Revue de Paléobiologie, *Genève* (2024) 43 (1): 35-43 ISSN 0253-6730

The toad stone (*Scheenstia* tooth) on the reliquary of Saint Maurus at Bečov Castle (Czech Republic) and its significance

Růžena GREGOROVÁ[1] & Dana STEHLÍKOVÁ[2]

[1] *Moravian Museum, Department of Geology and Paleontology, Zelný trh 6, 659 37 Brno, Czech Republic, rgregorova@mzm.cz*
[2] *Department of Classical Studies, Faculty of Arts, Masaryk University, Arna Nováka 1, 602 00 Brno, Czech Republic, dana.stehlikova@phil.muni.cz*

Abstract
This paper deals with the oldest evidence of the use of a *Scheenstia* tooth (Mesozoic lepisosteiform fish) as part of the gem decoration on the early 13th-century reliquary of St. Maurus kept at Bečov nad Teplou Castle (Petschau in German, Czech Republic). Since the Middle Ages, these teeth have been thought to be toad stones found in the heads of toads. Until the discovery of the toad stone on the reliquary of St. Maurus, no tangible evidence relating to this stone from this period was known. The discovery of a fossil tooth on such an important sacred art object was preceded by a similar discovery of two teeth on the imperial crown dated to the 14th century and held in the Aachen Cathedral Treasury. Color variations in about 500 specimens of teeth from more than 24 European localities were studied to find out how the color of teeth differs both within one locality and between individual localities. The goal was to understand whether it is possible to determine the provenance of teeth set as part of gem decoration in the reliquary of St. Maurus and in the crown on the bust of Charlemagne in Aachen. In addition, a comparison of the colors of toad stones from the most important medieval sources with fossil *Scheenstia* teeth is discussed. Not all toad stones described in medieval literature can be identified with fossil teeth.

Keywords
Toad stone, organic gem, gemology, fossil fish tooth, *Scheenstia*, reliquary of Saint Maurus, Aachen crown, Bečov nad Teplou Castle, Florennes Abbey, medieval encyclopedias.

1. INTRODUCTION

The early 13th-century reliquary of St. Maurus kept at Bečov Castle, is one of the most important Romanesque monuments in the Czech Republic. Its origin, however, must be sought in the present-day Belgian city of Florennes where it was made directly for the Benedictine monastery to store the remains of St. Maurus, St. Timothy, St. Apollinaire, and St. John the Baptist. During the French Revolution, it was hidden in a local church, and in 1838, it was acquired by Duke Alfred of Beaufort-Spontin (1816-1888). Fifty years later, Duke Alfred's descendants moved the St. Maurus reliquary to their estate at Bečov Castle, in western Bohemia. During World War II, the family buried the shrine under the chapel floor. The reliquary may have been lost to history, but enquiries by an American treasure hunter put Czechoslovak authorities on the trail. It was rediscovered in 1985 and later in 2002, the precious shrine was declared an item of national cultural heritage. The complex history of the reliquary was also reflected in its artistic evaluation and analysis. Robert Didier (1988, 1990) published a detailed study of the reliquary relying on a series of excellent photographs taken in 1935 and preserved in the Marburg Archive. Further research was later carried out by Czech authors (Šidlovský, 2004; Hejdová, 2007). The shrine is classified as a work of Mosan-Rhine art, a regional style of Romanesque art, which emerged in the valley of the River Meuse, during the 11th, 12th, and 13th centuries.

ABBREVIATIONS

JME (Jura-Museum, Eichstätt); **JMP** (Jurassica Museum, Porrentruy); **LMH** (Landesmuseum, Hannover); **MHNN** (Muséum d'histoire naturelle de Neuchâtel); **MMB** (Moravian Museum, Brno); **MNHNP** (Muséum national d'histoire naturelle, Paris); **MNJ** (Museum of Nový Jičín); **NHMB** (Naturhistorisches Museum, Basel); **NHMW** (Naturhistorisches Museum, Wien); **NHMUK** (Natural History Museum, London); **SMF** (Senkenberg Naturmuseum, Frankfurt); **SMO** (Silesian Museum,

Submitted May 2023, accepted September 2023
Editorial handling: Marie-Anne Heran, François Thirion
DOI: 10.5281/zenodo.10732333

Opava); **ZMZ** (Zoologisches Museum der Universität Zürich).

