

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

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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.

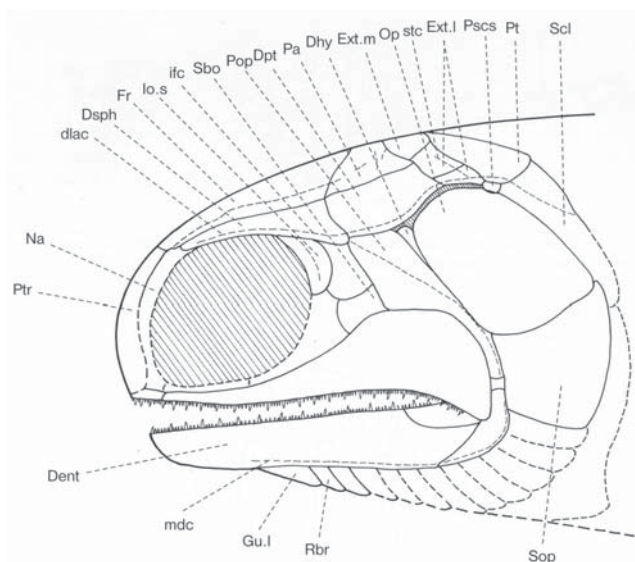
**Locus typicus:** Kladoruby “Dolní Pepřík”, near the town Letovice, Blansko district, Czech Republic.

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

**Occurrence:** Kladoruby “Dolní Pepřík”, Letovice “Jindřichov”, Zbraslavce.

**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 – dentalosplenic; Dhy – dermohyal; dliac – 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 – postspiracular; Pt – posttemporal; Ptr – postrostral; Rbr – branchiostegal rays; Sbo – suborbital; Scl – supracleithrum; Sop – suboperculum; stc – supratemporal commissural sensory canal.

The scale count is

$$\begin{array}{r} - \\ 15 \ 30 \ 46 \\ \hline 52 \end{array}$$

***Letovichthys multidentatus* ŠTAMBERG, 2007**

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

**H o l o t y p e:** Specimen MHK 72436 (part and counterpart) with well-preserved dentition on the jaws, partly preserved jaws, bones of the skull roof, and body.

**L o c u s t y p i c u s:** Kladoruby “Dolní Pepřík”, near the town of Letovice, Blansko district, Czech Republic.

**S t r a t u m t y p i c u m:** Lubě Horizon, Lower Letovice Formation, Lower Permian.

**O c c u r r e n c e:** Kladoruby “Dolní Pepřík”.

**D i a g n o s i s:** 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.

**R e m a r k s:** *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**

**D i a g n o s i s** (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.

**I n c l u d e d g e n e r a:** Only *Elonichthys* GIEBEL, 1848 is known from the Bohemian Massif.

**“*Elonichthys*” GIEBEL, 1848**

**T y p e s p e c i e s:** *Elonichthys germari* GIEBEL, 1848.

**D i a g n o s i s** (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 inequilateral. 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 lanianies 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*” *krejčii* (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 krejčii* (FRİČ, 1895); Štamberg, p. 31, figs 3–5, pls. 1–3.  
1991 *Watsonichthys sphaerosideritarum* (FRİČ, 1895); Štamberg, p. 37, figs 6–11, pl. 4.  
2006 “*Elonichthys*” *krejčii* (FRİČ 1895); Štamberg, p. 223, fig. 2C  
2006 “*Elonichthys*” *sphaerosideritarum* (FRİČ 1895); Štamberg, p. 223, fig. 2B  
2010 “*Elonichthys*” *krejčii* (FRİČ, 1895); Štamberg, p. 165; figs 9, 10.

