A NEW ODONTOPLEURID TRILOBITE GENUS FROM THE DEVONIAN OF BOHEMIA

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ABSTRACT. A new odontopleurid genus *Isoprusia* (type *I. mydlakia* sp. nov.) is described and assigned to the subfamily Miraspidinae R. and E. Richter, 1917. The new genus includes *Odontopleura laportei* Hawle and Corda, *Acidaspis ursula* Barrande, ? *A. sperata* Barrande, *A.* (*Ceratocephala*) *sandbergeri* R. and E. Richter, *Orphanaspis cornuticauda* Erben, and *Koneprusia pennata* Lütke. Features of the pygidium of the new genus enable it to be distinguished from *Koneprusia* Prantl and Přibyl 1949, the type material of which cannot be traced. *Odontopleura subterarmata* Barrande, is tentatively retained in the genus *Koneprusia*. The type, and where possible, topotype material of these species is redescribed and figured. Evidence from the thorax of *Isoprusia* indicates that, in the pleural field and spines, considerable morphological modification can exist between the first formed (anterior) and last formed (posterior) segments. The relationship of the new genus to one or both of the *Miraspis-Ceratocephala* root stocks has been briefly discussed. A reconstruction of *Isoprusia mydlakia* is given.

DURING a visit in 1963 to the Geological–Paleontological Museum at the University of Marburg, West Germany, I found amongst the collections some well-documented odontopleurid material collected by the late Professor J. Jahn, from the Devonian Limestones of Bohemia. It seems likely that the material came to Marburg to be identified by the late Dr. Fr. Drevermann, who examined specimens for Professor Jahn on other occasions (see Jahn, 1903, p. 23, footnote).

Preparation of the soft, yellow, argillaceous limestone, revealed numerous well-preserved cranidia, pygidia, thoracic segments and hypostomata, either retaining the entire exoskeleton, or partly exfoliated. All the exoskeletal parts are thought to represent one new species, *Isoprusia mydlakia*, the type selected for the new odontopleurid genus *Isoprusia*.

The excellent preservation and abundance of the material has allowed a fairly full diagnosis to be given, and because of this, it has been found that some of the species formerly assigned to *Koneprusia* by Prantl and Přibyl (1949), are best placed in the new genus as here defined.

Visits to Museums in Czechoslovakia (1962), West Germany (1963), and the United States of America (1964) have allowed me to study types and additional material of all these species.

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Terminology and techniques. The terminology used is that recommended by Whittington (1956*a*), but I have followed Jaanusson (1956, pp. 36–37) in using the terms rachis (= axis) and dorsal furrow (= axial furrow); and in numbering and lettering the glabellar lobes (L) and furrows (S), from the posterior forwards. Before making the photographs, each specimen was coated with a dilute 'Opaque', and then lightly coated with ammonium chloride in the manner described by Whittington (1963, 'Explanation of Plates' following p. 118). The orientation of the specimens is that used by Whittington.

SYSTEMATIC DESCRIPTIONS

Family ODONTOPLEURIDAE Burmeister 1843
Subfamily MIRASPIDINAE R. and E. Richter 1917
Genus ISOPRUSIA gen. nov.

Derivation of name. Greek *Isos*, equal: *prusia*, suffix from Konĕprusy, a small village in Bohemia.

Type species. Isoprusia mydlakia gen. et sp. nov.

Diagnosis. Cephalon rectangular in outline, cranidium trapezoidal; frontal glabellar lobe expanded laterally. Two pairs of lateral glabellar lobes well defined. Occipital ring strongly convex medially, with median spine which may rise straight upwards or curve backwards distally. Posterior band may or may not be obviously separated by weak furrow from remainder of ring. Eye ridge weakly convex, positioned on outer part of inflated fixed cheeks. Palpebral lobe short, with well-defined palpebral furrow; eye ovoid, non-stalked. Anterior suture gently curved forward outside and almost parallel to eye ridge. Posterior suture directed outwards and backwards approximately in line with anterior suture, and crossing posterior border so as to produce ear-like projection of the latter which is widest at the suture.

Free cheek as in *Ceratocephala*, with straight anterior and sigmoidal lateral outline; lateral margin considerably widened. Border with short peg-like spines directed outwards and downwards. Librigenal spine with origin inside posterior margin.

Hypostoma subquadrate, anterior margin gently curved convexly outwards; posterior margin with deep narrow median notch and lateral ears. Median body shield-shaped, gently convex; border furrow running from inside antero-lateral margins. Deepened notches may be present at antero-lateral parts of median body. Small anterior wings, lateral shoulder, and lateral notch.

Thorax of ? ten segments. Pleurae with flattened central ridge which may be weakly furrowed or smooth. Band produced into two spines, the terminal downwardly directed spine blade-like with secondary spines from edges, and the principal pleural spines apparently directed outwards and upwards on anterior segments, becoming progressively curved upwards and backwards on posterior segments.

Pygidium semicircular in outline. Rachis not reaching posterior border, composed of two obvious rings and sometimes a lower terminal portion. Principal border spine

connected to weakly raised ridge which curves backwards from first ring. Secondary border spines lacking or numerous, small downwardly directed from postero-lateral margin.

Exoskeleton granulate or finely spinose.

Discussion. The following species are now assigned to the new genus. *Acidaspis ursula* Barrande 1872, *Odontopleura laportei* Hawle and Corda 1847, *Orphanaspis cornuticauda* Erben 1952, *Acidaspis* (*Ceratocephala*) *sandbergeri* R. and E. Richter 1917, ? *Acidaspis sperata* Barrande 1872, and *Koneprusia pennata* Lütke 1965.

Geological range. The genus is known from the Lower Devonian (Pragian-Emsian) and Middle Devonian (Eifelian) in Bohemia; Lower Devonian (lower-upper Emsian) and Middle Devonian (Eifelian-Givetian) in Germany; Middle Devonian (Couvinian) in Poland, and Middle Devonian of Kazakhstan, U.S.S.R.

Isoprusia mydlakia sp. nov.

Plate 55, figs. 1–20; Plate 56, figs. 1–16; Plate 57, fig. 13

Derivation of name. From the word *mydlak*, a Bohemian quarry term for soap-stone.

Holotype. Mbg. 398, Plate 1, figs. 1, 3, 4, 10, 11. Geological–Paleontological Institute, Marburg University.

Paratypes. Mbg. 399, Plate 55, figs. 2, 5, 7; Mbg. 400, Plate 55, fig. 8, Plate 57, fig. 13; Mbg. 401, Plate 55, figs. 6, 14, 18; Mbg. 402, Plate 55, figs. 12, 13; Mbg. 403, Plate 55, fig. 19; Mbg. 404, Plate 55, figs. 15, 20; Mbg. 405, Plate 55, fig. 16; Mbg. 406, Plate 55, fig. 17; Mbg. 407, Plate 55, fig. 9; Mbg. 408–16, Plate 56, figs. 1–16.

Material. In addition to the types, several cranidia, pygidia, one free cheek, and many thoracic segments.

