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Autor: Bürgin, Toni
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Actinopterygian fishes (Osteichthyes; Actinopterygii) from the Kalkschieferzone (Uppermost Ladinian) near Meride (Canton Ticino, Southern Switzerland)

TONI BÜRGIN¹

Key words: Kalkschieferzone, Middle Triassic, Monte San Giorgio, fossil Actinopterygii, *Perleidus*

ABSTRACT

During three small-scale excavations in the Kalkschiefer-Zone (Uppermost Ladinian) near the village of Meride, Canton Ticino, some fish fossils were found alongside remains of plants, invertebrates and reptiles. The fishes are exclusively actinopterygians, with the neopterygian *Prohalecites porroi* being the predominant species with 60 found specimens. Five specimens of *Perleidus altolepis* allow a more detailed reconstruction of this species. Among the other taxa found are a fragment of *Gyrolepis* sp., two, presumably new species of *Peltopleurus*, a few specimens of *Archaeosemionotus* sp. and three specimens of *Ophiopsis* cf. *lepturus*. A preliminary comparison is made between the fossil fishes found near the village of Meride and those already described from the contemporaneous locality Ca' del Frate, (Viggiù, Northern Italy).

ZUSAMMENFASSUNG

Anlässlich drei kleinerer Grabungen in der Kalkschieferzone (spätes Ladin) nahe der Ortschaft Meride, Kanton Tessin, wurden neben Pflanzen-, Invertebraten- und Reptilresten auch eine Anzahl Fische gefunden. Bei den Fischen handelt es sich ausschliesslich um Actinopterygier, wobei Funde des Neopterygiers *Prohalecites porroi* mit rund 60 Exemplaren deutlich überwiegen. Fünf Exemplare von *Perleidus altolepis* lassen eine verbesserte Rekonstruktion dieser Art zu. Unter den weiteren Funden finden sich ein Fragment von *Gyrolepis* sp., zwei, vermutlich neue Arten der Gattung *Peltopleurus*, wenige *Archaeosemionotus* sp. und drei Exemplare von *Ophiopsis* cf. *lepturus*. Die Funde aus der Nähe von Meride werden soweit möglich mit den bisher beschriebenen fossilen Fischen aus der zeitgleichen Fundstelle Ca' del Frate (Viggiù, Norditalien) verglichen.

RESUME

Au cours de trois petits creusements dans la zone du Kalkschiefer (Ladinien le plus haut) auprès du village de Meride, Canton du Tessin, on a trouvé à part des restes de plantes, d'invertébrés et de reptiles ainsi que de poissons. Les poissons représentent seulement des actinoptérygiens, avec une dominance claire du néoptérygien *Prohalecites porroi*. Cinq spécimens de *Perleidus altolepis* permettent pour cette espèce une reconstruction plus détaillée que d'avant. Parmi les autres spécimens trouvés on constate *Gyrolepis* sp., deux, probablement nouvelles espèces du genre *Peltopleurus*, quelques *Archaeosemionotus* sp. et trois spécimens de *Ophiopsis* cf. *lepturus*. Finalement une comparaison préliminaire est faite entre les espèces auprès du village de Meride et celles-ci déjà décrits de la localité contemporaine de Ca' del Frate (Viggiù, Italie Nord).

¹ Hellberg, CH-8626 Ottikon

RIASSUNTO

Nell'ambito di tre piccole scavi eseguite presso il villaggio di Meride (Ticino meridionale, Svizzera) nella Kalkschieferzone (parte più alta del Ladinico superiore) sono stati trovati resti di piante, invertebrati, rettili e di pesci. Si tratta esclusivamente di pesci ossei tra i quali gli Neopterygii *Prohalecites porroi* sono rappresentati da ben 60 esemplari. Cinque esemplari di *Perleidus altolepis* permettono una ricostruzione più dettagliata di questa specie. Tra le altre forme rinvenute vengono segnalati frammenti di *Gyrolepis* sp., probabilmente due nuove specie di *Peltopleurus*, alcuni *Archaeosemionotus* sp., e tre esemplari di *Ophiopsis* cf. *lepturus*. E' inoltre possibile un primo confronto fra le specie rinvenute presso Meride e quelle contemporanee della località di Ca' del Frate presso Viggiù (Italia settentrionale).

1. Introduction

Wirz (1945), in his study on the Ladinian of Monte San Giorgio, mentioned the presence of plant remains, estherids, fish remains and coproliths in various strata of the so-called Kalkschieferzone (Calcari di Meride superiori of Italian authors). In 1971 a small *Lariosaurus* was found together with remains of estherids and some small actinopterygian fishes (Kuhn-Schnyder 1987, Bürgin 1992). Since then, no additional excavations have been carried out by Swiss paleontologists. However, between 1984 and 1990 volunteers from the Museo di Induno Olona together with scientists from the University of Milano explored some strata rich in fossils of the lower Kalkschieferzone in the neighbourhood of Ca' del Frate (above the village of Besano). They found two specimens of *Lariosaurus*, hundreds of actinopterygians and various invertebrates (Tintori et al. 1985, Tintori 1990a, 1990b, 1990c, 1990d, Tintori & Renesto 1990, Tintori 1992). Four actinopterygian species have already been recorded earlier by de Alessandri (1910) from a locality in the vicinity of Ca' del Frate.

In September 1994 three small-scale excavations were carried out by scientists of the Paläontologische Institut und Museum der Universität Zürich along the river Gaggiolo, close to the village of Meride (Furrer this volume). The main aim of this excavation was to prepare a preliminary species list, with additional data on the occurrence, frequency and the taphonomy of the fossils. The geochemistry and diagenesis of the sediments will be studied in detail in a diploma thesis carried out by Davide Bionda, Geologisches Institut der Eidgenössischen Technischen Hochschule Zürich.

The fossils from the 1994 excavations have been deposited in the Museo cantonale di storia naturale, Lugano, whereas those from the previous diggings are stored in the Tessin collection of the Paläontologische Institut und Museum, University of Zürich. There too, detailed information on the layers can be found. Some of the specimens have been mechanically prepared with steel needles; a few of them have been treated with dilute formic acid.

Abbreviations:

Paläontologisches Institut und Museum der Universität Zürich = PIMUZ

Museo cantonale di storia naturale, Lugano = MCSN

2. Systematic paleontology

The plants, invertebrates and reptiles, their taphonomy as well as the geology, stratigraphy and paleogeography of the localities are described in Furrer (this volume), where a complete floral and faunal list can be found as well.

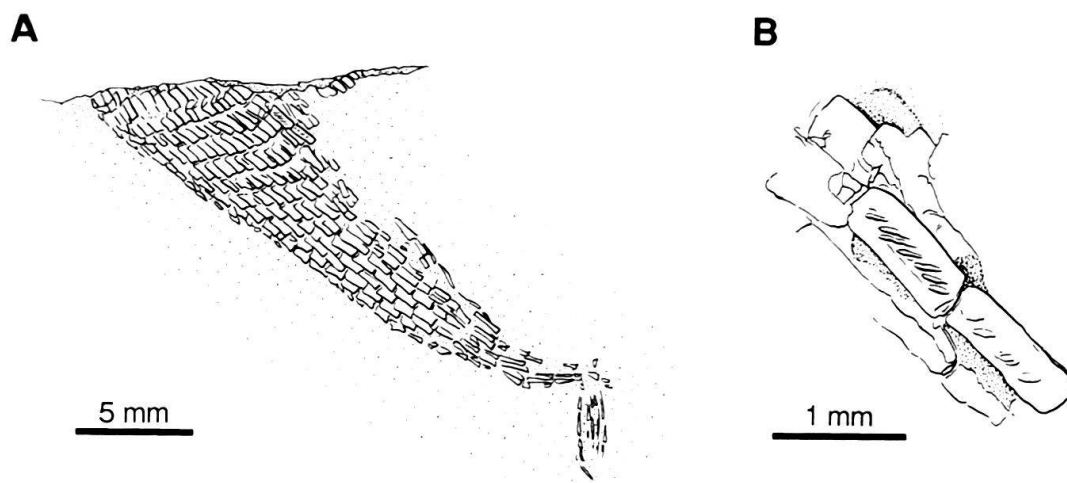


Fig. 1. *Gyrolepis* sp. PMIUZ T. 4959, fragment of the caudal fin. A: Overview; B: Detail showing the ornamentation of some basal lepidotrich segments.

Class Osteichthyes HUXLEY 1880

Subclass Actinopterygii KLEIN 1885

Order Palaeonisciformes HAY 1929

Family Palaeoniscidae sensu ALDINGER 1937

Genus *Gyrolepis* AGASSIZ 1833

Diagnosis: See Bürgin (1992: 12).

Distribution: The genus *Gyrolepis* is known from the Lower Triassic of eastern Asia, the Middle and Upper Triassic of Switzerland, Italy, Germany, France, England, Ireland, Sweden and the Upper Triassic of the United States.

Gyrolepis sp.

(Fig. 1)

Referred material: PIMUZ T 4959, part of a caudal fin lobe.

Description: The 23 mm long remain of a caudal fin lobe shows a considerably extended and narrow tip. There are about 20 segmented fin rays preserved. The presence of fringing fulcra has not been confirmed. The more basal and stouter segments show an ornamentation consisting of small, parallel ganoine ridges (Fig. 1).

Remarks: The reason to attribute this fragment to the genus *Gyrolepis* is based exclusively on the presence of the above described ornamentation of the lepidotrich segments. This kind of ornamentation has been reported from some *Gyrolepis* specimens from the Middle Triassic (Ladinian) of Monte San Giorgio (Bürgin 1992: Fig. 4E). The genus *Gyrolepis* represents the type of a medium sized pursuit hunter, with a pointed snout, a spindle-shaped body and a deeply forked, heterocercal caudal fin. Various, well preserved specimens are known from the German Muschelkalk (e.g. Dames 1888, Stolley 1920).

Order Perleidiformes BERG 1940
Family Perleididae BROUGH 1931

Genus *Perleldus* DE ALESSANDRI 1910

Synonymy: See Bärgin (1992: 59–60).

Diagnosis: See Stensiö (1932: 186–187) and Bärgin (1992: 60).

Distribution: The genus *Perleldus* was erected by de Alessandri (1910) to characterize a Perleidid (then Catopterid) species described by Deecke (1889) as *Semionotus altolepis*. According to de Alessandri (1910) the holotype of this species found in Perledo (Northern Italy) is stored at the Naturmuseum Senckenberg in Frankfurt, Germany, from where a second specimen is described, too (Stensiö 1921). The genus *Perleldus* had an almost worldwide distribution in the Lower and Middle Triassic (Neuman 1986, Beltan 1988).

