

# The first articulated antiarch (Vertebrata, Placodermi) from the Upper Devonian of the Holy Cross Mountains (central Poland)

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## ABSTRACT:

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The first articulated antiarch, *Bothriolepis jazwicensis* sp. nov., from the lowermost Famennian (Upper Devonian) of the Jazwica Quarry (Łgawa Hill) near Kielce, in the Holy Cross Mountains (central Poland), is described. *B. jazwicensis* sp. nov. is distinguished from all other species of *Bothriolepis* especially by possessing long and narrow armour and many unusual proportions of the head-shield and trunk-shield plates. This is the most complete specimen of a placoderm ever found in the Holy Cross Mountains and its state of preservation precludes its longer *post mortem* transport.

**Key words:** Antiarcha, Placodermi, Lower Famennian, Holy Cross Mountains.

## INTRODUCTION

The earliest information about the Antiarcha from the Devonian deposits of the Holy Cross Mountains is more than one hundred years old. This was GÜRICH's (1896) report of *Bothriolepis* sp. from the Emsian (Lower Devonian) "placoderm sandstone". Unfortunately, GÜRICH's original material was subsequently lost during World War I and partly during World War II. Although GÜRICH's (1896) report was questioned by the author of the present paper (cf. SZREK 2000), recent excavations in the "placoderm sandstone" indicate that he was most probably right (see SZREK 2003). GÜRICH's find was referred to subsequently by SIEMIRADZKI (1903) and CZARNOCKI (1919); the latter author also discussed the occurrence in the area of the representatives of *Asterolepidae* (*sic*).

Referring to GÜRICH (1896), *Bothriolepis* sp. from the Lower Devonian of the Holy Cross Mountains was also cited by GORIZDRO-KULCZYCKA (1934), who in the same publication reported on the Antiarcha from the

Upper Devonian of the area. She claimed to have found *Asterolepis* sp. in the upper Frasnian bituminous limestones of the Wietrznia and Kadzielnia Quarries, with *Rhynchonella coronula*, *Rhynchonella cuboides*, *Manticoceras intumescens* and *Beloceras* sp. In her subsequent paper (GORIZDRO-KULCZYCKA 1950) she recorded *Bothriolepis* cf. *maxima* and *Bothriolepis panderi* from the Kielce region. Both species were then cited and partly illustrated by KULCZYCKI (1957, pl. 12, fig. 1).

In the recent revision of the Late Devonian placoderms from the Holy Cross Mountains, IVANOV & GINTER (1997) could not confirm the occurrence of Antiarcha in the material studied by GORIZDRO-KULCZYCKA (1950) and KULCZYCKI (1957). In their opinion, the specimen illustrated by KULCZYCKI (1957, pl. 12, fig. 1) probably belonged to the Brachythoraci.

The aim of the present paper is to describe an almost complete articulated specimen of Antiarcha, the first really well preserved antiarch from the Holy Cross Mountains. The specimen was found in the Jazwica

Quarry on the Łgawa Hill near Kielce by Dr T.T. WRZOLEK (Faculty of Earth Sciences, Silesian University). The specimen comes from calcareous, brown, muddy limestone of the H-4 complex (RIGBY & al. 2001) assigned to the lower Famennian. The specimen is housed at the Faculty of Earth Sciences, Silesian University, Sosnowiec, Poland, under the registration number GIUS 402J172.

#### GEOLOGICAL SETTING

The Jaźwica Quarry on the Łgawa Hill is located about 4 km NE of Chęciny, on the southern limb of the Gałęzice Syncline in the southern (=Kielce) Region (*sensu* CZARNOCKI 1919) of the Holy Cross Mountains (Text-fig. 1).

The upper Frasnian and lower Famennian strata are well exposed in the quarry. The Łgawa Hill complexes are composed of marls, fine grained detrital limestones, nodular limestones and pelitic limestones. The sequence starts with the lower Frasnian biostromal and biohermal limestones with marly shales (A, B and C complexes – *transitans* conodont Zone, RIGBY & al. 2001), followed by fine-grained and coarse-grained detrital limestones, which dominate the sequence (D, E, F, G, H-1 complexes – *punctata* to *hassi-jamieae* conodont Zones, RIGBY & al. 2001). The marls with intercalations of fine-grained detrital and nodular limestones, in the top part of the Frasnian (H-2 and lowermost part of H-3 complex – *rhenana* to *linguiformis* conodont Zones), indicate a hemipelagic environment on the upper and/or middle foreslope of the platform reef in quiet water, with a brachiopod-sponge assemblage. "Rare placoderm fish plates" from the uppermost Frasnian of that quarry were mentioned by RACKI (1981). The environment was apparently favourable for antiarchs at the beginning of the Famennian period, with depths not exceeding 100 m. Although the specimen studied herein was found in a loose block it comes from the H-4 complex,

