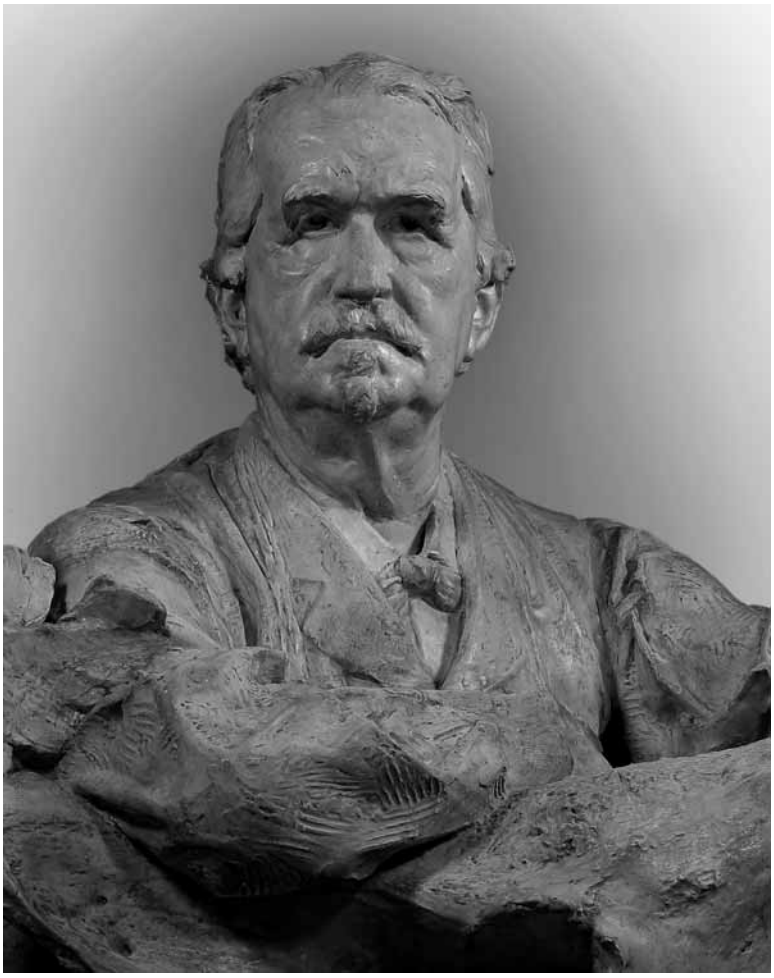

PROF. DR. ANTONÍN FRIČ (30. 7. 1832 – 15. 11. 1913)

V letošním roce si připomínáme sté výročí úmrtí vynikajícího českého přírodovědce Antonína Friče. Jeho činnost zasáhla do několika oborů přírodních věd, a to především ornitologie, ichtyologie, hydrobiologie, geologie a paleontologie. V některých z nich, zvláště paleontologii, si vydobyl mezinárodní věhlas.

Fričova profesní dráha byla od samého počátku pevně spjata s nově vznikajícím Národním (tehdy Vlasteneckým) muzeem, jehož rozvoj výrazným způsobem ovlivnil, později jako ředitel zoologických a geologicko-paleontologických sbírek. Byl také řádným profesorem Univerzity Karlovy a jedním z nejaktivnějších členů Komitétu pro přírodovědecký výzkum Čech.

Mnohé vědecké práce, publikované před více než sto lety, jsou dodnes jako výchozí podrobné monografie používány jak profesionálními, tak amatérskými badateli. Ve své profesní kariéře se Frič neomezoval jen na vědecká pojednání, ale soustavně se věnoval i popularizaci vědy a především díky ní zaujal širokou veřejnost. Nepřímo tak vychoval mnoho mladých přírodovědců a pro sbírky Národního muzea vlastními sběry, mezinárodní výměnou i nákupy získal velké množství mimořádně cenných exponátů.

K Fričovým stěžejním vlastnostem patřila cílevědomost, pracovitost, praktický vztah k řešení problémů a vysoké nároky kladené jak na sebe, tak na své kolegy. Z toho občas pramenily neshody se svým okolím, ale je nutné mít na paměti, že právě tyto vlastnosti ho předurčily k úspěšné vědecké kariéře. Bez nich by česká i světová věda byla ochuzena o velice hodnotné výsledky jeho práce.

This year, we commemorate the 100th anniversary of the death of an exemplary Czech natural scientist, Antonín Frič. His activities reached into many fields of natural science, primarily ornithology, ichthyology, hydrobiology, geology and paleontology. In some of these fields, particularly paleontology, he acquired an international reputation.

Frič's professional life was joined from the start with the newly emerging Patriotic (then National) Museum, whose development he strongly influenced, later even as a director of zoological and geological-palaeontological collections. He was also a ranking professor at Charles University, and one of the most active members of the Committee for Czech Natural Science.

Many of his scientific works, published over one hundred years ago, are still used as scientific references today, by both amateur and professional researchers. In his professional life, Frič did not limit himself to only scientific work, but also to popularizing scientific subjects, which earned him much public renown. Indirectly, he also inspired many young scientists, and acquired a great deal of valuable material for the National Museum, via his own collecting activities, as well as international exchanges and purchases.

Frič was also a difficult character, due to his intense goal orientation, industriousness, practical approach to problem-solving, and demanding nature, with regard to both himself and his colleagues. This sometimes led directly to personal clashes, but it is necessary to remember that it was exactly these characteristics that predisposed him to a successful scientific career. Without them, Czech and foreign natural science today would not have the benefits of his valuable contributions.

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FRIČ MUSEUM IN LÁZNĚ BĚLOHRAD

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Abstract. The town of Lázně Bělohrad, not far from Jičín, acquired its name in 1905. Until then, it was known as just Bělohrad. The spa (Lázně) was founded in 1888, when the long-known baths were officially acknowledged to have healing effects. In 1900, the newly opened moorland spa became a frequent destination for Dr. Antonín Frič. His summer stays there became a yearly ritual, consisting always of several weeks with his wife, and later also with their grandchildren, Karl and Toníček. This tradition continued until his death in 1913. It wasn't only the healing baths that benefitted the elderly man's health, but the surrounding countryside offered interesting geological material for study.
Frič soon gained the respect and deference of the local inhabitants, which enabled him to introduce a suggestion in 1903 – to found a new museum building in the rapidly growing town, constructed in accordance with all the then-recognized principles of museum design. Thanks to Frič's propagation and enlightened direction, the museum became a prime example for many subsequent cities and towns that decided to emulate Bělohrad.

FRIČOVO MUZEUM V LÁZNÍCH BĚLOHRAD

Abstrakt. Městečko Lázně Bělohrad nedaleko Jičína dostalo své dnešní jméno až v roce 1905, do té doby bylo známo pouze jako Bělohrad. Základ zdejšího lázeňství se traduje rokem 1888, kdy byly oblíbené vanové lázně úředně uznány za léčivé. Za zdejšími slatinnými koupelemi začal do nově zřízených lázní od roku 1900 jezdit i profesor dr. Antonín Frič. Jeho letní pobyt se stal každoročním rituálem, setrval zde vždy několik týdnů s manželkou, později i s vnoučaty Karlem a Toničkou, a to pravidelně až do své smrti v roce 1913. Nebyly to jen léčivé koupele, které starého pána uzdravovaly, Bělohrad se svým okolím dokázal přírodovědci na odpočinku nabídnout velmi zajímavý studijní materiál geologického charakteru.
Frič si záhy zjednal mezi zdejším obyvatelstvem respekt a úctu. Proto také mohl bez obav přijít v roce 1903 s návrhem, zbudovat v tomto, především díky lázeňství, rychle se rozvíjejícím městečku, samostatnou budovu městského muzea, navrženou a postavenou podle všech tehdy platných muzejních pravidel. Z nové muzejní budovy se velice rychle, také díky důsledné Fričově propagaci a osvětě, stal vzor pro mnohá další zemská města a městečka, která se rozhodla město Bělohrad následovat.

■ Lázně Bělohrad, Frič museum, museology, Antonín Frič

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"it is bitter to live in an area,
and know little about it"

A. E. Reuss[1]

The idea to build an exemplary regional museum, and use it as a showcase for methods of organizing and presenting its collections was a long-term ideal of Dr. Frič. His interest in such matters dated back to his youth. He published his first work in this vein, titled *Guide to ordering Animal Collections*, at age nineteen (before graduating!) in the Czech Museum Magazine (hereafter ČČM)[2]. His foundation and experience for this publication came from his knowledge of preparing birds and mammals, gained in childhood. He acquired further experience as a volunteer for zoological collections of the Czech Royal Museum (hereafter just Museum), where he began going in 1849. During his trips, both domestic and foreign, he not only worked on collecting specimens, but also visited museums. He went to both small, local museums, as well as renowned European ones, and zoos. Here he gained experience and information, acquired contacts, negotiated specimen exchanges and vital professional literature exchanges. After graduating from the school of medicine, Frič travelled to London in May of 1860. Upon his return, he organized a lecture about the Kensington Museum[3] and its educational activities, accompanied by a small exhibit. He repeated his

[1] August Emanuel Reuss (1811–1873) natural scientist, primarily geologist and paleontologist, played a great role in research in Bohemia. This quote was a favorite of Antonín Frič in his articles and lectures.

[2] Czech Museum Magazine (hereafter ČČM), yr. 25, vol. III, 1851, *Guide to ordering Animal Collections (Navedení ke zřízení sbírek živočišných)*, pp. 3–29. Frič describes the need to organize collections of stuffed animals for various institutions, mostly schools and museums, and advises how to assemble such collections. He offers an overview of necessary tools and materials, work procedures and suggests methods on how to subsequently store such assembled collections.

[3] Today's Victoria and Albert Museum, founded in 1857, intended then for presenting results of scientific research in industry and art, aimed first of all at educational activities. More about the museum's activity is in the book by Antonín FRIČ: *Dvě cesty do Londýna*, *Popis vzdělávacích ústavů Londýnských spolu se zprávou o poučných částech světové výstavy* (*Two journeys to London, description of London educational institutions together with information on instructional parts of world-class exhibitions)*, Prague 1864, p. 21–25.

trip to London two years later, at a time when there was a large international exhibition. The Prague board of elders sent him there with the specific goal of learning about pedagogical activities: assembling a report about English schooling, its use of supplementary material, textbooks, maps and other school materials, methods of storing collections and use of classroom furniture. Many Czechs visited the world's fair in London, and here arose the initial decree to create a Czech industrial museum, of which Frič had long been a proponent[4]. He spent ten weeks in London and purchased a great deal of material for Prague and for the Museum. Upon his return, together with his friend Vojtěch Náprstek, who had been in Prague with him, he organized a very successful and popular exhibition of supplementary educational material on Střelecký Island in the center of Prague, along with numerous professional lectures[5]. The exhibition comprised, besides practical teaching objects, huge tables and diagrams, supplemented by industrial-character items, both for domestic and production use. Another exhibition designed directly by Frič was presented during the second conference of physicians and natural scientists in Prague in 1882. At the time it was a novelty; no conferences before or after were accompanied by such an exhibition. The initiator and primary organizer was Frič again, "*the man of exhibitions and museums, experienced teacher, whose succinct prose, understandable by every layman, can attract the attention of the masses*"[6]. Ten years later, Frič fully devoted himself to organizing a fishing exhibition during the Jubilee Exhibition of 1891. Another of his undertakings was exhibiting items acquired during a trip to America in 1899. Nor can we forget his significant role in organizing and displaying collection items in both the old and new buildings of the National Museum. We can confidently proclaim that during his life, Frič became an expert in the theory of museology, which he repeatedly confirmed in practice[7].

Starting in the 1870s, Frič wrote about the necessity and need for creating local museums, which would gather natural materials from their immediate surroundings, along with ethnographic materials[8]. His wish was that local museums would be in independent buildings, serving only to house the museum, possibly also for display purposes. In the latter half of the 19th century, many such museums were created, but never in purpose-built buildings of their own. There remained no other course but to take matters into his own hands.

Frič celebrated his 71st birthday with his wife Marie once again in Bělohrad. At that time, he no longer taught at the university. He had retired and so had time to devote to his lifelong dream – a paradigmatic museum. The first sketches for a new museum building are dated July 31st, 1903, after his birthday, and the penmanship on the sketches seems to indicate that Frič himself was the artist. (text-figs 1a and 1b)[9]. A month later, a four-member committee was assembled, comprising Professor Dr. Antonín Frič and three distinguished citizens of Bělohrad: merchant Jindřich Pižl, mayor and hotelier Václav Vlach and city school principal Alois Hoch. The committee issued a printed proclamation stating its plan to build a museum on parcel #98/3 in Raisovi Sady. The county board of directors provided the parcel at no cost, due to which it was expected that the county would assume responsibility for the building after all construction costs were paid. Plans for the museum were drawn up by engineer Otto Tille[10], a Prague architect and builder, and Frič's son-in-law. The plans are dated October 17th, 1903, drawn on translucent paper, but not signed[11]. The budget and construction was directed by local builder Jan Poličanský, aided by local craftsmen: painter Čeřovský, locksmith F. Číp and glazier Ráliš. In accordance with Frič's desires, Tille drew up plans for a single-story building without windows in the outer walls. Light was provided by six ceiling windows, which were pointlessly removed during a subsequent reconstruction – light from above was one of Frič's primary design points. An advantage of the design was that it created a 65 square meter display surface (the museum's area was only 6.5 x 9.5 meters – text-fig. 2). The building had basements, intended for rough work and tool storage. Entrance was via a dual spiral staircase, adorned with columns. Four of them had metal flowers - agave, created by Prague tinsmith Kusý.

Construction began October 20th, without a construction permit. Frič applied for one personally on November 7th, and received it within five days, signed by mayor Vlach[12].

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4 More about the circumstances surrounding the birth of the industrial museum and exhibitions that preceded it are to be found in the article by Milena SECKÁ, *Náprstkovo muzeum asijských, afrických a amerických kultur slaví 140. výročí svého založení.* In: Muzeum 51, č. 1, 2013, p. 17–29.

5 Antonín FRIČ, *Popis výstavy na střeleckém ostrově*, Praha 1863.

6 This is how Frič was described by the co-author of the exhibition, J. Kafka. Josef KAFKA, *Z výstav a museí.* In: Antonín Frič, vzpomínky k 70. narozeninám, Prague 1902.

7 Articles and lectures by Antonín Frič about organizing museum collections have been published under these titles: Antonín FRIČ, *Návrh k zřízení přírodnického Musea*, ČČM, ed. 39, vol. IV, 1865, p. 317–330. TÝŽ, *Geologické museum v Praze*, Vesmír, ed. V., 1876, p. 270. TÝŽ, *O otázce musejní*, Zprávy spolku architektů a inženýrů v království českém. Book 1, 1884. Also published in Vesmír, ed. XIII, 1884, pp. 242–244. TÝŽ, *Zásady zřízení sbírek přírodnických v novém museu v Praze*, Vesmír, ed. XVII., 1888, pp. 91, 111, 126. (Also published in German titled *Principien der Organisation der naturhistorischen Abtheilung des neuen Museum zu Prag.* Vortraggehalten in der Jahresversammlung der Museumsgesellschaft am 22. Jänner 1888.).

8 Antonín FRIČ, *O zakládání místních museí ve větších městech českých*, Vesmír, ed. III, 1874, pp. 32–34. TÝŽ, *O místních musejích*, Vesmír, ed. XI., 1881, p. 39. TÝŽ, *O místních museích a školních sbírkách*, Národní listy 1906, also published in *Dějiny místního musea v Lázních Bělohradě,* Prague 1906. TÝŽ, *O místních museích v Čechách*, Živa, ed. XXI, #2, 1911. (also in German).

9 National Museum Archive (hereafter ANM), fund Antonín Frič, Pamětní kniha (hereafter PK) #4, fol. 23.

10 Otto (sometimes Otton) Tille, (Jan. 25, 1863 - Oct. 24, 1941) architect and teacher, married Frič's daughter Marie on May 6th, 1895. ANM, fund A. Frič, PK 5, fol. 87. As a builder, he worked in Prague, where he constructed several apartment building in Old Town and New Town, and Lesser Side. The museum in Bělohrad is his only known non-Prague construction. *Encyklopedie architektů, stavitelů, zedníků a kameníků v Čechách*, ed. Pavel VLČEK, Prague 2004, p. 663.

11 Lázně Bělohrad municipal board, construction board, construction documentation of parcel no. 191 - Frič's museum. It came into the construction board's possession in 1953; comment in lower part of sketch refers to the estate of mayor Václav Bekr (in office 1921-1927).

12 Lázně Bělohrad municipal board, construction board, construction documentation of parcel no. 191 - Frič's museum, file no. 769, Nov. 12, 1903.

This mayor was the same Vlach who built one of the first hotels in the spa town, in which Frič was a regular guest, and in which he even had an office installed (text-fig. 3). Consequently, Frič's construction permit was addressed directly to Bělohrad, where he probably lived in order to supervise the construction, since the entire project was his responsibility, both professionally and legally. On October 22nd, 1903, Frič sent a short article to the National Register about the commencing construction, individually naming and thanking all sponsors and benefactors. Besides money, which arrived via a publicly announced fund-raising campaign, building material was donated by local construction companies (bricks, rock and rock portal). Those who were able to do so loaned the project construction carts and tools. Work proceeded rapidly; the roof was on by winter. A photograph from November of 1903 documents the progress[13]. The partially completed building survived the winter in good order, a fact that Frič did not fail to mention the following spring in his press release[14]. In the meantime, work continued on the museum's interior. A display case arrived from Prague, built to Frič's specifications. Using that as a guide, a local carpenter built the remaining thirteen cases (text-fig. 4). School principal Hoch worked all winter under Fric's direction on a large geological map of Bělohrad and it surroundings. It measured a respectable 4 x 2.25 meters, drawn in oil on canvas. During his next summer therapeutic visit to the spa, Frič organized the first public lecture in the unfinished building, which took place on August 8th, 1904, at 5pm[15]. In his speech, Frič again appealed to city representatives in attendance, that the museum should serve for strictly local collections, and that nobody should be embarrassed to decline items from elsewhere. After the lecture, he personally conducted guests on a tour of the museum building and enthusiastically explained what had yet to be completed. The museum's outfitting was entirely in Frič's hands. Hoch's geological map dominated the front wall; directly under the map was Frič's own cross-section of Bohemia, traversing from Jičín to the Krkonoše foothills, and samples from all minerals shown in the cross-section, most gathered by Frič himself (text-fig. 5). Local flora and fauna were displayed in sequentially arranged display cases, positioned in the center of the room. Baseplates, display frames, hangers – all were made according to Frič's designs and wishes. Display cabinets, made according to the sample were dispersed along two walls. On the right, archeological and ethnographic collections, supplemented by samples of local design and art (textiles, buttons, baskets). On the left, rocks and fossils from the area, including mineral samples, later supplemented with precious and semi-precious gems, donated by the school in Turnov.

Frič expected that collection items would initially be those already collected, to be continuously supplemented from private collections of local inhabitants, once the building was completed and interest grew. He donated many of his own items, as can be seen from the museum's accession book[16]. He even had to defend himself against accusations that he had given Czech Royal Museum items to the Bělohrad museum without permission. Frič defended his gift with the statement that, via the exchange of duplicates, he had acquired valuable Permian and Cretaceous fossils, which manipulations are well within the rights of a collection's manager[17].

The museum was festively inaugurated and handed over to the public on September 12th, 1904 – less than a year after construction started. Flags in national colors flew over the museum, people showed up in national costume, the Sokol organization attended, music played, choral ensembles performed and speeches were presented (Frič, Vlach, Hoch and hetman Jaroslav Pecka). Even congratulatory and well-wishing telegrams were shown off. The National Register carried an article about the museum's opening on September 9th, 1904 (text-fig. 6). Largely due to Frič's propagation, the new museum building very quickly became an example followed by numerous other numerous other towns that decided to emulate Bělohrad. Among the first were Choceň and Skuteč[18]. Frič had demonstrated in Bělohrad that such a project could be managed even on a quite modest budget, of course, assuming that the local government provided a suitable property and the local populace became interested enough in the project to support it[19]. According to published accounts, the budget for the project was 5,000 Czech crowns for construction, 3,000 crowns for furnishing and outfitting. The fund-raising continued slowly, and so in 1905 a lottery was announced in connection with an exhibition containing paintings and statues from noted artists[20]. The exhibition committee handed in 1200 crowns after the exhibition ended, and

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[13] Antonín FRIČ: *History of local museum in Lázně Bělohrad*, Prague 1906, p. 6 - photo J. Pižl.

[14] ANM, PK 4, fol. 23 and fol. 28, May 28, 1904, publication unnamed.

[15] Invitation stored in ANM, PK 4, fol. 27. Lecture text Publisher under title *Přednáška o významu musea v Bělohradě,* Vesmír, ed. XXXIII, p. 258, 1904.

[16] Accession book no. 1 of Frič's museum is bound in solid covers and stored in the Frič museum archive, in the care of the city's cultural center. It does not have a title, but starts right in 1904. Another book was started in the museum in 1975, but currently, donated items are registered in the 1904 book again.

[17] ANM, fund RNM, call no. 1330 and call no. 1360.

[18] ANM, fund A. Frič, PK 4, fol. 30, *P.t. občanstvu okresu skutečského!* Committee proclamation of the future Skuteč museum from 1909. Also on fol. 36 is a small sketch of the future building with Frič's comment „*náčrtek Ottona k museu v Chocni, 1910*". How the museum was actually supposed to look and what were to be its contents, and therefore even its method of operation, Frič described in h is article *O místních museích v Čechách* (*About local museums in Bohemia),* published in 1911in Živa, ed. XXI, no. 2. The article was published as a one-sided PR flyer.

[19] Until his death, Frič promoted this museum using various articles and publications. Antonín FRIČ,*O místním museu v lázních bělohradských u Jičína*, Vesmír, ed. XXXIII, p. 159, 1904. TÝŽ, *The new local Museum in Bad Bielohrad near Jitschin, Bohemia*, Museum Journal for Juny 1905. TÝŽ, *Úvodní sbírka geologická v museu Bělohradském*, Vesmír, ed. XXXIV, p. 256, 1905. TÝŽ, *Stručný popis musea v Bělohradě*, Vesmír, ed. XXXIV, p. 52, 1905. TÝŽ, *Vnitřní zařízení musea Bělohradského*, Vesmír, ed. XXXIV, p. 147, 1905. TÝŽ, *Dějiny místního musea v Lázních Bělohradě,* Praha 1906, (also in German and English versions).

[20] MKS Bělohrad – Frič Museum archive, call no. 111, *Katalog umělecké výstavy v lázních Bělohradě 23. 7.-19. 8. 1905*. Ballot from this exhibition stored in ANM, fund A. Frič, PK no. 4, fol. 26.

additional funds came from volunteer presentations and the spa orchestra. Outfitting of the museum was aided by Frič's persistence in securing subsidies from the ministries of culture and education. After all financial arrangements had been concluded, and the museum had cleared all debts (seven years), it was formally transferred into the county's care and ownership, with emphasis on the fact that the museum's collections were strictly the property of the public, which had also contributed immensely to their assemblage.

After its opening, the museum's director became Alois Hoch, who not only cared for the collections, but faithfully and conscientiously carried on with gathering additional items, organized lectures and exhibitions, and looked after the library, which was housed in the museum at the time. The collections grew rapidly, and so in 1924, an expansion of the museum was approved. The architect was once again Tille, construction was by Josef Janáček and the Hišman company. Two wings with overhead lighting were added to the existing structure (text-fig. 7). One room was for displaying collections, the other was to serve as a depository and office. However, the collections grew so rapidly that even before the war, plans for an additional expansion were under consideration. The new plans called for a separate office for the museum's director, display rooms, and storage. But the war put an end to such plans and the museum was even closed for a time. In 1945, the Museum Committee requested part of the confiscated castle of the Merveldt family, but did not receive the requested rooms on the ground and second floors[21]. Eventually all plans for expansion or relocations were scrapped and the museum remained in its original home. It continued there until the 1970s as a branch of the county museum in Nová Páka. Some reconstruction was carried out, during which interior doors were replaced by aluminum and the ceiling windows were removed, destroying the overhead natural lighting effect that was so important to Frič. Subsequently, Frič's museum was declared superfluous and closed for many years; collections were partially looted, partially distributed to surrounding museums. Finally, in 1994, the museum was reconstructed and reopened, with some of the original collections even returned, but unfortunately, not all. Some exhibits still bear the original descriptive panels, reminding visitors of Frič's presence here. Several glass cylinders with taxidermic specimens still bear the labels from the shop of Václav Frič in Prague. Hoch's enormous geological map has been restored, but the mineral samples originally displayed below have not been returned. The museum is currently (2013) open to the public May – September, and only for seven hours per week.

For his tireless efforts to advance the cause of the spa town, Professor Dr. Antonín Frič was made an honored citizen in 1912. He died soon thereafter, November 15th, 1913. After his death, the museum was renamed Frič's Museum and his name is still prominently displayed on the building's frontispiece (text-fig. 8). Frič's museum does not bear only his name; with a bit of hyperbole, it can be said that it was his third child. It is important to note that Frič's success in creating the museum was due in large part to assistance of his close associates. Among the contributors to the museum project we find all the members of the extended Frič family, relatives on his wife's side, i.e. the Perners from Týnec nad Labem, his colleagues from the Prague Museum, fellow professors, assistants and students, and Prague booksellers and publishers. Without them and their financial assistance, Frič would have had a much more difficult time of it.

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„trpko jest v krajině bydleti
a málo o ní věděti“
A. E. Reuss[22]

Nápad, postavit vzorové regionální muzeum a příkladně uspořádat a předvést jeho sbírky, nosil profesor dr. Antonín Frič v hlavě dlouho. Zájem o pořádání a vystavování sbírek, a to nejen přírodnin, projevoval již od mládí. Svou první odbornou práci v tomto oboru, nazvanou *Navedení ke zřízení sbírek živočišných*, vydal ve svých devatenácti letech (ještě před maturitou!) v Časopise českého musea (dále ČČM).[23] Podklady a zkušenosti pro napsání odborného článku uplatnil díky dobrým znalostem preparování ptáků a savců, které si osvojil již v dětství. Další zkušenosti pak získal jako dobrovolný pomocník zoologických sbírek v Muzeu království Českého (dále jen Muzeum), kam od roku 1849 pravidelně docházel. Při svých tuzemských i zahraničních cestách věnoval čas nejen sběru vzorků různých přírodnin, ale také návštěvám místních či významných evropských muzeí a zoologických zahrad. Zde čerpal zkušenosti a informace, navazoval kontakty, domlouval výměny přírodnin a také tolik potřebné odborné literatury. Po promoci na lékařské fakultě odjel Frič v květnu roku 1860 do Londýna a po návratu uspořádal v Průmyslové jednotě přednášku o Kensingtonském muzeu[24] a jeho vzdělávacích aktivitách, doplněnou malou výstavkou exponátů. Svou cestu do Londýna si zopakoval o dva roky později v době, kdy se zde konala velká mezinárodní výstava. Na tu byl Frič cíleně vyslán Sborem obecních starších města Prahy s úkolem zaměřit se na oblast pedagogickou, vypracovat zprávu o stavu anglického školství a podat přehled o zdejším způsobu školní výuky, o používaných učebních pomůckách, učebnicích, mapách a dalším školním vybavení, o způsobu uklá-

[21] ANM, fund Association of Czech Museums, Lázně Bělohrad – correspondence 1941–1947.

[22] August Emanuel Reuss (1811- 1873) přírodovědec, především geolog a paleontolog, se výrazně zasloužil o výzkum Čech. Tento jeho výrok v mnoha obměnách rád používal Antonín Frič ve svých článcích a projevech.

[23] Časopis českého museum (dále ČČM), roč. 25, sv. III., 1851, *Navedení ke zřízení sbírek živočišných*, s. 3–29. Frič popisuje potřebu zřizování sbírek vycpanin pro různé instituce, tedy především školy a muzea a radí, jak tyto sbírky vytvořit. Nabízí přehled k tomu potřebných nástrojů a materiálu, postupu práce a navrhuje způsoby, jak takto vytvořené sbírky následně uložit.

[24] Dnešní Victoria and Albert Museum, založené v roce 1857, určené tehdy pro prezentaci výsledků vědeckého bádání v oblasti průmyslu a umění, zaměřené především na další edukační činnost. Více o provozu a činnosti tohoto muzea v knize Antonín FRIČ: *Dvě cesty do Londýna*, *Popis vzdělávacích ústavů Londýnských spolu se zprávou o poučných částech světové výstavy*, Praha 1864, s. 21–25.

dání sbírek či vybavení tříd nábytkem. Světové výstavy v Londýně se zúčastnilo mnoho cestovatelů z Čech a zde v Londýně byl dán konkrétní podnět ke zřízení českého průmyslového muzea, které právě Frič již delší dobu propagoval.[25] V Londýně strávil deset týdnů a pro obec pražskou i Muzeum nakoupil mnoho potřebného materiálu. Po návratu uspořádali spolu s přítelem Vojtěchem Náprstkem, který spolu s Fričem Londýn navštívil, úspěšnou a hojně navštěvovanou výstavu pedagogických pomůcek na Střeleckém ostrově, doplněnou řadou odborných přednášek.[26] Výstava představila mimo praktických učebních pomůcek, především velké tabule a diagramy, doplněna byla předměty průmyslového charakteru, jak pro domácnost, tak pro výrobní závody. Další výstava vzešlá přímo z návrhu Antonína Friče byla uspořádána u příležitosti II. sjezdu lékařů a přírodozpytců v Praze roku 1882. Jednalo se tehdy o novinku, u předchozího ani dalších sjezdů se už žádná taková výstava nekonala. Iniciátorem a hlavním pořadatel byl opět Frič *„muž výstav a museí, zkušený učitel, jenž lapidárným písmem, srozumitelným každému laiku, dovede upoutat pozornost davu“*.[27] O deset let později se Frič naplno věnoval pořádání rybářské výstavy u příležitosti Jubilejní výstavy 1891. Dalším jeho výstavním podnikem byla výstava předmětů, dovezených z cesty do Ameriky v roce 1899. Nesmíme také opomenout jeho velké zásluhy na uspořádání a vystavení sbírek ve staré i nové budově Muzea. Můžeme tedy směle prohlásit, že Frič se během svého života stal odborníkem v oboru teorie muzejnictví, což mnohokrát stvrdil i v praxi.[28]

Od 70. let 19. století psal Frič o nutnosti a potřebě zřizování místních muzeí, která by shromažďovala přírodniny ze svého nejbližšího okolí a spolu s předměty historickými také etnografický materiál.[29] Jeho přáním bylo, aby byla místní muzea umístěna v samostatných budovách, sloužících pouze muzejním, případně ještě výstavním účelům. V druhé polovině 19. století byla tato regionální muzea hojně zakládána, ale nikdy nebyla pro tyto účely postavena budova samostatná. Nezbylo tedy nic jiného než přistoupit od slov k činům.

Své sedmdesáté první narozeniny oslavil profesor Frič (*30. 7. 1832) se svou manželkou Marií opět na léčení v Bělohradě. V té době již neučil na universitě, odešel na odpočinek a měl dostatek času věnovat se svému vytčenému cíli – vzorovému muzeu. První kresba s návrhem budovy nového muzea nese datum 31. 7. 1903, vznikla tedy den po jeho narozeninách, a podle rukopisu kresby se zdá, že jejím autorem byl sám Frič (obr.1a,b).[30] O měsíc později bylo sestaveno čtyřčlenné komité – tvořili jej prof. dr. Antonín Frič a tři významní občané Bělohradu: obchodník Jindřich Pižl, starosta a hoteliér Václav Vlach a ředitel měšťanské školy Alois Hoch – které tištěným provoláním oznámilo úmysl postavit muzeum na pozemku č. 98/3 v Raisových Sadech. Parcelu bezplatně poskytlo místní obecní zastupitelstvo, od kterého se očekávalo, že budovu převezme po zaplacení všech nákladů do své správy. Plány k postavení muzea kreslil pražský architekt a stavitel, Fričův zeť, inženýr Otto Tille.[31] Výkres je datován 17. října 1903, proveden je na průsvitném papíře, není signován.[32] Rozpočet a stavbu vedl místní stavitel Jan Poličanský, dále se na stavbě podíleli místní řemeslníci – natěrač Čeřovský, zámečník F. Čip a sklenář Ráliš. Podle Fričova přání byla Tillem navržena jednopatrová budova bez oken v obvodových zdech, osvětlení zajišťovalo světlo z šesti stropních oken, která byla při pozdější přestavbě nesmyslně zrušena. Právě na osvětlení shora kladl Frič velký důraz. Výhodou stavby byla tak vzniklá výstavní plocha 65 m^2 (vnitřní půdorys muzea činil pouze 6,5 x 9,5 m – obr. 2). Budova byla podsklepena místností, určenou pro hrubé práce a uskladnění nářadí. Vstup do budovy umožňovalo dvouramenné točité schodiště, zdobené sloupy. Na čtyřech z nich byly umístěny kovové květiny – agáve, vytvořené pražským klempířem Kusým.

Stavět se začalo už 20. října a to dokonce bez stavebního povolení. O to požádal osobně sám Frič až dne 7. listopadu a dostal je hned po pěti dnech, podepsán je na něm starosta Vlach.[33] Tentýž Vlach, který postavil v lázních jeden z prvních lázeňských hotelů, ve kterém Frič pravidelně bydlel a kde měl zřízenu dokonce svou pracovnu (obr. 3). Proto bylo Fričovi stavební povolení adresováno na adresu přímo do Bělohradu, kde pravděpodobně setrval, aby dohlédl na celou stavbu, za kterou nesl nejen odbornou, ale teď také právní odpovědnost.

Dne 22. října 1903 informoval sám Frič prostřednictvím krátkého článku v Národních listech o zahájení stavby Bělohradského muzea a nezapomněl jmenovitě poděkovat prvním dárcům a přispěvatelům. Kromě peněz, které do-

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[25] Více o okolnostech vzniku průmyslového muzea a výstavách, které jeho vzniku předcházely, uvádí ve svém článku Milena SECKÁ, *Náprstkovo muzeum asijských, afrických a amerických kultur slaví 140. výročí svého založení.* In: Muzeum 51, č. 1, 2013, s. 17–29.

[26] Antonín FRIČ, *Popis výstavy na střeleckém ostrově*, Praha 1863.

[27] Takto se o Fričovi vyjádřil spolupořadatel výstavy J. Kafka. Josef KAFKA, *Z výstav a museí*. In: Antonín Frič, vzpomínky k 70. narozeninám, Praha 1902.

[28] Články a přednášky Antonína Friče o zřizování muzejních sbírek či o zásadách jejich uspořádání vyšly pod těmito názvy: Antonín FRIČ, *Návrh k zřízení přírodnického Musea*, ČČM, roč. 39, sv. IV, 1865, s. 317–330. TÝŽ, *Geologické museum v Praze*, Vesmír, roč. V., 1876, s. 270. TÝŽ, *O otázce musejní*, Zprávy spolku architektů a inženýrů v království českém. Sešit 1, 1884. Vyšlo také ve Vesmír, roč. XIII, 1884, s. 242–244. TÝŽ, *Zásady zřízení sbírek přírodnických v novém museu v Praze*, Vesmír, roč. XVII., 1888, s. 91, 111, 126. (Vyšlo též německy pod názvem *Principien der Organisation der naturhistorischen Abtheilung des neuen Museum zu Prag.* Vortraggehalten in der Jahresversammlung der Museumsgesellschaft am 22. Jänner 1888.).

[29] Antonín FRIČ, *O zakládání místních museí ve větších městech českých*, Vesmír, roč. III, 1874, s. 32–34. TÝŽ, *O místních musejích*, Vesmír, roč. XI., 1881, s. 39. TÝŽ, *O místních museích a školních sbírkách*, Národní listy 1906, otištěno též v publikaci *Dějiny místního musea v Lázních Bělohradě,* Praha 1906. TÝŽ, *O místních museích v Čechách*, Živa, ročník XXI, č. 2, 1911. (též v němčině).

[30] Archiv Národního muzea (dále ANM), fond Antonín Frič, Pamětní kniha (dále PK) č. 4, fol. 23.

[31] Otto (někdy Otton) Tille, (25. 1. 1863 – 24. 10. 1941) architekt a pedagog, se oženil s Fričovou dcerou Marií dne 6. května 1895. ANM, fond A. Frič, PK 5, fol. 87. Jako stavitel působil v Praze, kde realizoval několik obytných domů na Starém a Novém Městě a na Malé Straně. Muzeum v Bělohradě je jeho jedinou známou mimopražskou stavbou. *Encyklopedie architektů, stavitelů, zedníků a kameníků v Čechách*, ed. Pavel VLČEK, Praha 2004, s. 663.

[32] Městský úřad Lázně Bělohrad, stavební úřad, stavební dokumentace k č. p. 191 – Fričovo muzeum. Do složky stavebního úřadu se dostal až v roce 1953, poznámka v dolní části výkresu odkazuje na pozůstalost starosty Václava Bekra (ve funkci 1921–1927).

[33] Městský úřad Lázně Bělohrad, stavební úřad, stavební dokumentace k č. p. 191 – Fričovo muzeum, č. j. 769 ze dne 12. 11 1903.

cházely na základě vyhlášené finanční sbírky, dorazil na stavbu i stavební materiál, který věnovali místní podnikatelé (cihly, kámen a kamenný portál). Ti, kteří mohli, půjčili na stavbu povozy a nářadí. Spěchalo se, aby do zimy byla stavba pod střechou. Že se věc podařila, dosvědčuje fotografie z listopadu 1903.[34] Zimu přečkala rozestavěná budova v pořádku, jak neopomněl Frič na jaře následujícího roku opět prostřednictvím tisku informovat.[35] Mezitím se pracovalo i na vnitřním zařízení. Do Bělohradu dorazila z Prahy výstavní skříň, zhotovená podle Fričova návrhu. Podle tohoto zaslaného vzoru vyrobili místní truhláři všech zbývajících 13 kusů.(obr. 4) Ředitel školy Hoch pracoval celou zimu pod Fričovým vedením na velké geologické mapě Bělohradu a okolí. Její rozměry činily úctyhodných 4 x 2.25 m, kreslena byla olejem na plátno. Při svém dalším letním léčebném pobytu uspořádal Frič v ještě nedohotovené budově první veřejnou přednášku, konala se dne 8. srpna 1904 v pět hodin odpoledne.[36] Ve své řeči Frič opět apeloval na přítomné zástupce města, aby muzeum sloužilo pouze sbírkám místním a nikdo se nerozpakoval odmítnout věci cizokrajné. Po přednášce osobně provedl hosty po budově muzea a nadšeně předváděl, co ještě zbývá doplnit. Zařízení muzea bylo celé ve Fričově režii. Čelní stěně vévodila Hochova velká geologická mapa, přímo pod mapou byl samotným Fričem znázorněn průřez Čechami, směřující od Jičína k úpatí Krkonoš a dále vzorky všech hornin, na mapě znázorněných a většinou také Fričem nasbíraných (obr. 5). Místní flora a fauna byla návazně vystavena ve skříních, umístěných uprostřed místnosti. Podložky, tabulky, úchyty pro vzorky, vše bylo vytvořeno podle Fričových návrhů a přání. Skříně, vyrobené podle zaslaného vzoru, byly rozmístěny podél dvou stěn. Vpravo pro sbírky archeologické a etnografické, doplněné byly ukázkami zdejšího současného domácího průmyslu a umění (plátenictví, knoflíkářství, košíkářství). Vlevo pak pro řadu hornin a zkamenělin z okolí, a také pro sbírku nerostů, ke které později přibyly drahokamy a polodrahokamy, darované odbornou školou v Turnově.

Ohledně exponátů předpokládal Frič, že budou nejprve použity exempláře již shromážděné, které budou průběžně doplňovány z privátních sbírek místního obyvatelstva, až bude budova otevřena a vzbudí patřičný zájem. Sám Frič věnoval muzeu mnoho přírodnin, jak je patrné z muzejní přírůstkové knihy.[37] Dokonce se musel bránit nařčení, že bez souhlasu Správního výboru Muzea království Českého daroval do Bělohradského muzea sbírkové předměty. Frič svůj dar obhájil konstatováním, že pro pražské muzeum získal výměnou za duplikáty cenné permské a křídové zkameněliny, k čemuž je jako správce sbírek oprávněn.[38]

Muzeum bylo slavnostně otevřeno a odevzdáno veřejnosti dne 12. září 1904 – tedy za necelý rok od zahájení stavby. Vlály prapory v národních barvách, obecenstvo přišlo v krojích, nechyběli sokolové, hrála hudba, pěl sbor a zazněly proslovy (Frič, Vlach, Hoch a hejtman dr. Jaroslav Pecka). Nechyběly ani zdravice a blahopřejné telegramy. Článek o otevření muzea přinesly Národní listy 17. 9. 1904 (obr. 6). Z nové muzejní budovy se velice záhy, také díky Fričově propagaci, stal vzor pro všechna ostatní zemská města a městečka, která se rozhodla město Bělohrad následovat. Mezi prvními byla Choceň a Skuteč.[39] Fričovi se podařilo na příkladu Bělohradského muzea dokázat, že lze tuto akci provést i s velmi nízkým rozpočtem, ovšem za předpokladu, že obec poskytne vhodný pozemek a hlavně se podaří v místním obyvatelstvu probudit vřelý zájem o věc.[40] Podle zveřejněných údajů činil rozpočet na stavbu 5 000 K, na uspořádání a zařízení bylo určeno 3 000 K. Finanční sbírka na stavbu pokračovala pomalu, a tak bylo v roce 1905 přistoupeno k vyhlášení výherní loterie spojené s výstavou, do které byly zařazeny obrazy a plastiky významných umělců.[41] Komité výstavy odevzdalo po jejím skončení vysoký výnos 1 200 korun, další významné příspěvky přinesla uspořádaná ochotnická představení a lázeňský orchestr. Ke zřízení muzea pomohly také Fričem vyžádané a následně c. k. ministerstvem kultu a vyučování poskytnuté státní subvence. Po urovnání všech finančních poměrů, tedy bez dluhů, přešlo po sedmi letech celé muzeum pod správu obce a stalo se jejím majetkem s důrazem na okolnost, že sbírky v muzeu vystavené patří jednoznačně veřejnosti. Ta se také ve velké míře podílela na jejich sestavení.

Správcem muzea byl po jeho otevření ustanoven ředitel měšťanské školy Alois Hoch, který se nejen staral o svěřené sbírky, ale také je pečlivě a svědomitě rozšiřoval, pořádal přednášky a výstavy a pečoval o knihovnu, která byla tehdy v prostorách muzea umístěna. Sbírky se velice rychle rozrůstaly, proto bylo v roce 1924 přistoupeno k rozšíření muzea. Plány vypracoval opět architekt Tille, stavby se ujal stavitel Josef Janeček a firma Hišman. Ke stávající budově

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[34] Antonín FRIČ: *Dějiny místního musea v Lázních Bělohradě*, Praha 1906, s. 6 – foto J. Pižl.

[35] ANM, PK 4, fol 23 a fol. 28, zpráva ze dne 28. 5. 1904, název listu neuveden.

[36] Pozvánka je uložena v ANM, PK 4, fol. 27. Text přednášky byl vydán pod názvem *Přednáška o významu musea v Bělohradě,* Vesmír, roč. XXXIII, s. 258, 1904.

[37] Přírůstková kniha č. 1 Fričova muzea je vázána v tuhých deskách a uložena v archivu Fričova muzea, který spravuje Městské kulturní středisko. Není opatřena žádným nápisem, začíná přímo rokem 1904. V muzeu byla v roce 1975 založena ještě jedna kniha, v současné době se opět zapisuje do knihy z roku 1904.

[38] ANM, fond RNM, i. č. 1330 a i. č. 1360.

[39] ANM, fond A. Frič, PK 4, fol. 30, *P.t. občanstvu okresu skutečského!* Provolání komitétu budoucího skutečského muzea z roku 1909. Tamtéž na fol. 36 je malý náčrtek budoucí muzejní budovy s Fričovou poznámkou *„ náčrtek Ottona k museu v Chocni, 1910".* Jak mělo vlastně takové muzeum vypadat a jaký měl být jeho obsah a tedy i smysl jeho fungování, popsal Frič ve svém článku *O místních museích v Čechách*, který vyšel v roce 1911 v Živě, ročník XXI, č. 2. Článek byl vydáván také jako jednostránkový propagační leták.

[40] Až do konce svého života propagoval Frič toto muzeum pomocí různých článků a publikací. Antonín FRIČ,*O místním museu v lázních bělohradských u Jičína*, Vesmír, roč. XXXIII, s. 159, 1904. TÝŽ, *The new local Museum in Bad Bielohrad near Jitschin, Bohemia*, Museum Journal for Juny 1905. TÝŽ, *Úvodní sbírka geologická v museu Bělohradském*, Vesmír, roč. XXXIV, str. 256, 1905. TÝŽ, *Stručný popis musea v Bělohradě*, Vesmír, roč. XXXIV, str. 52, 1905. TÝŽ, *Vnitřní zařízení musea Bělohradského*, Vesmír, roč. XXXIV, s. 147, 1905. TÝŽ, *Dějiny místního musea v Lázních Bělohradě,* Praha 1906, (též v německé a anglické verzi).

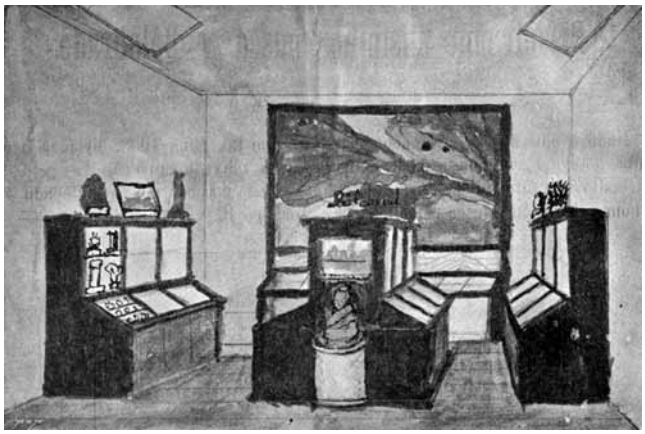
[41] MKS Bělohrad – archiv Fričova muzea , i. č. 111, *Katalog umělecké výstavy v lázních Bělohradě 23. 7.–19. 8. 1905*. Los z této výstavy je uložen v ANM, fond A. Frič, PK č. 4, fol. 26.

byla přistavěna dvě křídla s vrchním osvětlením. (obr. 7) Jedna místnost byla určena pro vystavování sbírek, druhá měla sloužit jako depozitář a pracovna. Nárůst sbírek byl však tak obrovský, že se ještě před válkou začalo uvažovat o dalším rozšíření muzea a jeho adaptaci. Plánována byla přístavba pracovny pro správce muzea, výstavní síně a skladiště. Válka tyto plány překazila a muzeum bylo dokonce na čas uzavřeno. V roce 1945 požádal Muzejní spolek v Lázních Bělohrad o postoupení části budovy zabraného zámku rodiny Merveldtů, ale požadované místnosti v přízemí a v prvním patře pro muzeum nedostal.[42] Nakonec se od všech plánů přestavby či stěhování upustilo a muzeum zůstalo v původní budově. Tady bylo v provozu až do 70. let minulého století jako pobočka okresního muzea v Nové Pace. V muzeu proběhly některé stavební úpravy, při kterých byly vyměněny vnitřní dveře za hliníkové a zároveň byla odstraněna stropní okna, zajišťující vrchní denní osvětlení hlavní místnosti, to osvětlení, na kterém si Frič tolik zakládal. Poté bylo Fričovo muzeum na dlouhá léta jako nepotřebné uzavřeno, sbírky byly částečně rozkradeny, částečně rozvezeny do okolních muzeí. K jeho rekonstrukci a znovuotevření se přikročilo až v roce 1994, do muzea se vrátily i některé původní sbírky, bohužel ne všechny. U některých exponátů se ještě zachovaly původní popisné tabulky, které připomínají Fričovu přítomnost. Také několik skleněných válců s preparáty má stále ještě nálepku z obchodu Václava Friče v Praze. Hochova velká geologická mapa byla zrestaurována, ale na doplnění ukázek hornin, které pod ní byly původně vystaveny, již nedošlo. Muzeum je dnes (rok 2013) otevřeno veřejnosti v sezoně květen – září a to pouze na sedm hodin v týdnu.

Za velký a obětavý přínos ke zvelebení lázeňského města se stal profesor dr. Antonín Frič v roce 1912 jeho čestným občanem. Zemřel brzy poté, 15. listopadu 1913. Po jeho smrti bylo muzeum přejmenováno na Fričovo a jeho název je dodnes čestně umístěn na průčelí budovy. (obr. 8) Fričovo muzeum nenese pouze jeho jméno, ono bylo opravdu „Fričovo“, dalo by se s nadsázkou říci, že bylo jeho třetím dítětem. Je potřeba zdůraznit, že Fričovi se podařilo vybudovat toto vzorové městské muzeum za velkého zájmu jeho bezprostředního okolí. Mezi přispěvateli na stavbu najdeme všechny členy rozvětvené rodiny Fričů, příbuzné ze strany jeho manželky, tedy Pernerů z Týnce nad Labem, jeho kolegy z pražského Muzea, kolegy profesory, ale i asistenty a studenty, nebo pražské knihkupce a nakladatele. Bez nich a jejich peněžních příspěvků by Frič tak snadno neuspěl.

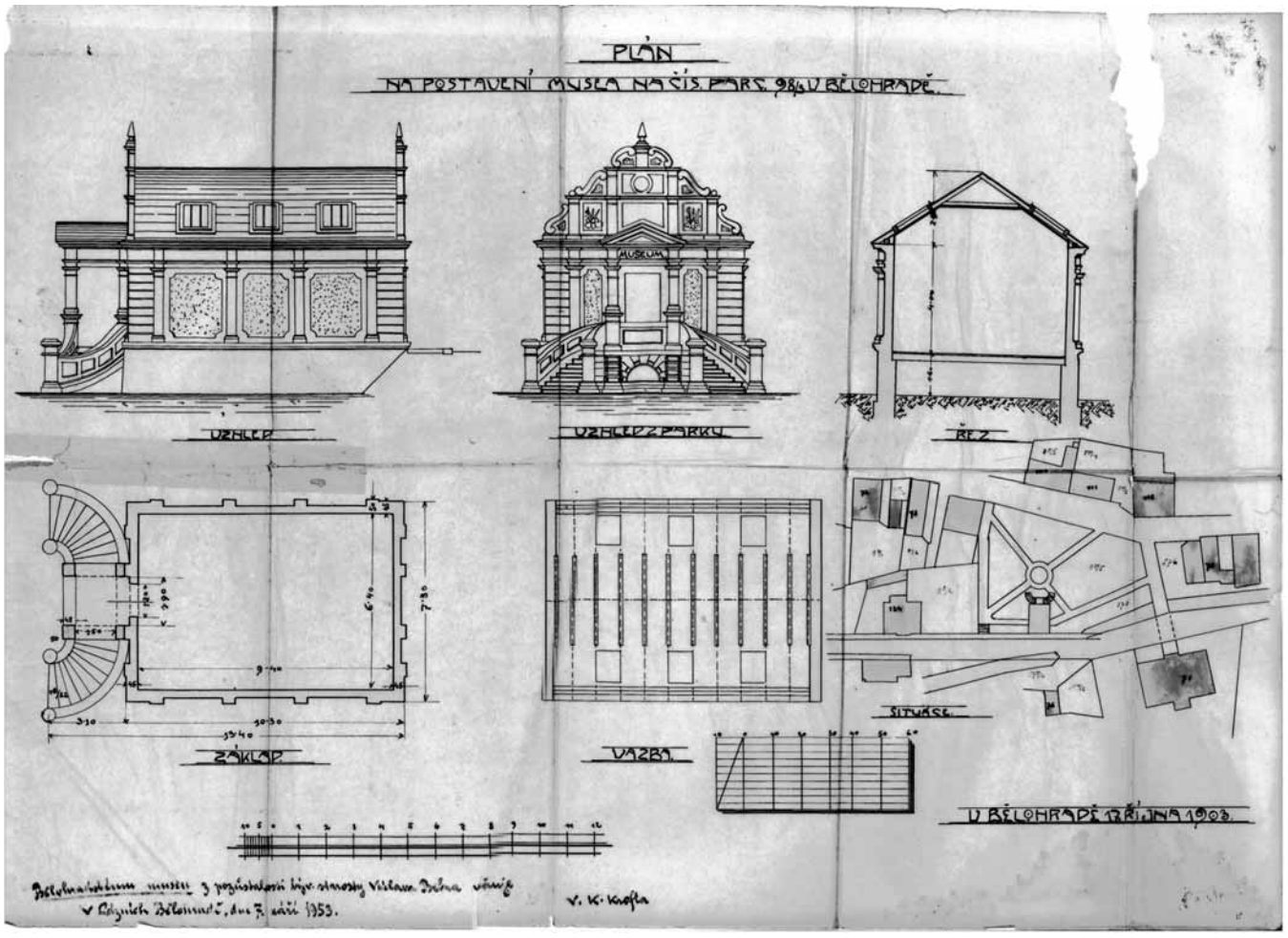
Text-fig. 1a. Frič's first sketch of the new building and its internal layout. (ANM, fund A. Frič, PK 4, fol. 23). / První Fričovy nákresy budovy muzea a jeho vnitřního uspořádání. (ANM, fond A. Frič, PK 4, fol. 23).

