2019).

The analysis of lime packages leads to the conclusion that the obtained slaked lime with chemically active properties could be used in the tanning process of leather. The presence of horse remains, as well as species that are alien to the high-mountain environment, e.g. swans, gives food for thought.

Some observations suggest that the late Pleistocene landscape exploited by humans occupying the Hučivá diera Cave was open, with (possibly short, shrub-like) trees clustering in sheltered locations and along the watercourses. This picture can be compared to the situation of sites on the border between Switzerland and Germany (Leesch *et al.* 2019).

Assuming that the obtained palynological image of vegetation is not the result of an accidental pollen import associated exclusively with the activity of Palaeolithic hunters using the cave, it may indicate the important role of open steppe-like grassland vegetation.

V. CONCLUSION

The discovery and comprehensive examination of the remains of Late Palaeolithic human activity in Hučivá diera Cave have several paleogeographic consequences and point to the dynamics of the recolonization process after the LGM climate crisis.

The sedimentary profile excavated in Hučivá diera Cave offered an interesting insight into the formation of sediments at the transition of the glacial/interglacial period and Holocene. The glacial period is recorded of silty loams, macroscopically and geochemically corresponding to loess. The formation of the cave record continued at the very end of the glacial period when a mass of limestone blocks frost eroded from the roof of the cave and its walls started to fall to the cave bottom. Sometime after these events, the Magdalenian occupation of the cave occurred. The human presence is represented by the appearance of fireplaces full of charcoal, burned bones, and ash. All these features are well preserved there. The dilution of burned and unburned bones and probably also of guano is the provenance for the phosphatic nodules and impregnations which are present as post-sedimentary features. Another post-sedimentary feature is carbonate neoformation, especially aragonite coating and its recrystallization into calcite. The cave is in a high mountain zone, which in Böling warming suddenly became accessible to humans and fauna after the decline of the oldest Dryas.

From the perspective of the Central European colonization of the Magdalenian area at that time (Połtowicz-Bobak 2009), we must note that somewhere in this zone there is the southern frontier of the colonization of this cultural unit. To the south, one can also point out an open site on the Poprad River in Stara Lubovnia (Valde-Nowak *et al.* 2007). Materials from old discoveries in the Gudenus Cave in Lower Austria (Obermaier, Breuil 1908) are probably related to Magdalen culture; however, from the older periods than Hučivá diera assemblage. A separate problem is the relationship between the Epigravettians and the Magdalenians in the watershed of the middle Danube and the upper Vistula, which is becoming ever more relevant (Wiśniewski *et al.* 2007; Lengyel *et al.* 2021).

Among the distinguished groups of the Magdalenian culture, faunal references to the Hučivá diera Cave can be seen in the Danube group, stretching from the Swiss-German border to France (McCartin *et al.* 2023). In the sites of this group, apart from reindeer and horses, hunting of *Capra ibex* is confirmed, although these are not the main species. The distinctiveness of the

discovered blade forms, which only seem to represent shouldered points, but are illustrative of Cresswell forms, is an important finding that sheds light both on the intergroup differentiation of the Magdalenians, as well as on the dynamics of contacts and even long-distance movements.

The simplest explanation for the originality of the Hučivá diera inventory may be the distinctiveness of the environment around the cave, which we can define as a high-mountain periglacial area on a micro-scale. A clear focus on alpine ibexes also proves originality. It is also possible that Hučivá diera was a point of animal dressing, in the sense of tanning hides on site. Many cut marks on the bones confirm the cutting of animal carcasses, and lime packets lead to the conclusion that the skins could have been processed here with slaked lime. This aspect should be analysed in the future.

The repeatedly examined dating results of sites from various phases of Magdalenian development and detailed conclusions regarding the settlement dynamics are consistent and show the GRIP GI-1e phase as a time of widespread Magdalenian culture (Miller 2012) and the simultaneous emergence of units such as the Creswellian and Hamburgian. The Hučivá diera Cave is part of this increase in Magdalenian activity in the earlier part of this Bölling climatic phase.

The Dziura and Obłazkowa caves did not provide any traces of prehistoric settlements, but based on the research carried out, it is highly probable that the sediments in this part of the Tatra massif were largely destroyed. From today's perspective, S. Zwoliński's many years of activity must be assessed as a harmful and senseless act that caused irreversible losses of the Tatra archaeological heritage. This activity has so far not attracted much attention and has avoided criticism. This has been negative for archaeological research in the Polish part of the Tatras.

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