ARCHAEOLOGY AND THE WINTER SOLSTICE IN THE CAVES OF THE BOHEMIAN KARST, CZECH REPUBLIC

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After the Moravian Karst, the Bohemian Karst is the most important region of speleo-archaeological interest in the Czech Republic. The region's caves are primarily smaller in size, but around 80 known sites with archaeological finds document interest in them throughout prehistory. During the agricultural prehistoric era, use of the caves peaked in the Middle to Later Neolithic and the Late Bronze to Early Iron Age. When contemplating their function, the most clearly visible aspects tend to be those related to cult activities. During the Bronze Age, vertical caves and dark caves were used as well. In the Neolithic, abundant finds are often concentrated in caves that for various reasons were not suitable for regular habitation. The example of Nová Cave shows a possible connection between the cave's unusual Neolithic find context and lighting impressions inside the dark cave during sunrise around the winter solstice, which allows us to assume the possibility of cult rituals associated with this important date in the surrounding caves with an entrance oriented to the southeast.

1. Introduction

The roughly 130 km^2 Bohemian Karst is the largest karst region in Bohemia and the only karst region with a demonstrated incidence of prehistoric cave localities in Bohemia. It consists of islands of Silurian and Devonian limestone, separated from one another by non-karst rock, fault lines or valleys at an elevation of 200–499 meters above sea level. The region's cave systems tend to be smaller in size (as compared, for instance, to the largest karst region in the Czech Republic, the Moravian Karst), which is caused in part by the region's lack of water – and this despite the fact that the its axis between Prague and Beroun is made up of the Berounka River. The climate of the Bohemian Karst is moderately warm to warm, with mild winters, an average annual temperature of 8–9 °C, and average annual rainfall of 530 mm.

2. Summary of the caves' use

There are around 80 speleo-archaeological cave localities registered in the Bohemian Karst from practically all periods of the prehistoric and historic eras. The high level of interest in caves is related to the region's location within the ancient settlement area of the Bohemian Basin, which has been continuously settled since at least the early Neolithic. The distribution of caves with evidence of human presence significantly corresponds to the natural concentration of karst phenomena resulting from geological developments, and is concentrated in three more or less separate regions: a central region delineated by the municipalities of Karlštejn, Tetín, Srbsko and Svatý Jan pod Skalou; the southeastern region of Koněprusy; and a northeastern region on the outskirts of Prague. The main archaeological interest in the caves of the Bohemian Karst was in the 1920s to 1940s, when many of today's known localities were explored, for the most part comprehensively. Other individual explorations followed in the 1950s (F. Prošek) and the 1980s and '90s (V. Matoušek). The findings of these explorations have been published (Fridrich and Sklenář 1976, Sklenář and Matoušek 1994, Svoboda et al 2004).

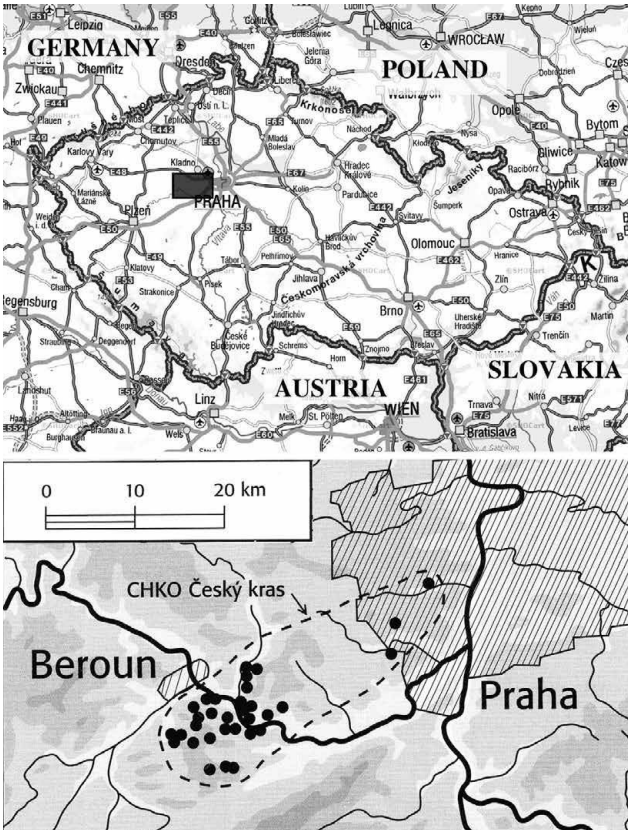

Figure 1. Location of the Bohemian Karst and sites of caves from the Bronze Age/Hallstatt Period.