[42] ANM, fond Svaz českých muzeí, Lázně Bělohrad – korespondence 1941–1947.

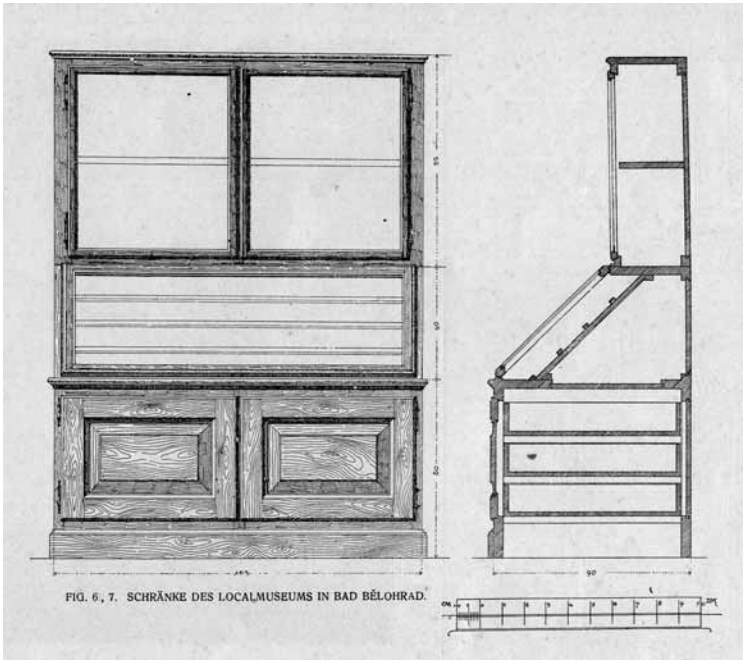


Text-fig. 1b. Frič's design for internal layout (Antonín FRIČ: *Dějiny místního musea v Lázních Bělohradě*, p. 21). / Fričův návrh vnitřního uspořádání (Antonín FRIČ: *Dějiny místního musea v Lázních Bělohradě*, s. 21).

➢ Text-fig. 3. Photograph of Frič's worktable; his office was probably in the Vlach hotel (ANM, fund A. Frič, PK 4, fol. 29). / Fotografie Fričova pracovního stolu, pracovnu měl se vší pravděpodobností v hotelu Vlach (ANM, fond A. Frič, PK 4, fol. 29).

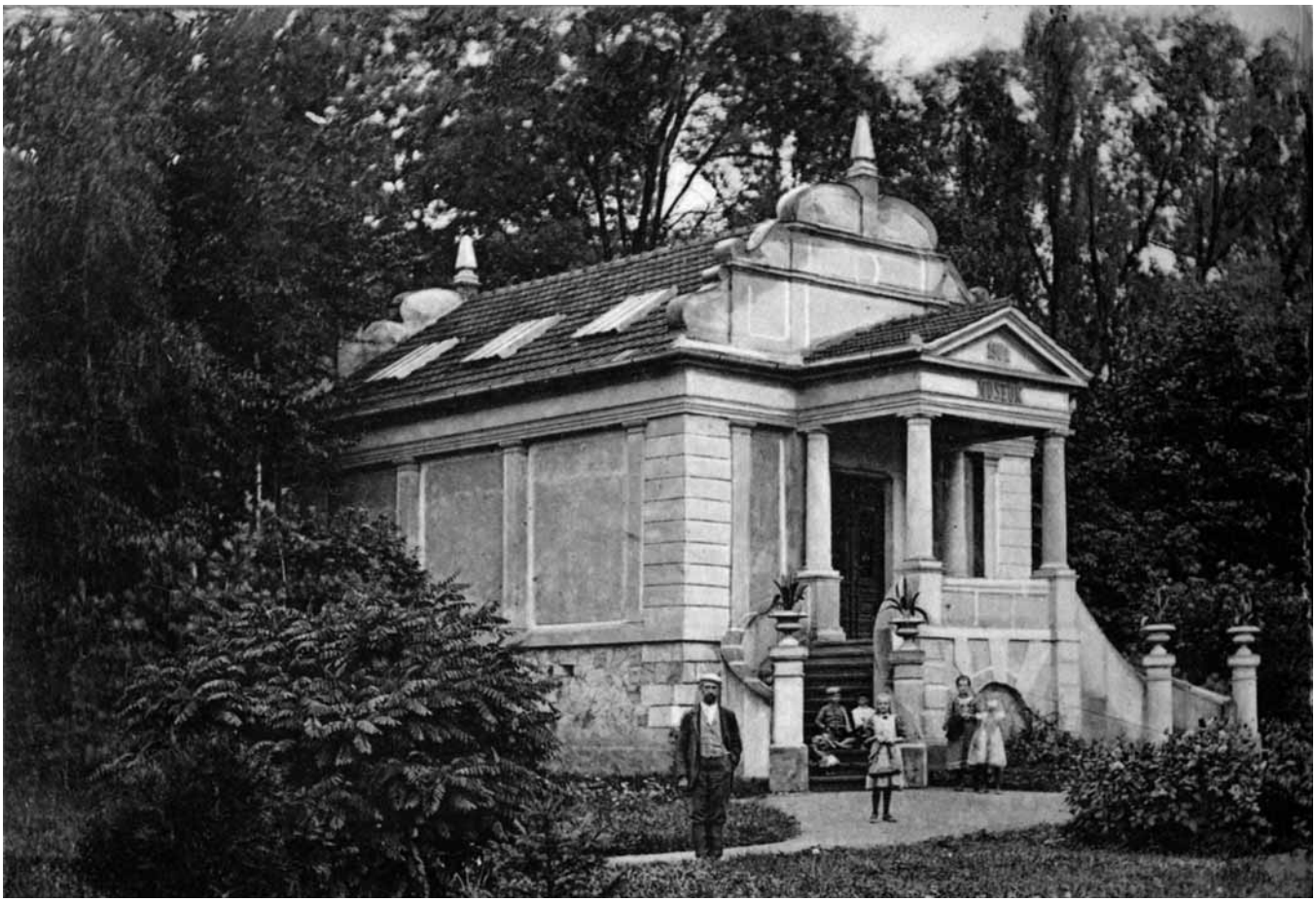


Text-fig. 2. Museum plan from 1903 – author Otto Tille. (City council Lázně Bělohrad, construction board, construction documentation, parcel no. 191). / Plán muzea z roku 1903 – autor Otto Tille. (Městský úřad Lázně Bělohrad, stavební úřad, stavební dokumentace k č. p. 191).

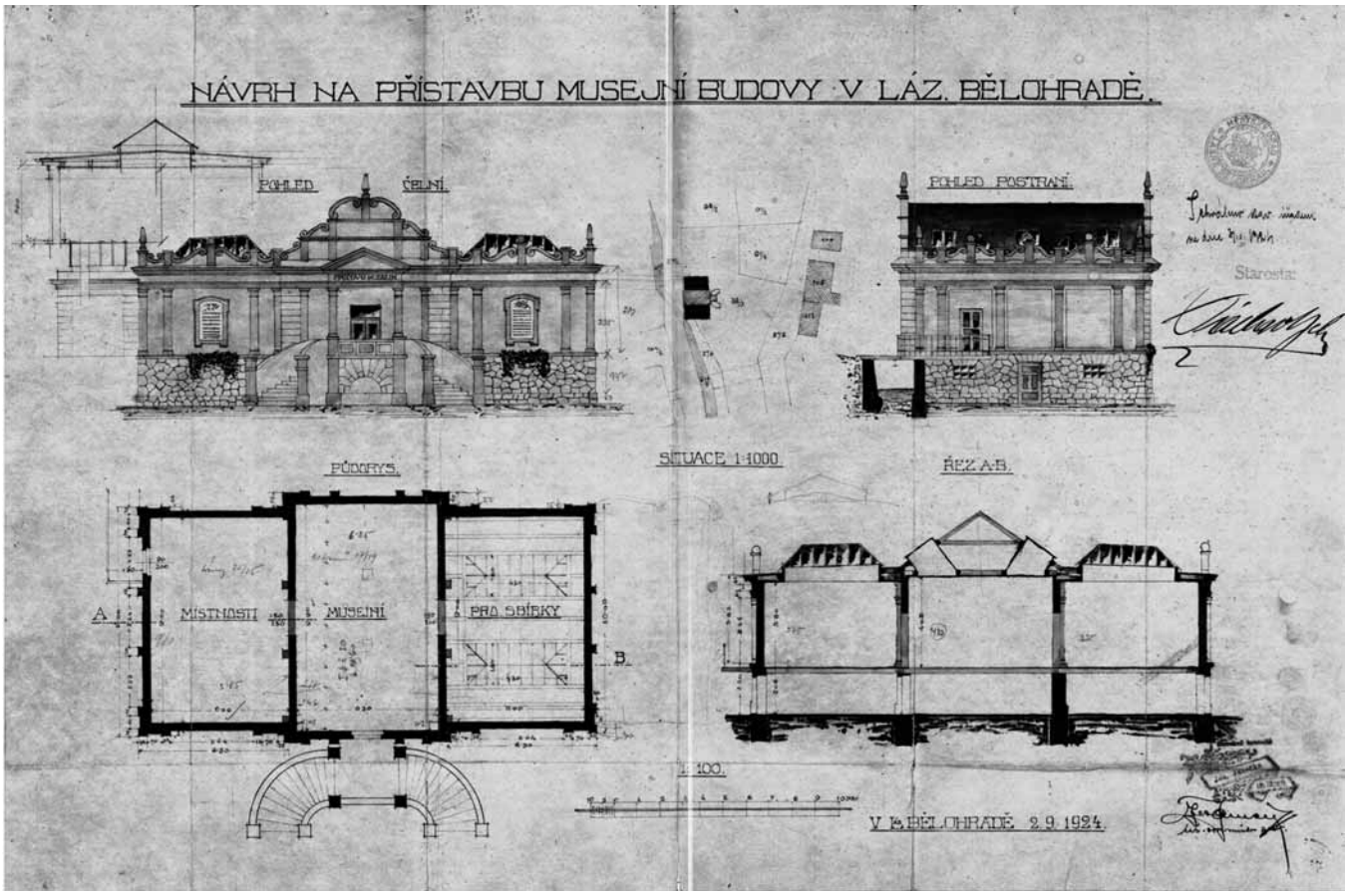


Text-fig.4. Design for museum display case (Antonín FRIČ: Dějiny místního musea v Lázních Bělohradě, p. 7). / Návrhy skříně pro muzeum (Antonín FRIČ: Dějiny místního musea v Lázních Bělohradě, s. 7).

➢ Text-fig. 5. Frič during his work on the staircase of "his" museum in Bělohrad (ANM, fund A. Frič, PK 4, fol. 13). / Frič sedíc při práci na schodišti „svého“ muzea v Bělohradě (ANM, fond A. Frič, PK 4, fol. 13).



Text-fig. 6. Finished museum building cca. 1905 (ANM, fund A. Frič, PK 4, fol. 29). / Budova hotového muzea asi 1905 (ANM, fond A. Frič, PK 4, fol. 29).



Text-fig. 7. Plan for expansion of museum from 1924. (City council Lázně Bělohrad, construction board, construction documentation, parcel no. 191.). / Plán přístavby muzea z roku 1924. (Městský úřad Lázně Bělohrad, stavební úřad, stavební dokumentace k č. p. 191.).

Text-fig. 8. Museum summer of 2013. (photo by author). / Muzeum v létě roku 2013. (foto autorka).

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FRICIA NOBILIS FROM THE TURONIAN OF THE CZECH REPUBLIC REINTERPRETED AS AN OVULIFEROUS CONE OF A CUPRESSOID CONIFER

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Abstract. *Fricia nobilis* VELENOVSKÝ from the Bílá Hora Formation (Turonian) of the Bohemian Cretaceous Basin is reinterpreted as an ovuliferous cone of a conifer from the family Cupressaceae. A number of arguments are presented to show that its presumed cycadalean affinity can be ruled out. The most important argument is the presence of seeds in the cone. The seeds of *Seletya* type with a campylotropous locule found *in situ* argue for the systematic position of *Fricia* within the Cupressaceae s. l. The differences between the genera *Fricia* and other conifers, particularly *Geinitzia* are discussed. The diagnosis of *Fricia* is emended and a lectotype and an epitype are selected.

■ *Fricia*, *Geinitzia*, *Seletya*, Cupressaceae, Turonian, Bohemian Cretaceous Basin

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Introduction

The genus *Fricia* was erected by Velenovský (1885) to celebrate Professor Antonín Frič, one of the most influential people in the National Museum in the late 19th and early 20th century. The fossil was described by Velenovský (1885) as a male cone of a cycad. This interpretation by Velenovský (1885) was frequently accepted (Berry 1916, Domin 1938), although sometimes with hesitation (Seward 1917, Němejc 1968). Although, the morphology of *Fricia* does resemble male cones of some recent cycad genera as *Zamia*, the typical Mesozoic genus *Androstrobus* SCHIMPER 1870 is quite dissimilar to *Fricia*. Velenovský (1885) associated *Fricia* with the Cenomanian cycad foliage *Nilssonia bohemica* (Velenovský 1885, J. Kvaček and Knobloch 1997), however his association was not supported by any real characters.

A detailed study of the *Fricia* material, particularly the specimen from Praha – Prosek, which was for a long time inaccessible for study, shed new light on the nature of the genus *Fricia*. The discovery of seeds *in situ*[1] in that specimen clearly argued for a definite rejection of the interpretation of *Fricia* as a cycad pollen cone.

Material and Methods

Material

Six specimens of *Fricia* ovuliferous cones are housed in the old Museum collection. The specimens are preserved as partly limonitized casts. They come from the Bílá Hora Formation, which was formed from classical sandy marlstones (opuka in Czech). This type of rock has been excavated since medieval times as an important building stone building for the City of Prague. The Bílá Hora Formation as defined by Čech et al. (1980) is formed by shallow-water marine marlstones. A high percentage of sponge spicules is characteristic for most of the Bílá Hora Formation sediments. The marine fauna is characterised by *Inoceramus labiatus* (SCHLOTHEIM), *I. hercynicus* PETRASCHEK, *I. inaequivalis* SCHLÜTER, *I. cuvieri* SOWERBY, *Mammites nodosoides* (SCHLOTHEIM), *Lewesiceras peramplum* (MANTELL) etc. (Čech et al. 1980).

In the 19th century numerous quarries on the slopes between the village of Bílá Hora and Strahov Gate in Prague city town wall were exploited for the sandy marlstones for use as building stone. All of them are now closed being replaced by large Strahov stadiums and also housing developments as a part of the expanding city. Fossils were quite rare in the quarries as mentioned by Frič (1878, 1879). In all these quarries however, the stone was excavated and thus the hand mined fossils were collected by quarry miners or local people. A. Frič often went there and a regular base bought fossils from these people. This is the way most of the fossils were accumulated. In the Museum collection they are generally labeled as Bílá Hora, but due to amateur sampling usually nothing was known about their precise location within the Bílá Hora Formation. This is also the case with *Fricia nobilis*.

[1] Revision of the National Museum's Turonian fossil plants began with a complete rearrangement of the Mesozoic and Cenozoic collections. This was motivated by the transfer of the entire palaeontological collection from the old building to new depositories in Praha – Horní Počernice. This largely happened between 2007–2011.

Some profiles in the Bílá Hora area are however still accessible e.g. near to the Landronka farm house sediments of the Bílá Hora Formation crop out at a height of about 5 m. The closest working quarry in the area nowadays is located in Přední Kopanina. The profile there was designated as a neostratotype of the Bílá Hora Formation (Čech et al. 1980).

In the 19th and early 20th century quarries mining sandy marlstones from the Bílá Hora Formation were also act in north east of Prague in Prosek (Prosík). The stone v mined in an area between streets Na Prosecké vyhlídce, Vyhlídce, Na Pokraji and Na Prosecké cestě (now Litoměřick Fossils were even rarer there, but the best preserv specimen of *Fricia* was found in that area..

are not preserved

Methods

The specimens were photographed under low angle incident light using a Canon EOS 6D camera with a Canon 100 macro lens. The material was studied and photographed under Olympus SZX 12 binocular microscope equipped with an Olympus DP72 digital camera. Detailed photographs were taken by digital microscope Keyence VHX-2000. Photographs were processed and the plate assembled using Adobe Photoshop 7.01.

Systematic palaeontology

Order: **Pinales**

Family: **Cupressaceae**

Genus: ***Fricia*** **Velenovský 1885**

Type: *Fricia nobilis* Velenovský 1885 p. 8, pl. 3, figs 1–3, 6, 11

Emended diagnosis. Isolated ovoid ovuliferous cones, cone scales helically arranged, massive, cylindrical with centrally placed vascular bundle and polygonal smooth fasete (escuatcheon). Each cone scale bearing seeds of *Seletya* type in irregular rows.

Discussion. *Fricia* Velenovský is defined as an ovuliferous cone with unknown foliage. In that way it differs from the genus *Geinitzia* Endlicher 1847 which is based on sterile foliage. The genus *Geinitzia* was previously understood in two ways, either as a form genus based on sterile foliage (Harris 1979) or a natural genus based on foliage and ovuliferous cone (as emended by Kunzmann 1999). Because the conservation of *Geinitzia* as a natural genus with the new type (*G. formosa*) was not successful (Zijkstra et al. 2010, Herendeen 2011), *Geinitzia* is in this paper understood as a morphogenus based on its type *G. reichenbachii* and which has as the holotype a sterile twig (Kunzmann 2010). However, differences exist between ovuliferous cones of *Fricia nobilis* and *Geintzia formosa* in the morphological characters. The ovuliferous cones of *Fricia nobilis* differ from those of *Geinitzia formosa* in having a more conical and massive cone axis, and cone scales bearing more seeds, in at least two irregular rows. *Fricia* has flat cone scale fasetes (escuatcheons) while *Geinitzia formosa* has ornamented fasetes. Both cones however contain *Seletya* type seeds. The occurrence of *Seletya* type seeds in ovuliferous cones was a major argument used by Kunzmann (1999) when establishing the family Geinitziaceae. However, the Geinitziaceae is in need of revision and should be reconsidered with respect to more recentstudies based on molecular data (Gadek et al. 2000, Kusumi et al. 2000, Farjon 2005) in which the Taxodiaceae and Cupressaceae were united in the Cupressaceae (s.l.). The Geinitziaceae can be distinguished from other Cupressaceae by the racters: seed morphology (campylotropous/ arrangement of vascular bundles and resin ne scale complex (Kunzmann 1999). From ew Geinitziaceae are a distinguishable group st likely within Cupressaceae s.l., its status e thetopic of a forthcoming publication.

ilar ovuliferous cone *Cupressospermum* Mai, *icia* in the lower number of seeds born in a zigzag row and particularly in having seed morphology more similar to *Kozykorpeshia* than *Seletya* (Kunzmann 1999).

From other cupressoid ovuliferous cones e.g. *Cunninghamites lignitum* (Bosma et al 2012) *Fricia* differs in the type of seed (*Seletya*) and in shape of the cone scale. *Fricia* has very conical massive cone scales whereas *Cunninghamites* has more flat peltate cone scales. In the shape of its cone scales, *Fricia* resembles the recent genus *Cupressus*, however *Fricia* does not exhibit a decussate arrangement of cone scales. The genus *Conago* Miller et Hickey 2010 (type *Conago tonsifera* Miller et Hickey 2010 from the Early Cretaceous Wintrop Formation in Washington) is presented as a morphogenus of cones of unknown systematic affinity. *Fricia* differs from Conago in having a clear systematic position. In morphology it particularly differs in having *Seletya* type seed and massive conical ovuliferous cone scales.

Fricia also differs from cycadoid male cones of *Androstrobus* Schimper 1870 in the absence of pollen sacs and from the ovuliferous cones *Microzamia* Corda in Reuss (see Kvaček 1997), it differs in the high number of curved seeds per cone scale.

Fricia nobilis **Velenovský**

Pl. 1, figs 1–6, Pl. 2, figs 1-4

1885 *Fricia nobilis* Velenovský, p. 8, pl. 3, figs 1–3, 6, 11
1917 *Fricia nobilis* Velenovský, Seward, p. 505
1938 *Fricia nobilis* Velenovský, Domin, p. 117
1968 *Fricia nobilis* Velenovský, Němejc, p. 253, 256, pl. 29

Lectotype: NMP F 340 designated here, pl. 1, figs 1, 4, 6.

Epitype: NMP F 1444, designated here, pl. 1, figs 2, 5.

Type locality: Prague City, Bílá Hora district.

Type horizon: Bílá Hora Formation, Turonian, Late Cretaceous.

Occurrence: Praha – Bílá Hora, Praha – Prosek, Nové Strašecí.

Material: NMP F 338, F 339, F 3735 – F 3738.

Emended diagnosis. Isolated ovoid ovuliferous cones, cone scales helically arranged on robust main axis. Each cone scale massive, cylindrical having polygonal, usually hexagonal smooth fasetes (escuatcheons). Seeds

curved, *Seletya* type, numerous, arranged irregularly in two or more irregular rows on she surface of the whole cone scale cylinder.

D e s c r i p t i o n . The lectotype F 340 exhibits ovoid ovuliferous cone 68 x 32 mm. Its axis is 0.9-1.1 mm broad bearing about 60 helically arranged cone scales (pl. 1, fig. 1). The massive axis shows helically arranged circular scars from detached cones-scales showing centrally located limonitized vascular bundle. Each massive cylindrical ovuliferous cone scale is 11-14 mm long and about 3-5 mm broad. It is narrow at the base (4 mm in diameter), widening towards the apex (12–14 mm in diameter). The facete (escuatcheon) is difficult to observe, because it is usually tightly embedded in the sediment. In one place it had been previously remooved by Velenovský. It shows a smooth hexagonal facete (escuatcheon) (pl. 1, fig. 4). The inner surface of the cone scale shows a number of small pits which are arranged in irregular rows (pl. 1, figs 1, 4). Two seeds *in situ* with limonitized integuments are filled with sediment (pl. 1, fig. 6). The seeds are ovoid (2–3 x 3–3.5 mm). Terminally they show fragmentary micropyle. More details are not preserved. The epitype F 1444 as the best preserved specimen (pl. 1, fig. 2) shows an ovoid, cylindrical cone (30 x x 60 mm) and massive axis bearing about 50 cone scales. The cone scales are relatively small (4 x 10 mm) bearing number of fragmented curved *Seletya* type seeds. The seeds are small 1.5 x 3.5 mm. Although not usually complete, they show clearly curved campylotrpous locules (pl. 1, fig. 5). The largest specimen, 93 mm long, shows an ovuliferous cone (pl. 2, fig. 1) broken longitudinally. Other ovuliferous cones (e.g. F 3738) are broken obliquely or perpendicularly showing a helical arrangement of ovuliferous cone scales (pl. 1, fig. 3, pl. 2, figs 3, 4). The figured specimen F 3738 (pl. 1, fig. fig. 3) from Nové Strašecí displays cone scales which are very narrow basally (3 mm in diameter) and broad apically (15 mm in diameter).

D i s c u s s i o n . *Fricia nobilis* was described by Velenovský (1885) as a cycad male cone. This assumption was based on an interpretation of pits on the cone scales as scars left after detachement of sporangia. This fact and the weakness of the argument were already questioned by Seward (1917). Having a very well preserved specimen available, designated here as an epitype (F 1444) which shows fragments of seeds it is clear that *Fricia nobilis* is not a cycad cone. The epitype shows (pl. 1, fig. 5) *Seletya* type seeds with campylotropous locules in some place which have nothing in common with the pollen sacs of the Cycadaceae. Also *Fricia nobilis* cone scales internal anatomy includes in particular a vascular bundle which corresponds with coniferous cone scales of *Geinitzia formosa* Heer (Kunzmann 1999). Additionally, the ovuliferous cones *Fricia nobilis* co-occur with sterile twigs of *Geintzia reichenbachii.*

The genus *Seletya* (with its type *S. krystofovichii*) was designed by Dorofeev (1979) for seeds with a campylotropous locule. A new name *Geinitzia krystofovichii* (Dorofeev) Knobloch and Mai was introduced by Knobloch and Mai (1986) who recorded such seeds in the Santonian of Quedlinburg. The seeds were also described by Kunzmann and Friis (1999) from the Santonian of Asen. Later these seeds were found *in situ* by Kunzmann (1999) in ovuliferous cones of *Geinitzia formosa* Heer and *Geinitzia schlotheimii* Kunzmann (2003) in the Santonian of Germany. This type of seed is characteristic for the whole group of conifers assigned to the Geinitziaceae by Kunzmann (1999).

Ovuliferous cones of *Geinitzia formosa* Heer and *Geinitzia schlotheimii* Kunzmann differ from *Fricia nobilis* in having seeds arranged in one row per cone scale and in a number of morphological characters of the cone (see discussion of the genus). *Geinitzia formosa* from the Campanian of Grünbach, decribed by Herman and Kvaček (2010), shows the same type of cone, however seeds *in situ* were not recorded.

As previously mentioned in the discussion of the genus, *Fricia nobilis* resembles in overall shape ovuliferous cones of other Cupressaceae. An covuliferous cone of similar shape and size is known in *Cunninghamites lignitum* from the Bohemian Cenomanian (Kvaček 1999, Bosma et al. 2012). However *C. lignitum* has peltate cone scales and only few seeds per cone scale. *Fricia nobilis* is even less similar to other ovuliferous cones of *Quasisequoia crispa* (Velenovský) J. Kvaček and *Ceratostrobus sequoiaphyllus* Velenovský (1885) both from the Bohemian Cenomanian (Kvaček 1999). Ovuliferous cones of these conifers are smaller and their surface is covered by the leafy tips of their elaborated escuatcheons.

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Explanation to the plates

PLATE 1

***Fricia nobilis* Velenovský, Bílá Hora Formation, Turonian**

1. Lectotype showing longitudinally broken ovuliferous cone with robust axis and helically arranged cone scales, Praha – Bílá Hora, F 340, scale bar 10 mm.
2. Epitype showing longitudinally broken ovuliferous cone with well preserved seeds, Praha – Prosek, F 1444, scale bar 10 mm.
3. Transversally broken specimen showing helically arranged conicaly shaped ovuliferous cone scales, Nové Strašecí, F 3738, scale bar 10 mm.
4. Lectotype, detail of conical ovuliferous cone scale showing smooth surface of facete (escuatcheon), Praha – Bílá Hora, F 340, scale bar 2 mm.
5. Epitype, detail of seed of *Seletya* type showing campylotropous locule, Praha – Prosek, F 1444, scale bar 0.5 mm.
6. Lectotype, detail of two seeds of *Seletya* type with campylotrpous locule, Praha – Bílá Hora, F 340, scale bar 0.5 mm.

PLATE 2

***Fricia nobilis* Velenovský, Bílá Hora Formation, Turonian, Praha – Bílá Hora**

1. The largest specimen comming from the type collection, F xxx, scale bar 10 mm.
2. Apical part of the ovuliferous cone, F xxx, scale bar 10 mm.
3. Detail of ovuliferous cone scale, F xxx, scale bar 10 mm.
4. Transversely broken specimen, F xxx, scale bar 10 mm.

PLATE 1

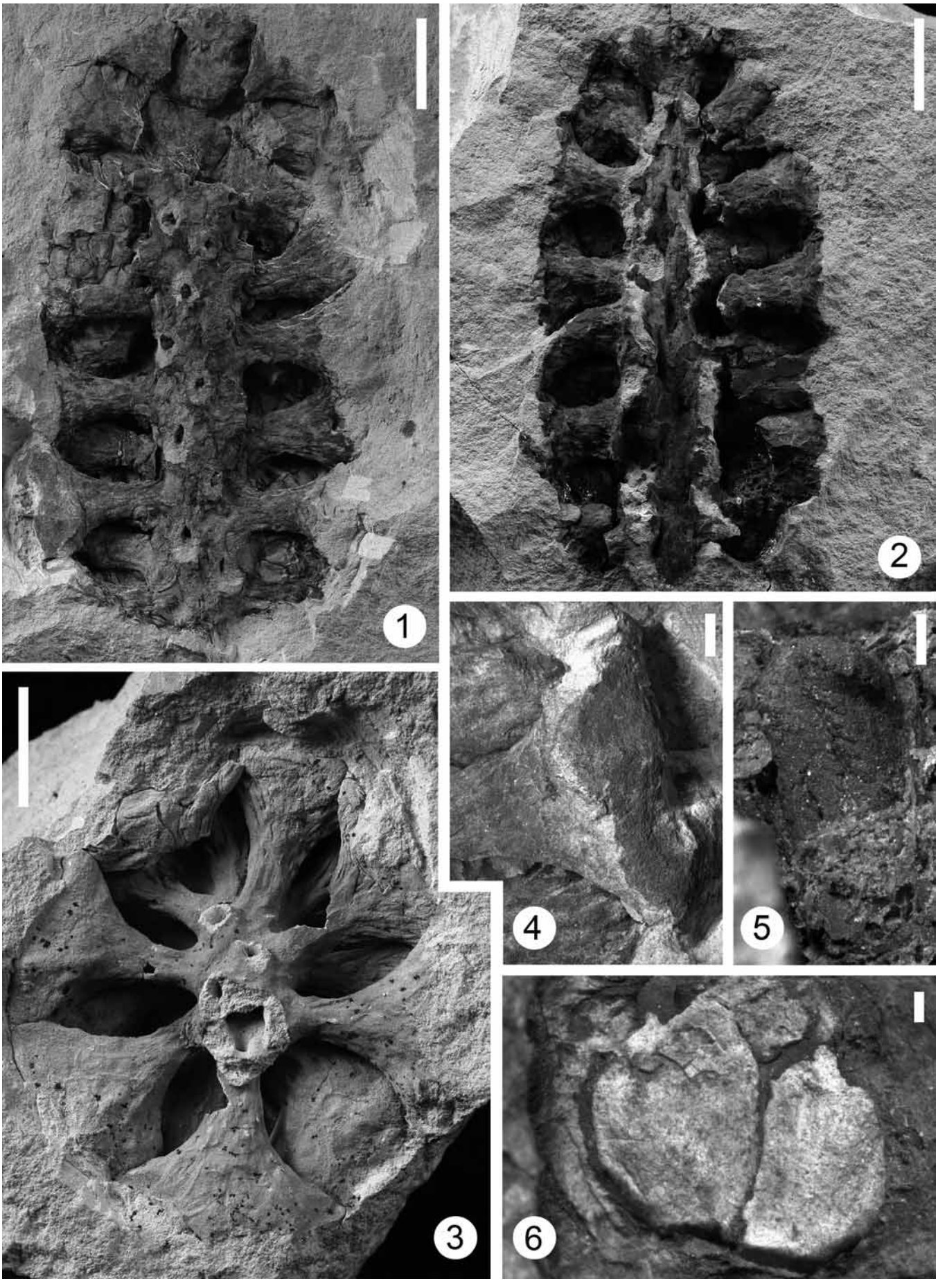
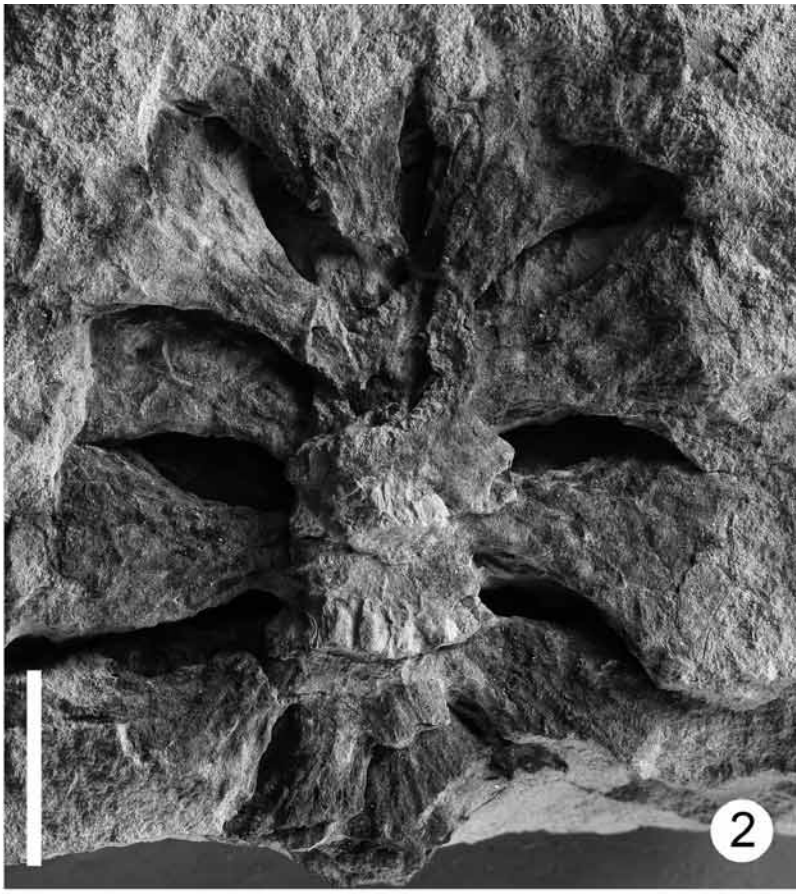
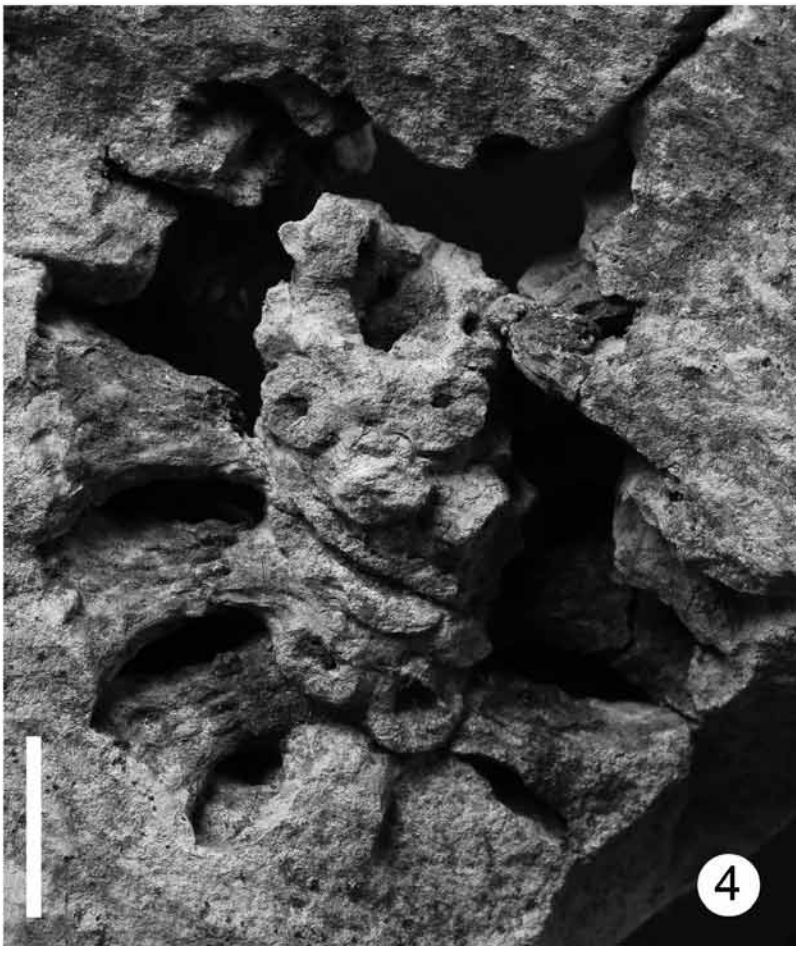


PLATE 2





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SABELLID AND SERPULID WORMS FROM THE BOHEMIAN CRETACEOUS BASIN (UPPER CENOMANIAN – MIDDLE CONIACIAN) ORIGINALLY IN THE COLLECTION OF DR. ANTONÍN FRIČ

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Kočí, T., Jäger, M. (2013): Sabellid and serpulid worms from the Bohemian Cretaceous Basin (Upper Cenomanian - Middle Coniacian) originally in the collection of Dr. Antonín Frič. – Acta Mus. Nat. Pragae, Ser. B Hist. Nat., 69(3-4): 129-146, Praha. ISSN 0036-5343. DOI 10.14446/AMNP.2013.xxx

Abstract. Nine specimens of sabellid and serpulid worms which had been figured by Dr. Antonín Frič in his series of publications on the strata of the Bohemian Cretaceous Basin and which are kept in the collection of the National Museum in Prague are re-described, re-figured, re-determined and discussed in detail. The specimens belong to seven species: *Glomerula serpentina* (Goldfuss), *Glomerula plexus* (J. De C. Sowerby), *Filograna socialis* (Goldfuss), *Neovermilia* cf. *ampullacea* (J. De C. Sowerby), *Dorsoserpula wegneri* (Jäger), *Dorsoserpula conjuncta* (Geinitz)? and Serpulidae gen. et sp. indet. In addition, those species and specimens mentioned but not figured by Dr. Antonín Frič are listed and partially discussed although these specimens had not been found in the collection and are presumably lost.

■ Sabellidae, Serpulidae, *Glomerula, Filograna, Dorsoserpula, Neovermilia, Serpula,* Dr. Antonín Frič, Bohemian Cretaceous Basin

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Introduction

Dr. Antonín Frič, his life, scientific career and stratigraphical scheme for the Cretaceous of the Bohemian Cretaceous Basin

Antonín Frič was born in Prague on 30 July 1832 as the second son of Dr. Josef Frič, a lawyer and politician who played an important role in Czech public life, parliament and Prague municipal council. His house was a centre of patriotic life. Perhaps the fact that Dr. J. Frič had held the position of treasurer for the Society of the Czech Patriotic Museum (today the National Museum) and Matice česká since 1842 and continued to do so for many years was the reason why the young Antonín came into contact with the Czech Patriotic Museum at an early age. In 1848 Antonín Frič became a volunteer at the museum and helped the custodian Maxmillian Dormitzer in structuring the collections. In his early twenties he became the unpaid assistant of Dormitzer and worked in the museum's zoological collections .

Following his father's profession, young Antonín began to study law at the Prague University. However, his passion for nature and the natural sciences was greater. In 1854 he started medical school which at that time was the best route for studying natural sciences. He became a qualified doctor in 1860.

When Dormitzer died prematurely, Frič became his successor.

Frič was primarily a zoologist. First he worked on birds, and began publishing the unique detailed book, "Birds of Europe", which includes 708 beautiful colour plates of all the bird species of Europe. In 1872 he completed a publication about the birds of Bohemia. Later Frič's main interest shifted to Czech fish. In 1863 he qualified at the medical faculty of Prague University in comparative anatomy and physiology, and the following year also at the Technical University for zoology. In 1871 the Prague University appointed him associate professor of zoology teaching in Czech language, and in 1881 the Czech University appointed him ordinary professor.

In 1864, the Society of the Czech Patriotic Museum together with the Patriotic economical society founded the "Committee for natural science research of Bohemia" ("Komitét pro přírodovědecký výzkum Čech"), under the leadership of Karel Kořistka and Jan Krejčí. Dr. Antonín Frič was among the founder members of the Committee and, at times, he was the secretary of the president, Karel Kořistka. Then his attention turned to the extinct fauna of the Czech geological formations and thus to geology. Together with Dr. Jan Krejčí he began studying the Czech Cretaceous formation. By 1869 Krejčí had already published his new stratigraphical scheme for subdividing the Cretaceous sediments of the Bohemian Cretaceous Basin (BCB) into eight stratigraphical units ("Schichten") which were named after localities. In the same year Frič started publishing his much more detailed descriptions of

the geology and palaeontology of Krejčí's "Schichten", one unit after the other. The paper by Krejčí (1869) and the eight volumes published by Frič (1869–1911); the seventh volume (1901) with Edwin Bayer named as a co-author) together formed a series of publications entitled "Studien im Gebiete der Böhmischen Kreideformation". Thus, Krejčí and Frič together, although in separate papers in the same series and the same journal, founded, established and spread their stratigraphical scheme. From a geologist's point of view, this series may be considered as Frič's main work. Each volume was first published in German and in Czech, differing in pagination and, in part, in the year of publication. In the present paper, we refer to the year and pagination of the German versions only. In the Czech as well as in the German versions of the eight volumes, Frič's name is given in its Czech spelling, although elsewhere his publications are cited with his name in the German spelling, "Fritsch".

His other publications include a monograph, published with the support of the "Committee", on cephalopods, co-authored by U. Schlönbach (1872), a later publication on reptiles and fish (1878), and another about crustaceans with J. Kafka (1887). Frič's biggest honour in the field of paleontology came from his four-volume work, "Fauna der Gaskohle Kalkstein und der Permformation Böhmens" (1879–1901). With the Czech translation of his research Frič practically founded the Czech paleontological school as his work could then be read in the mother languague of Czech geologists and interested layman and thus was spread among the general public. Antonín Frič died on November 15th, 1913 in Prague.

Due to radical facies changes within the Cretaceous of BCB and due to lithological similarities of rock strata of different geological ages and sparsity of index fossils in some thick rock units, stratigraphical work on the Cretaceous of the Czech Republic has always been a difficult task, progressing only gradually from the publications of Reuss and Geinitz in the first half of the 19th century until today. Krejčí's and Frič's scheme was amongst the most important milestones. The stratigraphic extent of the individual units was redesigned by many authors. The history of Czech Cretaceous stratigraphy was summarized by Dvořák (1958). Čech et al. (1980) introduced a severely revised scheme of stratigraphical Formations and (a few) Members which follows the rules of modern lithostratigraphy. Čech (2011) provided the most recent summary of the stratigraphy and paleogeography of BCB. It compares the schemes of rock stratigraphy presented by Frič (1877, 1889, 1893), sequence stratigraphy by Uličný et al. (2009) and Čech et al's (1980) lithostratigraphy, and, moreover, presents chronostratigraphy; see Čech (2011:19, fig. 2).

Material and methods

All of the nine specimens described by A. Frič were studied by one of us (T. K.) in the collections of the National Museum (NM) in Prague. They belong to seven species, of sabellid and serpulid worm tubes which were figured by Frič in his "Studien im Gebiete der böhmischen Kreideformation (1869–1911)" which were measured, re-described and re-photographed. The modern systematical and taxonomical descriptions of these nine specimens are the main topic of the present publication. However, in most cases Frič's stratigraphical data ("Schichten") have been cited by us in its original form. This is because apart from the type localities of modern lithostratigraphy and a few other well-known and re-studied localities, it would have required much fieldwork and literature study to try to reconstruct the stratigraphical provenience of the specimens in terms of modern lithostratigraphy, especially in those cases where outcrops do not exist anymore.

Moreover, Frič had mentioned sabellids and serpulids in the text or in fossil lists but without a figure or description. A minor part were citations of earlier data published by earlier authors, but the major part were specimens either collected by Frič himself or presented to him by colleagues or local fossil collectors. In contrast to the sabellid and serpulid specimens which are figured in Frič's publications and which were all found by T. K. in the National Museum's collection, despite some considerable effort, T. K. did not manage to find or identify any of the non-figured but only mentioned specimens in the National Museum. It seems that they had either been lost, or, in part, may have not even been removed from the outcrop. Of course, if neither a specimen nor a figure nor a description exists anymore, it is not possible to control and revise Frič's genus and species determinations. However, all the specimens mentioned are cited by us, with locality names given in Czech as well as (in brackets) in old German. In many cases, we have tried to give at least a "best guess" opinion of which species Frič may have had in his hands, based on our own experience with species occurrences in BCB.

In the six tables below we list all sabellids and serpulids mentioned by Frič in his eight volumes, except for Frič's (1911, p. 101) citation of Geinitz' species list from Saxony, which is omitted here, because one of us (M. J.) is preparing a revision of the Saxony sabellids and serpulids from the Geinitz collection. We affiliate the citations to the six tables according to Frič's scheme of "Schichten". Page numbers are given without adding the year of publication for the "main" volume of the respective "Schichten" mentioned in the caption, with the exception of Table 1 because Frič described the Korycaner "Schichten" in detail in two of his volumes. In Table 1, page numbers 181–242 are from volume one (1869), whereas page numbers 1–101 are from volume eight (1911). Moreover, Frič gave lists of the stratigraphical ranges of the fossil species providing data on occurrence or non-occurrence in the other "Schichten" which were not the topic of the respective volume. We list such citations from "foreign" volumes in the form of: year of publication plus page numbers, both in brackets. "*Serpula*" *amphisbaena* Goldfuss which is a bivalve is listed by us only once because Frič had used the correct combination *Gastrochaena amphisbaena* (or, rarely, *Teredo amphisbaena*) elsewhere, this indicates that Frič clearly recognised that the species *amphisbaena* is a bivalve. In our tables, we corrected the species name "*ampulacea*" to "*ampulacea*". Frič used both spellings, but most often the wrong spelling with only one "l". Occasionally Frič cited the (in his time) correct species names, but combined it with the wrong author. These errors occur irregularly and are therefore considered only typing errors. We corrected them without comment. Locality names, as far as is known, are given with the modern spelling (some of them with old German names or old Czech names in brackets).

Table 1. Sabellids and serpulids from the Korycaner "Schichten" mentioned by Frič (1869, pp. 181–242, and 1911, pp. 1–101), and in some of his other volumes (years and page numbers in brackets).

Pages	Name used by Frič	Stratigraphy according to Frič	Localities	Determinations and remarks
197, 206, 220, 221, (1883, 82) (1889, 58), (1893, 61), (1897, 33)	*Serpula gordialis*, Schl.	Korycaner Schichten	Zálabí near Kolín, Kolín, Kamajka near Chotusice, Zbyslav, Želenice (Schillinge) near Bílina, Teplice region: Kopfhügel hill near Řetenice (Settenz) and Jeníkov (Janegg or Janig), above Teplice-Šanov (Teplitz-Schönau) (in part Frič cited Reuss)	*Glomerula* sp., presumably *G. serpentina*
72 incl. fig. 304	*Serpula gordialis* (in figure caption), resp. var. *serpentina* (in the text)	Korycaner Schichten	Kamajka near Chotusice, Zbyslav, Kolín, Velim, Skutíčko near Skuteč (Skuč), Kojetic, Kněžívka (Kleinherrendorf)	*Glomerula serpentina*
208, 211, 212, 231, 237	*Serpula plexus*, Sow., *Serpula* (*plexus*), *Serpula* (cf. *plexus*)	Korycaner Schichten	Ronov near Čáslav, southwest of Koryčany, Skutíčko near Skuteč (Skuč), between Kněževes (Kněžoves, Herrendorf) and Kněžívka (Kleinherrendorf)	*Glomerula* sp., probably *G. plexus*
206, 221, 223, 235	*Serpula filiformis*, Sow.	Korycaner Schichten	Zbyslav, Želenice (Schillinge) near Bílina, south foot of Trupelník hill (Trippelberg) near Kučlín, Zlosejn (in part Frič cited Reuss)	*Filograna socialis*
(1883, 81)	*Serpula socialis*, Goldf.	Korycaner Schichten	(general list)	*Filograna socialis*
197, 231	*Serpula* (cf. *canteriata*, Hagenow)	Korycaner Schichten	Zálabí near Kolín, Kolín, southwest of Koryčany	indeterminable (maybe *Nogrobs* sp.?)
220	*Serpula fluctuata*, Sow.	Korycaner Schichten	near Novosedlice (Weisskirchlitz) near Teplice	maybe *Filogranula cincta*
221	*Serpula cristata*, Duj.	Korycaner Schichten	Želenice (Schillinge) near Bílina	*Filogranula cincta*
221	*Serpula Leonhardi*, Reuss	Korycaner Schichten	Želenice (Schillinge) near Bílina	*Vermiliopsis leonhardi* (syn. *Vermiliopsis dorsolineata*)

Table 2. Sabellids and serpulids from the Weissenberger "Schichten" (with subunits in brackets) and Malnitzer "Schichten" mentioned by Frič (1878), and in some of his other volumes (years and page numbers in brackets).

Pages	Name used by Frič	Stratigraphy according to Frič	Localities	Determinations and remarks
(1889, 58), (1893, 61), (1897, 33)	*Serpula gordialis*, v. Schl.	Weissenberger Schichten and Malnitzer Schichten	(general list)	*Glomerula* sp., presumably *G. serpentina*
47	*Serpula gordialis*	Weissenberger Schichten (Dřinower Knollenschicht)	Base of the Pětihorka	*Glomerula* sp., presumably *G. serpentina*
48	*Serpula gordialis*	Weissenberger Schichten (Wehlowitzer Pläner) – Malnitzer Schichten	path to the Kirchberg hill near Hodkovice (Liebenau)	*Glomerula* sp., presumably *G. serpentina*

71	*Serpula gordialis*	Weissenberger Schichten (Wehlowitzer Pläner)	Strahov gate (Strahöwer/Strahover Tor) on the Bílá hora hill (Weisser Berg) near Teinka in Prague	*Glomerula* sp., presumably *G. serpentina*
45	*Serpula* sp.	Weissenberger Schichten (Semitzer Mergel)	above Svatoňovice (Schwadowitz)	indeterminable
64	*Serpula*	Weissenberger Schichten (Wehlowitzer Pläner)	Peruc (Perutz)	indeterminable
76	*Serpula* sp.	Weissenberger Schichten (Dřinower Knollen)	vineyard Zděnčina above Nové Dvorce (Neuhof)	indeterminable

Table 3. Sabellids and serpulids from the "Iserschichten" (with subunits in brackets) mentioned by Frič (1883), and in some of his other volumes (years and page numbers in brackets).

Pages	**Name used by Frič**	**Stratigraphy according to Frič**	**Localities**	**Determinations and remarks**
129, (1889, 58), (1893, 61), (1897, 33)	*Serpula gordialis*, Schloth.	Iserschichten	Brandýs nad Orlicí (Brandeis an der Adler) (and general list)	*Glomerula* sp., presumably *G. serpentina*
13, 82	*Serpula gordialis*, Sch.	Iserschichten (Zwischenpläner within the Kokořiner Quader)	Řepín, Nosadlov = Novosedlov?	*Glomerula* sp., presumably *G. serpentina*
31, 82, 129	*Serpula gordialis*	Iserschichten (Trigoniaschichten)	Choroušky (Choroušek)	*Glomerula* sp., presumably *G.*
18, 31, 82, 129	*Serpula gordialis*	Iserschichten (Bryozoenschichten)	Kanina region, Choroušky (Choroušek), Vtelno, Husovodol (Husodol), Živonín	*Glomerula* sp., presumably *G. serpentina*
138, (1897, 33)	*Serpula socialis*, Goldf.	Iserschichten	(general list)	*Filograna socialis*
13, 81	*Serpula socialis*, Goldf.	Iserschichten (Zwischenpläner, Kokořiner Quader)	Řepín	*Filograna socialis*
15, 16, 31, 39, 41, 43, 47, 53, 74, 81, 128 with fig. 113	*Serpula socialis*, Goldf.	Iserschichten (Trigoniaschichten)	Choroušky (Choroušek), Labe (Elbe) region, Jizera (Iser) region, Orlice (Adler) region, Jizera (Iser) valley in Zámostí, Mladá Boleslav (Jungbunzlau), Čejtic station near Mladá Boleslav (Jungbunzlau), below Bezděz (Bösig) village, Dolánky (Dolanek) near Turnov, Báčův quarry near Choceň (Chotzen), near Česká Třebová (Böhmisch Trübau), Desná	*Filograna socialis*
61, 128	*Serpula socialis*, Goldf.	Iserschichten (Trigoniaschichten, Callianassaschichten)	between Třebovice (Triebitz) and Rybnik near Česká Třebová (Böhmisch Trübau)	*Filograna socialis*
71, 73	*Serpula socialis*, Goldf.	Iserschichten (either top of Trigonienschichten or base of Bryozoenschichten, with *Callianassa*)	Vraclav, Desná	*Filograna socialis*

57, 128	*Serpula filiformis*	Iserschichten (either top of Trigonienschichten or base of Bryozoenschichten)	Brandýs nad Orlicí (Brandeis an der Adler)	*Filograna socialis* (*Serpula filiformis* was affiliated to *socialis* by Frič on page 128)
18, 31, 54, 81	*Serpula socialis*, Goldf.	Iserschichten (Bryozoenschichten and equivalents)	Kanina region, Choroušky (Choroušek), ?Újezd, Báčův quarry near Choceň (Chotzen), Choceň (Chotzen) graveyard	*Filograna socialis*
128-129, (1889, 58)	*Serpula ampullacea*, Sow.	Iserschichten	Mladá Boleslav (Jungbunzlau)	*Dorsoserpula wegneri* (or *Neovermilia ampullacea*)
31, 39, 43, 53, 81, 128-129 incl. fig. 114	*Serpula ampullacea*, Sow.	Iserschichten (Trigoniaschichten)	Choroušky (Choroušek), Bezno, Písník near Česká Lípa (Böhmisch Leipa), Báčův quarry near Choceň (Chotzen), Choceň (Chotzen) graveyard	Fig. 114 is *Dorsoserpula wegneri*. Some other specimens may either be *Dorsoserpula wegneri* or *Neovermilia ampullacea*
62, 128-129	*Serpula ampullacea*, Sow.	Iserschichten (Trigoniaschichten, Callianassaschichten)	near Česká Třebová (Böhmisch Trübau)	*Dorsoserpula wegneri* (or *Neovermilia ampullacea*)
18, 31, 81	*Serpula ampullacea*, Sow.	Iserschichten (Bryozoenschichten)	Kanina region, Choroušky (Choroušek), Živonín	*Dorsoserpula wegneri* (or *Neovermilia* ampullacea)
128-129, (1889, 57)	*Serpula macropus*, Sow.	Iserschichten	Dalovice (Dalovic), Písník near Česká Lípa (Böhmisch Leipa)	*Neovermilia* cf. *ampullacea*
31, 40, 53, 58, 82, 128-129 incl. fig. 115	*Serpula macropus*, Sow.	Iserschichten (Trigoniaschichten)	Choroušky (Choroušek), Čejtic station near Mladá Boleslav (Jungbunzlau), Báčův quarry near Choceň (Chotzen), Brandýs n. Orlicí (Brandeis an der Adler)	*Neovermilia* cf. *ampullacea* (*triangularis* was affiliated to *macropus* by Frič on page 128)
18, 31, 82, 128-129	*Serpula macropus*, Sow.	Iserschichten (Bryozoenschichten)	Kanina region, Choroušky (Choroušek), Živonín, Vtelno	*Neovermilia* cf. *ampullacea* (*triangularis* was affiliated to *macropus* by Frič on page 128)
71	*Serpula adhaerens*	either Weissenberger Schichten (Wehlowitzer Pläner) or Iserschichten (lower portion of Trigoniaschichten)	Vinary (Vinar) quarry	indeterminable

Table 4. Sabellids and serpulids from the Teplitzer "Schichten" mentioned by Frič (1889), and in some of his other volumes (years and page numbers in brackets).

