SOME TRILOBITES FROM THE SILURIAN/DEVONIAN BOUNDARY BEDS OF CZECHOSLOVAKIA

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ABSTRACT. Some new or stratigraphically especially important trilobites from the Uppermost Silurian (Přídolian) and the Lowest Devonian (Lochkovian) of Bohemia are described. *Tropidocare* gen. nov. and *Prantlia* (*Tetinia*) subgen. nov. are newly erected, and new species described are: *Tropidocare index* sp. nov., *Wolayella ranuncula* sp. nov., *Scharyia nympha* sp. nov. and *Ceratocephala lochkoviana* sp. nov. The description of some species significant for the definition of the Silurian/Devonian boundary, i.e. *Prantlia* (*Tetinia*) *minuta* Přibyl et Vaněk 1962 and *Warburgella* (*Podolites*) *rugulosa rugosa* (Bouček 1934), are completed. In the latter species, particular attention is directed to the individual variability of the sculpture and the changes during ontogeny. The diagnosis of *Warburgella* (*Podolites*) Balashova 1968 is discussed, and the species *Prionopeltis striatus troilus* Hawle et Corda 1847, characteristic of the Uppermost Silurian of Bohemia, has been restituted.

ON the occasion of recent investigations of the Silurian/Devonian boundary beds in the classical area of the Barrandian in central Bohemia, a new rich trilobite material was found; it not only contributes to a more accurate knowledge of the species already well known, but has also yielded some new ones. The present paper contains the descriptions of these several trilobites, especially those which are stratigraphically or otherwise noteworthy.

The pertinent localities are described in detail and the general evaluation of the biostratigraphical significance of the fauna from boundary beds is given in another paper presented at the same time (Chlupáč *et al.* 1970), to which the reader is referred. The terminology in the descriptions of the fauna has been used according to the *Treatise on Invertebrate Paleontology*, Part O, *Arthropoda I* (1959); some further commonly accepted abbreviations have also been employed: L = lateral glabellar lobes, PF = pleural furrows, IPF = interpleural furrows, the greek symbols α–ω = bends of facial suture (in the same sense as, for instance, in G. K. B. Alberti 1969), abax. = abaxially, adax. = adaxially.

The material studied is deposited in the collections of the Geological Survey of Czechoslovakia, Prague (the specimens are designated by the symbol ICh before the inventory number). A further comparative material is to be found in the collections of the National Museum, Prague (abbreviated NM).

Acknowledgements. The author thanks Dr. H. Alberti of the University of Göttingen, Dr. G. K. B. Alberti of the University of Hamberg, Dr. R. Horný of the National Museum, Prague, Dr. E. Vogel of the Central Geological Institute, Berlin, for having made available the comparative material; also Dr. J. Kříž of the Geological Survey, Prague, for the gift of the material collected by him, and Mr. P. Lukeš for his help in field collecting.

SYSTEMATIC PALAEONTOLOGY

Family PROETIDAE SALTER 1864

Subfamily PROETIDELLINAE Hupé 1953

Genus TROPIDOCARE gen. nov.

[Palaeontology, Vol. 14, Part 1, 1971, pp. 159–77, pls. 19–24.]

Type species. *Tropidocare index* sp. nov.

Derivation of name. From the related genus *Tropidocoryphe*.

Diagnosis. Cephalon resembling that of *Tropidocoryphe*, with subtrapezoidal glabella, 3 pairs of glabellar furrows of which deeply incised S_1 completely separates the basal lobes. Preglabellar field long with narrow tropidium, anterior border narrow, without wall-like vaulting. Palpebral lobes strongly abax. curved, of medium size. Occipital ring not tapering laterally with indistinctly separated occipital lobes. Pygidium of Proetidellinae-like character with a narrow axis, richly segmented, and with prominent ribs on the lobes. PF and IPF sharp, both bands of the ribs well and equally developed. Border very narrow.

Remarks. The characteristic feature of the genus is the *Tropidocoryphe*-like cephalon and the Proetidellinae-like pygidium having equally developed the anterior and posterior bands of the ribs. The configuration of the carapace of *Tropidocare* furnishes evidence that the subfamilies Tropidocoryphinae and Proetidellinae are closely related and that connecting links may exist between them. As the first representatives of the subfamily Tropidocoryphinae appear later than those of Proetidellinae, it is possible to conclude that Tropidocoryphinae separated from Proetidellinae, and that just the genus *Tropidocare* could represent one of the connecting links between them. On the other hand, it cannot, however, be excluded that the subfamily Proetidellinae, as conceived in the *Treatise on Invertebrate Paleontology*, is an artificial taxonomical unit to which various proetid trilobites, not related to each other, are assigned. At any rate, *Tropidocare* belongs to phylogenetically noteworthy trilobites.

Prantlia Přibyl 1946 shows a certain analogy, but it differs in the configuration of the frontal part of cranidium, lacks a tropidium and has a (sag.) longer pygidium inflated in another way, with a broader border.

Occurrence. See the type species.

Tropidocare index sp. nov.

Plate 19, figs. 1–11, text-fig. 1

Holotype. Cranidium (ICh 3067) figured on Plate 19, fig. 2.

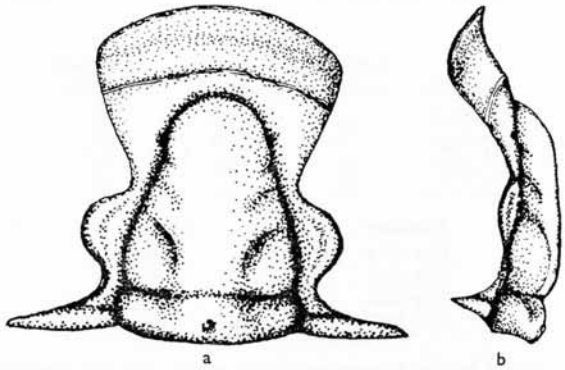
Type locality. Klonk near Suchomasty.

