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REVIEW OF THE PTERASPIDIFORM HETEROSTRACANS (VERTEBRATA, AGNATHA) FROM THE DEVONIAN OF PODOLIA, UKRAINE, IN THE THEODOR VĂSCĂUȚANU COLLECTION, BUCHAREST, ROMANIA

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Abstract – The pteraspidiform heterostracans are jawless vertebrates known from the Pridolian (Upper Silurian) to the Givetian (Middle Devonian). This preliminary study focuses on the redetermination and restudying of the material collected in 1931 by Văscăuțanu from the Devonian formations from the former Romanian bank of the Dniester river, figured by Paucă in 1938. The material comes from the following collections: University of Bucharest Laboratory of Palaeontology and the National Geological Museum. The redetermination of the material is based on the study of the orbito-pineal region; biometric data and overall morphology and shape of the plates. The identification of the material follows the criteria presented by Blieck (1984) for his systematic, phylogenetic and biostratigraphic review of the pteraspidiform heterostracans from Great Britain, Podolia, Spitzbergen and the Ardenne Massif. Given the progres made in the study and of fossil agnathans, and also the fact that from 1938 until the present no study has been carried out on the material collected by Th. Văscăuțanu, the present review aims to show for the first time part of the ostracoderm diversity from the former Romanian part of Podolia.

Keywords – Devonian, heterostracans, Podolia, Pteraspidiformes, revision, Văscăuțanu

Abstract – Heterostracii pteraspidiformi sunt vertebrate agnate, cunoscute din Pridolian (Silurian superior) până în Givetian (Devonian mediu). Acest studiu preliminar are ca obiect redeterminarea şi studiul materialului colectat de Th. Văscăuțanu în 1931 din formațiunile devoniene din fostul mal românesc al Nistrului şi figurate de Paucă în 1938. Materialul provine din următoarele colecții: Universitatea din Bucureşti, Laboratorul de Paleontologie şi Muzeul Național de Geologie. Redeterminarea materialului urmăreşte criteriile prezentate de Blieck (1984) pentru revizia sistematică, filogenetică şi biostratigrafică a heterostracilor pteraspidiformi din Marea Britanie, Podolia, Spitzbergen şi Masivul Ardeni. Având în vedere progresele făcuteîn studiul agnatelor fosile, şi faptul că din 1938 până în prezent nu a mai fost făcut nici un studiu asupra materialului colectat de Văscăuțanu, acest studiu are ca scop prezentarea pentru prima oară a diversității de ostracodermi din Basarabia.

Cuvinte cheie – Devonian, heterostraci, Podolia, Pteraspidiformi, revizuire, Văscăuțanu

INTRODUCTION

Heterostracan remains from the Devonian of Podolia (**fig. 1**) have been thoroughly studied by Stensiö (1964). Most recently the whole of the Podolian pteraspid fauna has been revised by Blieck (1984). Due to the scarcity of the fossil bearing Paleozoic outcrops in Basarabia, and also to the fact that the region in which they occur has been under political dispute for many years, it has attracted only minor attention by, Văscăuțanu (1931), Athanasiu and Paucă (1938), none of whoum has carried out a comprehensive study of the heterostracan fauna from Basarabia. After the death of Văscăuțanu, his collection of heterostracan material, was given to Paucă for further study and description.It also included, two new species of *Palaeaspis* and one of *Cephalaspis*, that were only mentioned by Văscăuțanu, as well as some specimens collected by S. Athanasiu. Paucă's findings were published in 1938, as well as his rather less then detailed description of Văscăuțanu's new species. At present time most of Văscăuțanu's collection of ostracoderms remains unaccounted for, except the few specimens deposited in the collections of the National Geological Museum, and those in the collection of the Laboratory of Palaeontology at the University of Bucharest. The new species mentioned by Văscăuțanu pose a different problem in the sense that they have never been accurately described or figured, and in one particular interest, the specimen of *Palaeaspis simionescui* is only known from a contour drawing made by Paucă (1938), its current location remains unknown. It is these particular species which will hopefully form the subject of a new and more detailed study, as to try to answer the current taxonomic problems which revolve around them. At the same time as Paucă's studies, a few other studies have been carried out on the (at that time) Polish side of the Dniester, by Zych and Balabai.

MATERIALS AND METHODS

The specimens are preserved in a hard reddish sandstone or a crystalline limestone and were prepared mechanically using a mounted needle under a ZEISS binocular microscope. Some of the specimens, whose structures were too delicate to withstand mechanical removal of the matrix, were prepared using diluted hydrochloric acid. Photographs of the specimens were taken using a 7 mega pixels digital camera; drawings of the most