Pages	Name used by Frič	Stratigraphy according to Frič	Localities	Determinations and remarks
(1883, 82), 11, 22, 40, 42, 48, 51, 58, (1893, 61), (1897, 33)	*Serpula gordialis*, v. Schl.	Teplitzer Schichten	Teplice region, including Hudcov (Hundorf), Řetenice (Settenz) and Lahošt (Loosch), Čížkovice near Lovosice, Veveří (Gaubenhof) near Litoměřice (Leitmeritz), Sedlec near Benátky (Benatek), near Smiřic on road to Smržov	*Glomerula* sp.
96 incl. fig. 122	*Serpula gordialis*, v. Schl.	Teplitzer Schichten	Třtěno (Kröndorf) near Chožov	*Glomerula plexus*

96	*Serpula gordialis*, v. Schl., var. *infibulata*	Teplitzer Schichten	Hudcov (Hundorf) (Frič cited Reuss)	*Glomerula* sp.
96	*Serpula gordialis*, v. Schl., var. *implicata*	Teplitzer Schichten	Brozánky (Brozan) (Frič cited Reuss)	*Glomerula* sp.
(1883, 81), 7	*Serpula socialis*, Goldf.	Teplitzer Schichten. However, on page 7 Frič stated that Serpula socialis is absent in the Teplitzer Schichten.	(general list)	*Filograna socialis*
(1883, 81), 58, 97	*Serpula ampullacea*, Sow.	Teplitzer Schichten	Dresden-Strehlen in Saxony (Frič cited Geinitz)	*Neovermilia ampullacea*
(1883, 82), 57, 96	*Serpula macropus*, Sow.	Teplitzer Schichten	Dresden-Strehlen in Saxony (Frič cited Geinitz)	*Neovermilia ampullacea*
22, 58, 96	*Serpula pustulosa*, Gein.	Teplitzer Schichten	Teplice region, including Hudcov (Hundorf), Řetenice (Settenz) and Lahošt (Loosch), Dresden-Strehlen in Saxony (Frič cited Reuss and Geinitz)	*Neovermilia ampullacea*
22, 57	*Serpula biplicata*, Reuss	Teplitzer Schichten	Teplice region, including Hudcov (Hundorf), Řetenice (Settenz) and Lahošt (Loosch)	*Serpula*? (*Cementula*?) *biplicata*
22, 57, 96	*Serpula depressa*, v. Münst.	Teplitzer Schichten	Teplice region, including Hudcov (Hundorf), Řetenice (Settenz) and Lahošt (Loosch)	*Laqueoserpula reussi*
24, 40, 58, 97	*Serpula granulata*	Teplitzer Schichten	Kyselka (Sauerbrunnberg) near Bílina, Čížkovice near Lovosice	*Neomicrorbis crenatostriatus crenatostriatus*
57, 96	*Serpula umbilicata*, v. Hag.	Teplitzer Schichten	(general list), Dresden-Strehlen in Saxony (Frič cited Geinitz)	*Neomicrorbis crenatostriatus*, subsp. indet.
22, 58, 97	*Serpula rotula*, Goldf.	Teplitzer Schichten	Teplice region, including Hudcov (Hundorf), Řetenice (Settenz) and Lahošt (Loosch), Kučlín (Kutschlin) near Bílina	?*Neomicrorbis crenatostriatus*, subsp. indet.
48	Serpularöhren	Teplitzer Schichten	Sedlec near Benátky (Benatek)	indeterminable

Table 5. Sabellids and serpulids from the Priesener "Schichten" mentioned by Frič (1893), and in some of his other volumes (years and page numbers in brackets).

Pages	**Name used by Frič**	**Stratigraphy according to Frič**	**Localities**	**Determinations and remarks**
61, (1897, 33)	*Serpula gordialis*, Schl.	Priesener Schichten	(general list)	*Glomerula* sp.
109	*Serpula gordialis*, Schl. var. *tuba* Sow.	Priesener Schichten	Lužice (Luschitz), Březno (Priesen) (Frič cited Reuss)	?*Glomerula* sp.
7, 61, 109	*Serpula tetragona*, Sow.	Priesener Schichten (not in older Schichten)	Lužice (Luschitz) (Frič cited Reuss)	*Nogrobs* sp.
7, 61, 109	*Serpula subtorquata*, v. Münster	Priesener Schichten (not in older Schichten)	Lužice (Luschitz) (Frič cited Reuss)	*Pentaditrupa subtorquata*
7, 61, 109	*Serpula subinvoluta*, Reuss	Priesener Schichten (not in older Schichten)	Březno (Priesen) (Frič cited Reuss)	needs revision
61, 109	*Serpula spinulosa*, Reuss	Priesener Schichten	Lužice (Luschitz) (Frič cited Reuss)	needs revision
41, 61	*Serpula*, *Serpula*?	Priesener Schichten, topmost layers	near Vinařice near Doubravice	indeterminable

Table 6. Sabellids and serpulids from the Chlomeker Schichten mentioned by Frič (1897), and in some of his other volumes (years and page numbers in brackets).

Pages	Name used by Frič	Stratigraphy according to Frič	Localities	Determinations and remarks
19, 23, 33, 71	*Serpula gordialis*, v. Schloth.	Chlomeker Schichten	Chlomek hill near Vinařice, Jedlová (Tannenberg) near Česká Kamenice (Böhmisch Kamnitz), Chřibská (Kreibitz), Idzików (Kieslingswalde) in Poland	*Glomerula* sp.
19, 23, 33, 71	*Serpula socialis*, Goldf.	Chlomeker Schichten	Chlomek hill near Vinařice, Jedlová (Tannenberg) near Česká Kamenice (Böhmisch Kamnitz), Chřibská (Kreibitz), Idzików (Kieslingswalde) in Poland	*Filograna socialis*

Systematic palaeontology

Classification of ranks higher than genus level follows that of the World Register of Marine Species (WoRMS), see http://www.marinespecies.org. Much information on systematics and taxonomy of living serpulids can be found in ten Hove and Kupriyanova (2009). Classic work on European Cretaceous sabellids and serpulids include, among others, J. de C. Sowerby (1826–1829, 1840–1846), Goldfuss (1826–1844), von Hagenow (1840), Brünnich Nielsen (1931), Regenhardt (1961), Ware (1975), Lommerzheim (1979) and Jäger (1983, 1993, 2005). Important publications about sabellids and serpulids of BCB , beside those of Frič dealt with in the present paper are, among others, Reuss (1845–1846), Geinitz (1839–1842, 1843, 1871–1875), Ziegler (1967, 1969, 1973, 1974, 1978, 1984), Kočí (2007, 2010, 2012) and Sklenář et al. (2013). The species from the Teplitzer Schichten have only recently been revised in the two last mentioned publications.

Class **Polychaeta Grube, 1850**

Subclass **Canalipalpata Rouse et Fauchald, 1997**

Order **Sabellida Fauchald, 1977**

Family **Sabellidae Latreille, 1825**

Subfamily **Sabellinae Chamberlin, 1919**

Genus ***Glomerula* Brünnich Nielsen, 1931**

Glomerula serpentina (Goldfuss, 1831)

Pl. 3, figs 1a–c, figs 2 a–c

1831 *Serpula gordialis* Schloth. varietas *serpentina*; Goldfuss: p. 240, pl. 71, fig. 4.
1840 *Serpula implicata* nob; von Hagenow: p. 668, pl. 9, fig. 17.
1845 *Serpula serpentina* Goldf; Reuss: p. 106, pl. 42, fig. 22.
1911 *Serpula gordialis*, [resp.] var. *serpentina;* Frič: p. 72, fig. 304.
pars 1983 *Glomerula gordialis* (Schlotheim, 1820); Jäger: pp. 26–31, pl. 2, figs 1–10, 13–18, non figs 11–12.
1984 *Glomerula gordialis* (Schlotheim, 1820); Ziegler: p. 215, pl. 1, figs 3–5.
2005 *Glomerula serpentina* (Goldfuss, 1831); Jäger: p. 130, pl. 1, fig. 1.

Material. The three original specimens figured by Frič (1911, p. 72, fig. 304) from the lowermost Turonian Korycaner "Schichten" of Kamajka (originally named Kamajk or Kamýk) near Chotusice, coll. National Museum, Prague, left specimen NM O7127, middle specimen NM O7128, right specimen NM O7129 according to the original illustrated by Frič.

Description: The two specimens figured by Frič on the left and on the right (on our pl. 3, figs 1a, 1c, 2a and 2c) are irregular planar spirals whereas the specimen in the middle (figs 1b and 2b) is a 3D coiled ball. Specimen figs 1a and 2a measures 12.5 mm x 10.5 mm, specimen figs 1b and 2b is about 8.4 mm high, and specimen figs 1c and 2c is 8.7 mm x 9 mm. Tube diameters for the same order of specimens are respectively, 1.8 mm, 1.4 mm and 1.6 mm. All tubes have a smooth surface and lack trilobate lumina.

Remarks and relationships: A natural scheme of differentiation between species of the genus *Glomerula* is almost impossible because the tubes are palaeogeographically widepread and have existed since circa 200 million years from the lowermost Jurassic (Hettangian) until today with little change in the general construction of the tube. The more or less smooth tubes lack the most common features, for example ornamentation, which normally enable differentiation between serpulid species. The only obvious phylogenetic progress within *Glomerula* was the optional introduction of trilobate constrictions into the tube's lumen somewhere around the Jurassic/Cretaceous transition (the hitherto geologically oldest specimens with trilobate narrowings are found in the uppermost Valanginian) enabling differentiation between a Jurassic set and a Cretaceous to Recent set of *Glomerula* species. Within the Cretaceous to Recent set further differentiation between fossil species is very artificial, based on distinguishing between small (*G. lombricus*) versus large (*G. serpentina* and *plexus*) tube diameter and more or less solitary (*G. lombricus* and *G. serpentina*) versus more or less social, cluster forming (*G. plexus*) occurrence. This artificial scheme had been introduced by one of us (M. J.) and had been slightly modified several times by Jäger (1983, 1993, 2005, 2012), with the latest slight modification introduced by T. K. (in Sklenář et al. 2013), see remarks in the chapter on *Glomerula plexus.*

Glomerula lombricus (Defrance) occuring in offshore facies on fine-grained sediments is a similar but smaller species with a smooth tube surface. Its tube diameter ranges from 0.4 to 1 mm and is usually 0.5–0.9 mm. The tube diameter of *Glomerula serpentina* most often ranges from ca. 1 to ca. 2 mm and usually does not exceed 2 mm. Occasionally larger tubes occur, for example in nearshore shallow water deposits in BCB, for example at the locality Velim, where tube diameter may become very large, but when occuring in clusters the number of individual tubes in a cluster is less compared to typical specimens of *Glomerula plexus.* More detailed remarks and discussion of relationships was published by Kočí (2012) and Sklenář et al. (2013).

Palaeoecology. See Seilacher et al. (2008).

Occurrence in BCB. Upper Cenomanian – Bílina, Brázdim, Hodkovice (Ve skalách), Korycany, Miskovice, Velim, Kamajka, Vítězov. Lower Turonian – Běstvina u Ronova nad Doubravou, Chrtníky, Kamajka, Kaňk, Turkaňk, Nová Ves u Kolína, Předboj, Velim – Skalka, Starkoč, Nová Lhota u Kutné Hory. Middle Turonian – Benátky nad Jizerou, Brandýs nad Orlicí, Česká Třebová, Dolánky u Turnova, Klokočské Loučky, Kokořín, Libuň, Kněžnice, Nouzouv u Svitav, Rovensko pod Troskami, Turnov. Upper Turonian – Čížkovice, Oškobrh, Přerovská hůra, Teplice, Vinařice. Coniacian – Hrdoňovice, Prachovské skály, Valdštejn, Mašov u Turnova.

Glomerula plexus (J. de C. Sowerby, 1829)

Pl. 1, fig. 1; Pl. 2, fig. 1

? 1820 *Serpulites contorquatus*; von Schlotheim: p. 96.
1829 *Serpula Plexus*; J. de C. Sowerby: p. 201, pl. 598, fig. 1.
1831 *Serpula vibicata* Münster; Goldfuss: p. 240, pl. 71, fig. 3 a–b.
pars 1875 *Serpula gordialis* Schl; Geinitz, II: p. 200, pl. 37, fig. 4, non fig. 3.
1889 *Serpula gordialis*, v. Schl; Frič: p. 96, fig. 122.
1961 *Filograna congesticia* n. sp; Regenhardt: pp. 23–24, pl. 2, fig. 3.
non 1973 *Filogarana* [sic!] *congesticia* Regenhardt, 1961; Ziegler: pp. 34–35, pl. 5, fig. 3.
1983 *Glomerula plexus* (Sowerby, 1829); Jäger: pp. 31–33, pl. 3, figs 1–3.
pars 1984 *Filograna congesticia* Regenhardt, 1961; Ziegler: pp. 214–215, pl. 1, fig. 1, non fig. 2.
non 1984 *Sarcinella plexus* (Sowerby, 1829); Ziegler: p. 220, pl. 2, fig. 6.
2005 *Glomerula plexus* (J. de C. Sowerby, 1829); Jäger: p. 131.
2013 *Glomerula plexus* (J. de C. Sowerby, 1829); Sklenář et al., pp. 678–679, figs 3A–F, 5A, 6Fa.

Material. The original specimen figured by Frič (1889, p. 96, fig. 122) from the Upper Turonian Teplitzer Schichten of Třtěno (Kröndorf) near Chožov, coll. National Museum, Prague, registration number NM O4378.

Description. The specimen is a ball-shaped mass of irregularly intertwined tubes. It measures 37 mm x 31.2 mm. Tube diameter is very large: 3.3–3.5 mm. All tube have a smooth surface and, as far as visible from outside, lack trilobate lumina.

Remarks and relationships: Differentiation between the more or less solitary *G. serpentina* and the more or less social, cluster-forming *G. plexus* is at least in part artificial. The most typical *G. plexus* clusters from England, Germany and Sweden consist of dozens or even hundreds of tubes, with the whole cluster showing a tendency to form either a bundle or a large ball or dome. However, at many localities where *Glomerula* tubes are common, small clusters occur composed of two to circa five tubes, thereby standing morphologically between *serpentina* and *plexus*. Are these finds small examples of *G. plexus*, or are they only by-chance aggregates of a few *G. serpentina* tubes which attached to each other due to dense spatfall in this area of the sea-floor, sparsity of solid substrates on a generally soft sea-floor, and general tendency of the genus *Glomerula* to adnate its tube closely to solid objects of any kind, including earlier-built portions of its own tube or tubes of other *Glomerula* individuals? While M. J. generally tends to affiliate the small clusters composed of two to circa five tubes to *G. serpentina*, we nevertheless agreed with the suggestion of T. K. (in Sklenář et al. 2013) that in the Teplice Formation of the Úpohlavy quarry all finds of large tube diameter should be determined as *G. plexus* and that *G. serpentina* does not occur at Úpohlavy. The reason for our decision was that medium-sized clusters composed of two to circa five tubes are relatively common here and that many of the tube fragments found in a solitary state seem to be only fragments of such clusters or fragments of ‘seeking‘ tubes growing off from a cluster so that differentiation between the two species seems senseless here. The medium-sized cluster figured by Frič clearly matches the finds from Úpohlavy and was found in the Teplitzer Schichten and therefore presumably in the same layer, even though there are, of course, differences in the detailed ranges of Teplitzer Schichten and Teplice Formation. However, it must be stated that even in the Teplitzer Schichten or Teplice Formation the *Glomerula plexus* clusters are on one hand never composed of as many tubes as in typical *plexus* clusters found in England, Germany or Sweden, but that on the other hand in the Teplitzer Schichten or Teplice Formation the tube diameter may grow much larger compared to the moderate size of tubes in typical *plexus* clusters. For more detailed remarks and discussion of *Glomerula* and its species see Sklenář et al. (2013).

Palaeoecology. This species was adapted to life on the soft bottom. The thin-walled sabellids use the same strategy as corals, which use dead portions of their own skeleton as an anchor. Similarly, sabellids use previously built, abandoned portions of their own tube or other tubes within their cluster as an anchor for attachment, after the primary attachment had been to a lithoclast or bioclast of any kind. The spaghettiform, smooth tubes of the sabellid cluster grow fast in length but relatively slowly in diameter so that in a fragment one can often not decide which end had been posterior and which anterior (for example, Seilacher et al. 2008, fig. 3A).

Occurrence in BCB. Upper Turonian – Křtěnov, Čížkovice, Úpohlavy, Radovesice.

Family **Serpulidae Rafinesque, 1815**

Subfamily **Filograninae Rioja, 1923**

Genus ***Filograna* Oken, 1815**

***Filograna socialis* (Goldfuss, 1831)**

Pl. 1, fig. 2; Pl. 2, fig. 2

1831 *Serpula socialis* nobis; Goldfuss: p. 235, pl. 69, fig. 12 a–c.
1836 *Serpula filiformis*; Sowerby in Fitton: p. 340, pl. 16, fig. 2.
1845 *Serpula filiformis* Sow; Reuss: p. 20, pl. 5, fig. 26.
1846 *Serpula filiformis* Sow. bei Fitton; Geinitz: p. 253, pl. 16, fig. 25.
1875 *Serpula socialis* Goldf; Geinitz: p. 200, pl. 37, fig. 2.
1883 *Serpula socialis* Goldf; Frič: p. 128, text–fig. 113.
1961 *Sarcinella socialis* (Goldfuss, 1831); Regenhardt: p. 29, pl. 1, fig. 5.
1961 *Filograna sollistima* n. sp; Regenhardt: p. 24, pl. 2, fig. 4.
1973 *Sarcinella socialis* (Goldfuss); Ziegler: p. 36, pl. 5, figs 4–6; pl. 6, fig. 1.
1978 *Sarcinella socialis* (Goldfuss); Ziegler: p. 218, pl. 50, fig. 4.
1979 *Filograna plexus* (Sowerby, 1829); Lommerzheim: p. 128.
1983 *Filograna socialis* (Goldfuss, 1831); Jäger: pp. 20–23, pl. 1, figs 3–8.
1984 *Sarcinella socialis* (Goldfuss, 1831); Ziegler: pp. 219, pl. 2, figs 7–8.
2005 *Filograna socialis* (Goldfuss, 1831); Jäger: p. 135.
2012 *Filograna socialis* (Goldfuss); Kočí: p. 9, pl. 1, fig. 5.

Material. The original specimen figured by Frič (1883, pp. 128–129, fig. 113) from the Middle Turonian Iserschichten of Mladá Boleslav (Jungbunzlau), coll. National Museum, Prague, registration number NM O6051.

Description. A staghorn- or Y-shaped bundle composed of more than sixty tubes attached to each other and oriented more or less parallelly. All tubes have a smooth surface and are more or less circular in cross-section. The width of the right branch of the staghorn-shaped bundle is 11 mm, and height is 7.5 mm in oval cross-section Total length of the specimen is circa 30 mm. Tube diameter ranges from 1 to 1.8 mm.

Remarks and relationships. *Filograna filosa* (Dujardin) forms similar staghorn-shaped bundles consisting of many tubes, but differs from *F. socialis* by its smaller tube diameter which is only 0.2–0.4 mm.

Palaeoecology. The staghorn-shaped colonial bundles composed of many thin-walled *Filograna* tubes growing more or less parallel to each other represent another adaptation for living on a soft substratum by forming ‘reeflets‘heavy enough to remain stable on a soft bottom, with the anterior portions of theirY-like dividing branches, as in staghorn corals, ascending above the sea-floor (Seilacher et al. 2008, fig. 3C–D). However, in contrast to staghorn corals, the *Filograna* bundles not only divide, but sometimes unite to form a kind of ‘noose‘ or 3D ‘web‘. This is seen, for example, also in Frič’s original specimen. In the fossil state, such large web-shaped colonies are often found broken into cylindrical or Y-shaped fragments of bundles, and it is hard to distinguish if an isolated Y-shaped fragment represents a division or rather a uniting of bundles. More detailed remarks and discussion of relationships were published by Jäger (1983, 2005) and Kočí (2012).

Occurrence in BCB (data mainly from different volumes of Frič’s work and from Ziegler (1973, 1978). The genus *Filograna* is easily recognised by its bundle-shaped colony fragments consisting of many small parallel tubes, therefore it is very probable that locality data provided in the literature represent true occurrences of *Filograna* even if the specimens are neither described nor figured. *Filograna socialis* is widespread in the Middle Turonian of BCB and is especially common at Dolánky u Turnova, Klokočské Loučky, Jizerní Vtělno, Sychrov. General list: Lower Turonian – Kaňk. Middle Turonian – Dolánky near Turnova, Malá Skála, Klokočské Loučky, Vápeník near Turnov, Libuň, Železnice (quarry – „Na Váze“), Rovensko pod Troskami, Jizerní Vtělno, Sychrov, Mladá Boleslav, Benátky nad Jizerou, Kokořín, Brandýs nad Orlicí, Desná, Bezno near Zámostí, Čejtice, Česká Lípa, Choceň, Písník, Česká Třebová, Dalovice, Svitavy area.

Subfamily **Serpulinae Rafinesque, 1815**

Genus ***Neovermilia* Day, 1961**

***Neovermilia* cf. *ampullacea* (J. de C. Sowerby, 1829)**

Pl. 1, figs 4 a–b, Pl. 2, fig. 4

1883 *Serpula macropus* Sow; Frič: pp. 128–129, fig. 115 a–b.
1889 *Serpula macropus*, Sow; Frič: p. 96.

Material. The original specimen figured and mentioned by Frič (1883, p. 129, fig. 115) from the Middle Turonian Iserschichten of Choroušky (Choroušek), but labelled from Živonín, coll. National Museum, Prague, registration number NM O6050.

Description. A curved tube, attached to a substrate along its entire preserved length. Frič oriented the specimen so that the posterior tube portion is situated in the lower part of the drawing and seen from above, whereas the less well preserved anterior tube portion is situated in the upper part of the drawing and seen in lateral aspect. The tube has a small but distinct keel which is undulated in the posterior tube portion but straight in the anterior tube portion. Tube width at the base is 5 mm. Diameter of the lumen is 1.4 mm. The transverse ornamentation consists of densely packed parallel striae and ribs which are curved so that they protrude anteriorly at the base and at the keel. However, in Frič’s drawing the transverse ornamentation is shown idealized and a bit too regular. The tube is triangular in cross-section. The lumen is circular. The cells of the basal cellular layers are broad.

Remarks and relationships. Following Geinitz (1875), Frič and other authors of the 19th century and first decade of the 20th century misdetermined the morphological variety of *Neovermilia ampullacea* with a keel and triangular cross-section as *Serpula macropus* J. de C. Sowerby. However, this species, which today is named *Pyrgopolon* (*Septenaria*) *macropus* (J. de C. Sowerby) and is well defined by morphological as well as structural features, occurs only very rarely in BCB. Frič’s tube is a

triangular keeled specimen of the very variable group of *Neovermilia* cf. *ampullacea* (J. DE C. SOWERBY). However, its distinct and curved transverse ribs are rather unusual for *Neovermilia* cf. *ampullacea* and resemble the genus *Placostegus* PHILIPPI instead, but the tubes of *Placostegus* are usually smaller, therefore *Neovermilia* cf. *ampullacea* seems to be the more reliable determination.

P a l a e o e c o l o g y . Like most serpulids, *Neovermilia ampullacea* is an epibiont usually attached to a litho- or bioclast, for example an oyster or inoceramid valve, an ammonite shell or a sponge. However, some specimens are attached to a foreign object with only a short posterior tube portion and later are attached to their own previously built tube portions and/or may built a more or less long free anterior tube portion. For more detailed informations see Sklenář et al. (2013).

O c c u r r e n c e i n B C B . Middle Turonian – Živonín.

Genus ***Dorsoserpula*** **PARSCH, 1956**

Dorsoserpula wegneri **(JÄGER, 1983)**

(Pl. I, Fig. 3a–b; Pl. II, Fig. 3)

1883 *Serpula ampulacea* [sic!] SOWERBY; Frič: pp. 128–129, fig. 114 a–b.
1905 *Serpula carinata* nov. sp; Wegner: p. 152, pl. 8, fig 3 a–c.
1983 *Parsimonia wegneri* nom. nov; Jäger: pp. 38–39, pl. 4, figs 1–9.
pars 1984 *Sarcinella minor* nov. spec; Ziegler: pp. 220 pl. 2, fig. 4, non fig. 5.
1984 *Martina parva* nov. spec; Ziegler: pp. 227–228, pl. 3, fig. 9.
1984 *Spirorbis asper* (VON HAGENOW), 1840; Ziegler: p. 242, pl. 7, fig. 6.
1984 *Spirorbis subrugosus* (MÜNSTER), 1831; Ziegler: p. 244, pl. 8, fig. 2.
1984 *Spirorbis superminor* nov. spec; Ziegler: pp. 245, pl. 8, fig. 3.
2005 *Dorsoserpula wegneri wegneri* (JÄGER, 1983); Jäger: p. 163, pl. 4, figs 3–6.

M a t e r i a l . The original specimen figured by Frič (1883, p. 129, fig. 114) from the Middle Turonian Iserschichten of Choroušky, coll. National Museum, Prague, registration number NM O6057.

D e s c r i p t i o n . The tube is coiled to form an irregular 3D spiral consisting of 3″ whorls lying upon each other. Tube diameter is 4.5 mm. The surface of the tube has a delicate but distinct transverse striation with the striae densely packed and parallel to each other. The tube has a thin wall and is circular in cross-section. During examination of this specimen, one of us (T. K.) detected the very small cross-section of a side tube (‘Nebenröhre‘; Jäger, 1983) at the base of the tube (on the lower left side of the figures).

R e m a r k s a n d r e l a t i o n s h i p s . During joint fieldwork in 2006 at the serpulid-rich Middle Turonian locality Klokočské Loučky we noted in addition to the striking predominance of the species *Filograna socialis* which is usual for the ‘Iserschichten‘, the absence of *Neovermilia ampullacea*, and only a single find of the rare *Filogranula cincta* (GOLDFUSS) by M. J., and the frequent occurrence of a species which resembles *Dorsoserpula wegneri*. However, all the *wegneri*-like specimens we found at Klokočské Loučky lack the optional special features of the genus *Dorsoserpula*, that is the presence of the ‘Nebenröhre‘ and the tube coiling spirally around an upright cylindrical substrate. Similar tubes displaying some variability were found at the same locality during fieldwork between 2001 and 2010 by T. K., one of them has a tube shape similar to *D. wegneri* and another one (donated to Dr. R. Vodrážka in 2007) has a fine but sharp keel. Determination of our finds had remained uncertain for several years. We even discussed possible affiliation to *Parsimonia* REGENHARDT, a genus which is indeed similar to *Dorsoserpula*, but always lacks a ‘Nebenröhre‘ and should be considered separate (Jäger 2005, p. 162) from *Dorsoserpula* and be restricted to thin-walled, more or less large-sized species in general similar to the type species *Parsimonia parsimonia* REGENHARDT. For example, the specimens we collected at Klokočské Loučky as well as Frič’s specimen, resemble *Parsimonia* sp. as described and figured by Jäger (1983; Taf. 4, fig. 10) from the Lower Campanian of Merfeld in northern Germany. However, the recent discovery of a ‘Nebenröhre‘ in Frič’s original specimen by one of us (T. K.) clarified the situation: Frič’s original specimen and very probably also our specimens from Klokočské Loučky, which are found in rocks of similar geological age and in similar facies, belong to *Dorsoserpula wegneri*.

P a l a e o e c o l o g y . Frič“s original specimen as well as many other specimens are attached to a more or less large solid object, for example an oyster valve, which generally is the most common situation in the family Serpulidae. Some other specimens of the genus *Dorsoserpula*, although only a few specimens in BCB during the Middle Turonian, had become specialized and coiled their tube in the shape of a low 3D spiral around an upright cylindrical object, thereby managing to live a short distance above the sea-floor. Moreover, some specimens of *Dorsoserpula* form a similar 3D spiral or a less regular ‘ball‘, but without coiling around an upright substrate, being attached only in the juvenile state to some tiny solid object lying on the sea-floor.

O c c u r r e n c e i n B C B . Middle Turonian – Choroušky, Klokočské Loučky.

Dorsoserpula conjuncta**? (GEINITZ, 1843)**

(Pl. III, Fig. 3 a–b)

1843 *Serpula conjuncta* m; Geinitz: p. 7, pl. 4, figs 6–9.
1849 *Serpula conjuncta* GEIN; Geinitz: pp. 106–107.
1875 *Serpula conjuncta* GEIN; Geinitz: pp. 283–284, pl. 63, figs 6–9.
1911 *Serpula ampulacea* [sic!], SOW; Frič: p. 72, fig. 305.
1969 *Serpula conjucta* [sic!] GEINITZ; Ziegler: p. 38, text-figs 1–4.
? 1984 *Serpula conjucta* [sic!] GEINITZ, 1846 [sic!]; Ziegler: p. 223, pl. 3, fig. 2.
1984 *Mucroserpula velimia* nov. spec; Ziegler: pp. 229, pl. 4, fig. 6.

M a t e r i a l . The original specimen figured by Frič (1911, p. 72, fig. 305) from the Upper Cenomanian or

Lower Turonian Korycaner Schichten of Kojetice, coll. National Museum, Prague, specimen NM O7130, collected by J. Petrbok.

D e s c r i p t i o n . The specimen is limonitised. It is a slightly irregularly curved fragment of the free portion of a large robust tube. The tube diameter is 12.2 mm in the anterior portion of the fragment and 11.5 mm in the posterior portion. The transverse ornamentation is distinct and well developed, consisting of many densely packed small rings.

R e m a r k s a n d r e l a t i o n s h i p s . According to Ziegler (1984) the tube diameter of *Dorsoserpula conjuncta* (GEINITZ) is 13–17 mm, the diameter of the lumen is 12–14 mm, and thickness of the tube wall is 0.9–1.2 mm. Some specimens from the type area in Saxony grew to a larger tube diameter, and the thickness of the tube in these specimens is usually several millimetres (Jäger, in prep.) *Protula planianica* ZIEGLER, 1984 resembles *D. conjuncta*, but remains somewhat smaller in diameter and differs by its much thinner tube wall. Although Ziegler (1984) stated that *D. conjuncta* is attached along its entire length, specimens with a free anterior tube portion are found in Saxony (Jäger, in prep.), so that absence of a free portion can no longer be stated as a feature distinguishing *D.conjuncta* from *P. planianica* which possesses an attached portion and also a free portion. Such *P. planianica* specimens were previously mentioned by Ziegler (1984). Among the *P. planianica* specimens collected by one of us (T. K.) there are tubes with an attached and a free portion as well as tubes attached for their entire length which are developed as 3D coiled and meandering tubes, for example from the localities Velim and Uhelná Příbram. *D. conjuncta* has a more distinct transverse ornamentation in the middle and anterior parts of the tube compared to the weaker transverse ornamentation of *P. planianica*. T. K. noted that in the material he collected specimens of *Dorsoserpula cf. conjuncta* from the locality Kaňk can be distinguished from specimens of *D. conjuncta* from Kojetice, Velim and Uhelná Příbram by their more developed cellular layers.

P a l a e o e c o l o g y . According to Ziegler (1969, 1984) *D. conjuncta* was adapted to life on sandy, marly-sandy and marly sediments close to characteristic surf sediment. It attached itself to the soft bottom, pebbles or oyster valves. The specimens of Geinitz's type series and other specimens from the type area in Saxony are found in a rocky coast facies (Jäger, in prep.).

O c c u r r e n c e i n B C B . Upper Cenomanian: Velim, Holubice, Kojetice, Markovice, Nová Ves u Kolína, Plaňany, Radim near Pečky, Uhelná Příbram. Lower Turonian: Kaňk – Na Vrších.

Serpulidae gen. et sp. indet.

(Pl. III, fig. 4 a–b)

1911 *Serpula* sp; Frič: 72, fig. 306 (as *Serpula* n. sp.).

M a t e r i a l . The original specimen figured by Frič (1911, p. 72, fig. 306) from the Upper Cenomanian or Lower Turonian Korycaner Schichten of Skuteč (Skuč), coll. National Museum, Prague, specimen NM O7131.

D e s c r i p t i o n . The tube which is presumably figured upside down is three-dimensionally coiled, the tube spirals upwards to form a screw-like nearly cylindrical 'tower' consisting of four somewhat 'flattened, turns. The first three turns are coiled regularly, the anteriormost turn elevates obliquely and initially is nearly straight but later continues coiling. In total, the specimen is circa 40 mm high. Tube diameter increases gradually from 4 mm in the posterior part and reaches circa 9.6 mm in the anterior part. Transverse ornamentation consisting of many small, regular, densely shaped rings is not well preserved, but is visible on the surface of one coil.

R e m a r k s a n d r e l a t i o n s h i p s . This specimen, although looking quite impressive at first sight, is only moderately well preserved. No other specimen is available, and therefore variability of the species is unknown. It is indeterminable. It resembles *Dorsoserpula conjuncta* in its large size and by the shape of its three dimensionally coiled tube. Moreover, *Dorsoserpula conjuncta* occurs in strata of similar geological age at some localities of BCB, and also Frič's original specimen (1911, p. 72, fig. 305) described above by us as *Dorsoserpula conjuncta*? was found in the Korycaner Schichten and may represent the same species as Frič's specimen (1911, p. 72, fig. 306). However, in typical *Dorsoserpula conjuncta* specimens the whorls are more closely and smoothly cemented together than in Frič's specimen (1911, p. 72, fig. 306).

P a l a e o e c o l o g y . Presumable the tube had initially been attached to only a small substrate. By using its own previously built tube portions as a substrate, the tube spiralled upward like a screw or tower. By using this strategy, the whole tube became relatively stable in spite of the presumably small initial substrate, and the tube's aperture gained a relatively high position above the sea-floor. Two tubes of an indeterminable species, presumably *Glomerula serpentina* (GOLDFUSS), are attached to the basal portion of the large tube.

O c c u r r e n c e i n B C B Upper Cenomanian or Lower Turonian – Skuteč (Skuč).

Conclusions

We provide a modern revision of the nine specimens figured by Frič, belonging to seven species of sabellid and serpulid tube-worms, all of which are kept in the collection of the National Museum at Prague. Comparison of the old drawings and old photographs figured in Frič's works with our modern photographs made by T. K. prove that Frič's figures are very true to nature. However, the sabellid and serpulid tube-worms figured by Frič represent only a small portion of the many sabellid and serpulid species and specimens mentioned by him in the text of his detailed descriptions of the stratigraphical units of the Cretaceous rocks in BCB, reflecting his broad indepth knowledge of Cretaceous fossils. Unfortunately, all efforts made by T. K. to find these specimens not figured but only mentioned in Frič's text in the collections of the National Museum were in vain, the non-figured specimens seem either not to have been included in the collection, or they were later thrown away or lost. In our six tables we try to reconstruct the actual determination of these no longer existing specimens,

although this reconstruction can only be a 'best guess' trial. However, it is possible to produce the following results which correspond well with our experience with museum specimens collected by authors other than Frič and with specimens collected during our fieldwork. However, we did not try to 'translate' Krejčí's and Frič's historical scheme of stratigraphic units (‚Schichten') into modern stratigraphic formations, because with the exception of the stratigraphical type localities and a few other well-studied sites, such a task would be difficult to do due to the fact that many outcrops do not exist anymore.

Frič did not mention any sabellids or serpulids from the Perucer Schichten. This is easily explained by the non-marine facies.

The rocky shore facies of the Korycaner Schichten is very rich in sabellid and serpulid species and specimens.

Note the relative sparsity of data from the Weissenberger Schichten and the extreme sparsity of data from the Malnitzer Schichten.

Frič did not mention any sabellids or serpulids from the Byšicer Übergangsschichten which is the lowermost subunit of the Iserschichten.

In contrast, the other three subunits of the Iserschichten are very rich in sabellid and serpulid specimens, although not very rich in species. The most common species, especially in the Trigoniaschichten subunit, is *Filograna socialis*. However, in BCB this species is absent in the Teplitzer and Priesener Schichten. Frič's (1883, p. 81) mentioning of the occurrence of *Filograna socialis* in the Teplitzer Schichten is an error which he corrected himself (1889, p. 7).

The facies change from the Iserschichten to the Teplitzer Schichten is combined with a moderate change in the sabellid and serpulid fauna.

However, the greatest change in the sabellid and serpulid fauna occured at the facies change from the Teplitzer Schichten to the offshore marls of the Priesener Schichten. The fauna then became even more dominated by soft-bottom dwellers than in the Teplitzer Schichten. The serpulid fauna of the Priesener Schichten is the least well known of BCB, because after being described by Reuss, only very few new finds were mentioned by Frič (1893) or by Ziegler (1984).

In the Chlomeker Schichten there is only one sabellid species and one serpulid species. The fauna can be considered as an impoverished return of the Iserschichten fauna.

The sabellid genus *Glomerula* occurs in all of Frič's 'Schichten' except in the non-marine Perucer Schichten, whereas each serpulid species occurs in only one unit or a few units.

It is interesting to note that the first modern monograph of serpulids (including sabellids and spirorbins) from BCB was written by Ziegler (1984) almost one hundred years after Frič's work.

Frič's descriptions of the 19th century outcrops (long abandoned quarries and other lost localities) including detailed sections of strata together with their fossil record are an excellent example of the work of a scientist with a vast amount of knowledge. They are of great value for us today because these old descriptions combined with new field data and new fossil finds enable the reconstruction of palaeoenvironment, facies changes and palaeogeography. The significance of Frič's work is still considerable for new generations of geologists and palaeontologists.

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Explanation of the plates

PLATE 1

1. ***Glomerula plexus* (J. DE C. SOWERBY, 1829).** Copy of Frič's original drawing (1889, p. 96, fig. 122), specimen originally determined as *Serpula gordialis* V. SCHL., Upper Turonian Teplitzer Schichten, Třtěno (Kröndorf) near Chožov, coll. National Museum, Prague, registration number NM O4378. 3 x.
2. ***Filograna socialis* (GOLDFUSS, 1831).** Copy of Frič's original drawing (1883, p. 128, fig. 113), specimen originally determined as *Serpula socialis* GOLDF., Middle Turonian Iserschichten, Mladá Boleslav (Jungbunzlau), coll. National Museum, Prague, registration number NM O6051. 3 x.
3. ***Dorsoserpula wegneri* (JÄGER).** Copy of Frič's original drawing (1883, p. 129, fig. 114), specimen originally determined as *Serpula ampulacea* SOW., Middle Turonian Iserschichten, Choroušky (Choroušek), coll. National Museum, Prague, registration number NM O6057. a – Lateral view showing cross-section of the tube. 2.8 x. b – Detail of the transverse ornamentation. 8.4 x.
4. ***Neovermilia* cf. *ampullacea* (SOWERBY, 1829).** Copy of Frič's original drawing (1883, p. 129, fig. 115), specimen originally determined as *Serpula macropus* SOW., Middle Turonian Iserschichten, Choroušky (Choroušek), coll. National Museum, Prague, registration number NM O6050. a – View of posterior portion of the tube. 3 x. b – Detail of the transverse ornamentation. 9 x.

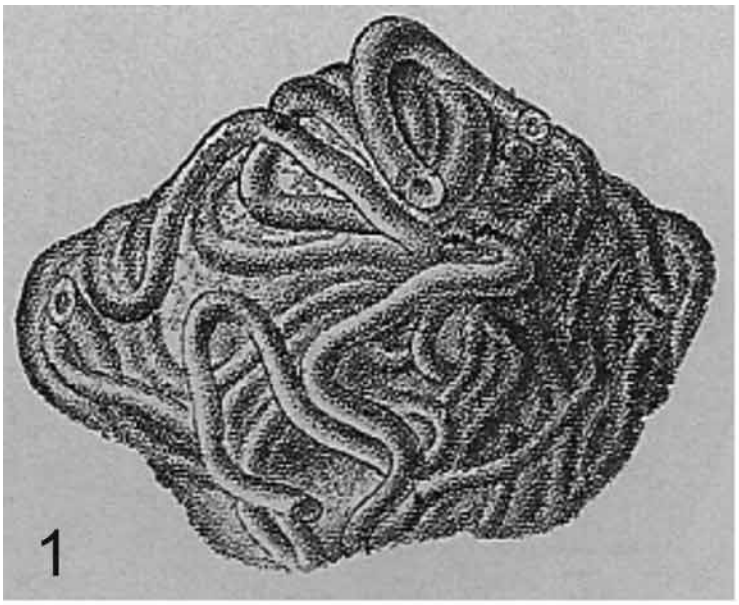
PLATE 2

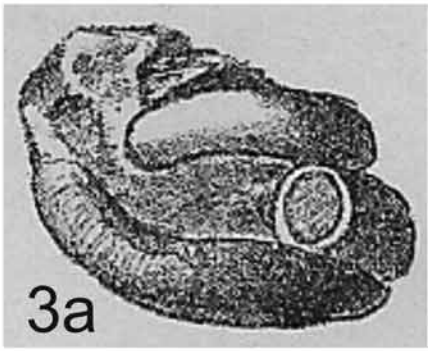
1. ***Glomerula plexus* (J. DE C. SOWERBY, 1829).** New photograph of Frič's original specimen (1889, p. 96, fig. 122), compare our pl. 1, fig. 1 (this is the only one of the new photographs which shows the specimen from a very different view compared to the view in the original figure), originally determined as *Serpula gordialis* V. SCHLOTH. Upper Turonian Teplitzer Schichten, Třtěno (Kröndorf) near Chožov coll. National Museum, Prague, registration number NM O4378. Scale bar is 10 mm.
2. ***Filograna socialis* (GOLDFUSS, 1831).** New photograph of Frič's original specimen (1883, p. 128, fig. 113), compare our pl. 1, fig. 2, originally determined as *Serpula socialis* GOLDF.,Middle Turonian Iserschichten, Mladá Boleslav (Jungbunzlau), coll. National Museum, Prague, registration number NM O6051. Scale bar is 10 mm.
3. ***Dorsoserpula wegneri* (JÄGER, 1983).** New photograph of Frič's original specimen (1883, p. 129, fig. 114), compare our pl. 1, fig. 3, originally determined as *Serpula ampulacea* SOW., Middle Turonian Iserschichten, Choroušky (Choroušek), coll. National Museum, Prague, registration number NM O6057. Scale bar is 10 mm.
4. ***Neovermilia* cf. *ampullacea* (SOWERBY, 1829).** New photograph of Frič's original specimen (1883, p. 129, fig. 115), compare our pl. 1, fig. 4, originally determined as *Serpula macropus* SOW., Middle Turonian Iserschichten, Choroušky (Choroušek), labelled from Živonín coll. National Museum, Prague, registration number NM O6050. – view to posterior portion of the tube. Scale bar is 10 mm.

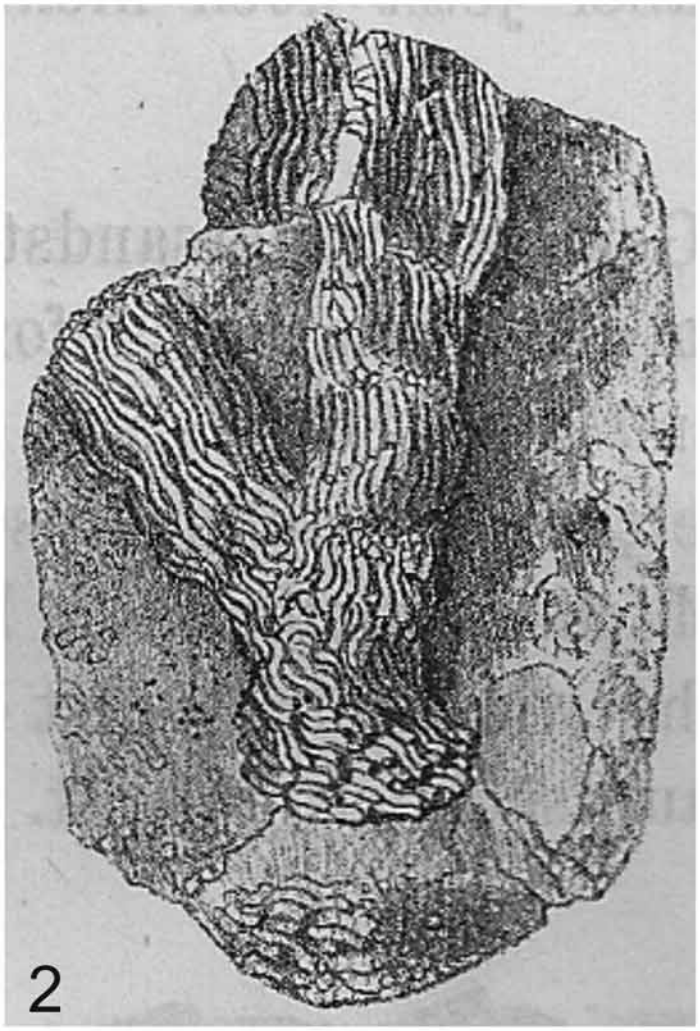
PLATE 3

1. **a–c** Three specimens of ***Glomerula serpentina* (GOLDFUSS,1831).** Copy of original drawing by Frič (1911, p. 72, fig. 304), specimens originally determined as *Serpula gordialis* (in the caption of fig. 304) and *Serpula gordialis*, var. *serpentina* (in the text), Lower Turonian Korycaner Schichten, Kamajka (Kamajk) near Chotusice, coll. National Museum, Prague, left specimen NM O7127, middle specimen NM O7128, right specimen NM O7129. Reproduced at same magnification as in Frič's fig. 304.
2. **a–c** Three specimens of ***Glomerula serpentina* (GOLDFUSS, 1831).** New photograph of Frič's original specimen (1911, p. 72, fig. 304), compare our pl. 3, fig. 1, originally determined as *Serpula gordialis* (in the caption of fig. 304) and *Serpula gordialis*, var. *serpentina* (in the text), Lower Turonian Korycaner Schichten, Kamajka (Kamajk) near Chotusice, coll. National Museum, Prague, left specimen NM O7127, middle specimen NM O7128, right specimen NM O7129. Scale bars are 5 mm.
3. **a–b** Tube fragment of ***Dorsoserpula conjuncta* (GEINITZ)?** Frič's original specimen (1911, p. 72, fig. 305), originally determined as *Serpula ampulacea*, SOW., Upper Cenomanian or Lower Turonian Korycaner Schichten, no locality data specified, coll. National Museum, Prague, specimen NM O7130. a – Copy of original drawing by Frič. Reproduced at same magnification as in Frič's fig. 305. b – New photograph of Frič's original specimen. Scale bar is 5 mm.
4. **a–b** Serpulidae gen. et sp. indet. Frič's original specimen (1911, p. 72, fig. 306), originally determined as *Serpula* sp. (in the text) respectively *Serpula* n. sp. (in the caption of fig. 306), Upper Cenomanian of Lower Turonian Korycaner Schichten, Skuteč (Skuč), coll. National Museum, Prague, specimen NM O7131. a – Copy of original drawing by Frič. Reproduced at same magnification as in Frič's fig. 306. b – New photograph of Frič's original specimen. Scale bar is 10 mm.