Horizon. Lower part of the Lochkov Formation, *Monograptus uniformis* Zone. Early Lower Devonian (Lower Lochkovian).

Material. Eighteen cranidia, 21 free cheeks, 35 pygidia preserved as external moulds and their counterparts.

Description. Cranidium analogous to that of *Tropidocoryphe*. Glabella subtrapezoidal, of moderate convexity, in the anterior half strongly tapering, anteriorly rounded, bounded by sharp and deep dorsal furrows. Three pairs of glabellar furrows: the posterior (S_1) deep, simply bent, less incised at the occipital furrow, but completely separating the basal lobe which shows a prominent convexity of its own. The median furrows (S_2)

shorter than S_1 but well discernible as a line directed obliquely backwards. The anterior furrows (S_3) short, developed as a short notch in the anterior third of the glabella (easily seen especially on internal moulds). Preglabellar field long sag. (approx. $\frac{1}{3}$ of the length of glabella) with a well-developed narrow tropidium. Frontal part of cranidium anteriorly markedly concave, anterior border not-differentiated, without wall-like vaulting, only moderately upraised. Occipital furrow sharp, laterally (posterior to L_1) widened and connected with the dorsal furrow. Occipital ring not tapering laterally with indistinctly separated occipital lobes; median tubercle small.



TEXT-FIG. 1*a–b*. *Tropidocare index* sp. nov., cranidium: *a*, dorsal view; *b*, lateral view from the left, ×10.

Fixed cheeks in the anterior part moderately convex, sloping antero-laterally. Palpebral lobe of medium size, strongly curved abax., inflated, with a shallow palpebral furrow. The posterior part of the fixed cheeks triangular, strongly widened abax., posterior border narrow. Facial sutures: anterior branch (β–γ) long, diverging at an angle of 20–25° to the sag. axis, β rounded, γ at a short, almost equal distance from dorsal furrows as ϵ; ω, in a longitudinal projection lies considerably further from the sag. axis than β.

Free cheeks show a moderately convex genal field with a narrow tropidium which dies out postero-laterally. The border furrow is represented by a broad depression, lateral border gently upraised. Genal spine of medium length, rapidly tapering distally, with a marked longitudinal furrow which extending from the genal angle continues on to the spine. The posterior border broadening abax., separated by a sharp posterior border furrow. Doublure concave with parallel lines.

Pygidium semicircular, richly segmented. Axis narrow, strongly arched tr., very slowly tapering backwards, composed of ten complete rings (+articulating half-ring and terminal piece). In the antero-lateral part of each ring a pit-like appendifer. Post-axial ridge narrow but distinct, continuing onto the border. Dorsal furrows deep. Pygidial lobes inflated, near the border region abruptly sloping to the border. On the lobes, 5–6 sharply separated complete ribs broadening abax. The ribs are separated by sharp narrow PF which in their whole course maintain the same breadth and depth.

IPF also sharp during their whole course, however, less incised than PF, dividing the ribs into almost equally broad bands (the posterior bands near the border region broadened). Border furrow weak, border very narrow, flat. Pygidial doublure narrow, concave, with parallel lines.

Sculpture. Not whitened, the surface of the carapace seems to be smooth, and only after whitening it shows very fine granulation on the glabella, occipital ring, and pygidial axis; marks of ridges indicate genal caeca; in addition, on the genal field, punctation is also discernible (for instance, ICh 3165).

Measurements (*in mm*)

Cranidium	*Length of cranidium*	*Length of glabella*	*Breadth of glabella*
ICh 3067	4·5	3·0	2·2
ICh 3068	3·2	2·0	1·7
ICh 3069	4·0	2·7	2·0
ICh 3070	4·1	2·6	2·1

Pygidium	*Length*	*Breadth*
ICh 3072	4·0	(6·8)
ICh 3073	3·0	6·5
ICh 3074	3·9	7·0
ICh 3075	4·0	(7·0)

Remarks. As mentioned in the discussion of the genus, the characteristic feature is the analogy with *Tropidocoryphe* as to the configuration of cranidium, and typically proetidellid-like pygidium. The cranidia examined belong, no doubt, to the pygidia, as at the type locality, Klonk, in a 20–25-cm thick bed (No. 95: Chlupáč *et al.* 1970) a confusion with another trilobite is excluded, any other analogous trilobites being absent there; in addition, the cranidia and pygidia also correspond to each other as to their frequency and size, and with regard to the fact that occasionally both were found lying close to each other on the same bedding plane.