Type locality and Horizon. The label accompanying the material reads, 'Menanian Kalk (zone 9 mydlak), Zlatý Kůň; Professor Jahn 1904'. This information and the profile given by Jahn (1903, p. 21, fig. 4; see also Chlupáč, 1959, fig. 7, pp. 475–6), allows the material to be accurately placed in the Devonian succession exposed at Zlatý Kůň; the zone 9 corresponding to a local lens of soft limestone near the base of the *Acanthopyge* Limestone, i.e. at the base of the Upper Eifelian (Chlupáč, personal communication). The occurrence in the material of *Phacops* cf. *breviceps* also supports this conclusion.

Associated fauna listed by Chlupáč (1957, p. 473; 1959, pp. 490–5).

EXPLANATION OF PLATE 55

Figs. 1–20. *Isoprusia mydlakia* gen. et sp. nov., Acanthopyge Limestone (Upper Eifelian), Zlatý Kůň, Bohemia. 1, 3, 4, 10, 11, Mbg. 398, holotype, cranidium; dorsal, right lateral, oblique side, oblique posterior, and posterior views; ×4. 2, 5, 7, dorsal view, posterior view showing posterior occipital band and anterior view of Mbg. 399, cranidium with exoskeleton partly exfoliated; ×4. 8, Mbg. 400, slightly damaged cranidium with exoskeleton complete; anterior view; ×5. 6, 14, 18, Mbg. 401, free cheek and eye lobe; 6, left lateral view; ×6. 14, anterior view; ×4·5. 18, external surface of eye lobe, oblique view; ×18. 12, 13, anterior and dorsal views of Mbg. 402, pygidium; ×4. 19, Mbg. 403, postero-lateral margin of pygidium showing secondary border spines; dorsal view; ×18. 15, 20, oblique left lateral and dorsal views of Mbg. 404, internal mould of incomplete hypostoma; ×7·5. 16, Mbg. 405, internal mould of incomplete hypostoma showing small depression on antero-lateral part of median body; dorsal view; ×6. 17, Mbg. 406, small hypostoma, dorsal view; ×12. 9, Mbg. 407, complete eye lobe, oblique lateral view; ×18.

Description. Cranidium (Pl. 55, figs. 1, 2; Pl. 57, fig. 13) trapezoidal in outline, gently convex (sag., tr.). Glabella (Pl. 55, figs. 3, 8, 11), gently convex (sag., tr.) maximum width (tr.) at occipital ring tapering forward to slightly more than half this width at frontal lobe; length (sag.) approximately equal to maximum width. Occipital ring of length (sag.) slightly less than half total glabellar length, becoming narrower (exs.) where its lateral parts fuse with inner area of fixed cheek. Outline of posterior margin of ring strongly curved posteriorly; median part rather strongly convex (tr.) and bearing a slim occipital spine (length unknown), which arises from inside posterior margin (Pl. 55, figs. 3, 10, 11). Spine inclined backwards at approximately 70–80°. Occipital furrow broad, shallow and transverse medially, deepened as it becomes directed backwards and outwards around base of L_1. Occipital lobes lacking. Posterior occipital band (Pl. 55, figs. 5, 10, 11) indistinctly separated from remainder of ring; widest and vertically sloping beneath base of spine, becoming slightly narrower and turned inwards and forwards laterally. Two pairs lateral glabellar lobes, L_1 the larger; both weakly convex and elongated (exs.). S_1 shallow, directed obliquely outwards and forwards, deepest between lobes becoming very shallow adjacent to dorsal furrow. S_2 shorter, very deep and slot-like (Pl. 57, fig. 13). Median lobe (Pl. 55, figs. 8, 11) gently convex (tr.) almost flat longitudinally (Pl. 55, fig. 3); frontal lobe sloping steeply downwards to anterior border furrow. Median lobe parallel-sided and separated from lateral lobes by broad, shallow longitudinal furrows which run into the curved S_2 furrow thus delimiting the broad lateral expansion of frontal lobe. Immediately in front of S_2 a small prominent swelling (Pl. 55, figs. 2, 8; Pl. 3, fig. 13), which may represent a third lateral lobe. Dorsal furrow deepest between adjacent parts of fixed cheek and lateral lobes, elsewhere, weakly defined and marked only by change in slope. Fixed cheek subtriangular, tapering forward from maximum width (tr.) just posterior to palpebral lobe; moderately to strongly convex (tr.), highest point on transverse line drawn midway through palpebral lobe. Such a line passes just posterior to outer extremity of S_1 furrow and crosses median glabellar lobe at approximately half length (sag.). When cranidium is viewed from anterior (Pl. 55, fig. 8), highest point of cheek above the level of median lobe. From highest point, cheek slopes gently forwards and then more steeply downwards to eye ridge; posteriorly cheek more steeply inclined and posterior part drops vertically down to posterior margin. Palpebral lobe gently curved and sloping slightly outwards from side of and below highest point of fixed cheek; lobe separated from cheek by broad shallow palpebral furrow which runs into shallower furrow along inner side of eye ridge (Pl. 55, fig. 1). Eye ridge broad, weakly defined, and directed forward before curving around outer anterior part of cheek to merge with smooth depressed area at lateral expansion of frontal lobe (Pl. 55, fig. 8). Anterior branch of facial suture curves forwards outside and sub-parallel to eye ridge and crosses anterior border (Pl. 55, fig. 8). Latter straight, gently arched (tr.) narrow (sag.) separated from frontal lobe by narrow, deep border furrow which becomes wider (exs.) and deepened just inside suture (Pl. 55, fig. 2). Posterior branch of suture continued outwards and downwards at some 45° to run out and over posterior margin. Posterior border furrow shallow to lacking at inner corner where fixed cheek and occipital ring fuse; laterally, furrow deepens and curves forwards around base of fixed cheek separating it from gently convex border widest (exs.) at the suture. Posterior margin (Pl. 55, fig. 11) gently swept upwards at suture, curved under with short downwardly projecting edge to doublure. External surface of cheeks,

fronto-median lobe, and lateral glabellar lobes covered with evenly, but widely spaced spine bases; furrows, occipital ring, and posterior border smooth.

Free cheek (Pl. 55, figs. 6, 14) wider (tr.) than long (exs.), with approximately straight anterior and sigmoidal lateral margins. Anterior border area near suture narrow and convex, becoming flatter and broader (exs.) laterally, here occupying half cheek length. A broad, smooth concave area separates lateral margin from convex part of cheek; area becoming deeper and narrower (exs.) near anterior suture. Librigenal spine arising from just inside border, its base merging with the lateral border and convex part of the cheek. Spine present on one specimen (Mbg. 407) but incomplete; apparently slim and directed straight upwards and backwards. One isolated spine curves distally at its tip. Lateral margin deep and ventrally directed immediately beneath librigenal spine (Pl. 55, fig. 6) becoming lower and rolled under towards fronto-lateral margin. At this point, six small, short peg-like border spines (Pl. 55, fig. 14), directed outwards and downwards from upper edge. Spines extend around outer lateral area as indicated by broken spine bases, but they do not extend along the whole length of anterior margin. Eye (Pl. 55, fig. 18) ovoid in plan, situated on highest point of cheek and sloping gently outwards and downwards; non-stalked and arising directly off cheek surface.

Eye surface (Pl. 55, fig. 9) covered in small, closely packed hexagonal lenses each facet convex externally. Convex part of cheek and flattened border with regularly spaced spine bases which extend on to and down the length of librigenal spine.