Perleldus altolepis (DEECKE 1889)
(Fig. 2–6)

- 1857 ? *Lepidotus serratus* BELLOTTI; C. Bellotti, Studii geologici e paleontologici sulla Lombardia, p. 419.
- 1889 *Semionotus altolepis* DEECKE; W. Deecke, Palaeontographica 35, pp. 120–121, plt. VI, fig. 10.
- 1895 *Semionotus altolepis* DEECKE; A. S. Woodward, Catalogue of the Fossil Fishes in the British Museum (Natural History), part III, p. 57.
- 1901 *Semionotus altolepis* DEECKE; E. Schellwien, Schrift. Phys.-ökonom. Ges. Königsberg, pp. 24–25.
- 1906 *Semionotus altolepis* DEECKE; O. Abel, Jb. K. K. geol. Reichsanstalt Wien 46, p. 5.
- 1910 *Heterolepidotus serratus* BELLOTTI; G. de Alessandri, Mem. Soc. It. Sci. Nat. Mus. Civ. Stor. Nat. Milano 7 (1), pp. 103–105, plt. VI, fig. 3.
- 1910 *Perleldus altolepis* (DEECKE); G. de Alessandri, Mem. Soc. It. Sci. Nat. Mus. Civ. Stor. Nat. Milano 7 (1), pp. 49–51, plt. II, fig. 2.
- 1921 *Perleldus altolepis* (DEECKE); E. A:son Stensiö, Triassic Fishes from Spitzbergen, part I, pp. 256–257, text-fig. 78–79.
- 1932 *Perleldus altolepis* (DEECKE); E. A:son Stensiö, Medd. Grönl. 83 (3), pp. 214–215, 218 & 221.
- 1934 *Perleldus altolepis* (DEECKE); J. Piveteau, Ann. Paléont. 23, p. 131.
- 1952 *Perleldus altolepis* (DEECKE); J.-P. Lehman, Kungl. Svenska Vetensk. Handl. 2 (6), p. 137.
- 1990 *Perleldus altolepis* (DEECKE); A. Tintori, Pesci Fossili Italiani – scoperto e riscoperto, pp. 31–33.
- 1990 *Perleldus altolepis* (DEECKE); A. Tintori, Atti Tic. Sc. Terra 33, pp. 193, plt. 1.
- 1992 *Perleldus* sp.; T. Bärgin, Schweiz. Paläont. Abh. 114, pp. 60–61, fig. 59.

Referred material: MCSN 3007, a nearly complete specimen from the 1994 quarry level 2, lacking only the skull-roof (Fig. 2, 3); MCSN 3008, a small specimen in similar condition from rock-fall debris (Fig. 4); PIMUZ T 4960, a body with dorsal and anal fin and the ventral parts of the skull, T 4961 a small, incompletely preserved acid-prepared specimen (Fig. 5) and T 4798, an almost complete, but strongly weathered specimen (described in Bärgin 1992: 60–61) from a small-scale excavation in 1971; T 4962 with counterplate T 4962a, another small (total length about 50 mm), strongly weathered specimen.

Differential diagnosis: *Perleldus altolepis* is distinguished from the other species of the genus by an almost vertically oriented preoperculum (Fig. 6), the absence of a clavicle (present in *P. madagascariensis*, and *P. woodwardi*) and by scales with a smooth surface (longitudinal ridges and grooves on the anterior flank scales of *P. yangtzensis*).

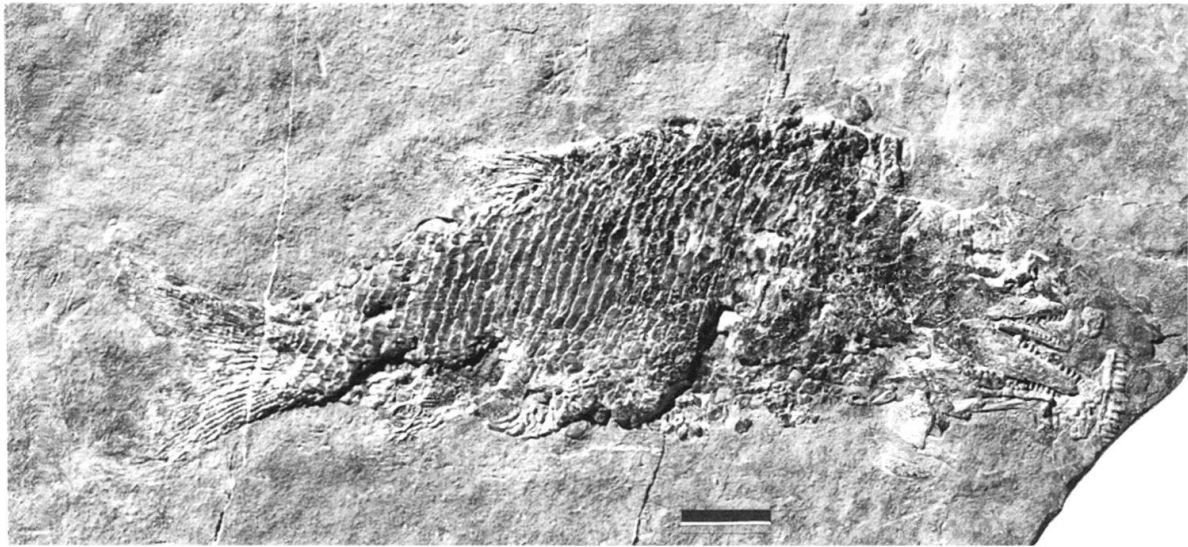


Fig. 2. *Perleidus altolepis* (DEECKE 1889). MCSN 3007, an almost complete specimen from the Kalkschieferzone near the village of Meride (see also Fig. 3). The scale bar indicates 5 mm.

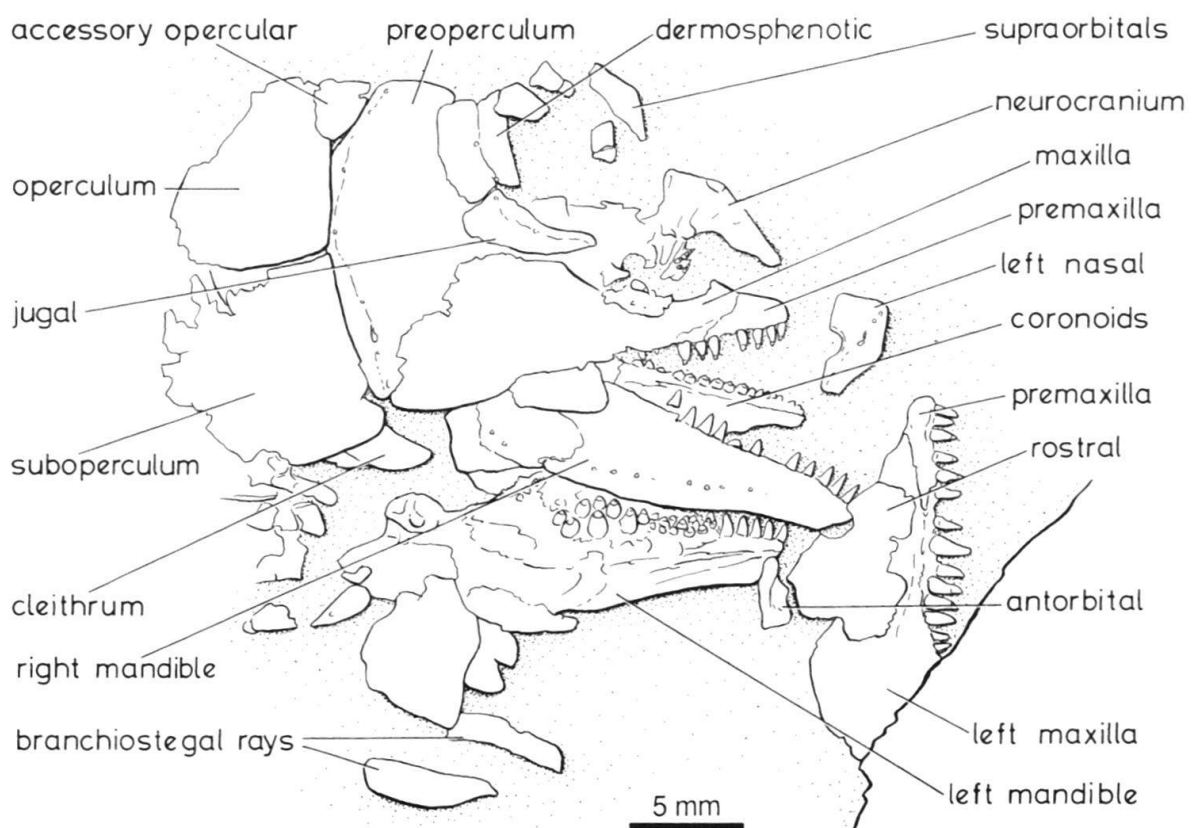


Fig. 3. *Perleidus altolepis* (DEECKE 1889). MCSN 3007, details of the skull region.

Description: Spindle-shaped perleidid fish of medium size (total length up to 130 mm). Head blunt with a broad preoperculum and a medium-sized orbita. Fins relatively small. Position of the dorsal fin opposing the middle of the distance between pelvic fins and anal fin. Caudal fin distinctly forked. The axial lobe of the caudal fin is short and inconspicuous.

Skull roof and snout. – The skull-roof is only partly preserved in the specimens from Meride (Fig. 4). The dermopterotics are narrow and elongate. The extrascapulars are tabular-shaped. Tiny pores indicate the T-like course of the sensory canal. Of the snout elements a single nasal and the rostral can be identified in MCSN 3007 (Fig. 3). The nasal shows a broad dorsal and a narrow ventral part. Its medial edge is characterized by the semicircular indentation of the anterior nostril. The lateral edge is somewhat sinusoidal, the lower curve representing the anterior rim of the posterior nostril. The sensory canal passes the nasal along its longitudinal axis. The unpaired rostral is roughly triangular. The narrow and blunt dorsal apex is separated from the wide ventral part by the semicircular indentation of the anterior nostril. Traces of an ethmoid commissure are not found.