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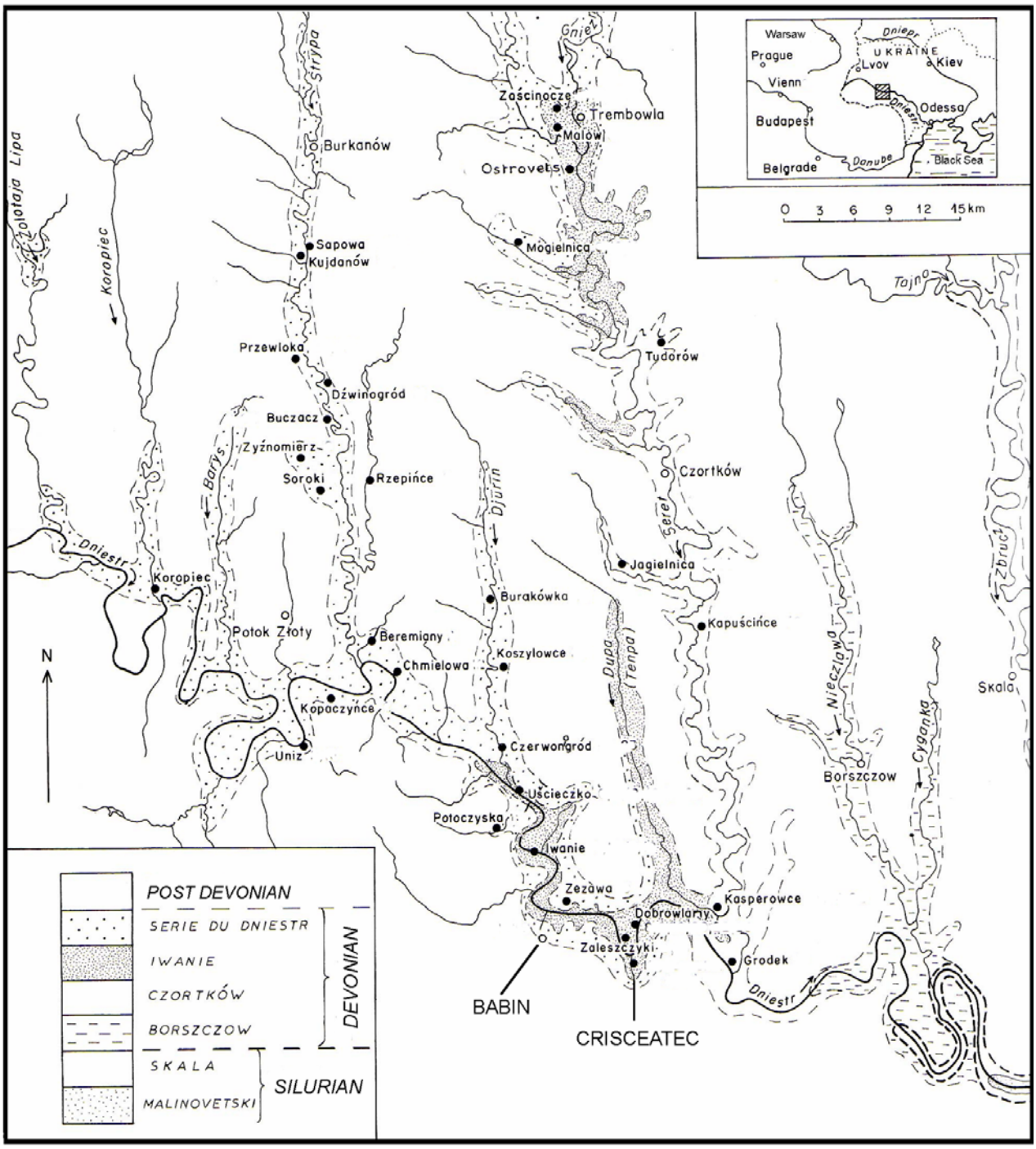


Fig. 1 - Geological map of Podolia (after Blieck, 1984)

interesting structures were made by means of a LEITZ camera lucida and then reproduced on tracing paper. Reconstructions of the entire specimens were drawn after photos. The measurements employed follow wherever possible those used by Blieck (1984). The specimens are deposited in the vertebrate collection of the Laboratory of Paleontology at the University of Bucharest (LPB), and in the collections of the National Geological Museum, Bucharest (MNG).

GEOLOGICAL SETTING

The two sites from which the material comes from are both of Early Devonian age. At the site called Babin (Bobince, **fig. 2**) both the Lochkovian and Pragian are represented, and are discordantly below the mesozoic.The specimens that we have studied seem to come from the Pragian deposits, as suggested by the lithology of the matrix in wich the specimens are preserved, all the data about their stratigraphical location were either not recorded or have been lost. The stratigraphical succession at Babin starts with greenish white limestones having a thickness of about 2 meters, containing large amounts of ostracods (*Leperditia tyraica*). Lying on top of this, there is a thickness of 3 meters of compacted greenish marls, probably Pridolian in age. The major part of the sequence at Babin (30 meters) is represented by a succession of marls and reddish sandstones, witch contain only ostracoderm remains. Within this sequence,