The caves of the Bohemian Karst were already known to the populations of the Middle Palaeolithic, but more localities are not recorded until during the Upper Palaeolithic. Human skeletal remains and artefacts in the tourist complex of the Koněprusy Caves are dated around 30000 BP. Several smaller caves (e.g., Děravá Cave with a ibex carved on a shale tablet) were settled during the Magdalenian period, and a larger open settlement was located on the promontory near the village Hostim. Occasional finds document a human presence in caves in the Late Palaeolithic and Mesolithic as well (Fridrich and Sklenář 1976, Vencl 1995, Svoboda 2000). By the Early Mesolithic, the highest peak in the Bohemian Karst, Bacín (499 m), was probably a shrine, as documented by the

lowest horizon of human remains in vertical fissure I (Matoušek 2001). A significant increase in archaeological cave finds is associated with the Middle and Late Neolithic (see section 3). During the Aeneolithic, interest in caves apparently fluctuated depending on the various archaeological cultures (e.g., Koda and Tří Volů caves, and the Bacín II fissure). Sporadic interest in caves continued in the Early and Middle Bronze Age (Sklenář and Matoušek 1994, Matoušek 2001).

A second significant find horizon from the caves of the Bohemian Karst corresponds with the period from the Late Bronze Age (Bz D / Ha A, ca. 1200 BC) to the Early Iron Age (Ha D, ca. 380 BC) – a total of 37 sites. All types of caves were used: vertical (pit) caves, horizontal clefts, cave passages, and halls. Less commonly found non-ceramic finds (in particular bronze rings, bone awls and human bones) come from vertical caves, horizontal caves with shafts, narrow clefts, and caverns whose height does not exceed 160 cm – i.e. not from spacious and bright caves. According to a pottery analysis, sets consisting primarily of decorated vessels and graphite-painted ceramic tableware are associated with caves that have narrow or overwhelmingly dark interiors (Barrandova, Turské Maštale/Poslední Síň, Ve Stráni) and are found alongside other find categories (human bones, zoomorphic vessel, strainers/incense burners, or items made of bronze, stone and bone). The relationship between the spectrum of finds and the choice of caves leads the author to consider the possibility that these caves held a special status, for instance associated with ritual activities. This is because a profane use of these localities can be imagined only under the most extreme conditions. During this period, the caves were located in a relatively densely settled area, so they were no farther than 2 km from the settlements of the time (Matoušek and Peša 1998, Peša 2006).

In terms of archaeology, during the Late Iron Age (the Celtic era), the time of the Roman empire, the Migration Period, and the Early Middle Ages caves appear only as isolated localities or finds (Sklenář and Matoušek 1994). The onset of the Middle Ages (and the general spread of Christianity) probably led to a transformation of the importance of caves. Exceptional places with a prehistoric tradition and a spirit of a place (*genius loci*) were Christianised (Svatý Jan pod Skalou, Tetín, Prokopská Cave), while the most common use for other caves was as shelters or refuges – later mostly during wars. An important locality in this regard are the tourist-accessible Koněprusy Caves, whose public tour route includes a money-forging workshop from the 1460s to 1470s. During the 16th and early 17th century, the Bohemian Karst (like other regions) was probably sought out by prospectors, as possibly indicated by passages dug into the clayey sediments and roughly dated using archaeological finds (Koněprusy Caves, Krápníková), as well as by the proximity to Prague, which under Emperor Rudolf II had become a European centre of alchemy. This era also saw an increased interest in speleothems, which the monks mined in the no longer extant caves near Svatý Jan pod Skalou, then processed, and sold as medication (Peša 2013).

3. Caves during the Neolithic (5100 – 4300 BC)

There are Neolithic finds from around 30 caves in the Bohemian Karst. In terms of inhabitability, only the largest of these (Koda, Nad Kačákem, Sloupová) offer room for 2–3 nuclear families – i.e. hardly enough for the inhabitants of a Neolithic long house. The other caves could be used at most by a few individuals – in the case of crevice passages with a width of up to 2 m only in the most extreme circumstances, while others are entirely unsuited for settlement purposes either because of their small size or their (for instance, vertical) shape (Peša 2011).