**H o l o t y p e:** 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).

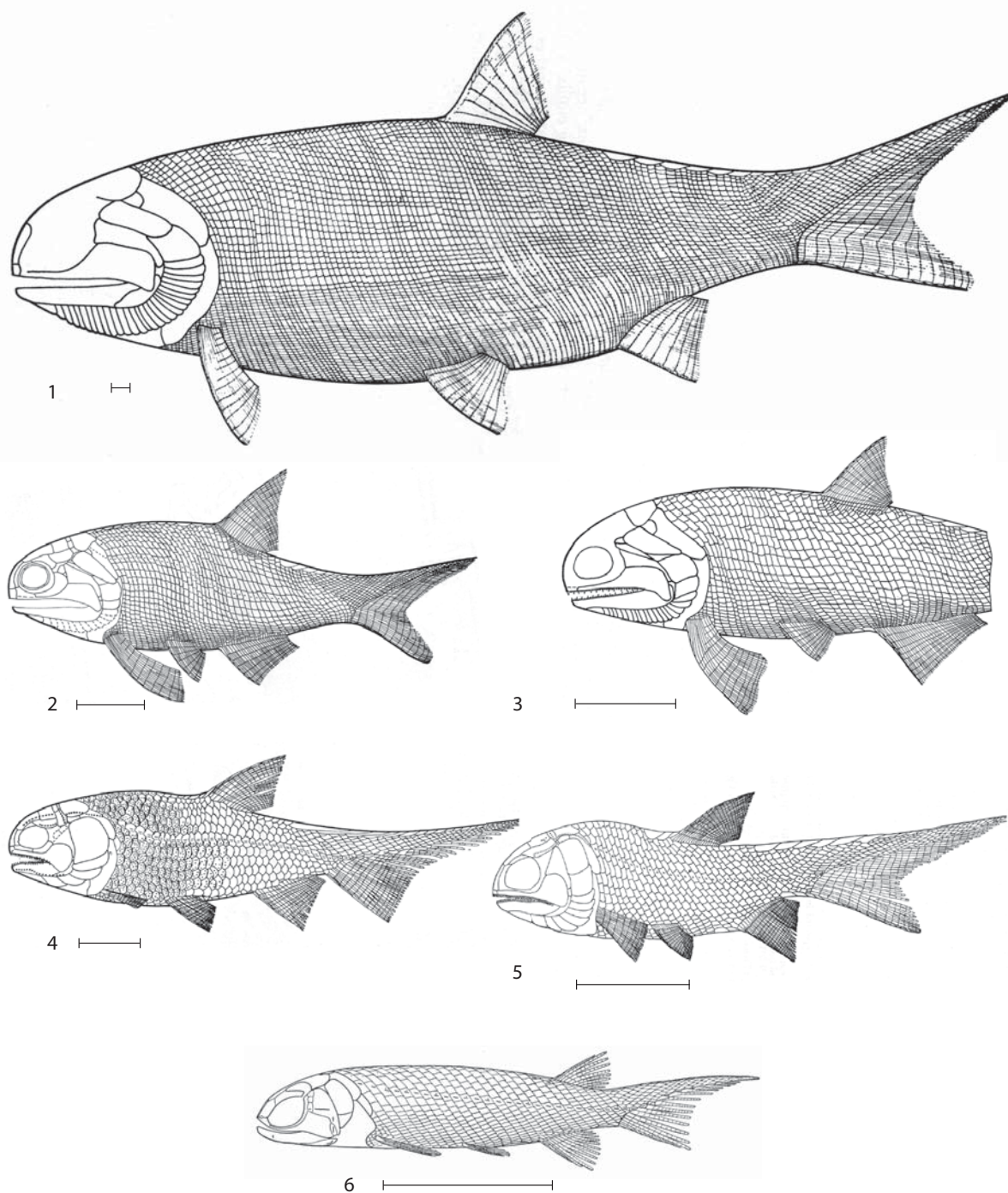


**Locus typicus:** Malesice, district Plzeň – north, Czech Republic.

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

**Occurrence:** A few fragments of the bodies are known as sphaerosiderite 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).

**Diagnosis** (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*” *krejci* (FRITSCH, 1895), figured after the original holotype of *Acrolepis sphaerosideritarum* FRITSCH, 1895, 3 – “*Elonichthys*” *krejci* (FRITSCH, 1895), figured after the original holotype of *Acrolepis krejci* 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 krejci* and *Acrolepis sphaerosideritarum* from the sphaerosiderite 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*” *krejci*. The significant difference in the shape of the upper jaw is the primary reason for removing “*E.*” *krejci* 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*” *krejci* 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*” *krejci* (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.