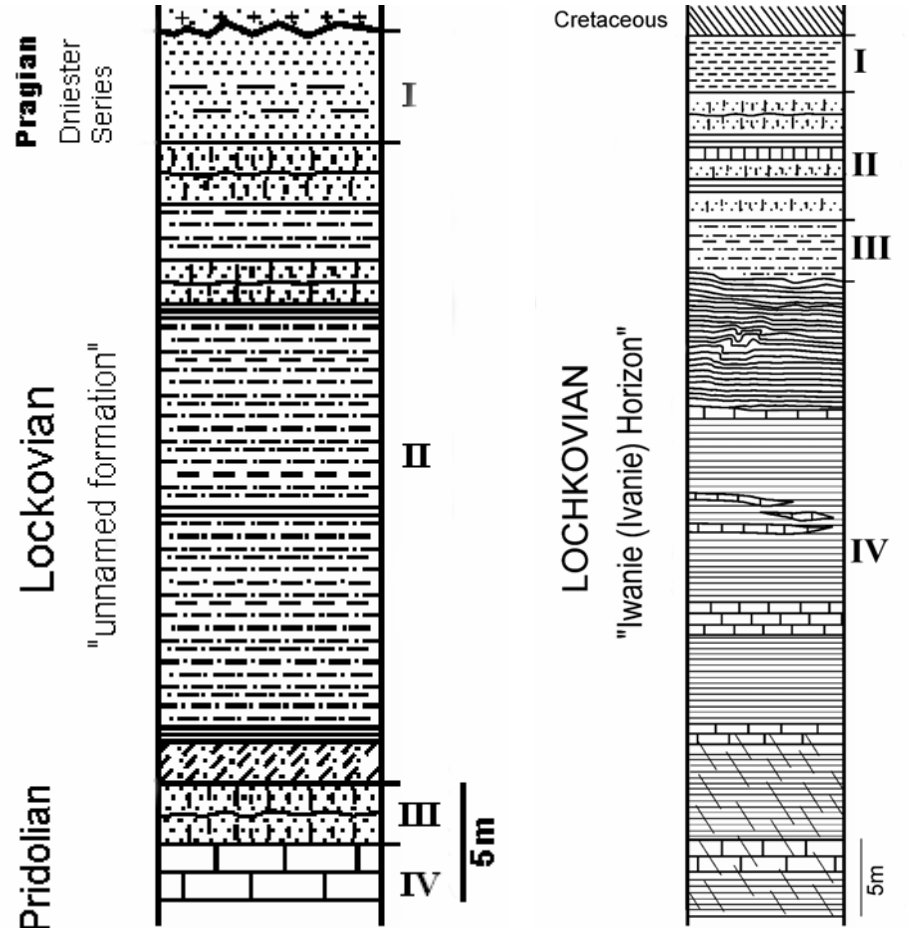


Fig. 2. a – Lithostratigraphic column for Babin; b – Lithostratigraphic column for Crisceatec (after Văscăuțanu, 1931)

Vascăutanu (1932) has mentioned the following species*: Auchenaspis. sp; Phlictenaspis. sp; Pteraspis rostrata; Pteraspis major; Pteraspis kneri,* now determined as *Larnovaspis major; Larnovaspis kneri.* By far, the most interesting portion of the Babin sequence is the Pragian, represented by 5 meters of quartzitic limestones with lenses of bone breccia (Babin sandstone) containing an almost identical faunal assortmen to that found in Frasnian deposits from Greenland from wich *Acanthostega* was described (Jenny Clack, pers. comm, 2004), containing placoderms, acanthodians, actinopterygians and sarcopterygians. This upper part of the Palaeozoic sequence at Babin seems to contain an invaluable source of data which has yet to undergo a thorough study. The vertebrate faua is represented by: *Auchenaspis. sp., Cephalaspis bucovinensis, Pteraspis major, Phlictenaspis. sp.* (Văscăuțanu, 1931).

At the site called Crisceatec (Kryszczatek, **fig. 2b**), the entire outcropping sequence is of Lochkovian age and the ostracoderm remains are limited to the lower part of a 50 meter thick sequence of olive green clays alternating with limestones, and lying below Cretaceous deposits. The sequence yielded the following ostracoderm fauna: *Pteraspis rostrata; Pteraspis podolicus; Pteraspis kneri; Palaeaspis simionescui; Cyathaspis sturi* (Văscăuțanu, 1931); other faunal elements are not present. The overlying beds, represented by 5 meters of finely layered siltic shales, 8 meters of reddish marls alternating with finely layered shales, and topped by 3 meters of finely laminated sandstones with *Fucoides*, are devoid of any vertebrate remains. The stratigraphical level from which the specimens come from is not recorded.

SYSTEMATIC PALAEONTOLOGY

Class PTERASPIDOMORPHI Stensio, 1958
Subclass HETEROSTRACI Lankester, 1868
Order PTERASPIDIFORMES Berg, 1940
Family PTERASPIDIDAE Claypole, 1885

Podolaspis lerichei (Zych, 1927)
Text-fig. 3 a, b, c; Pl. 1., figs. 3, 10, 11.