MATERIAL

The following material of *Scheenstia* teeth was studied for color variations from the most important European Upper Jurassic to Lower Cretaceous sites. The number of specimens is given in parentheses. Due to the size of the teeth measuring more than 10 mm in diameter, we assume that the teeth belong to the species *Scheenstia maximus* (Wagner, 1863). This species is better known under the older synonyms, which are often found on the original museum labels: *Lepidotus maximus* Wagner, *Sphaerodus gigas* Agassiz, *Lepidotus giganteus* Quenstedt. Detailed information about the systematics of the genus *Scheenstia* is analyzed in López-Arbarello & Sferco (2011) and López-Arbarello (2012).

England: Potton (18), Shotower (29), Upware (7) in **NHMUK**
France: La Dive (12), Boulogne-sur-Mer (6), Hodenc en Bray (80), Auxerre (16), Grandpré (33), Wassy (19), Bar-sur-Seine (12) in **MNHNP**
Switzerland: La Joux (12), surroundings of Neuchâtel (cca 50) in **MHNN**; Porrentruy (7), Banné (2), La Sagne (6) in **JMP**; Sainte-Croix (11) in **NHMB**, **ZMZ**, **MNHNP**; Oberbuchsiten (cca 20) in **NHMB**; Thayngen (5) in **ZMZ**
Germany: Langenaltheim (20) in **SNF**; Eichstätt (8) in **JME**; Cananohe (29) in **LMH**
Italy: Trento (25) in **NHMW**, **ZMZ**, **NHMB**
Austria: Falkenstein (25) in **NHMW**, **ZMZ**
Czech Republic: Mikulov-Turold (20), Štramberk (20) in **MMB**, **MNJ**, **SMO**, **NHMW**

2. DESCRIPTION OF THE SHRINE

The reliquary is 138 cm long, 42 cm wide, and 64 cm high. The wooden shrine is covered with a gilded silver plate and decorated with many statuettes, filigree decorations, and gems (Fig. 1). As regards the decoration with precious stones, the reliquary is embellished with a total of 352 gemstones. These were studied during the restoration of the reliquary by Jaroslav Bauer in the 1980s; only handwritten notes of this exercise survive. In the next decade, Jaroslav Hyršl (1998 and 2021) examined the gemstones with some exceptions already in the embedded state. The gems were divided into four categories: ancient (i.e. almost certainly original), new (i.e. additions probably from the 20th century), unclassifiable (more likely original), and gems (mostly ancient). Quartz materials are represented in the largest number (crystal, amethyst, citrine, chalcedony, carnelian, agate, onyx, and jasper). In the second order are the glasses. In smaller numbers are sapphire, garnet, and zircon. From stones of organic origin, there are amber, pearl, shells, gagate, and the fossil fish tooth of the genus *Scheenstia* described here. This tooth was originally determined to be a chalcedony and is marked with the number 33-3 in the list of stones of Hyršl (1998).
The reliquary has recently been often remembered

Fig. 1: The left side of the reliquary of St. Maurus with the position of the toad stone (*Scheenstia* tooth), (blue arrow), Bečov nad Teplou, Photo archives Bečov nad Teplou Castle.

in connection with its opening and sealing of the holy remains. During the restoration work, some precious stones were also examined and determined. As it was suspected that the stone identified as chalcedony was more likely a fossil tooth, restorer Andrej Šumbera removed the stone from its setting (with the consent of the National Heritage Institute), so that the stone could be studied by R. Gregorová from the underside. The assumption that this is not a gemstone but a fossil tooth has indeed been confirmed.

The tooth is located in the upper row of the left side of the reliquary (from the front view of the statue of St. Maurus). It is set on a filigree plate on the right side below a medallion with the penultimate scene from the life of St. John the Baptist (Salome brings Herodias the head of St. John the Baptist). An orange faceted glass and orange chalcedony carnelian are set on the left side.

The tooth has a slightly oval shape with dimensions of 9.5 x 8.7 mm (Figs 2, 3). The apical side of the tooth forms a very slight taper. This character suggests that the tooth originates from the labial side of the jaws, where they had a biting rather than a crushing function (the teeth on the lingual side are spherical). The color of the enameloid is not homogeneous. The apex of the tooth is darker (grey-beige) than its base (brownish-beige). Small dark inclusions are trapped inside the enameloid. The tooth surface contains microstructures in the form of small pits and furrows which are typical for *Scheenstia* teeth. The tooth was neither abraded nor polished.