the stratigraphically youngest unit in the Łgawa Hill Devonian sequence. The conodonts identified from the block (by Prof. H. MATYJA) indicate that the specimen is of early Famennian (*Palmatolepis triangularis* conodont Zone) age.

#### ABBREVIATIONS

Adl – anterior dorsolateral plate; Amd – anterior median dorsal plate; Avl – anterior ventro-lateral plate; Cn – centro-nuchal plate; Cd<sub>1</sub> – dorsal central plate 1; La – lateral plate; Mxl – mixilateral plate; Pf – pectoral fin; Pm – paranuchal-marginal plate; Pmd – posterior median dorsal plate; Pmg – postmarginal plate; Prm – premedian plate; Pp – postpineal plate; al – antero-lateral corner of the nuchal plate; csl – central sensory line groove; dlg – posterior oblique abdominal pit-line groove; dlr – dorsolateral ridge; dma – tergal angle; dmr – dorsal median ridge; ifc – upper infraorbital sensory canal groove; lcg – main lateral line groove; mc – lateral corner of nuchal plate; nm – obtected nuchal area; obm – orbital facet of anterior margin; orb. fen. – orbital fenestra; pnoa – post-nuchal ornamented corner; pro – processus obstans.

#### SYSTEMATIC DESCRIPTION

The following description is based on the head-shield and the trunk-shield. The plate measurements are taken from the points designated in STENSIÖ (1948, pp. 11-16).

Class: Placodermi M'COY, 1848

Order: Antiarcha COPE, 1885

Family: Bothriolepididae COPE, 1886

Genus: *Bothriolepis* EICHWALD, 1840, designated by WOODWARD 1891

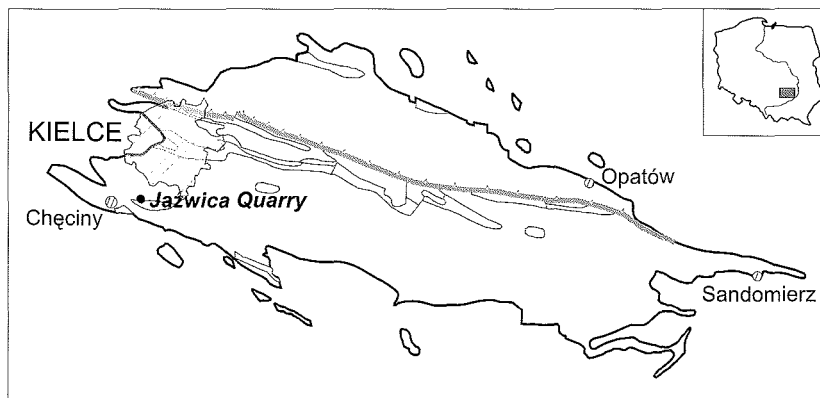


Fig. 1. Location of Jaźwica Quarry at Łgawa Hill in the Holy Cross Mountains. The outcrop marked with a black point, Upper Devonian deposits – grey colour

TYPE SPECIES: *Bothriolepis ornata* EICHWALD, 1840, subsequently designated by WOODWARD 1891

*Bothriolepis jazwicensis* sp. nov.  
(Text-figs 2-5)

HOLOTYPE: GIUS 402J172; collections of the Faculty of Earth Sciences; Silesian University, Sosnowiec, Poland.

ETYMOLOGY: After the fossil locality of Jaźwica Quarry (Łgawa Hill) in the Holy Cross Mountains.

MATERIAL: Single, almost complete specimen.

LOCALITY AND HORIZON: Jaźwica Quarry on the Łgawa Hill, 4 km NE of Chęciny, near Kielce, Holy Cross Mountains (south-central Poland); lower Famennian, complex H-4 of RIGBY & *al.* 2001); *Palmatolepis triangularis* conodont Zone.

