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**Wilfried Rosendahl, Stephan Kempe & Doris Döppes**

## **The scientific discovery of „*Ursus spelaeus*“**

### **Zusammenfassung:**

Die Aufstellung der Art *Ursus spelaeus* durch den jungen Anatom ROSENMÜLLER (1794) ist ein Meilenstein der Paläontologie und der Höhlenforschung. Diese Leistung kam nicht von ungefähr, sondern war eingebettet in eine Reihe von tastenden Schritten, die Rosenmüllers Vorgänger geleistet haben und die nur zum Teil in der Literatur bekannt geworden sind (z.B. SHAW 1992, KURTÉN 1995). Im Folgenden wird die Geschichte der Entdeckung dargestellt, die zu der Erkenntnis führte, dass viele Knochenfunde aus Höhlen zu einer ausgestorbenen Bärenart zu stellen sind. Erste Höhlenerkundungen des 15., 16. und 17. Jahrhunderts berichteten über Funde von großen Knochen, die als „unicornu fossile“ für medizinische Zwecke verwendet wurden. HORST (1656: 10) vermutete als erster, dass Knochen aus der Einhornhöhle (Scharzfeld, Harz) von Bären, Löwen und Menschen stammen. PATERSON HAIN (1673 a, b) und VOLLGNAD (1676) publizierten Figuren von Höhlenbärenknochen und -schädeln, sahen in den Resten aus den karpatischen Höhlen aber Drachenknochen. 1774 stellte ESPER die Funde aus der Zoolithenhöhle zu den Eisbären. Bald wurde von verschiedenen Autoren erkannt, dass die Funde größer als die Knochen der heute lebenden Braunbären sind. Schließlich beschrieb ROSENMÜLLER in seiner ersten Doktorarbeit 1794 einen Bärenschädel und stellte eine neue Art auf.

### **Abstract:**

The proclamation of the species *Ursus spelaeus* by the young physician ROSENMÜLLER in 1794 was a milestone for palaeontology and cave research. Nevertheless, this accomplishment was not entirely unexpected; rather it resulted from a series of small steps taken by Rosenmüller's scientific predecessors. These steps are not well known in the main stream speleological and palaeontological literature (e.g., SHAW 1992, KURTÉN 1995). Here we present the history of discoveries which led to the realization that much of the bones recovered from caves belong to an extinct species of bears. Already the first written records of Central European cave exploration in the 15th, 16th and 17th century mention large bones. They were first mined for „unicornu fossile“ used for medical purposes. HORST mentioned in 1656 that bones from the Einhornhöhle (Unicorn Cave; Scharzfeld, Harz) may belong to bears, lions and humans. In 1673 and 1676 PATERSON HAIN

and VOLLGNAD, respectively, published the first anatomically recognizable pictures of cave bear bones and skulls, albeit claiming that they belong to dragons lurking in Carpathian caves. The first lavishly illustrated monograph dealing entirely with a cave and its bones was published by ESPER in 1774. He claimed that the bones may be those of the polar bear. Soon after several authors realized that the fossil bear was much larger than any living bear species. Finally ROSENMÜLLER, in his doctoral thesis for his first, philosophical doctorate, described in 1794 the bear (from a skull) as a separate species according to the system of Linné.

## Résumé:

L'invention de l'espèce *Ursus spelaeus* par le jeune médecin ROSENMÜLLER en 1794 marque une étape importante dans la recherche paléontologique et spéléologique. Néanmoins, celle-ci ne survint pas de façon tout à fait inattendue; elle résulte davantage d'une série d'éléments développés par les prédécesseurs scientifiques de Rosenmüller. Ces étapes préliminaires sont souvent ignorées dans la littérature paléontologique actuelle (p.ex. SHAW 1992, KURTÉN 1995). Les auteurs présentent dans cet article l'histoire des découvertes ayant conduit à la prise de conscience qu'une grande partie des ossements découverts en grotte appartiennent à une espèce disparue d'ours. Les premiers compte-rendus d'explorations spéléologiques en Europe centrale datant des 15<sup>e</sup>, 16<sup>e</sup> et 17<sup>e</sup> siècles mentionnent déjà de grands ossements. Ceux-ci furent longtemps considérés comme appartenant à „unicornu fossilis“ (licorne) et exploités à des fins médicinales. HORST mentionna en 1656 que des ossements en provenance de l'Einhornhöhle (Grotte de la Licorne, Harz) pourraient appartenir à des ours, des lions et des êtres humains. En 1673 et 1676, PATERSON HAIN et VOLLGNAD respectivement publièrent les premières illustrations identifiables de crânes et d'ossements d'ours des cavernes, tout en mentionnant qu'il s'agit de restes de dragons nichant dans les grottes des Carpates. La première monographie abondamment illustrée consacrée entièrement à une grotte et ses ossements fut publiée par ESPER en 1774, qui postula que les ossements pourraient appartenir à l'ours polaire. Peu de temps après, plusieurs auteurs notèrent que l'ours fossile était beaucoup plus grand que toute espèce actuelle connue. Finalement, ROSENMÜLLER étudia dans sa première thèse de doctorat en Philosophie et Lettres en 1794 un crâne d'ours des cavernes et le classa dans le système de Linné comme appartenant à une espèce indépendante.

**Key words:** *Ursus spelaeus*, „unicornu fossilis“, Einhornhöhle, Zoolithenhöhle

## **The long path of the birth of a species: From antique times to 1794 AD**

The story of the scientific discovery of the cave bear has its roots in antique times and represents an interesting example of the development of natural sciences. Greek authors, such as Ctesias and Aristotle, and later Roman writers, such as Plinius and Aelius, knew of the monoceros (Greek, masculine) or the unicornis (Latin, masculine), i.e. the unicorn (Einhorn in German). With certainty these descriptions referred to the Indian rhinoceros (*R. unicornis*; CAVALLO 1998).

Julius Caesar („De Bello Gallico“, Com. Sextus, 25-26, HEINZE & ROSENBERG 1908) was the first link the unicorn with German forests, i.e. more precisely with the Hercynian forest (either the Swabian-Franconian Alb or the Harz Mountains).

His matter-of-fact description was supplemented by the Physiologus, a book of a 2nd Century author from Alexandria about imaginary and real animals and the morals they could teach to the Christians. According to it, the wild and powerful unicorn can be tamed only by a virgin. Even in the Old Testament a Monoceros suddenly occurred (in the Deuteronom (33:17) and in the Book of Job (39:9-10)). It made its appearance due to a translation error because the meaning of the Hebrew word for the aurochs was lost and the Greek translator replaced it with „monoceros“ in the Septuaginta. It then became a „unicornis“ in the Latin version of the bible of St. Jeronimus in the 4th Century (CAVALLO 1998).