Fig. 2: Detailed photo of the toad stone (*Scheenstia* tooth) set in the filigree decoration. Photo © Petr Kříž.

Fig. 3: *Scheenstia* tooth taken out from the shrine. Photo © Petr Kříž.

3. THE SIGNIFICANCE OF THE TOAD STONE IN THE RELIQUARY OF ST. MAURUS

Recently, two fossil teeth have been identified on another unique art object (Gregorová *et al.*, 2020), namely the crown that decorates the bust of Charlemagne in Aachen Cathedral. Since the crown is dated with a question mark to the 14th century and its origin remains unknown, the reliquary is the oldest evidence of the use of the fossil tooth, and the only one in the field of sacral art. It should be noted that the presence of the teeth on two such rare artifacts is an extremely valuable finding, because until now, teeth were mostly known to be set in rings, very rarely also in other objects (e. g. Forbes, 1972; Duffin, 2010).

From the first half of the 13th century, when the reliquary was made, we have so far only written references to the rings, while rare exemplars have survived since the 14th century.

Both discoveries raise many interesting questions, which cannot be the subject of this article, but are worth mentioning at least briefly. In the Middle Ages, these fossil teeth were referred to as toad stones and were believed to come from the head of a toad. They have been ascribed magical powers, the most important of which

was the ability to detect and neutralize poison. If they were worn so that they touched the skin, in the presence of poison they were believed to burn the skin. In addition to the protective function of toad stones set in rings, the stones were also used internally to treat diseased viscera. Although such practical use of toad stones is described in medieval encyclopedias, nothing is yet known about their symbolic function on the crown and the reliquary, where they should be examined in the context of the whole decoration.

It is equally important to look for other occurrences of toad stones in medieval literature and to examine them in a literary-historical context. The reports on toad stones in Latin literature are well documented, but the vernacular texts also deserve attention, as the case of the poem *Tournoi de l'Antéchrist* from the first half of the 13th century by the French monk Huon de Méry shows (ed. Wimmer, 1994). Unlike the short references to other stones in this poem, the author talks about setting toad stones in the crown along with topazes and cameos, emphasizing that they are the rarest of them. It even includes the detail that the stone grows between the eyes of the toad. In the poem, the Antichrist has a crown with toad stones on his iron helmet, and the Archangel Gabriel strikes the devil's helmet with a sharp sword and takes the stones from him. We believe that the aforementioned Aachen crown offers an interesting analogy to this literary description. An interesting question is what inspired the French monk to decorate the crown with the toad stones in his narrative. Chrétien de Troyes, a French poet of the 12th century considered a predecessor of Huon de Méry, lists several precious stones in his five poems, but the toad stone is not named among them (Gontero, 2002). It is unclear whether the assignment of the meaning of the toad stone by Huon de Méry is a poetic invention of the author or if it came from a source unknown to us. Three centuries later, a toad stone motif appears in the oft-cited works of William Shakespeare and Francois Rabelais at a time when the popularity of the use of toad stones is the most widespread according to preserved rings in European museums (The British Museum London, The Ashmolean Museum Oxford, The Victoria and Albert Museum London, The Royal Danish Collection, The Royal Armoury Collections, Stockholm, Musée Cluny Paris, Museum für angewandte Kunst, Wien). Only two rings are dated to the 14th century, but most of them range from the 15th to the 17th century (Gregorová *et al.*, in preparation).

The outlined directions of research are within the purview of historians, nevertheless, paleontology can also contribute to further research on medieval toad stones, not only in terms of their identification on art objects. The color varieties of teeth encourage the question of whether the different coloring is dependent on the locality in which the teeth were found and whether, in the case of teeth used on art objects, it would be possible to identify the place of their origin and thus find out where medieval traders could have obtained them. Since we have no written records from the Middle Ages about the places where these teeth were found, we have tried to compare color variations of isolated teeth from the most important paleontological sites (Tab. I) with descriptions of the colors of toad stones in the most important medieval sources.

4. TOAD STONES IN WRITTEN SOURCES

A thorough review of the Latin and vernacular literature on toad stones up to the early modern period is given by Forbes (1972). His survey of medieval sources had to be supplemented and updated because Forbes did not always consult original Latin editions and did not consult all the passages that can be found in the sources.

