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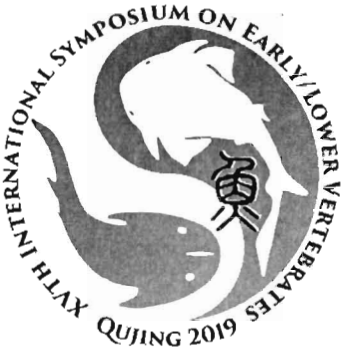

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newly described fossil materials indicate that South China was one of the centers of radiation and evolution of early sphenosids in the Late Devonian.

Diversity of the Famennian ptyctodont placoderms from the European Russia

Alexander O. Ivanov

Institute of Earth Sciences, St. Petersburg State University, St. Petersburg, Russia. *IvanovA-Paleo@yandex.ru*

The single ptyctodont *Chelyophorus verneuili* Agassiz 1844 is known from the Famennian (Late Devonian) of European part of Russia (Obrucheva, 1983). Although, five species of *Chelyophorus* were described earlier (Agassiz, 1844; Eichwald, 1861), they were included in synonymy of *Chelyophorus verneuili* (Denison, 1978; Obrucheva, 1983). *Chelyophorus verneuili* occurs in the Lebedyan - Plavsk Regional stages of several localities of Orel Region (Central Devonian Field): Rybnitsa quarry, Gamayunovo and Saburovo.

The study of specimens from the collections of Eichwald, Pander and Rohon, as well as from the new collections using a micro-CT allows to redescribed *Chelyophorus*. The material includes the numerous isolated plates of head and trunk shields, postcranial elements, as well as articulated specimens with orbital and occipital ossifications of endocranium. *Chelyophorus* is characterized by short and broad preorbital plates with transversal pit line and supraorbital sensory-line canal; small pineal surrounding by preorbital plates anteriorly and posteriorly; narrow central plates with posterior sensory-line canal; large nuchal plate; elongated marginal plates; arched median dorsal plate with triangular posterior groove and short ventral keel; short and broad anterior dorsolateral, lateral and ventrolateral plates; and long heamal and neural arches.

A new ptyctodont has been found in the Lebedyan – Optukha interval of Famennian in the Orel Region. The head shield of a new genus possesses the large pineal plate placed anteriorly; the long and wide preorbital plates with single supraorbital sensory-line canal; the large central plates bearing the posterior sensory-line canal and posterior part of supraorbital canal; the wide postorbital and paranuchal plates; long and narrow orbital and occipital ossifications of endocranium. The nuchal plate is missing and the central plates have a contact along midline of the head shield. The supraorbital and posterior sensory-line canals meet in the anterior part of that contact. Such structure of the head shield with missing nuchal plate is still

unknown among the ptyctodonts. The head shield of *Denisonodus plutonensis* Johnson and Elliott 1996 has a small nuchal (postpineal) plate and long contact of central plates (Johnson and Elliott, 1996).

The Famennian ptyctodonts of the Central Devonian Field demonstrate the diversity in the morphology of head shield unknown in other taxa. Possibly, a new genus with subsequent reduction of nuchal plate belongs to some Frasnian ptyctodonts, such *Ctenurella*, *Kimbryanodus* and *Australoptyctodus*.

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Late Palaeozoic anachronistid neoselachians: diversity and dental morphology

Alexander O. Ivanov[1], Christopher J. Duffin[2]

[1] Institute of Earth Sciences, St. Petersburg State University, St. Petersburg, Russia. *IvanovA-Paleo@yandex.ru*

[2] Palaeontology Section, Earth Science Department, The Natural History Museum, London, United Kingdom. *cduffin@blueyonder.co.uk*

The oldest neoselachian sharks belong to the family Anachronistidae. They have been described from isolated teeth and have been recorded from Viséan (early Carboniferous) to Capitanian (middle Permian) rocks of Europe, South and North America. The dentition of anachronistid sharks is characterized by a unique tooth morphology: they possess a smooth crown in which the occlusal crest separates the short lingual face from an extended, sloping labial face which is produced to form a well-developed labial flange; the crown/base junction is incised; and the base has an extended lingual face and a narrow labial face, with a basal tubercle located under the

labial flange. The orthodont crown possesses a thin single layered enameloid with randomly oriented short crystallites. The simplified vascularization system of anachronistid neoselachians comprises a single main vascular canal connected to the pulp cavity.