Cheek-region. – The cheek-region is dominated by the large, triradiate preoperculum. Its broad dorsal edge is blunt and rounded, whereas the anterior and the ventral processes are elongate and pointed. The posterior margin is slightly rounded. Near its posterior edge passes the sensory canal, recognized by a few small pores. The orbita is surrounded by several supra- and infraorbitals of different shape and size. The dermosphenotic is a small quadrangular element. More or less the same is true of the supraorbitals. The infra-orbital series is composed of larger elements, which rostrally become elongate and narrow. In the acid-prepared PIMUZ T 4961 the hyomandibula is clearly visible (Fig. 5). It shows a broad, antero-ventrally inclined neurocranial articulation facet. The opercular process and the ventral shaft are only proximally preserved.

Upper and lower jaw. – The upper jaw is composed of a large, club-shaped maxilla and a small and narrow premaxilla. The maxilla is characterized by a deepened posterior plate and a narrow anterior shaft. On the dorsal edge of the anterior shaft, there is a small, pointed process (Fig. 3). Along the anterior half of the ventral edge of the maxilla, several stout and pointed teeth are found. The premaxilla fits neatly onto the anterior end of the maxilla. Its anterior edge is gently rounded. The posterior part is elongated and pointed. There are about 9 teeth on the premaxilla. The wedge-shaped lower jaw is externally composed of a large anterior dentary, and a smaller posterior angular. The dentition of the dentary is composed of about 15 teeth, similar in shape and size to those on premaxilla and maxilla. Medially, there are some coronoid and prearticular plates furnished with a dense plaster of short and thick teeth. Each of these teeth shows a wart-like tip.

Gill-cover and branchiostegal series. – The gill-cover is made up of a smaller, almost quadrangular operculum and a larger, subrectangular suboperculum. Between operculum and preoperculum, there is a small, roughly triangular accessory opercular. There seem to be just a few branchiostegal rays present, of which the most posterior seems to be the largest. The shape of the gular elements is unknown in this species.

Shoulder girdle. – The shoulder girdle consists of a rectangular posttemporal, a deep supracleithrum and a sickle-shaped cleithrum, well exposed in T 4961 (Fig. 5). A clavicle has not been recognized (present in the Lower Triassic species *P. woodwardi* and *P. madagascariensis*).

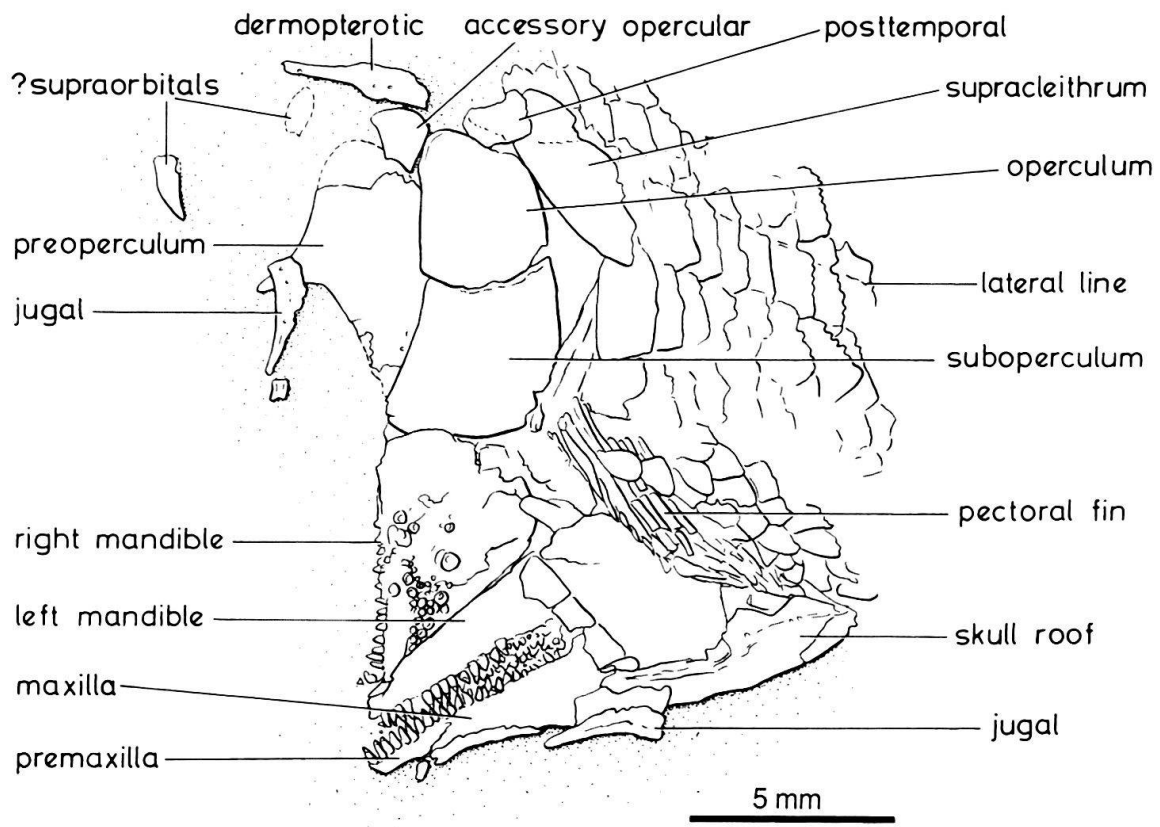


Fig. 4. *Perleidus altolepis* (DEECKE 1889). MCSN 3008, an almost complete, smaller specimen from the Kalkschieferzone near the village of Meride; details of the skull and the most anterior parts of the body.

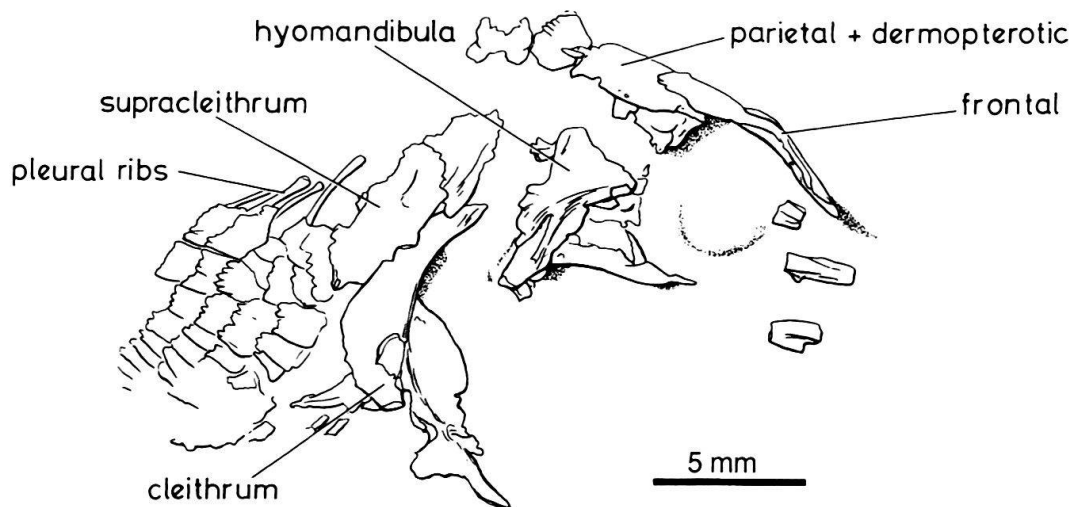


Fig. 5. *Perleidus altolepis* (DEECKE 1889). PIMUZ T. 4961, some details of the skull region and the axial skeleton.

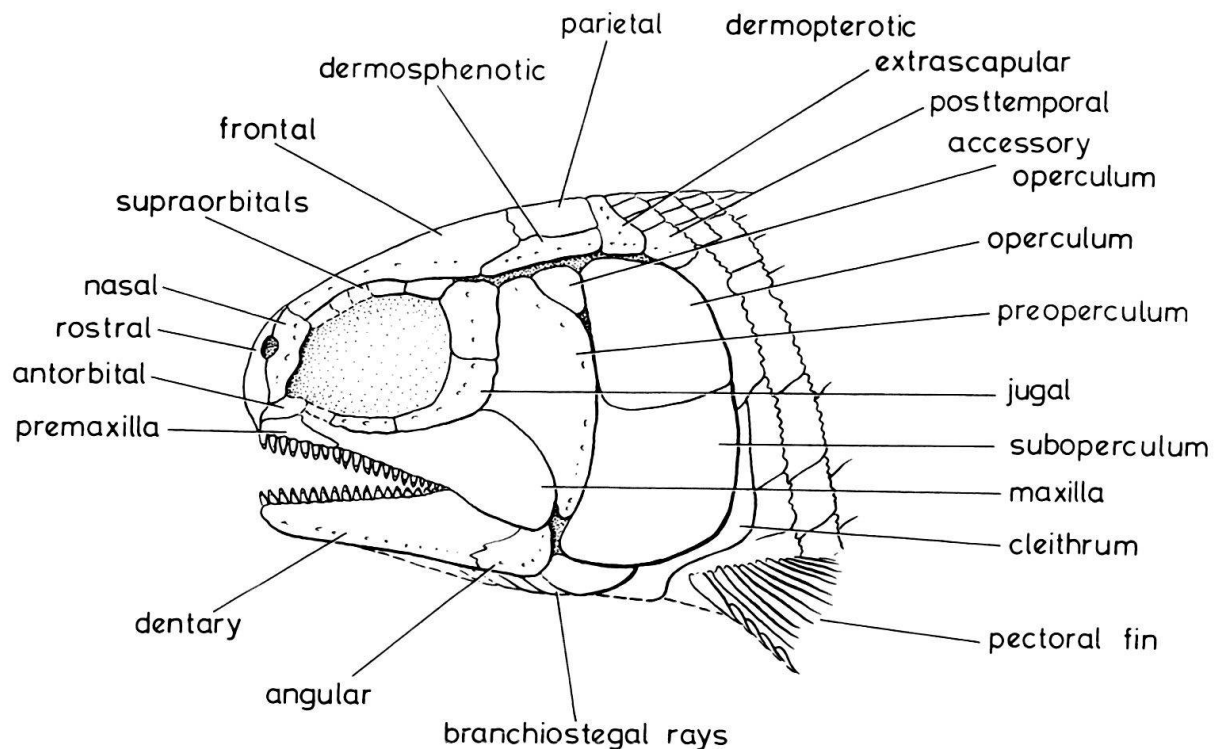


Fig. 6. *Perleidus altolepis* (DEECKE 1889). Composite reconstruction of the head skeleton based mainly on the specimens MCSN 3007 and 3008 found in the Kalkschieferzone near Meride.