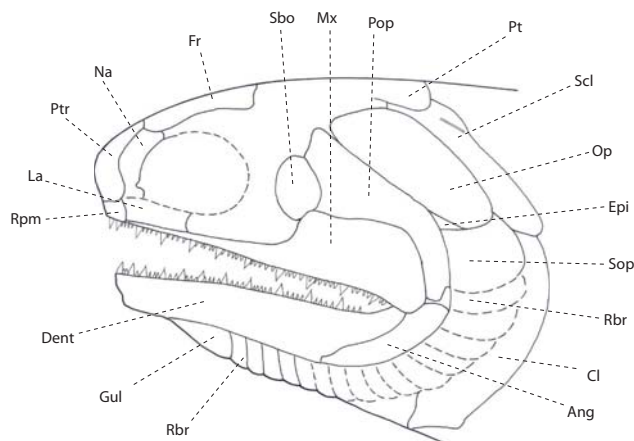
**Stratum typicum:** Kounov Member, Stephanian B, Upper Carboniferous, Kladno–Rakovník Basin.

**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*.

**Diagnosis:** 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.

**Remarks:** *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* (FRİČ, 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 – rostrompremaxillar; Sbo – suborbital; Scl – supracleithrum; Sop – suboperculum.**

#### Genus *Zaborichthys* ŠTAMBERG, 1989

**Type species:** *Zaborichthys fragmentalis* ŠTAMBERG, 1989.

**Included species:** Only type species.

**Diagnosis** (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.

**Holotype:** 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.

**Diagnosis:** Same as for genus.

**Locus typicus:** Zábřeh, district Plzeň – north, Czech Republic.

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

**Occurrence:** 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

**Type genus:** *Acrolepis* AGASSIZ, 1833

**Included genera:** Only *Acrolepis* is known from the Bohemian Massif.

#### Genus *Acrolepis* AGASSIZ, 1833

**Type species:** *Acrolepis sedgwicki* AGASSIZ, 1833.

**Included species:** Only *Acrolepis gigas* (FRİČ, 1877) occurs in the Bohemian Massif.

**Diagnosis** (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. krejci* 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*” *krejci* 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*” *krejci* (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 *Trissolepididae* FRITSCH, 1895 together with the *Sphaerolepis* FRIČ, 1877 – the type genus of the family *Trissolepididae* (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* (FRİÇ); Lehman, p. 78, p. 79.  
 1967 *Sceletophorus biserialis* FRİÇ; Gardiner, p. 169, figs 19–21.  
 1983 *Sceletophorus biserialis* FRİÇ, 1895; Štamberg, p. 44, figs 1–10.  
 1991 *Sceletophorus biserialis* FRİÇ, 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 verrucosus* (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* (FRİÇ, 1895); Štamberg, p. 61, figs 11–14.

1991 *Sceletophorus verrucosus* (FRİÇ, 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 verrucosus* was reassigned (Štamberg 1983) as *Sceletophorus verrucosus* (FRITSCH, 1894).

### Family *Trissolepidae* FRITSCH, 1893

**Type genus**: *Sphaerolepis* FRİÇ, 1877.

**Included genera**: Type genus only.

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

### Genus *Sphaerolepis* FRİÇ, 1877

**Type species**: *Sphaerolepis kounoviensis* FRİÇ, 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 buccohypophysial 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°. Suboperculum 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.

**L e c t o t y p e** (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).

**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**: Kounov, distr. Rakovník, Czech Republic.

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

**R e m a r k s**: 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 available 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 suboperculum) 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**

**T y p e g e n u s**: *Igornichthys* HEYLER, 1969.

**I n c l u d e d g e n e r a**: Only *Igornichthys* HEYLER, 1969 and *Setlikia* ŠTAMBERG et ZAJÍC, 1994 occur in the Bohemian Massif.