Original nomenclature: *Pteraspis lerichei* ZYCH and *Pteraspis lerichei* var *plana* BROTZEN, in Paucă, 1938 pp.25-27, Pl: 2 fig 2-3

Locality: Babin

Diagnosis (after Blieck, 1984): Small *Podolaspis*. Rostral plate with the ventral surface ending in a well defined median crest. Pineal plate with a crescent shape, and pointed lateral sutures**.**

Material: It is composed of three specimens, two of which were figured by Paucă (1938, Pl II 2-3), MNG I (V) 0033 and MNG I (V) 0032. A third

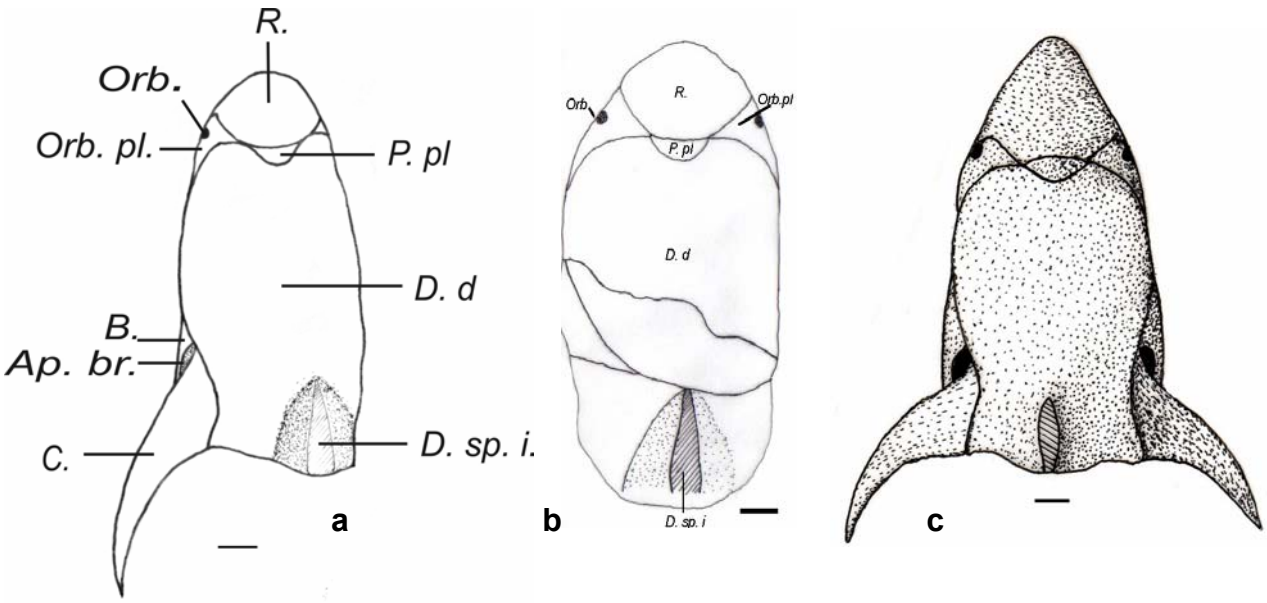


Fig. 3. a - *Podolaspis lerichei*, specimen MNG I (V) 0033, almost complete specimen composed of rostrum, pineal plate, left orbital and partial right orbital plate, left branchial plate, partial dorsal disc and left cornual plate; b – *Podolaspis lerichei*, specimen MNG I (V) 0032, composed of rostrum, pineal plate, right and left orbital plate and dorsal disc; c – *Podolaspis lerichei*, reconstruction (modified after Blieck 1984). Scale bar = 1 cm.

specimen, very poorly preserved, consists of an interior mould of the posterior part of the dorsal disc with the insertion for the dorsal spine (Paleontology Laboratory at the University of Bucharest LPB II (V) 0314. Of these, by far the best preserved is specimen nr. MNG I (V) 0033, consisting of an almost complete carapace, say for the right cornual plate. Specimen nr. MNG I (V) 0032 consists of a partial dorsal carapace composed of the following plates: rostral, pineal and dorsal disc. All the specimens are preserved as internal molds, with some remnants of the laminated layer still present, but this is due to the poor collecting methods employed by Văscăuțanu, and is not indicative of the actual mode of preservation.

Description:

Rostral plate. Triangular in shape with a bluntly rounded tip.

Pineal plate. Has an overall crescent shape, with a slightly concave anterior margin and a convex posterior margin.

Orbital plates. Possess a short triangular medial extension tapering towards the pineal plate, meeting the lateral tips of the pineal plate in a pointed contact. Orbits small and medially placed. A short, triangular process extends onto the dorsal rostral lamina. Posteriorly an elongated, tapering post-orbital process extends along the lateral margin of the dorsal disc.

Dorsal disc. Elongated, with an elliptical shape, moderately arched anteriorly and posteriorly, widening anteriorly and sloping gently from the growth center in front of the insertion for the dorsal spine. Dorsal spine insertion very deep, having the shape of an inverted "V". Lateral margins convex anteriorly, narrowing abruptly behind the branchial openings, almost straight posteriorly.

Branchial plates. Extending along the lateral margins of the shield from below the posterior process of the orbital plates, to the narrowest part of the dorsal disc, represented by the insertion for the cornual plate.