PLATE 1







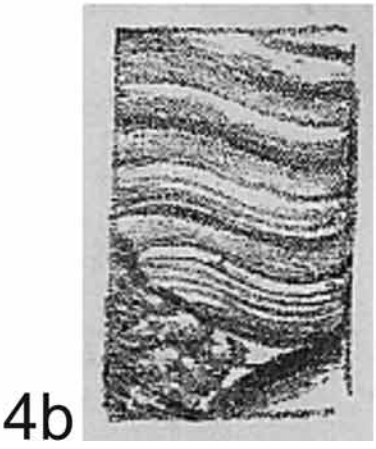


PLATE 2

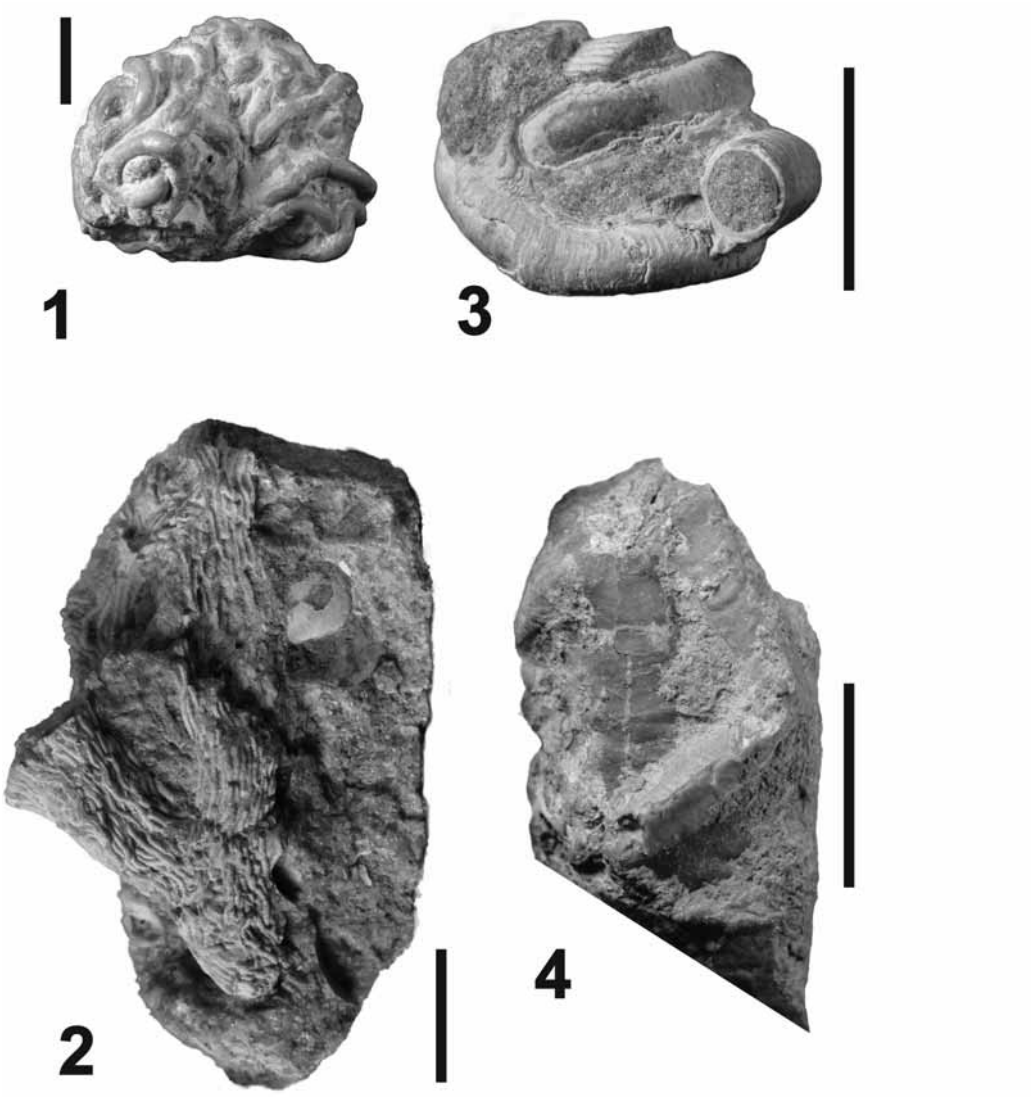
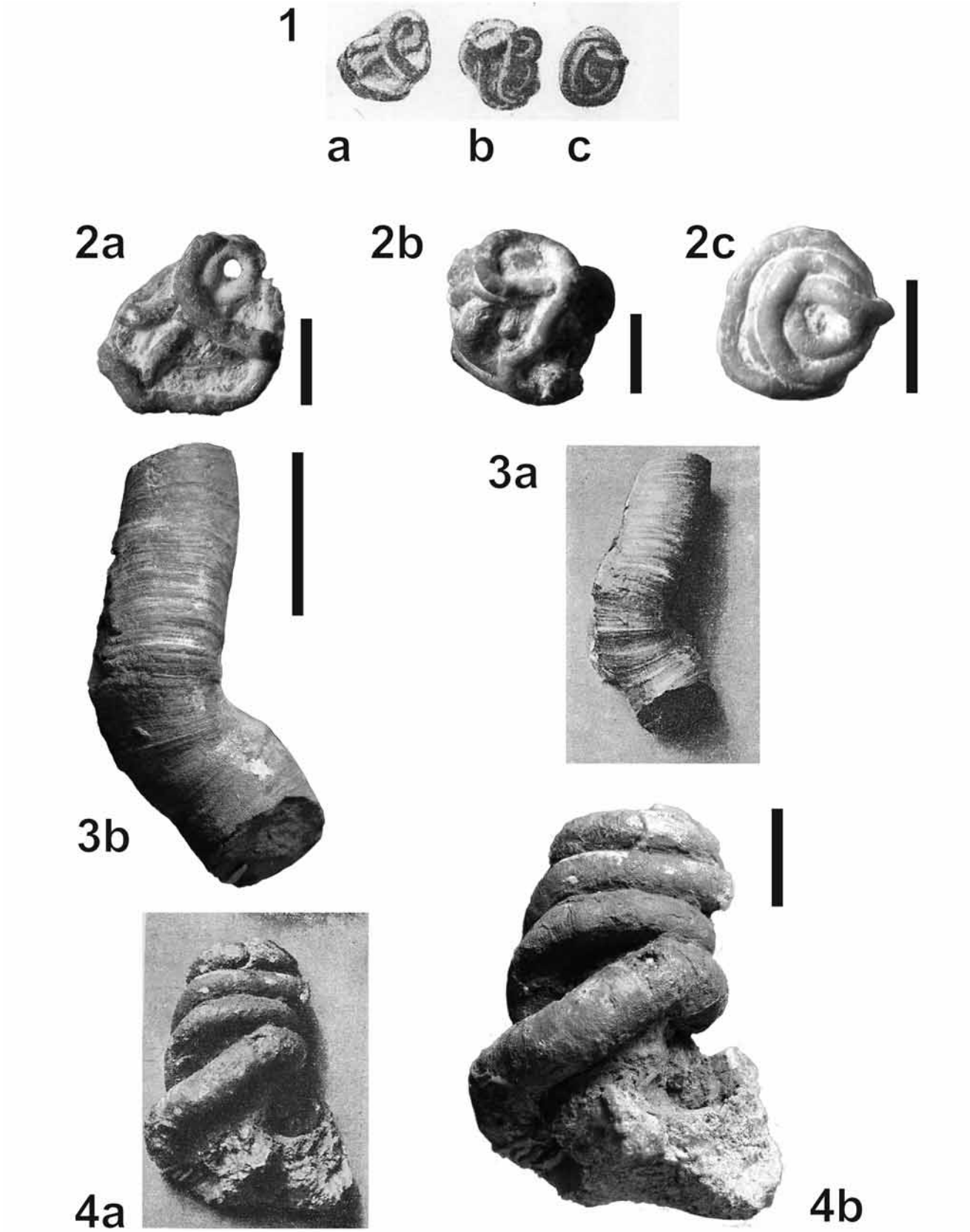


PLATE 3



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THE FIRST RECORDED OCCURRENCE OF *SMILIUM* ? *PARVULUM* WITHERS, 1914 (CIRRIPEDIA, THORACICA) FROM THE BOHEMIAN CRETACEOUS BASIN (THE CZECH REPUBLIC)

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Kočí, T., Kočová Veselská, M. (2013): The first recorded occurrence of *Smilium* ? *parvulum* WITHERS, 1914 (Cirripedia, Thoracica) from the Bohemian Cretaceous Basin (the Czech Republic). – Acta Mus. Nat. Pragae, Ser. B Hist. Nat., 69(3-4): 147-150, Praha. ISSN 0036-5343. DOI 10.14446/AMNP.2013.xxx

Abstract. A single minute cirriped carina from the *Smilium* ? *parvulum* WITHERS, 1914 was recorded in deposits of the Cenomanian-Turonian boundary interval preserved in the Velim (western part of the quarry – "Václav pocket"). This specimen represents the first recorded occurrence of the species in the Bohemian Cretaceous Basin.

■ Cirripedia, *Smilium* ? *parvulum*, Upper Cretaceous, Bohemian Cretaceous Basin, Velim

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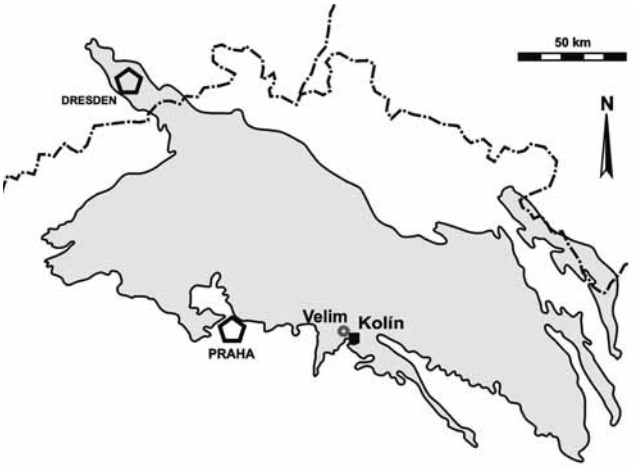
Introduction

The cirripeds from the Bohemian Cretaceous Basin (BCB) were studied by Reuss (1844, 1845–46, 1864), who described them from the Ohře area (W of the BCB). The first scientist to study cirripeds from the nearshore/shallow water facies in the BCB was Kafka (1885). He described several species from the well-known locality of Kamajka near Chotusice, followed by Fritsch and Kafka (1887) and Frič (1911a, b), who described an additional cirriped specimens from the BCB. Withers (1935) published the first modern revision of the Cretaceous cirripeds (including specimens from the BCB). He revised several specimens recorded by Dr. A. Fritsch and Dr. J. Šulc from the following localities: Kaňk, Kamajka, Na Vinici (overgrown locality, NE from Kolín according to J. Šulc), Kučlín near Bílina, Koštice, Duchcov, Bílá Hora in Prague, Holice, Lhota Úhřetická and Choceň. Withers (1935) mentioned 11 species from the BCB: *Zeugmatolepas cretae* (STEENSTRUP), *Calantica* (*Scillaelepas*) *conica* (REUSS), *Calantica* (*Titanolepas*) *tuberculata* (DARWIN), *Cretiscalpellum glabrum* (F. A. ROEMER), *Cretiscalpellum striatum* (DARWIN), *Scalpellum* (*Arcoscalpellum*) *angustatum* (GEINITZ), *Scalpellum* (*Arcoscalpellum*) *maximum* (J. DE C. SOWERBY), *Loriculina laevissima* (VON ZITTEL), *Stramentum pulchellum* (G. B. SOWERBY, jun.), *Proverruca vinculum* WITHERS, *Brachylepas fallax* DARWIN.

Methods and history of cirriped research at Velim

The first systematic revision of cirripeds from the nearshore/shallow water facies at Velim – Skalka (Text-fig. 1) was undertaken by Kočí and Kočová Veselská (2012a, b, c). They described the following species, which were collected and sieved from a further 100 kg of rubble during 2001–2013: *Zeugmatolepas* sp., *Cretiscalpellum glabrum*



Text-fig. 1. Geographical setting of the nearshore/shallow water locality of Velim (circle) within the Bohemian Cretaceous Basin (grey).

(Roemer), *Cretiscalpellum striatum* (Darwin) and *Arcoscalpellum angustatum* (Geinitz). The species *Zeugmatolepas* sp. was re-described later as a new species *Zeugmatolapeas sklenari* (Kočová Veselská et al. – submitted). During these fieldworks, in April 2012, a further 10 kg of rubble was collected and sieved from the underlying sediments of the so-called "Václav pocket" – section VII *sensu* Žítt et al. (1997a) in the western part of the former quarry (Text-fig. 2), with the net result of one plate – a minute carina of *Smilium* ? *parvulum* Withers, 1914 (Kočí and Kočová Veselská 2013). The stratigraphic position is probably the Lower Turonian. Unfortunately, further details could not be determined, because this locality has been a protected National Monument since 1986 and collecting in the geological profile is forbidden. However, the specimen probably comes from grey claystones developed in section VII *sensu* Žítt et al. (1997a), and occurs with a paleo-association of oysters *Amhidonte* (*A.*) *reticulatum* (Reuss), *Amphidonte* (*A.*) *sigmoideum* (Reuss), *Gryphaeostrea canaliculata* (Sowerby), stems of octocorals *Moltkia* sp., sabellid worms *Glomerula serpentina* (Goldfuss), spines of echinoids *Stereocidaris sorigneti* (Desor) and *Stereocidaris vesiculosa* (Desor), stem plates of crinoids *Isocrinus* sp., brachiopods *Terebratulina striatula* (Mantell) and other fossils typical for rocky coast facies. The most recent palaeontological research carried out at Velim locality was by Žítt et al. (1997a, b). Then Košťák et al. (2010) referred to the occurrence of two species of cirripeds at Velim, *Pollicipes glaber* Reuss and *Scalpellum* sp., figured in Tab. 2 as fauna associated with rhyncholites *Nautilorhynchus simplex* (Fritsch). The local bio-stratigraphical potential of these nautilid jaws was mentioned by these authors, who also assumed the Lower Turonian age of the rhyncholite-bearing sediments.

Text-fig. 2. The western part of Velim (former quarry) shows sections VII and VIII *sensu* Žítt et al. (1997a) – (photographed by T. K.).

A single carina of *Smilium* ? *parvulum* (NM O7133) was photographed using SEM in low vacuum (JEOL JSM-6380LV) at the Institute of Geology and Palaeontology (Charles University, Prague). When using SEM, the specimen was not coated with any metal and therefore low vacuum was used instead.

Systematic palaeontology

Classification of the genus *Smilium* Withers, 1914 follows that of Darwin (1851), Withers (1912, 1914, 1928, 1935), Newman et al. (1969) and Newman and Ross (1971). The minute carina specimen was compared with other cirriped specimens stored in the collection of the National Museum in Prague.

Class **Cirripedia Burmeister, 1834**

Order **Thoracica Darwin, 1854**

Suborder **Lepadomorpha Pilsbry, 1916**

Family **Scalpellidae Pilsbry, 1916**

Subfamily **Calanticinae Zevina, 1978**

Genus **Smilium Leach, 1825**

Type species. *Scalpellum* sp. (in Darwin 1851); a single carina from the Cenomanian of Cambridge vicinity.

***Smilium* ? *parvulum* (Withers, 1914)**

Text-fig. 3

1851 *Scalpellum* sp.; Darwin, p. 21
1912 *Scalpellum* sp.; Withers, p. 231
1914 *Scalpellum parvulum* Withers; Withers, p. 496, text-figs 1–6.
1935 *Smilium* (?) *parvulum* (Withers); Withers, p. 141, pl. 12, figs 9–15.
2013 *Smilium* (?) *parvulum* (Withers); Kočí and Kočová Veselská, p. 179, figs 1–2.

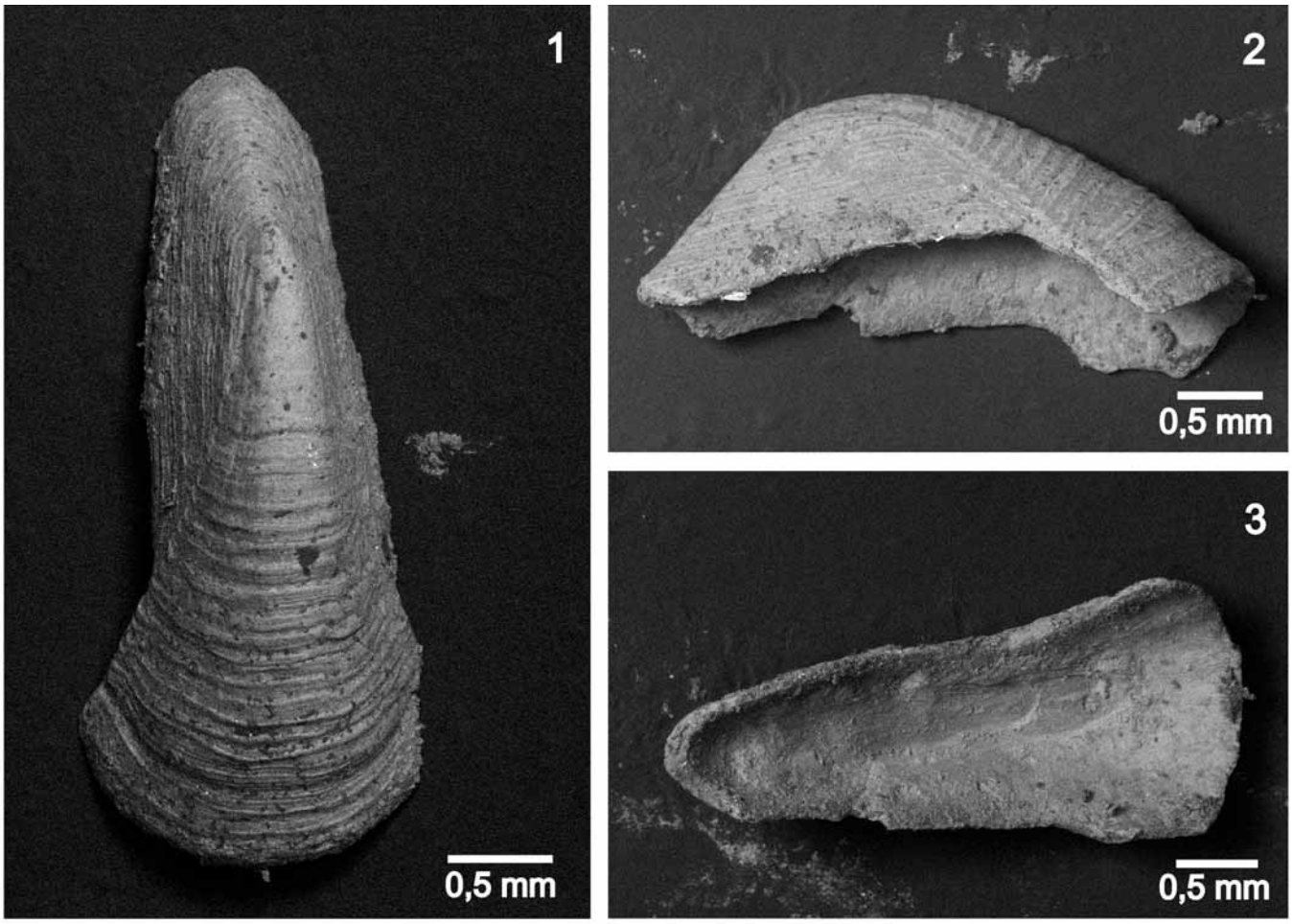
Material. NM O7133, the single specimen exhibits a minute carina in the palaeontological collections of the National Museum (Prague).

Distribution. England – Upper Albian – Cambridge Greensand: locality Cambridge; Lower Cenomanian – Chalk Marl, *Schloenbachia varians* Zone: localities Cambridge, Burham and Kent; Upper Turonian – *Plesiocorys plana* Zone: localities Alton District, Hampshire.

Czech Republic – Lower Turonian – ? *Mytiloides labiatus* Zone: Velim.

Description. The umbo is removed from the apex by about one-third the length of the carina. The uppermost third of this plate is rounded with well-developed longitudinal ridges on the tectum. Parieties, lateral sides with distinct transversal lines, are developed in the lower two thirds of the plate. The internal lateral sides, intraparieties, form an elongation of the plate and give it a tapered beaked shape. Incremental growth lines are fine and distinct. The inner surface is smooth without growth lines. The carina length equals 4 mm and the width at its basal edge is 1.4 mm.

Remarks and relationships. Withers (1935) mentioned and described only four specimens of minute carina of *Smilium* ? *parvulum* from the Cenomanian of England. These carinae are of exceptionally minute size. Because all the carinae are of the same small size, it indicates that they belong to adult specimens. Withers (1928) noted that some specimens of the Cenomanian



Text-fig. 3. Smilium ? parvulum (Withers, 1914), carina, specimen No. NM O 7133, 1 – outer view of carina with umbo under apex, 2 – lateral view of carina, 3 – inner view of carina with remains of claystone after preparation. All specimens are to scale.

species *Arcoscalpellum lineatum* (DARWIN) show a slight tendency for the intraparieties to extend a little beyond the umbo, but there is no relationship with the Cenomanian *Smilium* ? *parvulum*. Withers (1928, 1935) mentioned an identical tendency in the Upper Senonian species *Scalpellum hagenowianum* BOSQUET, and *Scalpellum beisseli* BOSQUET et MÜLLER from the Middle and the Upper Senonian of England (*Micraster coranguinum* Zone, Upper Coniacian – Lower Santonian; *Belemnitella mucronata* Zone, Upper Campanian – Lower Maastrichtian) and in the Maastrichtian species *Scalpellum gabbi* PILSBRY, *Scalpellum darwinianum* BOSQUET, *Scalpellum hagenowianum* BOSQUET and *Scalpellum ryckholti* WITHERS from Belgium, the Netherlands and the United States of America. These scalpellid species were recently placed in the genus *Virginiscalpellum* WITHERS, 1935. *Smilium* ? *parvulum* is distinguished from the aforementioned species of *Virginiscalpellum* on the basis of a less complex structure of carina. The umbo of the genus *Virginiscalpellum* is closer to the apex than in the genus *Smilium*. In the Cenomanian–Turonian species *Smilium* ? *parvulum* WITHERS, extant species *Smilium peronii* GRAY (see Withers 1953: 170, fig. 69) and extant species *Euscalpellum rostratum* (DARWIN), the carinae run straight from the base to the umbo, and the umbo has moved from the apex along the carina, about one-third of the way down its length (see Withers 1953:173, fig. 75).

Conclusions

The one minute carina of *Smilium* ? *parvulum* was described from the nearshore/shallow water facies at Velim as the first recorded occurrence in the Bohemian Cretaceous Basin. This species is problematic and very rare in the context of the European Cretaceous cirripeds. Withers (1935) mentioned only four carinae and fifteen scuta of this species; carinae come from the Chalk Marl and are deposited in the British Museum of Natural History, the largest of which measures 2.1 mm; scuta were collected from different horizons, one of them, deposited in the Sedgwick Museum in Cambridge, comes from the Cambridge Greensand. In addition, there is one carina of length 3.8 mm from the *Plesiocorys plana* Zone in Hampshire, deposited in the private collection of Mr. R. M. Brydone (No. 131).

Acknowledgements

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A SYSTEMATIC REVISION OF *STRAMENTUM* (*STRAMENTUM*) *PULCHELLUM* (G.B. SOWERBY JR., 1843) (CIRRIPEDIA, THORACICA, STRAMENTIDAE) FROM THE BOHEMIAN CRETACEOUS BASIN, THE CZECH REPUBLIC

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Abstract. We review the single species within the genus *Stramentum* Logan, 1897, *Stramentum* (*Stramentum*) *pulchellum*, from the Lower to Upper Turonian strata in the Bohemian Cretaceous Basin (BCB). Only seven specimens are known to date; one is housed at Krupka Museum (Teplice), the others are held in the palaeontological collections of the National Museum in Prague. These specimens were first described in 1887 by Fritsch and Kafka, but have not received attention since. Despite the fact that stramentids are rare within the BCB, all individuals available are articulated and very well preserved and, without exception, belong to *S.* (*S.*) *pulchellum*. The Krupka Museum specimen differs in the shape of both the scuta and the upper latera, but this is interpreted as a result of slight disarticulation. Varying numbers of peduncular scales amongst individuals are indicative of several age groups and small, juvenile stramentids occur as external moulds in one lot at the National Museum. Most Czech stramentids have been found attached to shells of the ammonite genera *Lewesiceras* and *Collignoniceras*.

■ Cirripedia, *Stramentum*, Late Cretaceous, Lower to Upper Turonian, Bohemian Cretaceous Basin

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Introduction

Cirripede assemblages from the Bohemian Cretaceous Basin (BCB) comprise representatives of six families, Zeugmatolepadidae Newman, 2004, Calanticidae Zevina, 1978, Scalpellidae Pilsbry, 1907, Stramentidae Withers, 1920, Brachylepadidae Woodward, 1901 and Verrucidae Darwin, 1854. Dissociated capitular plates of cirripedes are relatively common in this area (see Kafka 1885; Fritsch and Kafka 1887; Kočí and Kočová Veselská 2012). In contrast, articulated specimens of the genus *Stramentum*, all collected near the end of the nineteenth century and now housed in Czech museums, are rare. All of them are well preserved and probably were epizoic on ammonite shells. The first scientists to study *Stramentum* from the BCB were Frič (1879), Kafka (1885), and Fritsch and Kafka (1887), who assigned the material to *Loricula pulchella* Sowerby, 1843 and distinguished two morphotypes, var. *gigas* Frič, 1878 and var. *minor* Frič, 1878. These authors also compiled lists of all cirripede taxa then known from the BCB, with indications of their stratigraphic and geographic provenance (Fritsch and Kafka 1887). All specimens except one are deposited in the palaeontological collections of the National Museum (Prague); a single individual is housed at Krupka Museum in northern Bohemia. Later, Withers (1920, 1935) revised the family Stramentidae Withers, 1920, distinguishing three genera: *Stramentum*, *Loriculina* Dames, 1885 and *Squama* Logan, 1897. Withers (*loc. cit.*) also mentioned stramentids from the BCB, including a single scutum of *Loriculina laevissima* (Zittel, 1885) from the out-quarried and now overgrown locality of 'Na Vinici', northeast of Kolín, an outcrop some 237 meters above sea level. Unfortunately, he did not describe or illustrate this scutum; the original (NHM 31672) forms part of the collections of the Natural History Museum, Department of Palaeontology (London). Consequently, it is uncertain whether this scutum really belongs to *Loriculina*. Frič (1878) and Fritsch and Kafka (1887) neither recorded nor described any dissociated plates of *Loriculina*. Recent authors (Jagt and Collins 1989; Hauschke 1994; Hauschke et al. 2011; Ifrim et al. 2011; Schöllmann and Hauschke 2012), have also referred to stramentids from the BCB, but

have not discussed these in any detail. *Stramentum* from the area was mentioned briefly by Kočová Veselská and Kočí (2012).

Stratigraphic and geographic setting

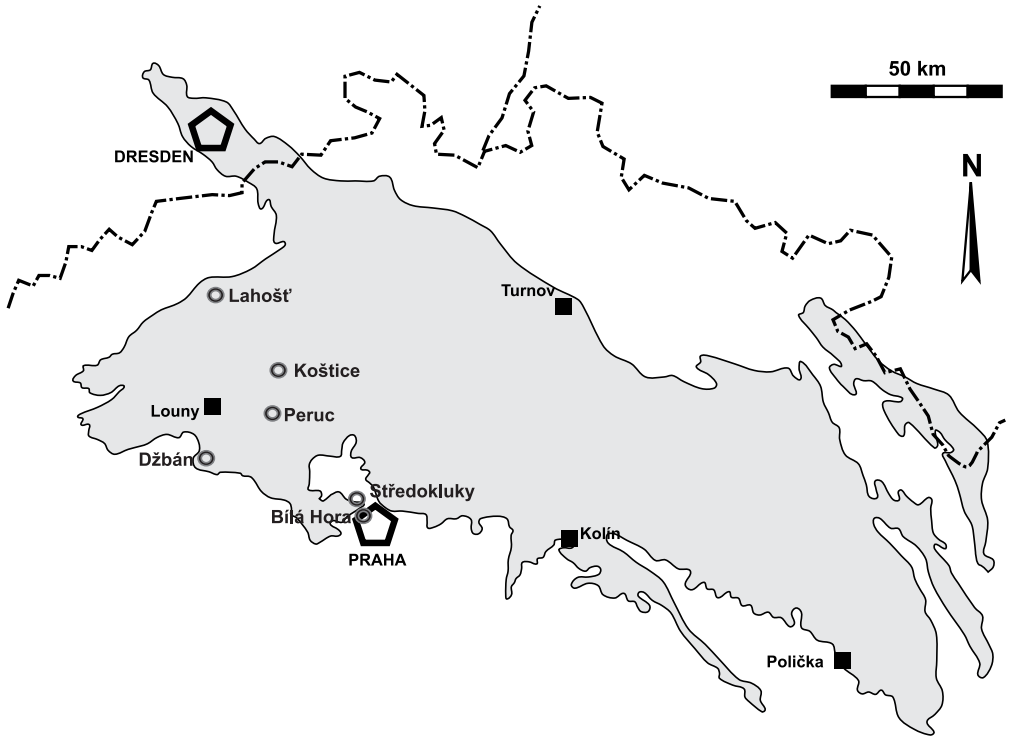
The exact provenance of *Stramentum* in the BCB is problematic, because all material known to date comprises old museum collections. In addition, some of the localities that yielded stramentids have long been excavated, eroded or are inaccessible. In all, eight specimens of *Stramentum* are available from six localities within the area (see text-fig. 1). Five of these originate from the Lower-Middle Turonian (Bílá Hora Formation, *Mytiloides labiatus/Mytiloides hercynicus* Zone) at Bílá Hora in Prague (now overgrown quarries), Středokluky (now overgrown outcrops), Peruc vicinity near Louny (one of several overgrown quarries) and probably an old disused quarry in the Džbán Plateau (Hředle vicinity near Rakovník; see below). Three others are from the Upper Turonian (Teplice Formation, *Mytiloides labiatoidiformis/striatoconcentricus-Cremnoceramus erectus* Zone) at Koštice and Lahošť. All localities are situated in the western part of the basin and the strata exposed mainly reflect shallow-water marine (hemipelagic) settings.

Although it is not known precisely from what lithologic horizons stramentids originate, it is very likely that they were epizoic on shells of the ammonites *Collignoniceras woollgari* and *Lewesiceras peramplum*. The former ammonite species helps date stramentids because its first appearance datum (FAD) is at the Lower-Middle Turonian boundary. *Lewesiceras peramplum* may occur first in the uppermost Cenomanian, as based on putative records from the Dölzschen Formation in Saxony, eastern Germany (Wilmsen and Nagm 2013). Otherwise, this species is common in the Lower to lower Upper Turonian of Germany, the Czech Republic, Poland, France, Tunisia and Morocco (see Wright and Kennedy 1981).

The Bílá Hora Formation consists mainly of shallow-water marine marlstones. Glauconite occurs in horizons at both the base and in the upper part of the formation. Typical of most rocks of this unit is the high admixture of sponge spicules; spongilites are commonly present. In the western and northern ranges of the BCB, the formation is developed as quartzose sandstones. Along the southern margin of the basin, a surf facies, consisting of conglomerates and biomicritic and biosparitic limestones, is developed. Across most of the BCB, strata assigned to this formation show coarsening-up cycles (for summary see Čech et al. 1980).

The locality of Bílá Hora was Frič's standard section, where "marlite" (calcareous marlstone) was quarried. From here, Frič (1878, 1879) described inoceramids (*Mytiloides labiatus*, *M. hercynicus*), ammonites (*Mammites nodosoides*, *Collignoniceras woollgari*), echinoids (*Epiaster michelini*), decapod crustaceans (*Enoploclytia leachi*, *Glyphea bohemica*, *Paraclytia nephropica*, species of *Hoploparia* and *Thalassinoides* burrows) and other biotic groups.

Frič's (1878) original sample of *Stramentum*, which comprises juveniles only, was collected from the Lower-Middle Turonian sediments of an old overgrown quarry in the Džbán Plateau (its precise geographical position is unknown). These juveniles are preserved as external moulds on a shell of the ammonite *Collignoniceras woollgari* Mantell, 1822. Unfortunately, the original specimen and its label have been replaced by other juveniles, in the same state of preservation, but from an unknown locality. However the nature of the matrix suggests that these have come from similar horizons; in all probability, they were recovered from the same locality as the misplaced (lost) original. Strata at the Džbán Plateau comprise mainly silty, sandy marlstones, spongilitic



Text-fig. 1. Simplified map of the Bohemian Cretaceous Basin (grey) showing the occurrence of *Stramentum* (*Stramentum*) *pulchellum* (G. B. Sowerby jr., 1843).

sandstones and siltstones with spongilite cavities (15– 20 cm in diameter) with an abundant molluscan fauna containing bivalves e.g. *Mytiloides labiatus* (Schlotheim) and ammonites, e.g. *Mammites nodosoides* (Schlotheim). A diverse assemblage, dominated by *Protocallianassa bohemica* (Fritsch), occurs in the upper part of the spongilitic sandstone (Váně 1999; Svoboda 2003).

The lower part of the Teplice Formation is characterized by shallow-water, marine biomicritic limestones. Calcareous claystones to marlstones, with limestone intercalations occur higher in the sequence. This formation differs from both underlying and overlying units in comprising fewer psammitic sediments. At the base of Teplice Formation, a 'coprolite layer' is developed, with a high glauconite content, phosphatic nodules, casts of shells and coprolites (Čech et al. 1980). Macrofossils from this unit include mainly inoceramids (*Inoceramus costellatus*, *I. cuvieri*), ammonites (*Lewesiceras peramplum*, *Scaphites geinitzii*, *Helicoceras reussianum*, *Baculites undulatus*), gastropods (*Natica*, *Pleurotomaria*, *Turbo*), non-inoceramid bivalves (*Isocardia cretacea*, *Cardium bipartitum*, *Nucula semilunaris*, *Syncyclonema nilsoni, Spondylus spinosus*) and other groups.

Two stramentids are known from the Teplice Formation at Koštice (GPS co-ordinates: 50°23'59.680"N, 13°57'47.190"E) and Lahošť (GPS co-ordinates: 50°37'52.999"N, 13°45'50.894"E) in the northwest of the basin. At Koštice exposures are mainly of clayey limestones and calcareous marlstones; at present this locality is covered by scree and is much overgrown. Koštice is the site of Frič's sample locality and is now referred to as the Teplice Formation. Accumulations of comminuted mollusc and ostracod shells, vertebrate bones and large benthic foraminifera known as 'Koštice plates' occur at the base of this formation. Below this and close to the surface of the River Ohře, a coprolite bed occurs. Above the 'Koštice plates' horizon, is a compact horizon of clayey limestones also known as 'Hundorf limestone' with ammonites (*Lewesiceras peramplum*) or their body chambers (Váně 1999). From these, Frič (Frič 1889a, 1889b) described a specimen of *Stramentum* (*S.*) *pulchellum*.

Outcrops at Lahošť near Teplice expose very compact quartzites at the base with glauconitic sandstones above. The upper part has clayey and calcareous marlstones, which yield most of the fauna, and probably is the source of a single individual of *Stramentum*.

Methods

All stramentids known from the BCB were examined. Ammonium chloride sublimate was used, hoping to achieve a higher contrast when photographing the specimens from the collections of the National Museum in Prague (NM). However, with the exception of NM O3449, the results were not satisfactory. Photographs of NM O3448 and NM O3449 were taken using the microphotography setting Olympus DP70 and photographs of additional material deposited in NM (O3445 – O3447 and O7132) were taken using the microphotography setting Keyence VHX-2000. Specimen PA 1476 was photographed by museum curator Miroslav Radoň from Krupka Museum where material is deposited. Plates were made using Corel Graphic Suite X4.

Systematic palaeontology

In terminology and taxonomy, we follow Fritsch and Kafka (1887), Logan (1897), Withers (1920, 1935), Hattin (1977), Stevenson (1979), Collins (1986), Breton and Boiné (1993), Hauschke (1994), Hauschke et al. (2011) and Wittler (1996).

Subclass **Cirripedia Burmeister, 1834**

Superorder **Thoracica Darwin, 1854**

Order **Scalpelliformes Buckeridge et Newman, 2006**

Family **Stramentidae Withers, 1920**

Genus and subgenus ***Stramentum* Logan, 1897**

Type species. *Pollicipes haworthi* Williston, 1897; Late Santonian of Kansas.

***Stramentum* (*Stramentum*) *pulchellum* (G.B. Sowerby jr., 1843)**

Pl. 1

1843 *Loricula pulchella*; G. B. Sowerby jr., p. 260.
1851 *Loricula pulchella*; Darwin, p. 81.
1878 *Loricula gigas* Fr.; Frič, p. 147.
1879 *Loricula gigas* Fr.; Frič, p. 137.
1885 *Loricula gigas* Frič; Kafka, p. 21– 22, pl. 3, fig. 5.
1886 *Loricula gigas* Frič.; Kafka, p. 573.
1887 *Loricula pulchella*, Sow.; Fritsch and Kafka, p. 1 (including var. *minor* and var. *gigas*).
1889a *Loricula pulchella*, Sow. var. *gigas*, Fr.; Frič, p. 96.
1889b *Loricula pulchella*, Sow. var. *gigas*, Fr; Frič, p. 90.
1920 *Stramentum pulchellum*, G. B. Sowerby, jun., sp.; Withers, p. 70.
1935 *Stramentum pulchellum* (G. B. Sowerby, jun.); Withers, p. 316.
1977 *Stramentum pulchellum* (Sowerby); Hattin, p. 812.
1986 *S. pulchellum* (G. B. Sowerby jr); Collins, p. 130.
1989 *Stramentum pulchellum* (Sowerby); Oekentorp, p. 134, pl. 1, fig. 1; pl. 2, figs. 3– 4; pl. 4, figs. 1, 4.
1993 *Stramentum pulchellum* (G.B. Sowerby jun., 1843); Breton and Boiné, p. 20.
1994 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby); Hauschke, pp. 15– 19, pls. 1– 5.
1996 *Stramentum (S.) pulchellum* (Sowerby 1843); Wittler, p. 94.
2011 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby, 1843); Ifrim et al., p. 527.
2011 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby); Hauschke et al., p. 202, figs. 3– 5.
2012 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby); Schöllmann and Hauschke, pp. 61– 64, fig. 5; taf. 1, figs. 1– 7.

Holotype: A specimen from the Turonian (Upper Chalk) at Rochester, England; described and illustrated by G. B. Sowerby jr. (1843); in the collections of the Natural History Museum (London), registration number NHM 59150.

Material: A total of eight specimens; NM O3445 – O3449, NM O4255 and NM O7132 in the palaeontological collections of the National Museum (Prague) and PA 1476 at Krupka Museum. With the exception of NM O3448, NM O7132 and PA 1476, these represent Fritsch's (1877) and Fritsch and Kafka's (1887) originals. NM O3445 – O3447,

NM O3449, NM O4255 and NM O7132 were recorded as epizoans on shells of *Lewesiceras* or *Collignoniceras*. The original substrate of NM O3448 and PA 1476 is uncertain. All ontogenetic stages, from juvenile to adult, are presented and all individuals are (semi-) articulated.

Distribution: Cenomanian of England, France and northwest Germany; Turonian of northern Ireland, England, northwest Germany and the Czech Republic; Coniacian of Mexico; ?lower Campanian of northern Germany (Jagt 2013). For summaries of geographical and stratigraphical distribution, reference is made to Hauschke (1994), Nomura et al. (2009), Ifrim et al. (2011), Hauschke et al. (2011) and Schöllmann and Hauschke (2012). Specimens from the BCB originate from the Lower-Upper Turonian, as follows: Lower to Middle Turonian (Bílá Hora, Prague: NM O3446, NM O3447; Středokluky: NM O3449; Peruc vicinity NM O7132; Džbán: NM O3448, see below), Upper Turonian (Koštice: NM O3445, with negative imprint NM O4255; Lahošť: PA 1476).

Diagnosis. Tergum triangular with growth lines sharply upturned (near occludent margin); scutum triangular with umbo removed from apex by between one quarter to one third the length of the plate; ventro-apical (occludent) margin straight or gently convex; carinolatus with growth lines sharply upturned along tergal margin; upper latus triangular; peduncular plates arranged in eight vertical imbricating rows: six broad rows aligned beneath and of about the same width as the carinolatera, upper latera and scuta; two narrower rows aligned beneath the carina and rostrum; rostrum is not preserved.

Description. All specimens conform broadly to the species; PA 1476 differs slightly in scutal and upper lateral outline. Individuals expose external surfaces of capitular and peduncular plates, representing either left-hand (NM O3445, NM O3446) or right-hand sides (NM O3447 – O3449, NM O7132, PA 1476). NM O4255 represents an internal mould of NM O3445. Rostrum not preserved (it may seem that a rostral fragment is preserved in NM O7132, but a small piece placed on the connection of the occludent and basal margin is only a broken part of a scutum).

Capitulum about one third length of peduncle. Scutum subtriangular with convex occludent margin, growth-lines sub-parallel to basal margin, then sharply upcurving to parallel upper lateral margin; scutal umbo removed from apex by about one quarter to a third the length of occludent margin. Upper latus almost isosceles-triangular in outline, length comparable to scutum; growth-lines parallel to basal margin. Tergum broadly triangular with acute occludent-upper lateral angle, carinolateral margin straight to slightly convex, apex acute and level with that of carinolatus; growth-lines parallel upper lateral margin, but upturn sharply to run sub-parallel to occludent margin; basal angle of tergum extends to just above the capitulum-peduncle boundary. Carinolatus obliquely triangular with growth lines parallel to a straight or gently convex basal margin. Carina narrow and long triangular slightly convex with length comparable to carinolatus.

Peduncle. Heavily calcified, joining capitulum obliquely and sloping gradually towards rostral side, widest at one third of length (measured from base of capitulum) narrowing towards base and capitulum, with size of single plates decreasing. Arranged with three broad vertical rows aligned with paired scuta, upper latera and carinolatera and two narrower, unpaired outer rows (rostral and carinal). All plates with fine growth lines parallel to plate outline; plates of scutal, upper lateral and carinolateral columns of similar size, becoming narrower, towards both capitulum and the base. Shape of scutal and carinolateral columns broadly sub-trapezoidal, straight or gently convex on rostral and carinal sides, plates of upper lateral column broadly sub-hexangular with convex upper margin and concave lower margin (more markedly than in adjacent columns), plates narrower just below capitulum and with near-straight upper margins; width about four times height. Carinal plates almost quadrangular, slightly higher than wide and slightly less than four times width of corresponding plates in adjacent column. Plates of rostral column rather subtrapezoidal; of similar size to carinal row, but broader in width; towards base, plates become narrower and scutal margin straightens. Outer plates overlap neighboring inner plates; row of plates corresponding to upper latus overlapped from both sides. Within each row, overlapping occurs from base to top. Basal plates of peduncle not preserved.

Lot NM O3445 contains two specimens, the upper one preserving only scutum, upper latus and a deformed tergum; occludent margin in both capitula straight, peduncle is almost complete, lacking solely lower part of carinal column, lower specimen lacks rostrum, carina and lower half of peduncle, uppermost plates of carinolateral and scutal columns are sub-hexangular as in upper lateral column; plates of rostral column have convex upper margins and heavier growth lines.

NM O3446 has a fragmentary part of the right-hand side scutum exposed; tergum longer than carinolatus and carina and tergum exceeding both; plates in rostral column about twice width of those in carinal column; peduncle almost complete, lacking only lowest part of each column.

NM O3447 lacks rostrum, carina and apex of a rounded and deformed tergum, occludent margin straight; three main columns of peduncle complete, rostral column and most of carinal column not preserved.

Lot NM O3448 represents some juvenile individuals as external moulds; very small juveniles have about 6-8 plates in peduncular columns, most of them preserved only as fragments of capitulum or peduncle; a single specimen almost complete, capitulum without carina and rostrum and peduncle with three main columns (scutal, upper lateral, carinolateral) corresponding to description above; occludent margin of capitulum straight.

NM O3449 capitulum incomplete (rostrum, scutum and rostral and scutal column of peduncle lost); scutal margin of upper latus broken; remaining part of occludent margin straight, only upper lateral, carinolateral and carinal columns preserved, all lacking lower parts; size and shape of two main columns similar, upper plates narrowest; towards base, plates of carinolateral column rather broadly subtrapezoidal as in other specimens, lower plates of carinal column with spurs on both sides and with convex upper and lower margins (rhomboidal outline), connection of upper lateral and carinolateral columns disarticulated; slight

deformation displaced upper lateral margin towards carinolateral row.

Lot PA 1476 comprises two specimens, the upper (smaller and younger) lacking rostrum, tergum and upper parts of scutum and upper latus; peduncle almost complete, lacking only lower part; rostral column disarticulated; the lower specimen (larger and more mature) lacking only rostrum and apex of tergum; specimen retaining part of second scutum from left-hand side as in NM O3446; scutum and upper latus slightly deformed, scutum with strongly convex upper lateral margin (*vs* straight in other specimens) and outline less rounded-triangular and upper latus with concave scutal margin. This results from slight disarticulation of some peduncular plates (N. Hauschke, pers. comm., 2012). Occludent margin convex (because of lack of uppermost part of tergum and almost rounded scutum), upper lateral and rostral columns nearly complete, only few plates of carinal column and upper half of carinolateral and scutal columns present; upper and lower margins of scutal and carinolateral plates almost straight, towards base, plates of rostral column rhomboidal (with spur on both sides) rather than subtrapezoidal.

R e m a r k s . All material, collected near the end of the nineteenth century, is articulated or semi-articulated (e.g., PA 1476) and well preserved. NM O3445 (and counterpart NM O4255), NM O3446, NM O3447, NM O3449 and NM O7132 were found as epizoans of body chambers of ammonite shells. We are not certain about the original substrate of NM O3448 and PA 1476. NM O3448, which represents external moulds of juvenile individuals and was recorded by Fritsch and Kafka (1887) as an epizoan of *Collignoniceras woollgari*. As noted, the original has been replaced with other juveniles in a similar state of preservation. Fritsch's original stems from the Lower-Middle Turonian calcareous marlstones from a defunct quarry in the Džbán Plateau; he differentiated three growth stages – on the basis of the number of peduncular plates; all individuals have four capitular plates preserved: scutum, upper latus, tergum and carinolatus. NM O3448 also comprises juveniles, but unfortunately, information on either the substrate or provenance area is lacking, but we assume them to have come from Džbán as well. One of the juveniles is nearly complete, having four capitular plates and 6-8 plates in each peduncular column. Others also have four capitular plates, but due to their fragmentary preservation it is impossible to distinguish growth stages. It cannot be determined whether specimens in lot NM O3448 were attached or not, but in view of the good state of preservation, it is most likely that these juveniles were also attached to some shell. A similar case is PA 1476, which also comprises two well-preserved stramentids, although it is not clear what were originally attached to. Only small pieces of matrix survive with these collections.

Fritsch and Kafka (1887) described two varieties of *Stramentum pulchellum* from the BCB, namely *minor* and *gigas*, on the basis of differences in peduncular plates and overall body size. Var. *gigas* was recorded to have pointed plates in the carinal column (reflecting rapid growth of the body), with plates of the carinolateral and scutal columns broadly subtrapezoidal and produced into a spur on the upper lateral sides, and plates of the upper lateral column equally developed on the upper lateral and scutal sides and all plates of the three main columns have rounded margins. However, these features are typical of all Czech stramentids. Individuals of var. *gigas* are also larger, reflecting older age and these have a greater number of peduncular plates. Fritsch's var. *minor* comprised six specimens of 15 to 20 mm in size, all from the Lower-Middle Turonian; unfortunately, only three of these survive (NM O3446, NM O3447 and NM O3449). NM O3446 was described as an epizoan of the body chamber of a juvenile *Lewesiceras peramplum*; it is the largest and best preserved of individuals of var. *minor.* The substrate of NM O3447 was *Collignoniceras woollgari*, while the deformed NM O3449 was fixed on *L. peramplum*. All individuals are from the Lower-Middle Turonian. NM O3445 comprises two stramentids, originally described by Fritsch and Kafka (1887) as var. *gigas*, as epizoans on the body chamber of a large *L. peramplum*. PA 1476 is of the Upper Turonian age. In short, any preferred orientation and position of attached stramentids cannot be recognised, contrary to other Cretaceous stramentids described by Breton and Boiné (1993), Hauschke (1994), Wittler (1996), Hauschke et al. (2011), Ifrim et al. (2011) and Schöllmann and Hauschke (2012).

Finally, it should be stressed that the figures and animal restorations (drawings) presented in works by Fritsch (notably in Fritsch and Kafka 1887) often do not fully correspond with the original specimens (pers. obs. MKV, TK) as in many cases his reconstructions are idealised. This is especially true for stramentids NM O3446 (figured in Fritsch and Kafka 1887: pl. 1, fig. 2) or NM O3449 (figured in Fritsch and Kafka 1887: pl. 1, fig. 4). Thus, caution must be taken when dealing with Frič's taxa on the basis of published figures only.

Palaeoecology and taphonomy

Stalked barnacles, a highly successful group of crustaceans, most often occur in the fossil record as dissociated plates of capitulum and peduncle, because soon after death plates tend to disarticulate and become scattered, similar to modern lepadids and scalpellids (Hauschke et al. 2011). The Cretaceous genus *Stramentum* provides some notable exceptions, because under certain conditions, individual plates of heavily calcified stramentids have remained articulated during fossilisation. Unfortunately, finds of articulated stramentids are rather rare and their occurrence appears to be restricted to three exceptional circumstances: when their cypris larvae attached directly to a substrate (e. g. ammonite shells); when cirripedes were embedded in black shales; or when cirripedes were rapidly buried. Examples of completely articulated stramentids, often in groups, on shells of ammonites or inoceramid bivalves, are commoner than finds from anoxic settings exemplified by black shales. Attachment was by the uncalcified basal part of the peduncle. In the majority of cases, attachment occured on live ammonites, and a few generations are occasionally represented (Ifrim et al. 2011). Stramentids appear to have preferred rather smooth planispiral ammonite morphotypes with widely spaced, shallow ribs, such as members of the genera *Collignoniceras*

Breistroffer, 1947 and *Lewesiceras* Spath, 1939. However, there is a single case of attachment to heteromorph ammonites of the genus *Sciponoceras* Hyatt, 1894 from northwest Germany (Hauschke et al. 2011). Schöllmann and Hauschke (2012: table 1) presented a highly detailed picture of palaeoecological and palaeogeographical relationships and of preservational and taphonomical implications of *Stramentum*.

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Explanation of the plate

PLATE 1

***Stramentum* (*Stramentum*) *pulchellum* (G. B. SOWERBY JR., 1843)**

1, 2. NM O3446 from the Lower-Middle Turonian, Bílá Hora (Prague); nearly complete specimen and detail of capitulum, respectively. Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 2). Explanation of names of capitular plates: c = carina, cl = carinolatus, t = tergum, ul = upper latus, sc = scutum. Scale bars equal 2 mm.

3. NM O3447 from the Lower-Middle Turonian, Bílá Hora (Prague). Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 3). Scale bar equals 2 mm.

4, 5. NM O3449 from the Lower-Middle Turonian, Středokluky; fragmentary specimen and detail of capitulum, respectively. Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 4). Scale bars equal 2 mm.

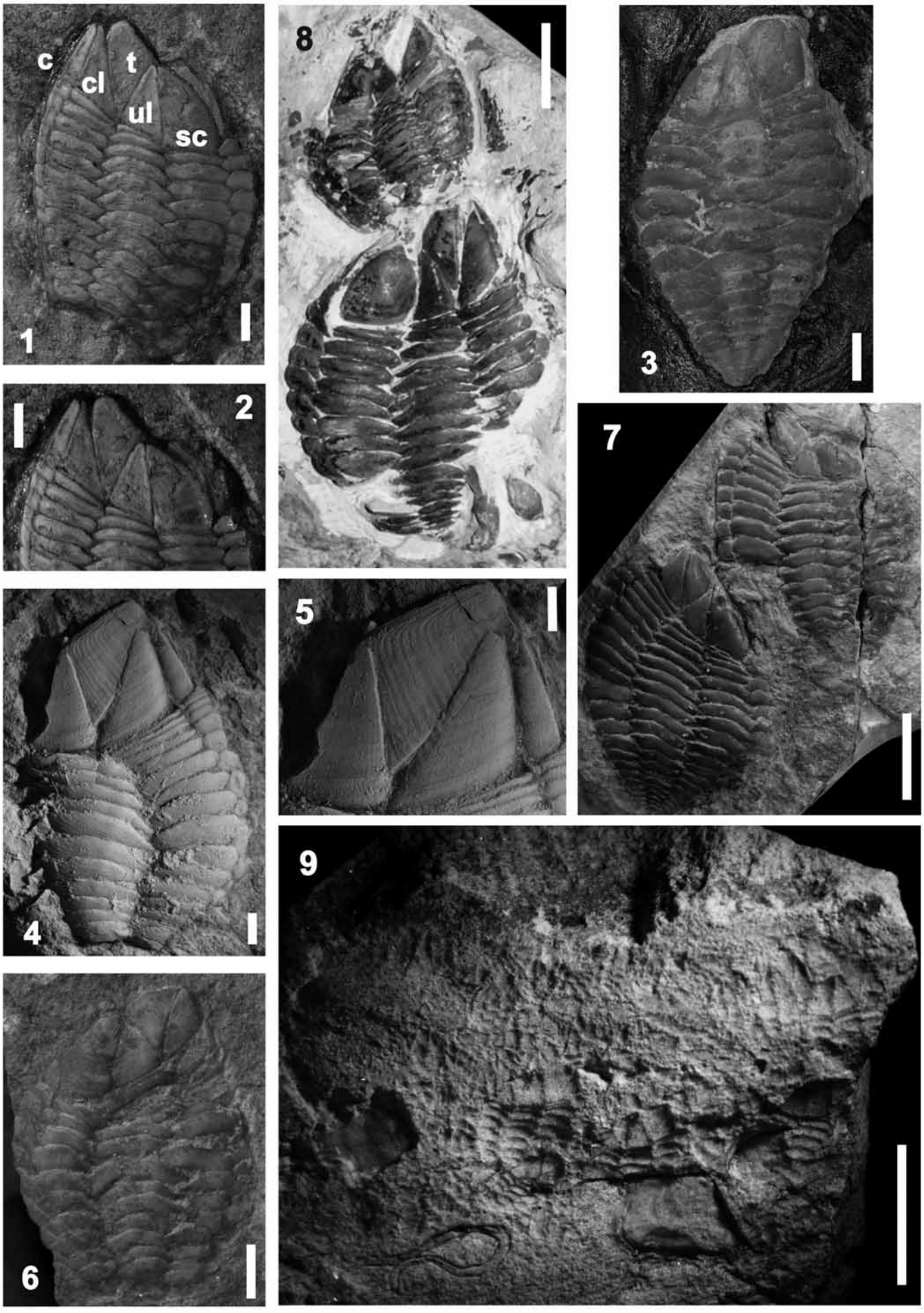
6. NM O7132 from the Lower-Middle Turonian, Peruc vicinity (one of several overgrown outcrops), collected by Mr. Daneš. Scale bar equals 2 mm.

7. NM O3445 from the Upper Turonian, Koštice. Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 1). Scale bar equals 1 cm.

8. PA 1476 from the Upper Turonian, Lahošť, which is deposited in Krupka Museum (North Bohemia). Scale bar equals 1 cm.

9. NM O3448, external mould of juvenile specimens from the Lower-Middle Turonian, old overgrown quarry in the Džbán Plateau. Scale bar equals 5 mm.

PLATE 1



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KNOWLEDGE OF THE CARBONIFEROUS AND PERMIAN ACTINOPTERYGIAN FISHES OF THE BOHEMIAN MASSIF – 100 YEARS AFTER ANTONÍN FRIČ

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Štamberg, S. (2013): Knowledge of the Carboniferous and Permian actinopterygian fishes of the Bohemian Massif – 100 years after Antonín Frič. – Acta Mus. Nat. Pragae, Ser. B, Hist. Nat., 69(3-4): 159-181. ISSN 0036-5343 . DOI 10.14446/AMNP.2013.xxx

Abstract. A summary of twenty-three actinopterygian taxa that are known from the Carboniferous and Permian basins of the Bohemian Massif is presented here. Descriptions of all taxa are given, including their characteristic features, synonymy, stratigraphical range, geographical distribution and information about the types. Those species that were already known in the time of Antonín Frič are commented upon in relation to Frič's original conception.