The age of the reliquary belongs to the period when relatively abundant references to toad stones appeared in Latin encyclopedias. In our research, however, we have not only focused on encyclopedic texts from the first half of the 13th century. The ancient texts also deserve at least brief attention, because they were available to medieval readers. In each entry on the toad or toad stone, we were interested in a description of the appearance of the stone, which in most cases is limited to a mention of its color.

In the older literature, it is usually said that the earliest references to the toad stone are found in Pliny the Elder's *Naturalis historia* from the 1st century, in the *Kyranides* written originally in Greek and compiled three centuries later, and finally in the *Etymologiae* of Isidore of Seville from the second and third decade of the 7th century. All three texts can be ignored, however. As far as Pliny's encyclopedia is concerned (*Natur. hist*. 37, 55, 149; ed. Eichholz, 1962), it has been already shown that the stone called *batrachites* (*batrachos* means frog in ancient Greek) was a local Egyptian rock (Gregorová *et al.*, 2020; Harrell, 2012; Peacock & Maxfield, 2007). In the second text, the *Kyranides* collection, there is no mention of the shape or color of the stone, and therefore we cannot assess this record (for the English translation see Evans, 1922, p. 19). Moreover, in the encyclopedias of the 13th century, this source is not cited in the passages about toads or toad stones. Finally the third author, Isidore of Seville, in his encyclopedia, like Pliny, describes a stone called *batrachites*, but Pliny was obviously not the source (*Etym*. XVI, 4, 20; ed. Lindsay, 1911). Unlike that of Pliny, Isidor's stone could be something similar to a mollusc shell from which thin slices are peeled off. The author was certainly not considering a fossil tooth believed to be a toad stone because the teeth do not have the character of thin slices. Further notice of a stone from a toad's head is not found until the end of the 12th century when Alexander Neckam writes about growth lines on the stone that show how old the toad was (*De naturis rerum* II, 121; ed. Wright, 1863). We will probably never know what Neckam meant by comparing the growth lines with

Table I: Teeth color variation from the 24 Europen paleontological localities showing the great color variability among the sites but also within one locality, a big bold letter **X** means the most typical color.

Locality/color	black	dark grey	grey	brownish grey	brownish	beige	white	varicolored
Štramberk	x	**X**	x	x		x		
Mikulov						**X**		
Falkenstein	x	x	**X**					x
Trient			**X**	x			x	
Neuchâtel			**X**				x	
Sainte Croix					**X**			
La Joux			**X**					
Porentruy			**X**					
La Sagne			**X**	x				
Banné					x			
Thayngen	**X**							
Oberbuchsiten	**X**							
Wassy			x	x				
Bar-sur-Seine		x	x	x				
Auxerre				x				
Grandpré		x			x	x		
Hodenc en Bray	x	x			x			
Boulogne-sur-Mer	x	**X**						
La Dive	x				x			
Potton					x	x	x	x
Shotover	x	x	**X**	x	x			
Upware					**X**			
Wiltshire					**X**			
Isle of Wing	**X**							

the furrows of cattle horns. Anyway, we do not find this feature on fossil teeth and can exclude this identification. If we move to the first half of the 13th century, i.e. to the time of the reliquary's origin, chronologically the first evidence of the toad stone is the encyclopedia cited as *Experimentator* from the first half of the 1220s (ed. Deus, 1998). The anonymous author, however, speaks in general terms about the stone and neither gives it a name nor describes what the stone looks like. Significantly more interesting for us are the other texts from the first half of the 13th century, which mention the toad stone under two different names, *borax* and *nose*, eventually also providing the vernacular name *crapondine* (with several different graphic variants), and not agree in describing its appearance. These differences arose because information on the toad stone was taken from two different encyclopedic texts, whose authors used different sources for their chapters on the toad stone. Although we do not yet know all of them, it can be assumed that there was an older tradition, either written or oral, which, after all, could have been reflected in the description of the crown of the aforementioned Hugo de Méry.

