Comments on the Late Devonian placoderms from the Holy Cross Mountains (Poland)

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Taxonomy of the Late Devonian placoderm remains from the Holy Cross Mountains, Poland, described by Gorizdro-Kulczycka (1934, 1950) and Kulczycki (1956, 1957), is revised. Several recently found specimens are also mentioned. The old collections are composed of representatives of Ptyctodontidae, Holonematidae, Plourdosteidae, Pholidosteidae, Selenosteidae, Titanichthyidae and Dinichthyidae, the latter with an undescribed species of *Eastmanosteus*. Newly found specimens belong to Ptyctodontidae, Plourdosteidae and Dinichthyidae. The occurrence of the Antiarcha in the Late Devonian of the Holy Cross Mountains, suggested by former authors, has not been confirmed.

K e y w o r d s : Placodermi, Late Devonian, Holy Cross Mountains, Poland.

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Introduction

The main goals of this study are to revise placoderms from the Late Devonian of the Holy Cross Mountains collected by Jan Czarnocki, Julian Kulczycki and Zinaida Gorizdro-Kulczycka in the first half of the century (the material now housed in the Museum of the Polish Geological Institute and in the Museum of the Earth in Warsaw), and to describe a few new specimens collected recently by Jerzy Dzik and Grzegorz Racki. The old collections have formerly been described in part by Gorizdro-Kulczycka (1934, 1950) and Kulczycki (1956, 1957). The specimens in these collections come from Wietrznia Quarry, Kadzielnia Quarry and Psie Górki Hills in Kielce, and from the vicinities of Gałęzice in the western part of the Holy Cross Mountains. The new specimens were found in Wietrznia Quarry, Kowala (south of Kielce), Ostrówka Quarry in Gałęzice region, and Płucki in the vicinities of Łagów, eastern part of the Holy Cross Mountains (Fig. 1).

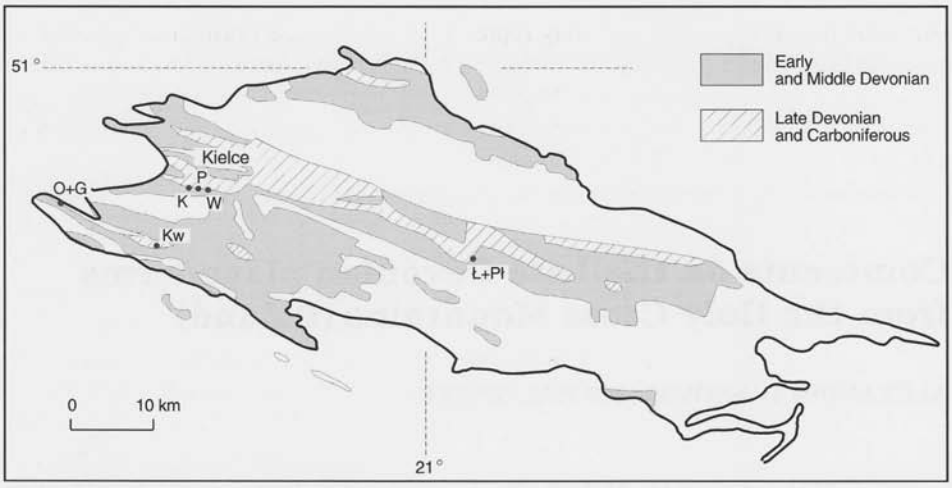


Fig. 1. Location of outcrops mentioned in the paper on a sketch map of Palaeozoic core of the Holy Cross Mountains; K – Kadzielnia, Kw – Kowala, Ł+Pł – Łagów and Płucki, O+G – Ostrówka and Gałęzice, P – Psie Górki, W – Wietrznia.

Following abbreviations of the institution names are used herein: GIUS – Geological Institute, University of Silesia, Sosnowiec; MZ – Museum of the Earth, Polish Academy of Sciences, Warsaw; PIG – Polish Geological Institute, Warsaw; ZPAL – Institute of Palaeobiology, Polish Academy of Sciences, Warsaw.

Stratigraphy

Any analysis of the stratigraphical distribution of placoderms in the Late Devonian of the Holy Cross Mountains faces considerable difficulties. First of all, the specimens from old collections were dated according to the subdivision of the Late Devonian used by Czarnocki (in Gorizdro-Kulczycka 1934: p. 14; see also Czarnocki 1947; Gorizdro-Kulczycka 1950; Kulczycki 1957). Only the Famennian part of that subdivision corresponds roughly to modern zonations, based on goniatites or conodonts. The Frasnian was subdivided into three local zones (Polish *'poziom'*): zone I, with *Hypothyridina procuboides*; zone II, with *H. coronula*; and zone III, with *H. cuboides* and *Manticoceras intumescens*; Kulczycki (1957) used the terms 'Lower', 'Middle' and 'Upper Frasnian', respectively. There is no confirmation that the characteristic brachiopod and goniatite species mentioned above have ever been found together with, or at least in the same horizon as the specimens of placoderms under study. Moreover, it is possible that Czarnocki applied a superficial lithostratigraphic correlation to subdivide the rocks in a particular quarry or such a correlation might even have been used between the quarries (Szulczewski, personal communication 1994). This could have lead to very confusing results, since Frasnian and lower Famennian rocks of the Holy Cross Mountains were deposited in complicated conditions of synsedimentary block tectonics (Szulczewski 1989). In Wietrznia Quarry a single lithostratigraphic unit can span different numbers of conodont zones even at a distance of several tens of meters.

The same lithostratigraphic unit may represent either the late Frasnian or an interval from the late Frasnian through the early Famennian. Thus, for instance, if a museum label reads that a specimen comes from the Frasnian zone III, one cannot be sure that it was found together with *H. cuboides* or *M. intumencens*, and one cannot even be sure whether it was really found in Frasnian rocks.

Famennian specimens come from the so-called '*Cheiloceras*-beds' and '*Clymenia*--beds'. In this case it is possible to determine that the specimens found in the *Cheiloceras*-beds are of the unspecified early Famennian age. Those found in the *Clymenia*-beds are of late Famennian age, probably from the interval of the Early *Palmatolepis marginifera* through the Middle *P. praesulcata* conodont zones.