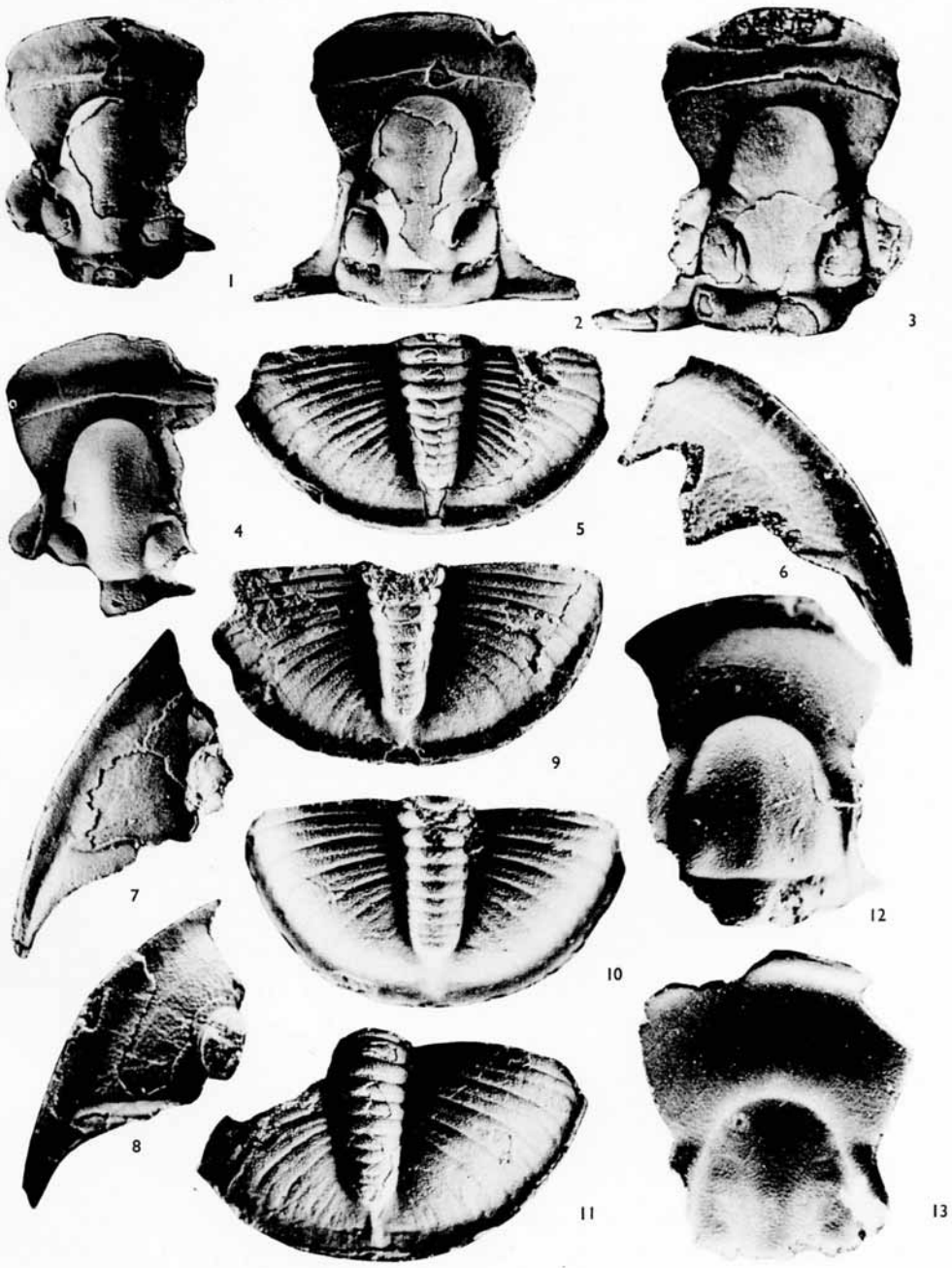
In the bed 95 at Klonk, in addition to the specimens of normal size, remains of young individuals have also been encountered. The smallest pygidium found measured 1·5 mm in length and 3·00 mm in max. width (ICh 3078). Compared with the remains of adult specimens, this pygidium is flatter with deeper incised PF and wider border. Another pygidium (ICh 3077) 2·0 mm long and 3·8–4·0 mm broad already very closely resembles the adult specimens from which it differs in a somewhat wider border only.

There is only one trilobite from the Lochkovian, so far described, which displays a certain similarity, i.e. *Tropidocoryphe*? *heteroclyta* (Barrande 1872) which is known

EXPLANATION OF PLATE 19

Figs. 1–11. *Tropidocare index* sp. nov. Lower Lochkovian, Klonk (figs. 1–9, 11), Karlštejn (fig. 10). 1, Cranidium (ICh 3069), ×11·5. 2, Cranidium, holotype (ICh 3067), ×10. 3, Cranidium (ICh 3068), ×13. 4, Cranidium (ICh 3070), ×11. 5, Pygidium (ICh 3072), ×8. 6, Right free cheek (ICh 3076), ×8. 7, Left free cheek (ICh 3071), ×10. 8, Left free cheek (ICh 3079), ×9. 9, Pygidium (ICh 3073), ×8. 10, Pygidium (ICh 3074), ×8. 11, Pygidium (ICh 3075), ×8.

Figs. 12–13. *Wolayella ranuncula* sp. nov. Upper Lochkovian, Kosoř. 12, Cranidium (ICh 3273), ×13. 13, Negative counterpart of cranidium (ICh 3269), ×12.



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from the find of a single pygidium. This pygidium, however, has the anterior and posterior bands of ribs developed in the anterior three ribs only, furthermore, the axis is substantially shorter and the general configuration much more resembles *Tropidocoryphe*.

Occurrence. All the occurrences so far known belong to the Lower Lochkovian, *Monograptus uniformis* Zone.

In addition to the locality Klonk near Suchomasty where *Tropidocare index* sp. nov. occurs fairly abundantly in the bed 95 (black-grey fine-grained limestone) together with *Ceratocephala lochkoviana* sp. nov., further finds come from the locality Karlštejn-Budňanská skála rocks, the Koukolova hora Hill (the quarry below the summit) and Lejškov near Zdice (for detail of localities, see Chlupáč *et al.* 1970).

Genus PRANTLIA Přibyl 1946

Type species. *Proetus longulus* Hawle et Corda 1847.

Subgenus PRANTLIA (TETINIA) subgen. nov.

Type species. *Prantlia minuta* Přibyl et Vaněk 1962.

Derivation of name. From the locality Tetín near Beroun, where the type species commonly occurs.

Diagnosis. Glabella longly subtrapezoidal, blunt anteriorly. The posterior glabellar furrow S_1 completely separates the basal lobes, S_2 short and shallow, S_3 scarcely perceptible. In the frontal area, parallel shallow axial furrows continue forward to the border furrow, defining a low preglabellar lobate tract. Border furrow sharp, deeply incised laterally, bent in a connecting line with the dorsal furrows, shallowed and conspicuously arcuate anterior to the frontal lobe. Anterior border flat, broad (sag.). Pygidium similar to that of *Prantlia* but shorter, with conspicuously inflated lobes and a lesser number of axial rings (10) and ribs (4–6).