**Genus Igornichthys HEYLER, 1969**

**T y p e s p e c i e s**: *Igornichthys doubingeri* HEYLER, 1972.

**D i a g n o s i s** (after Heyler 1969): Maxilla with the strong maxillary plate which is prolonged ventroposteriorly; lower jaw strong, not high posteriorly; operculum and suboperculum 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 9<sup>th</sup> 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.

**C h a r a c t e r i s t i c s**: 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 bohémica* 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 bohémica* ŠTAMBERG et ZAJÍC, 1994

Text-fig. 4

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

2006 *Setlikia bohémica* ŠTAMBERG et ZAJÍC, 1994; Štamberg, p. 224.

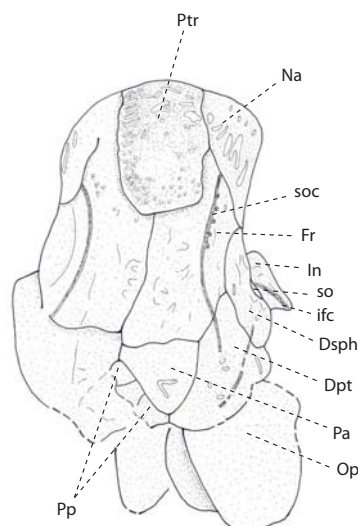
**Holotype:** Specimen Ya 1352 deposited in the collection of the Czech Geological Survey, Prague.

**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 bohémica* 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 bohémica* 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 Aduellidae ROMER, 1945

**Type genus:** *Aduella* WESTOLL, 1937.

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

**Diagnosis** (after Poplin 2001, 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

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

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.

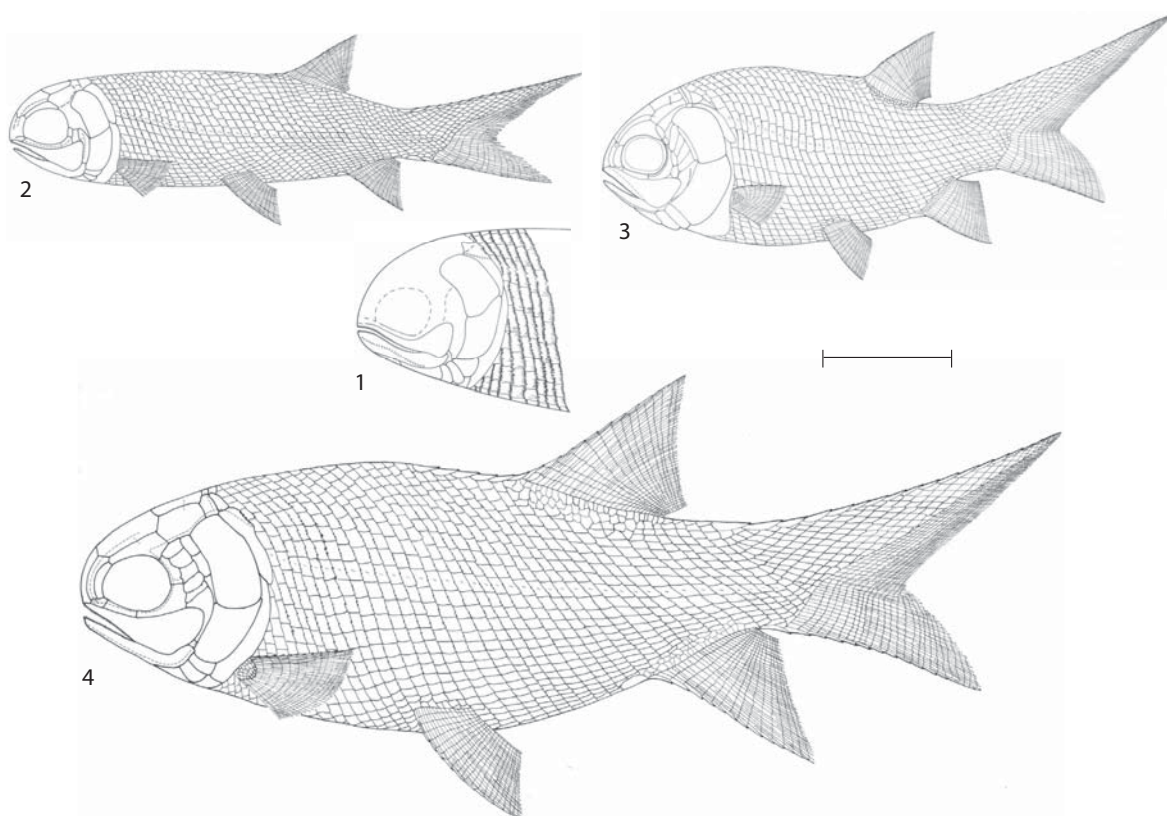
Referred specimens: Besides the holotype, specimen MHK 70611, and plate MHK 70610 (part and counterpart), there are two specimens: one of which belongs to *Bourbonnella hirsuta*, and the other to the genus *Paramblypterus*.