From here it was a small step to the mystics of the Middle Ages, in which the unicorn was paralleled with Jesus and the virgin with Maria. The hunting of the unicorn, its passion and death were a wildly used allegory to symbolize the passion of Jesus (BEER 1972). Since Caesar's report (which actually is a slanted description of the moose) had made clear that the unicorn lived actually in Germany, it was natural to identify all mysterious bones with the powerful animal living in the dark of the forest. The fact, that these bones occurred in hidden caves almost proved this chain of reasoning.

This was all the more reasonable since the unicorn was mentioned several times by medieval travellers to the Far East such as Marco Polo (TSCHARNER 1935). However, Conrad Gesner already identified these reports in his „Thierbuch“ correctly as those of the rhinoceros (GESNER 1669: 76). He did this in spite of the fact that he treated the unicorn in the same book as a really existing animal which he even depicted ten times (p. 71-83). He treasured it so much, that he even used it for a frontispiece of his book. Nevertheless he also noted, that nobody of the older „Scribenten“ (authors) ever saw it personally and that it never occurred in Europe (GESNER 1669: 76). He, however, also added that unicorn can be bought in all pharmacies (GESNER 1669: 80-81). One may speculate that much of this easily pulverized material was originally bear bones mined from caves.

Already the old reports claimed healing powers for the horn of the monoceros. It specifically offered protection from poison, a belief, which is still present in East-Asia and which sadly may lead to the quick demise

author	year	sites	cranium/upper jaw/teeth/bones
PATERSON HAIN	1673a	Carpathians, Poland	2 crania fragments, 7 bones
PATERSON HAIN	1673b	Carpathians, Poland	1 cranium fragment, 4 teeth, 1 bone
VOLLGNAD	1676	Carpathians	1 cranium, 1 tooth, 2 bones
BRÜCKMANN	1739	Demänovská ľadová jaskyna at Liptovský Mikulas, Slovakia	1 lower jaw fragment, 4 teeth, 1 bone
LEIBNIZ	1749	Einhornhöhle, Germany	2 cranium fragments, 2 teeth
ESPER	1774	Zoolithenhöhle, Germany	5 cranium fragments, 2 lower jaw fragments, 17 teeth, 4 bones
HUNTER	1794	Zoolithenhöhle, Germany	1 cranium, 2 cranium fragments, 2 bones
ROSENMÜLLER	1794	Zoolithenhöhle, Germany	1 cranium
ROSENMÜLLER	1795	Zoolithenhöhle, Germany	1 cranium
ROSENMÜLLER	1804	Zoolithenhöhle, Germany	2 crania, 2 lower jaws, 28 bones
BENZENBERG	1806	Sundwig, Germany	1 cranium
GOLDFUß	1810	Zoolithenhöhle, Germany	1 cranium
VOLPI	1821	Adelsberger Grotte, Slovenia	2 crania, 1 cranium fragment, 2 lower jaws, 3 bones, 4 juvenile bones
CUVIER	1821/24	Zoolithenhöhle ?, Germany	4 crania, 3 lower jaws, 11 teeth, 40 bones, 4 juvenile bones
BUCKLAND	1823	Kirkdale, Great Britain	1 tooth
SERRES et al.	1829	Lunel-Vieil/Herault, France	1 lower jaw fragment, 5 teeth
SCHMERLING	1833	caves at Liège, Belgium	4 crania, 12 lower jaws (1 juvenile), 22 teeth, 86 bones, 1 juvenile bone
MASSALONGO	1851	surrounding of Verona, Italy	3 crania fragments, 1 lower jaw, 1 lower jaw fragment, 16 teeth, more than 10 bones, 6 juvenile bones
NORDMANN	1858	Nerubajskoe, Ukraina	1 cranium, 2 lower jaws, 20 teeth, 8 bones, many metapods

Table 1: List of the oldest graphics of cave bear bones published till 1860.

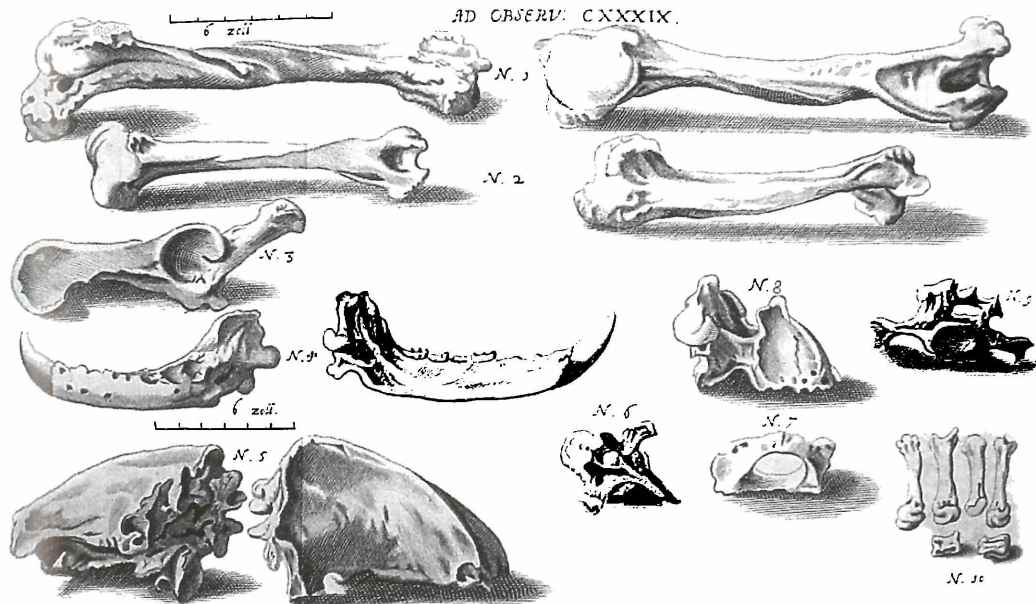


Fig. 1: The first scientifically exact graph of cave bear bones with scale and correct anatomical designation from a cave in the Carpathian Mountains published by PATERSON HAIN (1673 a). They were, however, incorrectly assigned to the gender „draco“.