Hypostoma (Pl. 55, figs. 15–17, 20) subquadrate, slightly wider (tr.) than long (sag.). Anterior margin gently curved convex forwards; posterior margin with deep, narrow notch. Median body shield-shaped, gently convex (sag. and tr.), delimited by deep narrow border furrow which runs from antero-lateral margin convergently backwards to circumscribe posterior margin of body. Short dorsally directed anterior wings; lateral

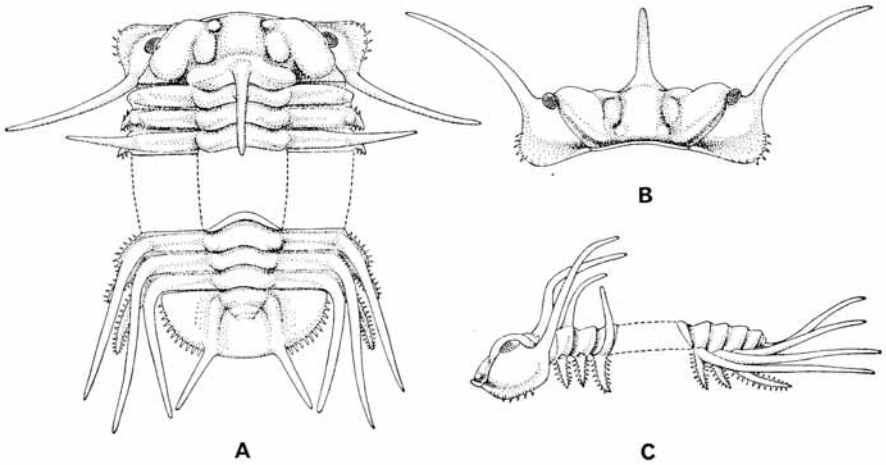
EXPLANATION OF PLATE 56

Figs. 1–16, *Isoprusia mydlakia* gen. et sp. nov. Thoracic segments; all specimens paratypes. 1, Mbg. 408, dorsal view of assumed first segment, showing broken base of median rachial spine, pleural area with faint furrow, and articulating flanges and sockets; ×5. 3, 5, 11, Mbg. 409; first thoracic segment; 3, 5, dorsal and anterior views; ×6. 11, oblique left lateral view showing articulating flanges, tubercle-like pleural spine and short barbed terminal spine; ×9. 2, 4, 9, 14, lateral, dorsal, oblique lateral and anterior views of Mbg. 410; ? second thoracic segment; note absence of median rachial spine, unfurrowed pleural area, tubercle-like pleural spine and short, downwardly directed terminal spine; ×4. 8, Mbg. 411; dorsal view of incomplete segment with upwardly directed pleural spine; note well-developed pleural furrow; ×4. 6, Mbg. 412; dorsal view of more posterior segment with lengthened pleural spine curved backwards; note longer and curved terminal spine, also pleural furrow; ×4. 7, Mbg. 413; similar segment; oblique lateral view; ×4. 10, 15 Mbg. 414; dorsal and right lateral view of incomplete posterior segment; ×4. 12, 13, Mbg. 415; assumed tenth thoracic segment 13, dorsal view; ×4. 12, left lateral view of distal end showing the blade-like pleural spine and the long, backwardly curved, barbed terminal spine; note also articulating flanges and presence of articulating process only; ×9. 16, Mbg. 416; left lateral view of long terminal spine of a posterior segment; ×9.

Fig. 17, *Isoprusia sandbergeri* (R. and E. Richter), Stringocephalus Limestone (Lower Givetian), Villmar-Lahn, West Germany. Dorsal view of holotype (Nat. Hist. Museum, Wiesbaden); ×10. The incomplete cranidium, an internal mould, has been compressed from the left-hand side along the line of the longitudinal furrow so that the glabella has become partly pushed under.

Fig. 18, *Isoprusia cornuticauda* (Erben), Greifensteiner Kalk (Eifelian), Wiege near Greifenstein, Harz, West Germany. Dorsal view of holotype T.U. Ar. 1010/40, a pygidium with damaged left pleural region; ×10.

margin convex and narrow anteriorly with small pointed shoulder and shallow lateral notch. Posteriorly, margin becoming wider, outwardly sloping and produced into flattened ear-like projections separated by the posterior notch. Latter does not reach border furrow. On largest hypostoma (Pl. 55, fig. 16) a short ovoid depression occurs on edge of median body opposite shoulder. Depression absent on the smallest specimen



TEXT-FIG. 1. *Isoprusia mydlakia* gen. et sp. nov. Reconstruction. A, dorsal view; B, anterior view of cephalon; C, left lateral view. Number of thoracic segments unknown. Approximately ×2.

(Pl. 55, fig. 17), slightly impressed on the next largest one (Pl. 55, fig. 20). Median body smooth to slightly granulated; lateral margin and posterior ears very finely granulated.

Number of thoracic segments not known but the reconstruction (text-fig. 1) has been made assuming the number to have been ten. From the attitude of the pleural spines, it has been assumed that those segments which have spines directed laterally outwards or upwards and forwards belong anteriorly, and those on which the spines are directed progressively more backwards, belong posteriorly. Such an assumption seems a valid one since this is always the case in the Miraspidinae and Apianurinae Whittington (1956*a*), two subfamilies with genera possessing similarly shaped thoracic pleurae. Numerous fairly complete and some broken segments allow the following descriptions and observations to be made. Rachis (Pl. 56, figs. 1, 2, 5, 14) moderately to strongly convex and wide (tr.) occupying almost half entire width of segment. Posterior margin gently curved convex forward (sag.); articulating halfring approximately half as long (sag.) as rachial ring; anterior margin convex forward like articulating furrow, sloping backwards and becoming narrower at dorsal furrow. Pleurae horizontal and flattened; anterior segments (Pl. 56, figs. 1, 3, 4) smooth or very weakly furrowed; posterior segments (Pl. 56, figs. 6–8, 10, 13) with shallow but obvious pleural furrow. Anterior and posterior margins straight with very narrow (exs.) flattened flanges. Small fulcral

articulating (anterior) and socket (posterior) processes developed (Pl. 56, figs. 3, 11, 16). Principal pleural spine on at least the first two anterior segments in the form of a small upwardly and outwardly directed tubercle (Pl. 56, figs. 1–5, 9, 11, 14) from the pleural surface. Immediately beneath tubercle (Pl. 56, figs. 2, 9, 11), short, tapering terminal spine. Latter downwardly directed, flattened dorso-ventrally and bearing row of small spines along edges. Two pleural segments (Pl. 56, figs. 1, 3, 5, 11) with a similar pleural spine, have a rachis like the occipital ring of the cranidium including the median spine (unfortunately this was broken during preparation, but the base can be seen). In these segments, the rachis is slightly greater than twice the width (tr.) of the very short pleural area and such proportions fit those of the occipital ring and posterior margin of the larger cranidia. For these reasons, it is thought most likely that this type of segment is the first. Segments (Pl. 56, figs. 6–8, 10, 13, 15) from positions more posterior have a rachis of the same configuration as those described for pleurae without median rachial spine but in addition, the tubercle-like pleural spine is produced into long, slim pleural spines, the lengths, curvature, and directions of which are indicated on the reconstruction. Articulating flanges and processes visible on pleurae with upwardly directed pleural spine (Pl. 56, fig. 8) while only flanges and anterior process visible on segments in which pleural spine is directed backwards (Pl. 56, figs. 7, 10, 15). Terminal spines as on anterior pleurae but much longer (Pl. 56, fig. 16) and curved backwards distally. Pleural spines circular in cross section. Pleurae of type shown (Pl. 56, fig. 13) regarded as representing the tenth segment. Pleural area, rachis, and halfring identical to other posterior segments, but pleural and terminal spine (Pl. 56, fig. 12) differ in, (1) pleural spine flattened in cross-section and blade-like; spine produced backwards and slightly upwards from fulcrum, becoming incurved distally; (2) terminal spine similar to those on other segments, but inclined backwards and almost horizontal.