Paired and unpaired fins. – The pectoral fin is composed of about 12 segmented fin rays. The proximal segment is considerably longer than the following ones. The segmented fin rays are preceded by a long, spinous ray. The fin's leading edge is furnished with small fringing fulcra. The small pelvic fin, located between scale rows 11 to 13, consists of about 7–8 segmented fin rays, again preceded by a spinous ray. The triangular dorsal fin spreads between scale rows 22 to 27 and is composed of about 14 segmented fin rays. The fin's leading edge is preceded by two to three basal fulcra dorsally followed by small fringing fulcra. The smaller anal fin, located between scale rows 24 to 27, is composed of about 9 to 11 segmented fin rays. There are about one to two basal fulcra and a series of small fringing fulcra along the fins leading edge. The deeply forked caudal fin is composed of about 30 to 31 segmented fin rays. About 20 of the them are distally branched. The dorsal and ventral leading edge of the fin are each bordered by two or three basal fulcra followed by a series of small fringing fulcra.

Axial skeleton and squamation. – Of the axial skeleton only a few pleural ribs are exposed in T 4961 (Fig. 5). They show a broadened proximal articulation facet. The squamation is composed along the lateral line of about 37 to 40 vertical scale rows. There are about five horizontal scale rows above and 7 to 8 below the row containing the lateral line canal. The axial lobe is very small and inconspicuous. Most of the scales are rectangular in shape with those of the anterior flank region being considerably deeper than wide. The posterior margin is serrated in most of the specimens (e.g. T 4960). This serration is partially absent in the largest specimen (MCSN 3007). The mid-dorsal scale row is

composed of posteriorly rounded scales. At the beginning of the anal fin in MCSN 3008 there are a large medial and two enlarged lateral scales with strongly serrated posterior edges.

Remarks: Comparing de Alessandri's (1910: plt. 6, fig. 3) *Heterolepidotus serratus* BELLOTTI 1857 with the above described specimens of *Perleidus altolepis* leaves little doubt on Stensiö's supposition that this is one and the same species (Stensiö 1921: 256). The consequences of this would be that *Perleidus altolepis* is a junior synonym of *P. serratus*. Since the type material is lost and the species name *altolepis* is in use since 1910, I would argue for the suppression of Bellotti's name.

Until now, *Perleidus altolepis* has not been described in full detail. The previous studies have been based upon just two specimens from Perledo (Deecke 1889, de Alessandri 1910, Stensiö 1921). Quite recently additional specimens of *Perleidus altolepis* have been found during a new excavation near Ca' del Frate (Tintori 1990b, 1990d). They will all be described together with other actinopterygian species in a doctoral thesis by Christina Lombardo, University of Milano. The new specimens from Meride show some previously unreported details in the composition of the upper jaw and therefore help complete our knowledge of this species. The attempted reconstruction (Fig. 6) comes close to previously described ones from other species of the genus *Perleidus* (e.g. Gardiner & Schaeffer, 1989: Fig. 23B) and corresponds quite well with Hutchinson's (1973: Fig. 50) hypothetical perleidid (his colobodontid) morphotype.

The genus *Perleidus* often functioned something like a prototype of the Sub-holostean level, combining both primitive and derived characters (Schaeffer 1956, Beltan 1988). The improved knowledge of the type species, *P. altolepis* justify some remarks on the genus itself as well as on the constituent taxa. In his studies on Triassic fishes Deecke (1889) described a 106 mm long, fusiform fish specimen and erected for it the new name *Semionotus altolepis*. The relatively well preserved specimen (Deecke 1889: Plt. VI, Fig. 10) was found in the black shales of Perledo, Northern Italy. Deecke noticed the considerably shortened axial lobe (Deecke 1889: 120). However, the fusiform body shape, the broad preoperculum, the acute head shape, the spiny, elongated scales of the medio-dorsal row and the blunt, cone-shaped teeth however, convinced him to assign the species to the Agassizian genus *Semionotus*. Already Schellwien (1901) realised the generic incompatibility with *Semionotus* and the closer affinities to the family Catopteridae WOODWARD 1890. But it was left to de Alessandri (1910) to clearly separate *Semionotus altolepis* DEECKE from this genus and to put it into the newly erected genus *Perleidus*. Stensiö (1921) summarized the former history of the genus *Perleidus* and further showed that *Colobodus altilepis* WOODWARD from the Lower Triassic of Spitzbergen was in fact a member of this genus, too. He described it as a new species, *P. woodwardi*. Based on the material of the Naturmuseum Senckenberg, he further improved knowledge about *P. altolepis* considerably (Stensiö 1921: 255–257). Judging from the figures he suggested further that de Alessandri's *Heterolepidotus serratus* BELLOTTI and *Pholidophorus barazetti* BASSANI belong to *Perleidus altolepis*, as well (Stensiö 1921: 256). Later, he emended the definition of the genus *Perleidus* and described the new species, *P. stoschiensis*, from the Early Triassic of East Greenland (Stensiö 1932). A list of the presumably valid species of the genus *Perleidus* is presented in Tab. 1 and is based on Deecke (1889), Stensiö (1921, 1932), Piveteau (1934), Teixeira (1948, 1949, 1978), Lehman (1952) and Su (1981).

Tab. 1. Species of the genus *Perleidus* accepted as valid

| Species | Occurrence |
|---|--|
| <i>Perleidus altolepis</i> (DEECKE 1889) | Middle Triassic of Italy and Switzerland |
| <i>Perleidus woodwardi</i> STENSIÖ 1921 | Lower Triassic of Spitzbergen |
| <i>Perleidus stoschiensis</i> STENSIÖ 1932 | Lower Triassic of East Greenland |
| <i>Perleidus madagascariensis</i> PIVETEAU 1934 | Lower Triassic of Madagascar |
| <i>Perleidus lutoensis</i> TEIXEIRA 1948 | Lower Triassic of Angola |
| <i>Perleidus piveteaui</i> LEHMAN 1952 | Lower Triassic of Madagascar |
| <i>Perleidus yangtzensis</i> SU 1981 | Lower Triassic of China |

Other specimens assigned to *Perleidus* but indeterminate at the species level are known from the Middle Triassic of France (Mazin & Martin 1983) and Spain (Beltan 1984). A further likely *Perleidus*, the youngest one, is reported from the continental Upper Triassic of Morocco (Martin 1982).

Other named species of *Perleidus*, but most probably belonging to other taxa are:

Perleidus viai BELTAN 1972

This supposed species of *Perleidus* from the Muschelkalk of Spain (Beltan 1972) does not show the taxon-typic shape of maxilla, preoperculum, operculum and suboperculum. Together with the anterior position of the dorsal fin, the extended body lobe and the shape of the scales it seems more likely that this represents a species of the contemporaneous genus *Ptycholepis*.

Perleidus giganteus BELTAN 1972

Quite in contrast to the genus *Perleidus* this species from the Muschelkalk of Spain displays an operculum which is larger than the suboperculum (Beltan 1972). The shape of the maxilla, the dentary and the preoperculum as well as the scales ornamented with distinct, horizontally arranged ganoin ridges is close to the genus *Colobodus* s. str.

Perleidus canadensis NEUMAN 1986

This 50 to 70 mm long species from the Lower Triassic of British Columbia does not have the characteristic dentition of the genus *Perleidus*. Instead it shows small, pointed teeth. The shape of the maxilla, preoperculum, operculum, suboperculum and the extended body lobe are also found in the Lower Triassic genus *Helmolepis* and in the Middle Triassic and Lower Liassic genus *Platysiagum* (see Bürgin 1992). That *Perleidus canadensis* definitely not be included into the genus *Perleidus* was confirmed by Neuman (in litt.).

Perleidus ? letticus (FRAAS 1861)

The shape of the maxilla and preoperculum as well as an operculum larger than the suboperculum places this Upper Triassic species from Germany (Schmidt 1928) close to *Colobodus*.

Other specimens assigned to the genus *Perleidus* but presumably belonging to different taxa are:

Perleidus sp. of Beltan et al. (1979: Fig. 3).

This large species from the Ladinian of Turkey should not be included into the genus *Perleidus*. It shows, like *P. giganteus*, close similarity to the genus *Colobodus*.

Perleidus sp. of Beltan (1984: Fig. Pl. 2B)

This small species of the Muschelkalk of Spain displays two rows of deepened flank scales, a character found in the genus *Peltoperleidus*. Additionally, both the dorsal and anal fin are well developed, quite in contrast to the situation found in the genus *Perleidus*.

cf. *Perleidus* of Schaeffer & Mangus (1976: Fig. 12).

Based on the shape of the maxilla, the preoperculum, operculum, suboperculum, the branchiostegal rays and the small, pointed teeth these large specimens from the Lower Triassic of British Columbia are, like Neuman's *P. canadensis*, closer to the genera *Helmolepis* or *Platysiagum*.

Order Peltopleuriformes GARDINER 1967

Family Peltopleuridae BROUGH 1939

Genus *Peltopleurus* KNER 1866

Synonymy: See Bürgin (1992: 114).

Diagnosis: See Bürgin (1992: 114).

Distribution: The genus *Peltopleurus* is known from the Middle Triassic of Switzerland, Spain and China as well as the Middle and Upper Triassic of Austria and Italy (Griffith 1977).

Peltopleurus sp. A

(Fig. 7, 8)

Referred material: MCSN 3009, an almost complete specimen in left lateral view (Fig. 7A, 8); MCSN 3010, a more or less completely preserved specimen in right lateral view, both from Bank 1/50 (Fig. 7B). PIMUZ T 4966, T 4978 with counterplate T 4978a, T 4979 with counterpart T 4979a and T 4980 are four specimens found by A. Wirz in 1941; T 4966 is the best preserved of them.

Description: A small sized specimen of the genus *Peltopleurus* (total length up to 26 mm) with a blunt and rounded head and a distinctly forked caudal fin.

Skull and shoulder girdle. – The broad skull-roof is partially preserved in T 4966. Except for the course of the supraorbital sensory canal no further details can be observed. The cheek-region is dominated by a broad, upright preoperculum (Fig. 8). Between the dorsal edge of the preoperculum and operculum, sits a small, triangular antoperculum. Of the upper jaw only the club-shaped maxilla is well preserved. It consists of a narrow, anterior shaft, bearing a single series of about 12 pointed teeth, and a dorsally expanded posterior plate. The lower jaw appears to be narrow and elongate. It bears a series of pointed teeth on the dorsal edge of the dentary, similar in size to those of the maxilla. The gill-cover is composed of a large, shield-like operculum and a distinctly smaller, semicircular suboperculum. Gular and branchiostegal elements are not identifiable. Of the shoulder girdle, only the plate-like supracleithrum is comparatively well preserved.