Cornual plates. Large, well developed, originating behind the branchial plates, with a gentle convex outer edge, and a concave inner edge, ending in a sharp tip that extends behind the posterior margin of the disc.

Discussion: This species has been the subject of some dispute ever since its establishment, mostly because of the insufficient number of specimens available for research. Three specimens are available for the present study, two of which show all the specific characters of this species given by Blieck (1984, *pp*. 40-43) restricted to the plate contacts in the orbito-pineal region; the third specimen LPB II (V) 0314, which lacks the diagnostic area of the shield, was referred to this species due to the almost exact resemblance of its dorsal spine insertion to the other two specimens.

Measurements: *Width of Rostrum* – 27 mm; *Length of Rostrum* – 15 mm;*Length of Dorsal disc* – 100 mm;*Width of Dorsal disc* - 60 mm; *Width of Pineal plate* – 6 mm; *Length of Orbital plate* – 10 mm; *Length of Cornual plate* – 52 mm

Brachipteraspis sp.* cf. *B. latissima (Zych, 1927)
Text fig – 4a, b; Pl I. fig – 12.

Original nomenclature: *Pteraspis latissima* ZYCH, in Paucă (1938, pp 27-28, Pl II fig 1)

Locality: Babin

Diagnosis: Large pteraspids with a wide dorsal shield and very deep ventral shield, especially in its posterior part. Orbital plates with a short posterior process. Large branchial and cornual plates. Dorsal spine small with a short base.

Material: A portion of the dorsal shield composed of the rostrum, the right orbital plate,

pineal plate and anterior part of the dorsal disc [MNG I (V) 0031], already figured by Paucă (1938, pp. 27-28; Pl II, fig 1: *Pteraspis latissima* ZYCH).

Description: *Rostral plate*. Semicircular, with a flattened dorsal lamina; rounded anterior margin and almost straight posterior margin, except the postero-lateral edges which have an indentation for the anterior process of the orbital plate; on the dorsal surface of the rostral lamina, several growth ridges are clearly visible.

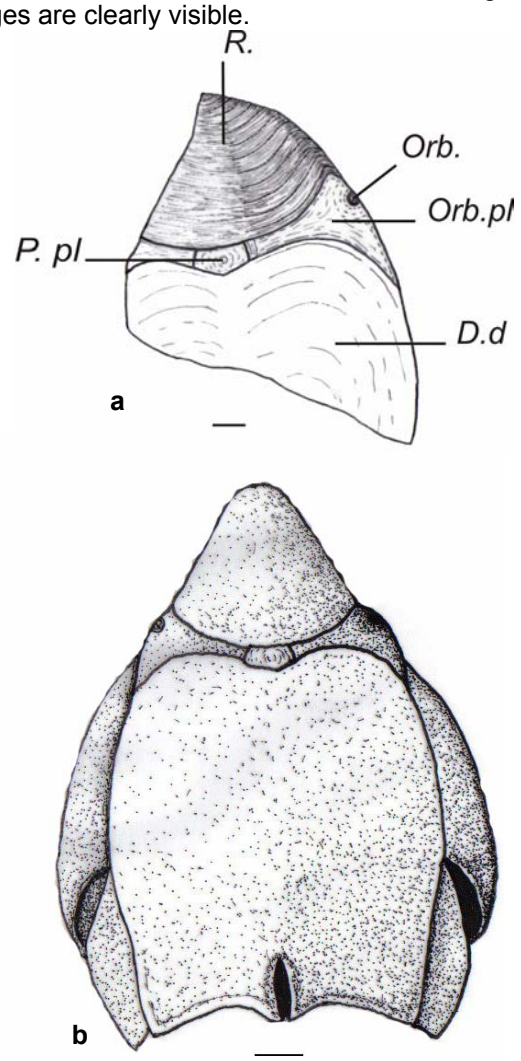


Fig. 4. a – *Brachipteraspis sp.* cf. *Brachipteraspis latissima*, specimen MNG I (V) 0031, composed of rostrum, pineal plate, right orbital plate and anterior portion of dorsal disc; b – *Brachipteraspis latissima* reconstruction (modified after Blieck). Scale bar = 1

Pineal plate. Large, with an overall laterally elongated shape, a straight anterior margin, slightly concave projections and a strongly convex posterior margin similar to that of an elongated trapezium.

Orbital plates. Orbit small, laterally placed; anteriorly a very short and broad anterior process extends onto the rostral plate. Posterior process short, but longer and more pointed than the anterior process, extending onto the antero-lateral margin of the dorsal disc; medial process in a wide contact with the pineal plate, forming a quite unique orbito-pineal belt (Blieck 1984, Paucă, 1938).

Dorsal disc. Very broad and flat in its anterior portion; the anterior margin is almost flat, the lateral margins are convex.