Remarks. The most characteristic feature of *P.* (*Tetinia*) is the configuration of frontal area of cranidium. *Prantlia* (*Prantlia*) Přibyl 1946 differs especially in long (sag.) concave preglabellar field, ill-defined border furrow, narrow upraised border, subconical shape of glabella, three distinct pairs of glabellar furrows (S_2 substantially longer, S_3 well perceptible) and in prominent occipital lobes. It should be noted that the drawing of *Prantlia longula* published by Přibyl (1946, pl. 1, fig. 12) according to a figure taken over from Novák's unpublished manuscript and reprinted in the *Treatise* (1959, fig. 301*b*) is idealized. A good figure of the same specimen according to which the drawing was made (NM 55/67) was presented by Horný and Bastl (1970); see also Plate 20, figs. 10–11. *Warburgella* Reed 1931 is distinguished especially by the frontal area with distinct tropidium. The punctation of carapace of *P.* (*Tetinia*) may be of some importance, but with regard to the single species of *P.* (*Tetinia*) so far known it could be hardly regarded as a diagnostic feature of subgeneric value.

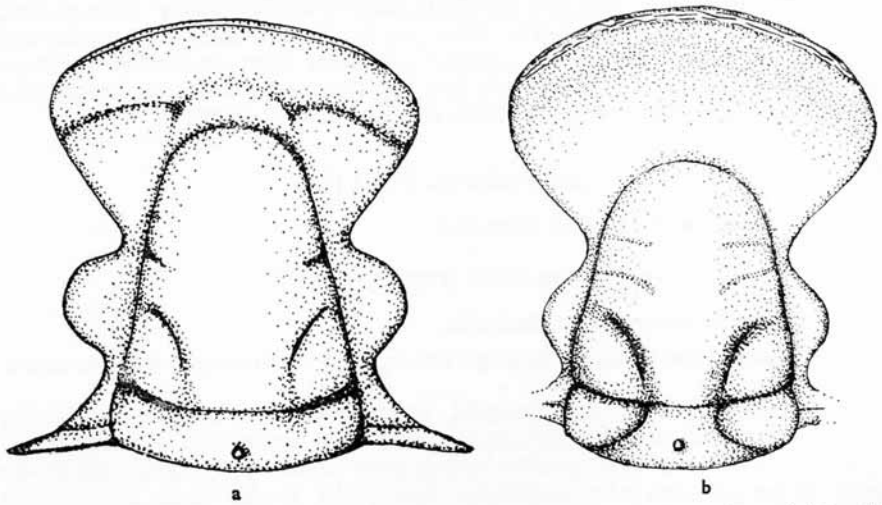
Occurrence. See the type species.

Prantlia (*Tetinia*) *minuta* Přibyl et Vaněk 1962

Plate 20, figs. 1–9, Plate 24, fig. 9; text-fig. 2*a*

1962 *Prantlia minuta* Přibyl et Vaněk; pp. 26–30, pl. 1, figs. 1–5, text-fig. 1.

Material. More than 120 selected cranidia, 150 pygidia, a great number of free cheeks, and 5 hypostomes mostly well preserved in limestones.



TEXT-FIG. 2. Comparison of cranidia of *Prantlia* (*Tetinia*) *minuta* Př. et V. (*a*), and *Prantlia* (*Prantlia*) *longula* (H. et C.) (b). Dorsal view, about ×15.

Remarks. On the basis of a recently found rich material, the description presented by Přibyl and Vaněk (1962) can be completed. On the carapace surface two lateral glabellar furrows (S_1, S_2) are clearly discernible: S_1 sharp, completely delimiting L_1, S_2 much shorter. S_3 mentioned by Přibyl and Vaněk in most specimens not perceptible. The occipital lobes ill-defined, their separation marked by broadening of occipital furrow only. If well preserved, cranidium and free cheeks display a distinct sculpture: fine punctation, on basal lobes and on the occipital ring combined with scale-like ridges. A marked rather deep punctation to reticulation can be seen on the anterior part of