On all segments, pleural area smooth or with odd spine bases; rachis with transverse row of small spine bases which extend diagonally down the lateral parts. Terminal and pleural spines apparently finely spined.

EXPLANATION OF PLATE 57

Figs. 1, 4, 6, 7. *Isoprusia laportei* (Hawle and Corda), ? Suchomasty Limestones (Upper Emsian–Lower Eifelian), Měňany near Koněprusy, Bohemia. Plaster cast of lectotype, N.M.P. ČF639; cranidium, part internal mould; 1, 6, dorsal and oblique views; 4, posterior view showing posterior occipital band; 7, anterior view; ×3.

Figs. 2, 3, 5, 8–12, 14, 16. *Isoprusia ursula* (Barrande), Upper Koněprusy Limestone, Koněprusy area, Bohemia. 2, 3, 9, plaster cast of holotype, N.M.P. ČF635, incomplete cephalon, internal mould; 2, 3, oblique and dorsal views showing posterior position of eye and long anterior facial suture; 9, anterior view; ×3. 5, 16, M.C.Z. 4215, incomplete cranidium; 5, posterior view showing narrow posterior occipital band; 16, anterior view; ×6. 8, 10, M.C.Z. 4216, incomplete cranidium, anterior and dorsal view showing narrow (sag.) occipital ring and backwardly directed spine; ×4·5. 11, 12, 14, M.C.Z. 4217, incomplete and partly exfoliated cephalon, anterior, dorsal, and oblique views showing position of free cheek and librigenal spine; ×3. Schary Collection.

Fig. 13. *Isoprusia mydlakia* gen. et sp. nov. Mbg. 400, incomplete cranidium, dorsal stereograph; ×4.

Figs. 15, 17, 18. ? *Koneprusia subterarmata* (Barrande), Suchomasty Limestones (Upper Emsian–Lower Eifelian), Měňany near Koněprusy, Bohemia. 17, 18, plaster cast of lectotype N.M.P. ČF644a, incomplete pygidium, internal mould; 18, dorsal view; 19, posterior view; ×5. 15, plaster cast of paralectotype, N.M.P. ČF664b, incomplete pygidium, internal mould, dorsal view; ×5.

Discussion of Pleural Modification

Accepting the theory that during ontogeny new segments are formed by growth to the anterior border of the hind-most somite and then released forward (Stubblefield 1926), it follows that the most anterior segments are the first formed, and the posterior, the last. Thus it is possible that the posterior segments resemble in character more closely the original pleural condition, the anterior showing some modification. In *Isoprusia mydlakia*, the anterior segments either lack the pleural furrow or have it very faintly defined, while on the posterior segments it is still obviously present. On segments with an upwardly directed spine (Pl. 56, fig. 8), a pleural furrow with point of origin at the antero-lateral part of the rachis, is directed straight outwards towards the base of the spine where it becomes obliterated. Thus the pleura is divided into two bands of equal length (sag.), the spine base straddling both bands. In more posterior segments (Pl. 56, figs. 6, 10, 13), a pleural furrow runs diagonally across the pleural area and distally follows the inner posterior part of the pleural spine base. Hence the pleura is divided into two bands as before, but here the principal pleural and terminal spine both belong to the anterior band. The degree of modification is taken further in the most anterior segments (Pl. 56, figs. 1, 2, 4, 9) where the terminal spine is a downward continuation of the full pleural width, and the pleural spine is reduced to a small tubercle. Transverse sections of the segments suggest that the doublure does not extend beneath the pleura, and only the curled-down edge of the pleura forms the articulating process and socket. Such an arrangement is similar to that found in *Ceratocephala laciniata* Whittington and Evitt (1954, p. 59, pl. 6, figs. 5, 6). It seems reasonable to suppose that on the anterior segments, the reduction to a tubercle of the pleural spine, is an accommodation to ease of articulation and possibly enrolment, since an upwardly directed spine would interfere with the librigenal spine. In view of the obvious presence of a pleural furrow on the posterior segments, it seems unlikely that the anterior segments represent the original pleural type from which the posterior segments have become secondarily modified by the extreme elongation of the tubercle in the form of a spine.

To homologize the pleural spines in *Isoprusia* with those found on the pleurae of other odontopleurid genera is more difficult. In genera (*Primaspis*, *Diacanthaspis*, *Leonaspis*, and others; see Whittington 1956*a*) with a recognizable pleural furrow, the principal pleural spine, without exception, belongs to the posterior band, and a second spine, if developed, to the anterior band. Even in *Ceratocephala laciniata* Whittington and Evitt, the second spine (= barbed spine), belongs to the posterior part of the segment. In *Isoprusia*, it forms as a continuation of the full pleural width, or belongs to the anterior band. For this reason I have called this spine in *Isoprusia mydlakia* terminal (not terminal in the sense of Reed 1925; Prantl and Přibyl 1949; = anterior spine of Whittington 1956*a*, p. 161). It has been shown that the pleural spines can belong to either band and thus it is difficult to use them for comparative morphology.

Isoprusia laportei (Hawle and Corda, 1847)

Plate 57, figs. 1, 4, 6–7

1847 *Odontopleura Laportii* Hawle and Corda, p. 156.
1852 *Acidaspis Laportei*: Barrande, p. 750, pl. 39, fig. 22 only.
1926 *Acidaspis* (*Leonapis*) *laportei*: Kegel, p. 20, pl. 2, fig. 15.

1949 *Acanthaloma* (*Acanthaloma*) *laportei*: Prantl and Přibyl, p. 162, pl. 3, fig. 3 only.
1950 *Ceratocephala* (*Leonaspis*) *laportei*: Erben, p. 281.
1952*a* *Acanthaloma* (*Acanthaloma*) *laportei*: Erben, p. 289, pl. 20, figs. 11–12.
1965 *Koneprusia laportei laportei*: Lütke, p. 223, pl. 22, figs. 9–11; text-fig. 35*a*; not *Koneprusia laportei* n. subsp. A.
non 1957 *Leonaspis* (*Leonaspis*) *laportei*: Osmólska, p. 69, pl. 3, fig. 8.

Lectotype (Prantl and Přibyl 1949, p. 162). N.M.P. ČF639, Plate 57, figs. 1, 4, 6–7, Cranidium in limestone and still retaining part of exoskeleton.

Material. Several paralectotypes, N.M.P. ČF640; the specimen of Kegel, H.U. T292; the original cranidia of Erben, H.U. T343–4; plus topotype material from the Schary Collection. M.C.Z. 4213–14.