Discussion: The subrostral surface, which shows some diagnostic features of the taxon (after Stensio, 1964) has not been prepared. The specimen was referred to this species, because of its unique orbito-pineal region. The specimen has an abnormal rostral shape for this species. Whereas the type specimen has a rostral plate with relatively straight lateral margins (Blieck, 1984, fig 45A), our specimen has a semicircular rostral plate. Wether these differences are due to infraspecific variability is unclear, but highly probable, as the specimen was not studied first-hand, and only a photograph of it was available for study.

Pteraspididae gen. et sp. indet. A
Pl I., fig. 4.

Locality: Crisceatec
Material: An internal cast of a complete dorsal disc and partial pineal plate, with some very well preserved fragments of bone tissue LPB II (V) 0313.

Description: *Dorsal disc*. Moderately elongated with an overall elliptical shape. Gently arched anteriorly, strongly arched posteriorly. Lateral margins gently convex, narrowing abruptly about two thirds of the way from the anterior part. Maximum height of the disc at the growth center in front of the dorsal spine insertion, sloping gently and widening towards the anterior margin. Posterior edge with well developed terminal lobe for the insertion of the dorsal spine.

Discussion: The complete mould of a dorsal disc with part of the pineal plate preserved presents a posterior lobe for the insertion of the dorsal spine, similar to that seen in Blieck (1984: fig. 41E).

Measurements: *Length dorsal disc* – 59.5 mm; *Width dorsal disc* – 39.4 mm

Pteraspididae gen. et sp. indet. B
Pl I., fig. 9.

Locality: Crisciatic
Material: Ventral disc of an immature individual.

Description: *Ventral disc*. The plate is crushed so its natural longitudinal and transverse vaulting cannot be easily seen. The anterior margin is broadly rounded, while the posterior margin has a well-developed medial lobe. Lateral margins gently convex, almost straight, bound by narrow upturned lamina. Very fine ornamentation composed of flat topped dentine ridges with well developed lateral crenulations, having a density of about 10 – 11 per mm.

Discussion: LPB II (V) 0315 is strikingly similar to the ventral disc of *A. senniensis* (Loeffler & Thomas, 1980) which also possesses a posterior projection as well as an overall similar shape. The disc most likely belong to an immature individual

due to the fact that the edges of the disc are rounded, indicating that the plates had not been fused together as occurs in mature individuals (Denison, 1973), the shorter than normal prismatic vacuoles and finally the generally slender appearance of the disc. This type of elongated ventral disc is also known in *Errivaspis depressa* (Stensio 1964: fig 39)

Measurements: *Length ventral disc* – 67 mm; *Width ventral disc* – cca. 31 mm

PTERASPIDIDAE gen. et sp. indet. C
Pl I. fig. 6.

Material: Anterior part of an incomplete dorsal disc LPB II (V) 0316

Description: Part of the anterior portion of the dorsal disc of a probably immature individual, showing very well preserved enamel capping of the dentine tubercles.

PTERASPIDIDAE gen. et sp. indet. D
Pl I, fig. 2.

Locality: Babin

Material: Ventral disc LPB II (V) 0317

Description: Poorly preserved internal mold of a complete dorsal disc with a rounded anterior margin, gently convex lateral margins, convex posterior margin with an up-turned edge. Maximum height occurs at the posterior edge of the disc that widens and broadly flattens towards the anterior margin.

Discussion: The specimen is similar to *Spitsbergaspis prima* (Pernegre 2003, fig 3b, 7b) in overall shape but it is slightly larger. Due to the poor state of preservation it has been impossible at this time to assign it to any genus.

Measurements: *Length of ventral shield* – 73 mm; *Width of ventral shield* – 52 mm