Locustypicus: 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 rzhaki* 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 suboperculum is high, the operculum is 1.5 times higher than the suboperculum. The posterior edge of the suboperculum 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 inequilateral. 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 suboperculum. 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): Aeuellid 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, inequilateral. 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 dermothyal 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.

**H o l o t y p e:** Specimen MHK 80447 deposited in the Museum of Eastern Bohemia at Hradec Králové.

**T y p e h o r i z o n a n d l o c a l i t y:** Košťálov (“Behind the Tavern”); Rudník Horizon, Vrchlabí Formation, Asselian, Krkonoše Piedmont Basin.

**O c c u r r e n c e:** 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).

**D i a g n o s i s** (after Štamberg 2010): Small aeuellid 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:

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

**R e m a r k s:** *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 aeuellids 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**

**T y p e s p e c i e s:** *Spinarichthys dispersus* (FRITSCH, 1895).

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

**D i a g n o s i s** (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* (FRIC, 1895); Štamberg, p. 156, figs 1–6, 7B, pls. 1, 2.

**D i a g n o s i s:** The same as for the genus.

**H o l o t y p e:** Specimen M 814 and the cast M 1200 of the same specimen deposited in the National Museum, Prague.

**T y p e l o c a l i t y:** Kounov, district Rakovník, Czech Republic.

**S t r a t u m t y p i c u m:** Kounov Member, Stephanian B, Kladno and Rakovník Basins.

**O c c u r r e n c e:** Several localities of the Kladno and Rakovník Basins and Krkonoše Piedmont Basin (see Štamberg and Zajíc 2008).

**R e m a r k s:** 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.

**Material:** 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).

**Locality and stratigraphical range:** Klášterská Lhota, near Vrchlabí. Krkonoše Piedmont Basin, Early Permian, Prosečné Formation.

**Remarks:** 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

**Diagnosis** (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.

**Included genera** from the Bohemian Massif: *Paramblypterus* SAUVAGE, 1888.

#### Genus *Paramblypterus* SAUVAGE, 1888

**Diagnosis** (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.

**Included species** from the Bohemian Massif: *Paramblypterus rohani* (HECKEL, 1861); *Paramblypterus reussii* (HECKEL, 1861), *Paramblypterus vratslaviensis* (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).

**Remarks:** 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.; Zidek, 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 rohoni* (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 Zidek (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)**