■ Actinopterygii, Carboniferous, Permian, Bohemian Massif

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Introduction

Actinopterygian fishes are the most numerous vertebrates in the limnic Carboniferous and Permian sediments of the Bohemian Massif. Antonín Frič established the basic knowledge about their taxonomy and anatomy in his fundamental four-volume work "Fauna der Gaskohle und der Kalksteine der Permformation Böhmens". Antonín Frič, however, was not the first to describe actinopterygian fishes from the Permo-Carboniferous basins of the Bohemian Massif. Agassiz (1833–43) was the first, and he described *Amblypterus vratislaviensis* from the Early Permian of the Intrasudetic Basin. *Amblypterus kablikae* was the second species, described by Geinitz (1860) from the Early Permian of the Krkonoše Piedmont Basin, and then Heckel in Heckel and Kner (1861) added several other species of amblypterids from the Krkonoše Piedmont Basin. The earliest papers of Antonín Frič concerning Carboniferous and Permian actinopterygians date from 1875 (Frič 1875), and he published subsequently a set of papers about their anatomy and taxonomy. He published a summary of all the knowledge he obtained at that time in his excellent work "Fauna der Gaskohle und der Kalksteine der Permformation Böhmens". Frič published descriptions of twenty-one species of actinopterygians from the Carboniferous and Permian basins of the Bohemian Massif in his Fauna der Gaskohle, and in the last minor paper (Frič 1912a,b) supplemented this with a short description of an additional species.

Subsequently, many years passed during which the study of actinopterygians from the Bohemian Massif was neglected. Westoll (1944), Gardiner (1963) and Heyler (1969) then published partial revisions of several species. The author of this paper initiated his research of the Carboniferous and Permian actinopterygians of the Bohemian Massif, beginning in the mid-nineteen seventies (Štamberg 1975, 1976). Revisions of most species described by Frič have been published since that time, and voluminous material of actinopterygians from new localities that were unknown to Frič has been obtained. Considerable extension of our knowledge about Carboniferous and Permian actinopterygians of the Bohemian Massif has progressed during this last period. The following section presents an overview of those actinopterygian species that are known at present from the freshwater Carboniferous and Permian sediments of the Bohemian Massif briefly including their characteristic features, stratigraphical range and geographical distribution. Those species that were already known in the time of Antonín Frič are commented upon in relation to Frič's original conception.

The descriptive terminology conforms to that adopted by Grande and Bemis (1998), with inclusion of some terms after Poplin and Lund (1997). Measurement methods and the scale count are the same as those described by Štamberg (1991, 2007).

Specimens figured are deposited in the National Museum, Prague (M), Museum of Eastern Bohemia at Hradec Králové (MHK), Czech Geological Survey (Ya) and Municipal Museum at Nová Paka (P).

Systematic palaeontology

Order **Palaeonisciformes Hay, 1929**

Genus ***Letovichthys* Štamberg, 2007**

Type species: *Letovichthys tuberculatus* Štamberg, 2007.

Locus typicus: Kladoruby "Dolní Pepřík", near the town Letovice, Blansko district, Czech Republic.

Stratum typicum: Lubě Horizon, Lower Letovice Formation, Early Permian.

Diagnosis: Body slender-fusiform, head low with moderately pronounced rostral part. Frontal very narrow and long, not in contact with orbit. Length/width ratio is 3.3, interfrontal suture straight, and lateral border of the bone is without any process. Frontals two times longer than the parietals. Interparietal suture half as long as lateral edge of parietal. The fronto-parietal suture is shifted only slightly posteriorly or nearly at the same level as the suture between the dermosphenotic and dermopterotic. The dermosphenotic is triangular, anteroposteriorly elongated, and tapering anteriorly to the nasal. The dermosphenotic carries the infraorbital canal, which probably bends ventrally, and dorso-lateral-anterior canal extends to the anterior extremity of the dermosphenotic. The dermopterotic is rectangular; its posterior margin is at the same level as the posterior termination of the parietal. All bones of the skull roof are ornamented with outstanding closely arranged tubercles or very short ridges. All tubercles and ridges bear fine ridges that are concentrated on their tops. From one to three pairs of extrascapular lateral and one or two pairs of extrascapular medial form a narrow strip between the parietal, dermopterotic and posttemporal. Preoperculum reaches to the dermopterotic and dermosphenotic. Antero-ventral border of the preoperculum bends at an angle of 90 degrees, the posterior border of the bone is not inflexed, but only moderately bent. Lower jaw is very strong, and ornamented on ventral half of the lateral surface with prominent mounds of ganoin. Large dorsal region of the lateral surface of the lower jaw is without sculpture. Maxilla with large maxillary plate of trapezoidal form tapers ventroposteriorly to the projection. The length of the maxilla is 1.5 – 2.2 times the length of the maxillary plate, and 3 – 3.3 times the height of the maxillary plate. Pre-maxilla is present and is probably toothed. Marginal teeth on the jaws are arranged in two rows. Outer row is composed of numerous, small, sharp-pointed teeth. The inner row possesses large conical teeth, three times taller than those in the outer row. They can be less numerous, numbering about 16 teeth per jaw, with large gaps between neighboring teeth, or they are numerous, arranged closely without gaps, with about 40 teeth per jaw. Prearticular provides numerous very small teeth. Hyomandibular with well-developed processus opercularis. Rectangular operculum, 1.8 times higher than long. Suboperculum with sloping dorsal border, anterior border of the bone two times shorter than the posterior one. Oval paired posttemporal, with distinctive ridges longitudinally arranged. Small presupracleithrum present. Distinctive sculpture from long ridges parallel with the posterior border of the bone covers posterodorsal region of the supracleithrum. Pectoral fins with lepidotrichia probably not segmented at their bases. Leading two or three lepidotrichia of the pectoral fins are stout, not segmented along their entire length. Fringing fulcra present on the pelvic and anal fins and on the ventral lobe of the caudal fin. The scales are small, and those on dorsal side of the body are strongly sculptured. Sculpture consists of dorsoventrally arranged ridges, sometimes anastomosing on dorsal two third of the scale, and long ridges along ventral border of the scale. The scales are situated on the dorsal side of the body, but those more ventrally have less numerous simple ridges dorsoventrally arranged, while long ridges along the ventral border of the scale disappear completely.

Included species: *Letovichthys multidentatus* Štamberg, 2007 besides the type species *Letovichthys tuberculatus* Štamberg, 2007.

Letovichthys tuberculatus Štamberg, 2007

Text-fig. 1

2007 *Letovichthys tuberculatus* n. sp.; Štamberg, p. 56, figs 56–71, pls. 26–36.

Holotype: Specimen MHK 72424 (part and counterpart) with well preserve dermal bones of the skull roof, jaws, subopercular, dermohyal, cleithrum and scales.

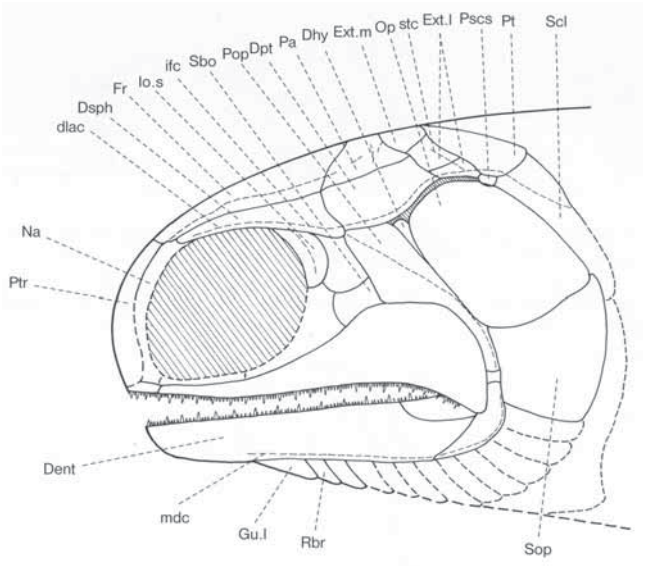
Locus typicus: Kladoruby „Dolní Pepřík", near the town Letovice, Blansko district, Czech Republic.

Stratum typicum: Lubě Horizon, Lower Letovice Formation, Early Permian.

Occurrence: Kladoruby "Dolní Pepřík", Letovice "Jindřichov", Zbraslavec.

Diagnosis: Maxilla with trapezoidal maxillary plate. The length of the maxilla is 1.5–2 times the length of the maxillary plate, and 3 times the height of the maxillary plate. Jaws bear two types of marginal teeth in two rows. Outer row bears numerous, small, sharply pointed teeth.

The inner row posses large, sharply pointed, conical teeth, three times higher than those on the outer row. They are less numerous, with about 16 teeth per jaw, and with large gaps between neighbouring teeth.



Text-fig. 1. ***Letovichthys tuberculatus*** **Štamberg, 2007. Reconstruction of the dermal skull in lateral view, x 3. After Štamberg (2007). Dent – dentalosplenial; Dhy – dermohyal; dlac – dorso-lateral-anterior sensory canal; Dpt – dermopterotic; Dsph – dermosphenotic; Ext.l – extrascapular lateral; Ext.m – extrascapular medial; Fr –frontal; Gu.l – gular lateral; ifc – infraorbital canal; Io.s – infraorbital superior; mdc – mandibular canal; Na – nasal; Op – operculum; Pa – parietal; Pmx – premaxillar; Pop - preoperculum; Pscs – post-spiracular; Pt – posttemporal; Ptr – postrostral; Rbr – branchiostegal rays; Sbo – suborbital; Scl – supracleithrum; Sop – suboperculum; stc – supratemporal commisural sensory canal.**

The scale count is

$$\frac{-}{15\ 30\ 46}\ 52$$

Letovichthys multidentatus Štamberg, 2007

2007 *Letovichthys multidentatus* n. sp.; Štamberg, p. 67, figs 72–74, pls. 37, 38.

Holotype: Specimen MHK 72436 (part and counterpart) with well-preserved dentition on the jaws, partly preserved jaws, bones of the skull roof, and body.

Locus typicus: Kladoruby "Dolní Pepřík", near the town of Letovice, Blansko district, Czech Republic.

Stratum typicum: Lubě Horizon, Lower Letovice Formation, Lower Permian.

Occurrence: Kladoruby "Dolní Pepřík".

Diagnosis: Maxilla with low and elongated trapezoidal maxillary plate. Jaws bear two types of marginal teeth in two rows. The inner row possesses at least 40 large conical teeth, bluntly pointed, closely spaced without gaps. Outer row bears numerous, small, sharp pointed teeth.

Remarks: *Letovichthys tuberculatus* and *Letovichthys multidentatus* share many identical features, including body shape, skull roof construction, basic jaw morphology, fin position, pectoral fin construction, and the shape and sculpture of the scales. The differences between these two species lie in the shape of the maxillary plate and in the type of dentition on the jaws. Both species occur in horizons of laminated claystones and limestones at the Kladoruby "Dolní Pepřík" locality (Boskovice Graben). They are accompanied by very abundant acanthodians of the species *Acanthodes gracilis* (Beyrich, 1848) and *Acanthodes stambergi* Zajíc, 2005. Xenacanthid elasmobranchs and discosauriscid amphibians also occur there, but are rarer. More precise assignment of *Letovichthys* at the family level is difficult at present.

Family **Elonichthyidae Aldinger, 1937**

Diagnosis (after Schindler in Poschmann and Schindler 2004, emended): Skull triangular in lateral aspect. No prominent rostrum. Orbit positioned far anteriorly. Infraorbital sensory canal running far anteriorly on the dermosphenotic. Three pairs of otoliths present, one hemispherical and strongly enlarged. Parasphenoid toothless, without anterior processus ascendens, but with long posterior processus ascendens, processus cultriformis undivided. Skull roof ornamented with knobs, rarely with short striae with ridges of ganoin. Jaws sculptured with long, undivided striae of ganoin with a sharp ridge. Shoulder girdle with long branching striae showing ganoin ridges, striae partly with posterior denticulation. Opercular bones sculptured with small pits. No pineal foramen present. No intertemporal present. Posterior skull roof in one species narrower than anterior skull roof, otherwise of the same width. Dermosphenotic and dermopterotic arranged in line. Dermosphenotic not reaching the nasal. Upper mouth margin formed by premaxilla and maxilla, both of them plus dentary with strong heterodont dentition arranged in 2 – 3 rows. Maxilla with crescent-shaped posterior plate. Antorbital in truly orbital position. Posterior infraorbital posteroventrally enlarged. Ventral accessory operculum present (ventrally or anteroventrally to operculum). More than ten branchiostegal rays present, the first one clearly higher than the remaining ones. Hyomandibular with processus opercularis. Presupracleithrum present. Supracleithrum, with one exception, ventrally stretching beyond operculum. Total body length up to 50 cm. Body slender, with large triangular dorsal and anal fins. Caudal fin heterocercal and deeply forked. Anterior margin of pectoral fin always denticulate, anterior margin of other fins depending on species. Scales sculptured with striae, diagonally divided into a posterodorsal and anteroventral field; striae running posterodorsally parallel to diagonal, anteroventrally parallel to lower scale margin.

Included genera: Only *Elonichthys* Giebel, 1848 is known from the Bohemian Massif.

"*Elonichthys*" Giebel, 1848

Type species: *Elonichthys germari* Giebel, 1848.

Diagnosis (after Gardiner 1963): Body fusiform; fins large with small fulcra anteriorly and lepidotrichia distally bifurcated. Dorsal and anal fins triangular and of much the same size, dorsal fin opposite the space between pelvic and anal fins; pectoral fins with rays joined to their base, and pelvics short based; anal fin triangular, without fringe, similar in shape to pelvics, caudal fin deeply cleft and inequilobate. Skull with well-developed rostrum, oblique suspensorium and medium-sized orbit; operculum larger than suboperculum, with antero-dorsal dermohyal, but no ventral accessory bone in opercular series; suborbitals present, and row of supraorbitals between dermosphenotic and nasal bones. Branchiostegal rays numerous, teeth acutely conical and arranged in two series – inner row of well-spaced, large laniaries and outer row of numerous, closely arranged teeth. Scales rhomboidal, often denticulated posteriorly, large ridge scales in front of median fins. Skull bones ornamented with tuberculations and striae of enamel.

"*Elonichthys*" *krejcii* (Fritsch, 1895)

Text-fig. 2, figs 2, 3

1895 *Acrolepis Krejčii*, Fr.; Fritsch, p. 115, pl.128, figs 1–8.
1895 *Acrolepis sphaerosideritarum*, Fr.; Fritsch, p. 116, pl. 127, figs 1–7.
1991 *Watsonichthys krejcii* (Frič, 1895); Štamberg, p. 31, figs 3–5, pls. 1–3.
1991 *Watsonichthys sphaerosideritarum* (Frič, 1895); Štamberg, p. 37, figs 6–11, pl. 4.
2006 "*Elonichthys*" *krejcii* (Frič 1895); Štamberg, p. 223, fig. 2C
2006 "*Elonichthys*" *sphaerosideritarum* (Frič 1895); Štamberg, p. 223, fig. 2B
2010 "*Elonichthys*" *krejcii* (Frič, 1895); Štamberg, p. 165; figs 9, 10.

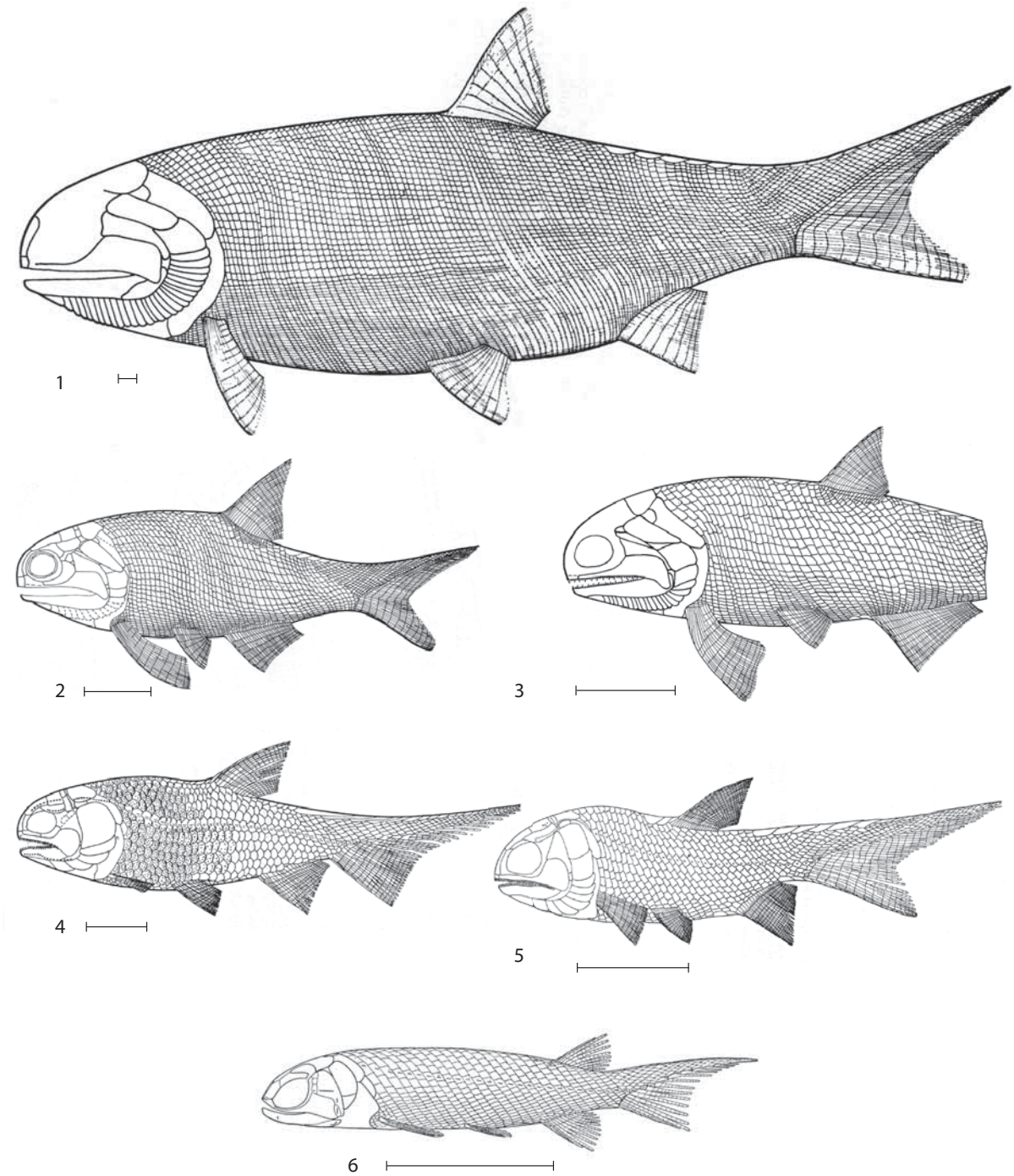
Holotype: Specimen figured by Fritsch (1895) on pl. 128, figs 1–8, deposited in the National Museum, Prague under No. M 1208 (both counterparts) and M 890 (galvanic cast).

L o c u s t y p i c u s : Malesice, district Plzeň – north, Czech Republic.

S t r a t u m t y p i c u m : Mšec Member, Stephanian B, Upper Carboniferous, Plzeň Basin.

O c c u r r e n c e : A few fragments of the bodies are known as spherosiderite nodules from the locality Malesice in the Plzeň basin. Isolated scales mainly come from several boreholes in the Central and West Bohemian late Paleozoic basins, and the Krkonoše Piedmont Basin (Štamberg and Zajíc 2008).

D i a g n o s i s (after Štamberg 1991, emended): Body fusiform not exceeding 130 mm total length. Pectoral fins very long, reaching at least the anterior margin of the pelvic fin. Anal fin base is longer than the dorsal one. Dorsal fin partly opposite the space between the pelvic and anal fins, and partly opposite anal fin base. Small fringing fulcral scales on the leading edge of the pectoral, pelvic, anal and dorsal fins. Maxillary plate is anteroposteriorly elongated, and forms prominent processus ventroposteriorly. Oval operculum narrowing ventrally. Square suboperculum. Numerous branchiostegal rays, first branchiostegal ray



Text-fig. 2. Reconstruction of some Westphalian and Stephanian actinopterygians. Figs 1 – 5 after Štamberg (1991), Fig. 6 after Westoll (1944). Scale bars represent 20 mm. 1 – *Acrolepis gigas* (Frič, 1877), 2 – "*Elonichthys*" *krejcii* (Fritsch, 1895), figured after the original holotype of *Acrolepis sphaerosideritarum* Fritsch, 1895, 3 – "*Elonichthys*" *krejcii* (FRITSCH, 1895), figured after the original holotype of *Acrolepis krejcii* Fritsch, 1895, 4 – *Sphaerolepis kounoviensis* Frič, 1877, 5 – *Sceletophorus biserialis* Fritsch, 1894, 6 – *Pyritocephalus sculptus* (Frič, 1875).

ventrally to the suboperculum is two times higher than the rest. Triangular accessory operculum fits tightly in space among operculum, suboperculum and preoperculum. Oval presupracleithrum sits between operculum and supracleithrum.

Remarks: Fritsch (1895) originally described *Acrolepis krejcii* and *Acrolepis sphaerosideritarum* from the spherosiderite nodules of the Plzeň Basin. Štamberg (1991) removed these species from the genus *Acrolepis* particularly for the presence of the accessory operculum and for the similarity of both species with *Rhabdolepis eupterygius* (Agassiz, 1833). *Rhabdolepis eupterygius* was revised at that time by Heyler (1976) who assigned this species to the genus *Watsonichthys*. Only after having studied the type specimen of *Watsonichthys pectinatus* at the Royal Scottish Museum at Edinburgh was I convinced that the maxillary plate of *Watsonichthys pectinatus* is conspicuously elongated and low, just as different from that of *R. eupterygius* as from that of "*Elonichthys*" *krejcii.* The significant difference in the shape of the upper jaw is the primary reason for removing "*E.*" *krejcii* from *Watsonichthys*. The configuration of the cheekbones, bones of the opercular apparatus and the dermal bones of the skull roof show close relation to the genus *Meisenheimichthys* Schindler, 2004 and to the family Elonichthyidae in the sense of Schindler (Poschmann and Schindler 2004, Schindler 2007). Therefore, I tentatively place "*Elonichthys*" *krejcii* in the genus "*Elonichthys*" and family Elonichthyidae, in the sense of Schindler (Poschmann and Schindler 2004). Finally, study of additional material showed that "*Elonichthys*" *sphaerosideritarum* is a synonym of "*Elonichthys*" *krejcii* (Štamberg 2010). A revision of the genus *Elonichthys* and its type specimen deposited in the University at Halle is necessary in order to distinguish the principal condition for a correct determination of the actinopterygians from within the range of the Elonichthyidae.

"*Elonichthys*" sp.

1997 *Watsonichthys*; Zajíc, p. 198; pl. 1, fig. 8.
2007 *Elonichthys* sp.; Zajíc, p. 13, p. 14.
2007 *Elonichthys* sp.; Štamberg, p. 73; fig. 75; pl. 39.
2008 "*Elonichthys*" sp.; Štamberg and Zajíc, p. 145, fig. 213.

Material: Specimen GBW 2006/65/4 (fragment of the body with scales from the Late Carboniferous of the Mine Julius, Zastávka u Brna, Boskovice Graben) housed at the Geologisches Bundesanstalt Wien, and amount of isolated scales from the Late Carboniferous of the Central and West Bohemian late Palaeozoic basins and the Krkonoše Piedmont Basin housed mainly at the National Museum, Prague and Geologisches Bundesanstalt Wien.

Occurrence: (see Štamberg and Zajíc 2008)

Family **Pygopteridae Aldinger, 1937**

Type genus: *Pygopterus* Agassiz, 1833.

Included genera from the Bohemian Massif: *Progyrolepis* Fritsch, 1895; *Zaborichthys* Štamberg, 1991.

Genus ***Progyrolepis* Fritsch, 1895**

Type species: *Progyrolepis speciosus* (Frič, 1875).

Included species: *Progyrolepis heyleri* Poplin, 1999 from the Early Permian of Buxières-les-Mines (Massif Central) beside the type species.

Diagnosis (after Štamberg 1991, emended): Fish approximately 60 cm long. Lepidotrichia of pectoral fins unjointed in their proximal part, distally articulated and dichotomously branched. Endocranium ossified. Frontal 2.5 times longer than wide, sculpture formed by conspicuous tubercles. Rostral region of head conspicuously convex orally, comprising large single postrostral, paired nasal and rostro-premaxillar. Rostro-premaxillary with teeth. Medial side of the palatoquadratum formed by entopterygoid, ectopterygoid, dermometapterygoid and small dermopalatines. Maxilla with long and low maxillary plate. The sculpture on the maxilla is formed by conspicuous tubercles and ridges. Lower jaw very stout. Dentition comprising two types of teeth in two rows. The preoperculum is conspicuously bent and inclined anteriorly. The angle of the obliqueness of the preoperculum is 27°; angle of preoperculum bend is 137°. Orbit small and placed anteriorly. Oval operculum, three times higher than long. Operculum obliqueness angle is 30°. Square suboperculum. Triangular accessory operculum tightly placed in space among operculum, suboperculum and preoperculum. Numerous branchiostegal rays. Rhomboidal scales small, stout, and sculptured by several ridges. Posterior margin of scales not serrated.

Remarks: Poplin (1999) described a new species *Progyrolepis heyleri* based on isolated jaws from the Buxières-les-Mines locality (French Massif Central). It differs from *P. speciosus* in a more elongated maxillary plate, sculpture in the anterior region of the maxillary plate and sculpture on the conical teeth. However, *Progyrolepis tricessimalaris*, described by Dunkle (1946) from the Early Permian of Texas is distinct from the genus *Progyrolepis* in the shape of the maxilla and preoperculum (Štamberg 1991).

***Progyrolepis speciosus* (Frič, 1875)**

Text-fig. 3

1875 *Gyrolepis speciosus* Fr.; Frič, p. 77.
1891 *Elonichthys speciosus*; Woodward, p. 501.
1895 *Progyrolepis speciosus* (Frič, 1875); Fritsch, p. 118; fig. 308; pl. 131, figs 1–15; pl. 132, figs 1–7.
1991 *Progyrolepis speciosus* (Frič, 1875); Štamberg, p. 47; figs 12–23; pls. 5–9.
2006 *Progyrolepis speciosus* (Frič, 1876); Štamberg, p. 223; fig. 3.
2008 *Progyrolepis speciosus* (Frič, 1876); Štamberg and Zajíc, p. 148; fig. 217.

Lectotype (Štamberg 1991): Specimen figured by Fritsch (1895, pl. 131, fig. 12) deposited in the National Museum, Prague under No. M 1217 (positive) and M 881 (negative).

Locus typicus: Kounov, district Rakovník, Czech Republic.

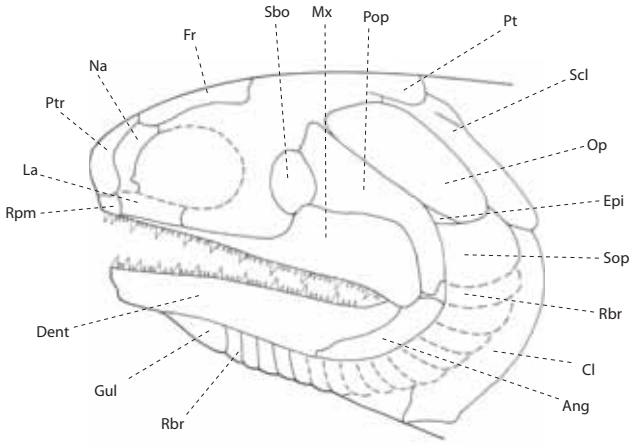
Stratum typicum: Kounov Member, Stephanian B, Upper Carboniferous, Kladno–Rakovník Basin.

Occurrence: Bone fragments and mostly isolated scales occur in the Late Carboniferous sediments of the Central and West Bohemian late Paleozoic basins and the

Krkonoše Piedmont Basin. Štamberg and Zajíc (2008) enumerate a complete list of the localities with *Progyrolepis speciosus*.

D i a g n o s i s : Maxilla with long and low maxillary plate, the length/height ratio of the maxillary plate is 1.6, the ratio of the length of the maxillary plate to the length of the anterior narrow maxillary part is 0.9. The sculpture on the maxilla is formed by conspicuous tubercles and ridges. The sculpture of these irregularly arranged tubercles and ridges covers the entire lateral surface of the maxillary plate, except for the narrow strip on its anterior border, which is smooth. The surface of the large conical teeth carries numerous vertical grooves with small oval bumps regularly placed among them.

R e m a r k s : *Progyrolepis speciosus* represents a large predatory fish. Despite the absence of a complete specimen, the fragments of the body and the formation of the bones of the skull figured previously by Fritsch (1895) provide a good reconstruction of the morphology of the fish.



Text-fig. 3. *Progyrolepis speciosus* (FRIČ, 1875). Reconstruction of the dermal skull in lateral view, x 0.7. After Štamberg (1991). Ang – angular; cl – cleithrum; Dent – dentalosplenial; Epi – epipreoperculum; Fr –frontal; Gul – gular lateral; La – lacrimal; Mx – maxilla; Na – nasal; Op – operculum; Pop - preoperculum; Pt – posttemporal; Ptr – postrostral; Rbr – branchiostegal rays; Rpm – rostropremaxillar; Sbo – suborbital; Scl – supracleithrum; Sop – suboperculum.

Genus ***Zaborichthys*** **Štamberg, 1989**

T y p e s p e c i e s : *Zaborichthys fragmentalis* Štamberg, 1989.

I n c l u d e d s p e c i e s : Only type species.

D i a g n o s i s (Štamberg 1991): Head with the rostral part conspicuously convex anteriorly. Frontal in its anterior part broader than in the posterior, four times longer than wide. Postrostral large, wide. Maxilla with very low and long maxillary plate, its length/height ratio is 2.3. Dentition on the jaws comprises two types of teeth in two rows. Preoperculum very oblique, obliqueness angle is 30°, bend angle 145°. Anterodorsal part of the preoperculum is short, not reaching up to the anterior margin of the maxillary plate. Lower jaw strong. Oval operculum, three times higher than long, ventrally narrow. Accessory operculum is probably present. Square suboperculum, lower anteriorly by one third than in its posterior part. Suboperculum is one and half times lower, but one and half times longer than the operculum. Clavicle is short and wide. Dermal bones sculptured mostly with tubercles and rare ridges. Rhombic scales small, stout, sculptured with diagonally arranged ridges. Posterior margin of scales is denticulated.

Zaborichthys fragmentalis **Štamberg, 1989**

1989 *Zaborichthys fragmentalis* Štamberg, 1989; Štamberg, p. 262; fig. 5; pl. 2, figs 1, 3.
1991 *Zaborichthys fragmentalis* n. sp.; Štamberg, p. 58; figs 24–27; pls. 10, 11.
2008 *Zaborichthys fragmentalis* Štamberg, 1989; Štamberg and Zajíc, p. 148; fig. 218.

H o l o t y p e : Specimens M 2065 and M 2066 (part and counterpart) figured by Štamberg (1991, figs 24, 25, 27; pls. 10–11) deposited at the National Museum, Prague.

D i a g n o s i s : Same as for genus.

L o c u s t y p i c u s : Záboř, district Plzeň – north, Czech Republic.

S t r a t u m t y p i c u m : Kounov Member, Stephanian B, Upper Carboniferous, Kladno–Rakovník Basin.

O c c u r r e n c e : Isolated lower jaw and isolated scales occur in the Late Carboniferous sediments of the Central and West Bohemian late Paleozoic basins, and the Krkonoše Piedmont Basin. Štamberg and Zajíc (2008) enumerate a complete list of the localities with *Zaborichthys fragmentalis.*

Family **Acrolepidae Aldinger, 1937**

T y p e g e n u s : *Acrolepis* Agassiz, 1833

I n c l u d e d g e n e r a : Only *Acrolepis* is known from the Bohemian Massif.

Genus ***Acrolepis*** **Agassiz, 1833**

T y p e s p e c i e s : *Acrolepis sedgwicki* Agassiz, 1833.

I n c l u d e d s p e c i e s : Only *Acrolepis gigas* (Frič, 1877) occurs in the Bohemian Massif.

D i a g n o s i s (Štamberg 1991, emended): Body fusiform reaching almost one meter in length. Pelvic fin small, dorsal and anal fins triangular with similar dimensions. Caudal fin deeply cleft and unequally lobed. All fins protected with small fulcral scales. Lepidotrichia articulated except those on proximal part of the pectoral fins. Endocranium probably only partly ossified. One pair of extrascapular bones, small postparietal bones present. Square parietal, oblong frontal, three times longer than the parietal, anteriorly broader than in its posterior part. Dermopterotic orocaudally elongated with posterior projection. Dermosphenotic anteriorly from the dermopterotic. Conspicuous sculpture on all dermal bones of the skull roof. Rostral part of the head blunt, postrostral wide. Suborbital bones present. Maxilla with well-developed maxillary plate. Ratio of the length of the maxillary plate to the length of the narrow anterior part of the maxilla is 1. Length/height ratio of the maxillary plate is 1.1. Lower jaw strong.

Dentition consists of two types of teeth in two series. The inner series is formed of a few larger teeth, while the outer comprises numerous minute teeth. Preoperculum obliqueness angle about 35°, bone is apparently bent anteriorly. Operculum relatively small, narrower than the suboperculum. Operculum obliqueness angle about 40°. Branchiostegal rays numerous. Scales stout, minute, widely overlapping. Sculpture on the scales and dermal bones conspicuous, formed by anastomosing ridges. Ridge scales on dorsal margin of caudal fin and caudal peduncle, sometimes also anteriorly from the dorsal fin. Lateral sensory line on the trunk scales not very distinct.

Acrolepis gigas (Frič, 1877)

Text-fig. 2, fig. 1

1877 *Amblypterus gigas* Fr.; Frič, p. 50.
1891 *Elonichthys* (?) *gigas* (Frič); Woodward, p. 494.
1895 *Acrolepis gigas*, Fr.; Fritsch, p. 117; pls. 129–130.
1989 *Acrolepis gigas* (Frič, 1877); Štamberg, p. 263; figs 2, 6; pl. 1.
1991 *Acrolepis gigas* (Frič, 1877); Štamberg, p. 65; figs 28–30; pls. 12–15.
2008 *Acrolepis gigas* (Frič, 1877); Štamberg and Zajíc, p. 149; fig. 219.

Lectotype (Štamberg 1991): Specimen figured by Fritsch (1895, pls. 129, 130, fig. 1) deposited at the National Museum, Prague under no. M 125.

Locus typicus: Žilov, district Plzeň – North, Czech Republic.

Stratum typicum: Mšec Member, Stephanian B, Upper Carboniferous, Plzeň Basin.

Occurrence: Beside a complete specimen from Žilov, only isolated scales from the Late Carboniferous of the Central and West Bohemian late Paleozoic basins and Mnichovo Hradiště Basin are known. (Štamberg and Zajíc 2008).

Diagnosis (Štamberg 1991, emended): Large fish, reaching 1250 mm. Base of the dorsal fin opposite to the base of pelvic fin. Caudal peduncle long. 30 branchiostegal rays considerably overlapping one another. Height of the suboperculum half the height of the operculum. Preoperculum obliqueness angle is 25°, operculum obliqueness angle 30°. Scales with sculpture formed by diagonally arranged ridges. Scales overlap one another, posterior margin is not denticulated. The scale count is

$$\frac{55}{32\ 60\ 87}\ 95?$$

Remarks: Three species of the genus *Acrolepis* were initially described by Fritsch (1895) from the Late Carboniferous of the Central and West Bohemian late Paleozoic basins: *A. gigas, A. krejcii* and *A. sphaerosideritarum*. After revision of these three species, it is evident that only *A. gigas* belongs to the genus *Acrolepis*, whereas the other two are classified tentatively as "*Elonichthys*" *krejcii* to the genus "*Elonichthys*", in the family Elonichthyidae in the sense of Schindler (Poschmann and Schindler 2004). Finally, study of additional material showed that "*Elonichthys*" *sphaerosideritarum* is a synonym of "*Elonichthys*" *krejcii* (Štamberg 2010). The biggest actinopterygians from the Carboniferous and Permian belong in *Acrolepis gigas*. In a matter of related interest, in the year 2000 *Acrolepis gigas* became the symbol of the emblem and flag of the village Žilov.

Family **Sceletophoridae Štamberg, 2006**

Type genus: *Sceletophorus* Fritsch, 1894 is the single genus of the family.

Diagnosis (Štamberg 2006): The family Sceletophoridae is characterized by fusiform shape of the body, pelvic fin placed closer to pectoral than to anal fin. Caudal fin with unequal lobes, but only moderately cleft. Fin rays of pectoral fins articulate from their base. Orbit large, lying well forward. Maxilla with large square maxillary plate. Lower jaw stout. The upper and lower jaws bear robust, smooth, sharp-pointed teeth of equal size. Suspensorium nearly vertical. Oblong operculum and suboperculum, small number of branchiostegal rays. Scales are rhombic.

Remarks: The genus *Sceletophorus* was formerly included in the family Trissolepidae Fritsch, 1895 together with the *Sphaerolepis* Frič, 1877 – the type genus of the family Trissolepidae (Štamberg 1991). *Sceletophorus* has several features similar to *Sphaerolepis* (large orbit, construction of the skull roof, type of dentition on the jaws, nearly vertical suspensorium), but several other important characters separate *Sceletophorus* from Trissolepididae: well-developed operculum and suboperculum, greater number of branchiostegal rays, shape of the parasphenoid, caudal fin moderately cleft and rhombic scales.

The family Sceletophoridae includes *Sceletophorus biserialis* Fritsch, 1894 and *Sceletophorus verrucosus* (Fritsch, 1894) from the Westphalian D of the Central and West Bohemian Late Palaeozoic basins.

Genus *Sceletophorus* Fritsch, 1894

Type species: *Sceletophorus biserialis* Fritsch, 1894.

Included species: *Sceletophorus biserialis* Fritsch, 1894; *Sceletophorus verrucosus* (Fritsch, 1894).

Diagnosis: Frontals only are one third longer or of the same length as parietals. Dermopterotic and dermosphenotic present. Narrow strip of extrascapular bones posteriorly to parietal. Rostral part of head not conspicuously convex anteriorly. Parasphenoid well ossified, even in young specimens. One pair of posterolaterally directed processus ascendens posterior developed. Orbit large, lying well forward. Maxilla with a large maxillary plate, with equal ratio of length to height. Both upper and lower jaws bear robust, smooth, sharp-pointed teeth of identical size. Lower jaw strong. The preoperculum is not conspicuously curved anteriorly, it is inclined at an angle of 60° – 70°. The operculum is higher than long by 1/3 to 1/2 and it is 1/3 higher than the suboperculum. Operculum inclined at angle 60° – 70°. No more than six branchiostegal rays. Presupracleithrum present, cleithrum considerably

elongated dorsoventrally. Lateral sensory canal very conspicuous. Scales very delicately sculptured with fine concentric ridges of enamel only in the oral region of the trunk. Dorsal fin of approximately the same size as the anal fin, but with shorter base. Lepidotrichia of all fins segmented and distally once or twice dichotomized.

Sceletophorus biserialis Fritsch, 1894

Text-fig. 2, fig. 5

1894 *Sceletophorus biserialis*, Fr.; Fritsch, Band 3, p. 88, figs 281–286, pls. 116, 117, fig. 3.
1894 *Phanerosteon pauper*, Fr.; Fritsch, Band 3, p. 92, fig. 287, pl. 117, figs 1–4.
1894 *Amblypterus verrucosus*, Fr.; Fritsch, partim, Band 3, fig. 290.
1936 *Gymnoniscus pauper*; Berg, p. 345.
1966 *Gymnoniscus pauper* (Frič); Lehman, p. 78, p. 79.
1967 *Sceletophorus biserialis* Frič; Gardiner, p. 169, figs 19–21.
1983 *Sceletophorus biserialis* Frič, 1895; Štamberg, p. 44, figs 1–10.
1991 *Sceletophorus biserialis* Frič, 1895; Štamberg, p. 88, figs 49–51, pls. 19, 20.

Lectotype (Štamberg 1983): specimen figured by Fritsch (1894) on pl. 116, fig. 3, pl. 117, fig. 5 and text-figs 284, 285, deposited in the National Museum, Prague under No. M 1202.

Type locality: Třemošná, district Plzeň.

Stratum typicum: Nýřany Member, Westphalian D, Upper Carboniferous.

Stratigraphical range: Westphalian D.

Occurrence: Třemošná, Nýřany.

Diagnosis (Štamberg 1983, emended): Body slender, fusiform, attaining a length 10 cm. Interparietal and interfrontal sutures are straight. Segments of lepidotrichia always longer than wide. The longest lepidotrichia of the anal fin composed of 14 – 18 segments. The longest lepidotrichia of the caudal fin's ventral lobe have a maximum of 20 segments. The scale count

$$\frac{21}{6\ 19\ 30}\ 35$$

Remarks: *Phanerosteon pauper* Fritsch, 1894 is a juvenile specimen of *Sceletophorus biserialis*. For that reason, the newly erected genus *Gymnoniscus* by Berg (1936), on the basis of *Phanerosteon pauper* Fritsch, 1894, is considered to be synonymous with *Sceletophorus biserialis* (Westoll 1944, Gardiner 1967, Štamberg 1991). Additionally, one specimen of *Amblypterus verrucossus* (Fritsch 1894, fig. 290) was reclassified (Štamberg 1983, 1991) to *Sceletophorus biserialis*. Fritsch (1894) assigned the species name *biserialis* for the presence of two lateral sensory lines on each side of the body. In fact, though there is a single lateral sensory line on each side of the body that is very conspicuous, an impression of this line from the opposite side of the body may also be seen on some specimens.

Sceletophorus verrucosus (Fritsch, 1894)

1894 *Amblypterus verrucosus*, Fr.; Fritsch, Band 3, pp. 96–99, fig. 289, pl. 120.
1983 *Sceletophorus verrucosus* (Frič, 1895); Štamberg, p. 61, figs 11–14.
1991 *Sceletophorus verrucosus* (Frič, 1895); Štamberg, p. 8, pl. 21

Lectotype (Štamberg 1983): Specimen figured by Fritsch (1894) on fig. 289 and pl. 120, deposited in the National Museum, Prague as No. M 1205.

Type locality: Třemošná, district Plzeň.

Stratum typicum: Nýřany Member, Westphalian D, Upper Carboniferous.

Stratigraphical range: Westphalian D.

Occurrence: Třemošná, Nýřany.

Diagnosis (Štamberg 1983, emended): Body elevated-fusiform, attaining a length 14 cm. Interparietal and interfrontal sutures are conspicuously sinuous, as is the suture between the frontal and the parietal. Segments of lepidotrichia usually wider than long. The longest lepidotrichia of the anal fin composed of 30 or more segments, the longest lepidotrichia of the ventral lobe of the caudal fin composed of 30–42 segments. Scale count is

$$\frac{21}{6\ 18\ 31}\ 36$$

Remarks: *Sceletophorus verrucosus* was initially described by Fritsch (1894) as *Amblypterus verrucosus*. Though the general appearance of the body is reminiscent of the bodies of amblypterids from the Krkonoše Piedmont Basin, the anatomy of the skull exhibits several distinctions. These are seen in the dentition on the jaws, very strong lower jaw or small frontal in comparison to parietal. These characters are, on the contrary, common for *Sceletophorus* and for that reason *Amblypterus verrucossus* was reassigned (Štamberg 1983) as *Sceletophorus verrucosus* (Fritsch, 1894).

Family **Trissolepidae Fritsch, 1893**

Type genus: *Sphaerolepis* Frič, 1877.

Included genera: Type genus only.

Remarks: The family Trisolepidae was erected by Fritsch (1893) on the basis of the genus *Trissolepis*, for which its original name *Sphaerolepis* is now used.

Genus *Sphaerolepis* Frič, 1877

Type species: *Sphaerolepis kounoviensis* Frič, 1877.

Included species: Type species only.

Diagnosis (after Štamberg 1991, emended): Body fusiform reaching a total length of 15 cm. Paired fins small, pectoral fins composed of 11–12 lepidotrichia, pelvic fin of 14–15 lepidotrichia. Dorsal fin with short base consists of 15–19 lepidotrichia, and placed opposite the space between the pelvic and anal fins. Anal fin consists of 19 lepidotrichia, caudal fin not deeply cleft, with long and slender dorsal lobe. All fins have stout basal fulcra forming their leading edges, and the dorsal edge of the caudal fin. Fringing fulcra are absent. Lepidotrichia of all fins segmented. Head anterior bluntly terminated, not conspicuously convex. Paired

extrascapular lateral and unpaired extrascapular medial present. Square parietal, frontal one-third longer than parietal. Small triangular dermosphenotic. Parasphenoid with one pair of processus ascendens posterior, posteriorly elongated corpus parasphenoidis same length as the anterior part of corpus parasphenoidis anteriorly from the bucco-hypophysial foramen. Vomers and dermal bones on medial face of the palatoquadratum, with well developed teeth. Suborbital bones present. Maxillary plate short and high, the length/height ratio is 0.8–1.1. Lower jaw strong, moderately curved anteriorly. Dentition comprises numerous, relatively stout, sharp pointed teeth. Preoperculum not conspicuously bent anteriorly, obliqueness angle of preoperculum is 65–70°. Operculum large, moderately dorsoventrally elongated. Operculum obliqueness angle is 80°. Subopercular is not developed, no more than five branchiostegal rays. Scales covering the trunk are cycloidal, except those on the dorsal lobe of the caudal fin and on the part of the caudal peduncle, which are rhombic. Cycloidal scales are thin, sculpture is formed on overlapped part by concentrically arranged lines which terminated posteriorly in small sharp pointed tubercles on uncovered part of the scale. Scale count

$$\frac{18}{6\ 16\ 29}\ 32$$

Sphaerolepis kounoviensis Frič, 1877

Text-fig. 2, fig. 4

1875 (Nov. Gen.) *Kounoviensis*; Frič, p. 76.
1877 *Sphaerolepis* (n. g.) *Kounoviensis*; Frič, p. 46.
1893 *Trissolepis Kounoviensis*, Fr.; Fritsch, p. 76; figs 277, 278; pls. 109–112.
1967 *Sphaerolepis kounoviensis* Frič; Gardiner, p. 164; figs 16–18.
1985 *Sphaerolepis kounoviensis* Frič, 1877; Štamberg, p. 101; figs 4–7.
1989 *Sphaerolepis kounoviensis* Frič, 1875; Štamberg, p. 264; figs 7, 8; pl. 4, fig. 3.
1991 *Sphaerolepis kounoviensis* Frič, 1875; Štamberg, p. 72; figs 31–48; pls. 16–18.
2000 *Sphaerolepis kounoviensis* Frič; Štamberg and Zajíc, p. 455; figs 1, 2E.

Lectotype (Štamberg 1991): Specimen figured by Fritsch (1893) on pl. 110, fig. 1, deposited in National Museum, Prague under no. M 1198 and M 1197 (galvanic cast).

Diagnosis: Same as for genus.

Locus typicus: Kounov, distr. Rakovník, Czech Republic.

Stratum typicum: Kounov Member, Stephanian B, Upper Carboniferous, Kladno and Rakovník Basins.

Remarks: Frič (1875) briefly described a newly found fish with the specific name "*kounoviensis*", but without a combination with any name of a genus. According to the International Code of Zoological nomenclature (Art. 11.9.3) this is considered an unavailable name. The name was availably published by Frič in his next work (Frič 1877) when he erected the new genus *Sphaerolepis*. Later Fritsch (1893) gave a more detailed description of the fish with figures, and erected for this fish the new name *Trissolepis* and the new family Trissolepidae. With regard to priority, the name *Sphaerolepis* is to be kept.

Sphaerolepis kounoviensis possesses several distinctive features (the cycloidal shape of the scales, shape of the maxilla, shape of the parasphenoid, large operculum and missing subopercular) that make the easy determination of the species possible. Gardiner (1967) redescribed *S. kounoviensis*, and he confirmed the presence of the fossa in the region of junction between the parietal, frontal and dermopterotic. The same fossa was figured also by Fritsch (1893). I am convinced that the fenestration in the above described skull roof does not exist, and the seeming fenestration is deformation of the skull roof caused by the presence of the otolith.

Fragments of bodies, and mostly isolated bones and scales are known from many localities of the Central and West Bohemian late Paleozoic basins, and the Krkonoše Piedmont Basin. Štamberg and Zajíc (2008) enumerated a complete list of the localities with *Sphaerolepis kounoviensis.* Occurrence of the species is limited to Stephanian B, C, and no occurrence from the Bohemian Massif is known from the Permian. The occurrence of the genus *Sphaerolepis* is also registered by Bürgin (1990) on the basis of the presence of the scales from the Early Permian of the Weiach Basin in Northern Switzerland. Zajíc (2000) used *S. kounoviensis* for its relatively easy recognizable features, and its wide distribution, as one of the actinopterygians for biozonation of the Late Carboniferous.

Family **Igornichthyidae Heyler, 1977**

Type genus: *Igornichthys* Heyler, 1969.

Included genera: Only *Igornichthys* Heyler, 1969 and *Setlikia* Štamberg et Zajíc, 1994 occur in the Bohemian Massif.

Genus ***Igornichthys* Heyler, 1969**

Type species: *Igornichthys doubingeri* Heyler, 1972.

Diagnosis (after Heyler 1969): Maxilla with the strong maxillary plate which is prolongated ventroposteriorly; lower jaw strong, not high posteriorly; operculum and subopercular rather narrow; preoperculum is indistinct but bent anteriorly in its dorsal part; branchiostegal rays are narrow and numerous; the body is elongated, the pelvic fin joins at about 9th row of the scales; the surface of the scales is extraordinarily ornamented, with one or two pointed tubercles posteriorly and partly ventrally directed.

Igornichthys sp.

1994 *Igornichthys* sp.; Štamberg, p. 21; fig. 2; pl. 1, fig. 1.
2006 *Igornichthys* sp.; Štamberg, p. 226, p. 227.
2008 *Igornichthys* sp.; Štamberg and Zajíc, p. 152; fig. 225.

Characteristics: Very small fish, not exceeding 50 mm total length. Anteriorly situated lepidotrichia of the pectoral fins are proximally not segmented. The lateral side of the scales bear in their central

region one or two conspicuous sharply pointed tubercles posteriorly oriented. Large orbit borders dorsally anteroposteriorly elongated dermosphenotic. The dermopterotic is square, two times shorter than the dermosphenotic, and is situated in the same line behind the dermosphenotic. The orbit is not in contact with the frontal. Supraorbital canal on the frontal bends laterally and traverses to the dermopterotic. Maxilla with ventroposteriorly elongated maxillary plate. The teeth have a wide base, are sharply pointed and arranged in one row.

Material: Specimen MHK 30866 deposited at the Museum of Eastern Bohemia at Hradec Králové.

Locality and stratigraphical range: Příkrý, district Semily, Krkonoše Piedmont Basin. Rudník Horizon Vrchlabí Formation, Asselian.

Remarks: Genus *Igornichthys* was erected by Heyler (1969) on the basis of several specimens from the Igornay Formation of the Autun Basin (France). Heyler at the same time (Heyler 1969) determined also another new genus and species, *Igornella comblei*. While the specimens of *Igornichthys* demonstrate mainly the maxilla with the teeth, operculum, suboperculum, narrow branchiostegal rays and the scales with one or two tubercles posteriorly oriented, *Igornella comblei* shows a well preserved rostral region of the skull, the skull roof and partly also the opercular region. The specimen MHK 30866 from the Krkonoše Piedmont Basin demonstrates the characters of both genera, and it is questionable whether the genera *Igornichthys* and *Igornella* are synonymous. In that case, only the genus *Igornichthys* would be valid.

Genus ***Setlikia*** Štamberg et Zajíc, 1994

Type species: *Setlikia bohemica* Štamberg et Zajíc, 1994.

Included species: The type species only.

Diagnosis (after Štamberg and Zajíc 1994): Supraorbital canal runs across the frontal and passes onto dermopterotic. Parietal triangular, with two pit lines. Postparietal bones probably present. Dermosphenotic narrow, anteroposteriorly elongated.

Setlikia bohemica Štamberg et Zajíc, 1994

Text-fig. 4

1994 *Setlikia bohemica* sp. nov.; Štamberg and Zajíc, p. 53, figs 2–4, 5D; pls. 1, 2.
2006 *Setlikia bohemica* Štamberg et Zajíc, 1994; Štamberg, p. 224.

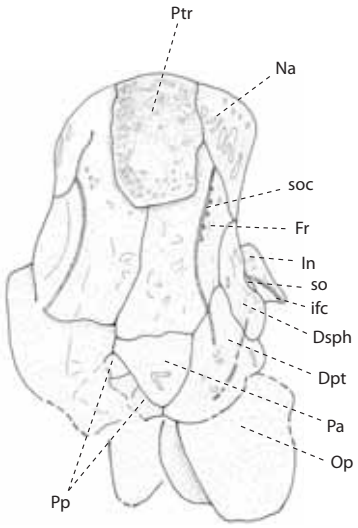
Holotype: Specimen Ya 1352 deposited in the collection of the Czech Geological Survey, Prague.

Type locality: Kroučová (borehole Kr-11, 178-179 m), Rakovník district, Bohemia, Czech Republic.

Stratum typicum: Stephanian B, Ledce Member of the Slaný Formation, Kladno-Rakovník Basin.

Diagnosis: Same as for genus.

Remarks: *Setlikia bohemica* is known only from the holotype, which shows relatively well-preserved dermal bones of the rostrum, skull roof, infraorbital and indistinct contours of the operculum and supracleithrum.