The precision of dating of the new material is different in particular cases. The specimens from Wietrznia (undetermined *Mesotaxis asymmetrica* conodont Zone), Kowala road cut and Płucki (Late *P. rhenana–P. linguiformis* Zones) come from samples whose age was determined by conodonts. The specimen from Ostrówka has no exact age determination, but it is known that it comes from the upper Famennian part of the Quarry (J. Dzik, personal communication 1994).

The revised and updated distribution of placoderms considering the new findings is shown in Table 1 and 2. For the detailed stratigraphy of the outcrops see Szulczewski (1971, 1989), Szulczewski *et al.* (1996), and Racki (1993).

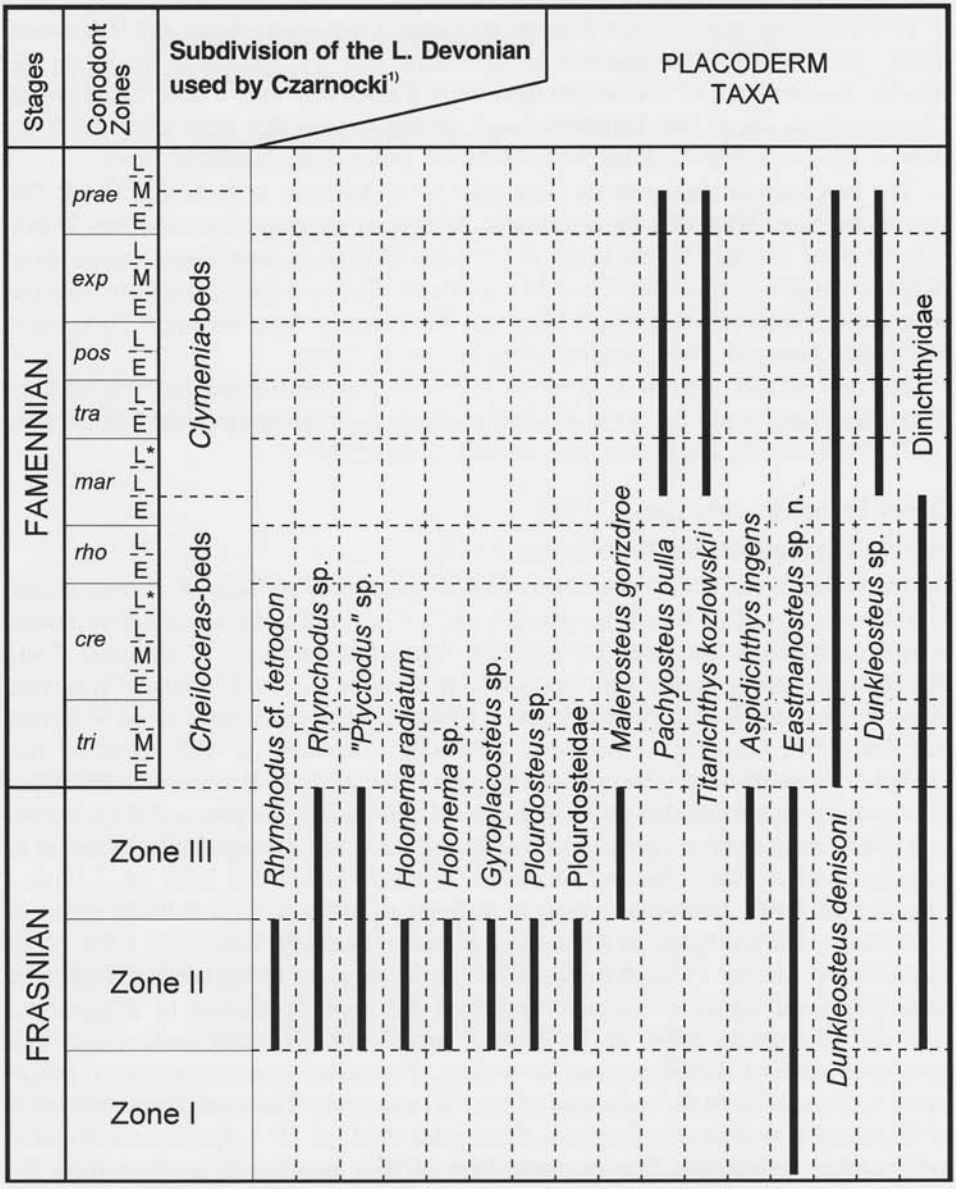
Order Ptyctodontida Gross, 1932

Family Ptyctodontidae Woodward, 1891

Gorizdro-Kulczycka (1934) described two new species of *Ptyctodus*: *P. czarnockii* and *P. kielcensis*, as well as *P. obliquus* Pander, 1858, *P.* sp., and a new species *Rhynchodus marginalis* based on the isolated toothplates. *Ptyctodus czarnockii*, *P. obliquus*, *P.* sp., and *Rhynchodus marginalis* were reported from the zone II of the Frasnian of Wietrznia Quarry. The remains of *P. kielcensis* and *P. obliquus* occur in the zone III of Wietrznia and Kadzielnia Quarries, respectively. *Ptyctodus czarnockii* is represented by two toothplates, one of them (Gorizdro-Kulczycka 1934: pl. I: 1, 2) belongs to the upper jaw toothplate (supragnathal plate) with curved oblique anterior part and flat posterior part of the biting surface, characteristic of *Rhynchodus*, and is very similar to that of *R. tetrodon* (Jaekel, 1903). Second specimen (Gorizdro-Kulczycka 1934: pl. I: 3) is a fragment of lower toothplate which is difficult to attribute to a definite genus of ptyctodonts. The toothplate of *Ptyctodus kielcensis* (Gorizdro-Kulczycka 1934: pl. II: 5) should be referred to *Rhynchodus* based on the shape of biting surface. Under the name *Ptyctodus obliquus* she also described the upper toothplate of *Rhynchodus* (Gorizdro-Kulczycka 1934: pl. II: 4) with curved oblique biting surface and well developed anterior dorsal process, as well as *'Ptyctodus'*-type toothplates (unillustrated specimens from the collection of the PIG museum). The toothplates referred to as *Rhynchodus marginalis* (Gorizdro-Kulczycka 1934: pl. II: 7, 8) were not found in the museum collections. The determination of their taxonomic position from the illustrations alone cannot be done.