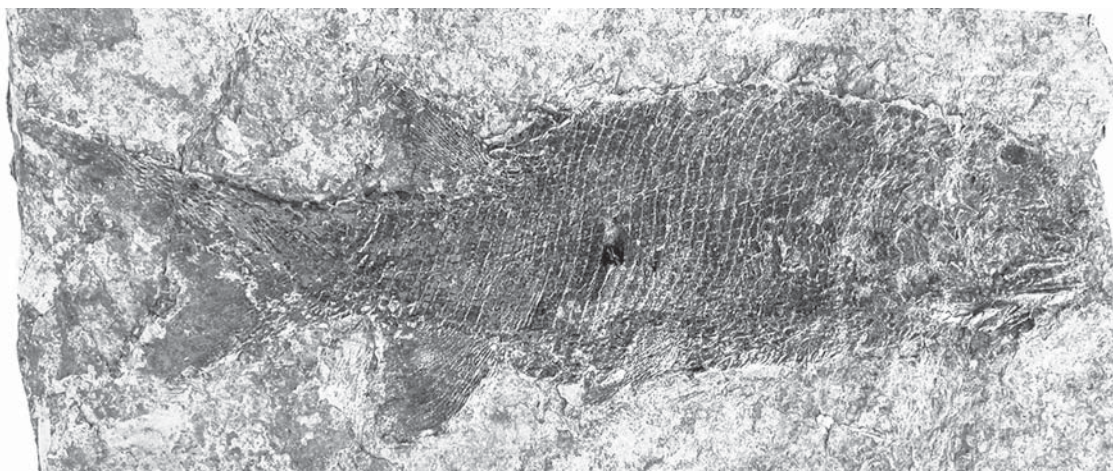
Pl. 2, fig. 3

- 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.

**Occurrence:** Čistá; Ruprechtice “Limestone quarries”; Olivětín; Horní Kalná; Veselá; Bítouchov.

**Remarks:** *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.

**Characteristics:** (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.

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

**Type locality and horizon:** Specimen M 1352 was found in Horní Kalná (Kalná Horizon), Prosečné Formation), and specimen M 898 was found in Bítouchov (Prosečné Formation, Sakmarián, Krkonoše Piedmont Basin).

**Remarks:** 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.

**Characteristics:** (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.

**Types:** Holotype M 901 described and figured by Fritsch (1895, pl. 125, figs 4–5) is deposited in the National Museum, Prague.

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

**Occurrence:** Horní Kalná; Horní Kalná “Za garáží”; Klášterská Lhota; Ruprechtice.

**Remarks:** 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.



**Material:** 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.

**Remarks:** 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 **Haplolepididae** WESTOLL, 1944

Type genus: *Haplolepis* MILLER, 1892.

Included genera from the Bohemian Massif: *Pyritocephalus* FRITSCH, 1894.

#### Genus **Pyritocephalus** FRITSCH, 1894

Type species: *Pyritocephalus sculptus* (FRIČ, 1875).

**Diagnosis** (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.

Included species: *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.

**Lectotype** (Štamberg 1978): Specimen figured by Fritsch (1894) on pl. 115, fig. 4, deposited in the National Museum, Prague under No. M 1201.

**Diagnosis** (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

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

Type locality: Nýřany, district Plzeň, Czech Republic.

Stratum typicum: Nýřany Member, Westphalian D, Late Carboniferous, Plzeň Basin.

Occurrence: Nýřany, Třemošná.

**Remarks:** 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*” *krejci* (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 bohemia* ŠTAMBERG et ZAJÍC, 1994; *Bourbonnella hirsuta* ŠTAMBERG, 2007; *Neslovicella rzehaki* ŠTAMBERG, 2007; *Neslovicella elongata* ŠTAMBERG, 2010; *Spinariichthys dispersus* (FRITSCH, 1895); *Paramblypterus rohani* (HECKEL, 1861); *Paramblypterus reussii* (HECKEL, 1861), *Paramblypterus vratislaviensis* (AGASSIZ, 1833); *Paramblypterus kablikae* (GEINITZ, 1860); *Paramblypterus feistmanteli* FRITSCH, 1895; *Paramblypterus zeidlereri* 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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## Explanations of the plates