Locality. Měňany near Koněprusy, Bohemia.

Horizon. Not known with certainty, but most probably from the Suchomasty Limestones (Upper Emsian–Lower Eifelian).

Description. The species *Isoprusia laportei* (Pl. 57, fig. 1), is closest to *I. mydlakia* (Pl. 57, fig. 13), but differs in the following features: (1) More strongly inflated fronto-median glabellar lobe and lateral lobes. (2) The less strongly inflated fixed cheek which is flatter and narrower (tr.) and slopes less steeply down to the posterior margin (Pl. 57, figs. 6, 7). (3) Highest part of cheek and that of median lobe at approximately the same level (Pl. 57, fig. 7), when specimen is viewed from the anterior. In this respect *I. laportei* resembles *I. ursula* (Pl. 57, fig. 9), but in this species the position of the eyes (Pl. 57, figs. 3, 10) and the configuration of occipital ring and posterior band (Pl. 57, figs. 5, 10) are different. In *I. mydlakia* (Pl. 55, fig. 8), the median glabellar lobe is lower than the adjacent fixed cheeks. The hypostoma which Lütke (1965, pl. 22, fig. 10) figured as belonging to *laportei*, differs from that of *I. mydlakia* in having a narrower posterior notch and deeper middle furrows. The free cheek, thorax, and pygidium of *I. laportei* are not known.

Discussion. New collections made by Barrande (1852, p. 751, pl. 39, fig. 25) enabled amplification of the original description, and the description of a pygidium considered to belong to the species. Prantl and Přibyl (1949, pl. 3, fig. 4) also thought that the pygidium belonged to the species, but it is quite unlike any known for the genus *Isoprusia* and is more likely to belong to a species of *Leonaspis*. Vaněk (1961, p. 85, footnote) has noted the similarity to *Leonaspis pigra* (Barrande, 1872).

Prantl and Přibyl (1949, p. 162) assigned this species to *Acanthaloma* (= *Leonaspis*). In their remarks, they noted that the specimen figured by Barrande does not show distinctly 'The subtrigonal areas on both sides of the frontal lobe, nor the course of the anterior branch of the facial suture, which deviates distinctly from the ocular ridge'. Study of the type (Pl. 57, figs. 1, 6, 7) does not confirm this observation. The anterior suture is curved convergently towards the anterior border and runs sub-parallel and just outside the weakly defined eye ridge. In other respects, the glabella, frontal lobe with lateral swellings, and shape of occipital rings are like those of the other species now placed in the genus *Isoprusia*. Examination of the second cranidium figured by Prantl and Přibyl (1949, pl. 10, fig. 9), leads me to believe that this belongs to the genus *Leonaspis*.

Horizon. The exact horizon in which the lectotype was found is still not known, and it seems likely that Prantl and Přibyl were wrong in referring all of the reddish limestone material from Měňany to the Vinařice Limestone. At Měňany, beds from the lowest Pragian to Upper Eifelian are exposed in which the lithologies are very much alike, but careful collecting has shown the distinctiveness of faunas from the Vinařice, Suchomasty, and Acanthopyge Limestones (see Chlupáč and Vaněk 1957; Chlupáč 1959).

The specimen of Kegal from the Steinberger Kalk of Lindener Mark is exceedingly small, but it is like those figured by Erben (1952*a*) and Lütke (1965, pl. 22, figs. 9, 11) from the Upper Emsian of the Harz, and all seem to be indistinguishable from the Bohemian material of *I. laportei* (for remarks cf. Lütke 1965, pp. 223–4).

Isoprusia ursula (Barrande, 1872)

Plate 57, figs. 2, 3, 5, 8–12, 14, 16

1872 *Acidaspis ursula* Barrande, p. 84, pl. 16, fig. 28.
1949 *Koněprusia ursula*: Prantl and Přibyl, p. 201, pl. 3, fig. 25.
1957 *Leonaspis* (*L*) *laportei*: Osmólska, p. 69, fig. 4; pl. 3, fig. 8.

Holotype. N.M.P. ČF635, Pl. 57, figs. 2–3, 9. An incomplete cephalon with damaged occipital ring and fronto-median lobe as internal mould.

Material. In addition to the type, two cranidia and an incomplete cephalon from the Schary Collection, M.C.Z. 4215–17.

Locality and Horizon. The type specimen was collected from the general area of Koněprusy, most probably from the Upper Koněprusy Limestones.

Description. Cranidium (Pl. 57, figs. 9, 11, 16) flat to gently convex (tr.); when specimen is viewed from anterior, highest point of median glabellar lobe and fixed cheeks at approximately the same level. Median glabellar lobe widest at occipital furrow, tapering forwards (Pl. 57, figs. 10, 12); dorsal furrow shallow. Lateral lobes suboval, and inflated to same level as adjacent cheek. Occipital ring (Pl. 57, figs. 5, 10) broad (tr.) very short (sag.) and gently convex. Occipital furrow shallow and only change of slope marks off ring from median lobe. Narrow posterior band (Pl. 57, fig. 5) separated from lateral part of anterior band by shallow furrow; medially, furrow shallow to lacking and separation of two bands indistinct. Ring with stout spine which curves backwards in almost horizontal plane from posterior margin. Eye ridge narrow (tr.) and disposed on highest outer part of fixed cheek. Latter very narrow (tr.). Palpebral lobe far back and directed upwards and slightly backwards (Pl. 57, figs. 5, 16), so that mid-point lies on transverse line through middle of L_1. Anterior facial suture very long (exs.), runs straight forward to point opposite outer end of S_1 furrow, and then curves inwards to anterior margin parallel to and outside eye ridge (Pl. 57, figs. 2, 9, 14). Posterior suture (Pl. 57, fig. 12) at approximate right-angle to anterior suture at base of eye; from here, directed outwards and downwards across cheek to border furrow before curving around base of librigenal spine.

Free cheek as in *I. mydlakia*, but more convex and swollen around eye. On the holotype (Pl. 57, fig. 3) only this part of the cheek is visible, the lateral margins being obscured by matrix. The material from the Schary Collection at Harvard (Pl. 57, figs. 11, 14) shows the sigmoidal outline and the lateral margin with at least five short fringing spines. Librigenal spine directed upwards and backwards.

Fronto-median glabellar lobe with sub-symmetrical rows (both tr. and exs.), of coarse

granules or spine bases. Remainder of cephalon with granules or spine bases more unevenly distributed.

Thorax, pygidium, and hypostoma not known.

Discussion. The species resembles *Isoprusia laportei*, but the narrow fixed cheeks, eye position, shape of occipital ring, and nature of posterior band and spine in *I. ursula* are distinguishing features.

Osmólska (1957) noted that the glabellar proportions of the Couvinian specimens from the Holy Cross Mountain area of Poland were different to those specimens from Bohemia and Germany. Dr. Osmólska has kindly supplied additional photographs of her material and study of these suggests a closer relationship to *I. ursula* than *I. laportei*, on account of the transverse profile and shape of occipital ring and spine. She notes (p. 70) that the eye ridge and palpebral lobe is not discernible on the material, but study of her figure (pl. 3, fig. 8) clearly shows a well-defined eye ridge and base of the palpebral lobe; the latter positioned far back. The Polish material comes from a higher horizon than Barrande's type, but Osmólska (1957, p. 54) has shown that some of the species associated with the Polish Couvinian fauna are known from the Lower Devonian of both Bohemia and the Harz regions.