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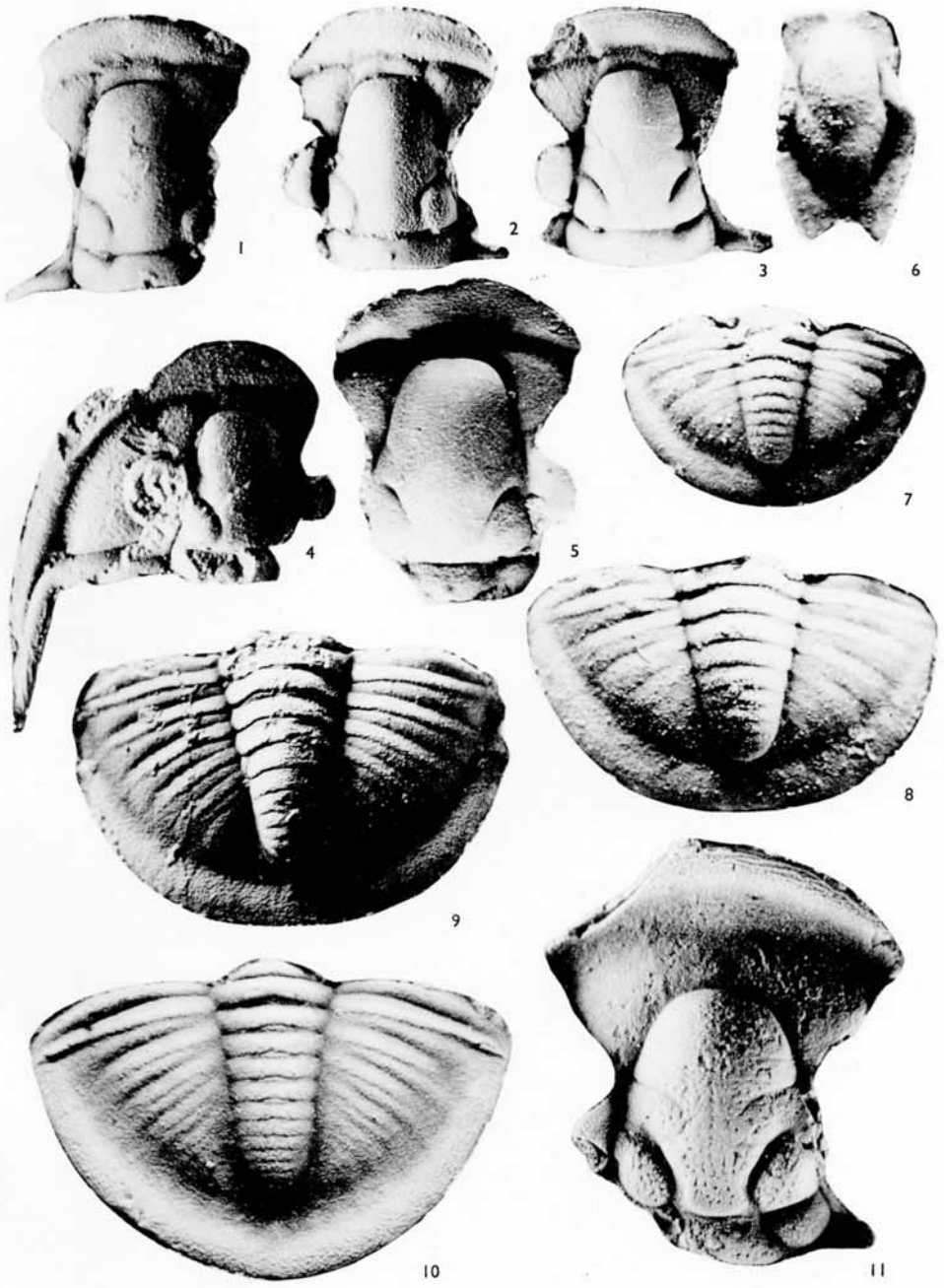
EXPLANATION OF PLATE 20

Figs. 1–9. *Prantlia* (*Tetinia*) *minuta* Přibyl et Vaněk, 1962; Uppermost Přídolian. 1, Cranidium (ICh 3313); Tetín, ×10. 2, Cranidium (ICh 3315); Tetín, ×10. 3, Cranidium (ICh 3314); Holyně, ×10. 4, Cranidium and left free cheek (ICh 3310); Svatý Jan, ×10. 5, Cranidium of a large specimen (ICh 3312); Srbsko, ×9·5. 6, Hypostome (ICh 3307); Nová Ves, ×12. 7, Pygidium (ICh 3305); Holyně, ×9. 8, Pygidium (ICh 3306); Holyně, ×12. 9, Pygidium of a large specimen (ICh 3303); Tetín, ×9.

Figs. 10–11. *Prantlia* (*Prantlia*) *longula* (Hawle et Corda 1847). Kopanina Formation, Řeporyje. 10, Pygidium (ICh 3316), ×10. 11, Cranidium (ÚÚG p. 12258), ×12.



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fixed cheeks and the genal field of free cheeks. The anterior border proper pitted finely and regularly.

Pygidial axis composed of 10 complete rings (plus terminal piece). In adult specimens of normal size, 6 ribs are usually developed on the lobes; between the last discernible rib and the axis there is a certain space; PF and IPF on the surface of carapace of adult specimens are shallow, the relief of the lobes being therefore not sharp.

Hypostome: anterior lobe oval, only in the abax. part separated by a weak median furrow from the broader (tr.) posterior lobe. The border region extends anterolaterally into broad short anterior wings; lateral wings rounded, very conspicuous posterior wings prolonged into sharp points. Border region, on the whole, flat.

During recent collecting, remains of young specimens were found. Even the smallest cranidia encountered, measuring 1·5–2·0 mm in length do not substantially differ in any way from the specimens of normal size. The smallest pygidia found, 1·0–1·5 mm in length (sag.) and of a max. breadth 2·0–2·7 mm are in general broader than those of the adult specimens; their pleural lobes are flatter, their PF and IPF are sharper, the border furrow is deeper and the border is somewhat broader and flatter.

Measurements. The smallest cranidium found is 1·5 mm in length (sag.), the largest 4·8 mm. The smallest pygidium is 1·0 mm long, breadth being 2·0 mm; the length of the largest pygidium is 5 mm, its breadth being 7·5 mm.

Occurrence. P. (*T.*) *minuta* characterizes an important horizon of small thickness (not exceeding 3 m) at the Přídolian/Lochkovian boundary in the Barrandian Area, closely underlying the *Warburgella rugulosa rugosa* Horizon. However, its occurrence is restricted to a purely carbonate facies that is locally very abundant at the pertinent level. Localities: Nová Ves near Praha, Holyně (north-east of Opatřilka), Řeporyje (quarries 'Na požárech), environs of Svatý Jan pod Skalou and further localities as Mořina, Srbsko, Tetín, etc. (Chlupáč *et al.* 1970).

Genus WARBURGELLA Reed 1931

Type species. Asaphus stokesi Murchison 1839.