### PLATE 1

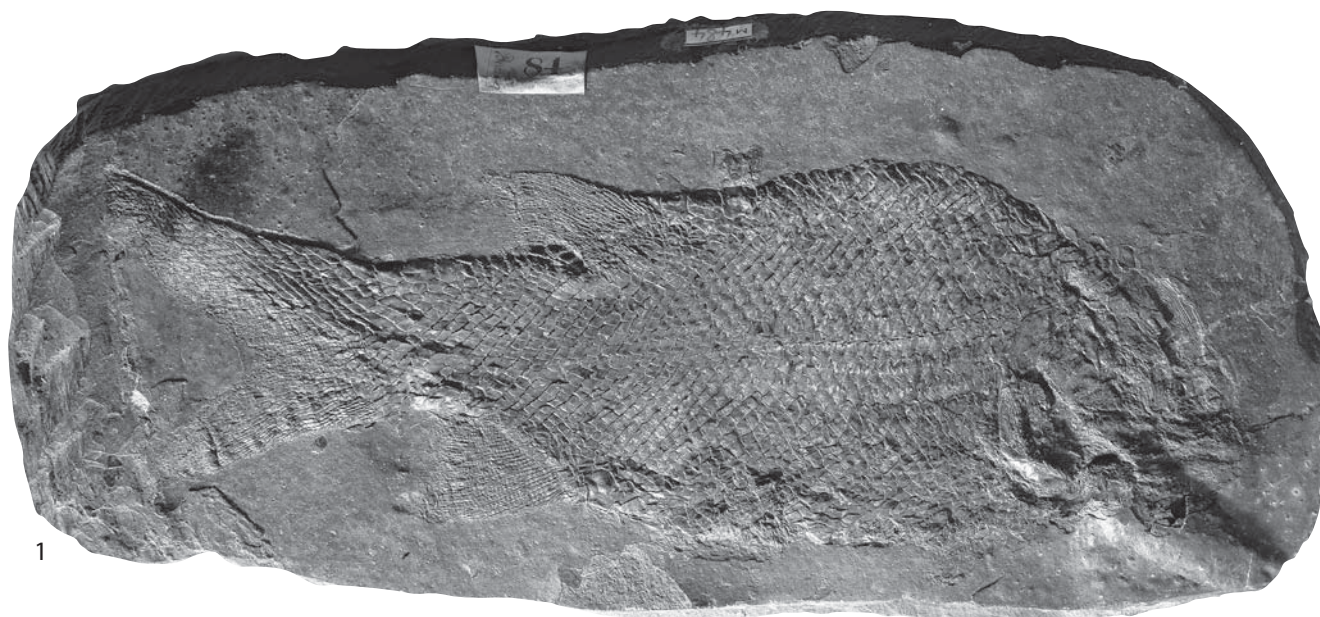
1. *Paramblypterus rohani* (HECKEL, 1861). Specimen M 484 from Košťálov (Early Permian, Krkonose Piedmont Basin), x 0.7.
2. *Paramblypterus reussii* (HECKEL, 1861). Holotype M 1215 from Semily (Early Permian, Krkonose Piedmont Basin), x 0.9.

3. *Paramblypterus zeidleri* (FRITSCH, 1895). Holotype M 901 from Ruprechtice (Early Permian, Intrasudetic Basin), x 1.