DIAGNOSIS: Moderately large *Bothriolepis* with prolate shape of armour. Breadth/length index of armour c. 36. Trunk-shield relatively high, with breadth/length index 100. Head-shield cone-shaped and prolated, with breadth/length index c. 107. Orbital fenestra (orb. fen.) not large, wide. Centro-nuchal plate (Cn) vaulted and broadest across posterior corners. Orbital facet of anterior margin longer than distance from antero-lateral (al) corner to lateral corner (mc). Breadth/length index of centro-nuchal plate approximately 140. Postpineal plate (Pp) small and moderately vaulted. Central sensory line groove (csl) weakly marked. Dorsal crest sharp. Dorsal

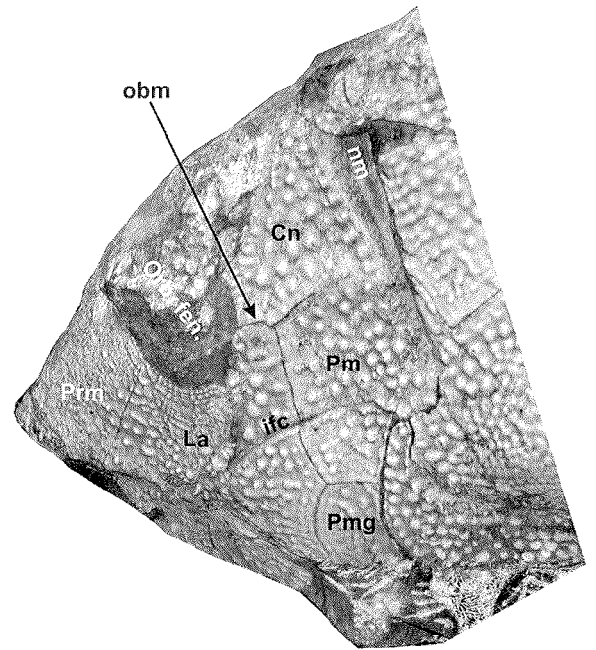


Fig. 3. *Bothriolepis jazwicensis* sp. nov. Holotype, lateral view of the head-shield; GIUS 402J172;  $\times 0.9$

walls enclose an angle of c.  $80^\circ$ . Anterior median dorsal plate (Amd) with breadth/length index of 100. Posterior margin of the anterior median dorsal plate and the anterior margin of posterior median dorsal plate quite wide. Anterior median dorsal plate not very long, with breadth/length index of approximately 85. Postnuchal ornamented corner of anterior dorso-lateral plate (pnoa) long and narrow, with breadth/length index 30. Main lateral line groove (lcg) and the posterior oblique

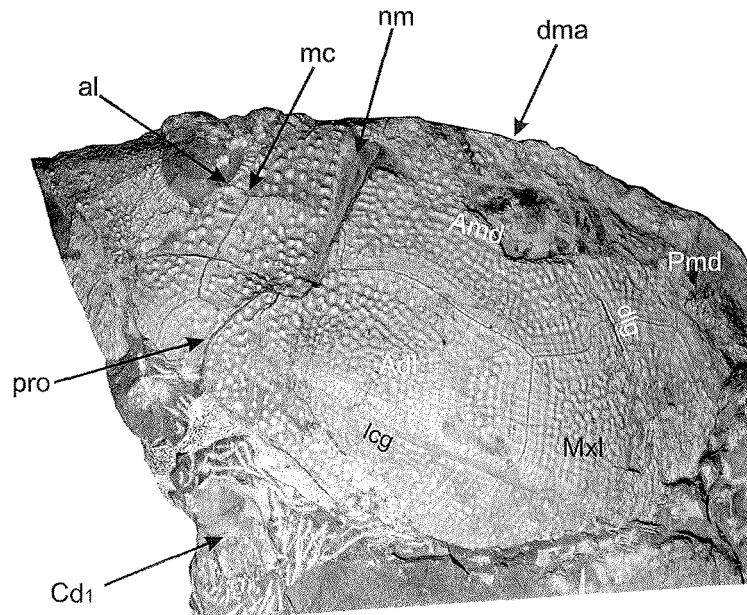


Fig. 2. *Bothriolepis jazwicensis* sp. nov. Holotype, an almost complete armour in lateral view; GIUS 402J172;  $\times 2$