Remarks. Emended diagnosis and discussion of this genus was presented by Ormiston (1967). Within the framework of the above genus Balashova (1968) has recently separated the subgenus *Warburgella* (*Podolites*) Bal., which, however, in most of the diagnostic features given by Balashova (1968, p. 102) agrees with the nominate subgenus (see redescription of the type species *W. stokesi* by Whittard 1938), i.e. breadth of preglabellar field, configuration of the border, course of tropidium, sharp incision of S_1, size of palpebral lobes, configuration of occipital ring, narrow pygidial axis, and short postaxial ridge. The value of some further diagnostic features given by Balashova is questionable as they are either individually variable (sculpture) or varying during the ontogenic development, sometimes also influenced by the state of preservation (sharpness of the border line, etc.). Of the characteristics which can be regarded, although with reserve, as really diagnostic for *W.* (*Podolites*), there remains only the presence of a transverse ridge posterior to the anterior border furrow (before tropidium) and

a lower number (8) of thoracic segments; the latter feature, however, should be still more thoroughly verified by more finds of complete carapaces of adult specimens.

Occurrence. Lower Silurian (or even Ashgillian) to early Lower Devonian. Europe (Podolia, Barrandian area, the Rheinishes Schiefergebirge, Poland), North Africa (Morocco), North America (Canadian Arctic).

Warburgella (*Podolites*) *rugulosa rugosa* (Bouček 1934)

Plate 21, figs. 1–14

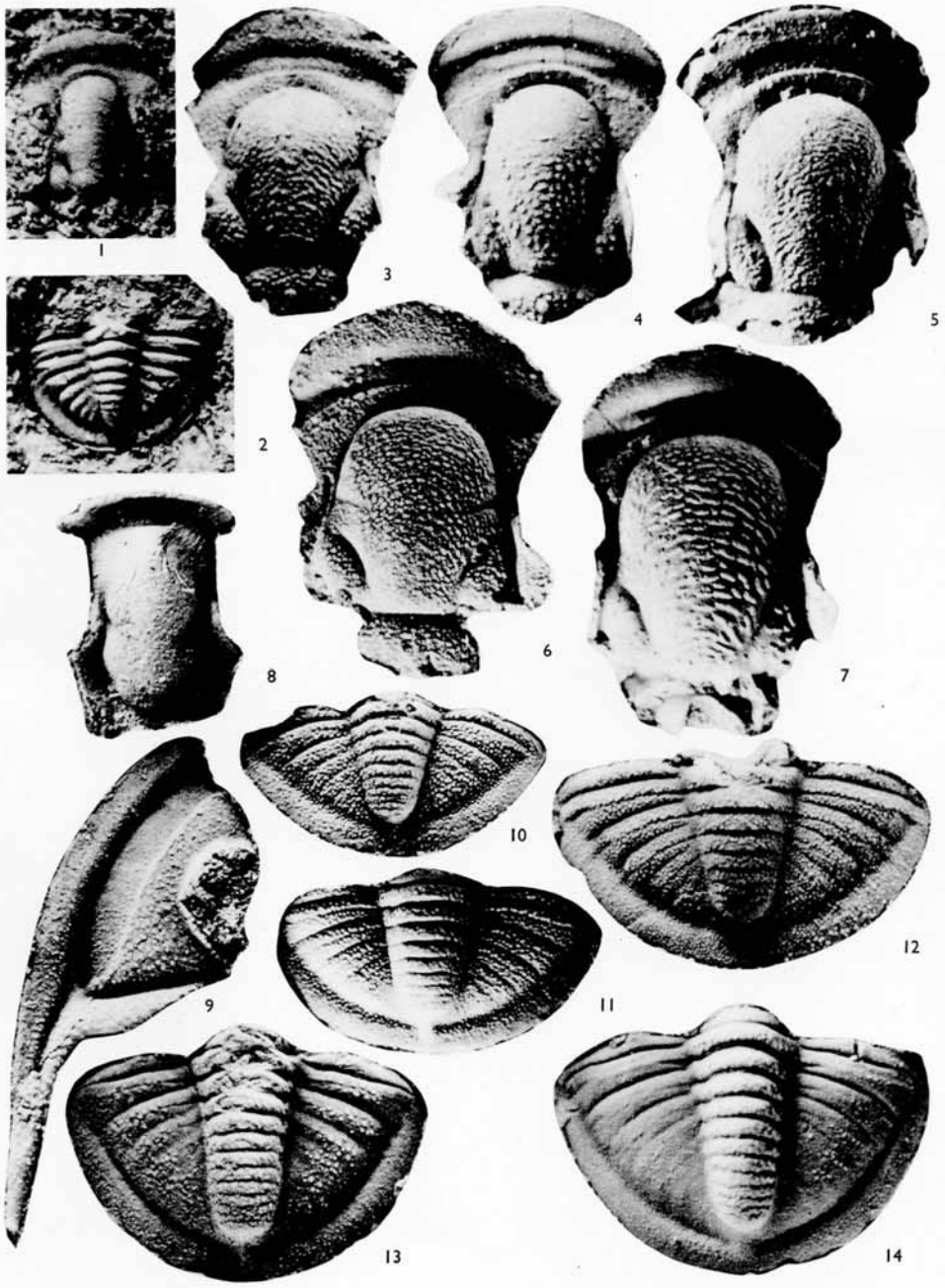
1934 *Cyphoproetus rugosus* Bouček; pp. 2–3, pl. 1, figs. 7–10.
1963 *Warburgella rugulosa* (Alth 1874) *rugosa* (Bouček 1934); G. Alberti, pp. 157–8, pl. 15, figs. 1–6; pl. 16, figs. 1–4; text-fig. 1*b* (here earlier synonymy).
1968 *Warburgella* (*Podolites*) *rugulosa*: Balashova, pp. 102–3, pl. 2, figs. 15–23.
1968 *Warburgella* (*Podolites*) *rugosa rugosa*: Balashova, p. 104, pl. 2, figs. 10–14.
1969 *Warburgella rugulosa maura*: G. Alberti, pp. 353–6, pl. 32, figs. 1–11; pl. 33, figs. 5–13; pl. 43, fig. 17; text-fig. 42, 43b_{1-3}. (here further synonymy).