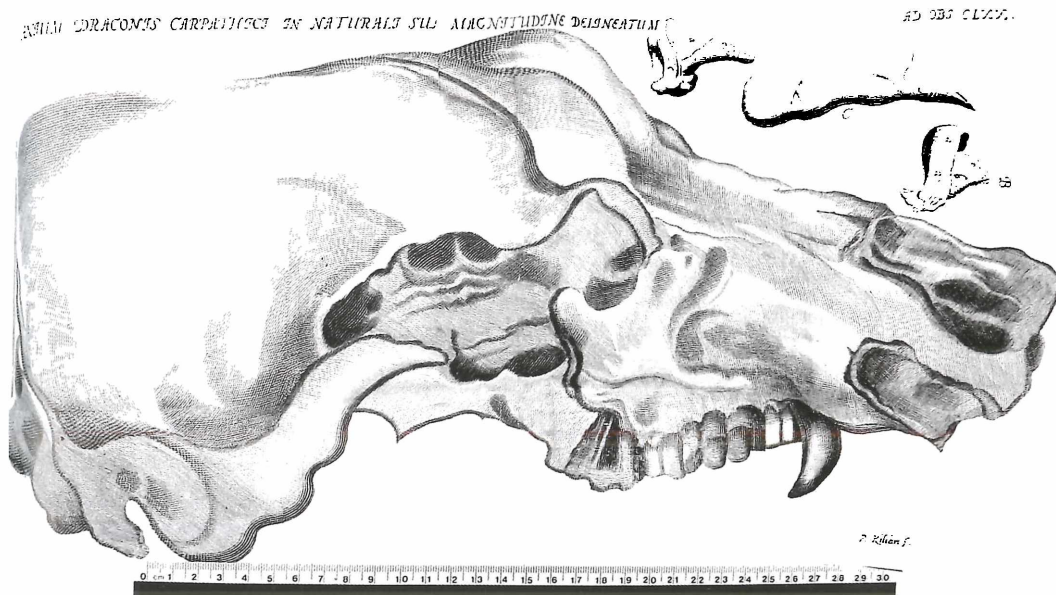


Fig. 2: In addition to Paterson Hain VOLLGNAD (1676) published a copper etching with a cave bear skull in original size marked by the headline (translated): „Skull of a dragon from the Carpathian Mountains in natural size“. In order for the skull to look like that of a dragon, a canine-kind bone was inserted into the alveoli of one of the premolars. The teeth are not very well represented overall. Even though, Vollgnad correctly depicts the canine of a cave bear in the upper corner plus two claws.

of the last wild rhinoceroses. The trade with rhino horns to Europe was insecure, but mammoth tusks (sold as *Unicornu verum*) and teeth of the narwhale (traded as *Unicornu falsum*) were ample replacements. If the horns had healing power, then also the bones of the respective animals could be used as remedies. Following this logic the mining of caves for bones became a profitable business in the late Middle-Ages and throughout the Renaissance and Baroque. The thus acquired bones found a brisk market and many pharmacies named themselves „Einhorn-Apotheke“. Important caves, such as the Einhornhöhle at Scharzfeld (Harz), the Zoolithenhöhle at Burggailenreuth (Franconia) and the Drachenhöhle at Mixnitz (Styria), not only owe their names to the bones, but also their early scientific attention. Due to the profitable unicorn trade many bones made their way into the curiosity cabinets of the nobility and into the petrifact collections of the educated citizens.

Already the first cave descriptions mention bones. For example the account of a discovery of a cave near Sundwig AD 1477 recorded in the city chronicle of Lübeck (GRAUTOPF 1829/1830) and the narrative of the heroic first exploration of the Breitenwinner Windloch 1535 (LACHMUND 1669). In the first report about the Baumannshöhle (Harz) by ECKSTORM (published 1620, written 1589; KEMPE et al. 2004) bones („Unicornu“) and large molars also play a prominent role. Similarly bones are also mentioned for the Baumannshöhle in the two descriptions by MERIAN (1650, 1654; KEMPE & REINBOTH 2001).

The first natural scientist that compared the bones of the Einhornhöhle with those of real animals was HORST, who, in a medical paper published 1656, denoted the bones as „being like those of bears, lions and humans“. With the foundation of the first scientific periodicals in the middle of the 17<sup>th</sup> century, scientists obtained the opportunity to publish their findings and precisely illustrate them with engravings. Table 1 lists the oldest graphics of cave bear bones published.

The first of these representations of recognizable cave bear bones were published by PATERSON HAIN (1673 a, b) (Fig. 1), VOLLGNAD (1676) (Fig. 2), KUNDMANN (1737) (see KEMPE 2004) and LEIBNIZ (1749). Paterson Hain already gave examples of all important bones of the cave bear on one large fold-out copper plate (Fig. 1): a skull cap, a lower jaw, the ilium, four vertebrae and humerus, femur and tibia plus a few metacarpalia. Even though Paterson Hain was a physician, he can only think of „draco“, dragon when it comes to identifying the animal. VOLLGNAD (1676) even tops this nonsense: Under his full scale representation of a complete skull of the cave bear in natural size he writes: „*Cranium draconis Carpathici in naturali sua Magnitudine delineatum*“ (skull of a Carpathian dragon drawn in natural size) (Fig. 2). As if to underscore his interpretation, he placed the canine of another animal into to alveoli of one of the premolars, giving the skull the impression of a ferocious reptile. Separately he depicts however the correct canine of a cave bear plus two of his claws. The Latin texts, that accompany the figures of Paterson Hain and Vollgnad and which describe the circumstances of how these bones were recovered still need translation.

Half a century later also Franz Ernst BRÜCKMANN (1739) reports about dragon bones from the cave of Liptovien in Hungary (Demänovská ľadová jaskyňa bei Liptovský Mikuláš (Slovakia), also called dragon cave), which also clearly represent cave bear bones.

Early on some researchers tried already to image extinct animals. LEIBNIZ (1749) published the „reconstruction“ of an unicorn, based on a few bones of a mammoth and of an ungulate which had been recovered from a karstic depression in gypsum on the Seweckenberg near Quedlinburg in 1663. It is still unknown who the author of this first „reconstruction of a fossil animal“ was, it certainly was not the famous major of Magdeburg, Otto von Guericke, who only reported about the recovery of the bones in 1678 (REINBOTH 2001).

Compared with the early texts, is the description of bones from the Baumannshöhle published by the physician Johann Friedrich Zückert quite detailed. ZÜCKERT (1763) saw the specimens either in the Collection Lesser or in the cave. The description is medically correct almost recreating the *Ursus spelaeus* canine virtually and shows a love for details since even the dental plaque is noticed. Other bones are correctly identified such as molars, lower jaw, shine bone and skull cap. Nevertheless ZÜCKERT does not dare to designate these bones to certain animals, even though HORST (1656) and BRÜCKMANN (1734: p. 2 verso) suspected that the bones from the Einhornhöhle to be those of bears. Zückert thus missed the chance to claim this also for the bones of the Baumannshöhle, a step which a few years later was taken by WALCH (1769).