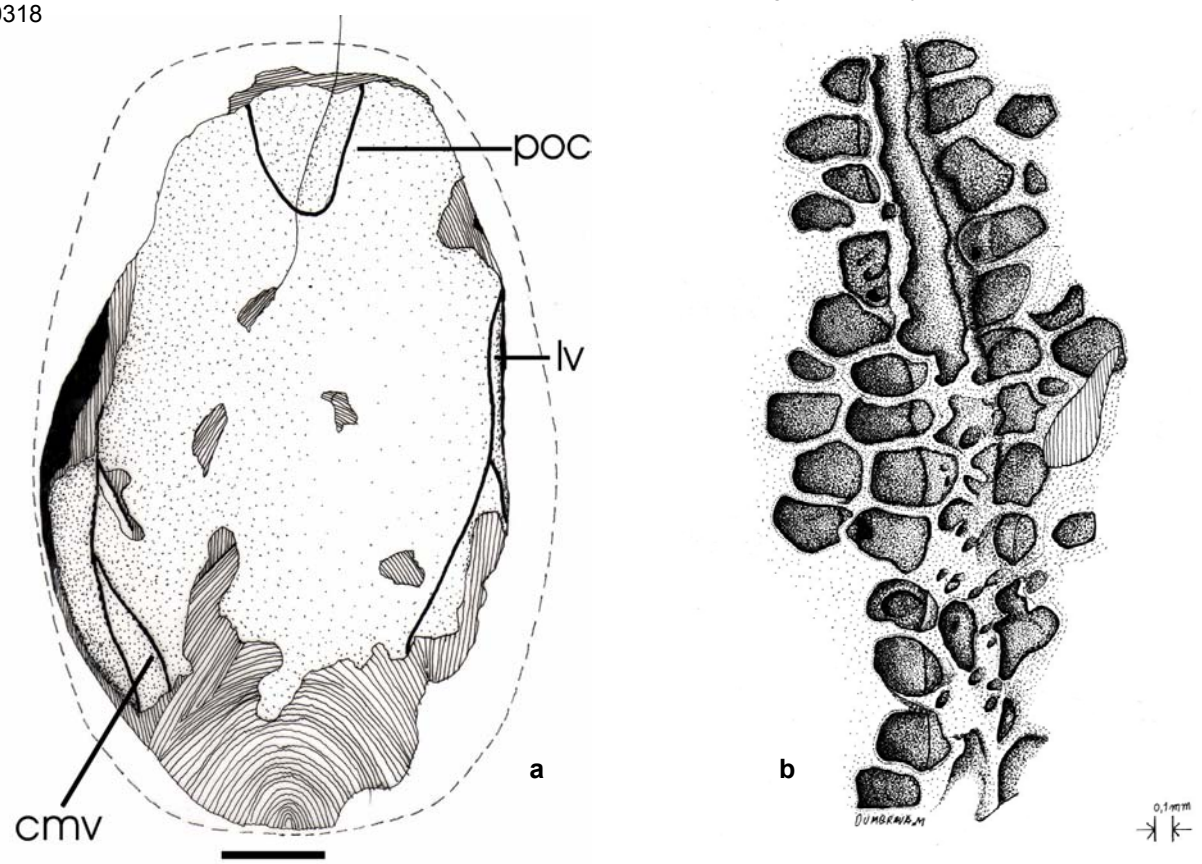
PTERASPIDIDAE gen. et sp. indet. E
Text-fig. 5a, b, Pl. I, figs. 5, 8.

Locality: Crisceatic

Material: ventral disc LPB II (V) 0318

Description: An almost complete ventral disc with all of its bony tissue preserved, but the edges of the disc are broken away so that its precise shape cannot be identified. The disc has a very pronounced vaulting both longitudinally and transversely. The sensory canal system seems to be preserved in great detail, although some of the ventral commisures are not present. Through the use of hydrochloric acid it was possible to expose the sensory canal pattern and to reveal some particular morphological structures, namely pores within the walls of the sensory canals. They appear to have an irregular distribution and are opened to the spongy layer above them as well as opening inside the honeycomb layer, thus connecting the interior of the sensory canals to the rest of the internal structures of the plates. The canals do not show any sign of the lateral tubules which are seen in some other pteraspids (Stensiö, 1926).

Fig. 5 a – Camera lucida drawing of the sensory canal pattern of specimen LPB II (V) 0318: *poc* – post oral canal; *lv* – latero-ventral canal; *cmv* – ventral commisures; b – Camera lucida drawing of a sensory canal, specimen LPB II (V) 0318



PTERASPIDIDAE gen. et sp. indet. F
Pl I, fig. 1.

Locality: Babin
Material: ventral disc LPB II (V) 0320
Description: An almost complete internal mould of a ventral disc lacking the anterior portion and which posses some remnants of the laminated bone layer. Lateral margins almost straight, posterior margin semicircular.
Measurments: *Length of ventral disc* – 43,5 mm; *Width of ventral disc* – 31mm

PTERASPIDIDAE gen. et sp. indet. G
Pl. I, fig. 7.

Locality: Babin
Material: rostrum LPB II (V) 0319
Description: Internal mould of an almost complete rostral plate, very badly preserved, with the tip and left posterior process missing .Dorsal lamina flat, subrostral lamina too poorly preserved to make out any details of its morphology.
Measurments: *Length of Rostral plate* – cca. 36 mm; *Width of Rostral plate* – cca. 29 mm

CONCLUSIONS

Some of the specimens of heterostracans in the collection of the Laboratory of Paleontology at the University of Bucharest, wich previously were labeled as *Pteraspis sp* have been identified. A new range of interspecific variability has been established for *P. lerichei.* For the first time since their discovery by Văscăuțanu in 1931 these specimens are described, and some are figured in the present paper for the first time. The issue of the material collected by Văscăuțanu and its taxonomic status is brought for the first time.