Thus, in the original material published by Gorizdro-Kulczycka (1934), ptyctodonts are represented by toothplates of *Rhynchodus* cf. *tetrodon* (Jaekel, 1903), *Rhynchodus* sp., and *'Ptyctodus'* sp. A few new specimens were found in the lower Frasnian of Wietrznia Quarry (*M. asymmetrica* conodont Zone; new zonation: Early *P. falsio-*

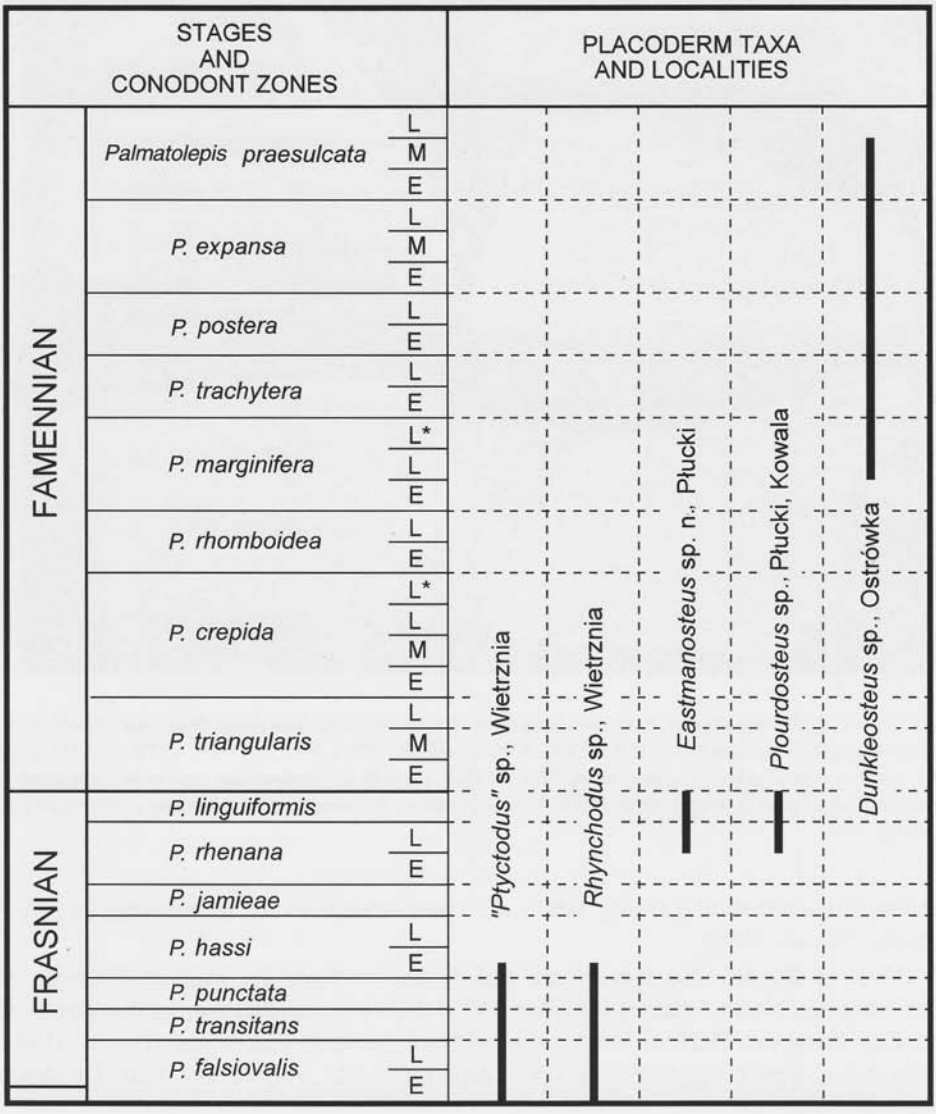
Table 1. Distribution of placoderms in the Late Devonian of the Holy Cross Mountains: collections of J. Czarnocki, Z. Gorizdro-Kulczycka and J. Kulczycki; taxa revised by present authors. Conodont zones: *tri – Palmatolepis triangularis, cre – P. crepida, rho – P. rhomboidea, mar – P. marginifera, tra – P. trachytera, pos – P. postera, exp – P. expansa, prae – P. praesulcata*, E – early, M – Middle, L – late, L* – latest.



1) see Gorizdro-Kulczycka (1934: p. 14; 1950).

valis–Early *P. hassi* Zones). These are toothplates and fragments of the exoskeleton. Among the first type there are few *'Ptyctodus'*-type toothplates and abundant tooth-

Table 2. New findings of placoderms in the Late Devonian of the Holy Cross Mountains: collections of J. Dzik (ZPAL) and G. Racki (GIUS). E – early, M – Middle, L – late, L* – latest.



plates of *Rhynchodus,* mostly the upper ones (Figs. 2A–C). The upper toothplates of *Rhynchodus* resemble those of *R. rostratus* Eastman, 1898 or *R. secans* Newberry, 1873 (Eastman 1898a), but specimens from the Holy Cross Mountains are much smaller (4–6 mm long). The anterior dorsal process is thin and the groove for attachment to the autopalatine is located close to the anterior edge. The biting surface is narrow and a small cusp is present on the lingual side.

Of the exoskeletal plates there is a fragment of a median dorsal spine (Fig. 2D) and an incomplete median ventral plate (Fig. 2E). The former resembles median dorsal