Caves were used during the Middle Neolithic (Late Linear Pottery) and during the Late Neolithic with an overlap into the Early Aeneolithic (Stroke-ornamented ware culture, Lengyel horizon), but only in the central area and the NE Prague area. The finds and find context offer evidence of cultural strata with numerous preserved and scattered fireplaces and occasional preserved structures (Na Průchodě Cave). The dominant finds are fragments of vessels, but there are also larger pieces or even some vessels preserved in their entirety (Malá and Hlohová caves). It is highly probable that these last two caves involved the final placement of vessels in connection with cult activities. Generally associated with sacral purposes are the finds of dislocated human bones in the Late Neolithic cultural layers in Galerie and Nová Caves and, in Prague, possibly in Prokopská Cave as well. The significance of the extraordinary archaeological context in the rear portion of Nová Cave is further enhanced by an astronomical observation of the unusual conditions at sunrise around the winter solstice, which offers the possibility that this cave (and possibly, though with a less spectacular effect, the neighbouring Patrová and Úzká caves as well, and perhaps even Galerie Cave) was associated with cult rituals marking the start of the astronomical year (Peša 2011).

4. Astronomical phenomenon and archaeology

Nová Cave (municipality Srbsko, Beroun county) and another 12 archaeologically significant caves are located in a distinctive rock formation above the Berounka River. The cave's entrance, which opens towards the southeast, is located 45 m above the surface of the river in the upper part of a side ravine. The entryway narrows into a low passageway that opens up into a vestibule that today measures ca. 190 cm in height. From here, two impassable crawlspaces lead off into the rock massif. In both summer and winter, the lighting conditions inside the cave can be called twilit or semi-dark, which reflects the enclosed shape of the cavern.

On 21 December 1996 (i.e. on the winter solstice), the author and A. Majer recorded unexpected lighting conditions in the cave. At 9.30 in the morning, the sun rose above the opposite slope of the ravine, and the sun's rays illuminated the rock above the cave's entrance. As the sun rose in the sky, the rays entered the cave and projected a brilliant orange disk onto the cave's rear-most part 12 m

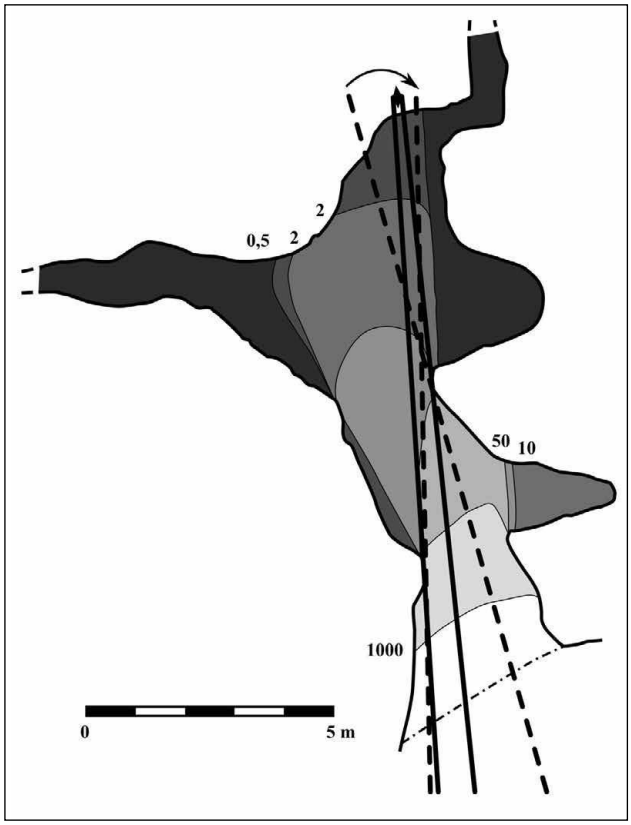

Figure 2. Nová Cave – illumination map (isolines in lux) showing the penetration of sunrays from 9.30 to 10 a.m. (dashed lines) with diamond-shaped climax (full line).