Paired and unpaired fins. – The pectoral fin is only partially preserved and must have been composed of more than 6 individual fin rays. The first fin ray seems to be preceded by a spinous basal fulcrum. The small pelvic fin is composed of an elongate basal fulcrum and about six distally segmented fin rays. The triangular dorsal fin is composed of about 10 distally segmented fin rays. The fin's leading edge is preceded by two basal fulcra. The triangular anal fin is easily visible in MCSN 3010; it is composed of about 11 distally segmented fin rays. The fin's leading edge, similar to the dorsal fin, is preceded by about two

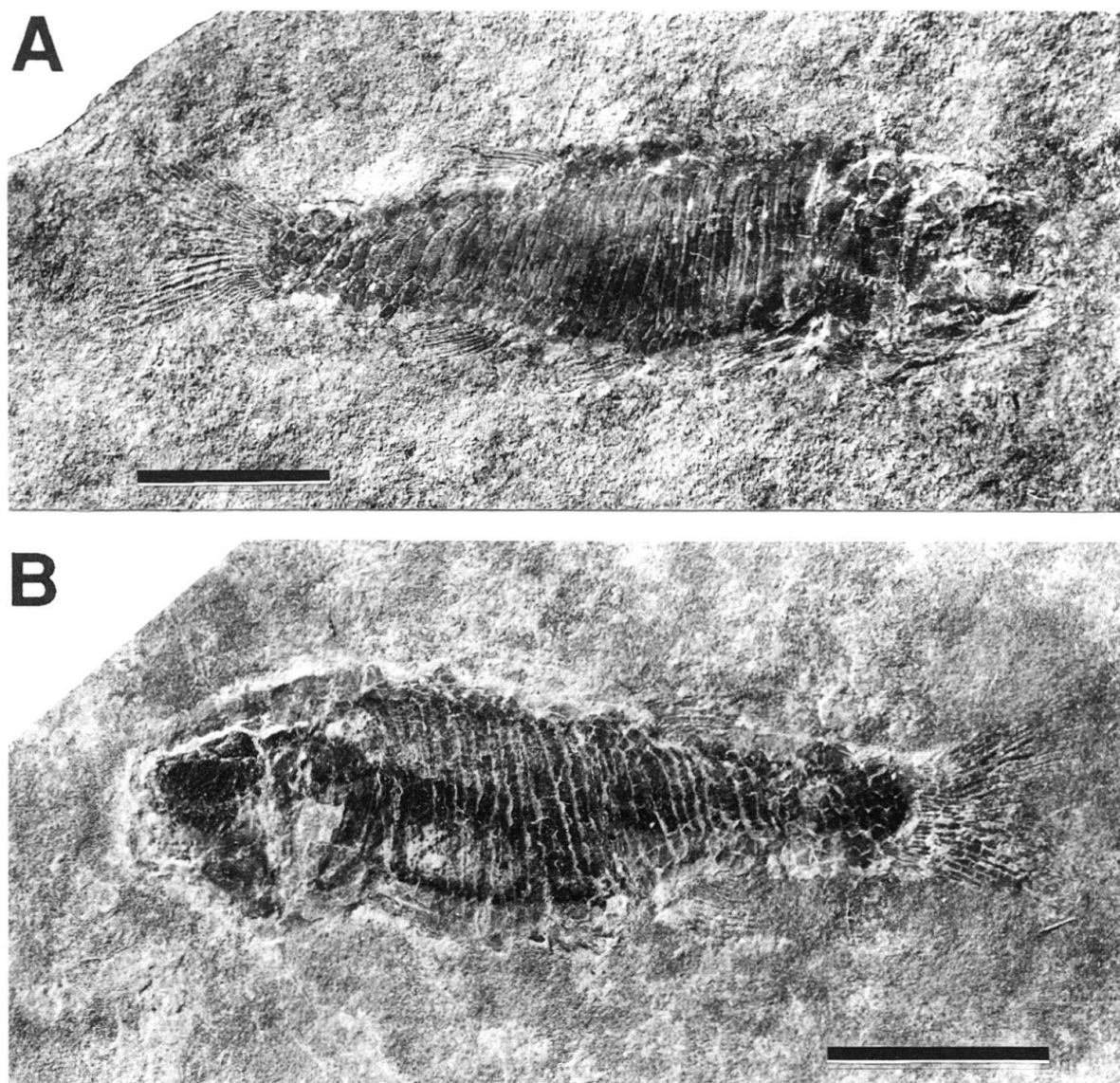


Fig. 7. *Peltopleurus* sp. A from the Kalkschieferzone near the village of Meride. A) MCSN 3009 from bed 1/50. B) PIMUZ T. 4966 from material collected by A. Wirz in 1941. The scale bar indicates 5 mm.

basal fulcra. The distinctly forked caudal fin is composed of about 22 to 27 segmented fin rays. Its leading edges are each preceded by two to three basal fulcra.

Squamation. – Along the lateral line, the squamation is composed of 33 to 35 vertical scale rows. These flank scales are considerably deepened in the anterior part of the body and diminish in size caudally. There are two scale rows above and two or maybe three scale rows below the flank scales. The body lobe is small and inconspicuous. The scale surface is smooth and the posterior margin is entire. In some of the specimen remnants of the pigmentation can be seen (e.g. T 4966). Similar cases have been described from one Permo-Carboniferous and in several Triassic actinopterygians (Gottfried 1989, Tintori 1990a).

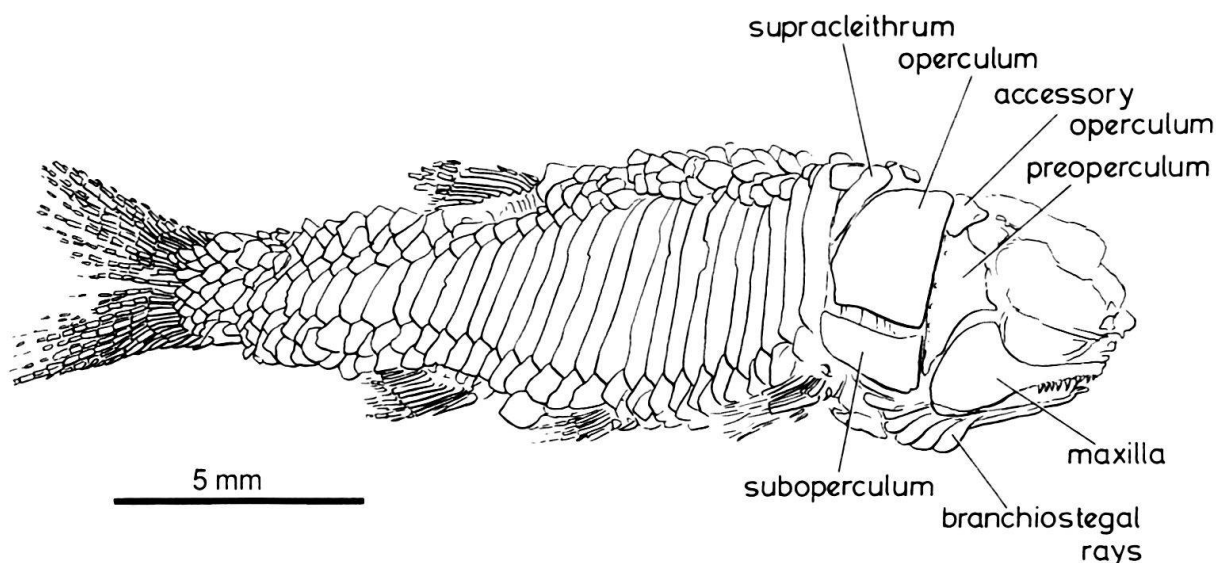


Fig. 8. *Peltopleurus* sp. A. MCSN 3009. Interpretative drawing to Figure 7A.

Remarks: The squamation of *Peltopleurus* sp. A from Meride shows close similarities with the Ladinian *P. nothocephalus* from southern Switzerland (Bürgin 1992) and the probable Ladinian *P. orientalis* from China (Su 1959). The shape of the preoperculum and the small size, however, sets *Peltopleurus* sp. A clearly apart from the aforementioned species. In *P. orientalis*, these characters are not well known. The most overall similarities are found with the small *Peltopleurus* sp. from the Upper Ladinian of Monte San Giorgio (Bürgin 1992). The small sample size and the lack of distinct skull-roof features do not justify the establishment of a new species as yet. This possible new species is therefore indicated by a symbol: A, and awaits new and better preserved material.

Peltopleurus sp. B

(Fig. 9, 10)

MCSN 3011, a partly preserved, small (TL ca. 20 mm, SL about 17 mm) specimen, differs from *Peltopleurus* sp. A by having an edentulous and narrow oral jaw, a larger number of vertical scale rows (37 instead of 32–35) and flank scales which remain relatively deep even in the posterior part of the body (Fig. 9, 10). There seems to be only one additional scale row above and below the deepened flank scales. Of special interest is the composition of the anal fin: The posterior half of the fin is composed of very thin fin rays (Fig. 10). The total number is about 16; they are all segmented and distally branched. The fin's leading edge is preceded by about three basal fulcra. In front of these fulcra there are two large anal scutes. The deeply forked caudal fin is composed of about 20 segmented and distally branched fin rays. Both leading edges are preceded by about three basal fulcra.