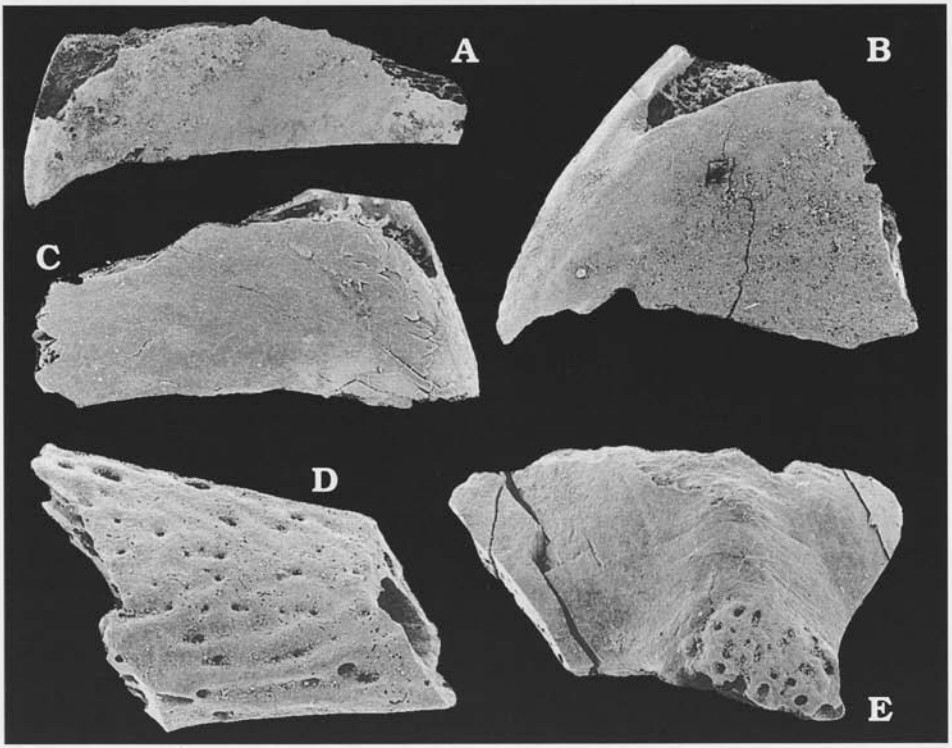


Fig. 2. **A–C, E.** *Rhynchodus* sp., Frasnian, *Mesotaxis asymmetrica* conodont Zone; Wietrznia Quarry. **A–C.** Upper toothplates in lingual views: **A** – ZPAL P.VI/1, × 15, **B** – ZPAL P.VI/2, × 16, **C** – ZPAL P.VI/3, × 22; **E** – median ventral plate in ventral view, ZPAL P.VI/4, × 17. **D.** Ptyctodontidae gen. indet., fragment of median dorsal spine in lateral view, ZPAL P.VI/5; Frasnian, *M. asymmetrica* conodont Zone; Wietrznia Quarry; × 40.

spines of *Campbellodus* (Long 1987), the latter belongs to the exoskeleton of *Rhynchodus* (Ivanov 1992).

Most of *Rhynchodus* species are mainly known from the Eifelian–Frasnian of Germany and North America (Denison 1978). Latest representatives of this genus on the East European Platform were recorded from the early Famennian (Ivanov 1992). *'Ptyctodus'*-type toothplates are very common in the Middle and Late Devonian carbonate sections.

Order Arthrodira Woodward, 1891

Family Holonematidae Obruchev, 1933

Kulczycki (1957) described and illustrated *Holonema radiatum* Obruchev, 1933, as well as new genera and species *Deveonema obruchevi* and *Operchallosteus vialovi* from the zone II of the Frasnian. The attribution of the incomplete anterior dorsolateral plate to *H. radiatum* is apparently correct. The identification of the middle part of the median dorsal plate as *Deveonema obruchevi* is rather doubtful. A tuberculated ornament and narrow central part between the overlap areas are main characters of the

alleged new genus. However, the smaller individuals of *H. westolli* Miles, 1971 have a median dorsal plate covered with the tubercles which are arranged in the row in places (Miles 1971: fig. 19). The overlaps on the visceral surface of the median dorsal plate are broader in these individuals than those in large ones and respectively the central part between the internal margins of overlaps is narrower (Miles 1971: p. 156). It is possible, therefore, that the fragment of median dorsal plate from the Holy Cross Mountains belongs to a small individual of *Holonema*.

The diagnosis of *Operchallosteus vialowi* Kulczycki, 1957 was based on the characters of ornament of a plate fragment, identified by Kulczycki (1957) as a posterior ventrolateral plate. This fragment was redescribed by Obruchev (1964) and Miles (1971) as a posterior part of an anterior ventrolateral plate of *Gyroplacosteus vialowi*. Most probably this specimen should be referred to as *Gyroplacosteus panderi* Obruchev, 1933 which is characterised by the similar outline of anterior ventrolateral plate and the ornament of ventral plates.

This being the case, the representatives of Holonematidae found in the Holy Cross Mountains should be referred to the following taxa: *Holonema radiatum*, *Holonema* sp. and *Gyroplacosteus* sp. The first was reported from the upper part of lower Frasnian of the Main Devonian Field (Obruchev 1933), the Frasnian of Iran (Lelièvre *et al.* 1981), as well as possibly from the Eifelian of Spain (Lelièvre *et al.* 1990). The representatives of *Gyroplacosteus* occur in the the upper lower Frasnian of the Main Devonian Field in association with *Holonema radiatum*, the Frasnian of the Kuznetsk Basin (Obruchev 1933) and the lower Frasnian of Germany (Miles 1971).

Family Plourdosteidae Vézina, 1990

Kulczycki (1957) described *Plourdosteus* sp. on the basis of two plates: inferognathal and marginal from the Frasnian zone II of Wietrznia Quarry. From the same beds he established a new genus and species *Tomaiosteus grossi*, which is represented by a fragment of skull roof and a posterior supragnathal plate. Denison (1978) synonymised this genus with *Plourdosteus*. The inferognathal and posterior supragnathal plates belong to *Plourdosteus*, while the skull roof fragment and the marginal plate are attributed to some plourdosteid arthrodires. The supraorbital sensory line divides the preorbital plate into the central and lateral parts. The central part of the preorbital in this specimen is long and of similar size to the lateral part. Such shape of the preorbital and shape of dorsal and visceral surface of the pineal plate are characteristic of some plourdosteids: *Harrytoombsia* (Miles & Dennis 1979), *Janiosteus* (Ivanov 1988), *Mcnamaraspis* (Long 1995) and *Torosteus* (Gardiner & Miles 1990). In addition, Kulczycki (1957) mentioned the incomplete median dorsal plate from the same beds as *Oxyosteus* sp. This plate probably belongs to coccosteid or plourdosteid arthrodires.