During a recent visit to the Central Geological Museum at Leningrad, I had the opportunity of examining the specimen described from the Middle Devonian of Kazakhstan (Turkestan) by Weber (1932, p. 134, pl. 1, fig. 20*a–c*) as *Acidaspis cornuta*. I have no doubt that this is a species of *Isoprusia* which is closely related to *I. ursula*.

Acidaspis cornuta Weber 1932 is a junior primary homonym of *Acidaspis cornuta* Beyrich 1846, a species of *Miraspis* from the Upper Ordovician of Sweden. However, I do not intend to designate a new name here, but leave this until the specimen is redescribed by one of my Russian colleagues.

Isoprusia cornuticauda (Erben, 1952)

Plate 56, fig. 18

1952*a* *Orphanaspis cornuticauda* Erben, p. 314, pl. 20, fig. 13.

Holotype. T.U. Ar.1010/40, Plate 56, fig. 18. Incomplete pygidium.

Locality. 'Wiege' near Greifenstein, Harz, West Germany.

Horizon. Greifensteiner Kalk (Eifelian).
For full description, see Erben (1952*a*).

Discussion. The similarity between this species and the pygidium of *I. mydlakia*, indicates that *cornuticauda* should be transferred to the genus *Isoprusia*.

This specimen of *cornuticauda* is very similar to the pygidium described and figured by Lütke (1965, p. 226, text-fig. 36*c*) under the name *pennata*. Further material may prove that there is no distinction. These pygidia differ from *I. mydlakia* in not having the numerous secondary border spines. The cranidium of *I. pennata* and *I. mydlakia* are quite distinct.

It should be pointed out that the free cheek of *I. pennata* has been reconstructed by Lütke (op. cit., p. 226, text-fig. 36*a*) from broken material (cf. Lütke, pl. 22, fig. 13*a*, *b*), and I am not satisfied that the reconstructed outline is reliable. A free cheek with

a sigmoidal outline like that of *I. mydlakia* (Pl. 55, figs, 6, 14) and *I. ursula* (Pl. 57, fig. 14) is more likely to be the correct one.

Isoprusia sandbergeri (R. and E. Richter, 1917)

Plate 56, fig. 17

1850 '*Odontopleura* fragmenta, speciei incertae (? novae)' G. and F. Sandberger, p. 56, pl. 2, fig. 5*a*, *b*.
1917 *Acidaspis* (*Ceratocephala* ?) *sandbergeri* R. and E. Richter, p. 467, fig. 8*a*, *b*.

Holotype. Plate 56, fig. 17. Incomplete and distorted cephalon. Type deposited in the Natural History Museum, Wiesbaden, West Germany.

Locality. Villmar-Lahn, West Germany.

Horizon. Stringocephalus Limestone (Lower Givetian).

Description. Despite the compression and distortion, the free cheek and eye lobe (Pl. 56, fig. 17) does not appear to have been displaced to any great extent (cf. R. and E. Richter 1917, p. 467).

The posterior position of the eye and the long, gently curved eye ridge, is reminiscent of *Isoprusia ursula*. The free cheek, although damaged along the anterior margin is more like that of *I. mydlakia*, in so far as the cheek area is less convex than in *I. ursula*. The lateral swelling of the frontal glabellar lobe is typical of the genus *Isoprusia*. The convexity and outline of the glabella and lobes, and the depths of furrows have no doubt been exaggerated owing to the distortion of the specimen.

Discussion. R. and E. Richter, assigned this species with some reservation to *Ceratocephala*, and remarked on the unusually high stratigraphic position of the genus. *Isoprusia sandbergeri* is, to date, the youngest known for the genus, and one of the youngest species of the family Odontopleuridae Burmeister.

? *Isoprusia sperata* (Barrande, 1872)

1872 *Acidaspis sperata* Barrande, p. 423, pl. 32, figs. 20–21.
1872 *Acidaspis sparsa* Barrande, p. 82.
1949 *Koněprusia* (?) *sperata*: Prantl and Přibyl, p. 202.

Discussion. The type of *Acidaspis sperata* illustrated by Barrande is extremely misleading and inaccurate when one compares the figure and actual specimen, a poorly preserved internal mould of a pygidium. The rachis seems to have three rings; the small median outgrowth at the posterior margin and the small secondary border spines are just discernible (it is impossible to count the actual number; cf. Prantl and Přibyl 1949, p. 202). In addition, details of the pleural region, ornamentation and general outline are not apparent. The holotype is the only known specimen and its preservation makes it an inadequate basis for the species.

Barrande (1872, p. 424) gave the locality of Braník which most likely refers to the former 'Podolská cementárna' (= cement works). Only the lowermost Dvorce–Prokop Limestone (Pragian) is exposed at this locality (Chlupáč, personal communication).

Barrande described both *Acidaspis sperata* and *A. sparsa* from the same locality and horizon, and their respective descriptions seem remarkably similar. Further confusion is caused by the fact that both species were said to be figured (Barrande 1872, pl. 32), but only the figure of *Acidaspis sperata* appears on this plate. To my knowledge, no specimens labelled *A. sparsa* have been found amongst the Barrande collections at the National Museum, Prague.

Vaněk (1961, p. 85) notes that former references to the occurrence of *laportei* (presumably of cranidia) from the Dvorce–Prokop Limestone, should in fact relate to *sperata*, but this cannot be proved with the material available.

Genus KONEPRUSIA Prantl and Přibyl 1949

Type species (by monotypy). *Acidaspis fuscina* Novák 1883 (not traced).

Diagnosis. Pygidium differing from that of *Isoprusia* gen. nov., in being more triangular with the development of a stout median border spine. In the type species, the remainder of the border is apparently smooth, but one species tentatively assigned to this genus shows the development of numerous small secondary border spines. Details of thorax and cephalon not known.

Discussion. In erecting the genus *Koneprusia*, Prantl and Přibyl (1949, pl. 3, fig. 26; pl. 5, fig. 2) reproduced Novák's (1883, pl. 10, fig. 19*a*) two figures of the type species, an incomplete thorax and pygidium with very damaged cephalon attached. The type specimen was not rephotographed nor was any documentary evidence published of additional material. During my stay in Prague (Autumn, 1962) I was unable to trace the holotype among the collections in the National Museum and both previous and subsequent searches have also failed (Vaněk, personal communication, 9 March 1964). The type species of *Koneprusia* is thus only known from Novák's (1883, pl. 10, fig. 19*a*) illustration.

I have regarded the type of pygidium Novák portrays, with a well-developed stout median border spine, as sufficiently distinct to enable the separation of *Koneprusia* from *Isoprusia*. The species *K. fuscina* (Novák) is very rare and the pygidium has not been found during recent collections made by Dr. Chlupáč and Mr. Vaněk from the Acanthopyge Limestone. Thus, until an exoskeleton bearing the characteristic pygidium figured by Novák for *Acidaspis fuscina* is known, it is not possible to define the characters of thorax and cephalon in *Koneprusia*.