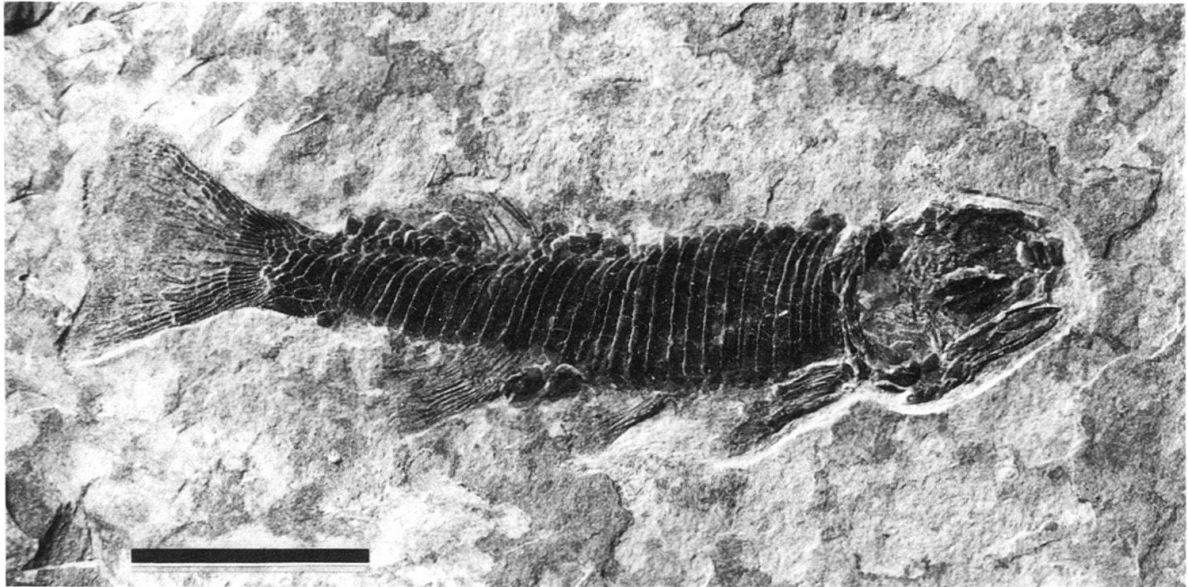


Fig. 9. *Peltopleurus* sp. B MCSN 3011 from a loose block in the river Gaggiolo.

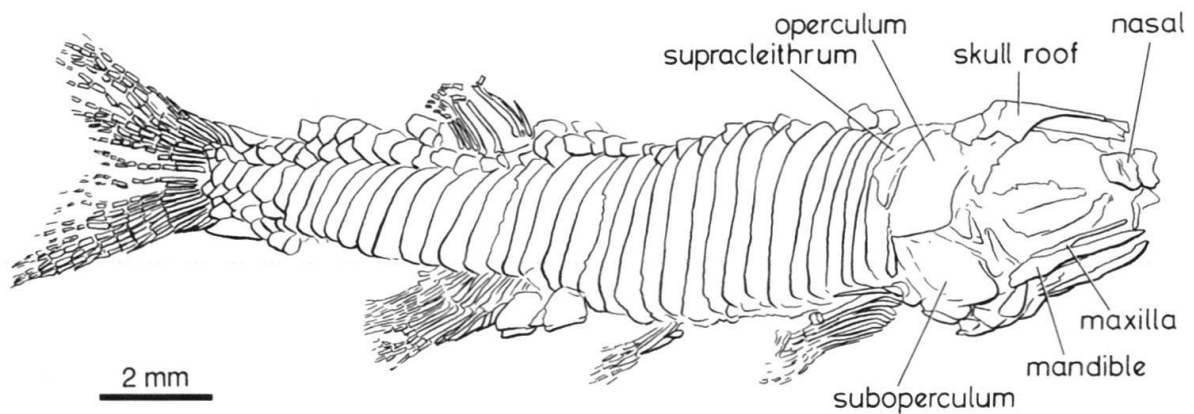


Fig. 10. *Peltopleurus* sp. B. MCSN 3011. Interpretative drawing to Figure 9.

The specimen shows some overall similarity with *Habroichthys gregarius* GRIFFITH 1977 from the Upper Triassic of Polzberg near Lunz, Austria (Griffith 1977). However, *Habroichthys gregarius* has 48 vertical scale rows and a totally reduced axial lobe (Griffith 1977: Fig. 10). Again, like in *Peltopleurus* sp. A, the lack of abundant and well preserved specimens do not justify the naming of a new species yet.

Superseries Neopterygii REGAN 1923

Division Halecostomi PATTERSON 1973

Order Semionotiformes ARAMBOURGH & BERTIN 1958

Family Semionotidae sensu PATTERSON 1973

Genus *Archaeosemionotus* DEECKE 1889

Diagnosis: Medium sized semionotid genus with the cheek-region being composed of a large dorsal and numerous small ventral suborbitals (e.g. Bärnli 1991: Fig. 22). A further detailed diagnosis will be presented along with the description of numerous well preserved specimens from the Middle Triassic of Monte San Giorgio (Bärnli in prep.).

Distribution: Presently known from the Middle Triassic of Italy and Switzerland.

Archaeosemionotus sp.

(Fig. 11)

Referred material: MCSN 3012 (Fig. 12) and 3013 with counterplates 3012a and 3013a, both strongly weathered, but almost complete specimens of about 60 and 55 mm total length respectively; T 4963, a posterior part of the body with remains of the unpaired fins, from the 1973 excavation, estimated total length between 70 and 80 mm.

Description: The outline is spindle-shaped and clearly exposed in MCSN 3012. Due to the bad preservation little can be said about morphological details of the head skeleton. However the mosaic of small suborbitals and the presence of acinaciform branchiostegal rays can be confirmed. The triangular dorsal fin is composed of about 15 distally segmented and branched fin rays. The fin's leading edge is preceded by two basal fulcra followed distally by small fringing fulcra. The smaller anal fin consist of about 9 fin rays. The weakly forked caudal fin is composed of about 23 segmented fin rays. The fin's leading edges are each preceded by some basal and numerous fringing fulcra.

Remarks: The reason to assign the above described three specimens to the genus *Archaeosemionotus* is based on the presence of the unique cheek-bone mosaic and the acinaciform branchiostegal rays.



Fig. 11. *Archaeosemionotus* sp. MCSN 3012 an almost complete but strongly weathered specimen from the Kalkschieferzone near the village of Meride, bed 1/43. The scale bar indicates 5 mm.

Subdivision Halecomorphi PATTERSON 1973

Family Ophiopsiidae BARTRAM 1975

Genus *Ophiopsis* AGASSIZ 1934

Diagnosis: See Bartram (1975: 184–185).

Distribution: Middle Triassic of Italy and Switzerland. Upper Jurassic of Germany, France, England, Spain and Zaire. Early Cretaceous of Brazil.

Ophiopsis cf. *lepturus* (BELLOTTI 1847)

(Fig. 12–14)

Referred material: MCSN 3014, a small specimen (total length about 30 mm) from the 1994 quarry (Fig. 12B, 14); T 4964 (Fig. 12A, 13) with counterplate T 4964a, a more or less well preserved specimen in lateral view and T 4965 with counterplate 4965a, a strongly weathered specimen in lateral view, both from the 1973 excavation; T 4967, an isolated caudal fin.

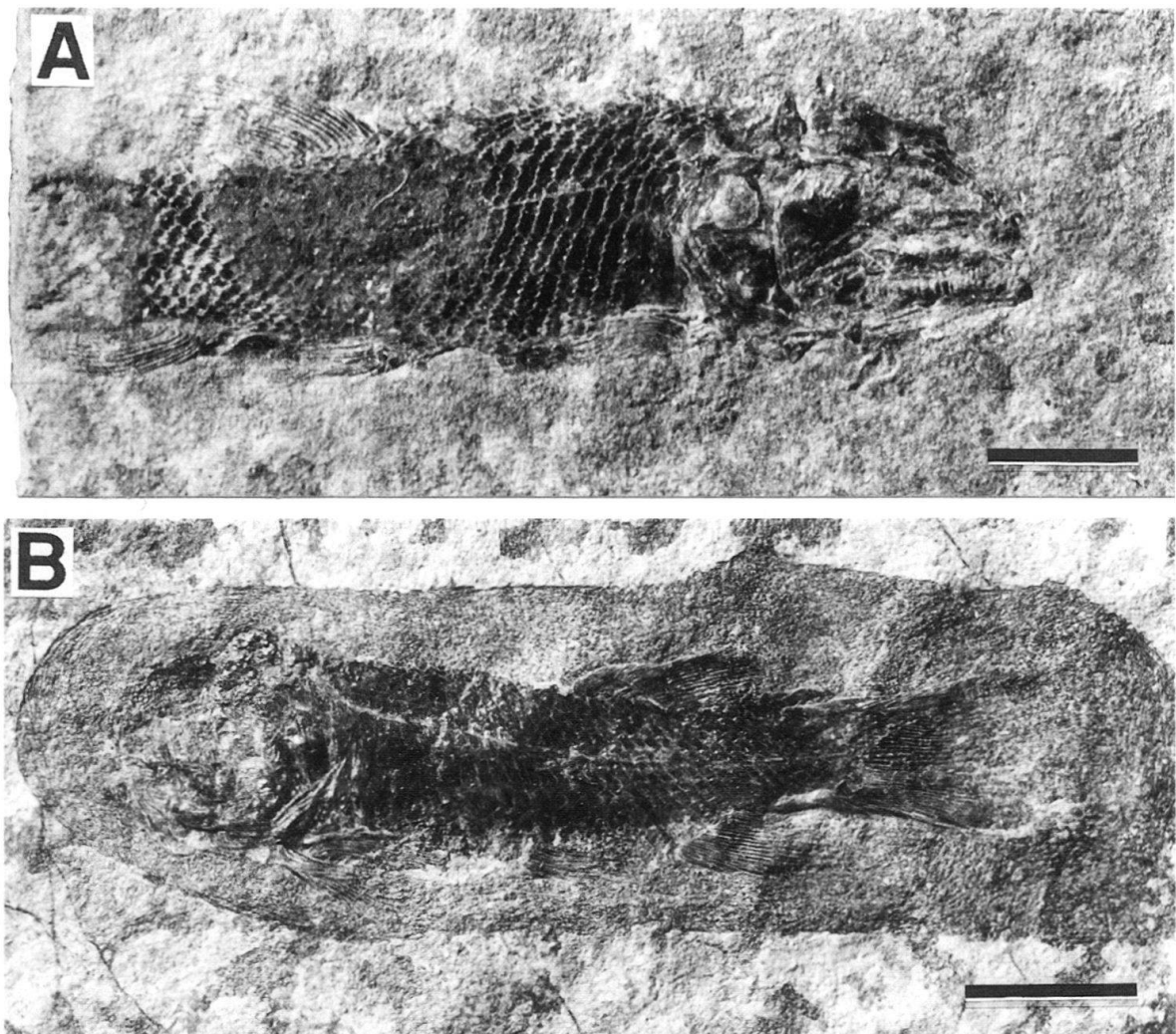


Fig. 12. *Ophiopsis* cf. *lepturus* (BELLOTTI 1847). A: PIMUZ T. 4964 from the Kalkschieferzone near the village of Meride, an almost complete specimen lacking just the caudal fin. The scale bar indicates 5 mm. B: MCSN 3014 an almost complete specimen from the 1994 diggings, layer 1/42.