There are new findings of *Plourdosteus* in the Holy Cross Mountains: a posterior dorsolateral plate from the late Frasnian, the Late *P. rhenana–P. linguiformis* Zones of Kowala road cut and an anterior ventrolateral plate from the late Frasnian of Płucki. The posterior dorsolateral plate has a broad overlap area for the median dorsal plate, relatively narrow overlap area for the anterior dorsolateral plate and a cavity for the posterior lateral plate. Margins of the first two form an almost right angle. The posterior margin of the plate is curved and slightly convex. There is no groove for canals on the external surface. The anterior ventrolateral plate is rounded in shape, its length is

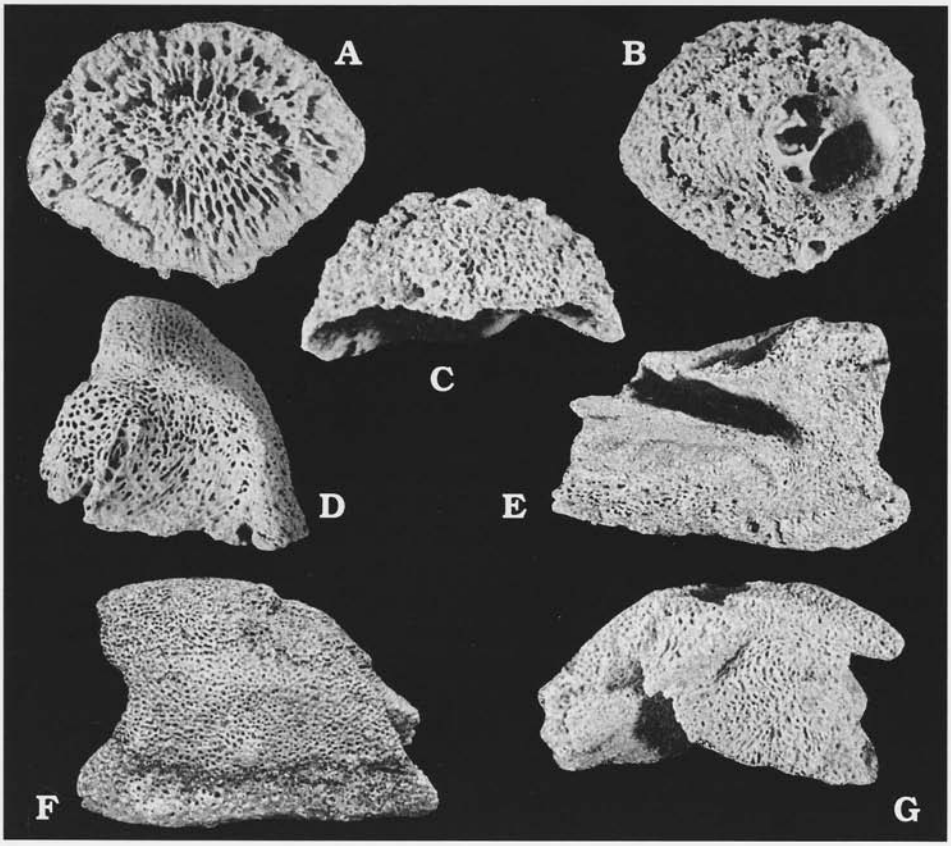


Fig. 3. **A–G**. *Malerosteus gorizdroae* Kulczycki, 1957, Frasnian, 'zone' III; Psie Górki; coll. J. Kulczycki. **A–C**. Nasal capsule in anterior (**A**), posterior (**B**) and lateral (**C**) views; MZ VIII/Vp-32/1, × 2.8. **D–G**. Left postnasal plate in right lateral (**D**, nasal notch), visceral (**E**), external (**F**), and oblique dorsal (**G**) views, MZ VIII/Vp-32/2, × 2.8.

similar to breadth. A groove for the ventral transverse sensory line is present in the anterior part of the plate.

Family Pholidosteidae Gross, 1932

Kulczycki (1957) erected a new genus and species *Malerosteus gorizdroae* based on the incomplete nuchal plates, articulated paranuchal, marginal and postorbital plates, articulated preorbital and suborbital plates. These specimens were found in the Frasnian zone III of Psie Górki.

There are two unpublished specimens of *Malerosteus gorizdroae*, which Kulczycki has extracted together with the described preorbital and suborbital plates: a nasal capsule (Fig. 3A–C) and a postnasal plate (Fig. 3D–G) in the collection described by Kulczycki (1957). These bones rarely occur among the isolated arthrodiran remains and are new for *Malerosteus*. The nasal capsule is frustum-shaped. The broad anterior surface is concave and oval. It bears numerous small foramina (Fig. 3A). It is the

cribrosal region of the postnasal wall. The posterior side of the bone has a rounded depression with the openings of various size (Fig. 3B). The largest of them probably fitted the olfactory nerve. The lateral surface of the nasal capsule is spongious with multiple fine canals. The mentioned specimen resembles the nasal capsule of *Eastmanosteus calliaspis* Dennis-Bryan, 1987, but the latter has a high conical shape and deep depression on the posterior side (Dennis-Bryan 1987: fig. 16).

The postnasal plate has a trapezoidal external surface with broad ventral and narrow dorsal edges. The latter is a contact face for the preorbital plate. The margin of fairly large nasal notch extends on the visceral side as a long interfenestral process (Fig. 3D). The narrow cavity for the contact of the suborbital plate is placed on the opposite side to the nasal notch. There is no groove for canals on the external surface. The visceral side of the plate bears a transversely elongate groove (Fig. 3E).

Family Dinichthyidae Newberry, 1885

Kulczycki (1956, 1957) described various material as *Dinichthys pustulosus* Eastman, 1897. The largest part of the collection comes from the Frasnian, mainly the zone II, of Wietrznia: fragments of skull roof, nuchal, paranuchal and anterior lateral plates, median dorsal plates and parasphenoid. The most complete part of the skull roof was found in the zone I of the Frasnian, and two fragments of median dorsal plates in the zone III. A single anterior supragnathal plate was reported from the Famennian '*Cheiloceras* beds' of Kadzielnia. Most of the isolated plates are incomplete and it is difficult to identify the genus, but all of them belong to Dinichthyidae. Two specimens of the skull roof, paranuchal plate and parasphenoid undoubtedly belong to *Eastmanosteus*. They differ from *Eastmanosteus* (*Dinichthys*) *pustulosus* (Eastman, 1897) from the Givetian–early Frasnian of North America (Eastman 1898b, 1907), *E. calliaspis* Dennis-Bryan, 1987 and other species of *Eastmanosteus* by the shape of nuchal, paranuchal and central plates on the external surface. The lateral lobe of the central plate of the North American species is much shorter and broader than it is in *Eastmanosteus* from the Holy Cross Mountains. The contacts of the central plate with postorbital and marginal ones in the Polish specimens nearly overlie on one line. The suture between the central and marginal plates is longer in the Kulczycki's specimens (MZ VIII/Vp-11, MZ VIII/Vp-12). The anterior margin of the nuchal plate in the American species is concave and bears two large anterolateral projections, but the same margin in *Eastmanosteus* from Poland has three small projections which are equal in length. The posterolateral parts of the nuchal plate in the skull roof from the Holy Cross Mountains bear transverse grooves. The nuchal plate of *E. pustulosus* described by Eastman has a breadth of posterior edge to breadth of anterior edge ratio of 3.1. *Eastmanosteus* from Poland has this ratio of 2.6. The paranuchal of this species is longer and narrower than that in the American species, and it has a broader postnuchal process. Thus, *Eastmanosteus* from the Holy Cross Mountains should be referred to a new species. The formal description of the species will be presented in a separate study.