This suspicion became truth in 1789 when LASIUS investigated bones from the Baumannshöhle again and found that they belong to a species of bears. However neither Lasius, nor Camper and von Trebra, who supported this conclusion, took the step to name this species. This species was named *Ursus spelaeus* just five years later by ROSENMÜLLER (1794). SCHRÖDER (1796: 86-87), who apparently did not know the thesis of Rosenmüller writes about the flowstone covered bones from there: „*They seem to belong to a now unknown gender of bears, that possibly had their hideout in long past antique times and long before the time of Tacitus and that did there of old age. Others think of them as of bones of elephants*“. The publication of LASIUS (1789) is also remarkable for another point of view: He rejects the „Sündfluth“ (the Deluge) as being the cause of the bone beds. Rather he introduces the notion that the bone assemblages could have formed over long time spans. With this he could be the actual father of the so called „Buckland-hyaena-den-theory“ (BUCKLAND 1822, 1824; commented in ANONYMOUS 1823). This hypothesis suggests that the bone beds in caves accumulate due to carnivorous animals over thousands of years, most importantly by the activity of hyenas. According to SHAW (1992) this hypotheses was first voiced by HUNTER (1794), i.e. five years after Lasius. The most important publication en route to the cave bear certainly was the voluminous monograph of Johann Friedrich ESPER (1732-1781), „*Extensive Report of newly discovered Zooliths of Quadruped Animals in the Markgrafentums Bayreuth*“ (1774). This made a huge impression on fossil

collectors as evident from contemporary correspondence (see KEMPE et al. 2005, MAYER 1975). Esper, however, thought that those bones belong to the polar bear, claiming the deluge might have washed them in from the arctic.

After long negotiations Esper finally obtained in 1778 an *Ursus maritimus* jaw bone for comparative purposes. Still ESPER maintained that the unknown „Hauptthier“ (main animal) from the Zoolithenhöhle was a polar bear (ESPER 1778/1790). This identification led to a hefty quarrel among the experts of the time. While Camper rejected the polar bear identification (in MERCK 1786: 23-24) BLUMENBACH (1788) and BORKHAUSEN (1793) agreed to it. Even though Camper did see that the Zoolithen material did not represent polar bear bones, he still refrained from introducing a new species, rather he used for the unknown beast the term „Ignotum“. This term was quickly taken up by others and used until the final clarification of the question (HELLER 1972).

### **Proclamation of the species by Rosenmüller 1794**

Johann Christian Rosenmüller (1771-1820) enrolled at the University of Erlangen in 1792 to begin his medical studies (KLUGHARDT & ROSENDAHL 2000). There he not only laid the foundations for his later successful professional life as a professor of medicine, but Erlangen also was the starting point for many excursions into the countryside, cave explorations and palaeontological investigations, that Rosenmüller conducted in the region around „Muggendorf im Bayreuthischen Oberland“ in the following years (ROSENDAHL & KEMPE 2004).

Even though Rosenmüller left Erlangen already in 1794 - when he changed to the University Leipzig - he was occupied with fossil remains from the Franconian bone caves of the „Muggendorfer Gebirgs“ for many years to come. The first step was the investigation of a completely preserved bear skull of the Zoolithenhöhle at Burggailenreuth. He presented it as the object of his „dissertatio“ which he delivered on 22<sup>nd</sup> October, 1794, which earned him the academic title of a „Doktors der Weltweisheit“ (i.e. the equivalent of a modern PHD) at the Philosophical Faculty of the University Leipzig (ROSENDAHL & KEMPE 2004).

The complete title of his Latin thesis is: „*Quaedam de ossibus fossilibus animalis cuiusdam, historiam eius et cognitionem accuratorem illustrantia, dissertatio, quam d. 22. Octob. 1794 ad disputandum proposuit Ioannes Christ. Rosenmüller Heßberga-Francus, LL.A.A.M. in Theatro anatomico Lipsiensi Prosector assumpto socio Io. Chr. Aug. Heinroth Lips. Med. Stud. Cum tabula aenea*“. Only one year later he also published a translation of this paper as well (ROSENMÜLLER 1795). He may have done this to make his thesis more accessible to all his non-academic friends in the area, or just to be sure that his new species was not lost in the dusty archives of doctoral theses.

Thus he answered the question that Esper had left open when he discussed the nature of his „*unbekanntes Creaturen*“ twenty years earlier. Of all the



many writers which concerned themselves with bones from caves only Esper and Rosenmüller really made them the object of an extended scientific study. Why it fell to young and actually still inexperienced Rosenmüller, to officially put a Linnean name to the cave bear is not quite clear. We think that it involved the „scientific fashion“ of the time. German scholars (could it be the German inclination towards order?) quickly adopted the Swedish system to classify nature, while French and British researchers were slow in this respect. Since Rosenmüller was young and therefore inclined to test new methods, he may have taken the risk, of establishing a species based on just one skull. This was very risky in deed since Esper's had voiced the opinion that the skulls may fall within the variance of the - at the time - poorly known polar bear (*Ursus maritimus* PHIPPS 1774) nor that the cave bear was just a larger cousin of the brown bear (*Ursus arctos* LINNÉ 1758). Obviously Rosenmüller did not have the comparative material at hand to disprove these possibilities entirely. Whatever the real circumstances were, it certainly was a lucky and possibly heroic strike to give the cave bear its Linnean (mixed Latin and Greek) name: *Ursus spelaeus*. With the two papers of 1794 and 1795 Rosenmüller firmly established his claim that the cave bear must be regarded as a separate and extinct species. At the same time he also underscored that there were large mammals that - by one way or the other - became extinct (at least in Europe). This is already an important step towards later evolutionary concepts. In case of the cave bear it was even suggested that it was the evolutionary predecessor of the brown bear, an opinion which still was uttered by BIESE as late as 1934!

According to the conventions of the zoological nomenclature established by Carl v. Linné 1758 the complete designation of the species is: *Ursus spelaeus* ROSENMÜLLER 1794. In many publications *Ursus spelaeus* is also quoted with ROSENMÜLLER & HEINROTH 1794 as the initiators of the species (e.g., ERDBRINK 1953, KURTÉN 1955, TORRES PÉREZ-HIDALGO 1984, ARGANT 1996, SABOL 2001). This is incorrect since Johann Christian August Heinroth (17.1.1773 - 26.10.1843) was - in the title of Rosenmüller's thesis - quoted as an assistant present during the presentation of the thesis but not as the earner of an academic title. In 1794 Heinroth was a medical Bachelor at the University of Erlangen. He presented his own dissertation for a medical doctorate at the University Leipzig in 1805 (ROSENDAHL & KEMPE 2004). The title winning paper was therefore the individual effort of Johann Christian Rosenmüller, and the correct determination of the cave bear remains *Ursus spelaeus* ROSENMÜLLER 1794 (ROSENDAHL & KEMPE 2004). Nevertheless, Rosenmüller did not stop with the skull of the cave bear; rather he published in 1804 a much longer paper dealing also with the postcranial bones of the cave bear, thus completing the description of the species.