Material. About 300 selected cranidia and more than 200 pygidia, a great number of isolated free cheeks and several hypostomes (all well preserved as external or internal moulds in limestones).

Remarks. The recently found material permits the study in greater detail of the individual variability as well as the changes during the ontogeny. In the first place, sculpture appears to be the most variable feature. Even in individuals of the same size and from the same stratigraphic horizon, variability of sculpture, especially marked on glabella, can be observed: some specimens display close-set, rather long curved ridges (cf. Pl. 21, fig. 5), or other specimens are frequently found which show rather short and interrupted coarse ridges more widely spaced from each other (Pl. 21, fig. 7 and also specimens figured by Alberti 1963, pl. 15, figs. 1–3); others have still sparser ridges which especially in the anterior part of glabella gradually die out (Pl. 21, fig. 4); some show fine, densely crowded short ridges (Pl. 21, fig. 3) and a sculpture resembling that of the specimens figured by Alberti (1969, pl. 32, figs. 1–11) from Morocco and designated as *W. rugulosa maura* Alberti. Finally, in the new material, specimens were also found, the ridges of which are very weak resembling in sculpture the cranidia of *W.* cf. *baltica* Alberti figured by Alberti (1963, pl. 15, figs. 10–11) from the Baltic Silurian. As on glabella, also on pygidium, especially on pygidial ribs, the size and density of granules

EXPLANATION OF PLATE 21

Figs. 1–14. *Warburgella* (*Podolites*) *rugulosa rugosa* (Bouček 1934); Lower Lochkovian. 1, Cranidium of the youngest specimen found (ICh 3286); Radotín Valley, ×30. 2, Pygidium of a young specimen (ICh 3285); Radotín Valley, ×25. 3, Cranidium (ICh 3287); Karlštejn, ×15. 4, Cranidium (ICh 3295); Svatý Jan, ×14·5. 5, Cranidium (ICh 3294); Holyně, ×14. 6, Cranidium (ICh 3290); Koukolova Hora, ×14. 7, Cranidium of a large specimen (ICh 3281); Karlík, ×12. 8, Hypostome (ICh 3293); Srbsko, ×11. 9, Left free cheek (ICh 3282); Karlík, ×11. 10, Pygidium (ICh 3279), slightly compressed; Karlštejn, ×10. 11, Pygidium (ICh 3280); Lejškov, ×11. 12, Pygidium (ICh 3278); Koukolova Hora, ×11. 13, Pygidium of a large specimen (ICh 3277); Srbsko, ×10.



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markedly varies (cf. Pl. 21, figs. 10–13); the cranidia with fairly coarse sculpture belong to pygidia with rather marked granulation, and inversely.

As the whole material was collected in the sections which had been studied in detail, its assignment to the same stratigraphic horizon is indubitably correct and it is evident that the variations of sculpture do not depend on the stratigraphic level of the occurrence. At a certain locality and especially in a definite lithological type of rocks, specimens frequently prevail which show a certain type of sculpture (in the facies of dark platy limestone individuals with a coarser sculpture predominate, while in light organodetrital limestones specimens with sparser or finer sculpture occur). However, at the same locality and in the same bed, specimens showing various deviations of sculpture can often also be found. From the mode of occurrence it may be concluded that the sculpture was evidently influenced in the first place by purely local microfacies conditions and that this variability is of individual character and depends on ecological conditions. In addition, certain changes in the sculpture can also be established during the post-larval ontogenic development (the younger specimens usually display a more close-set and finer sculpture); these variations, however, are less conspicuous.

Considering the results of the above observations it can be stated that the erection of subspecies within the species *Warburgella rugulosa* (Alth) on the basis of minor variations of sculpture only, does not appear as fully justified. On the other hand, variability of sculpture also has certain limits: for instance, none of the specimens found in the Barrandian Basin agrees in its sculpture with those described as *Warburgella rugulosa rhenana* Alberti from the Rhineland or with *W. rugulosa canadensis* Ormiston from the Canadian Arctic which both evidently represent true subspecies.

The recently found material makes a study of ontogeny possible. The smallest cranidia found (ICh 3284, 3286) 0·7–1·0 mm in length, compared with adult specimens, have substantially narrower and longer glabella with sharp S_1 and S_2 but with a weak tropidium and a transverse ridge posterior to the anterior border furrow (Pl. 21, fig. 1). In cranidia measuring 1·6–1·8 mm in length (e.g. ICh 3288), glabella is still relatively long, but the tropidium and the transverse ridge are already more prominent. During further development (cranidia 2·5–3·0 mm long (sag.) (Pl. 21, figs. 3–6)), glabella broadens, especially in the posterior part, assuming thus the characteristic usual shape, and the development proceeds in the way described by Alberti (1969, pp. 355–6). The specimens of this stage of growth mostly prevail in number. In specimens of larger size (length of cranidium 4–6 mm) the difference between the anterior and posterior parts of glabella diminishes, the glabella becoming rather subquadrate in outline (cf. Pl. 21, fig. 7).

Striking variations can be observed on pygidia during the ontogenic development. The smallest pygidia found 0·5–0·8 mm in length (Pl. 21, fig. 2) show a strikingly sharp relief, deep incised PF, 6–7 prominent ribs on the lobes and a markedly differentiated border; IPF of the anterior ribs, are characteristically abax. bent backwards in crescentic form, continue on to the border (typical larval feature of proetids). Pygidia 1·5–2·0 mm long are distinguished by a major breadth (ratio length to breadth = about 1:2), flatter lobes, less incised PF and IPF and a smaller number of ribs (5–6) on the lobes (Pl. 21, figs. 10–12). Pygidia of this size are most frequent and correspond to cranidia 2–3 mm long. In major pygidia, of lengths exceeding 2·5 mm, a tendency towards prolongation of the pygidium and continuing shallowing and reduction of PF and IPF

in the posterior parts of the pygidial lobes can be observed, so that only 2–3 complete anterior ribs are prominent, IPF being only very weak (see Pl. 21, fig. 13).