Description: A small, elongately spindle-shaped species of the genus *Ophiopsis*, estimated total length about 45 mm, standard length about 35 mm.

Skull and shoulder girdle. – The skull elements are only partly preserved and their exact outline is difficult to restore. The skull roof itself is anteriorly constricted, but not strongly elongate as for example in *Ophiopsis procera*. The shape of the snout elements are not clearly identifiable. The cheek-region seems to be dominated by a narrow preoperculum and some large, shield-like suborbitals. The jaw cleft reaches well behind the orbita. The upper jaw consists of a small premaxilla of uncertain shape and an elongate maxilla with about 20 pointed teeth. A supramaxilla cannot be identified. The lower jaw is elongate and wedge-shaped and displays the same type of teeth as the premaxilla and maxilla. The gill-cover is composed of a large, shield-like operculum, a distinctly smaller suboperculum and a tiny, triangular interoperculum.

Paired and unpaired fins. – The pectoral fin is composed of a short and spinous ray, followed by about 12 distally segmented and branched fin rays. The fin's leading edge is furnished with small fringing fulcra. The small pelvic fins consist of 8–10 fin distally segmented and branched fin rays. The fins leading edge is preceded by about two basal fulcra, which are distally followed by small fringing fulcra. The dorsal fin is composed as in *Ophiopsis lepturus* of about 15 distally segmented and branched fin rays. The fin's leading edge is preceded by three to four basal fulcra followed distally by small fringing fulcra. The anal fin is composed of 13 to 18 distally segmented and branched fin rays. The fin's leading edge is preceded by about three basal fulcra which are distally followed by small fringing fulcra. The deeply forked, almost equilobate caudal fin is composed of about 30 segmented and partly branched fin rays in PIMUZ T 4965 and about 37 fin rays in MCSN 3014. Both leading edges of the fin are preceded by 6–8 basal fulcra dorsally and three to four ventrally and are followed distally by small fringing fulcra.

Squamation. – The squamation consists of 35 to 38 vertical scale rows along the lateral line. There are about three scale rows above and about four below the lateral line scales. The axial lobe extends about halfway along the length of the dorsal lobe of the caudal fin. The scales are rhomboidal in shape, with those of the flank region being somewhat deeper than wide. The scale surface is smooth and their posterior margin is distinctly serrated. In front of the anal fin there is an enlarged anal scute.

Remarks: *Ophiopsis lepturus* is the earliest recorded species of the genus and has so far been recorded only from the Middle Triassic of Perledo, Northern Italy (de Alessandri 1910, Bartram 1975). It shows a set of characteristics which are primitive for the genus, e.g. the lower number of dorsal fin rays and the comparatively elongate axial lobe, but is otherwise only poorly known. It has not yet been reported from Ca' del Frate. On the contrary, the Macrosemiid *Legnonotus obtusus*, which has not yet been found near Meride, is present at Ca' del Frate (Tintori & Renesto 1983).

Although not perfectly preserved, the specimens described above seem to correspond closely to *Ophiopsis lepturus* from Perledo. There are however some differences in most meristic characters. The number of vertical scale rows (35 to 38 compared to about 42 in *Ophiopsis lepturus* from Perledo) and the number of fin rays pelvic 8–10 compared to about 7), anal (13–18 compared to about 10) and caudal fin (30–37 compared to about 22). These differences and the poor knowledge of the cranial elements do not allow for the erection of a new species for the specimens described above.

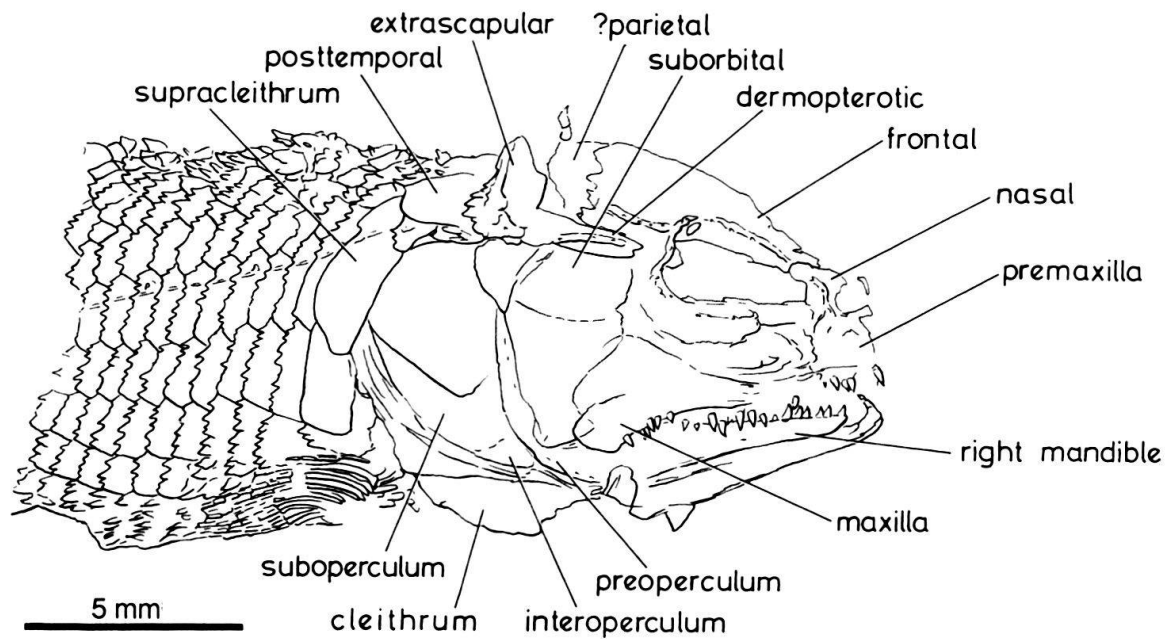


Fig. 13. *Ophiopsis* cf. *lepturus* (BELLOTTI 1847) PIMUZ T. 4964. Details of the skull region.

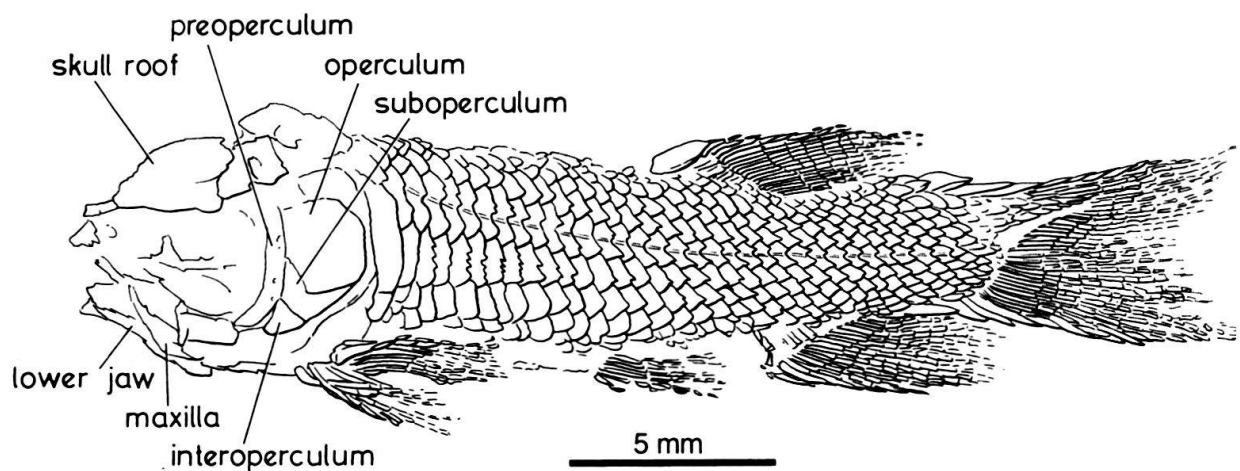


Fig. 14. *Ophiopsis* cf. *lepturus* (BELLOTTI 1847) MCSN 3014. Interpretative drawing to Figure 12B.

Infraclass Neopterygii incertae sedis

Genus *Prohalecites* DEECKE 1889

Diagnosis: See Tintori (1990: 156).

Distribution: *Prohalecites porroi* is known from the Uppermost Ladinian of Northern Italy (Tintori 1990a) and Southern Switzerland (Bürgin this paper).

Prohalecites porroi (BELLOTTI 1857)
(Fig. 15–17)

Referred material: The better preserved specimens from the 1994 quarry are, MCSN 3015 (Fig. 17), 3016 (Fig. 15A), 3017 (Fig. 16), 3018 & 3018a, 3019 & 3019a, 3020, 3021 & 3021a (Fig. 15B), 3022, 3023, 3024, 3025 & 3025a, 3026, 3027, 3028, 3029, 3030, 3031, 3032, and 3033. Less well preserved are MCSN 3034, 3035, 3036, 3037 & 3037a, 3038 & 3038a, 3039, 3040, 3041, 3042 & 3042a, 3043, 3044, 3045, 3046, 3047, 3048, 3049, 3050, 3051, 3052, 3053, 3054, 3055, 3056, 3057, 3058, 3059, 3060, 3061, 3062 and 3063. From the 1971/73 excavations are PIMUZ T 4943 & 4943a, 4944 & 4944a, 4946 & 4946a, 4947, 4948, 4949, 4951 & 4951a, 4952, 4953, 4954 & 4954a, 4955 & 4955a, 4956 & 4956a, 4957 and 4958.

Description: *Prohalecites porroi* has been thoroughly described from abundant and well preserved material from Ca' del Frate (Tintori 1990a). No additional features can be observed on the above mentioned specimens, therefore a detailed description will not be given here. The specimens from the Kalkschieferzone near Meride range between 30 and 50 mm total length and vary considerably in their state of preservation (see also Furrer this volume). Some of them show the body outline in the form of a carbonized shade (e.g. Fig. 8B). Regarding their meristic characters (number of fin rays and vertebral segments), they can be compared well with the specimens reported from Ca' del Frate.

Remarks: As mentioned above, *Prohalecites porroi* is well known from the Northern Italian locality Ca' del Frate (Tintori 1990a). However, its interrelationships among the Neopterygii, has not yet been solved. The problem is presently being reevaluated by Andrea Tintori in collaboration with Gloria Arratia.