In spite of these focused publications (other species proclamations often came about more en passant, such as the naming of the cave lion by Goldfuss, 1810) it took a long time before the species name *U. spelaeus* was accepted. First there were authors which simply did not know Rosenmüller's work or that ignored it knowingly, second there were others which talked of the

„cave bear“ without mentioning Rosenmüller and finally there was a group that thought that they either needed to separate the species into two different species (not accepting the large sexual dimorphism of the *U. spelaeus*) or that wanted to establish even more species. This part of the story and specifically the role of Blumenbach (the name creator of the mammoth and the woolly rhinoceros) is given in KEMPE et al. (2005) in detail.

## Conclusion

The cave bear is, possibly after the mammoth, the most widely known animal of the extinct glacial fauna. Today we know that it was an exclusive European and West Asian species and that it predominantly was a plant eater that occupied wide areas in plains and high mountains likewise (KURTÉN 1976, MUSIL 1979, 1980, 1981, RABEDER et al. 2000, ROSENDAHL et al. 2000). As a loner each animal must have defended a large area and the number of individuals must have been much smaller than those of horses, bison, mammoths and other glacial gregarious animals. Nevertheless a large amount of bones are preserved, specifically in caves. During hibernation, old or weak animals or bears giving birth had a much larger chance to die than during their summer roaming. Thus the chances of accumulating bones was much larger for this species than for any other glacial species and over ten-thousands of years of cave occupation a few hundred dead animals could have accumulated a large bone bed (SOERGEL 1940). Even though, we can only study a fraction of these bone beds since much of it was mined in the Middle Ages and during the Period of Enlightenment for pseudo-medical purposes. Additionally, in the beginning of the 19<sup>th</sup> century, cave sediments were mined for their phosphate content. Again large bone beds were destroyed such as in the Drachenhöhle at Mixnitz (ABEL & KYRLE 1931). Nevertheless there are still large deposits of bones available in many caves which form a profitable field for the study of this interesting species. Morphometric studies (e.g., RABEDER 1989, 1999, RABEDER et al. 2000), analysis of ancient DNA (e.g., HÄNNI et al. 1994, LOREILLE et al. 2001, HOFREITER et al. 2002, 2004) and analysis of isotopes (e.g., GRANDAL D'ANGLADE & VIDAL ROMANI 1997, BOCHERENS et al. 1997, ROSENDAHL & GRUPE 2001) are modern methods which may tell us more about the phylogenetic history of this species as well as about the still unknown causes of its demise.

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## References

- ABEL, O. & KYRLE, G. (eds.) (1931): Die Drachenhöhle bei Mixnitz.- Speläol. Monographien, 7-8, 953 S., Wien.
- ANONYMOUS (1823): Comment on the Paper of Buckland of 1822.- The Albion: British, Colonial, and Foreign Weekly Gazette (Nachdruck aus London, Quarterly Review), 1 (30), 234; 1 (32), 1; 1 (33), 1.
- ARGANT, A. (1996): Sous-famille des Felinae.- In: GUÉRIN, C. & PATOU-MATHIS, M.: Les Grandes Mammifères Plio-Pléistocènes d'Europe.- 200-215, Paris.
- BEER, R. R. (1972): Einhorn, Fabelwelt und Wirklichkeit.- 2. Aufl., 234 S., München (Verlag Georg D. W. Callwey).
- BENZENBERG, J. F. (1806): Ein Brief des Herrn D. Benzenberg, Prof. der Astronomie zu Düsseldorf und Director der Bergischen Landesvermessung an den Herausgeber, über verschiedene Gegenstände, besonders über die neuen Tertienuhren mit Centrifugalpendeln (Nebst Fig. eines fossilen Bärenschädels auf Taf. III).- Magazin für den neuesten Zustand der Naturkunde, 12, 181-188, Weimar.
- BIESE, A. (1934): Höhlenkunde.- In: DITTLER, R. et al. (Hrsg.): Handwörterbuch der Naturwissenschaften.- 2. Aufl., 5. Bd. (Gewebe-Kützing), 485-490, Jena (Gustav Fischer).
- BLUMENBACH, F. (1788): Handbuch der Naturgeschichte.- Dritte sehr verbesserte Ausgabe, XVI, 715 S., Göttingen.
- BOCHERENS, H., BILLIOU, D., PATOU-MATHIS, M., BONJEAN, D., OTTE, M., MARIOTTI, A. (1997): Paleobiological implications of the isotopic signatures ( $^{13}C$ ,  $^{15}N$ ) of fossil mammal collagen in Scladina Cave (Sclayn, Belgium).- Quat. Res., 48, 370-380, Washington.
- BORKHAUSEN, M. B. (1793): Epochen der Schöpfung, oder über die Ausbildung der Erde und besonders ihre gegenwärtigen Oberfläche, aus Urkunden der Natur und den Denkmälern der Vorzeit geschöpft; in Briefen.- Rheinisches Magazin z. Erweiterung der Naturkunde, 1, 135 S., Giesen.
- BRÜCKMANN, F. E. (1734): De antro Scharfeldiano et Ibergensi.- Epistola itineraria, 34, Wolfenbüttel.
- BRÜCKMANN, F. E. (1739): Antra Draconum Liptoviensia.- Epistola itineraria, 77, Wolfenbüttel.
- BUCKLAND, W. (1822): An account of an assemblage of fossil teeth and bones of elephant, rhinoceros, hippopotamus, bear, tiger and hyaena, and sixteen other animals, discovered in a cave at Kirkdale, Yorkshire, in the year 1821; with a comparative view of .ve similar caverns in various parts of England and other parts of the continent.- Philosophical Transactions Roy. Soc. London for 1822, Part I, 40, 171-236, London.
- BUCKLAND, W. (1824): Reliquiae Diluvianae; or, Observations on the Organic Remains Contained in Caves, Fissures, and Diluvial Gravel, and on Other Geological Phenomena, Attesting the Action of an Universal Deluge.- 303 S., London (Ed., J. Murray, Albemarle-Street).
- CAVALLO, A. S. (1998): The Unicorn Tapestries at the Metropolitan Museum of Art.- Metropolitan Mus. of Art, 128 S., New York.
- CUVIER, G. L. (1821/24): Recherches sur les ossemens fossiles.- Second edition, published in in 7 vols., Paris.
- ECKSTORM, H. (1620): Epistola de Specu Bumanni, vulgo Bumannshol, ex: Historia terrae motuum complurium et praecipue eius etc..- 210-227, Helmstedt.
- ERDBRINK, D. P. (1953): A Review of Fossil and Recent Bears of the Old World. - With remarks on their Phyllogeny, Based upon their Dentition, 2 Vol.- 597 + 12 S. Deventer (Jan de Lange).
- ESPER, J. F. (1774): Ausführliche Nachricht von neuentdeckten Zoolithen unbekannter vierfüssiger Thiere, und denen sie enthaltenden, so wie verschiedenen anderen, denkwürdigen Grüften der Obergebürgischen Landes des Marggrauthums Bayreuth.- 148 S., Nürnberg (Georg Wolfgang Knorrs seel. Erben).
- ESPER, J. F. (1778/1790): Kurze Beschreibung der in den Osteolithen Grüften bey Gailenreuth ohnweit Muggendorf im Baireutischen neuerlich entdeckten Merkwürdigkeiten. [Fn.:] nach der von dem nun-mehr verstorbenen Herrn Superint. Esper über die ihm aufgetragene neuere Untersuchung, erstatteten Anzeige vom Jahr 1778, bearbeitet.- Fränk. Archiv, 1, 77-105, Ansbach.
- GESNER, C. (1669): Gesnerus redivivus auctus & emendatus. Oder allgemeines Thier-Buch: d. ist eigentl. u. lebendige Abb. aller vierfüssigen so wohl zahmer als auch wilder Thieren,