The term *nose* is first attested in the encyclopedia of Arnold of Saxony (ed. Stange, 1906), a contemporary text to the *Experimentator* in which two species are spoken of, one which was whitish (*subalbidus*), the other varicolored or variegated (*varius*). Sometimes the form of a toad with outstretched legs is said to appear on this stone. The same information is repeated by Bartholomew of England in his encyclopedia *De proprietatibus rerum* (XVI, 71), completed no later than 1240 (ed. Pontano, 1601). At the same time, the first version of Thomas of Cantimpré's encyclopedia *De naturis rerum* was finished, in which the term *borax* was used and again two color variations of stone were mentioned, however, one should be white (*genus album*) and the other dark and black (*fuscum et nigrum*); the latter should have a yellowish eye in the middle (*De naturis rerum* 9, VII and 14, XII; ed. Boese, 1973). A little later, the encyclopedia

Speculum naturale by Vincent of Beauvais (*Spec. nat.* 8, 49 and 87; 20, 56 and 57; ed. s. n. 1624), the *Liber de mineralibus* by Albert the Great (*De min.* II, 2, 2 and 12; ed. Borgnet, 1890), and the third redaction of Thomas of Cantimpré's encyclopedia by an anonymous author (*De nat. rer.* 10.56; ed. Vollmann, 2017) were compiled, all of which already reflected the two names of the stone and the colors associated with them. Albert the Great adds two more pieces of information. In the *borax* entry, he states that he himself found a toad stone that was small and green. In the entry *nose*, he specifies the description of the color as being whitish, which the reader is to imagine as if the milk had been poured into the blood, leaving dark veins of blood.

Thus, the described color varieties of toad stones in medieval sources are: (1) white, (2) whitish, (3) whitish, as if milk were mingled with blood, (4) varicolored or variegated, (5) black or dark with a yellowish eye in the middle, (6) green. In the case of the name *nose*, it was also believed that the form of a toad with spread legs could appear on the stone. As far as the size of the stone is concerned, the stones had to be small because they were supposed to come from the toad's head. Furthermore, both Arnold and Bartholomew state that both types of stone (white and dark) are to be set (*includendi sunt*), presumably in a ring.

Regarding the material evidence of the teeth, it must be said that fossil remains including teeth belonging to the genus *Scheenstia* are widespread in mainly Upper Jurassic and Lower Cretaceous deposits throughout Europe. More than 500 specimens of teeth of the genus *Scheenstia* from 11 European collections and more than 20 European localities were documented to obtain an overview of the color variations and also an overview of the richness of the sites. It is one possible way to find the sites from which medieval goldsmiths obtained toad stones.

The comparison shows that the color varieties from medieval written sources largely coincide with the most typical colors of fossil teeth from known European localities. Most of these teeth are darker beige, brownish grey, and shades of grey. However, the white teeth described by medieval authors are known from the Italian locality Trento (Fig. 4A). The whitish color of medieval authors can probably be identified with light grey (Fig. 4B) and beige (Fig. 5), and these colors are known from several localities as well as varicolored teeth (Fig. 6). Dark color can be identified with shades of brownish grey (Fig. 7). Completely black teeth are known for example from the Swiss locality Thayngen, the English locality Shotover, and the Moravian locality Štramberk. It should be noted that these completely black shades of teeth were probably not popular, as they have not been recorded on art objects or rings so far. Interpretation of the whitish toad stone (*nose*) with blood veins described by Albertus Magnus is more complex, but it could refer to teeth that have a reddish-brown inclusion trapped inside the enameloid. We know such examples of the cabochons of rings, one from the Ashmolean Museum in Oxford (Fig. 8). The dark varieties with an eye described by medieval authors are, on the other hand, a typical feature of fossil teeth and we can record them in many European localities. A beautiful example is a ring cabochon from The Royal Danish Collection in Copenhagen, which has a yellowish eye in the middle (Fig. 9). The different color of the apex of the tooth is caused by the dentin showing through to the

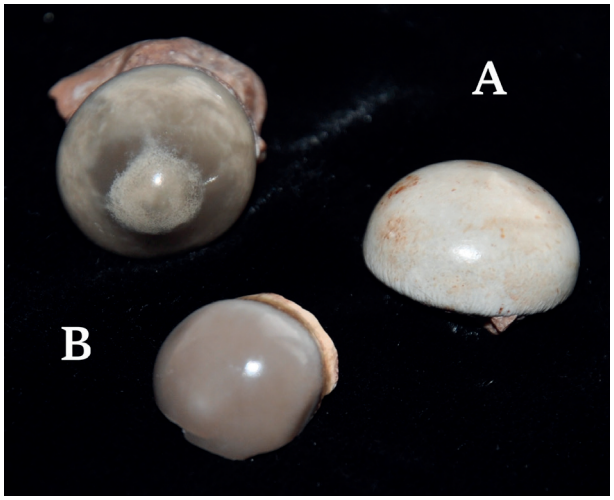

Fig. 4: *Scheenstia maximus*, A - white tooth (on the right), diameter = 16 mm, B - light grey teeth, diameter = 17 and 14 mm, Upper Jurassic, Trento (NHMW).