Text-fig. 4. *Setlikia bohemica* Štamberg et Zajíc, 1994. The postrostral and the skull roof in dorsal view. Holotype YA 1352, x 2.7. After Štamberg and Zajíc 1994. Dpt – dermopterotic; Dsph –dermosphenotic; Fr –frontal; ifc – infraorbital canal; In – infraorbital; Na – nasal; Op – operculum; Pa – parietal; Pp – postparietal; Ptr – postrostral; so – spiracular opening; soc – supraorbital canal.

Family **Aeduellidae Romer, 1945**

Type genus: *Aeduella* Westoll, 1937.

Included genera from the Bohemian Massif: *Bourbonnella* Heyler, 1967; *Spinarichthys* Štamberg, 1986; *Neslovicella* Štamberg, 2007.

Diagnosis (after Poplin 200l, emended Štamberg 2007). Palaeonisciforms with fusiform or elevated-fusiform body. The total body length is approximately 3 to 4 times the height of the body in front of the dorsal fin. Head is rather large. Orbit is large. Large medial rostro-postrostral is ornamented with tubercles. Large nasal is ornamented with distinctive longitudinal ridges. The supraorbital anterior with conspicuous sculpture is only present in some species, and in this case the nasal is without ornamentation. Only a few large sensory lines and pores are present. Supraorbital sensory canal passes along the lateral margin of the frontal, and traverses onto dermopterotic in the form of a "pit line" or a canal interconnected with the infraorbital canal. The "medial pit line" and "posterior pit line" are developed on the parietal only. The infraorbitals are either all small or a few (one or two) may be large. The premaxillary is absent. The maxillaries are in contact medially oroventrally from the rostro-postrostral, with an elevated postorbital region. The teeth along the oral margin are minuscule, numerous and in several ranges, and carry small tubules rooted on the bone. The preoperculum is vertical, and divided into an inferior plate with horizontal and vertical "pit lines," and into numerous small bones superiorly. The operculum is large with nearly vertical axis. The suboperculum is the same or nearly the same height as the operculum. There are one or a small number of branchiostegal rays. Median gular plate is elongated, with two "pit lines" in V or Y forms. The lateral gular plate has one "pit line". The scales are smooth. The series of large ridge scales in front of the dorsal fin does not continue to

the head. Ridge scales are not developed between the dorsal and caudal fins. One anal plate is present. The dorsal and anal fins begin on the same or nearly the same scale row. The lepidotrichia are numerous; they divide distally from the basal article to very short articles that usually have a sigmoid mutual connection. The basal article is long. The caudal fin is distinctively heterocercal with inversion of the scale rows.

Genus ***Bourbonnella*** **Heyler, 1967**

Type species: *Bourbonnella guilloti* Heyler, 1967.

Included species: Several species from the Carboniferous and Permian sediments of French Massif Central, Switzerland, New Mexico and Utah (USA). Only the species *Bourbonnella hirsuta* Štamberg, 2007 is known from the Bohemian Massif.

Diagnosis: (after Poplin 2001, Poplin and Dutheil 2005, emended Štamberg 2007): Aeduellid from 15 to 30 cm in total length. The total length ranges from 3.5 to 5.5 times length of the head. Average scale count is

$$\frac{25\text{-}29}{7\text{-}12 \;\; 24\text{-}27 \;\; 33\text{-}40}\; 42\text{-}44$$

One infraorbital is long and narrow, sometimes with a second considerably shorter one bordering the orbit posterodorsally. The rostral region composes the supraorbital anterior beside the postrostral and nasal on some species. The supraorbital canal terminates with a „pit line“ on the dermopterotic or dermosphenotic. Posterior region of maxilla is higher than on other Aeduellidae, and dorsal border is concave. Very high and unequal operculum and suboperculum, with a rectilinear common suture. Operculum only slightly inclined anteriorly. Three to six large ridge scales occur in front of the dorsal fin. Scaled lobes form bases of pectoral fins. Vertical row of scales in front of the origin of the dorsal fin contains from 22 to 31 scales.

Bourbonnella hirsuta **Štamberg, 2007**

Text-fig. 5, fig. 4

2003 *Aeduella* sp; Štamberg, fig. 4.
2006 *Bourbonnella* sp.; Štamberg, p. 226, fig. 5
2007 *Bourbonnella hirsuta* n. sp.; Štamberg, p. 39, figs 40–55, pls. 18–25.

Holotype: Specimen MHK 63858 has a well-preserved head and partly preserved anterior region of the trunk, housed in the Museum of Eastern Bohemia at Hradec Králové.

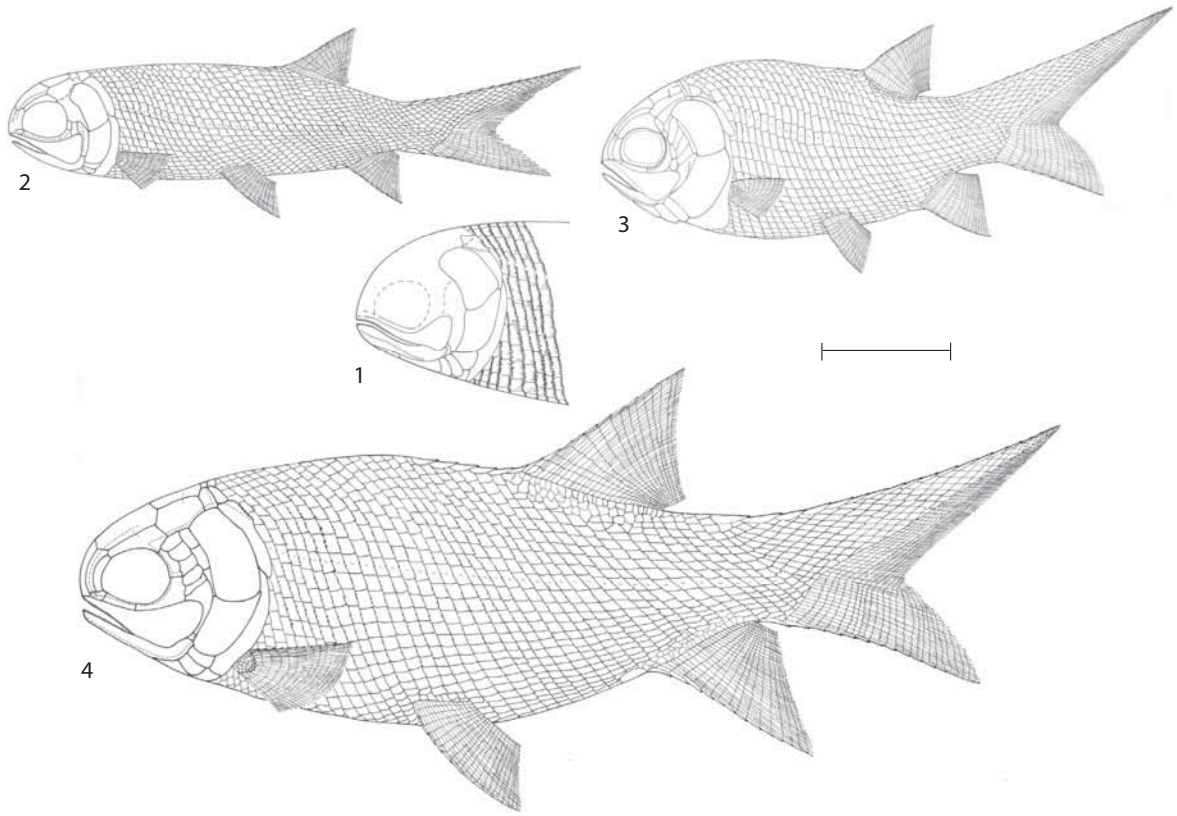
Referred specimens: Besides the holotype, specimen MHK 70611, and plate MHK 70610 (part and counterpart), there are two specimens: one of which belongs to *Bourbonnella hirsuta*, and the other to the genus *Paramblypterus.*

Locus typicus: Kochov “In the Streams” near by the town of Letovice, Blansko district, Czech Republic.

Stratum typicum: Kochov Horizon, Middle Letovice Formation, Early Permian.

Occurrence: Kochov “In the Streams”, Drválovice “Windmill”.

Diagnosis (Štamberg 2007): *Bourbonella* reaching 15 cm in total length. The total body length is 5 times the



Text-fig. 5. Reconstruction of aeduellids from the Bohemian Massif . 1 – *Spinarichthys dispersus* (Fritsch, 1895) (after Štamberg 1986). 2 – *Neslovicella elongata* Štamberg, 2010 (after Štamberg 2010). 3 – *Neslovicella rzehaki* Štamberg, 2007 (after Štamberg 2007). 4 – *Bourbonnella hirsuta* Štamberg, 2007 (after Štamberg, 2007). Scale bar represents 20 mm.

length of the head, and 3.6 times the height of the body at the level of pelvic fin. Scale count is

$$\frac{28}{12?\ 25\ 36}\ 40$$

Supraorbital anterior has conspicuous sculptured ridges, and forms the anterior and dorsal border of the orbit, together with the dermosphenotic. These bones separate the nasal and frontal from the orbit. The nasal and the dermosphenotic separate the supraorbital anterior from the frontal. Triangular antorbital is present in the rostral region. Rectangular frontal is 1.5 times longer than the square parietal. Triangular dermosphenotic has posterior margin shifted posteriorly, nearly to the level of the fronto-parietal suture. Dermopterotic is rectangular. The interconnection between the supraorbital and infraorbital sensory canals occurs through the pit line running from frontal to dermosphenotic, or from frontal to dermopterotic. The median pit line on the parietal runs from parietal to dermopterotic. Five small suborbital bones overlap one another dorsoventrally, some of which bear spines on their ventral margin. Strong maxilla has triangular maxillary plate. Operculum is very high, dorsal third of the bone bends anteriorly. The subopercular is high, the operculum is 1.5 times higher than the subopercular. The posterior edge of the subopercular is one-third higher than the anterior one. Two short branchiostegal rays, paired gular lateral, and median gular medial are present. Skull roof is posteriorly rimmed with paired extrascapular medial and paired extrascapular lateral. Posterior margin of the supracleithrum bears sharply pointed spines. Similar spines occur on the posterior margin of the flank scales behind the head. The flank scales from the eighth to twentieth scale row are pectinated posteriorly. Fringing fulcra on the leading edges of paired and unpaired fins are not numerous. Small field of minute scales present along the base of the dorsal and anal fins. Five or six large median scutes occur in front of dorsal fin, one pair of large scales occurs in front of anal fin. The oblique row in front of the anal fin is composed of 22 scales.

Genus *Neslovicella* Štamberg, 2007

Type species: *Neslovicella rzehaki* Štamberg, 2007.

Included species: *Neslovicella rzehaki* Štamberg, 2007; *Neslovicella elongata* Štamberg, 2010.

Diagnosis (Štamberg 2010): Fusiform body with maximum total length of 103 mm. Pectoral fins with scale-covered lobe. Lepidotrichia of pectoral fins articulated along their entire length. Leading edge of pectoral fins turned dorsally. Dorsal fin origin situated above the space between the pelvic fin and anal fin base. Dorsal and anal fins approximately equal in size, or anal fin slightly smaller. Caudal fin deeply incised and inequilobate. Scale-covered axis of dorsal lobe of caudal fin forms low angle with anteroposterior body axis. Caudal inversion abrupt. Frontals wide, with length/width ratio of 1.06-1.25. Frontal/parietal length ratio 1.06-1.7. Interparietal-interfrontal suture nearly straight. Dermosphenotic elongate. Supraorbital sensory canal extends from nasal posteriorly across frontal, turning laterally on frontal and continuing onto dermopterotic. Orbit large, with numerous postorbital bones. Preoperculum very small. Maxilla with triangular maxillary plate posteriorly. Maxilla length/height ratio of 2.2 in adult specimens. Lower jaw weak, slightly turned ventrally at oral extremity. Jaw dentition consisting of numerous minuscule tubular teeth. Operculum very high, curved orally in its dorsal region. Opercular axis inclined at about 60 degrees to the horizontal. Operculum less tall or as tall as subopercular. Opercular-subopercular suture oblique, two branchiostegal rays present. Posterior margin of scales conspicuously pectinate.

Neslovicella rzehaki Štamberg, 2007

Text-fig. 5, fig. 3

2007 *Neslovicella rzehaki* n. sp.; Štamberg, p. 18, figs 9–39, pls. 4–17.

Holotype: Specimen MHK 70615 (part and counterpart) deposited in the Museum of Eastern Bohemia at Hradec Králové.

Referred specimens: MHK 64207-64400, 64402-64411, 64413-64574, 64577-64592, 64594-64614, 70612-70614, 70616-70741, 71587-71606, 72427, M 25489.

Locus typicus: Neslovice “Fish Rock 2”, Brno district, Czech Republic.

Stratum typicum: Padochov Formation, Early Permian, Boskovice Graben.

Diagnosis (after Štamberg 2010): Aeduellid with elevated-fusiform body, total length of which ranges from 30 to 103 mm. Total body length is 4.6 times the length of the head, and 3.3 times the highest part of the body. Pectoral fins with scaled lobes and the lepidotrichia of pectoral fins articulated along their whole length. Oral margin of pectoral fins turns dorsally. Dorsal fin originates close to the posterior margin of the ventral fin base. Anal fin originates close to the level of the posterior margin of the dorsal fin base. Dorsal and anal fins are approximately the same size. Small field of minute scales present along the base of the dorsal and anal fins. Caudal fin deeply cleft, inequilobate. Frontal and parietal bones relatively wide. Length/width ratio of the frontal is 1.06-1.25. Oral region of the frontal narrower than the posterior ones. Dermosphenotic elongated, reaching the nasal. Dermopterotic short, borders the parietal and posterior margin of the frontal. Supraorbital sensory canal continues from the nasal across the frontal, where it turns laterally and continues to the dermopterotic. Supraorbital anterior with conspicuous sculpture developed beside the medial rostro-postrostral and paired nasal. Nasal and dermosphenotic separate supraorbital anterior from frontal. Orbit relatively large, and bordered dorsally by dermosphenotic, and orally by supraorbital anterior. Six postorbital bones and narrow dermohyal are developed between the orbit and the operculum. Strong maxilla with triangular maxillary plate. Lower jaw weak, slightly bent ventrally in oral termination. Dentition on the jaws formed by numerous minuscule teeth embedded in tubules arranged in several rows. Operculum very high and orally bent in dorsal region. Opercular axis forms a 63° angle to the

horizontal. Suboperculum is one-fourth higher than the operculum. Suture between the operculum and suboperculum is oblique. Oral margin of suboperculum is one-fourth shorter than caudal margin of suboperculum. One or two branchiostegal rays, single median gular and one pair of lateral gular. Scale count

$$\frac{22}{8\ \ 21\ \ 33}\ 36$$

Oblong flank scales. Caudal margin of scales pectinated, sharply pointed denticulation developed on the posterior region of lateral surface of scales. Pectination and ornamentation diminish posteriorly.

Neslovicella elongata Štamberg, 2010

Text-fig. 5, fig. 2, Pl. 2, fig. 1

2010 *Neslovicella elongata* sp. nov.; Štamberg, p. 185, figs 2–13.

Holotype: Specimen MHK 80447 deposited in the Museum of Eastern Bohemia at Hradec Králové.

Type horizon and locality: Košťálov ("Behind the Tavern"); Rudník Horizon, Vrchlabí Formation, Asselian, Krkonoše Piedmont Basin.

Occurrence: Košťálov ("Behind the Tavern"), Kundratice ("Doly"), Kundratice ("Gorge"), Semily ("Left Bank of Jizera River"), Rybnice ("Hrádecký Creek") (Rudník Horizon, Vrchlabí Formation, Asselian, Krkonoše Piedmont Basin); Weissig near Dresden (Weissig Formation, Weissig Basin, Lower Permian).

Diagnosis (after Štamberg 2010): Small aeduellid with elongate body, more slender than *N. rzehaki*, and not exceeding 75 mm in total length. Total body length 5 times the head length, and 5.1 times the maximum body height. Length of anal fin slightly shorter than length of dorsal fin. Base of anal and dorsal fins without field of small scales. Caudal peduncle long. Dorsal scaled lobe of caudal fin oriented at 20-25 degrees relative to body axis. Frontal/parietal length ratio about 1.1. Orbit large. Small suborbital bones posterior to orbit. Length of maxilla 2.2 times its height. Very small axe-shaped preoperculum with vertically oriented anterior margin of its dorsal region. Operculum very high, equal to that of suboperculum. Operculum-suboperculum suture oblique. Two branchiostegal rays. One pair of lateral gular. Posterior margin of trunk scales conspicuously pectinate. Scale count as follows:

$$\frac{26}{9\ \ 24\ \ 36}\ 40$$

Remarks: *Neslovicella rzehaki* is abundant, but entirely isolated in one locality of the Boskovice Graben. No other actinopterygian, acanthodian, xenacanthid or amphibian species accompany it, and its occurrence is bound to one small and time-limited lake. Small *Neslovicella elongata* occurs in several localities of the Krkonoše Piedmont basin, and it shared lake environments with paramblypterids that reached lengths up to 25 cm. Paramblypterids were present as a majority, but aeduellids occur in the same layer, and some samples show *Paramblypterus rohani* together with *Neslovicella elongata.* The two species, *N. rzehaki* from the Říčany Horizon of the Boskovice Graben and *N. elongata* from the Rudník Horizon of the Krkonoše Piedmont Basin, are very closely related. Their presence in both basins attests to an approximately equivalent age of the horizons. *Neslovicella elongata* was additionally recorded (Štamberg 2010) in the Weissig Basin (Early Permian, Weissig Formation; Schneider et al. 2005) near Dresden, Germany. The *Neslovicella elongata*-bearing beds of the Weissig Formation and Rudník Horizon may be of identical age, and document the interconnection of the Krkonoše Piedmont Basin in the Bohemian Massif and the Weissig Basin in Germany through fluvial and lacustrine drainage systems linked to the Elbe lineament (Schneider and Reichel 1989; Schneider and Zajíc 1994).

Genus *Spinarichthys* Štamberg, 1986

Type species: *Spinarichthys dispersus* (Fritsch, 1895).

Included species: Only type species is known.

Diagnosis (after Štamberg 1986): Small fishes not exceeding 8 – 10 cm in total body length. Rostral part of head rounded, not convex orally. Maxilla with small triangular maxillary plate. Lower jaw strong. Both lower and upper jaws bear a row of very small teeth joined to short tubules. Preoperculum not curved orally, situated in vertical position. Oblong operculum, dorsoventrally elongated, making an angle of 45° with the horizontal plane. Suboperculum dorsoventrally elongated, same height as operculum. No more than three branchiostegal rays, paired lateral gular and unpaired median gular. Clavicle is present. Caudal margin of the scale strongly pectinated. Scales possess a conspicuous peg and socket articulation.

Spinarichthys dispersus (Fritsch, 1895)

Text-fig. 5, fig. 1

1895 *Acentrophorus dispersus* Fr.; Fritsch, vol. 3, p. 81, fig. 279, pls. 113, 114.
1945 *„Acentrophorus" dispersus*; Romer, p. 422.
1986 *Spinarichthys dispersus* (Frič, 1895); Štamberg, p. 156, figs 1–6, 7B, pls. 1, 2.

Diagnosis: The same as for the genus.

Holotype: Specimen M 814 and the cast M 1200 of the same specimen deposited in the National Museum, Prague.

Type locality: Kounov, district Rakovník, Czech Republic.

Stratum typicum: Kounov Member, Stephanian B, Kladno and Rakovník Basins.

Occurrence: Several localities of the Kladno and Rakovník Basins and Krkonoše Piedmont Basin (see Štamberg and Zajíc 2008).

Remarks: Fritsch (1895) described a small fish under the species name *Acentrophorus dispersus* from the Carboniferous of the Kladno and Rakovník Basins. The study of the holotype and other material showed that this

fish belonged to the family Aeduellidae, and the new genus was erected for it. Beside the holotype, five additional specimens with jaws and scales are preserved, and numerous isolated scales are known from the Stephanian of the Kladno and Rakovník Basins and from the Stephanian of the Krkonoše Piedmont Basin (Štamberg and Zajíc 2008).

Aeduellidae – still indeterminate fragments

2002 *Aeduella* Westoll, 1937; Štamberg, p. 150, figs 6A, 7–10.
2013a Aeduellidae ; Štamberg, p. 1, fig. 2.

M a t e r i a l : Numerous isolated bones consisting of maxilla, operculum, suboperculum, frontal, supracleithrum (MHK 62441, MHK 81718, MHK 81720, MHK 81724, MHK 81732, MHK 81758, MHK 81905, MHK 81906) and one partly preserved specimen (MHK 81765).

L o c a l i t y a n d s t r a t i g r a p h i c a l r a n g e : Klášterská Lhota, near Vrchlabí. Krkonoše Piedmont Basin, Early Permian, Prosečné Formation.

R e m a r k s : Set of numerous isolated bones represent typical aeduellid fish. Some features similar to those in *Aeduella blainvillei* include an operculum with a sinusoidally curved ventral edge, suboperculum with a sinusoidal dorsal edge of the bone with the high dorsal process in the posterior region of the bone, and smooth scales posteriorly not denticulated. Wide frontals with moderately curved interfrontal suture, higher maxilla in its posterior region and more numerous scale rows between the supracleithrum and the beginning of the dorsal fin differ from *Aeduella blainvillei*, and might represent a new species of *Aeduella* or some of the species of *Bourbonnella*. Due to incompleteness of the osteological fragments of aeduellid fish from Klášterská Lhota locality, they cannot currently be assigned to one of above-mentioned species.

Family **Amblypteridae Romer, 1945**

D i a g n o s i s (after Dietze 2000): Medial extrascapular single. Medium or deep maxillary plate. "Spiracular" bone present. Single premaxilla. Two jugals. Two dermosphenotics. Laniary teeth absent; maxillary and dentary teeth in one series. Mouth terminal. Little ornamentation of scales.

I n c l u d e d g e n e r a from the Bohemian Massif: *Paramblypterus* Sauvage, 1888.

Genus ***Paramblypterus* Sauvage, 1888**

D i a g n o s i s (emended after Dietze 2000): Nasal split up secondarily. Dermohyal not present as a single ossification. More than two suborbitals. Seven to nine branchiostegal rays. Gap between opercular series and skull roofing bones absent. Duplication of the extrascapular series (postparietals) present. Scales serrated weakly, with little ornamentation.

I n c l u d e d s p e c i e s from the Bohemian Massif: *Paramblypterus rohani* (Heckel, 1861); *Paramblypterus reussii* (Heckel, 1861), *Paramblypterus vratislaviensis* (Agassiz, 1833); *Paramblypterus kablikae* (Geinitz, 1860); *Paramblypterus feistmanteli* Fritsch, 1895; *Paramblypterus zeidleri* Fritsch, 1895. Very close to *P. rohani* is *P. duvernoy* (Agassiz, 1833) from the Saar-Nahe Basin (Dietze 1999, 2000).

R e m a r k s : Genera *Amblypterus* Agassiz, 1833 and *Paramblypterus* Sauvage, 1888 are very close. The following important anatomical features are common to both genera (Štamberg 2013b): Shape of the upper jaw with the maxillary plate; type of the dentition on the jaws formed by tubular teeth; presence of the supraorbital anterior in the nasal region; configuration of the skull roof; configuration of the cheek including suborbital bones, preoperculum, inclination of the suspensorium; configuration of the opercular apparatus.

The following characters discriminate between *Amblypterus* and *Paramblypterus* (Dietze 2000, Štamberg 2014): Only one dermohyal present on *Amblypterus*, more dermohyals on *Paramblypterus;* scales of *Paramblypterus* carry fine mounds on their outer surface, and posterior margin of the scales is denticulated, whereas the scales of *Amblypterus* are smooth with concentric growth striae, and the posterior margin of the scales is not denticulated; D-values (see Dietze 2000) of scales are lower in *Amblypterus* (1.2) than in *Paramblypterus* (between 1.4 and 2.0); large paired and unpaired fins on *Amblypterus*. The fins on *Paramblypterus* (*P. decorus, P. duvernoy*) are smaller in the relation to the size of the body.

Species of the genus *Paramblypterus* are most common in the Early Permian of the Krkonoše Piedmont Basin, Intra-Sudetic Basin and in the Boskovice Graben.

***Paramblypterus rohani* (Heckel, 1861)**

Pl. 1, fig. 1

1861 *Palaeoniscus Rohani* Heck.; Heckel and Kner, p. 51, figs 1-3.
1861 *Palaeoniscus luridus* Heck.; Heckel and Kner, p. 54, fig. 4.
1861 *Palaeoniscus obliquus* Heck.; Heckel and Kner, p.56, fig. 5.
1861 *Palaeoniscus caudatus* Heck.; Heckel and Kner, p. 58, fig. 6.
1894 *Amblypterus Rohani* (Heckel).; Fritsch, p. 104; figs 297–301; pl. 123.
1895 *Amblypterus caudatus* (Heck.).; Fritsch, p. 111.
1895 *Amblypterus luridus* (Heckel).; Fritsch, p. 109; fig. 302.
1895 *Amblypterus obliquus* (Heckel); Fritsch, pp. 109, 111; figs 304, 305.
1942 *Amblypterus rohoni* Heckel; Lemke and Weiler, pp. 7-16, figs 2-12.
1967 *Janassa lacustris* sp. n.; Zídek, p. 203; pl. 1, figs 1, 2.
1969 *Paramblypterus rohani* Heckel (1861); Heyler, p. 72; fig. 22; pl. 14, figs 1, 2.
1971 *Paramblypterus rohani*; Heyler, figs 1–18, 20–22, 24, pls. 1–4.
1975 *Paramblypterus rohani* (Heckel, 1861); Štamberg, p. 305; figs 1, 2a; pls. 1–2.
1976 *Paramblypterus rohani* (Heckel, 1861); Štamberg, p. 12; figs 1–17; pls. 1, 2, fig. 1; pls. 3–7.
1976 *Paramblypterus caudatus* Heckel, 1861; Štamberg, p. 37; figs 22–24; pl. 2, fig. 2; pls. 10–12.
1976 *Paramblypterus luridus* Heckel, 1861; Štamberg, p. 44; pl. 2, fig. 3.
1976 *Paramblypterus obliquus* Heckel, 1861; Štamberg, p. 45.
1993 *Paramblypterus gelberti* (Goldfuss, 1847); Štamberg, p. 84, figs 1, 2; pl. 1.
2006 *Paramblypterus rohani* (Heckel 1861); Štamberg, pp. 225, 227.

2007 *Paramblypterus rohani* (HECKEL, 1861); Štamberg, pp. 6–8; figs 1–5.
2007 *Paramblypterus caudatus* (HECKEL, 1861); Štamberg, p. 8, fig. 1.
2008 *Paramblypterus rohani* (HECKEL, 1861); Štamberg and Zajíc, p. 157, fig. 235.
2008 *Paramblypterus caudatus* (HECKEL, 1861); Štamberg and Zajíc, p. 157, fig. 236.
2008 *Paramblypterus gelberti* (HECKEL, 1847); Štamberg and Zajíc, p 158, fig. 238.

D i a g n o s i s : Fusiform body gibbous in front of the dorsal fin, not exceeding 35 cm total length. Posterior margin of the scales is serrated, area of serrated scales above and below lateral sensory line and number of dents on their posterior margin decline to the anal fin. Square postrostral, convex anteriorly. Oblong frontals, two times longer than wide, with strongly curved interfrontal suture, and one or two process on lateral side of frontals. Parietals approximately square, two times shorter than the length of the frontals. Triangular dermosphenotic. Distinct sculpture is formed by ridges on the bones of the skull roof. 6 to 7 suborbital bones. Spiracular bone present. Sclerotic ring present. Preoperculum conspicuously bent anteriorly along posterior and dorsal borders of the deep maxillary plate. Scale count

$$\frac{29}{9\ 22\ 37}\ 41$$

L e c t o t y p e (Štamberg 1976): Specimen M 849 designated by Štamberg (1976) from the material figured by Heckel (Heckel and Kner 1861) is deposited in the National Museum, Prague.

T y p e h o r i z o n a n d l o c a l i t y : Košťálov; Rudník Horizon, Vrchlabí Formation, Asselian, Krkonoše Piedmont Basin.

O c c u r r e n c e : Čistá, Košťálov, Košťálov ("Kovář´s Mill"), Košťálov ("Behind the Tavern"), Kovářsko, Kundratice ("Doly"), Kundratice ("Gorge"), Příkrý ("Honkův creek"), Semily ("Behind the factory"), Rybnice ("Hrádecký creek"), Otovice ("Černý brook"), Veselá ("Veselka brook"), Horní Kalná ("Dump of the Adam mine").

R e m a r k s : *Paramblypterus rohani* (HECKEL, 1861) is the most common actinopterygian fish of the Rudník Horizon (Vrchlabí Formation, Asselian, Early Permian) of the Krkonoše Piedmont Basin. Isolated bones of this species are also occasionally found in the younger Kalná Horizon (Prosečné Formation, Sakmarian, Early Permian) of the Krkonoše Piedmont Basin and in the Otovice Horizon (Broumov Formation, Asselian) of the Intra-Sudetic Basin. *Paramblypterus rohani* is also common in the locality Surmoulin (Surmoulin Formation, Early Permian) of the Autun Basin in the French Massif Central (Heyler 1971).

Paramblypterus rohani was initially described under the name *Palaeoniscus rohani* together with *P. caudatus*, *P. luridus* and *P. obliquus* in the paper of Heckel and Kner (1861). Fritsch (1894, 1895) assigned all of these species to the genus *Amblypterus*. He redescribed these species in more detail, provided figures, and recognized a resemblance of the above-mentioned species to *Amblypterus duvernoy* (Agassiz, 1833). However, Fritsch (1894) considered two specimens figured by Agassiz (1833) as *Amblypterus duvernoy* to be two different species. Agassiz had failed to provide a detailed description of the head bones, scales and fins, and for that reason, Fritsch (1894, 1895) introduced the species *Amblypterus rohani*, *A. obliquus*, *A. caudatus*, *A. luridus* together with *A. vratislaviensis* as a variety of *A. duvernoy*. He redescribed only *A. reussii* separately. After new studies of numerous comparative material, and the high variation of the interfrontal suture, lateral process on the frontal, and for the high deformation of the body of some specimens, I consider the species *A. rohani, A. luridus, A. obliquus* and *A. caudatus* to be only one species *P. rohani*. Also, the specimen described by Štamberg (1993), and Štamberg and Zajíc (2008) as *Paramblypterus gelberti* actually belongs to *P. rohani*. The new taxon described by Zídek (1967) as a tooth of a holocephalian fish *Janassa lacustris* represents only a cleithrum of *P. rohani*.

Great similarity was noted several times between *P. rohani* and *P. duvernoy* (see Fritsch 1894, Woodward 1891, Štamberg 1976, Dietze 2000). The shape of the body, position of the fins and the anatomy of the head of both species are very close or identical. Lastly, Dietze (1999, 2000) did cast light on the relationship between both species. It is necessary after my last studies to confirm the presence of the sclerotic ring in the orbit of *P. rohani*, whereas it is missing (Dietze 2000) on *P. duvernoy*. The sclerotic ring is a delicate structure and it probably also occurred in *P. duvernoy*. I expect that both species will be united in the future.

Paramblypterus reussii (HECKEL, 1861)

Pl. 1, fig. 2

1861 *Palaeoniscus Reussii* HECK.; Heckel and Kner, p. 61; fig. 7.
1891 *Amblypterus reussi* (HECKEL); Woodward, p. 445.
1895 *Amblypterus Reussi* (HECK.).; Fritsch, p. 112; fig. 307.
1942 *Amblypterus reussi* HECKEL.; Lemke and Weiler, p. 16; pl. 2, fig. 3.
1976 *Paramblypterus reussii* (HECKEL, 1861); Štamberg, p. 31; figs 19–21; pls. 8–9.
2006 *Paramblypterus reussii* (HECKEL 1861); Štamberg, p. 225, p. 227.

D i a g n o s i s : Fusiform body gibbous in front of the dorsal fin, not exceeding 30 cm of the total length. Posterior margin of the scales is serrated, area of serrated scales above and below lateral sensory line and number of dents on their posterior margin decline toward the anal fin. Oblong frontals, more than two times longer than wide with only undulating interfrontal suture, and one small process on lateral side of frontals. Parietals are approximately square, two times shorter than the length of the frontals. Triangular dermosphenotic. Distinct sculpture is formed by ridges on the bones of the skull roof. Maxilla with short end and high maxillary plate. The dorsal fin base is opposite to the anal fin base.

T y p e : Holotype M 1215 figured by Heckel (Heckel and Kner 1861, fig. 7) is deposited at the National Museum, Prague.

L o c a l i t y : Semily, Semily district, Czech Republic.

Remarks: Only the holotype is known. *Paramblypterus reussii* is very close to *P. rohani*, and it is distinguished from *P. rohani* only in having an undulating interfrontal suture, a very short and high maxillary plate and in the position of the dorsal fin, which is above the base of the anal fin (Štamberg 1976). It is possible to consider whether the position of the dorsal and anal fins was subjected to deformation of the body when preserved, and only the undulation of the interfrontal suture and the shape of the maxilla indicate intraspecific variation (Dietze 1999). The holotype of *P. reussii* represents a relatively well-preserved specimen, and all specimens of *P. rohani* of the same size as *P. reussii* that I have studied demonstrate an intensively curved interfrontal suture, and exhibit the dorsal fin above the space between the pelvic and anal fins. I continue to separate *P. reussii* from *P. rohani* for these reasons.

Paramblypterus vratislaviensis (Agassiz, 1833)

Pl. 2, Fig. 4

1833 *Palaeoniscus vratislaviensis* Agass.; Agassiz, p. 60; pl. 10, figs 1, 2, 4–6.
1894 *Amblypterus Vratislavensis*, (Ag.).; Fritsch, p. 100; figs 294–296, 310; pls. 121–122.
1999 *Amblypterus vratislaviensis* (Agassiz, 1833–43); Štamberg, pp. 7, 9, 11, 12.
2006 *Amblypterus vratislaviensis* (Agassiz 1833–43); Štamberg, p. 225.
2008 „*Amblypterus*“ *vratislaviensis* (Agassiz, 1833–43); Štamberg and Zajíc, p. 155, fig. 232.

Characteristics: (emended after the features which Agassiz (1833) and Fritsch (1894) considered to be important): Fusiform body gibbous in front of the dorsal fin, not exceeding 15 cm. Total body length 4 times the head length, and no more than 3 times the maximum body height. The scales are smooth, only scales in the anterior portion of the body just above and just below the lateral sensory line have posterior margin denticulated, with three or four dents. Lateral sensory line consists of 40 scales, 27 scale rows are between head and the beginning of the dorsal fin. Ventral fin closer to the anal fin than to the pectoral fins. Dorsal fin without fulcral scales, and it is retroposed above the space between the ventral and anal fins, and above the beginning of the anal fin. The orbit is small, and teeth are very slender, slightly posteriorly bent.

Types: The type material which formed the basis of the description of the new species (Agassiz 1833) has not been found. Fritsch (1894) later used numerous material obtained during limestone mining, and during building work, for the revision study of *Paramblypterus vratislaviensis*. The most important specimens are M 1097 and M 1218 (part and counterpart) (Fritsch 1894, fig. 295), M 1095 (Fritsch 1894, fig. 296, pl. 121, fig. 1), M 1098 (Fritsch 1894, pl. 121, fig. 3), M 1206 (Fritsch 1894, pl. 121, figs 5, 6) and M 837 (Fritsch 1894, pl. 122, fig. 3) deposited at the National Museum, Prague.

Type locality and horizon: Ruprechtice or Olivětín, Ruprechtice Horizon, Olivětín Member, Broumov Formation, Asselian, Intra-Sudetic Basin.

Localities: Olivětín; Olivětín “*Over mill-race*”; Ruprechtice; Ruprechtice “*Limestone quarries*”; Ruprechtice “*Pod Světlinou*”; Otovice.

Remarks: *Paramblypterus vratislaviensis* is most common actinopterygian of the Ruprechtice Horizon. Agassiz (1833) described the new species on the basis of specimens obtained from Wroclaw through M. de Dechen, but they originated from Ruprechtice or Olivětín. Unfortunately, the type specimens from the collections of M. de Dechen from Berlin and Prof. Otto from Wroclaw, which Agassiz (1833) figured on the pl. 10, figs 1, 2 have not been seen since then. Woodward (1891) considered *Amblypterus vratislaviensis* described by Agassiz (1833) from Ruprechtice or Olivětín and specimens of *Amblypterus vratislaviensis* described by Weiss (1864) from Saar Basin to be synonymous with *Amblypterus duvernoy.* Fritsch (1894) redescribed *Amblypterus vratislaviensis* on the basis of the rich material. The species has not been the subject of any subsequent revision.

Paramblypterus kablikae (Geinitz, 1860)

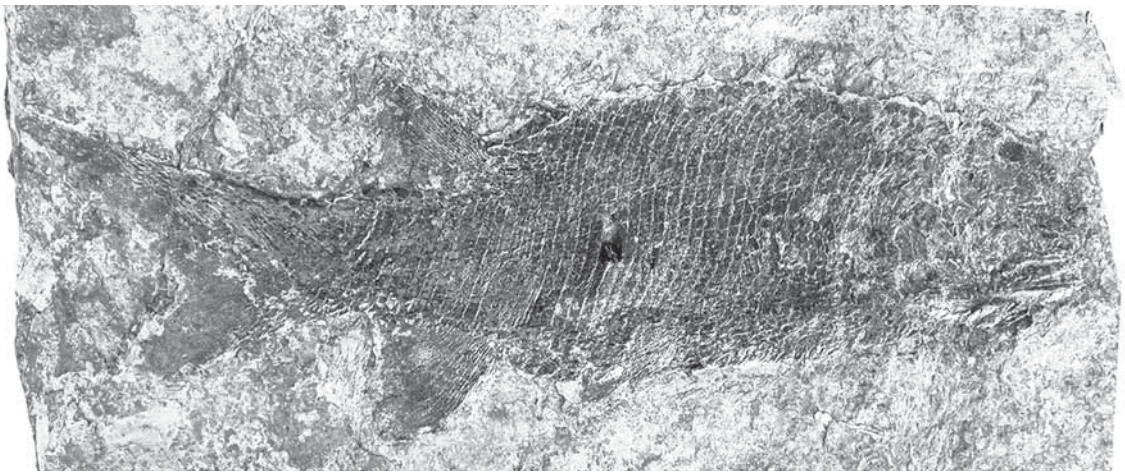
Plate 2, fig. 3

1860 *Palaeoniscus Kablikae* Gein.; Geinitz, p. 467.
1894 *Amblypterus Kablikae*, Gein. sp.; Fritsch, p. 94; fig. 288; pl. 118, figs 1–6; pl. 119, figs 1–5.
1894 *Chalkichthys*; Fritsch, p. 94.
1895 *Amblypterus angustus* (Ag.); Fritsch, p. 114; pl. 126, figs 1–4, non *Palaeoniscus angustus* (Agassiz 1833).
1912a *Platysomus pygmaeus* Fr.; Frič; p. 17, fig.15.
1912a *Platysomus pygmäus* Fr.; Frič, p. 17.
1912b *Platysomus pygmaeus* Fr.; Frič; p. 14, 17, fig.15.
1942 *Amblypterus* cf. *kablikae* Frič; Lemke and Weiler, p. 17; figs 13, 14; pl. 2, fig. 2.
1999 “*Amblypterus*” *kablikae* (Geinitz, 1860); Štamberg, p. 7, p. 11.
2006 “*Amblypterus*” *kablikae* (Geinitz 1860); Štamberg, p. 226, p. 227.
2008 “*Amblypterus*” *kablikae* (Geinitz, 1860); Štamberg and Zajíc, p. 155, fig. 233.

Diagnosis (after Fritsch 1894): Small fish, its length is 7 times the height of the body. Dorsal fin is at the midpoint of the body. Three to four scale rows just below the lateral sensory line are strongly denticulated on their posterior margin, with one vertical molding. Remaining scales smooth. The teeth are strong.

Types: The type described by Geinitz (1860), and initially deposited in the Museum in Dresden, was destroyed in the course of the Second World War. Two specimens M 847 and M 1221 next formed the basis for the revision study of Fritsch (1894, pl. 118, figs 1–6, pl. 119, figs 1–5). Another specimen, M 897, served Fritsch (1895, pl. 126, figs 1–4) for the description of *Amblypterus angustus* (Agassiz, 1833–43). An extensively deformed specimen M 1012 was described and figured by Frič (1912a, p. 17, fig. 15) as *Platysomus pygmaeus*. All above-mentioned specimens are deposited in the National Museum, Prague.

Type locality and horizon: Horní Kalná, Kalná Horizon, Prosečné Formation, Sakmarian, Krkonoše Piedmont Basin.



Text-fig. 6. ***Paramblypterus*** **sp., MHK 11024 from the locality Drválovice (Boskovice Graben), x 0.9.**

O c c u r r e n c e : Čistá; Ruprechtice "*Limestone quarries*"; Olivětín; Horní Kalná; Veselá; Bítouchov.

R e m a r k s : *Paramblypterus kablikae* is a small fish with a slender body not exceeding 15 cm. The specimens which Fritsch (1894) described and figured on pls. 118 and 119, figs 1, 2 are actually not well preserved, as Fritsch originally submitted. On the contrary, they are strongly deformed. Better-preserved specimens from the numerous collection of this species, which the author has for the study from the localities Horní Kalná and Veselá, show slender fish, but the total body length does not exceed 5.3 times the maximum body height. In my opinion, *Amblypterus angustus*, described by Fritsch (1895) from Olivětín, belongs to *Paramblypterus kablikae*. Additionally, *Amblypterus pygmaeus* described by Frič (1912a,b) from the Krkonoše Piedmont Basin is probably a heavily deformed *Paramblypterus kablikae*. The species *Paramblypterus kablikae* has not been the subject of any later revision, but the author of this paper is now preparing a redescription of this species.

Paramblypterus feistmanteli (Fritsch, 1895)

Pl. 2, fig. 2

1895 *Amblypterus Feistmanteli*, Fr.; Fritsch, p. 112; pls. 124, 125, figs 1–3.
2006 "*Amblypterus*" *feistmanteli* Frič 1895; Štamberg, p. 226, p. 227.
2008 "*Amblypterus*" *feistmanteli* Frič, 1895; Štamberg and Zajíc, p. 156, fig. 234.

C h a r a c t e r i s t i c s : (emended according to features Fritsch (1895) considered important): Small fish, about 10 cm long. The scales with stout border, marked incremental lines and strong dentition are on their posterior margins. The scales are lanceolate posteriorly. Square operculum with rounded edges. Preoperculum narrow, long, ventrally tapered and slightly anteriorly bent.

T y p e s : Two specimens M 1352 and M 898 figured by Fritsch (1895, pls. 124, 125, figs 1–3) deposited in the National Museum, Prague.

T y p e l o c a l i t y a n d h o r i z o n : Specimen M 1352 was found in Horní Kalná (Kalná Horizon), Prosečné Formation), and specimen M 898 was found in Bítouchov (Prosečné Formation, Sakmarian, Krkonoše Piedmont Basin).

R e m a r k s : The species *Paramblypterus feistmanteli* has not been revised from the description of Fritsch (1895).

Paramblypterus zeidleri (Fritsch, 1895)

Pl. 1, fig. 3

1895 *Amblypterus Zeidleri*, Fr.; Fritsch, p. 113; pl. 125, figs 4–5.
2006 *Paramblypterus zeidleri* (Frič 1895); Štamberg, p. 225, p. 227.
2008 *Paramblypterus zeidleri* (Frič, 1895); Štamberg and Zajíc, p. 159, fig.239.
2012 *Paramblypterus zeidleri* (Frič, 1895); Štamberg, p. 150.

C h a r a c t e r i s t i c s : (emended according to features Fritsch (1895) considered important): Length of the fish is about 16 cm. The total body length is 4 times the maximum height of the body. The dorsal fin begins at the midpoint of the body, and its posterior half is above the anal fin. Scales are smooth. Fine incremental lines occur along the posterior and ventral borders of the fins, and diminutive stipple is seen in the central area of the lateral side of the scales. 34 scale rows are between the head and the beginning of the dorsal fin, 4 ridge scales are in front and 7 scales behind the dorsal fin.

T y p e s : Holotype M 901 described and figured by Fritsch (1895, pl. 125, figs 4–5) is deposited in the National Museum, Prague.

T y p e l o c a l i t y a n d h o r i z o n : Ruprechtice, Ruprechtice Horizon, Olivětín Member, Broumov Formation, Asselian, Intra-Sudetic Basin.

O c c u r r e n c e : Horní Kalná; Horní Kalná "Za garáží"; Klášterská Lhota; Ruprechtice.

R e m a r k s : Fritsch (1895) mentioned, besides the holotype M 901 from Ruprechtice, another more poorly preserved specimen of *P. zeidleri* from Horní Kalná. Several other specimens that correspond to *P. zeidleri* were recently found in Krkonoše Piedmont Basin in localities Horní Kalná „Za garáží" and in Klášterská Lhota (Štamberg 2012). The species *Paramblypterus zeidleri* has not been revised from the description of Fritsch (1895).

Paramblypterus sp.

Text-fig. 6

1982 *Paramblypterus*; Štamberg, pl. 8, fig. 1; pl. 9, figs 3–4; pl. 10.
1997 *Paramblypterus* sp.; Štamberg, pp. 114–115; figs 2–3.
2006 *Paramblypterus* sp.; Štamberg, fig. 4.

M a t e r i a l : Newly found material collected by the author of this paper from the sediments of Early Permian of the Krkonoše Piedmont Basin and Early Permian of the Boskovice Graben. Specimens is deposited in the collection of the Museum of Eastern Bohemia at Hradec Králové.

R e m a r k s : The author of this paper has gathered hundreds of specimen from localities of the Krkonoše Piedmont Basin (Horní Kalná, Veselá, Klášterská Lhota, Arnultovice). A plentiful collection of amblypterids has also originated from Early Permian localities of the Boskovice Graben (Drválovice, Bačov, Kochov). Specimens show typical features of the genus *Paramblypterus*, such as maxilla with large maxillary plate, tubular teeth on the jaws and supraorbital anterior anteriorly placed to the orbit (Štamberg 1982, 1997). A collection of these specimens is presently being studied.

Family **Haplolepidae Westoll, 1944**

T y p e g e n u s : ***Haplolepis* Miller, 1892.**

I n c l u d e d g e n e r a from the Bohemian Massif: *Pyritocephalus* Fritsch, 1894.

Genus ***Pyritocephalus* Fritsch, 1894**

T y p e s p e c i e s : *Pyritocephalus sculptus* (Frič, 1875).

D i a g n o s i s (Huber 1992, emended): Small actinopterygian fishes, rarely exceeding 70 mm; head short and broad, with rostrum, postrostrum, and premaxillaries present; maxillary posteriorly expanded; skull roof deeply fenestrated; paired frontals and parietals variably fused to form a single ossification; dermopterotics lost, replaced by lapped extension of parietals; parietal deeply embayed for reception of posttemporals; skull roof ornamented with linear to semi-concentric grooves and terrace rugae; opercular series reduced; antopercular present; quadratojugal present; branchiostegal rays reduced, with median and paired lateral and posterior gulars present; dorsal fin posterior to anal fin; caudal completely heterocercal; fin rays completely segmented and reduced in number; squamation mostly smooth, with variable parallel-ridge ornamentation in anterolateral trunk region; vertical scale rows number 25–32 along main lateral line.

I n c l u d e d s p e c i e s : *Pyritocephalus lineatus* (Newberry, 1856); *P. gracilis* (Newberry et Worthen, 1870); *P. comptus* Westoll, 1944; *P. rudis* Westoll, 1944; *P. lowneyae* Huber, 1992.

Only the type species *P. sculptus* is known from the Bohemian Massif.

***Pyritocephalus sculptus* (Frič, 1875)**

Text-fig. 2, fig. 6

1875 *Palaeoniscus sculptus* Fr.; Frič, p. 73
1894 *Pyritocephalus sculptus*, Fr.; Fritsch, p. 86; fig. 280; pl. 115.
1944 *Pyritocephalus sculptus* Frič; Westoll, p. 43; figs 23–27.
1978 *Pyritocephalus sculptus* Frič, 1895; Štamberg, p. 276; figs 1–6; pls. 60–63.
1991 *Pyritocephalus sculptus* (Frič, 1883); Štamberg, p. 97; fig. 53; pl. 24.

L e c t o t y p e (Štamberg 1978): Specimen figured by Fritsch (1894) on pl. 115, fig. 4, deposited in the National Museum, Prague under No. M 1201.

D i a g n o s i s (after Štamberg 1991, emended): Slender fish not exceeding 70 mm. Pectoral fins consist of 10–15 lepidotrichia, pelvic fin small with short base consists of 6–9 lepidotrichia. Dorsal and anal fins approximately of the same size, dorsal fin consists of 7–9 lepidotrichia, anal fin of 8–12 lepidotrichia. All lepidotrichia segmented, distally only, exceptionally bifurcated near the distal tip, and distally separated from each other. Caudal fin not deeply cleft. Rostral part of the head not conspicuously convex, composed of paired rostro-premaxillar and nasal, unpaired postrostral, and sometimes the second small postrostral is developed orally. The paired dermal bones of the skull roof (parietal, frontal, dermopterotic) coalesce into one unit, often without visible sutures, and constitute a characteristic: formation with a large paired fenestration on the lateral sides. The fenestration is usually circular, but it can be also anteroposteriorly elongated. From two to four suborbitals are located in front of the preoperculum. Very large orbit is surrounded by dermosphenotic, nasal, rostro-premaxillar and narrow infraorbital bones. Maxilla with well-developed maxillary plate, the length/height ratio of the maxillary plate is 1.2. Lower jaw strong. Teeth on the jaws are not developed. The preoperculum not oblique, it inclines orally at angle 65°. Small triangular antoperculum present. Operculum inclines 67° anteriorly, and is dorsoventrally elongated, 2.5 times higher than the small triangular suboperculum. Branchiostegal rays are not developed, series of one median and two pairs of gulars between jaws is present. The scales are smooth, not pectinated on their posterior margin. The scale count

$$\frac{21–24}{6–8\ \ 14–17\ \ 23–25}\ 25–28$$

T y p e l o c a l i t y : Nýřany, district Plzeň, Czech Republic.

S t r a t u m t y p i c u m : Nýřany Member, Westphalian D, Late Carboniferous, Plzeň Basin.

O c c u r r e n c e : Nýřany, Třemošná.

R e m a r k s : Species *Pyritocephalus sculptus* described and figured initially by Fritsch (1894) was redescribed and excellently revised by Westoll (1944). Westoll (1944) placed four more species from the Late Carboniferous into the genus *Pyritocephalus*, namely *P. lineatus* (Newberry, 1856) from Linton (Ohio, USA), *P. gracilis* (Newberry and Worthen, 1870) and *P. comptus* Westoll, 1944 from Mazon Creek (Illinois, USA) and *P. rudis* Westoll, 1944 from Newsham (Northumberland, England). Huber (1992) later assigned to the genus *P. lowneyae* Huber, 1992 a specimen from the Pennsylvanian of Kinney Brick Quarry (New Mexico, USA). The above-mentioned species are alike in the anatomy of the head, structure of the fins, shape of the scales and their body. Westoll (1944) considered the species characters mainly in the formation of coalesced bones of the skull roof and in the variation of the scale count. Study of the numerous collections of *P. sculptus* from the National Museum, Prague and from the Museum of Western Bohemia in Plzeň demonstrated (Štamberg 1978) considerable

variability in the shape of coalesced bones of the skull roof, in the shape of the fenestration on the lateral side of the skull roof and variation in the scale count. For that reason, Štamberg (1978) did not find differences among *P. sculptus* from the Plzeň Basin, *P. gracilis* from Mazon Creek and *P. lineatus* from Linton.

Conclusions

The following 23 taxa of actinopterygians are known at present from the Carboniferous and Permian basins of the Bohemian Massif: *Letovichthys tuberculatus* Štamberg, 2007; *Letovichthys multidentatus* Štamberg, 2007; "*Elonichthys*" *krejcii* (Fritsch, 1895); "*Elonichthys*" sp.; *Progyrolepis speciosus* (Frič, 1875); *Zaborichthys fragmentalis* Štamberg, 1989; *Acrolepis gigas* (Frič, 1877); *Sceletophorus biserialis* Fritsch, 1894; *Sceletophorus verrucosus* (Frič, 1894); *Sphaerolepis kounoviensis* Frič, 1877; *Igornichthys* sp.; *Setlikia bohemica* Štamberg et Zajíc, 1994; *Bourbonnella hirsuta* Štamberg, 2007; *Neslovicella rzehaki* Štamberg, 2007; *Neslovicella elongata* Štamberg, 2010; *Spinarichthys dispersus* (Fritsch, 1895); *Paramblypterus rohani* (Heckel, 1861); *Paramblypterus reussii* (Heckel, 1861), *Paramblypterus vratislaviensis* (Agassiz, 1833); *Paramblypterus kablikae* (Geinitz, 1860); *Paramblypterus feistmanteli* Fritsch, 1895; *Paramblypterus zeidleri* Fritsch, 1895; *Pyritocephalus sculptus* (Frič, 1875), and other numerous representatives of the genus *Paramblypterus* and the family Aeduellidae that are not specified here. The 14 species originally described by Frič or earlier people continue to be valid. New species, which have increased in the course of recent years, have originated mainly from the sediments of the Boskovice Graben. Frič did not find actinopterygians from the Boskovice Graben during his lifetime. The richest of the actinopterygian fauna have only been uncovered quite recently, and contemporary research holds the promise of the discovery of new species.