- sampt e. ausführl. Beschreibung / vormals durch Conradum Gesnerum in lat. Sprache beschrieben und nochmals durch Conradum Forerum ins Teutsche übers. In d. heutige teutsche Sprache gebracht u. erw. durch Georgium Horstium, in Verlegung Wilhelm Serlin, Frankfurt am Mayn.- Faksimilie Nachdruck, 1980, 392 + VI + 2 S., Hannover (Schlütersche Verlagsanstalt).
- GOLDFUSS, G. A. (1810): Die Umgebungen von Muggendorf, ein Taschenbuch für Freunde der Natur und Alterthumskunde.- 352 S., Erlangen (Johann Jacob Palm).
- GRANDAL D'ANGLADE, A., VIDAL ROMANI, J. R. (1997): A population study on the cave bear (*Ursus spelaeus* ROSENMÜLLER-HEINROTH) from Cova Eirós (Triacastela, Galicia, Spain).- *Geobios*, 30 (5), 723-731, Montpellier.
- GRAUTOPF, F. H., (1829/1830): Die lübeckischen Chroniken in niederdeutscher Sprache.- Chronik des Franciscaner Lesemeisters, 2 Bd., Detmar.
- HÄNNI, C., LAUDAT, V., STEHELIN, D., TABERLET, P. (1994): Tracking the origins of the cave bear (*Ursus spelaeus*) by mitochondrial DNA sequencing.- *Proc. Natl. Acad. Sci. USA*, 91, 12336-12340, Washington.
- HELLER, F. (ed.) (1972): Die Zoolithenhöhle bei Burggailenreuth/Ofr., 200 Jahre wissenschaftliche Forschung, 1771-1971.- *Erlanger Forschungen*, B, 5, 131 S., Erlangen.
- HOFREITER, M., CAPELLI, C., KRINGS, M., WAITS, L., CONARD, N., MÜNDEL, S., RABEDER, G., NAGEL, D., PAUNOVIĆ, M., JAMBREŠIĆ, G., MEYER, S., WEISS, G., PÄÄBO, S. (2002): Ancient DNA analyses reveal high mitochondrial DNA sequence diversity and parallel morphological evolution of Late Pleistocene cave bears.- *Mol. Biol. Evol.*, 19, 1244-1250, Oxford.
- HEINZE, W., ROSENBERG, H. (1908): Quellenlesebuch für den Unterricht in der vaterländischen Geschichte.- 6. Aufl., 2, Hannover-List, Berlin (Verlag von Carl Meyer).
- HOFREITER, M., RABEDER, G., JAENICKE-DESPRÉS, V., WITHALM, G., NAGEL, D., PAUNOVIĆ, M., JAMBREŠIĆ, G., PÄÄBO, S. (2004): Evidence for Reproductive Isolation between Cave Bear Populations.- *Current Biol.*, 14, 40-43, Cambridge.
- HORST, J. D. (1656): *Observationum Anatomicarum Decas.*- 34 S., Frankfurt (W. Serlinus & G. Fickwirth).
- HUNTER, J. (1794): Observation on the fossil bones presented to the Royal Society by The Margrave of Anspach.- *Phil. Trans. R. Soc.*, 84, 407-417, London.
- KEMPE, S. (2004): Der Bericht von Dr. Johann Christian Kundmann über seine Befahrung der Baumannshöhle anno 1708.- *Mitt. Verb. dt. Höhlen- u. Karstforscher*, 50 (3), 82-89, München.
- KEMPE, S., REINBOTH, F. (2001): Die beiden Merian-Texte von 1650 und 1654 zur Baumannshöhle und die dazu-gehörigen Fig.en.- *Die Höhle*, 52 (2), 33-45, Wien.
- KEMPE, S., DUNSCH, B., FETKENHEUER, K., NAUMANN, G., REINBOTH, F. (2004): Die Baumannshöhle bei Rübeland/Harz im Spiegel der wissenschaftlichen Literatur vom 16. bis zum 18. Jahrhundert: Lateinische Quellentexte.- *Braunschweiger Naturkundliche Schriften*, 7 (1), 171-215, Braunschweig.
- KEMPE, S., ROSENDAHL, W., DÖPPES, D. (2005): The Making of the Cave Bear - Die wissenschaftliche Entdeckung des „*Ursus spelaeus*“.- *Mitt. Komm. Quartärforsch. Österr. Akad. Wiss.*, 14, 89-106, Wien.
- KLUGHARDT, W., ROSENDAHL, W. (2000): Johann Christian Rosenmüller (1771-1820) - ein biographischer Abriss.- In: JERONO, J., STEIN, G. (Hrsg.): *Die Moggaster Höhle.- Jahrbuch Karst und Höhle*, 1998/1999, 89-93, München.
- KUNDMANN, J. C. (1737): *Rariora Naturae & Artis item in Re Medica, oder Seltenheiten der Natur und Kunst des Kundmannischen Naturalien-Kabinetts wie auch in der Artzeney-Wissenschaft.*- 1312 Spalten, 23 Bl., Breslau und Leipzig (Michael Hubert).
- KURTÉN, B. (1955): Sex Dimorphism and Size Trends in the Cave Bear, *Ursus spelaeus* ROSENMÜLLER and HEINROTH.- *Acta Zool. Fennica*, 90, 1-48, Helsinki.
- KURTÉN, B. (1976): *The Cave Bear Story.*- 1st ed., 163 (Columbia Univ. Press).
- KURTÉN, B. (1995): *The Cave Bear Story, Life and Death of a Vanished Animal.*- 163, Columbia Univ. Press.
- LACHMUND, F. (1669): *Oryktographia Hildesheimensis, sive admirandorum fossilium quae in tractu Hildesheimensi reperiuntur.*- 80 + 5 S., Hildesheim (J. Müller).
- LASIUS, G. S. O. (1789): Beobachtungen über die Harzgebirge, nebst einem Profilrisse, als ein Beytrag zur mineralogischen Naturkunde.- Hannover (Helwingschen Hofbuchhandlung) (Baumannshöhle 196-201 und 215-218).