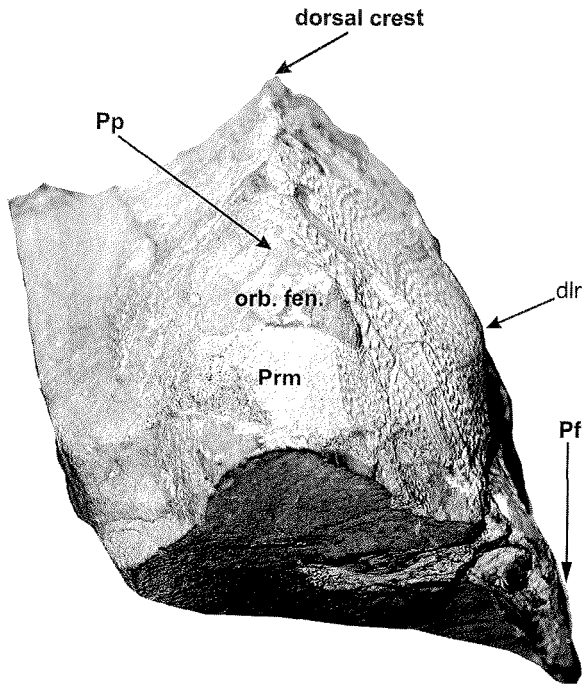


Fig. 4. *Bothriolepis jazwicensis* sp. nov. Holotype, front view; GIUS 402J172;  $\times 0.5$

abdominal pit line groove (dlg) visible as grooves on trunk-shield only. Main lateral line groove well marked, extending slightly below the dorso-lateral ridge (dlr).

**PRESERVATION:** The specimen is preserved in hard, crystalline limestone. Full preparation of the bone was not undertaken as it could damage the specimen. This is the reason why many elements of the armour are not exposed. The preparation was performed mechanically with a needle.

The armour is 220 mm at its maximum length. The left side of the specimen is better preserved. It is possible to observe the centro-nuchal plate (Cn), the paranuchal-marginal plate (Pm), the postmarginal plate (Pmg), the premedian plate (Prm), the anterior median dorsal plate (Amd), the anterior dorso-lateral plate (Adl), part of the posterior median dorsal plate (Pmd), part of the mixilateral plate (Mxl), and part of the dorsal central plate 1 (Cd<sub>1</sub>) of the pectoral fin. The orbital fenestra (orb. fen.), all the ventral plates and the posterior part of the lateral plates are covered with limestone. The lateral margin, rostral margins and the visceral skeleton of the skull roof are not preserved.

The right side of the specimen is partly covered with limestone and strongly abraded. The skull roof is in its maximum lowered position.

The specimen is laterally compressed, but its anterior part is not as strongly deformed as the posterior part of the specimen. The right posterior dorso-lateral plate touches the left posterior dorso-lateral plate on the internal surface. Also the right side of the anterior median dorsal plate and the right side of the posterior median dorsal plate