from the entrance, in front of the low right-hand passageway; the disk quickly grew in size, climaxing at 9.45 a.m. as a diamond measuring about 40 cm in height. This final shape was the result of the row of rocky protuberances in the cave's entryway, which allowed only some of the sun's light to enter. The sunrays reflecting back from the illuminated location coloured the cave's twilight in a dim orange glow. The entire event lasted half an hour, with the constantly shrinking sun's disk disappearing completely at 10 a.m. and the vestibule again falling into a half-darkness (Peša and Majer 2003). The author observed the entire event again during later years, and documented it photographically on December 24, 2000 and January 4, 2001. During the second measurement 13 days later, the astronomical phenomenon was the same, except that the changing angle of the sun's rays gradually deformed the diamond shape. Although it was not possible to precisely define the phenomenon's period of existence, it is probably observable at most for a period of 2–3 weeks before and after the solstice, but the shape is purely vertical only for a period of several days around December 21, 2000.

In Nová Cave, this unusual natural phenomenon is further accentuated by the extraordinary archaeological find context. The original surface in the Neolithic was a mere 30 cm higher than today, and the cave thus had similar lighting conditions. In the Middle Neolithic, there was a fireplace at the beginning of the right-hand passageway, and deeper inside, near where the sun's rays hit the cave wall, there was a layer of ash and an overturned bowl. Another fireplace located in the just 80 cm-high left-hand passageway contained chipped stone tools and a ground stone hatchet. A similar find context is repeated for the Late Neolithic, with a fireplace again located in front of the right-hand passageway, an ash heap in the left-hand crawlspace, and the vestibule yielding among other things splintered human bones (Sklenář and Matoušek 1994). Both fireplaces in a space just ca. 1 m high call into doubt the practical use of fire, not to mention that, at least today, the cave's microclimate is static and the crawlspaces do not act as natural chimneys. The lighting conditions inside the cave were thus very similar during the Neolithic, and we may assume that the rising sun shone into the cave in a similar manner as it does today. The exceptionally impressive spectacle – in which the reflection of the rising sun is briefly transformed into a shape resembling a woman's womb – makes Nová Cave a holy site that was home to rituals associated with the winter solstice and perhaps also Mother Earth. The site's special status is also confirmed by the unusual find context, which differs from profane activities. To date, the author has been unable to find any analogous phenomenon for a speleo-archaeological locality in the literature.

5. Conclusion

As much as the caves of the Bohemian Karst with their overwhelmingly bright interiors enabled occasional profane usage, more specific evidence relates primarily to cult activities. However, this claim may be made only for the Neolithic and Late Bronze to Hallstatt Period, when the caves were visited more frequently and for which we have corresponding archaeological findings. For the Neolithic, the group of caves around Nová Cave in the central Bohemian Karst offers a possible connection with cult activities and the winter solstice – i.e. the start of the agricultural year. It is certainly no coincidence that these caves with their presumed function as sites of cult activities are among the localities with the thickest cultural layers, unusual find contexts, and the largest number of archaeological finds. Similar contexts are found in other karst regions in central and southeast Europe during periods of intense interest in karst caves (Peša 2006, 2011).

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Figure 3. Srbsko – Rock face with caves, seen from the south. All photos V. Peša.

Figure 4. Srbsko – Rock face with Úzká and Patrová Caves; Nová Cave is outside of the picture on the right.

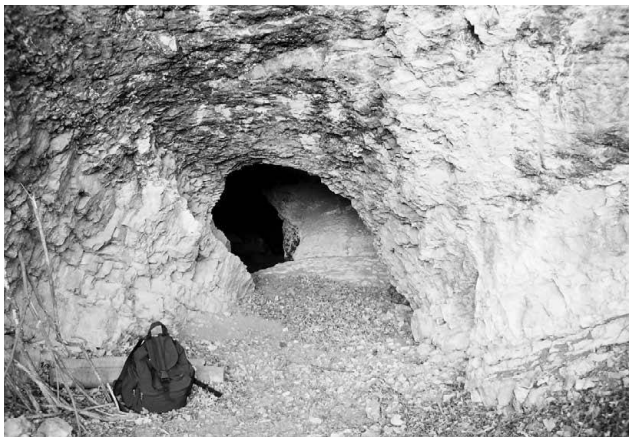

Figure 5. Srbsko – Nová Cave, entrance.

Figure 6. Nová Cave. Sunrays entering the cave.

Figure 7. Nová Cave. Sunrays being projected onto the cave wall around the winter solstice (4 January 2001).

Figure 8. Nová Cave. Sunrays being projected onto the cave wall near the right-hand crawlspace (24 December 2000).

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