- LEIBNIZ, G. W. (1749): *Protogaea*.- Goettingae (Descriptio antri Baumanniani, 67-69). - Deutsche Übersetzung durch W. v. Engelhardt, 1949.- 182 S., Stuttgart (W. Kohlhammer Verlag).
- LOREILLE, O., ORLANDO, L., PATOU-MATHIS, M., PHILIPPE, M., TABERLET, P., HÄNNI, C. (2001): Ancient DNA analysis reveals divergence of the cave bear, *Ursus spelaeus*, and brown bear, *Ursus arctos*, lineages.- *Curr. Biol.*, 11, 200-203, Cambridge.
- MASSALONGO, A. (1851): *Osteologia degli Orsi fossili del Veronese*.- *Naturwiss. Abh.*, 4 (4), 31-86, Wien.
- MAYER, G. (1975): Die Mineralien und Fossilienlieferungen des Freiherrn Carl Reinhard von Gemmingen in Ansbach an die Markgräfin Caroline Louise von Baden (1769-1778).- *Geol. Bl. NO-Bayern*, 25 (1), 46-51, Erlangen.
- MERCK, J. H. (1786) : Troisième lettre sur les os fossiles d'Elephants et de Rhinocéros qui se trouvent en Allemagne et particulièrement dans le pays de Hesse-Darmstadt adressée à Monsieur Forster.- 30 S., Darmstadt.
- MERIAN, M. (1650): *Topographia Superioris Saxoniae, Thuringiae, Misnae, Lusatiae etc.*: Das ist Beschreibung der Vornehmsten und Bekantesten Stätt, und Plätz, in Churfürstenthum Sachsen, Thüringen, Meissen, Ober und Niederlaußnitz und einverleibten Landen; auch in andern zu dem Hochlöblichsten Sächsischen Craiße gehörigen Fürstentumen (außer Brandenburg und Pommern) Graff: und Herrschaften etc.- 210 + 13 S., M. Merian, Frankfurt (Baumannshöhle 173-177 unter dem Eintrag Stolberg). Faksimile Ausgabe 1964, Nachwort von L. H. Wüthrich 10 S., Kassel und Basel (Bärenreiter-Verlag).
- MERIAN, M. (1654): *Topographia Germaniae: Topographia und Eigentliche Beschreibung der Vornembsten Stäte, Schlösser auch andere Plätze und Örter in denen Herzogthümern Braunschweig und Lüneburg, und denen dazu gehörenden Grafschafften, Herrschaften und Landen*.- 230 + 16 S., M. Merian, Frankfurt (Baumannshöhle 31-33, 63). Faksimile Ausgabe 1961, Kassel und Basel (Bärenreiter-Verlag).
- MUSIL, R. (1979): *Ursus spelaeus* - Der Höhlenbär, I. Teil.- Weimarer Monogr. Ur- u. Frühgeschichte, 2, 94 S., Weimar.
- MUSIL, R. (1980): *Ursus spelaeus* - Der Höhlenbär, II. Teil.- Weimarer Monogr. Ur- und Frühgeschichte, 2, 188 S., Weimar.
- MUSIL, R. (1981): *Ursus spelaeus* - Der Höhlenbär, III. Teil.- Weimarer Monogr. Ur- und Frühgeschichte, 2, 112 S., Weimar.
- PATERSON HAIN, J. (1673 a): *Observatio CXXXIX, de Draconibus Carpathicis*. - *Miscellanea Curiosa Medico-Physica Academiae Naturae Curiosorum, sive Ephemeridum Medico-Physicarium Germanicarum*.- Lipsiae & Francofurti, Sumptibus Haeredum Schnureri Gözianorum & Johannis Fritzschi, Typin Johann Georgii Drulmanni. 616 S. + Index, 257-259. [Anmerkung: die gleiche Veröffentlichung ist möglicherweise ein Jahr zuvor in der französischen Ausgabe der Zeitschrift erschienen: PATERSON HAYN, J. (1672): *Éphémérides des curieux de la nature, dec. I, an. III, obs. CXXXIX*.- 220.]
- PATERSON HAIN, J. (1673 b): *Observatio CXCV, de Draconum Carpathicorum Cavernis*. - *Miscellanea Curiosa Medico-Physica Academiae Naturae Curiosorum, sive Ephemeridum Medico-Physicarium Germanicarum*.- Lipsiae & Francofurti, Sumptibus Haeredum Schnureri Gözianorum & Johannis Fritzschi, Typin Johann Georgii Drulmanni. 616 + 31 S. Index, 366-370.
- RABEDER, G. (1989): *Modus und Geschwindigkeit der Höhlenbären-Evolution*.- *Schriftreihe des Vereins zur Verbreitung naturwiss. Kenntnisse in Wien*, 127, 105-126, Wien.
- RABEDER, G. (1999): *Die Evolution des Höhlenbärengebisses*.- *Mitt. Komm. Quartärf. Österr. Akad. Wiss.*, 11, 1-102, Wien.
- RABEDER, G., NAGEL, D., PACHER, M. (2000): *Der Höhlenbär*.- 111 S., *Species*, 4, Stuttgart (Jan Thorbecke Verlag).
- REINBOTH, F. (2001): *Über das „vermeinte bey Quedlinburg gefundene Einhorn“* - Ein Beitrag zur Geschichte der Paläontologie und der Leibnizforschung.- *Mitt. Verb. Dt. Höhlen- u. Karstforsch.*, 47 (4), 106-107, München.
- ROSENDAHL, W., DARGA, R., KÜHN, R., PACHER, M. (2000): *Der Höhlenbär in Bayern*.- 48 S., München (Verlag Dr. F. Pfeil).
- ROSENDAHL, W., GRUPE, G. (2001): *Mittelwürmzeitliche Höhlenbären und ihre Nahrungspräferenz* - Forschungen aus der Neuen Laubenstein-Bärenhöhle/Chiemgau.- *Mitt. Bayer. Staatsgl. Paläont. hist. Geol.*, 41, 85-94, München.
- ROSENDAHL, W., KEMPE, S. (2004): *Johann Christian Rosenmüller und der Höhlenbär (1794-2004)* - „Lebensbilder“ aus 210 Jahren.- *Natur und Mensch*, 2003, 145-159, Nürnberg.