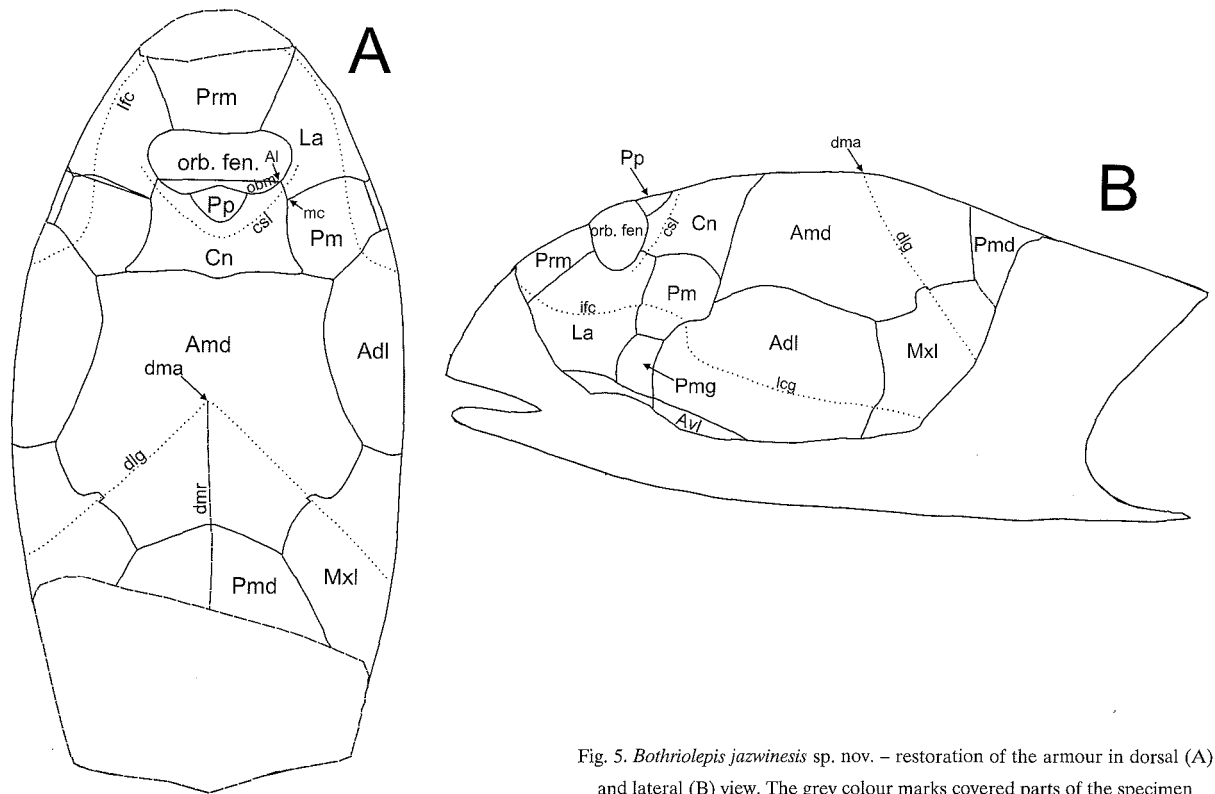


Fig. 5. *Bothriolepis jazwicensis* sp. nov. – restoration of the armour in dorsal (A) and lateral (B) view. The grey colour marks covered parts of the specimen

overlap each other a little on the analogous plates on the left side (at the dorsal crest). Ornamentation in the form of tubercles and ridges is well preserved on the left side.

**MEASUREMENTS:** length of head (>) 65 mm; breadth of head c. 70 mm; height of head c. 65 mm; height of trunk-shield (>) 155 mm; breadth of trunk-shield c. 80 mm; length of trunk-shield c. 155 mm; length of pectoral fin c. 95 mm; lines connecting antero-lateral angles of nuchal plate c. 28 mm; length of centro-nuchal plate (total) 27 mm; breadth of lateral plate 35 mm; total breadth of paranuchal-marginal plate 26 mm; breadth of postmarginal plate 10 mm; breadth of dorsal central plate 1 c. 17 mm.

**DESCRIPTION:** The anterior part of the head is incomplete. The anterior view exhibits the cone-shaped form of the skull roof. Its breadth is estimated to be a little larger than the height, with the breadth/length index around 36. Below the orbital fenestra (orb. fen.) both parts of the centro-nuchal (Cn) plate meet at around 77-80°. Separate plates on the head have different ornamentation. Tubercles, 1.5 mm in diameter, of the centro-nuchal, paranuchal-marginal (Pm) plates and of the posterior part lateral plate (La) create a quite distinct ornamentation. The anterior and the lower part of the lateral plate tubercles fuse into ridges and are much smaller (<0.5 mm). The smallest tubercles are visible on the premedian plate (Prm).

Unfortunately, the central part of the centro-nuchal plate is not clearly visible and it is impossible to establish its border with the postpineal plate (Pp). The centro-nuchal plate has an external length/breadth index c. 70. The distance between the lateral corner (mc) and the antero-lateral corner of the centro-nuchal plate (al) is probably very short (4.5 mm) in comparison with the orbital facet of the anterior margin (obm). The orbital facet of the anterior margin is longer (8 mm) than the distances from the antero-lateral corner to the lateral angle (5 mm). The shape of the border of the centro-nuchal plate with the paranuchal marginal and lateral plates is very similar to that in *Bothriolepis canadensis* (STENSIÖ 1948, text-fig. 76 A, B), but broader.

There is no contact of the postpineal plate with the lateral plate. The postpineal plate is not preserved but was probably rather small and slightly vaulted. The shape could be similar to that in *Bothriolepis laverocklochensis* (MILES 1968, pl. 5, fig. 5)

The orbital fenestra is quite wide (31 mm) in comparison with the dimension of the head-shield, similarly to *Bothriolepis prima* (LUKŠEVIČS 2001, fig 5).