The description of the horizon and associated fauna listed by Novák (1883, p. 38; Prantl and Přibyl 1949, p. 200) would seem to indicate that the type species of *Koneprusia*, like that of *Isoprusia*, was collected from the Acanthopyge Limestone near Koněprusy. Mr. Vaněk (personal communication) has recently collected two incomplete cranidia from this horizon (I have seen casts of both specimens which have the strongly inflated fixed cheek characteristic of *Isoprusia mydlakia*) which he considers to be topotype material of *Koneprusia fuscina*. This cannot be proved because of the loss of the holotype of this species and the inadequate illustration of it given by Novák. For the same reasons, *K. fuscina* cannot be compared with the cranidium of *Isoprusia mydlakia*, but as outlined above, the pygidia are considered to be generically different.

? *Koneprusia subterarmata* (Barrande, 1846)

Plate 57, figs. 15, 17–18

1846 *Odontopleura subterarmata* Barrande, p. 18.
1847 *Odontopleura impar* Hawle and Corda, p. 157.
1852 *Acidaspis subterarmata*: Barrande, p. 749, pl. 39, figs. 16–17.
1949 *Koněprusia subterarmata*: Prantl and Přibyl, p. 200, pl. 3, figs. 27.
1961 *Koněprusia subterarmata*: Vaněk, p. 85 (footnote).
1965 *Koneprusia subterarmata*: Lütke, p. 222, text-fig. 34.

Lectotype (wrongly designated as holotype by Prantl and Přibyl), N.M.P. ČF644a, Pl. 57, figs. 17–18, one of Barrade's two syntypes. An incomplete pygidium; internal mould.

Paralectotype. N.M.P. ČF644b, Plate 57, fig. 15. Pygidium, internal mould.

Horizon. Not known with certainty, but most likely from the Suchomasty Limestone.

Locality. Měňany near Koněprusy, Bohemia.

Description. Pygidium (Pl. 57, figs. 15, 17–18), triangular, approximately three times as wide (tr.) as long (sag.). Rachis of two obvious rings and a low, very narrow (sag.) terminal portion marked off by weakly impressed transverse furrow. First ring broad (tr.) moderately convex; second ring lower and narrower (sag.); rachis not reaching posterior border. Articulating half ring as wide as first ring, very narrow (sag.); articulating furrow broad and shallow, curved forward medially. Dorsal furrow shallow alongside first ring, deepened around second, but becoming shallow and lacking posteriorly. Pleural ridge broad, weakly convex, runs outwards and curves backwards to be produced into stout, slightly outwardly and upwardly directed major border spine (length unknown). Stout median border spine (Pl. 57, fig. 15), directed from posterior margin; spine apparently of equal strength to major border spine. Secondary border spine bases visible beneath the major border spines and at least eight short, downwardly directed secondary spines (Pl. 57, figs. 17–18) from lateral margin. Pleural area flat to gently depressed between rolled lateral, and straight and flattened anterior margin. At least four prominent spine bases along lateral margin and a pair each side of median spine. Rachis with pair of spine bases on each ring.

Discussion. This species is tentatively assigned to *Koneprusia* on account of the triangular outline of the pygidium and the presence of the stout median border spine.

Both Barrande and Hawle and Corda collected their material from the general area of Měňany, but the exact stratigraphic horizon remains uncertain. Prantl and Přibyl (1949, p. 120) recorded the species as having come from the Vinařice Limestone (Pragian), but since then revision of the stratigraphy indicates that it may well have come from the Suchomasty Limestone (Upper Emsian–Lower Eifelian). To date, the remainder of the exoskeleton of this species is unknown.

ORIGINS AND RELATIONS OF *ISOPRUSIA*

The relationship of *Isoprusia* to other members of the Miraspidinae R. and E. Richter, 1917; emend. Whittington 1956*a* (= Ceratocephalidae of Prantl and Přibyl 1949; Erben 1952*b*) is still obscure, but certain exoskeletal features found in *Isoprusia* also

occur in *Dicranurus* (Lower–Middle Devonian), *Ceratocephala* (Llanvirn–Lower Middle Devonian; see Whittington 1963, p. 103, pl. 31, figs. 18, 21; pl. 32, figs. 1–3; Prantl and Přibyl 1949, p. 183), and *Miraspis* (?Arenig–Llanvirn–Lower Devonian; see Whittington and Bohlin 1958; Whittington 1956*b*, p. 515, pl. 60, figs. 1, 4).

Dicranurus (see Whittington 1956*a*, p. 248, text-fig. 18), like *Isoprusia*, has a cranidium which is trapezoidal in outline and the frontal glabellar lobe is expanded laterally. The eye position and sutural directions are also alike, but *Dicranurus* has a conical eye raised well off the cheek surface. The lengthened (sag.) and less convex (tr.) occipital ring of *Dicranurus* is an important difference, although the configuration of the occipital spines (paired and strongly curved in *Dicranurus*) is not considered of great taxonomic importance. The pleural regions of *Dicranurus*, with well-marked pleural furrow and ridge, points to a closer connexion with *Miraspis*, while the smooth or weakly furrowed pleural band of *Isoprusia* resembles those found in *Ceratocephala*. The hypostoma of *Isoprusia*, although having the shoulder and lateral notch (a family characteristic, Whittington 1956*a*, p. 170), has a deep posterior median notch and posterolateral ears quite unlike any odontopleurid hypostomata previously known. A shallow, median notch is found in both *Miraspis* (see Barrande 1852, pl. 39, fig. 8) and *Ceratocephala* (see Whittington 1956*a*, pl. 14, fig. 11; pl. 15, fig. 23) and may indicate a relationship. The pygidium of *Isoprusia* bears no resemblance to those known for *Ceratocephala* (see Barrande 1852, pl. 38, figs. 5, 18; Whittington and Evitt 1954, pl. 6, fig. 8), and its semicircular outline sets it aside from the subtrigonal shape of *Dicranurus*. The development or loss of secondary border spines or median spine, and the disposition of the pleural ridge in pygidia of *Isoprusia* suggests a modification of a *Miraspis*-like pygidium. The shortened (sag.) rachis is a characteristic of *Miraspis*.

The discovery of a *Miraspis* species in the early Ordovician of Sweden (Whittington and Bohlin 1958, p. 42, pl. 3, figs. 1–4) now shows that at this time, *Miraspis* was distinct from *Ceratocephala* (cf. Whittington 1956*a*, pp. 188–90, fig. 3). However, the fact that *Isoprusia* has features of the exoskeleton which are shared by both *Miraspis* and *Ceratocephala* indicates that this genus must be either derived from one or other of these stocks, or be derived independently from an unknown Cambrian root stock which also gave rise to *Miraspis* and *Ceratocephala*.

A similar origin for *Dicranurus* seems likely, but whether this genus lies on the same branch which gave rise to *Isoprusia* is not known.