In the new placoderm material there is a skull roof fragment (Fig. 4A) with inferognathal plate of the juvenile individuals from the Late *P. rhenana* conodont Zone of Płucki (near Łagów), which can be attributed to the same, new species of *Eastmanosteus*.

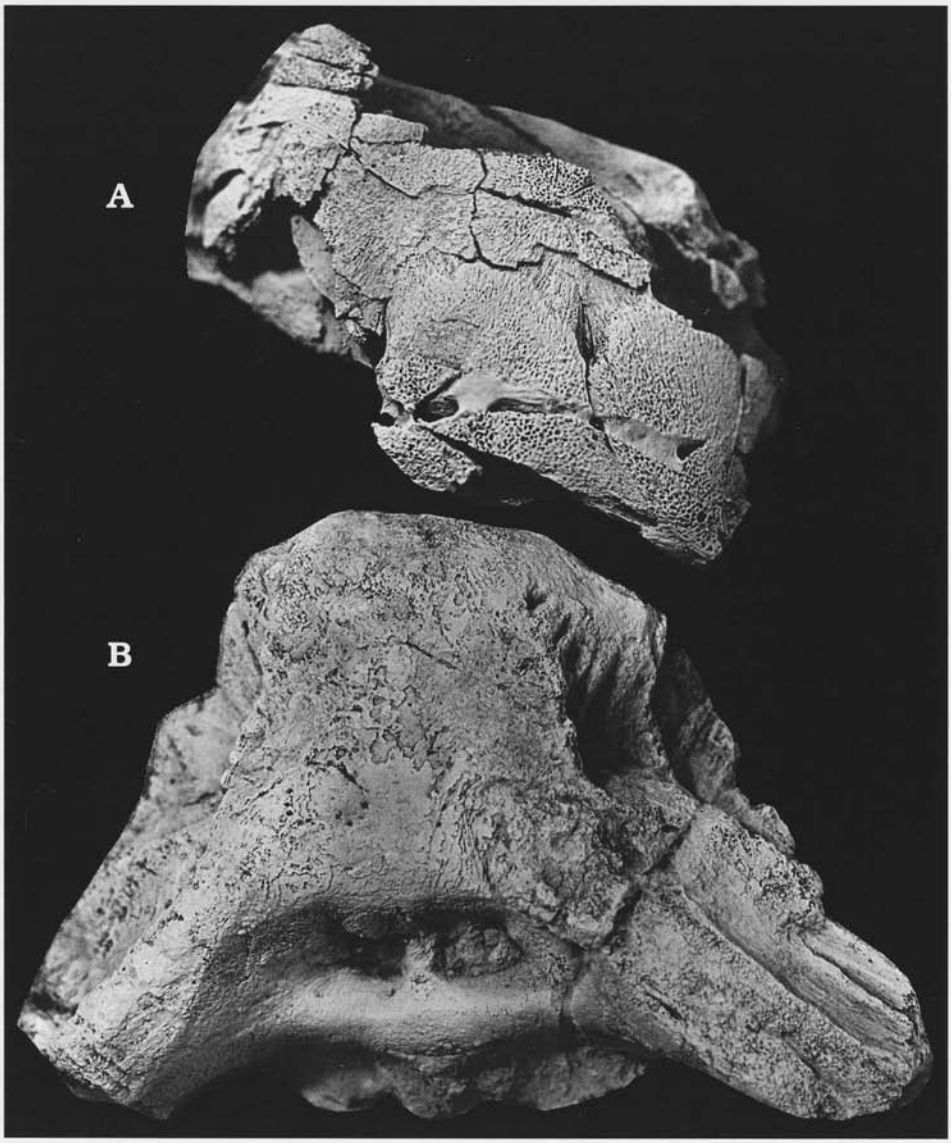


Fig. 4. **A**. *Eastmanosteus* sp. n., juvenile, fragment of skull roof in dorsal view, anterior margin is up; ZPAL P.VI/7; Frasnian, Late *Palmatolepis rhenana* conodont Zone; Łagów, Płucki; × 1.8. **B**. *Dunkleosteus* sp., nuchal plate in ventral view; ZPAL P.VI/6; upper Famennian; Ostrówka Quarry; × 1.

Kulczycki (1957) established two new species of *Dinichthys*: *D. ceretus* and *D. denisoni* based on the incomplete median dorsal plates. Both taxa occur in the Famennian, '*Cheiloceras* beds' of Kadzielnia, and the latter has also been found in '*Clymenia* beds' of Gałęzice. The median dorsal plate of first species belongs to Dinichthyidae and resembles that of *Dunkleosteus* (Heintz 1932) and *Heintzichthys* (Carr 1991). Denison (1978) referred *Dinichthys denisoni* to the genus *Dunkleosteus*.

The inferognathal plate described by Kulczycki as *Dinichthys* cf. *tuberculatus* Newberry, 1888 from the Famennian, '*Clymenia* beds' of Gałęzice (Kulczycki 1957: pl. VIII: 2) is similar to *Dunkleosteus terrelli* (Newberry, 1873) and *Dinichthys herzeri* Newberry, 1868, and possibly pertains to *Dunkleosteus*. Another specimen from the same beds, the fragment of the posterior ventrolateral plate (Kulczycki 1957: pl. VIII: 3) referred to *Dinichthys* cf. *tuberculatus* by Kulczycki does not belong to Dinichthyidae. However, it is difficult to identify its taxonomic position. A single nuchal plate of *Dunkleosteus* has recently been found in the late Famennian of Ostrówka Quarry (Fig. 4B). This plate has a rectangular anterior margin and deep overlap areas for the central and paranuchal plates on the visceral surface, which are characteristic features of *Dunkleosteus*. It resembles more closely that of *Dunkleosteus marsaisi* Lehman, 1954 from the early Famennian of Morocco (Lehman 1956) by the shape of dorsal and visceral surfaces of the nuchal, especially by the long posterolateral lobes of the plates.