The genus *Cooleyella* currently includes four species: *C. amazonensis* Duffin, Richter and Neis 1996, *C. duffini* Ivanov 2015, *C. fordi* (Duffin and Ward 1983), and *C. peculiaris* Gunnell 1933, the type species. Teeth of *Cooleyella* have a crown generally possessing three quite short cusps, the central cusp being well developed, a long labial flange, a basal pit leading to a large "T"-shaped pulp cavity, and a single vascular canal in the base with openings labially and lingually.

The teeth of *Ginteria fungiforma* Duffin and Ivanov 2008 are characterized by their overall mushroom-like shape, triangular labial and lingual crown surfaces, an occlusal crest with a central dip, a pedestal-like, deeply incised crown/base junction, and several vascular canals opening on the lingual side of the base (Duffin and Ivanov, 2008). The vascularization system of the teeth includes two lateral and two thin pulp canals.

The teeth of the recently described *Amaradontus santuccii* Hodnett and Elliott 2018 possess a crown which has a short labial surface and labial flange; high central and moderate lateral cusps; rare striations on the crown; and poorly developed basal tubercles (Hodnett and Elliott, 2018).

The teeth of a new anachronistid found in the Serpukhovian of the Moscow Region (Russia) have a crown which has three to five acuminate cusps, a large central cusp, short vertical striations on both surfaces, a poorly developed labial flange, and a very prominent basal tubercle (Ivanov et al., 2014). The vascularization system of the teeth comprises a large transverse and two longitudinal lateral canals.

The teeth of *Ginteria* vary little in morphology and represent a relatively homodont dentition. Variations in the weakly heterodont dentition of *Cooleyella* include slight differences in the height of central cusp, the relative proportions of crown and base, and the length of the labial flange. The dentitions of *Amaradontus* and the new anachronistid, by contrast, are strongly heterodont. The teeth of the new anachronistid vary considerably in the number of cusps, the height of central cusp, and in the degree of crown asymmetry.

Thus, anachronistid neoselachians include two groups, which can probably be distinguished at the subfamily level. The first, comprising *Ginteria* and *Cooleyella,* had a homodont or weakly heterodont dentition. The second group, consisting of *Amaradontus* and the new anachronistid, possessed a strongly heterodont dentition including teeth with asymmetrical crowns.

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Three dimensional paleohistology of the dorsal fin spine of *Psarolepis romeri*

Anna Jerve[1], Min Zhu[2], Sophie Sanchez[1,3], Qingming Qu[1,4], Jing Lu[4], Paul Tafforeau[3], Per Erik Ahlberg[1]

[1]Department of Organismal Biology, Uppsala University, Uppsala, Sweden.
anna.jerve@ebc.uu.se
[2]Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China
[3]European Synchrotron Radiation Facility, Grenoble, France
[4]Department of Biology, University of Ottawa, Ottawa, Ontario, Canada

Dermal spine are structures composed of differing proportions of bone, dentine, and sometimes an outer hypermineralized layer. They include the spines associated with the shoulder girdle and dorsal midline of the bodies and of placoderms (Jerve et al., 2017a), and fin spines that sit anterior to fins in acanthodians (Jerve, et al., 2017b), chondrichthyans, and fossil osteichthyans (Zhu et al., 1999; Jerve et al., 2016). Fin spines are widely used for studying early vertebrate relationships, but their characters are mostly limited to external morphology (Zhu et al., 2009). High-resolution propagation phase-contrast synchrotron radiation microtomography has shown that fin spines are a valuable source of phylogenetically informative characters relating to composition, cell distribution, and vascular morphology. These data also reveal information about the growth and development of the structures, underscoring the importance of using 3D data to investigate questions related to the evolution of the vertebrate skeleton (Jerve et al., 2016, 2017a, b). *Psarolepis romeri* is an early bony fish that was discovered in upper Silurian to Lower Devonian (410 Ma) rocks, around 10 km northwest of Qujing in Yunnan Province, China. This taxon is vital to our understanding of early vertebrate morphology as it has an array of characteristics from all major groups of jawed vertebrates, including the presence of dorsal and pectoral fin spines traditionally attributed to placoderms, acanthodians, and chondrichthyans; sarcopterygian-like skull and lower jaw; and tooth-bearing median rostral bone as in actinopterygians, placing it near the base of the osteichthyan phylogeny (Zhu et al., 1999). *Psarolepis* is one of the few fin spine-bearing osteichthyans that has well preserved histology, and while there is a detailed study on