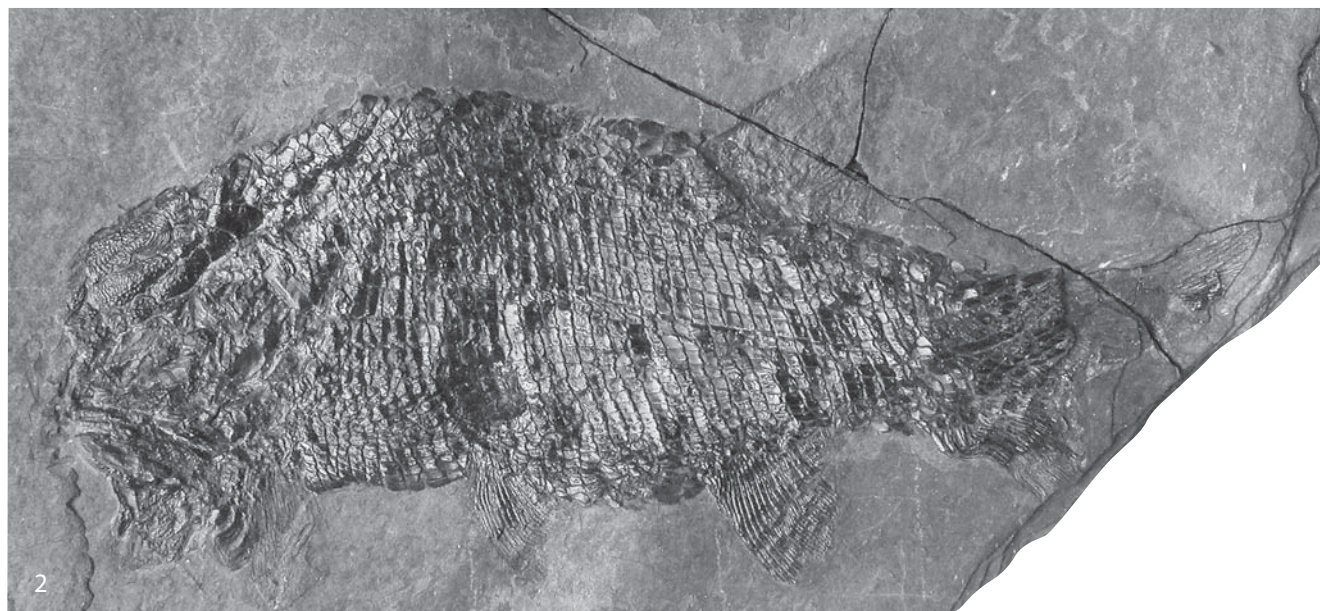
## PLATE 2

1. *Neslovicella elongata* ŠTAMBERG, 2010. Specimen P 167 from Košťálov (Early Permian, Krkonoše Piedmont 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.

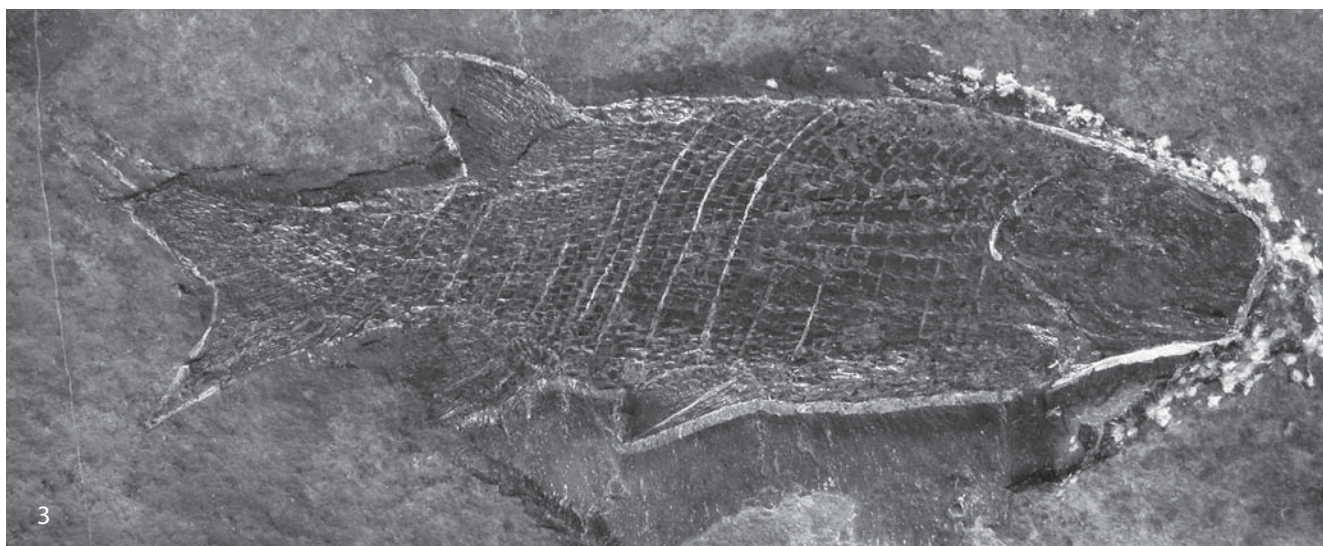




1



2



3



PLATE 2