Apart from the placoderms mentioned above, Kulczycki (1957) described a new species *Titanichthys kozlowskii* and *Pachyosteus bulla* Jaekel, 1903 from '*Clymenia* beds' of Gałęzice. *Aspidichthys ingens* Koenen, 1883 identified by Kulczycki as *Anomalichthys ingens* (Koenen, 1883) was found in zone III of the Frasnian, as well as in the late Frasnian *Manticoceras* beds of Rheinland, Germany, the Frasnian of Morocco and Iran (Denison 1978).

Order Antiarcha Cope, 1885

In her lists of ichthyofauna, Gorizdro-Kulczycka (1950) reported *Bothriolepis panderi* Lahusen, 1880, *B.* cf. *maxima* Gross, 1933 and *B.* sp. from the Frasnian zone II of Wietrznia. Apart from antiarchs in the same list, she mentioned the occurrence of *Onychodus jaekeli*, *Dipterus* sp. and *Osteolepis* sp. from the same locality. These forms are present in the PIG collection, however, we did not find any antiarch remains there. Kulczycki (1957) figured one fragment of a plate and assigned it as *Bothriolepis*. That specimen should probably be referred to one of the representatives of brachythoracid arthrodires. This shows that thus far no confirmed antiarch remains were found in the Holy Cross Mountains.

Relations to other regions

Most of the studied placoderms belong to widely distributed taxa. Only one genus: *Malerosteus* and the species of *Eastmanosteus*, *Titanichthys*, and *Dunkleosteus* are unique for the Holy Cross Mountains. There occur species typical for Rhenish facies, like *Aspidichthys ingens* and *Pachyosteus bulla*, together with *Holonema radiatum*, which is known from several localities on the East European Platform (Main and Central Devonian Fields, North Timan) and was also found in the eastern part of Iran.

Many forms which apparently coexisted in the Holy Cross Mountains were found together in some other regions, too: *Aspidichthys ingens* and *Pachyosteus bulla* in the Frasnian, *Manticoceras* beds of Rheinland (Gross 1932); *Titanichthys* and *Dunkleosteus* in North America, Cleveland Shale (Carr 1991); *Holonema* and *Eastmanosteus* in

the Gogo Formation in Australia (Long 1991); and *Holonema*, *Gyroplacosteus* and *Rhynchodus* in the upper part of the Lower Frasnian of the Main Devonian Field.

All placoderms mentioned in this paper were characterised either by high environmental tolerance (*Holonema*, *Gyroplacosteus*, *Eastmanosteus*, *Rhynchodus*) or were connected with pelagic carbonate facies: *Aspidichthys ingens*, *Pachyosteus bulla*, *Titanichthys* and *Dunkleosteus*. Pelagic conditions are confirmed by the absence of antiarchs and psammosteids, which usually predominate among the ichthyofauna of shallow water terrigenous deposits.

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References

Carr, R. 1991. Reanalysis of *Heintzichthys gouldii* (Newberry), an aspinothoracid arthrodire (Placodermi) from the Famennian of northern Ohio, with a review of brachythoracid systematics. — *Zoological Journal of the Linnean Society* **103**, 349–390.

Czarnocki, J. 1947. Przewodnik XX Zjazdu Polskiego Towarzystwa Geologicznego w Górach Świętokrzyskich. — *Rocznik Polskiego Towarzystwa Geologicznego* **17**, 237–299.

Denison, R. 1978. Placodermi. *In:* H.-P. Schultze (ed.) *Handbook of Paleoichthyology 2*. 128 pp. Gustav Fischer Verlag, Stuttgart–New York.

Dennis-Bryan, K. 1987. A new species of eastmanosteid arthrodire (Pisces: Placodermi) from Gogo, Western Australia. — *Zoological Journal of the Linnean Society* **90**, 1–64.

Eastman, C.R. 1898a. Dentition of Devonian Ptyctodontidae. — *American Naturalist* **32**, 473–488.

Eastman, C.R. 1898b. Some new point in dinichthyid osteology. — *American Naturalist* **32**, 747–768.

Eastman, C.R. 1907. Devonic fishes of the New York formation. — *Memoirs of the New York State Museum of Natural History* **10**, 1–235.

Gardiner, B.G. & Miles, R.S. 1990. A new genus of eubrachythoracid arthrodire from Gogo, Western Australia. — *Zoological Journal of the Linnean Society* **99**, 159–204.

Gorizdro-Kulczycka, Z. 1934. Ptyctodontidae górnodewońskie z Gór Świętokrzyskich. — *Prace Polskiego Instytutu Geologicznego* **3**, 1–38.

Gorizdro-Kulczycka, Z. 1950. Dwudyszne ryby dewońskie z Gór Świętokrzyskich. — *Acta Geologica Polonica* **1**, 53–105.

Gross, W. 1932. Die Arthrodira Wildungens. — *Geologische und Paläontologische Abhandlungen* **19**, 5–61.

Heintz, A. 1932. The structure of *Dinichthys*, a contribution to our knowledge of the Arthrodira. — *Bashford Dean Memorial Volume – Archaic Fishes* **4**, 115–224.

Ivanov, A.O. 1988. A new arthrodiran genus from the Upper Devonian of the Timan [in Russian]. — *Paleontologičeskij žurnal* **2**, 123–125.

Ivanov, A.O. 1992. Occurrences of ptyctodontids (Placodermi) in the Late Devonian of the East European Platform [in Russian]. — *Voprosy Paleontologii* **10**, 133–137.

Kulczycki, J. 1956. On the parasphenoid of the Brachythoraci. — *Acta Palaeontologica Polonica* **1**, 103–111.

Kulczycki, J. 1957. Upper Devonian fishes from the Holy Cross Mountains. — *Acta Palaeontologica Polonica* **2**, 285–380.

Lehman, J.-P. 1956. Les Arthrodires du dévonien supérieur du Tafilalet (Sud Marocain). — *Service Géologique Maroc, Notes et Memoires* **129**, 7–70.