3. Discussion and paleoecological remarks

The actinopterygian fishes described from the Kalkschieferzone of Meride are few in number but can nevertheless be compared with the extensive material already described from the nearby, contemporaneous Italian locality Ca' del Frate. The Ca' del Frate horizon is presently thought part of the basal Kalkschieferzone and of Latest Ladinian age (Tintori 1990a). The presence of fresh-water dwelling conchostracan crustaceans suggests a marine environment influenced by the continent. The actinopterygians described so far are clearly different from those of the Latest Anisian to Early Ladinian Besano /Monte San Giorgio fauna (Bürgin 1992) and the Early Carnian faunas of Lunz (Griffith 1977) and Raibl (Tintori, Muscio & Nardon 1985).

The differences between the species list of Meride and Ca' del Frate can be explained primarily by the different sample sizes. Whereas at Ca' del Frate more than 1,700 specimens have been found, only about 100 have been found near Meride so far. One obvious difference is the presence of *Gyrolepis* in Meride. This medium to large sized spindle shaped taxon is well known from the Middle Triassic of Europe (Bürgin 1992). Another difference is the presence of *Ophiopsis cf. lepturus* and the absence of *Legnonotus obtusus* in Meride. All the other specimens are found more or less at both localities and in similar relative abundance.

Both at Ca' del Frate and in Meride *Prohalecites porroi* is the dominating species. Many specimens found in the former locality closely associated within the same bedding plane suggest a mass mortality event on this presumably schooling fish (Tintori 1990a).

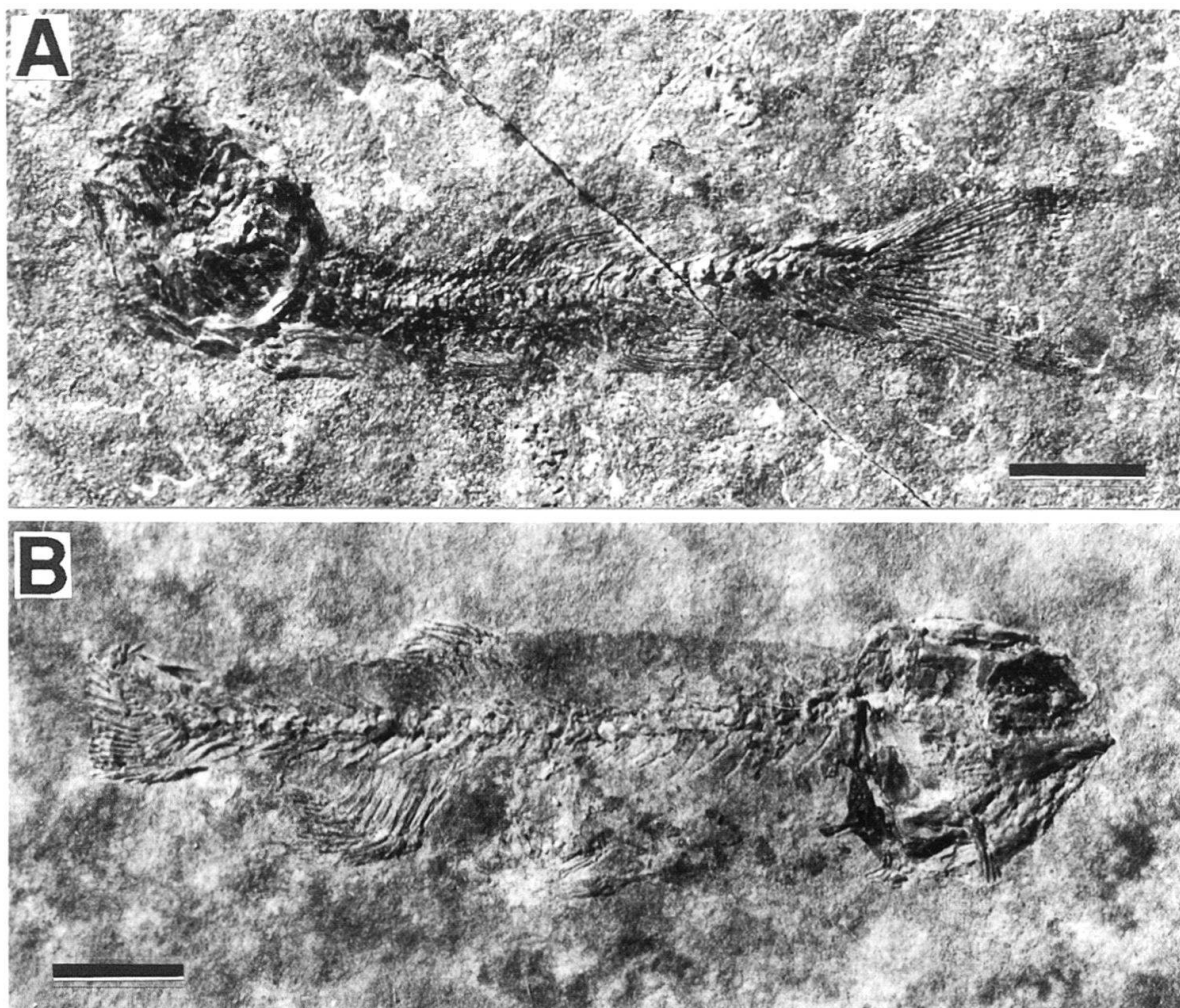


Fig. 15. *Prohalecites porroi* (BELLOTTI 1857) from the Kalkschieferzone near the village of Meride. A) MCSN 3016 showing the skull roof, the axial skeleton and the most of the fins. From bed 1/43. B) MCSN 3021 showing the skull, the axial skeleton and a carbonaceous film of the presumable body outline. From bed 1/50. The scale bar indicates 5 mm.

According to the dentition and the shape of the jaw element the prey of *Prohalecites porroi* is likely to have consisted of small, planktonic invertebrates. A similar diet can be presumed for *Peltopleurus*. *Ophiopsis* cf. *lepturus* displays larger and more pointed teeth suggesting invertebrate picking and piercing. Even larger and stouter oral teeth are found in *Perleidus altolepis* and *Dipteronotus olgiatii*. These would permit crushing of hard-shelled prey. All these latter types show a body form and fin shapes indicative of a well developed manoeuvrability. This is especially obvious in the deep-bodied *Dipteronotus olgiatii*.

During his studies on some Triassic fishes from Lombardy de Alessandri (1910) mentioned fossil fishes found at a locality in the vicinity of Ca' del Frate. The four species recorded by him are *Colobodus* (?) *triassicus*, *Colobodus* sp., *Pholidophorus Curionii* and *Pholidophorus Barazettii*. Judging from his plates the first species might be a Semionotid

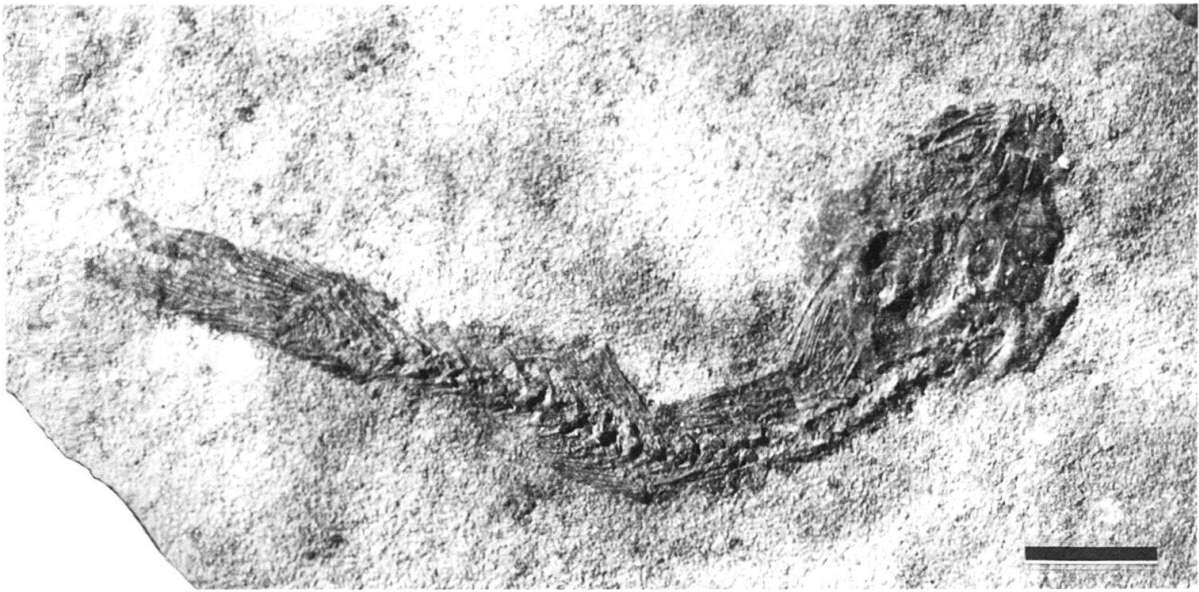


Fig. 16. *Prohalecites porroi* (BELLOTTI 1857) from the Kalkschieferzone near the village of Meride, bed 1/43. MCSN 3017 showing the skull roof, the axial skeleton and most of the fins. The scale bar indicates 5 mm.



Fig. 17. *Prohalecites porroi* (BELLOTTI 1857) from the Kalkschieferzone near the village of Meride, bed 1/50. MCSN 3015 showing the skull roof, the jaws, the axial skeleton and some fin details. The scale bar indicates 5 mm.

of uncertain generic relationships. The same might be true for *Pholidophorus Curionii* although no specimen from Ca' del Frate is figured. *Pholidophorus Barazettii* most probably belongs to the genus *Perleidus* de Alessandri 1910 (see also Stensiö 1921). Unfortunately all of de Alessandri's specimens stored at the Museo Civico di Storia Naturale in Milano were destroyed during the Second World War.

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Note added in proof:

While the present paper has been completed, Christina Lombardo's paper entitled '*Perleidus altolepis* (Actinopterygii, Perleidiformes) from the Kalkschieferzone of Ca' del Frate (N. Italy)'; Geobios, M.S., no. 19, 211–213, was published. Therein, based on the absence of epaxial caudal fin rays, she questioned the validity of the Lower Triassic species of the genus *Perleidus*. As a consequence, she accepted *P. altolepis*, as the only valid species of the genus. For the Lower Triassic *P. madagascariensis*, however, Lehman (1952) clearly figured (his Fig. 92) the presence of epaxial caudal fin rays. It therefore seems to be premature, excluding all the Lower Triassic species before a detailed analysis of the character complex under discussion has been done.

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