While actinopterygians are rare in the Late Carboniferous sediments of the Central and West Bohemian late Palaeozoic basins, Krkonoše Piedmont Basin and Boskovice Graben, the actinopterygians in the Early Permian of the Krkonoše Piedmont Basin, Intrasudetic Basin and Boskovice Graben are the most commonly found vertebrate remains. Species of the family Amblypteridae, specifically those from the genus *Paramblypterus* were present in a majority of all Early Permian basins of the Bohemian Massif. These fishes were already known in the time of Frič. However, family Aeduellidae is quite a newly distinguished group of actinopterygians in the Late Carboniferous and Early Permian of the Bohemian Massif. Species of this family form numerous associations, especially in the Early Permian sediments of the Boskovice Graben, and these rarely occur together with Amblypteridae in the Early Permian of the Krkonoše Piedmont Basin. Another newly discovered group of actinopterygians is represented by two species of the genus *Letovichthys*. These are small predatory fish from the Early Permian of the Boskovice Graben, and placed in the order Palaeonisciformes, since a more precise relationship with other actinopterygians is difficult to ascertain at present.

The numerous specimens of actinopterygians collected by the author of this paper during the last several years holds the promise of further extending of our knowledge about this fauna, and is a continuation of the study of the Carboniferous and Permian of the Czech Massif initiated by Antonín Frič more than hundred years ago.

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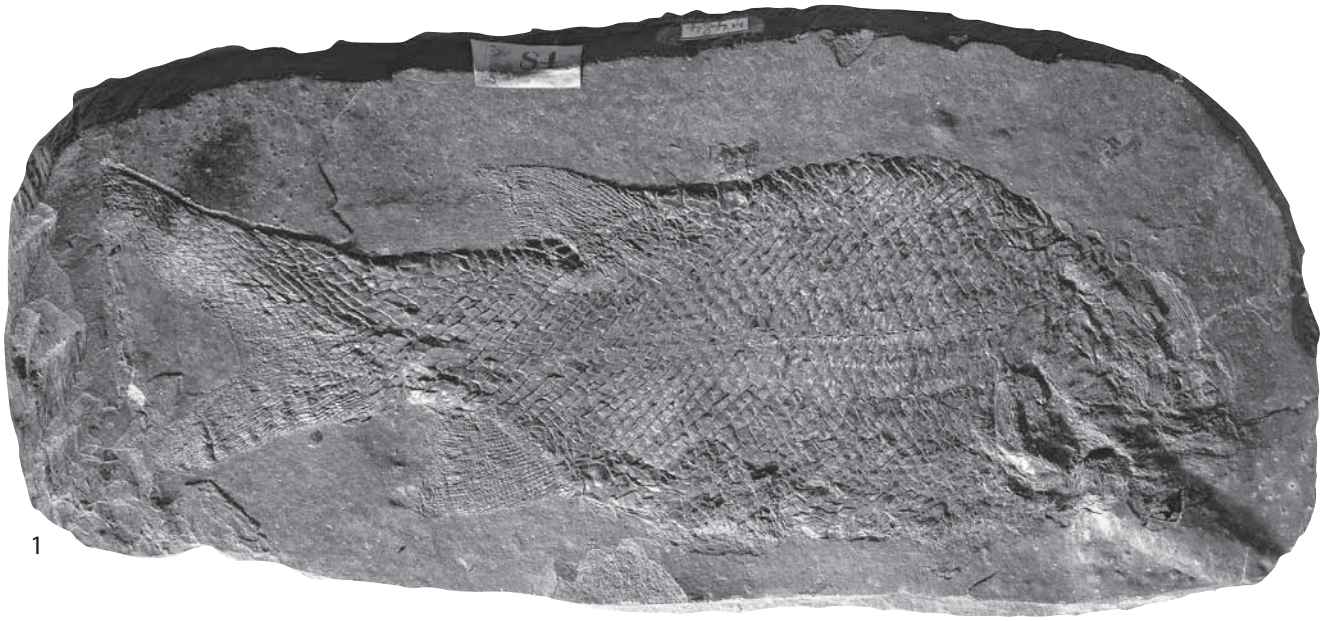
Explanation to the plates

PLATE 1

1. *Paramblypterus rohani* (HECKEL, 1861). Specimen M 484 from Košťálov (Early Permian, Krkonoše Piedmont Basin), x 0.7.
2. *Paramblypterus reussii* (HECKEL, 1861). Holotype M 1215 from Semily (Early Permian, Krkonoše Piedmont Basin), x 0.9.
3. *Paramblypterus zeidleri* (FRITSCH, 1895). Holotype M 901 from Ruprechtice (Early Permian, Intrasudetic Basin), x 1.

PLATE 2

1. *Neslovicella elongata* ŠTAMBERG, 2010. Specimen P 167 from Košťálov (Early Permian, Krkonoše Piedmonmt Basin), x 1.6.
2. *Paramblypterus feistmanteli* (FRITSCH, 1895). Specimen M 1352 from Horní Kalná (Early Permian, Krkonoše Piedmont Basin), x 1.6.
3. *Paramblypterus kablikae* (GEINITZ, 1860). Specimen M 1221 from Horní Kalná (Early Permian, Krkonoše Piedmont Basin), x 1.2.
4. *Paramblypterus vratislaviensis* (AGASSIZ, 1833). Specimen M 1095 from Ruprechtice (Early Permian, Intra-Sudetic Basin), x 1.2.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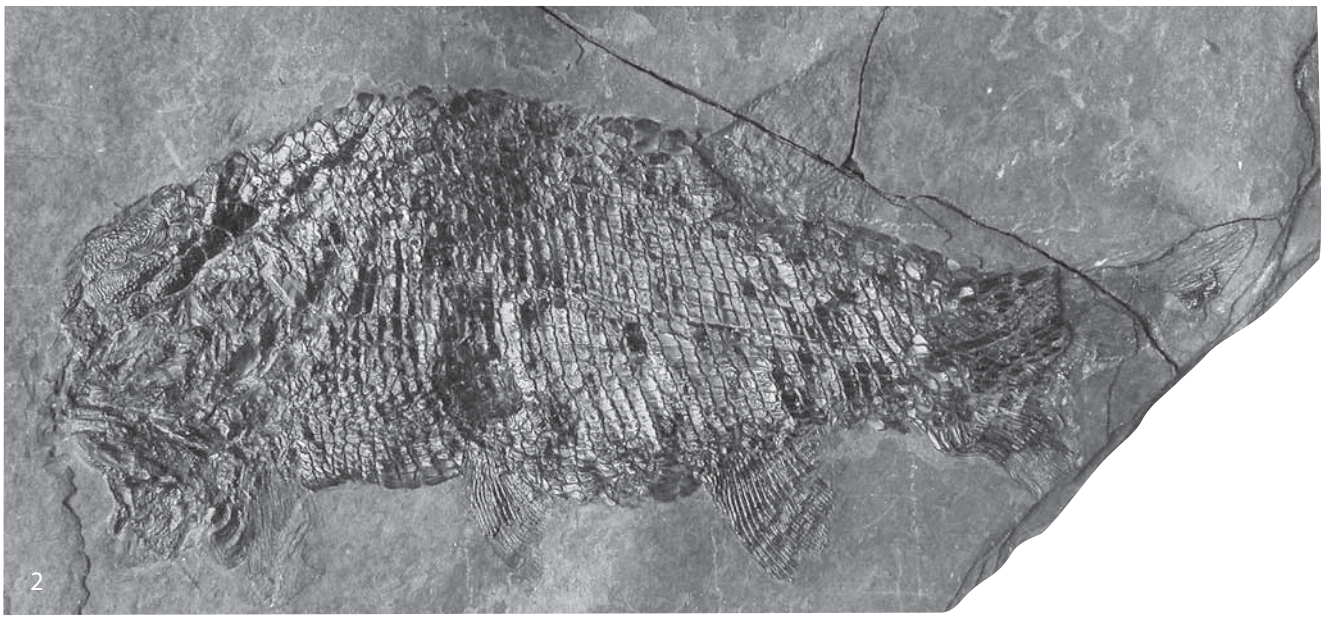
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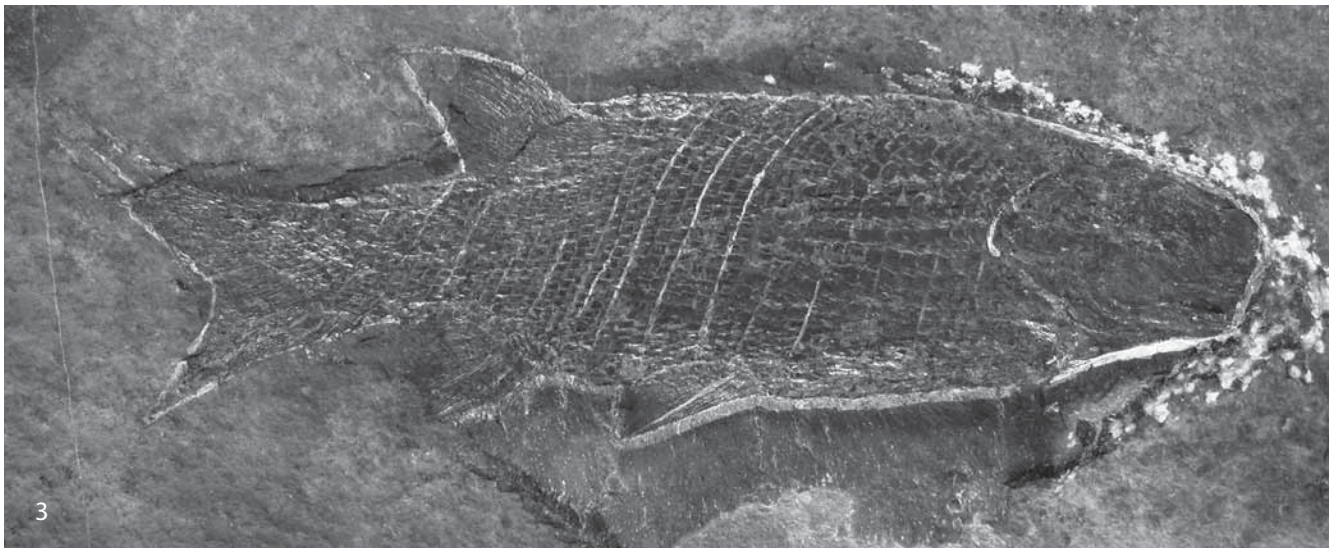
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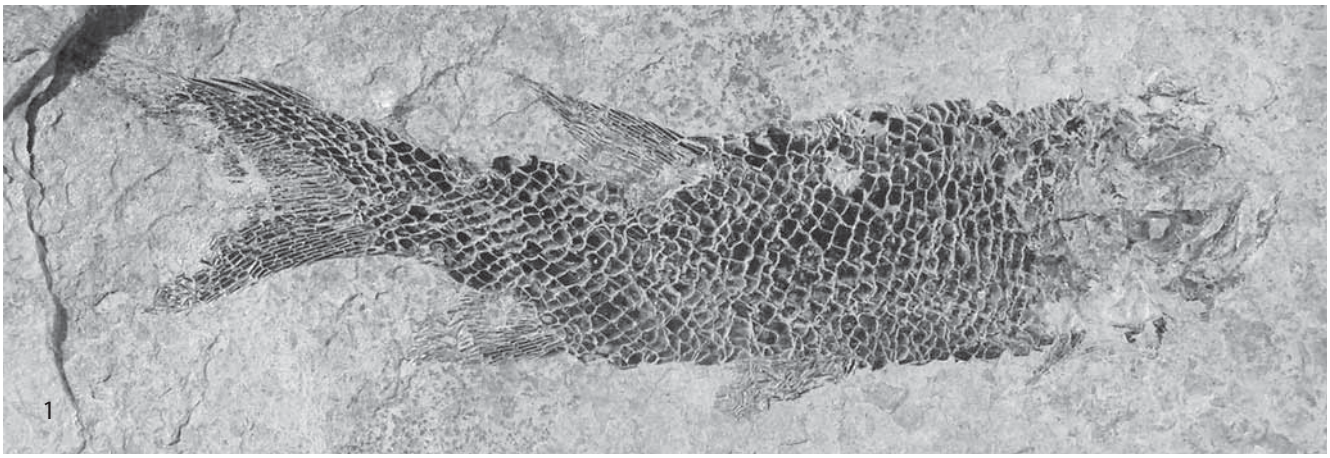
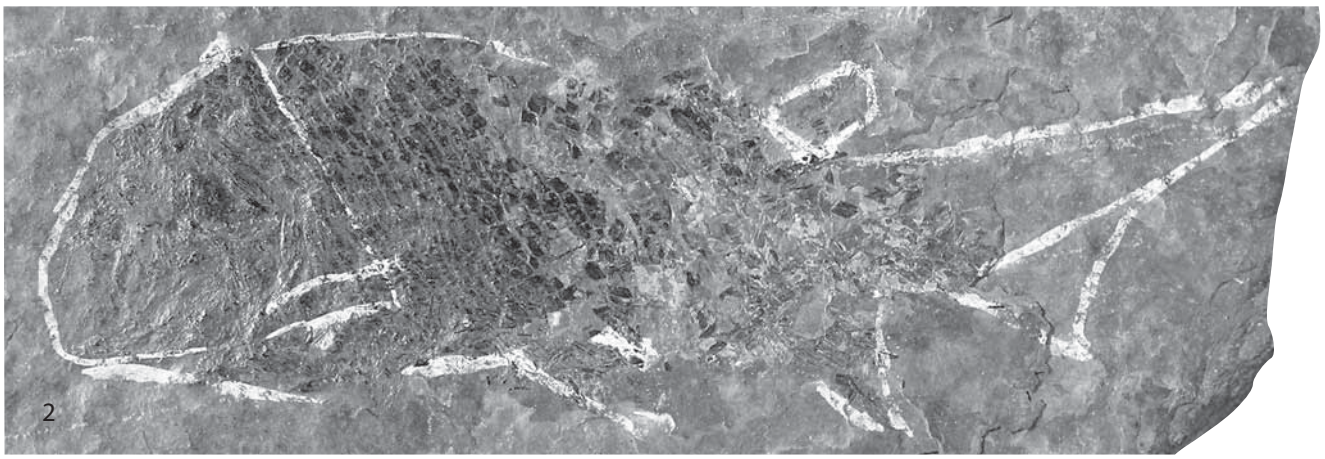
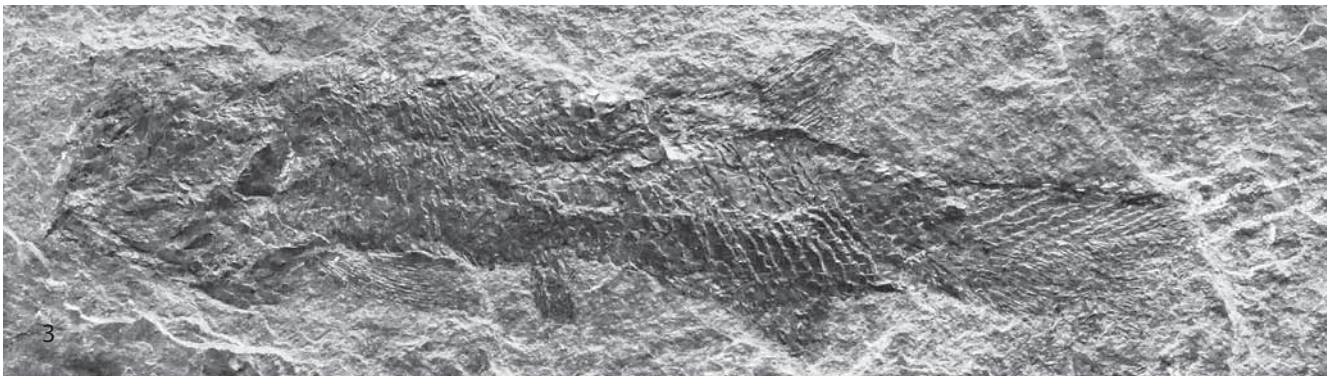
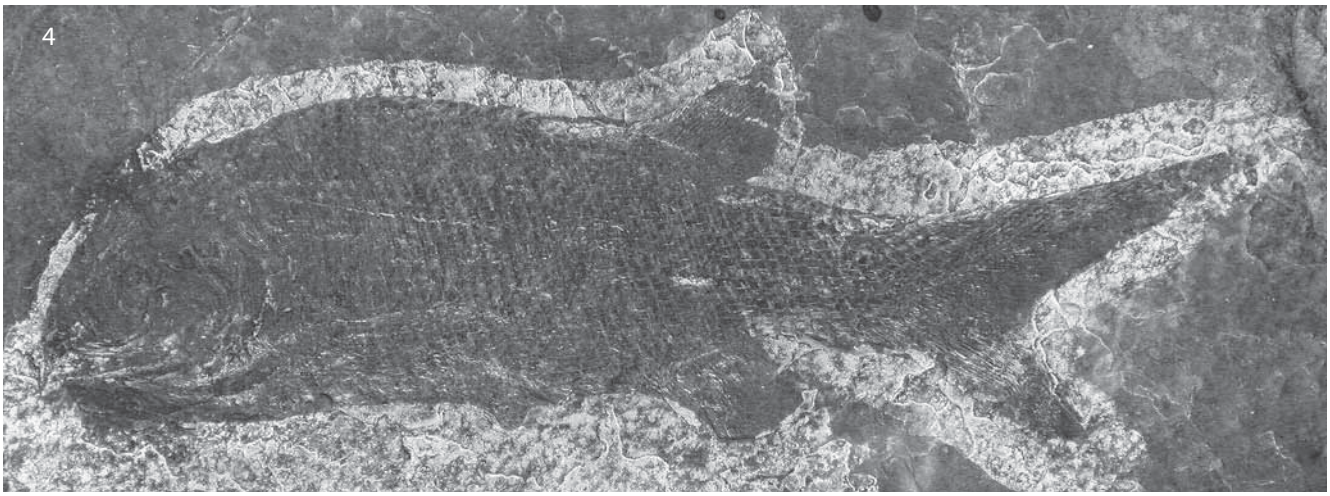
PLATE 2









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NEW DATA ON THE OSTEOLOGY OF THE ACTINOPTERYGIAN FISH *AMBLYPTERUS* AND THE RELATIONSHIP BETWEEN *AMBLYPTERUS* AND *PARAMBLYPTERUS*

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Abstract. The relationship between the actinopterygian genera *Amblypterus* and *Paramblypterus* from the Early Permian sediments of Central and Western Europe are resolved. Firstly a historical summary is presented of the various opinions on the position of *Amblypterus* and *Paramblypterus*, and secondly the results of the my own studies of the type specimen of *Amblypterus lateralis* and other material from the Saar Basin. New data on the osteology of *Amblypterus latus* including a new reconstruction of the head and body are introduced. A comparison of the species from the Saar Basin including the species *Amblypterus latus* and *A. lateralis* with the type species of *Paramblypterus decorus*, *Paramblypterus duvernoy* and *Paramblypterus rohani* supports the author's opinion of the close relationship between the genera *Amblypterus* and *Paramblypterus*.

■ Actinopterygii, *Amblypterus*, *Paramblypterus,* osteology, Permian

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Introduction

Fishes of the family Amblypteridae comprise the most numerous component of the actinopterygians in the Early Permian sediments of the limnic basins of Central and Western Europe. Amblypteridae markedly exceed other actinopterygians in the majority of localities in the basins of the Bohemian Massif, the French Massif Central and German basins. Localities where members of other families dominate are quite rare. The estimation that the specimens of Amblypteridae form at least 90% of the actinopterygian population in the Early Permian sediments of the limnic basins of the Bohemian Massif and are numerous in other Permian basins of Central and Western Europe will not be far from the truth. Thus it follows that species and genera of the family Amblypteridae belong to those first described in the papers about Carboniferous and Permian actinopterygians, and the discussions on position of the species of the type genus of *Amblypterus* and relationship to other genera including the genus *Paramblypterus,* appear simultaneously. A number of previous authors (Troschel 1857, Traquair 1877–1914, 1877, Woodward 1891, Gardiner 1963, Blot 1966, Boy 1976, Heyler 1969, 1976, Gad 1988, Dietze 1999, 2000) have considered the position of the genus *Amblypterus* and its relationship to other genera, namely to *Paramblypterus*.

Several species from the Bohemian Early Permian were formerly included in the genus *Amblypterus* or *Paramblypterus.* After studying the type material in depth, and in spite of the number of papers published about the relationship between *Amblypterus* and *Paramblypterus* I can present a different view of the situation. The relationship between the two genera can be resolved on the basis of my own study of the type specimen of *Amblypterus lateralis* and other material currently considered as *A. latus* and *A. lateralis* from Saar Basin, and a comparison with the species of *Paramblypterus*, namely *P. decorus, P. duvernoy* and *P. rohani*.

History

Romer (1945) erected the family Amblypteridae with designation of the type genus *Amblypterus*, but without any other description. The genus *Amblypterus* was originally described much earlier by Agassiz (1833). The first short description published in vol. 2, p. 3 can be quoted: "All fins very large compose from numerous lepidotrichia. Pectoral fins very large, anal large, dorsal fin opposite to the space between the ventral and anal fins, anterior margin of the fins with small pointed lepidotrichia beside the dorsal lobe of the caudal fin. Medium-sized scales."

Agassiz at the same time refers to vol. 1, pl. A, fig. 3. Agassiz (1833) mentioned on page 4 five species included in the genus *Amblypterus*:

1. *Amblypterus macropterus*
2. *Ambylpterus eupterygius*
3. *Amblypterus lateralis*
4. *Amblypterus latus*
5. *Amblypterus olfersi*

A conception of the genus *Amblypterus* is introduced by Agassiz in his reconstruction on pl. A, fig. 3. It is obvious that the reconstruction has very large pectoral fins, a low anal fin with its long base similar to *Amblypterus eupterygius*. Agassiz submited a thorough description of the

genus *Amblypterus* on pp. 28–31, and compared it with the genus *Catopterus*. He pointed out the difference in the relative size of the fins and in the position of the dorsal fin, being opposite to the anterior margin of the anal fin and to the space between the anal and ventral fins. He remarked on the close relationship between *Amblypterus* and *Palaeoniscus* (in the shape of the fins and in their relationship position), but that they differ in the structure of the lepidotrichia and in the formation of the fins as a whole. He considered the relatively enormous size of the fins to be a feature of the genus. Agassiz characterized *Amblypterus* as having a fusiform body shape, more or less concave dorsally above the space between the pectoral and ventral fins. The caudal fin is short but relatively large. The scales are of a rhombic shape, smooth in some species, and grooved in others. The fins are very large, consisting of lepidotrichia: dorsal fin 30–50 lepidotrichia, anal fin 30–50 lepidotrichia, ventral lobe of the caudal fin 25–30 lepidotrichia, dorsal lobe of the caudal fin 80–100 lepidotrichia, pectoral fin 20–30 lepidotrichia.

The position of the fins is considered to be an important feature of the genus, the dorsal fin is not at the midpoint but is positioned posteriorly, where the trunk decreases in size as it becomes the caudal fin. It is opposite to the anterior margin of the anal fin and to the space between the anal and ventral fins. The anal fin commences opposite to the middle of the dorsal fin or slightly posteriorly. The ventral fins are set anteriorly to the anterior margin of the dorsal fin. There is nothing about the bones of the skull except the mouth which is formed from large jaws, and along their entire margin they are equipped with extremely minute teeth arranged in a brush-like manner.

As was mentioned above, Agassiz (1833) described five species and included in the genus *Amblypterus*: *A. macropterus* (pp. 31–35), *A. eupterygius* (pp. 36–37), *A. latus* (pp. 37–38), *A. lateralis* (p. 39) and *A. olfersi* (p. 40). It was Agassiz who already distinguished two species with smooth scales (*A. lateralis* and *A. latus*), and two species with sculptured scales (*A. macropterus* and *A. eupterygius*) in his description.

Agassiz (1833–43) later also assigned to the genus *Amblypterus* the species *A. agassizii* MÜNST. (pp. 105–106), *A. nemopterus* (pp. 107–109), *A. punctatus* (pp. 109–110), and *A. striatus* (pp. 111–112).

Giebel (1848) distinguished between *Amblypterus* species having smooth scales: *Amblypterus duvernoy* (consistent with *Palaeoniscus duvernoy* AG. 1833, pp. 45–47), *Amblypterus latus* and *A. lateralis*; and those with sculptured scales: *Amblypterus macropterus*, *A. eupterygius*, *A. agassizii*, *A. nemopterus*, *A. punctatus*, *A striatus*, *A. olfersii* and others.

Troschel (1857) also differentiated between *Amblypterus* species, initially described from the Saar Basin as having sculptured or smooth scales, and placed them into two groups:

1. Sculptured scales: *A. macropterus* and *A. eupterygius*
2. Smooth scales: *A. lateralis* and *A. latus*

It is of note that Troschel (1857) characterized the species *A. macropterus* and *A. eupterygius* as having sculptured scales but also large conical teeth whereas the species from the second group with smooth scales have brush-like teeth. Troschel retained the species *A. lateralis* and *A. latus* in the genus *Amblypterus* with respect to one of Agassis´s characteristics of the genus *Amblypterus*, that is the minute brush-like teeth, whereas he erected a new genus *Rhabdolepis* for the species with large conical teeth and sculptured scales. Characteristics of the *Amblypterus* are after Troschel (1857, p. 18): brush-like teeth on the jaws, numerous teeth on the palate, robust smooth scales, large fins and small fulcral scales.

Traquair (1877) considered the species *Amblypterus latus* to be a typical representative of the genus *Amblypterus* and he pointed out differencies from the genus *Palaeoniscus*. At the same time he did not find any differences in *Palaeoniscus duvernoy,* and he recommended this species to be included in the genus *Amblypterus*. He described elsewhere in the text (1877, p. 558) a group of the fishes for which *Palaeoniscus duvernoy* is a typical representative, and he included it in the genus *Amblypterus*. He also included in this group the species *P. duvernoy*, *P. vratislaviensis* and *P. lepidurus* as described by Agassiz, species *P. dimidiatus, P. elongatus, P. tenuicauda, P. gibbus* and *P. opisthopterus* as described by Troschel (1857), species *P. gelberti* described by Goldfuss (1847), species *P. decorus, P. arcuatus, P. beaumonti*, as described by Egerton (1850), and also the species *P. rohani, P. caudatus, P. obliquus, P. reussii* and *P. luridus as* described by Heckel (Heckel and Kner 1861) from the Krkonoše Piedmont Basin.

Sauvage (1888) described the history of the genus *Amblypterus*, and also considered *A. latus* to be the type of the genus *Amblypterus.* He included in *Amblypterus,* in addition to the original species, new species *A. renaulti, A. commentryi, A. elaveris, A. euryi* and *A. fayoli*. He similarly summarised the history of *Amblypterus* in his other papers (Sauvage 1890, 1893) and he described the new species included in the genus *Amblypterus*.

Woodward's treatise from 1891 is significant. He regarded *A. latus* as the type of the genus *Amblypterus*, and he considered *A. lateralis* to be a synonym of *A. latus.* He borrowed the specimens from the Natural History Museum, London for his studies. Woodward (1891) also assigned to the genus *Amblypterus* the species *A. traquairi* WOODWARD, *A. beaumonti* (EGERTON), *A. decorus* (EGERTON), *A. arcuatus* (EGERTON), *A. reussii* (HECKEL), *A. blainvillei* (AG.), *A. voltzii* (AG.) and *A. duvernoy* (AG.). He included the specimens which were regarded as synonyms of *A. duvernoy* (*A. vratislaviensis* (AG.), *A. lepidurus* (AG.), A. *gibbus* (TROSCHEL), *A. dimidiatus* (TROSCHEL), *A. tenuicauda* (TROSCHEL), *A. elongatus* (TROSCHEL), *A. opisthopterus* (TROSCHEL), *A. rohani* (HECKEL), *A. obliquus* (HECKEL), and *A. caudatus* (HECKEL). He added several species into the genus *Amblypterus* but several otheres were added with some uncertainity. Agassiz´s original species *A. macropterus* and *A. eupterygius* were included by Woodward (1891) in the genus *Elonichthys* but as the species *Elonichthys macropterus.*

Traquair (1877–1914) alluded in his anatomical description of palaeoniscids to some anatomical features of the genus *Amblypterus*, and he refered to his reconstruction of *A. latus* on pl., 2, fig. 1. It is necessary to note that this reconstruction is much more elaborate in comparison with that of Agassiz (1833, pl. A, fig. 3), and differs in several features. Traquair (1877–1914) drew a smaller pectoral fin,

a shorter anal fin base, a triangular shape for both the anal and dorsal fins, and less numerous scale rows. The bones of the head indicate the operculum to have had a square shape, the maxilla a rounded posterior maxillary plate, and the jaws to possess minute teeth of equivalent size. It is necessary to point out that the maxilla, preoperculum and suborbital bones which are very similar to the later reconstruction by Gardiner (1963) which will be discussed further. It is not clear from the text which of the specimens served as a model.

Fritsch (1894) accepted the diagnosis of the genus *Amblypterus* (p. 94) by Woodward (1891), after Troschel (1857) and Traquair (1877). He remarked (p. 94) however that the diagnosis was uncertain. Fritsch (1894, 1895) included in the genus *Amblypterus* the following species: *A. verrucosus* FRITSCH, *A. duvernoy* (AGASSIZ), *A. vratislaviensis* (AGASSIZ), *A. rohani* (HECKEL), *A. luridus* (HECKEL), *A. obliquus* (HECKEL), *A. caudatus* (HECKEL), *A. lepidurus* (AGASSIZ), *A. reussii* (HECKEL), *A. feistmanteli* FRITCH, *A. zeidleri* FRITSCH and *A. angustus* (AGASSIZ).

Aldinger (1937) made reference to three species of the genus *Amblypterus* including *A. latus* from the Early Permian of Saarbrücken, but only within the context of the scale structure.

Gardiner (1963) revised the type species *Amblypterus latus,* he also provided a diagnosis of the family Amblypteridae ROMER, 1945 and a new diagnosis of the genus *Amblypterus*. GARDINER (1963, pp. 291–294) submitted a description of *A. latus* together with a reconstruction of the head. It is reported in the text that he used 18 specimens from the Natural History Museum, London in his research, but did not study the type specimens of *A. latus* or *A. lateralis*, and no neotype was determined. *A. lateralis* is included in *A. latus* as a synonym. The reconstruction of *A.latus* as exhibited by Gardiner is however at variance with the existing type species of *A. lateralis* and other material relating to *A. latus* or *A. lateralis*, as later studies proved.

Blot (1966) produced in his paper an excellent description and reconstruction of *Paramblypterus decorus* from the Carboniferous sediments of Commentry Basin. He deduced from the reconstruction and description of *A. latus* by Gardiner (1963) that *Amblypterus* and *Paramblypterus* were quite different genera. Blot (1966) introduced a diagnosis for the genus *Paramblypterus*, and also established a new family, Paramblypteridae. The type species *Paramblypterus decorus* for the genus *Paramblypterus* was initially described by Egerton (1850) as *Palaeoniscus decorus*, later Traquair (1877) refered to it as *Amblypterus decorus* and finally Sauvage (1888) considered it a subgenus, *Paramblypterus,* included within the genus *Amblypterus*. However, Blot (1966) included an excellent description and reconstruction of the type species *Paramblypterus decorus*, and his paper is an outstanding resource for understanding the actinopterygians of the genus *Paramblypterus*.

In his survey of Permo-Carboniferous actinopterygians Lehman (1966) published a reconstruction of *Amblypterus latus* in the sense of Gardiner (1963) and a reconstruction of *Paramblypterus decorus* in the sense of Blot (1966). These entirely distinct reconstructions of the animals which are essentially similar were thus introduced to science.

Heyler elaborated on the genera *Amblypterus* and *Paramblypterus* in several papers. Heyler (1969) summarised the history of the genus *Amblypterus*, and remarked on the description presented by Gardiner (1963) and that Gardiner did not look at the type and that his reconstruction differs in generic features from the type of *A. lateralis* VP 1301, which was studied by Heyler in Strasbourgh. Heyler confirmed that it is impossible to find the type specimen of *A. latus*, but all revising authors (Agassiz, Traquair, Troschel, Woodward) considered *A. lateralis* to be very similar or the same as *A. latus*, and for this reason *A. lateralis* should be the type species of *Amblypterus* instead of the missing *A. latus*. Heyler (1969) presented a description and reconstruction of *Amblypterus latus* according to Gardiner's conception of *Amblypterus latus,* and he later (Heyler 1976) suggested a new name, *Gardinerichthys latus* for this animal*,* for the reason that it differs entirely from the genus *Amblypterus*.

Heyler (1976) submitted a history of the genus *Amblypterus* in more detail, including a description of the type specimen of *A. lateralis* and other material deposited in the collection of the University in Strasbourgh.

Heyler (1997) again summarised the historical publications and gave his opinion on the *Amblypterus* and *Paramblypterus* question. He stated that *Amblypterus lateralis* and *Paramblypterus* were unquestionably close*.* However he consider *Amblypterus* and *Paramblypterus* to be two different genera.

Finally Dietze (2000) presented results of a study of *Amblypterus,* namely *A. latus* respectively *A. lateralis*. She provided a new diagnosis of *Amblypterus* on the basis of 73 specimens and the holotype of *A. lateralis*. She also revised the type species *Paramblypterus decorus*, and published an emended diagnosis of the genus *Paramblypterus*. Dietze (2000) considered the genera *Amblypterus* with the type species *A. latus* (*A.lateralis* as its synonym) and *Paramblypterus* with the type species *P. decorus,* to be separate and included in the family Amblypteridae ROMER, 1945. She enumerated (Dietze 2000, p. 949) several distinguishing features of *Amblypterus* and *Paramblypterus*:

1. The duplicate extrascapular bones in *Paramblypterus* are absent in *Amblypterus*.
2. The lateroventral process on the dermopterotic in *Amblypterus* is not developed in *Paramblypterus.*
3. Nasal 1 and nasal 2 (nasal 2 is superorbital anterieur in the sense of Blot 1966) is present in *Paramblypterus*. Nasal 2 is absent in *Amblypterus*.
4. A postcleithrum is present in *Paramblypterus* but not in *Amblypterus*.
5. Scales on *Paramblypterus* can have slight mounds, but are smooth with concentrically arranged incremental lines in *Amblypterus.*

Heyler (2000) noted briefly the relationship between *Amblypterus* and *Paramblypterus* in his survey of the Stephanian and Autunian actinopterygians of the French Massif Central. He included *A. lateralis* as *Paramblypterus lateralis* in the family Paramblypteridae (erected by Blot 1966) and in the order Paramblypteriformes (erected by Heyler 1969). He abandoned the genus *Amblypterus* and family Amblypteridae for several reasons:

a. Inaccurate original assignation of the genus *Amblypterus* by Agassiz.

b. Confusion caused by the reconstruction of *Amblypterus latus* presented by Gardiner (1963).

Prof. Daniel Heyler communicated to me by a letter dated 15.4.2002 his personal opinion regarding this research and suggested reserving the name *Amblypterus latus* for species which demonstrate the features which were described and figured by Gardiner (1963), and that the species *Amblypterus lateralis* should be transferred to the genus *Paramblypterus* because this genus is well defined.

There was no reference to the reconstruction published by Gardiner and Schaeffer (1989) and designated as *Paramblypterus decorus* after Blot (1966) and Štamberg (1976). This published reconstruction by Gardiner and Schaeffer (1989, fig. 9D) is very misleading. I have never published any reconstruction and the results of studies of *Paramblypterus decorus* and paramblypterids from the Permian of the Bohemian Massif significantly differ from *Paramblypterus decorus* from the Carboniferous of the French Massif Central. In my opinion, the above mentioned reconstruction is of an animal which is still unknown to this time from Permo-Carboniferous sediments.

We can reach several conclusions based on the historical opinions summarised in the research on the genera *Amblypterus* and *Paramblypterus*:

1. Reconstruction of the type species *Amblypterus latus* in the sense of Gardiner (1963) showed an animal quite distinct from *A. latus* or *A. lateralis* initially described by Agassiz from the Saar Basin (Heyler 1969, 1976, 1997, 2000; Dietze 2000).
2. The genus *Amblypterus* represented by the type species *Amblypterus latus*, or more precisely *A. lateralis* and the genus *Paramblypterus* with the type species *P. decorus* are separate although very similar genera within the family Amblypteridae (Heyler 1997, Dietze 2000, Schindler 2007).
3. *Amblypterus* and *Paramblypterus* are identical genera, and the generic name *Paramblypterus* should be used (Heyler 2000). The genus *Amblypterus* should have been abandoned due to the inaccurate original assignation of the genus *Amblypterus* by Agassiz, the type specimen of the type species *A. latus* is lost, and great confusion was caused by the description and reconstruction of *Amblypterus latus* presented by Gardiner (1963) which does not conform to any fish from the Saar Basin. The term Amblypteridae should have been abandoned for the same reason. The terms *Amblypterus* and Amblypteridae should be reserved for the actinopterygians described by Gardiner (1963), if these specimens exist. The species *Amblypterus lateralis*, which includes a holotype, should be considered to be *Paramblypterus lateralis* and included in the family Paramblypteridae HEYLER, 1969 as the genus *Paramblypterus* has been clearly identified (Heyler 2000).

Results of anatomical studies of *Amblypterus* and relationship between *Amblypterus* and *Paramblypterus*

There are several opinions on the position of the genus *Amblypterus* and relationship between *Amblypterus* and *Paramblypterus* as the previous section described. For this reason the present paper is focused on my own study of accessible material and presents a different opinion regarding the topic. The result of my own studies of Agassiz´s genus *Amblypterus* material is presented and it supports the results of Heyler (1976, 2000), Dietze (2000) and others. These publications are used at the end of this section in the comparison of the characteristics of *Paramblypterus* as published by Blot (1966), Heyler (1969), Štamberg (1976) and Dietze (2000).

The studied material referred to below is from Lebach nodules:

1. The *Amblypterus lateralis* holotype figured by Agassiz (1833, pl. 4, fig. 1) deposited in the University of Strasboug under No. VP 1310 (Plate 1, Fig. 1), (Heyler´s number – St 21).
2. Collection from the University of Strasbourg, Nos VP 1305; VP 1301a, b; VP 1302 a, b; VP 1303; VP 1304 a, b.
3. Collection deposited in The Natural History Museum, London (BMNH), namely Nos. P 978; P 14536; P 979; P 3458; P 29006; P 359; P 22658; P 36128; P 44082.
4. Collection deposited in the Humboldt University Museum in Berlin, namely Nos. MB. f. 3809; MB. f 1504; MB. f. 14396; MB. f.14400; MB. f. 14394; MB. f. 14395; MB. f. 3796; MB. f.3798; MB. f. 3800; MB. f. 3806; MB. f. 3805; MB. f. 3799.
5. Collection deposited in the Goldfuss-Museum in Bonn (GM), namely Nos. P 1125, P 1127, P 1130, P 1180, P 1271, P 1755 etc.
6. Collection deposited in the National Museum, Prague (NMP), Nos. M 1762/61/2688; M 1762/61/2691; M 1762/61/2690; 1762/61/2692; M 1762/612693; M 1762/61/2689; SC 117, Sc 118.

The type specimen *Amblypterus lateralis* Agassiz, 1833

Study of the type specimen of *Amblypterus lateralis* (No VP 1310) is an important first step (Plate 1, Fig. 1).

Specimen VP 1310 is approximately 145 mm in total length with the caudal extremity of the caudal fin missing. The trunk is partly preserved, moderately convex dorsally anteriorly to the dorsal fin. Smooth scales have a straight, not denticulated posterior margin (in those specimens preserved sufficiently well for study of their posterior margin). Clearly visible concentrically arranged growth lines are present where the upper ganoin layer is missing. The approximate scale count is:

$$\frac{28}{10\ 21\ 39}\ 43$$

Three or four large ridge scales are in front of the dorsal fin, one pair of large scales is in front of the anal fin. The paired fins are well developed, relatively large but smaller than the dorsal and anal fins. Lepidotrichia are articulated along their whole length, and branch dichotomically. The anal fin is triangular, and the same size as the dorsal fin. The dorsal fin is composed of 35 lepidotrichia.

The maxilla has a large oblong maxillary plate. The length/ height ratio of the maxillary plate is 1.3. The weak lower jaw contains the remains of minute teeth. The preoperculum bends anteriorly, and its anteroventral margin curves around

the maxillary plate forming an angle of 90°. The dorsal region of the preoperculum extends anteriorly whereas the anterior does not reach the level of the anterior margin of the maxillary plate. The anterior margin of the dorsal region of the preoperculum is concave with several small suborbital bones anteriorly. Four suborbital bones were found, but more were probably developed. The jugal borders the orbit posteroventraly, and lies anteriorly from the maxillary plate. Two fragments of the sclerotical bones were found in the ventral region of the orbit, but they were in fact more numerous. The suboperculum is of oblong shape, length greater than height. The remains of three branchiostegal rays are preserved.

Results of study of other *Amblypterus latus* material

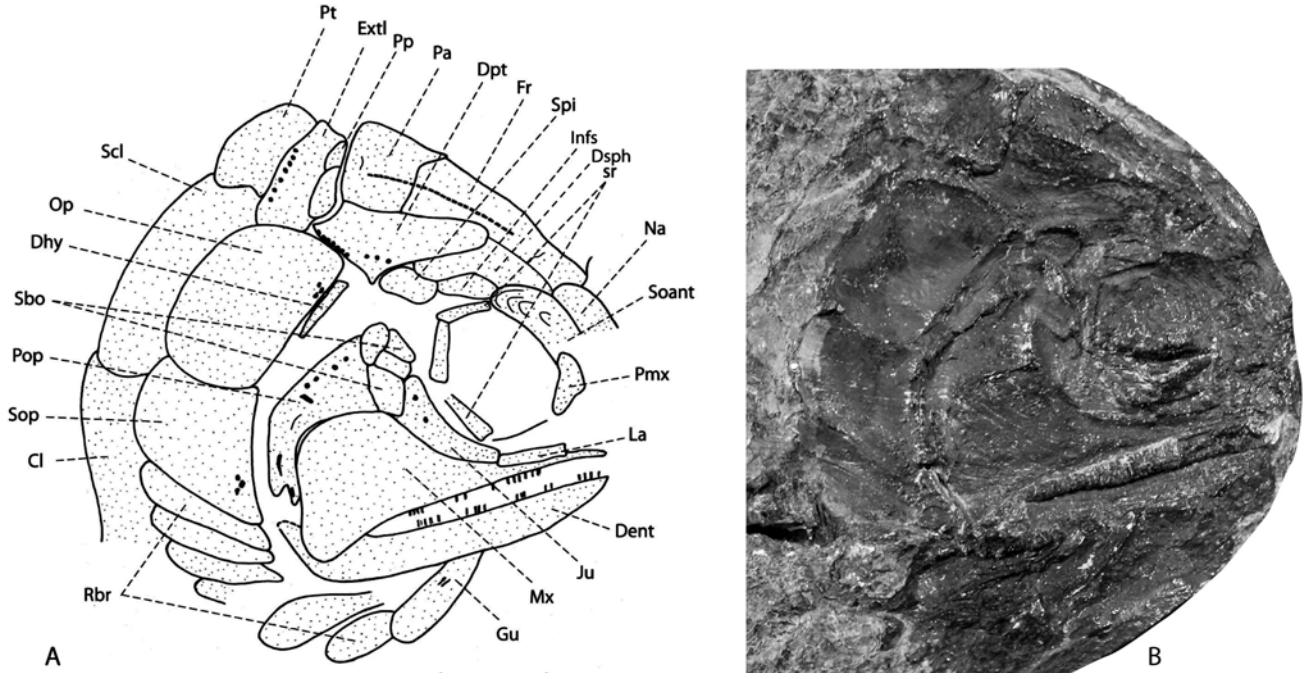
The study of comparative material specified in the introduction to this section is presented. The findings supplement our knowledge of the species *Amblypterus latus* published recently by Dietze (2000).

Skull roof. The interfrontal and interparietal sutures are straight. Two postparietal bones (additional lateral extrascapulars in the sense of Dietze 2000) lie posteriorly to the parietals, and are squeezed between the posterior process of the dermopterotic and the extrascapular lateral lying posteriorly (text-fig.1). Postparietal bones occur frequently. A dermopterotic with lateral process projecting between the opercular and spiracular (text-figs. 1–4) is also documented in several specimens.

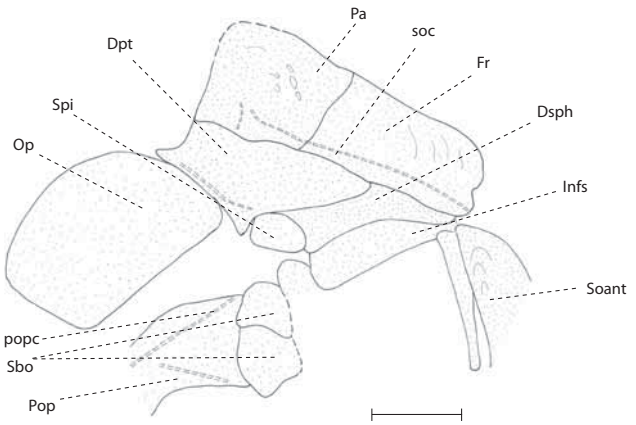
Rostral region. A pair of postrostral bones, a pair of nasal bones , supraorbital anterior and premaxilla compose the rostral region. The supraorbital anterior was previously described by Blot (1966) in *Paramblypterus decorus*, and was later recorded by several later authors in other paramblypterids. The well preserved upraorbital anterior in specimens MB f. 3809b (text-fig. 1) and BMNH – P 14536 (text-fig. 4) is a dorsoventrally elongated bone of oval shape flanking the orbit anteriorly. The bone is ornamented in its dorsal region with conspicuous mounds parallel to the margin of the bone. No remains of the sensory canal are recogniseable. The supraorbital anterior is in contact dorsoposteriorly with the infraorbital superior and with the dermosphenotic. The dermosphenotic totally separates the supraorbital anterior from the frontal. The premaxilla is partly preserved anteroventrally to the supraorbital anterior in MB f. 3809 and nearly complete in M 1762/61/2692, with a sickle-shaped form. The ventral margin of the bone is denticulated and forms the medial section of the mouth. Premaxilla posterior region borders slightly with the orbit anteroventrally, and in addition to the maxilla it is also in contact with lacrimal, and dorsally with the supraorbital anterior. However, this group of bones had not been found together in any of the studied specimens.

The sclerotic ring in the orbit probably consists of five thin bones, an assumption made from fragments in the specimens MB f. 3809, BMNH – P 3458a and the holotype VP 1310. The suprorbital anterior, and partly also the premaxilla, border the orbit anteriorly, infraorbital superior dorsally, jugal, infraorbital posterior and lacrymal posteriorly and ventrally. Between the orbit and preoperculum can be developed only two suborbital bones as described Dietze (2000) on MB f. 3796b, or there can be four or more small suborbital bones as can be seen in specimens VP 1310, VP 1301 or MB f. 3809.

Jaws. The maxilla deserves special attention. It was clearly figured earlier by Dietze (2000), and its diagnostic features markedly distinct from those figured by Gardiner (1963) which were revised several times by Heyler (1969, 1976, 1997, 2000). The maxilla is of a typical shape with



Text-fig. 1. ***Amblypterus latus*** **Agassiz, 1833. Pen and ink drawing (A) and photo (B) of the skull in lateral view. Mb. F. 3809b, scale bar represents 10 mm. Cl – cleithrum; Dent – dentalosplenial; Dhy – dermohyal; Dpt – dermopterotic; Dsph –dermosphenotic; Extl – extrascapular lateral; Fr –frontal; Gu – gular; Infs – infraorbital superior; Ju –jugal; La – lacrimal; Mx – maxilla; Na – nasal; Op – operculum; Pa – parietal; Pmx – premaxillar; Pop – preoperculum; Pp – postparietal; Pt – posttemporal; Rbr – branchiostegal rays; Sbo – suborbital; Scl – supracleithrum; Soant – supraorbital anterior; Sop – suboperculum; Spi – spiracular; sr – sclerotical ring.**

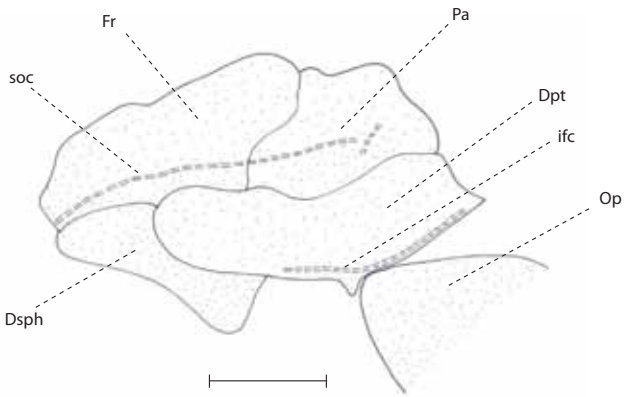


Text-fig. 2. ***Amblypterus latus*** **Agassiz, 1833. The skull roof, bones of the check and operculum. MB. f. 3796, scale bar represents 5 mm. Dpt – dermopterotic; Dsph – dermosphenotic; Fr –frontal; Infs – infraorbital superior; Op – operculum; Pa – parietal; Pop - preoperculum; popc – preopercular canal; Sbo – suborbital; Soant – supraorbital anterior; soc – supraorbital canal; Spi – spiracular.**

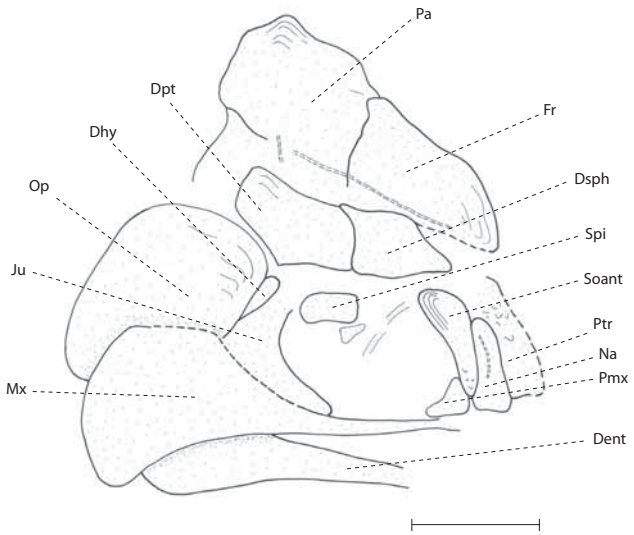
large maxillary plate. There are some differences in its length/height ratio when we consider the shape of the maxillary plate. The holotype of *A. lateralis* (VP1310) has a maxillary plate length/height ratio of 1.3, it is a relatively long maxillary plate. The maxillary plate is shorter in specimens MB f 3809b, BMNH – P 36128, VP 1305 and is very short with a length/height ratio of nearly 1 in the specimen NMP – M 1762/61/2688. The maxillary plate is in all specimens very large and high. The type of maxillary plate (long and low) which was described Gardiner (1963) is unknown in the *A. latus* or *A. lateralis* material from Lebach. None of the maxillary plates show any significant prolongation ventroposteriorly. It is however necessary to draw attention to the significant length/height variation, from 1 to 1.3. The reason can probably be due to the variation in the shape of the maxillary plate or in its deformation during the course of fossilization.

The lower jaw is relatively weak and slightly bent anteriorly.

Dentition. Dentition on the lower and upper jaws consists of minute sharply pointed teeth attached to long tubules. These tubules are clustered together in several rows



Text-fig. 3. ***Amblypterus latus*** **Agassiz, 1833. The skull roof in dorsal view. MB. F. 3799b, scale bar represents 5 mm. Dpt – dermopterotic; Dsph – dermosphenotic; Fr – frontal; ifc – infraorbital canal; Op – operculum; Pa – parietal; soc – supraorbital canal.**

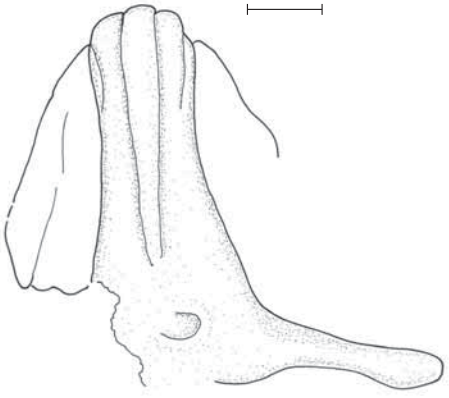


Text-fig. 4. ***Amblypterus latus*** **Agassiz, 1833. Jaws and the bones of the check in lateral view, the skull roof in dorsal view. BMNH P 14536, scale bar represents 5 mm. Dent – dentalosplenial; Dhy – dermohyal; Dpt – dermopterotic; Dsph – dermosphenotic; Fr – frontal; Ju – jugal; Mx – maxilla; Na – nasal; Op – operculum; Pa – parietal; Pmx – premaxillar; Ptr – postrostral; Soant – supraorbital anterior; Spi – spiracular.**

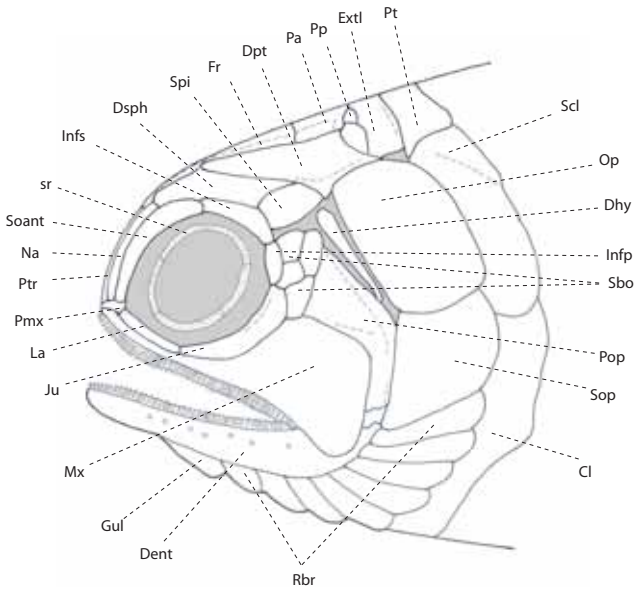
(BMNH – P 3458b, BMNH – P 979b, GM – P 1271, VP 1305). Small, strong, sharply pointed teeth without tubules are on the coronoids of the lower jaw (GM – P 1271).