Lelièvre, H., Janvier, P., & Goujet, D. 1981. Les Vértébres dévoniens d'Iran Central. IV: Arthrodires et Ptyctodontes. — *Géobios* **14**, 677–709.

Lelièvre, H., Goujet, D., & Henn, A. 1990. Un nouveau spécimen d'*Holonema radiatum* (Placodermi, Arthrodira) du Dévonien moyen de la région d'Oviedo, Espagne. — *Bulletin du Muséum national d'Histoire naturelle* **12**, 53–83.

Long, J.A. 1987. Late Devonian fishes from the Gogo Formation, Western Australia – new discoveries. — *Search* **18**, 203–205.

Long, J.A. 1991. The long history of Australian fossil fishes. *In:* P. Vickers-Rich, J.M. Monaghan, R.F. Baird, & T.H. Rich (eds), *Vertebrate Palaeontology of Australia*, 338–428. Monash University Publications Committee, Melbourne.

Long, J.A. 1995. A new plourdosteid arthrodire from the Upper Devonian Gogo Formation of Western Australia. — *Palaeontology* **38**, 39–62.

Miles, R.S. 1971. The Holonematidae (placoderm fishes), a review based on new specimens of Holonema from the Upper Devonian of Western Australia. — *Philosophical Transactions of the Royal Society of London* **263**, 101–234.

Miles, R.S. & Dennis, K. 1979. A primitive eubrachythoracid arthrodire from Gogo, Western Australia. — *Zoological Journal of the Linnean Society* **66**, 31–62.

Obruchev, D. 1933. Holonemidae des russischen Devons. — *Travaux de l'Institut Paleozoologique Academie des Sciences de l'URSS* **2**, 97–116.

Obruchev, D. (Obručev, D.) 1964. Class Placodermi [in Russian]. *In:* D. Obručev (ed.), *Osnovy Paleontologii 11*, 118–172, Nauka, Moskva.

Racki G. 1993. Evolution of the bank to reef complex in the Devonian of the Holy Cross Mountains. — *Acta Palaeontologica Polonica* **37**, 87–182.

Szulczewski M. 1971. Upper Devonian conodonts, stratigraphy and facies development in the Holy Cross Mts. — *Acta Geologica Polonica* **21**, 1–129.

Szulczewski, M. 1989. Światowe i regionalne zdarzenia w zapisie stratygraficznym pogranicza franu i famenu Gór Świętokrzyskich. — *Przegląd Geologiczny* **11**, 551–557.

Szulczewski M., Belka Z., & Skompski S. 1996. The drowning of a carbonate platform: an example from the Devonian–Carboniferous of the Holy Cross Mountains, Poland. — *Sedimentary Geology* **106**, 21–49.

Uwagi o późnodewońskich plakodermach z Gór Świętokrzyskich

ALEXANDER IVANOV i MICHAŁ GINTER

Streszczenie

Celem pracy jest rewizja taksonomiczna późnodewońskich plakodermów z Gór Świętokrzyskich, zebranych przez Jana Czarnockiego, Juliana Kulczyckiego i Zinaidę Gorizdro-Kulczycką. Zbiory te znajdują się obecnie w Muzeum Ziemi i w Muzeum Państwowego Instytutu Geologicznego w Warszawie. Ponadto opisano kilka nowych okazów, znalezionych w ostatnich latach przez Jerzego Dzika (Instytut Paleobiologii PAN) i Grzegorza Rackiego (Uniwersytet Śląski). Kolekcja starsza została po części opisana przez Gorizdro-Kulczycką (1934, 1950) i Kulczyckiego (1956, 1957).

Okazy badane pochodzą przede wszystkim z Wietrzni, Kadzielni i Psich Górek w Kielcach oraz z Ostrówki i innych odsłonięć w regionie gałęzickim, a także z Kowali na południe od Kielc i Płucek w pobliżu Łagowa (Fig. 1). Ustalenie wieku okazów ze

starszych kolekcji (Tabela 1) jest obecnie niezmiernie utrudnione. Wyżej wymienieni autorzy korzystali, przy określaniu pozycji stratygraficznej okazów, z podziału stratygraficznego używanego przez Czarnockiego (m.in. w Gorizdro-Kulczycka 1934). Czarnocki stosował swoisty trójdzielny podział franu i nie uwzględniał w rozważaniach stratygraficznych nieizochroniczności granic wydzieleń litostratygraficznych w dewonie świętokrzyskim, spowodowanej m. in. synsedymentacyjną tektoniką blokową (Szulczewski 1989).

Datowanie okazów nowych przedstawione jest w Tabeli 2.

W starszych zbiorach stwierdzono obecność przedstawicieli rodzin Ptyctodontidae, Holonematidae, Plourdosteidae, Pholidosteidae, Selenosteidae, Titanichthyidae i Dinichthyidae. Zilustrowano nie opisane przez poprzedników fragmenty szkieletu *Malerosteus gorizdroe* Kulczycki, 1957: puszkę nosową (Fig. 3A–C) i płytkę zanosową (postnasale) (Fig. 3D–G). Wbrew doniesieniom Gorizdro-Kulczyckiej (1950) i Kulczyckiego (1957) nie potwierdzono obecności Antiarcha w badanym materiale. Okaz zaliczony przez Kulczyckiego (1957) do *Bothriolepis* (Antiarcha) jest prawdopodobnie przedstawicielem Brachythoraci (Arthrodira).

Wśród okazów nowych znaleziono przedstawicieli Ptyctodontidae: fragmenty płytek zębowych (Fig. 2A–C) i brzusznej środkowej (medioventrale; Fig. 2E) *Rhynchodus* sp. oraz fragment kolca grzbietowego o nieokreślonej przynależności gatunkowej i rodzajowej (Fig. 2D). Oprócz ptyktodontów występują tam okazy Plourdosteidae i Dinichthyidae, a wśród tych ostatnich duża płytka karkowa (nuchale), należąca do *Dunkleosteus* sp. (Fig. 4A) oraz fragment grzbietu czaszki wraz z płytką szczękową dolną (inferognathale) młodocianego osobnika nowego gatunku z rodzaju *Eastmanosteus* (Fig. 4B). Należy on prawdopodobnie do tego samego gatunku, co najbardziej kompletny polski okaz Dinichthyidae, opisany przez Kulczyckiego (1957: pl. IV: 1, 2). Gatunkowi temu poświęcone będzie odrębne studium.