- ROSENMÜLLER, J. C. (1794): *Quaedam de ossibus fossilibus animalis cujusdam, historiam ejus et cognitionem accuratorem illustrantia, disertatio, quam d. 22. Oc-tob. 1794. Ad disputandum proposuit Ioannes Christ. Rosenmüller Heßberga-Francus, LL. AA. M. in Theatro anatomico Lipsiensi Prosector assumpto socio Io. Chrs. Heinroth Lips. Med. Stud. Cum tabula aenea.*- 34 S., Leipzig.
- ROSENMÜLLER, J. C. (1795): *Beiträge zur Geschichte und nähern Kenntniß fossiler Knochen.*- 92 S., 1 unpag. S., Leipzig (Georg Emil Beer).
- ROSENMÜLLER, J. C. (1804): *Fig.en und Beschreibungen der fossilen Knochen des Höhlenbären. Description des os fossiles de l'Ours des Cavernes avec figures.*- 22 S., IV, Weimar (Verlag d. F. S. Privil. Landes-Industrie-Comptoirs).
- SABOL, M. (2001): *Geographical Distribution of Cave Bears (Ursus spelaeus ROSENMÜLLER et HEINROTH, 1794) in the Territory of Slovakia.*- Beitr. Paläont., 26, 133-137, Wien.
- SCHMERLING, P. C. (1833): *Recherches sur les ossemens fossiles découverts dans les cavernes de la Province de Liège, 2 Bd.*- 167 + 8 S., 195 + 8 + 10 S., Liège (P. J. Collardin).
- SCHRÖDER, C. F. (1796): *Naturgeschichte und Beschreibung der Baumanns- und Bielhöhle wie auch der Gegend des Unterharzes worin beyde belegen sind; nebst den Jahrbüchern der Bielhöhle von 1788 bis 1796.*- 2. Aufl., 223 S., Berlin (F. Vieweg d. Ält.).
- SERRES, M. de, DUBRUEIL, M., JEAN-JEAN, B. (1829): *Recherches sur les ossemens fossils des caverns de Lunel-Vieil (Hérault), troisieme article, Chapitre V des différentes espèces de mammifères terrestres, section première, des espèces carnassières.*- Mem. du Mus. d'Histoire Nat., 18, 313-356, Paris.
- SHAW, T. R. (1992): *History of Cave Science, the Exploration and Study of Limestone Caves, to 1900.*- 338 S., Sydney Speleological Soc., Broadway, New South Wales (Australia).
- SOERGEL, W. (1940): *Die Massenvorkommen des Höhlenbären, die biologische und ihre stratigraphische Deutung.*- 112 S., Jena (Gustav Fischer Verlag).
- TORRES PÉREZ-HIDALGO, T. (1984): *El oso de las cavernas (Ursus spelaeus ROSENMÜLLER-HEINROTH) de los niveles yacimiento de Ekañ.*- In: ALTUNA, J., MERINO, J. M. (eds.): *El yacimiento preistorico de la cueva de Ekañ (Deba, Guipuzcoa).*- 297-316.
- TSCHARNER, E. H. (1935): *Der mittelhochdeutsche Marco Polo.*- Berlin (Weidmann).
- VOLLGNAD, H. (1676): *Observatio CLXX. De Draconibus Carpathicis et Transsylvanicis.* - *Miscellanea Curiosa Medico-Physica Academiae Naturae Curiosorum, sive Ephemeridum Medico-Physicarum Germanicarum.*- 315 S., 226-229, Francofurti & Lipsiaus, Sumptibus Johannis Fritschii, Bibliopolae Lipsiensis.
- VOLPI, G. de (1821): *Über ein bey Adelsberg neuentdecktes Paläotherium.*- Maldinische Schriften, 31 S., Triest.
- WALCH, J. E. (1769): *Die Naturgeschichte der Versteinerungen zur Erläuterung der Knorrischen Sammlung von Merkwürdigkeiten der Natur. II. Teil., 2. Abschnitt.*- 233-234, Nürnberg.
- ZÜCKERT, J. F. (1763): *Die Naturgeschichte einiger Provinzen des Unterharzes nebst einem Anhang von den Mannsfeldischen Kupferschiefern.*- 60-63, Berlin (Friedrich Nicolai).

### Appendix 1:

Original quotation of HORST (1656: p. 10): *In Comitatu Mansfeldensi minerae eruuntur, quae pisces, dentes, cornua, animalia & alia exprimant. Juxta sylvam Semanam at radicem Arcis Brunsvicensis Scharzfeld vidi erui ossa, dentis, mandibulas varias, Ursarum, Leonum, hominum & aliorum animatum emulas. Varia talia fossilia possideo in Museo meo, & inter alia cranium suturis apprime distinctum. Sennertus allegat similia Ellingerodae inveniri. Est Clarissimo Dn. Conerdingio, Archiatro Brunsvicensi Excellentissimo, spina dorsi, in saxo reperta, affabrè vertebrae et spinosis processibus instructa, admiratione longè dignissima.*

Translation by Fritz Reinboth, Braunschweig, and Stephan Kempe, Darmstadt:

*In the dukedom of Mansfeld stones are excavated which depict fishes, teeth, horns, animals and other things (this refers to the copper slate of the Zechstein). Close to the Sermanic Forest (the Harz) at the foot of the Castle of Scharzfeld belonging to Brunswig I saw how bones, teeth, various jaw bones were excavated looking like those of bears, lions, humans and other living beings (which means from the Einhornhöhle). I possess in my collection several of these fossils among others a skull with well developed sutures. Sennertus quotes that he found similar specimens in Elbingerode (i.e. in the Baumannshöhle). The most admirable piece is a backbone, found fossilized by the famous Mr. Conerding, the acclaimed physician of Brunswig, and artfully composed of vertebrae and dorsal processes.*

(\* The text actually is ambiguous. The word „*emulas*“ most probably should be read as „*aemulas*“ and must be interpreted as the Akk. Pl. of the adjective „*aemulus, aemula, aemulum*“, with the meaning „being the likeness of“. „*Aemulas*“ refers - similar to „*varias*“ - to „*ossa*“. Thus it remains unclear if Horst really recognized the bones as those of bears, or if he thinks of them as of plays of nature after the image of bear bones. Also the mentioning of lions is interesting and leads to the question if he in fact saw bones of a cave lion and if he recognized them to be different from those of the bears).

Addresses of authors:

Prof. Dr. Stephan Kempe, Dr. Doris Döppes, Institut für Angewandte Geowissenschaften, Schnittspahnstr. 9, D-64287 Darmstadt, Deutschland; E-mail: kempe@geo.tu-darmstadt.de, ddd@geo.tu-darmstadt.de

Dr. Wilfried Rosendahl, Reiss-Engelhorn-Museen, Zeughaus C5, D-68159 Mannheim, Deutschland; E-mail: wilfried.rosendahl@mannheim.de





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