The measurements of the lateral plate are not precise; its length may be smaller than, or equal to, its breadth. The surface of the lateral plate is larger below

the orbital fenestra than behind. The shape of the border of the lateral plate with the paranuchal-marginal plate is similar to that in *Bothriolepis panderi* (STENSIÖ 1948, text-fig. 229 A, B) and *Bothriolepis canadensis* (STENSIÖ 1948, text-fig. 76 A, B). It is straight with a weak zigzag pattern. Below the sensory line there is a small collapse, as in *Bothriolepis panderi* (STENSIÖ 1948, text-fig. 229 B). The distance between the antero-lateral corner (al) and the lateral corner of nuchal plate (mc) is smaller and the armour is less flat. The border with the postmarginal plate is typical of *Bothriolepis* and makes a gentle curve. The premedian plate is badly damaged, there is no anterior part. The border with the lateral plate is straight, there are no bends as in *Bothriolepis canadensis* (STENSIÖ 1948, text-fig. 229 A, B). The shape of the orbital fenestra cannot be precisely determined. The posterior margin of the premedian plate is similar to that in *Bothriolepis cellulosa* (STENSIÖ 1948, text-fig. 219 B).

The incompletely preserved pectoral fin (Pf) is not large – it could be a little shorter than, or equal to, the length of the trunk-shield. The ornamentation on the dorsal central plate 1 (Cd<sub>1</sub>) consists of isolated and small tubercles (0.5-1 mm in diameter).

The length of the trunk-shield is around 155 mm. The trunk-shield is relatively high (155 mm). The dorsal walls come together at around 80° and meet the lateral walls at 140°. The anterior median dorsal plate (Amd) has a flat breadth/length index of around 100 - similar to that in *Bothriolepis hydrophila* (MILES 1968, text-fig. 30), but is longer, particularly the distance from the antero-lateral corner to the lateral corner. The shape of the posterior lateral border (with mixilateral plate – Mxl) is similar to that in *Bothriolepis gippslandensis* (LONG 1983, fig. 5 B). The posterior border (with posterior median dorsal plate) is wedge shape as in *Bothriolepis hydrophila* (MILES 1968, fig. 30) or *Bothriolepis fergusonii* (LONG 1983, fig. 7). The dorsal crest is damaged, as is much of the border of the anterior median dorsal plate with the posterior median dorsal plate (Pmd). The distance from the tergal angle (dma) to the anterior margin of the anterior median dorsal plate is 28 mm. The processus obstans (pro) makes a gentle curve, bending to the front. The anterior median dorsal plate is anteriorly a little broader than posteriorly. The borders with the anterior dorso-lateral plate (Adl) are gentle, apart from the posterior part. The anterior part of the anterior median dorsal margin is parallel to the main lateral line canal, and slightly convex in the direction of the anterior median dorsal plate. The dorso-lateral ridge is shallow. The articular fossa is shallow and symmetrical. The post-nuchal ornamented corner of anterior dorso-lateral plate (pnoa) is long and narrow with the breadth/length index of 30; measurements are not precise because the anterior margin is poorly visible.

## CONCLUSIONS

The specimen described herein has the distinctive features of the genus *Bothriolepis*: it lacks the contact of the postpineal plate with the lateral plate, its orbital fenestra is relatively narrow, its trunk armour is even-crested, the posterior median dorsal plate narrows anteriorly, and its pectoral fins are quite long. *Bothriolepis jazwicensis* sp. nov. differs from all other species of *Bothriolepis* in possessing a general prolate shape of the armour, especially of the trunk-shield; in the long and curved anterior margin of the head; in the well developed high dorsal crest, which is slightly curved in lateral view; in the longer orbital facet of the anterior margin of the nuchal plate, compared to the length from the anterolateral angle of the nuchal plate to the lateral angle of the centro-nuchal plate; in the long and narrow postnuchal ornamented corner of the anterior dorso-lateral plate; and in plate proportions that differ from those of any other known species of this genus.

As this is the first antiarch discovered and described from the Holy Cross Mountains and particular species of this group are usually confined to definite regions (cf. DENISON 1978, MARK-KURIK 2000, MILES 1968, STENSIÓ 1948) it supports the distinction of a new species.

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