Fig. 5: *Scheenstia maximus*, light whitish (beige) teeth, diameter = from 10-12 mm, Upper Jurassic, Mikulov-Turold (NHMW).

Fig. 6: *Scheenstia maximus*, varicolored tooth, diameter = 18 mm, Upper Jurassic, Trento (NHMW).

Fig. 8: Charm (silver) ring with toad stone (*Scheenstia* tooth) with red-brown spot, WA1897.CDEF.F691, 15th–16th century. © Ashmolean Museum, University of Oxford.

Fig. 7: *Scheenstia maximus*, dark teeth with shades of brownish grey, Upper Jurassic – Neocomian, Bar-sur-Seine (MNHNP).

Fig. 9: Golden ring with toad stone (*Scheenstia* tooth) with a yellowish eye in the middle, 18th century. © The Royal Danish Collection, Rosenborg Castle, Copenhagen.

acrodin layer and different degrees of coloration during the diagenesis. The question mark is the green color of the toad stones mentioned by Albert the Great. We do not know teeth of this color from any locality, and therefore we do not know what kind of stone or mineral Albert considered toad stone to be.

5. DISCUSSION AND CONCLUSION

The fossil tooth of the genus *Scheenstia* (toad stone) on the reliquary of St. Maurus, kept at Bečov Castle (Czech Republic) represents the oldest evidence of its use on an object of sacred art. This is the period when there are relatively rich written Latin references to toad stones. We prove by color comparison that the medieval authors had in most cases in mind the fossil fish teeth as toad stones.

It is obvious that Isidore of Seville, Alexander Neckam, and Albert the Great (green variety) do not describe fossil teeth as toad stones, but other described color varieties of toad stones in medieval sources (Thomas of Cantimpré, Arnold of Saxony, Bartholomew of England, Vincent of Beauvais, Albert the Great) correspond to the large color scale of the teeth from the studied European sites. A certain color of the teeth is typical for each locality, but different color varieties of the same provenance have also been recorded. It is this circumstance that makes it impossible to determine the origin of the toad stones on the two artifacts mentioned above simply by direct observation and comparison of the tooth colors. However, more sophisticated methods such as Raman spectroscopy (Raman and photoluminescence spectra) are available for further investigation.

Despite this negative assessment, we would like to conclude by pointing out three isolated pieces of information that make an interesting intersection: (1) The origin of the 13th-century reliquary of St. Maurus is undoubtedly connected to the Florennes Abbey in Belgium. (2) At the same time, Thomas of Cantimpré was also active in this region (his life is not only bound up with this abbey near Cambrai but also with Louvain, Cologne, and Paris). It is noteworthy that Thomas is the first to provide original details about the toad stone that are not known in the older sources, including its vernacular name *crapaudine*, which testifies to the oral tradition associated with this "stone". (3) Although the origin of the crown preserved in the Aachen Cathedral Treasury is not precisely known, one of several hypotheses about its origin, proposed by Emanuel Poche, classifies it typologically among the crowns of the French type, referring to the crown preserved in the Cathedral of Amiens (Poche, 1982). All these points lead us to one geographical area, which also includes a paleontological site rich in teeth of the genus *Scheenstia*. We can therefore make a preliminary hypothesis that the fossil teeth used in the reliquary of St. Maurus, and possibly also the teeth of the Aachen crown, may have come from known paleontological sites in the departments of Ardennes, Burgundy, Haute Seine, Aube – the closest region to where these art objects originated, assuming that medieval goldsmiths used local resources.

ACKNOWLEDGEMENTS

This paper appears through the institutional support of long-term conceptual development of research institutions provided by the Ministry of Culture (ref. MK000094862). We thank Tomáš Wizovsky, castellan of the castle Bečov nad Teplou, and the National Heritage Institute for enabling the study of the reliquary of St. Maurus. Mathias Harzhauser and Ursula Göhlich for providing comparative material for this study from the collection of NHMW, Alan Pradel from the collection of MNHNP, Loic Costeur from the collection of NHMB, Thierry Malvesy from the collection of MHNN, Damien Becker from the collection of JMP, Christian Klug from ZMZ, Emma Bernard from the collection of NHMUK. We thank Lionel Cavin for fruitful discussions on the issue of tooth variability in the genus *Scheenstia*.

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