Opercular apparatus. The operculum is an oblong shape with round corners. The suboperculum extends anteroventrally into a blunt process. The anterior margin of the suboperculum is at least one third longer than the posterior. Eight branchiostegal rays are present (BMNH – P 122658, BMNH – P 15415, MB. f. 3800), paired gular lateral (BMNH – P 22658, MB.f. 3809b), and the gular medial in NMP – M1762/61/2691 is a relatively large wide bone, moderately orocaudally elongated. The remains of the sensory canals are not preserved. A small dorsoventrally elongated dermohyal is crushed between the anterior margin of the operculum and dorsoposterior margin of the preoperculum (BMNH – P 14536, MB f. 3809).

Palatal bones. The parasphenoid is visible in samples MB f. 3796, BMNH – P 44082 (text-fig. 5) plus others processus cultriformis and paired processus ascendens, whereas the corpus parasphenoidis ends just behind the processus ascendens similarly as in *Paramblypterus duvernoy* and *P. rohani*.



Text-fig. 5. ***Amblypterus latus*** **Agassiz, 1833. Parasphenoid in dorsal view. BMNH P 44082, scale bar represents 2 mm.**



Text-fig. 6. ***Amblypterus latus*** **Agassiz, 1833. Reconstruction of the skull in lateral view, x 2.1, original. Original. Cl – cleithrum; Dent – dentalosplenial; Dhy – dermohyal; Dpt – dermopterotic; Dsph – dermosphenotic; Extl – extrascapular lateral; Fr – frontal; Gul – gular lateral; Infp – infraorbital posterior; Infs – infraorbital superior; Ju – jugal; La – lacrimal; Mx – maxilla; Na – nasal; Op – operculum; Pa – parietal; Pmx – premaxillar; Pop – preoperculum; Pp – postparietal; Pt – posttemporal; Ptr – postrostral; Rbr – branchiostegal rays; Sbo – suborbital; Scl – supracleithrum; Soant – supraorbital anterior; Sop – suboperculum; Spi – spiracular; sr – sclerotical ring.**

Body and fins. The fusiform body has a conspicuously arched dorsal portion in the region above the space between the pectoral and pelvic fins. The body height is 3.5 times body length, and the length of the head is 4.2 times the total body length. It is necessary to point out the relatively large size of paired and unpaired fins. The paired fins are a little smaller than the unpaired fins, but they are large compared with the body of *Paramblypterus decorus* and other well-known paramblypterids. The pectoral fin is well preserved in Mb f. 14396. It has 21 mm long lepidotrichia whereas the longest lepidotrichia of the dorsal and anal fins are 22 mm. The pectoral fin is well preserved also in other specimens eg. BMNH – P 14536. The base of the pelvic fin extends over the length of five or six scale rows. The dorsal fin is large, and its base extends over the length of ten scale rows, and it borders the areas with small scales. The dorsal fin contains about 40 segmented and dichotomically branched lepidotrichia. The anal fin also borders on the area with small scales, and it base extends over the length of 13 scale rows. The anal fin consists of 40 segmented and dichotomically branched lepidotrichia. The leading edge of the paired and unpaired fins consists of fulcral scales.

Paired and unpaired fins of *Paramblypterus rohani* are however much smaller in relation to the body size. The base of the pelvic fin extends over the length of 4 to 4.5 scale rows, and it consits of approximately 19 lepidotrichia. The base of the dorsal fin extends over the length of 8 scale rows, and it contains 25 – 30 lepidotrichia. The anal fin extends over 8 – 9 scale rows, and it comprises 30 lepidotrichia.

The approximate scale count in the studied specimens of *Amblypterus latus* is:

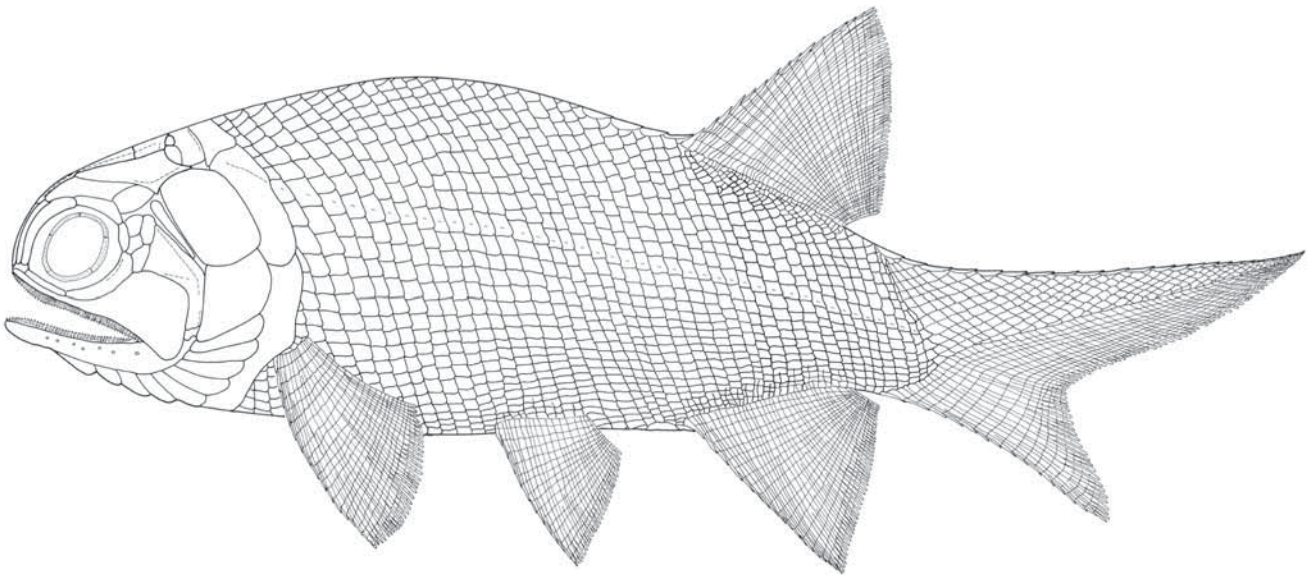
$$\frac{27}{9\ 21\ 37}\ 42$$

Comparing the genera *Amblypterus* and *Paramblypterus*

A summary of the newly obtained results from the study of the genus *Amblypterus*, including the results published by Dietze (2000) are compared with the characteristics of the genus *Paramblypterus* published by Blot (1966), Heyler (1969), Štamberg (1976), Dietze (2000) and the present study.

Dietze (2000, p. 949) presented the following differences in features of *Amblypterus* and *Paramblypterus*:

1. Duplication of lateral extrascapulars (postparietals in this paper) is present in *Paramblypterus*, but missing in *Amblypterus*.
2. The supratemporal (dermopterotic in this paper) of *Amblypterus* has a ventrolateral protuberance which has not been observed in *Paramblypterus.*
3. Two suborbitals are present in *Amblypterus*, six suborbitals in *Paramblypterus duvernoyi* and 6-9 suborbitals in *Paramblypterus decorus*.



Text-fig. 7. ***Amblypterus latus*** **Agassiz, 1833. Reconstruction of the body, x 1.0, original.**

4. Only one paired nasal forms the snout in *Amblypterus*, whereas nasal 1 and nasal 2 (supraorbital anterior in this paper) form the snout in *Paramblypterus*.
5. One dermohyal is present in *Amblypterus*, 1-3 in *Paramblypterus duvernoyi* and 7-10 dermohyal elements in *Paramblypterus decorus*.
6. A postcleithrum is present in *Paramblypterus*, but is absent in *Amblypterus.*
7. The scales of *Paramblypterus* have fine ridges and their posterior margin is serrated whereas the scales of *Amblypterus* are smooth with concentric striae and their posterior margin is straight.
8. D-values (see Dietze 2000, p. 931; 949) of scales are lower in *Amblypterus* (1.2) than in *Paramblypterus* (between 1.4 and 2.0).

Further study of the *Amblypterus* material showed that some characters which had been considered exclusive for *Paramblypters* were also present in *Amblypterus*. It is therefore not possible to consider these characters to be specific to only one of these two genera:

Considering:

Point 1. Postparietal bones (duplication of lateral extrascapular in the sense of Dietze 2000) are certainly developed at least in some specimens of *Amblypterus* (text-fig. 1).

Point 2. Ventrolateral protuberance of the dermopterotic (supratemporal in the sense of Dietze 2000) is distinct also in young specimens of *Paramblypterus rohani*, and thus it is not a unique character of *Amblypterus.*

Point 3. The holotype of *Amblypterus lateralis* exhibits three suborbital bones, specimen MB. f 3809b has four (text-fig. 1).

Point 4. A supraorbital anterior (nasal 2 after Dietze 2000) is also present in *Amblypterus* (text-figs 1, 2, 4).

Point 6. A postcleithrum is present in *P. rohani* from the Krkonoše Piedmont Basin NMP – P 1893, but is absent in many other specimens.

Only the following differencies can be found when distinguishing between *Amblypterus* from *Paramblypterus:*

– Only one dermohyal present in *Amblypterus*, more dermohyals in *Paramblypterus;*

– Scales of *Paramblypterus* carry fine mounds on their outer surface, and the posterior margin of the scales is denticulated, whereas the scales of *Amblypterus* are smooth with concentric growth striae, and the posterior margin of the scales is not denticulated. I consider this character to be of weak predicative value as *Amblypterus* preserved in nodules usually has the posterior margin of the scales missing, and Dietze (2000) also described a denticulated posterior margin on the scales of a large specimen of *Amblypterus*.

– D-values (see Dietze 2000, p. 931; 949) of scales are lower in *Amblypterus* (1.2) than in *Paramblypterus* (between 1.4 and 2.0).

– Large paired and unpaired fins in *Amblypterus*. The fins of *Paramblypterus* (*P. decorus, P. duvernoy, P. rohani*) are smaller in relation to the size of the body.

The reconstructions of the head and body (text-figs 6, 7) of *A. latus* represent the author's conception of its anatomy, shape of the body and position of the fins. Summarizing the results of previous studies of *Amblypterus* and *Paramblypterus* by other authors (Dietze, Heyler, Boy and others) and the new results obtained in this study, demonstrate the minute distinction between *Amblypterus* (fishes from Lebach described as *Amblypterus latus, A. lateralis*) on one side, and fishes of the genus *Paramblypterus* (described as *Paramblypterus decorus, P. duvernoy, P. rohani, etc.*) on the other. On the contrary many more characters have been found to be common for both *Amblypterus* (represented by *A. latus* and *A. lateralis)* and *Paramblypterus* (represented by *P. decorus, P. duvernoy* and *P. rohani)*. In particular the following consistent features should be noted:

1. Shape of the upper jaw with the maxillary plate.
2. Type of dentition formed by tubular teeth.
3. Presence of the supraorbital anterior in the nasal region.
4. Configuration of the skull roof.
5. Configuration of the cheek including suborbital bones, preoperculum, inclination of the suspensorium.
6. Configuration of the opercular apparatus.

The enumerated features convinced me that *Amblypterus* and *Paramblypterus* are very similar genera. The above mentioned differencies between these two genera are more likely characteristics of the separate species rather than being genera specific. I suggest keeping both genera separate for the present time for two reasons; firstly, the differencies mentioned above, and secondly to prevent further confusion evoked by integration of the two genera and according to the rule of the priority, using the genus name *Amblypterus*.

Conclusions

Conclusions from the historical summary and new studies of the *Amblypterus* and *Paramblypterus* genera relationship are as follows:

1. *Amblypterus latus* which was described and figured by Gardiner (1963) shows an animal quite distinct from *A. latus* or *A. lateralis* initially described by Agassiz from the Saar Basin.
2. New studies of specimens of *Amblypterus latus* or *A. lateralis* produced new data on the osteology, mainly the presence of supraorbital anterior, postparietal bones and numerous suborbital bones. All these osteological features are typical for *Paramblypterus decorus, P. duvernoy* and *P. rohani*.
3. Newly described osteological features conspicuously converge the two genera but I propose keeping the two genera separate for the present.
4. An emended diagnosis for *Amblypterus* (Dietze, 2000): Distinct ornamentation of frontals, parietals, extrascapulars, posttemporals, dermosphenotics and dermopterotics. No frontal process. Small postparietals can be present. Single pair of lateral extrascapulars. The supraorbital anterior borders the orbit anteriorly, and it contains the rostral region in addition to the postrostral and nasal. Dermopterotic more than twice the length of the dermosphenotic. Delicate sclerotic bones present. Maxillary plate deep. Numerous identical minute teeth on the jaws, consisting of long tubules tipped with fine sharply pointed teeth. More than two suborbitals. Single dermohyal. Operculum higher than the suboperculum. From 8 to 10 branchiostegal rays. Postcleithrum absent.

Posterior edges of scales straight, bearing concentric striae. 40-42 scale rows along the lateral line. Fins large.

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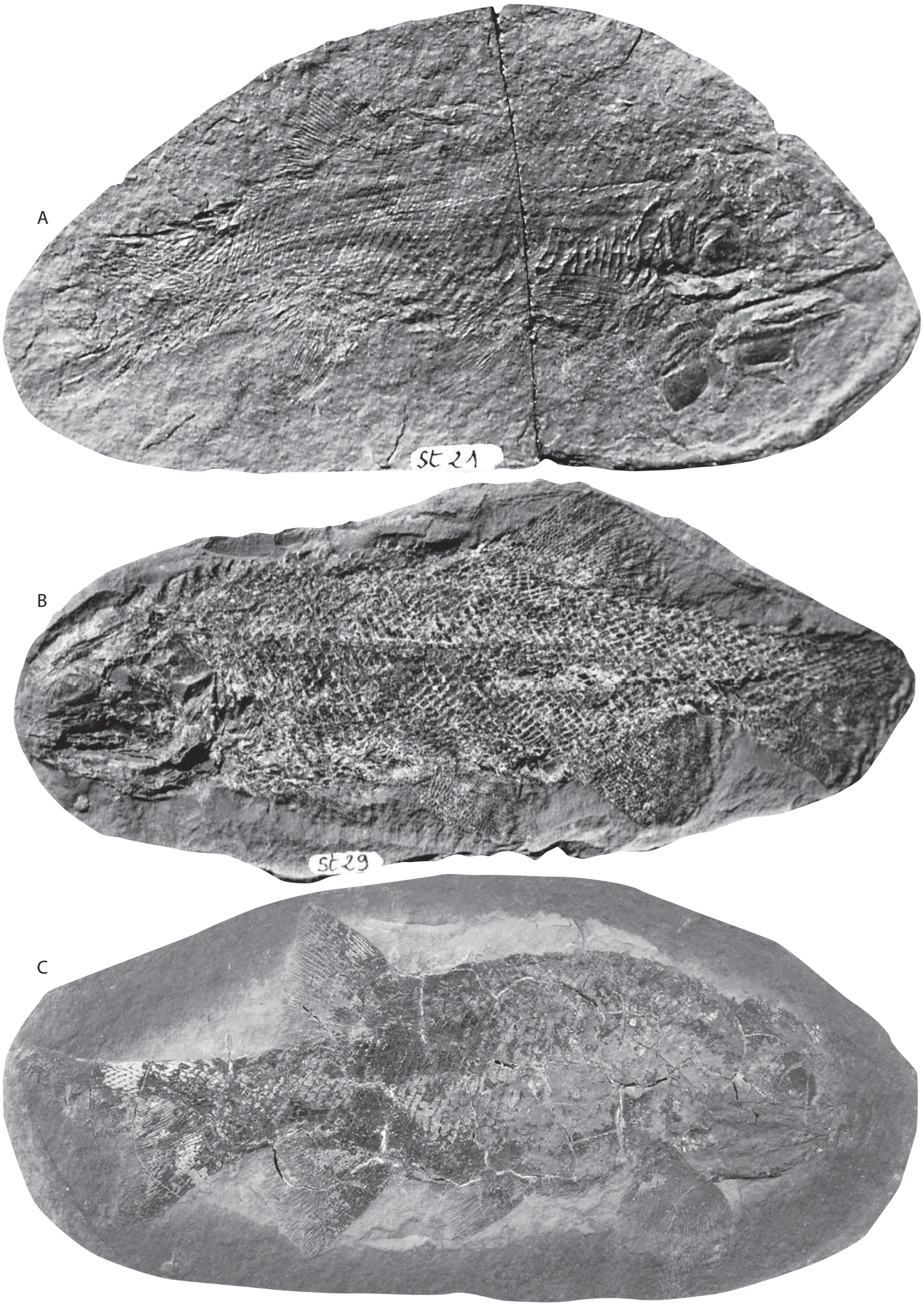
Explanation to the plates

PLATE 1

Amblypterus latus Agassiz, 1833

1. Holotype VP 1310 of *Amblypterus lateralis* Agassiz, 1833; x 1.0.
2. Specimen VP 1302; x 1.0.
3. Specimen BMNH P 14536; x 1.0.

PLATE 1



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AN ANNOTATED LIST OF THE OLIGOCENE FISH FAUNA FROM THE OSÍČKO LOCALITY (MENILITIC FM.; MORAVIA, THE CZECH REPUBLIC)

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Přikryl, T. (2013): An annotated list of the Oligocene fish fauna from the Osíčko locality (Menilitic Fm.; Moravia, the Czech Republic). - Acta Mus. Nat. Pragae, Ser. B, Hist. Nat., 69(3-4): 195-203, Praha. ISSN 0036-5343. DOI 10.14446/AMNP.2013.xxx

Abstract. The present article provides an annotated list of the Oligocene fish fauna from the Menilitic Formation of a new Osíčko locality (Silesian Unit), collected from two different parts of the formation, i.e., Subchert Member and Dynów Member. The specimens were classified as *Keasius* sp., *Elasmobranchii* gen. et spec. indet., *Scopeloides glarisianus*, *Sardinella sardinites*, *Clupeidae* gen. et spec. indet., *"Glossanodon" musceli*, *Anenchelum glarisianum*, and *Perciformes* gen. et spec. indet. The composition of the assemblage suggests meso- to benthopelagic environments.

■ Elasmobranchii; Teleostei; Oligocene; Moravia; Menilitic Formation.

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Introduction

The menilitic Formation is a distinctive lithostratigraphic unit represented by Lower Oligocene (Rupelian) sediments originated from the Paratethys area. These sediments, developed in the Ždánice, Subsilesian and Silesian Units, are exposed at many Moravian localities (and other parts of the Western Carpathians) and have yeilded numerous fish fossils (for reviews see e.g., Roth 1981, Stráník 1981).

Research on these fossil fish began in the 19th centuary – the oldest reference is possibly Heckel (1850) and is still continuing at the present time. They are represented by many Teleostei and Selachii families (for a review and complete list of the references see Kalabis (1981) and Gregorová (2011)).

Even after such long-term research new localities may provide information which can support (or occasionally contest) previous generally accepted results and ideas. The main goals of this contribution are: to briefly describe specimens from the Osíčko locality and comment on them within the context of other Moravian fish localities.

Material and methods

Specimens were collected in 2011 from the new Osíčko locality which is situated in the south of the village of Osíčko. The outcrop is discontinuously exposed in the right bank of the Moštěnka Creek (text-fig. 1; 49° 24' 50.761294" N, 17° 45' 14.2363071" E). The deposition is represented by sediments of the Menilitic Fm. (Silesian Unit, Menilite-Krosno Group of nappes) and specimens were collected from two collecting points (text-fig. 1C: P1 and P2). The sediments at point P1 are represented by grey to grey-brown claystones, and calcareous shales corresponding to the Subchert Member. Point P2 is situated at a higher stratigraphical position with exposed light brown marlstones (their lithology is typical for the Dynów Member). For details regarding the geology and sedimentology of the formation see Stráník (1981), Krhovský et al. (2001), and Švábenická et al. (2007).

The fossils are preserved in the bedding planes (rarely in the middle of the sediment layer) and they are occasionally accompanied by ichnofossils, such as regurgitates, coprolites and traces of burrowing (the ichnofossils are not described herein).

The specimens were left unprepared or with only slight mechanical prepared using needles. They are housed in the collection of the National Museum, Prague (NM) under the following numbers: Pc 02870 – Pc 02892.

Abbreviations: SL – standard length.

Systematic palaeontology

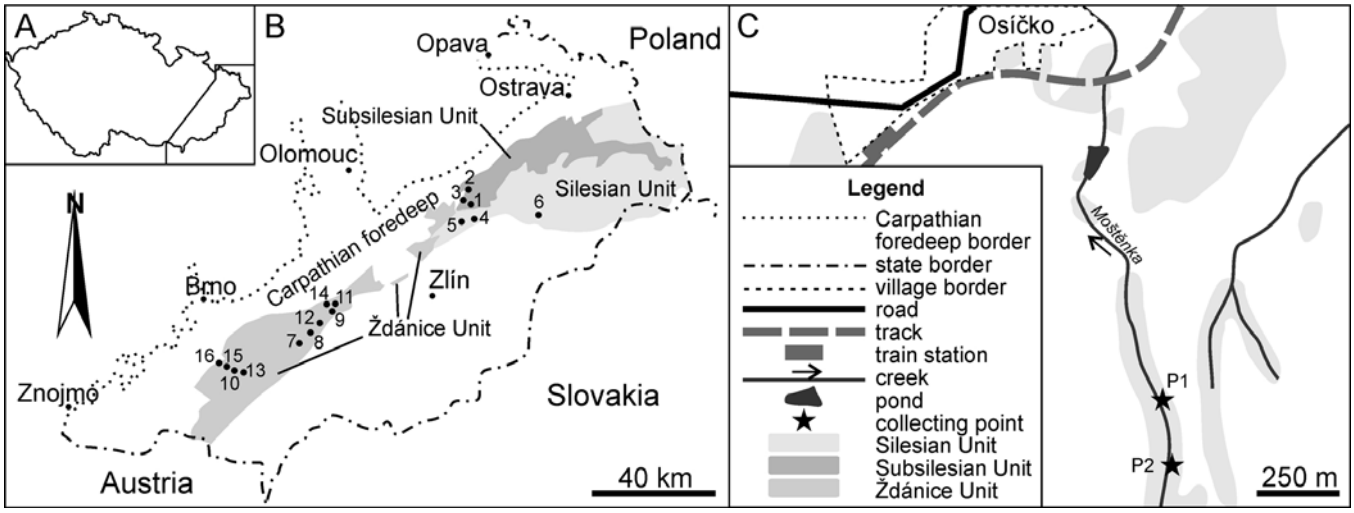
Family **Cetorhinidae Gill, 1862**

Genus ***Keasius* Welton, 2013**

***Keasius* sp.**

M a t e r i a l : NM Pc 02878a, b, Pc 02879; collected from the Dynów Mb.

R e m a r k s : The specimens are represented by well preserved distal parts of isolated branchiospines, their half-elliptical bases are preserved only as an imprint on the surface of the sediment. Due to incomplete preservation, the specimens are classified using open nomenclature.



Text-fig. 1. The geographic position of the localities mentioned in the text. A position within the Czech Republic. B Detailed map of the area. Subsilesian Unit: 1 – Kelč, 2 – Špičky, 3 – Horní Těšice; Silesian Unit: 4 – Loučka, 5 – Osíčko, 6 – Rožnov pod Radhoštěm; Ždánice Unit: 7 – Bohuslavice, 8 – Jestřabice, 9 – Kožušice, 10 – Křepice, 11 – Litenčice, 12 – Mouchnice, 13 – Nikolčice, 14 – Nítkovice, 15 – Nosislav, 16 – Židlochovice. The distribution of the units according to Čtyřoký and Stráník (1995). C map of the Osíčko vicinity with distribution of tof the Silesian Unit sediments (gray spots) and collecting points (P1 and P2). The distribution of the Silesian Unit sediments according to Stráník (1999).

The Oligocene – middle Miocene branchiospines were traditionally classified in the genus *Cetorhinus* Blainville, 1816, in particular as *C. parvus* Leriche, 1910 Welton (2013), however transferred this species into the new genus *Keasius*. The specimens were found in many Moravian localities, namely Kelč, Špičky, Litenčice, Nikolčice, Mouchnice, Rožnov pod Radhoštěm, and Nítkovice (Kalabis and Schultz 1974, Kalabis 1975a, b, Schultz 1982, Gregorová 1988, 2011, 2012, Gregorová and Požár 2003).

Branchiospines are usually found mainly as isolated elements, but articulated specimens are also known (see Hovestadt and Hovestadt-Euler 2012). The recent *C. maximus* (Gunnerus, 1765) is a coastal pelagic and semi-oceanic filter-feeder of the boreal to warm-temperate waters (Compagno 2002); the distribution in the water column is usually in the range of 200 to 2000 m, but they have also been also sighted in the surface waters and in the oceanic basins at 2000 to 4000 m (Compagno 2002).

Elasmobranchii gen. et sp. indet.

Text-fig. 2A

M a t e r i a l : NM Pc 02876a, b, Pc 02883a, b, Pc 02884, Pc 02885; collected from the Dynów Mb.

R e m a r k s : The specimens are represented by isolated amphicelous vertebrae. They appear as rounded objects with a small notochordal foramen in the middle region. The maximum size does not exceed 9 mm in diameter. They are distributed in several strata of the Dynów Mb., usually accompanied by ichnofossils and remains of "*Glossanodon*" skeletons. Due to the lack of any other preserved morphological features, more exact determination is not possible. Isolated elasmobranchian vertebra centrae were described only from the Litenčice locality as *Keasius parvus* and ?*Carcharias* sp. (Gregorová 2011).

Family **Gonostomatidae Gill, 1893**

Genus ***Scopeloides* Wettstein, 1886**

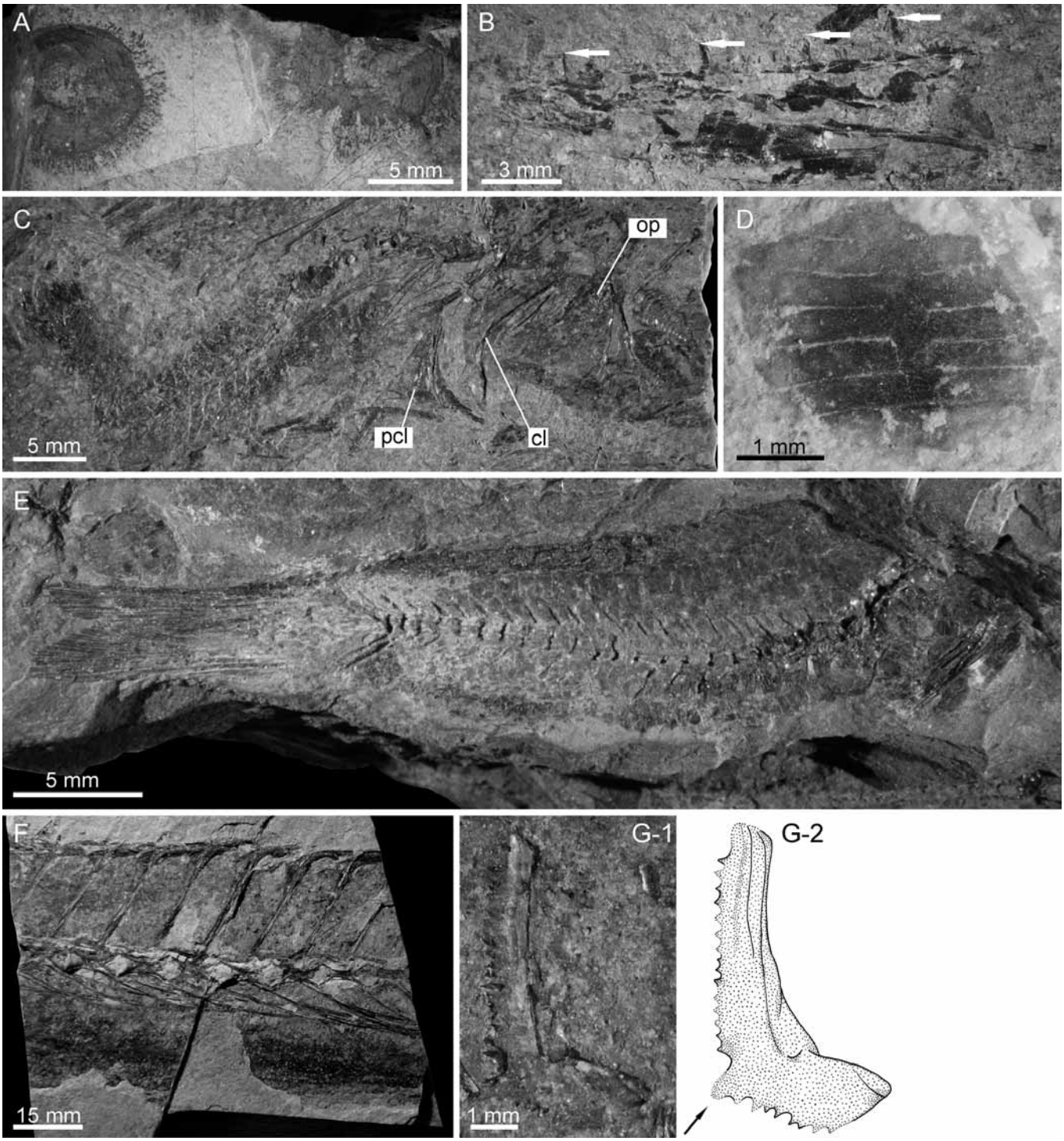
***Scopeloides glarisianus* (Agassiz, 1844)**

Text-figs 2B, C

1844 *Osmerus glarisianus*; Agassiz, vol. 5, p. 102, tab. 62, figs 3–4.
1886 *Scopeloides glaronensis* (Agassiz); Wettstein, p. 56, taf. 2, figs 7–13.
1901 *Scopeloides glarisianus* (Agassiz); Woodward, p. 255.
1908 *Thrissopteroides ? minutus*; Priem, p.6, pl. 1, figs 5–6.
1908 *Copeichthys morgani*; Priem, p. 8, pl. 1, figs 9–11.
1929 *Mrazecia mrazeci*; Paucă, p. 115.
1934 *Mrazecia mrazeci* Paucă; Paucă, p. 608, text-figs 10–11, pl. 2, figs 4–5, pl. 3, fig. 6.
1948 *Scopeloides glarisianus* (Agassiz); Kalabis, p. 136, pl. 1, fig. 1.
1960 *Scopeloides glarisianus* (Agassiz); Danilchenko, p. 27, text-fig. 3, pl. 2, fig. 1.
1967 *Scopeloides glarisianus* (Agassiz); Arambourg, p. 43, text-figs 14, 15, 17, pl. 2, figs 2–7, 9.
1968 *Scopeloides glarisianus* (Agassiz); Jerzmańska, p. 395, text-fig 3.
1977 *Scopeloides glarisianus* Agassiz; Ciobanu, p. 67, pl. 16, fig. 1.
1977 *Scopeloides paucai*; Ciobanu, p. 68, pl. 17, fig. 1.
1989 *Scopeloides glarisianus* (Agassiz, 1844); Gregorová, p. 89, pl. 7.
1989 *Scopeloides* sp.; Gregorová, p. 89, pl. 1, fig. 1.
1997a *Scopeloides glarisianus* (Agassiz); Gregorová, p. 124, text-figs 1–5, pl. 1, figs 1–5, pl. 2, figs 1–6.
2005b *Scopeloides glarisianus* (Agassiz); Prokofiev, p. S99, figs 5–6.
2011 *Scopeloides glarisianus* (Agassiz); Gregorová, p. 9, pl. 3, fig. 2.

M a t e r i a l : NM Pc 02887a, b, Pc 02888; collected in the Subchert Mb.

R e m a r k s : The species is represented by isolated dentary and a disarticulated skeleton at the locality. Although



Text-fig. 2. A Elasmobranchii gen. et spec. indet. specimen NM Pc 02876b; B *Scopeloides glarisianus* dentary NM Pc 02888 (the white arrows mark the tips of the "fang-like" teeth); C *S. glarisianus* disarticulated skeleton NM Pc 02887a; D *Sardinella sardinites* scale NM Pc 02886; E Clupeidae gen. et spec. indet. articulated skeleton without head NM Pc 02889; F *Anenchelum glarisianum* body fragment NM Pc 02880a; G Percoidei gen. et sp. indet. preoperculum (G-1) and its interpretation (G-2) NM Pc 02891. The arrow shows the enlarged spine in the angle between rami verticalis and horizontalis. Abbreviations: cl – cleithrum; op – operculum; pcl – postcleithrum.

the dentary is crushed, it is possible to recognize its lowelongated shape with typical dentition: small teeth alternate with large teeth (their tips are marked by white arrows in text-fig. 2B). The disarticulated skeleton consists of only 15 vertebrae (others are not preserved) and a strongly disarticulated head and pectoral girdle bones. The specimen was determined on the basis of morphology of the cleithrum, the postcleithrum, and organization of the caudal skeleton. Other morphological data are not sufficiently preserved. The species was found at the Moravian localities Bohuslavice, Kelč, Špičky, Horní Těšice, Mouchnice, Litenčice, Nikolčice, Nosislav, Židlochovice, Křepice, Rožnov pod Radhoštěm, and Loučka (Kalabis 1948, 1975a, b, Kalabis and Schultz 1974, Gregorová 1988, 1989, 2011, Přikryl et al. 2012 and unpublished data).

The species was characterized as mesopelagic or bathypelagic (Prokofiev 2005b or Jerzmańska 1968 respectively), similar to the recent genus *Gonostoma*.

Family **Clupeidae Bonaparte, 1831**

Genus ***Sardinella* Valenciennes, 1847**

***Sardinella sardinites* (Heckel, 1850)**

Text-fig. 2D

1850 *Meletta sardinites*; Heckel, p. 227, pls 23–24.
1850 *Meletta longimana*; Heckel, p. 231, pl. 25.
1850 *Meletta crenata*; Heckel, p. 233, pl. 26.
1901 *Clupea crenata* (Heckel); Woodward, p. 151.
1901 *Clupea sardinites* (Heckel); Woodward, p. 152.
1934 *Clupea longimana* (Heckel); Paucă, p. 601, pl. 1, figs 3a–3b, pl. 5, figs 2, 5.
1934 *Clupea sardinites* (Heckel); Paucă, p. 603, pl. 1, fig. 1.
1938 *Clupea sardinites* Heckel; Weiler, p. 11.
1958 *Clupea longimana* Heckel; Jonet, p. 36, pl. 3, figs 6, 9, 11.
1958 *Clupea sardinites* Heckel; Jonet, p. 37, pl. 4, figs 4–5, 10, pl. 8, fig. 8.
1960 *Clupea sardinites* Heckel; Jerzmańska, p. 371, pl. 5, fig. 1, pl. 6, fig. 1.
1968 *Clupea sardinites* Heckel; Jerzmańska, p. 390, text-fig. 2.
1977 *Clupea sardinites* Heckel; Ciobanu, p. 46, pl. 7, fig. 1.
1977 *Clupea longimana* Heckel; Ciobanu, p. 47, pl. 7, fig. 2.
1978 *Clupea sardinites* Heckel; Szymczyk, p. 394, text figs 4–5, pl. 58, figs 1–3, 5.
1980 *Sardinella sardinites* (Heckel); Danilchenko, p. 9.
1991 *Clupea sardinites* (Heckel); Pharisat, p. 27, figs 13–15.
2003 *Clupea sardinites* (Heckel); Gregorová and Požár, p. 195, fig. 3, photo 3.
2006 *Sardinella sardinites* (Heckel); Carnevale et al., p. 686, fig. 4
2011 *Clupea sardinites* (Heckel); Gregorová, p. 8.

M a t e r i a l : NM Pc 02886, Pc 02890, Pc 02892 and unnumbered specimens; collected from the Subchert Mb. and Dynów Mb.

R e m a r k s : Commonly found specimens are represented by scales, typical clupeid forms with transversal striae (text-fig. 2D) which distinguish them from other fish scales. They are practically the same as those described by Symczyk (1978) and they are distributed at both collecting points.

The specimens were traditionally classified in the genus *Clupea* Linnaeus, 1758, but according to the unpublished thesis by Nedvědová (2012), the Moravian clupeid specimens pertain to the genus *Sardinella*. This conclusion is in accordance and confirms results published earlier by Danilchenko (1980) and Carnevale et al. (2006).

The species (as scales and isloated bones) is widely distributed in Moravian localities, e.g., Litenčice, Kelč, Špičky, Rožnov pod Radhoštěm (Kalabis and Schultz 1974, Kalabis 1975a, b, Gregorová and Požár 2003 and others).

Clupeids are typically marine coastal and schooling, mainly pelagic fishes found in all seas from 70° N to about 60° S (Whitehead 1985).

Clupeidae gen. et sp. indet.

Text-fig. 2E

M a t e r i a l : NM Pc 02889; collected from the Subchert Mb.

R e m a r k s : The specimen is represented by an articulated postcranial section of a skeleton; with ca. 24 preserved vertebrae and insufficiently preserved fins. The body is covered by typical clupeid scales which are also preserved in the surrounding sediment. A more detailed description is not possible untill preparation of the specimen is completed which may reveal other features..

Family **Argentinidae Bonaparte, 1846 vel Osmeridae Regan, 1913**

Genus ***Glossanodon* Guichenot, 1867**

***"Glossanodon" musceli* (Paucă, 1929)**

Text-fig. 3

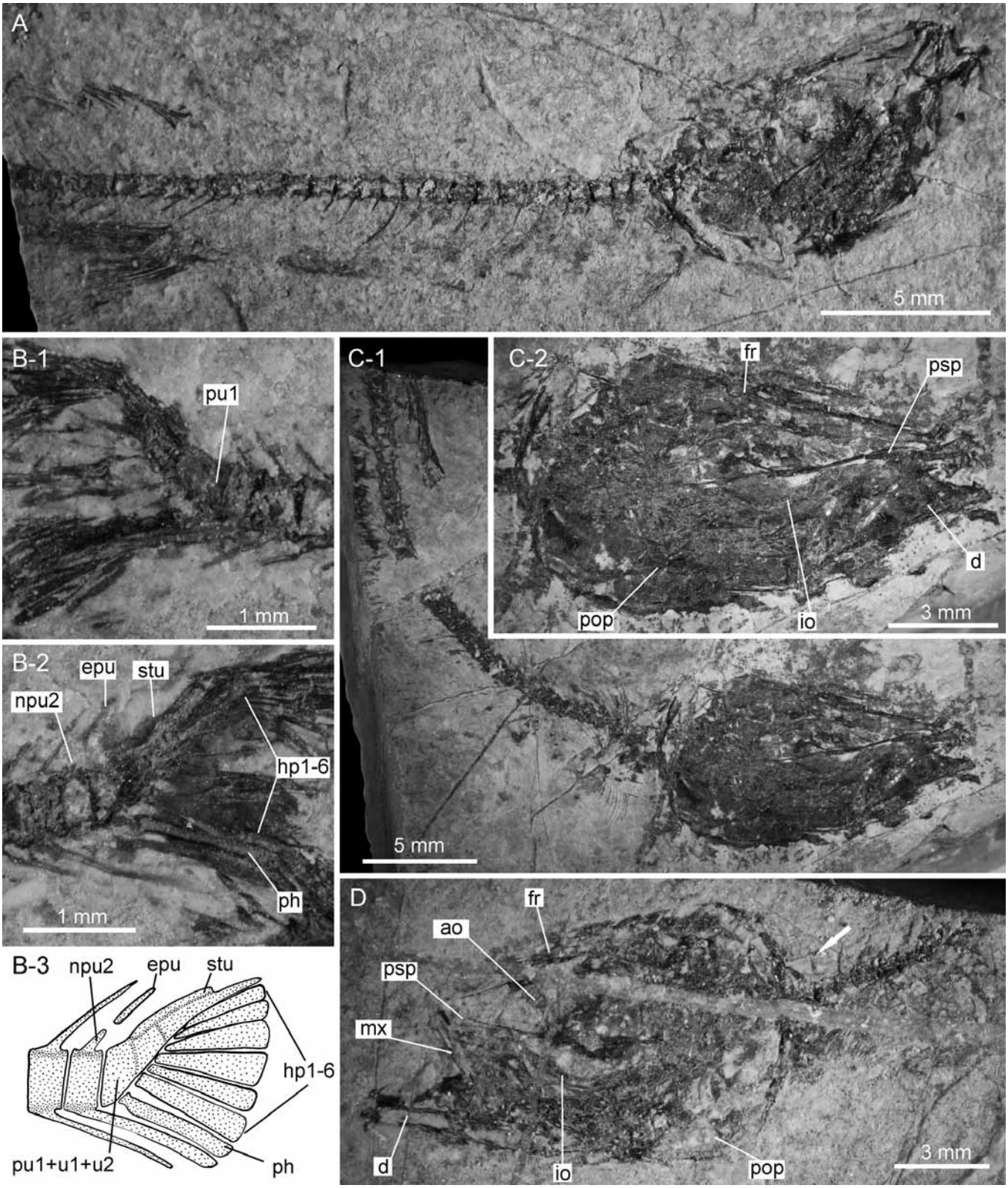
1929 *Nemachilus musceli*; Paucă, p. 114.
1934 *Nemachilus musceli* Paucă; Paucă, p. 598, pl. 2, figs 1–2.
1958 *Nemachilus Musceli* Pauca; Jonet, p. 44, pl. 5, fig. 7.
1967 *Glossanodon musceli* (Paucă); Jerzmańska, p. 200, text-figs 2, 4, 6, 8, 10, pl. 1, figs 1–2.
1968 *Glossanodon musceli* (Paucă); Jerzmańska, p. 394.
1974 *Glossanodon musceli* (Paucă); Kalabis and Schultz, p. 187, pl. 1, fig. 2.
1977 *Glossanodon musceli* (Paucă); Ciobanu, p. 65, pl. 15, fig. 1.
2003 *Glossanodon musceli* (Pauca); Gregorová and Požár, p. 196, photo 4.
non 2005a *Austromalotus musceli* (Paucă); Prokofiev, p. 10, figs 4–6.
2011 *Glossanodon musceli* (Paucă); Gregorová, p. 8, pl. 3, fig. 1.

M a t e r i a l : NM Pc 02870a, b – Pc 02875a, b, Pc 02877a, b; collected from the Dynów Mb.

R e m a r k s : The collected specimens are rather fragmentary, with a long slender body and maximal body depth close behind the head. It is possible to recognized ca. 47 vertebrae (22+25). The fin rays are insufficiently preserved and their numbers are not clearly discernable. The pectoral fin is totally unreadable. The dorsal fin is situated in the middle of the body length (with ca. 10 rays); the ventral fin (with more than seven rays) is shifted slightly anteriorly. Although the anal fin is not completely preserved in any of the specimens, the caudal peduncle in specimen Pc 02780a appears to be formed by 6–7 vertebrae (judging by the last preserved anal fin ray). The skull bones are crushed and therefore, hardly readable (it is however possible to identify some of them, or their general positions; see text-figs 3C-2 and 3D). The fragmentary caudal skeleton (text-figs 3B–1, 2) was tentatively reconstructed (text-fig. 3B–3).

The specimens were traditionally classified as *Glossanodon musceli* (Argentinidae), but Prokofiev (2005a) revised Caucasian and Turkmenistan Protacanthopterygii on the basis of important morphological features which have been overlooked for many years. His results showed that his specimens pertain to the family Osmeridae (rather than to the Argentinidae) and were thus placed in the new genus *Austromallotus*.

Material from the Osíčko locality cannot be similarly classified mainly due to the unsatisfactory preservation. The important morphological features, such as (1) presence of the notch on the dorsal edge of the operculare, (2) transformation of the neural spines at the anterior abdominal vertebrae (significant shortening is not present in all specimens, or it is not clearly visible), and (3)



Text-fig. 3. ***"Glossanodon" musceli*** **A nearly complete specimen NM Pc 02875a; B caudal skeleton of specimens NM Pc 02871b and NM Pc 02871a (B-1 and B-2 respectively; part and counterpart) and its tentative reconstruction (B-3); C specimen NM Pc 02873a, general view (C-1) and detail of the head (C-2); D specimen NM Pc 02874a (the white arrow shows normally developed neural spine on the anterior abdominal vertebra). Abbreviations: ao – antorbitale; d – dentale; epu – epurale; fr – frontale; hp1-6 – hypurals 1-6; io – infraorbitals; mx – maxillare; npu2 – neural spine of second preural vertebra; ph – parhypurale; pu1 – first preural vertebra; pop – preoperculum; psp – parasphenoideum; stu – stegurale; u1 – urale 1; u2 – urale 2.**

arrangement of 1st and 2nd infraorbitals 1 and 2 (if they are in contact or not) are not recognizable, or they were destroyed or are differentfrom those described by Prokofiev (2005a). Furthermore, the studied specimens show a longer caudal peduncle (6–7 vertebrae) and slightly different different morphology of the caudal skeleton than in *A. musceli* (according to Prokofiev 2005a: fig. 6c). Thus it is impossible to unify both forms and the specimens described herein are classified traditionally as members of the genus *"Glossanodon"*. A higher taxonomical position of the taxon

is uncertain due to the lack of clarity regarding construction of the circumorbital series.

The species (sensu Paucă, 1929) is distributed in many Moravian localities, such as Litenčice, Kelč, Špičky, Nikolčice, Mouchnice, Rožnov pod Radhoštěm and others (Kalabis and Schultz 1974, Kalabis 1975a, b, Gregorová 1988, 2011, Gregorová and Požár 2003).

As was mentioned above, the construction of the circumorbital series is unclear and thus also any concrete higher taxonomic position. Consequently it is difficult to estimate the bathymetric demands of these specimens. If we take into account the original classification (i.e., Argentinidae) these are found at a depth of 1000 m, but adults are commonly taken from the margin of the continental shelves (Weitzman 1997).

Family **Trichiuridae Rafinesque, 1810**

Genus ***Anenchelum* Blainville, 1818**

***Anenchelum glarisianum* Blainville, 1818**

Text-fig. 2F

1818 *Anenchelum glarisianum*; Blainville, p. 314.
1844 *Anenchelum glarisianum* DeBlainville.; Agassiz, vol. 5, p. 70, pl. 37, figs 1–2.
1850 *Lepidopides leptospondylus*; Heckel, p. 240, pl. 22.
1859 *Anenchelum Glarisianum* Blainville; von Rath, p. 122, pl. 3, fig. 5.
1886 *Lepidopus glaronensis*; Wettstein, p. 42, pl. 5, figs 1, 3–6, 9–10, pl. 6, figs 1–3, 5–8.
1901 *Lepidopus glarisianus* (Blainville); Woodward, p. 477.
1934 *Lepidopus glarisianus* (Blainville); Paucă, p. 615, text-figs 15–17, pl. 3, fig. 3.
1958 *Lepidopus glarisianus* Blainville; Jonet, p. 58, pl. 6, fig. 2.
1960 *Lepidopus glarisianus* (Blainville); Danilchenko, p. 143, text-fig. 29, pl. 14, figs 1–2.
1968 *Lepidopus glarisianus* (Blainville); Jerzmańska, p. 463, text-fig. 23, pl. 7, fig. 1.
1977 *Lepidopus glarisianus* Blainville; Ciobanu, p. 119, pl. 40, fig. 1.
1977 *Anenchelum glarisianum* Blainville; Ciobanu, p. 120, pl. 41, figs 1–2.
1991 *Lepidopus glarisianus* (Blainville); Pharisat, p. 60, text-figs 47-50.
2003 *Anenchelum glarisianum* Blanville; Gregorová and Požár, p. 200, photos 8–10.
2010 *Anenchelum glarisianum* Blainville; Gregorová, p. 142, photos 1–11.
2011 *Anenchelum glarisianum* Blainville; Gregorová, p. 17, pl. 6, figs 1–2.

M a t e r i a l : NM Pc 02880a, b, c, Pc 02881a, b, Pc 02882a, b; collected from the Dynów Mb.

R e m a r k s : The specimens are represented by fragments of the body and a disarticulated head. The elongated body is composed of vertebrae with straight neural spines which are articulated with pterygiophores of the dorsal fin. Ribs are attached to the ventral margin of the vertebrae are attached ribs. In the disarticulated head it is possible to recognize the premaxillare, maxillare, and dentale. The teeth are large, with marked striation.

The species is common in Moravian localities, such as Litenčice, Kelč, Špičky, Nikolčice, Mouchnice, Nítkovice, Jestřabice, Kožušice, Rožnov pod Radhoštěm (Kalabis and Schultz 1974, Kalabis 1975a, b, Gregorová and Požár 2003, Gregorová 2010, 2011).

Today living trichiurids are benthopelagic predators of the continental shelf and slope with depth up to 2000 m (in tropical and temperate regions; Gago 1998).

Perciformes gen. et sp. indet.

Text-fig. 2G

M a t e r i a l : one specimen NM Pc 02891; collected from the Subchert Mb.

R e m a r k s : The specimen is represented by an isolated preoperculum, preserved partly as an imprint, partly as a fossilized bone. Its ramus horizontalis is short (and robust) whereas the ramus verticalis is about twice longer. Both arms join together at almost a right angle. The posterior edge of the preoperculum is irregularly serrated, with one enlarged spine at the flexion point (see arrow in text-text-fig. 2G). The distal part of the enlarged spine is incompletely preserved. Classification of the specimen is difficult even though its morphology is relatively specific and it is comparable with some percichthyids, moronids, or polyprionids (see Schultz 2000: pl. 1, figs 18, 20, pl. 2 figs 29, 32). Although it is not possible to determine the specimen precisely, it is possible to say, that it does not belong to the species *"Serranus" budensis*.

Discussion

As was pointed out by Gregorová (1997b), the fossil fish remains found in the Subchert Mb. of the Moravian localities are very rare. The published material is concerned with the Litenčice locality (Gregorová 1997b, Bubík et al. 2006) where the assemblage is represented by Myctophidae, Trichiuridae, Clupeidae, Gadidae, Phosichtyidae, and Teleostei indet. and accompanied by remains of terrestrial flora. All these findings are related to the Pteropod Horizon.

Baciu (2010) reported *Keasius parvus*, *Clupea*, *Vinciguerria*, *Anenchelum*, Gadidae, *Palimphyes*, and Myctophidae from the same locality and horizon. Brzobohatý (1981) described clupeid scales from the Subchert Mb. captured in the Křepice – 5 borehole.

Clupeidae, *Sardinella sardinites*, *Scopeloides glarisianus*, an unspecified perciform were found in the Subchert Mb. at the Osíčko locality. The fossils are accompanied by undetermined fish bones (numerous debris), and fragments of carbonized and mineralized (? malachitized) organic material. The Subchert Mb. documents isolation of a sedimentary area from the World Ocean (Švábenická et al. 2007) which resulted in an insufficiently ventilated environment (Báldi 1980) which was then followed by mass mortality as documented by the Pteropod Horizon (Krhovský 1993).

The assemblage collected from the Dynów Mb. is characterized by the presence of *Keasius* sp., undetermined elasmobranchs and 3 types of Teleostei fishes, namely *Sardinella sardinites*, *"Glossanodon" musceli*, and *Anenchelum glarisianum*. These are commonly accompanied by fishes with light organs (mainly Myctophidae and Gonostomatidae) and other additional types of fishes at other Moravian localities (for conclusive data and the latest results see

Gregorová 1997b, 2011). Depletion of them may be related to limited numbers of findings.

From a bathymetric point of view, in accordance with other Moravian localities, the fish composition suggest mesopelagic to benthopelagic environments.

From the biostratigraphical point of view (sensu Kotlarczyk and Jerzmańska 1976, Kotlarczyk et al. 2006), the presence of *Scopeloides glarisianus* (in the Subchert Mb.) suggests the beginning of the IPM 1 Zone while the *"Glossanodon"* fossils (in the Dynów Mb.) indicate the IPM2 Zone. On the other hand it is necessary to mentioned the fakt that this biostratigraphic division is not completely valid (if at all) and in some parts of the Paratethys are individual zones obviously overlap (Gregorová 1997b).

Acknowledgements

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