ACKNOWLEDGMENTS

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EXPLANATION OF THE PLATES

PLATE 1
Pteraspidiforms from the Lower Devonian of Podolia

Fig. 1 - Pteraspididae gen. et sp. indet. internal mould of partial ventral plate LPB II (V) 0320
Fig. 2 - Pteraspididae gen. et sp. indet. poorly preserved internal mould of a complete ventral disc LPB II (V) 0317
Fig. 3 - *Podolaspis lerichei* Zych, 1927 internal mould of posterior part of dorsal disc with insertion for dorsal spine LPB II (V) 0314
Fig. 4 - Pteraspididae gen. et sp. indet. internal mould of complete dorsal disc and partial pineal plate LPB II LPB II (V) 0313
Fig. 5 - Same specimen, close-up of sensory canal and pores
Fig. 6 - Pteraspididae gen. et sp. indet., anterior part of incomplete dorsal disc LPB II (V) 0316
Fig. 7 - Pteraspididae gen. et sp. indet., internal mould of partial rostrum LPB II (V) 0319
Fig. 8 - Pteraspididae gen. et sp. indet., almost complete ventral disc, with all of its bony tissue preserved and sensory canal system LPB II (V) 0318
Fig. 9 - Pteraspididae gen. et sp. indet ventral disc LPB II (V) 0315
Fig. 10 - *Podolaspis lerichei* Zych, 1927 internal mould of an almost complete carapace, MNG I (V) 0033
Fig. 11 - *Podolaspis lerichei* Zych, 1927 dorsal shield comprised of rostrum, pineal plate and dorsal disc, MNG I (V) 0032
Fig. 12 - *Brachipteraspis sp*. cf. *latissima* Zych, 1927 anterior portion of dorsal shield comprised of partial rostrum, right orbital plate, pineal plate and anterior part of dorsal disc MNG I (V) 0031

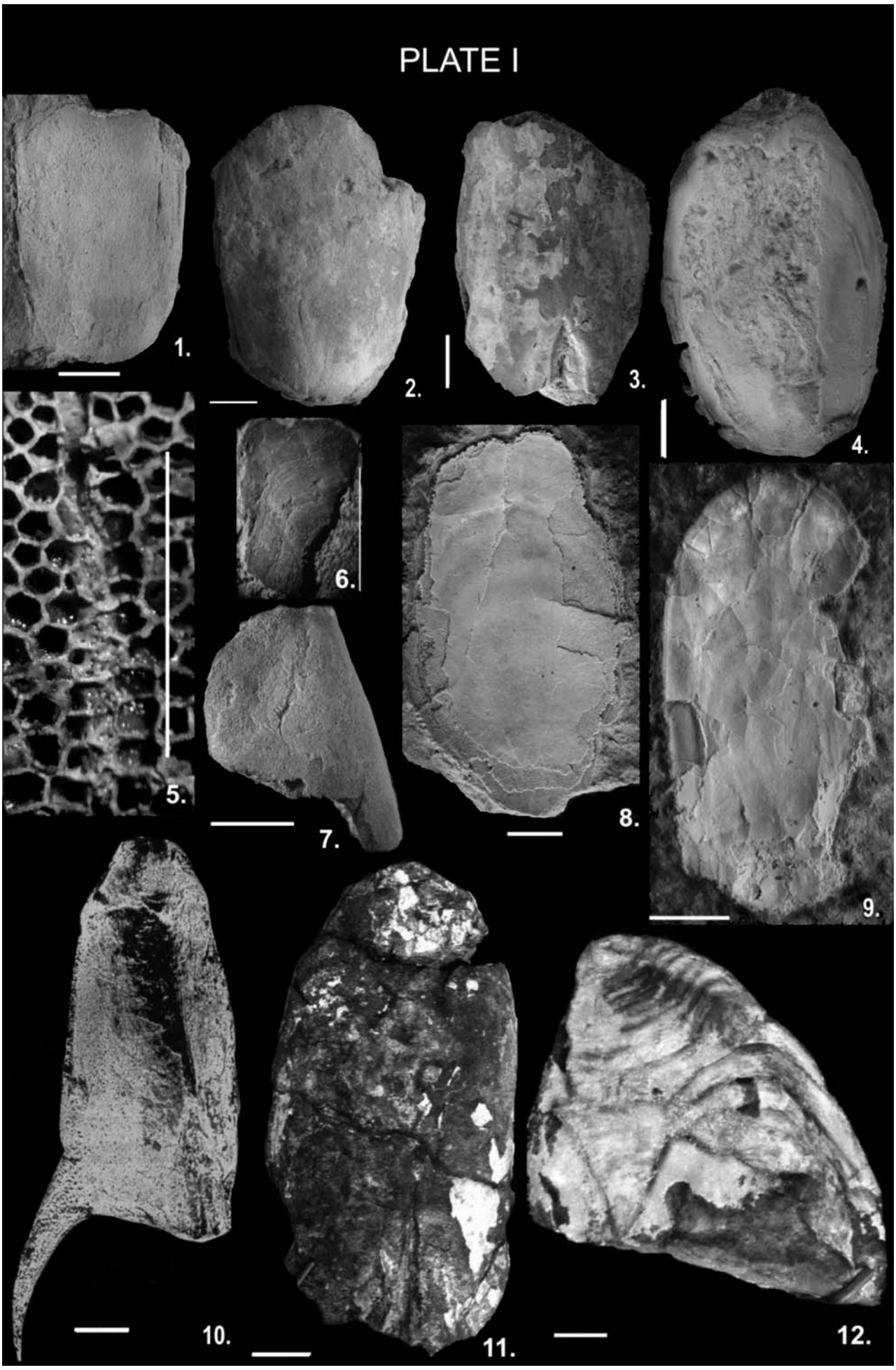
PLATE I
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