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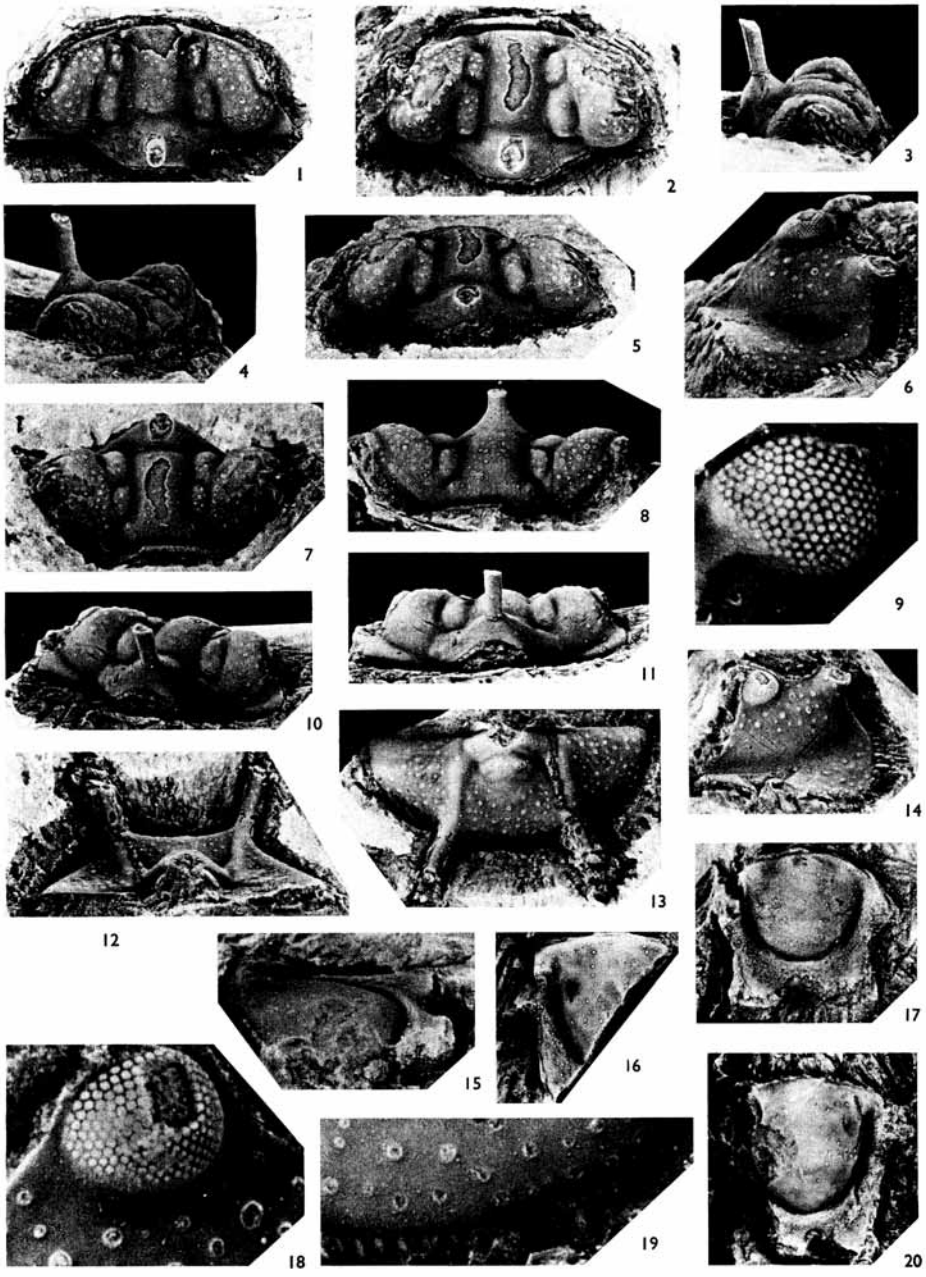

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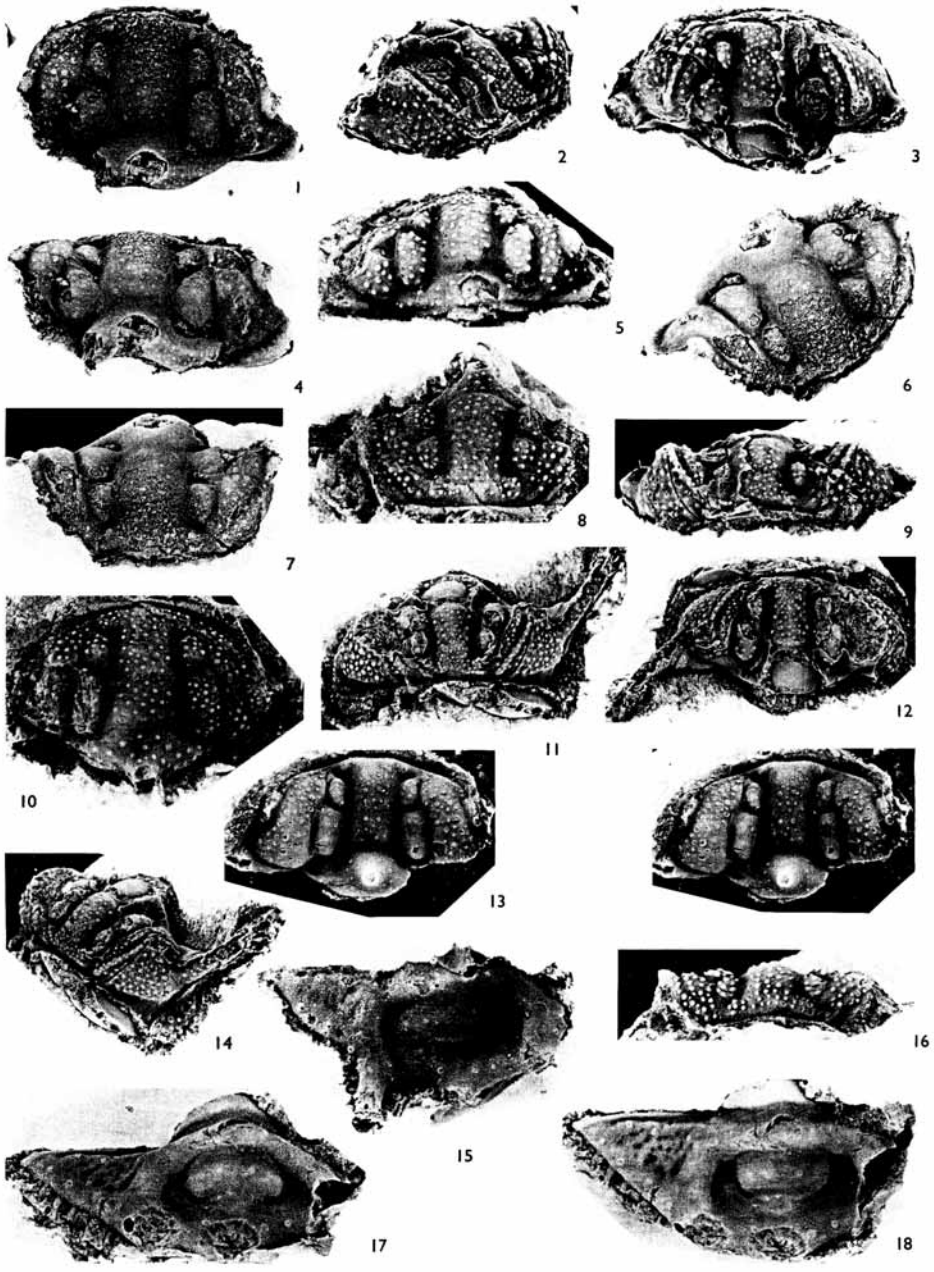

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