From the above notes it follows that in evaluating the diagnostic features within *Warburgella rugulosa* (Alth) it is necessary to proceed with considerable caution and to use specimens derived from various environments and of different stages of ontogenic development. In this connection the distinguishing of *W.* (*P.*) *rugulosa rugulosa* (Alth) and *W.* (*P.*) *rugulosa rugosa* (Bouč.) on the basis of diagnostic features given by Balashova (1968) appears as not fully justified and insufficient for an objective differentiation. However, as the problem of the types of the nominate subspecies *W.* (*P.*) *rugulosa rugulosa* (Alth) has not yet been definitively solved (the original material being lost?), the present author retains, for the sake of objectiveness, the designation *W.* (*P.*) *rugulosa rugosa* (Bouček) for the material from the Barrandian area, pointing out that a possible identity with the nominate subspecies (cf. Alberti 1969) could be proved only after the establishment of the lectotype or neotype of the nominate subspecies.

Occurrence in the Barrandian. Warburgella (*P.*) *rugulosa rugosa* (Bouč.) forms a significant horizon in the early Lower Devonian (Lower Lochkovian), approximately corresponding to the *Monograptus uniformis* Zone. The above species was found at practically all localities where the Silurian/Devonian boundary was studied in detail: Karlštejn–Budňanská skála (type locality), Klonk near Suchomasty, Čertovy Schody, Lejškov, Koukolova hora, Tetín, Kosov, Srbsko, various localities in the environs of Svatý Jan pod Skalou, Loděnice–Branžovy, Reporyje, Holyně, Nová Ves, Praha–Podolí, Černá rokle gorge below Barrandov, localities in the Radotín valley, Vonoklasy, Karlík, and others (Chlupáč *et al.* 1970). It is important that *W.* (*P.*) *rugulosa rugosa* (Bouček) is abundant at the same level in the facies of dark platy limestones as well as in organodetrital facies, so that it is one of the most suitable fossils for correlation in the boundary interval.

Subfamily PRIONOPELTINAE Přibyl 1946
Genus PRIONOPELTIS Hawle et Corda 1847

Type species. Phaeton archiaci Barrande 1846.

Prionopeltis striatus troilus Hawle et Corda 1847

Plate 22, figs. 1–6; Plate 23, figs. 7–10; text-fig. 3*a*, *b*

1847 *Prionopeltis troilus* Hawle et Corda, p. 124.

Lectotype. Cranidium with free cheek (NM 361/67).

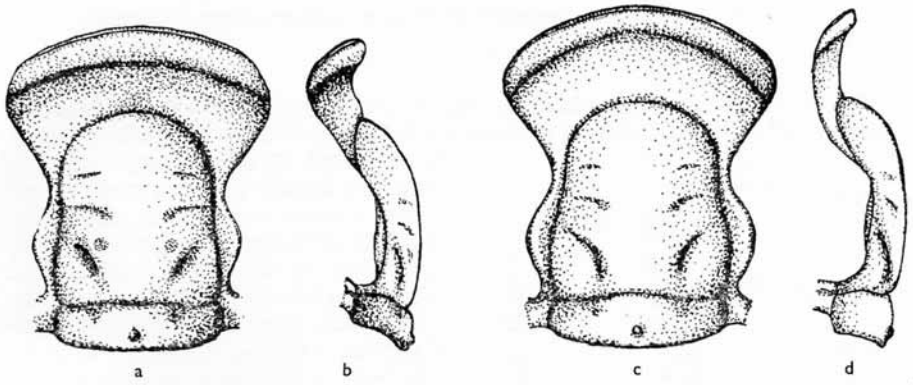
Type locality. Koledník near Beroun.

Horizon. Lower part of the Přídolí Formation, Upper Silurian.

Diagnosis. Subspecies of *P. striatus* differing from the nominate subspecies in a shorter concave preglabellar field, the anterior part of fixed cheeks with convexity of their own, interrupted in the median part only anterior to the frontal lobe of the glabella (in *P. striatus striatus* the preglabellar field is flat and fuses completely with the anterior part of fixed cheeks), wider and deeper border furrow and the sculpture on glabella where,

in addition to small ridges, granules are also present (in the nominate subspecies ridges only).

Remarks. Although Hawle's and Corda's (1847) description is not adequate, the lectotype of *P. troilus* H. et C. differs from *P. striatus striatus* H. et C. from the Kopanina Formation and, on the contrary, agrees with the abundant representative of *Prionopeltis* frequently found in the Přídolí Formation. The lithological character of the rock in which the lectotype has been preserved, furnishes evidence that the assignment to the Přídolian is correct. A close relationship to *P. striatus striatus* (Barr.) is of course indubitable, the differences being of subspecific rank only; *P. striatus troilus* is incontestably a direct descendant of the nominate subspecies.



TEXT-FIG. 3. Comparison of cranidia: *a–b*, *Prionopeltis striatus troilus* H. et C. (*a*, dorsal view; *b*, lateral view from the left), *c–d*, *Prionopeltis striatus striatus* H. et C. (*c*, dorsal view; *d*, lateral view from the left), ×11.

On the recently found material some changes during the post-larval ontogenic development can be traced: the young specimens (e.g. ICh 3264, 3260) have a somewhat longer glabella, deeper glabellar furrows and a shorter preglabellar field (Pl. 22, figs. 1, 6).

Of other subspecies, *P. striatus praecedens* (Bouček 1934) is distinguished by a long (sag.) preglabellar field, more convex pygidial lobes with shorter marginal spines. *P. striatus incisus* Kegel 1928 from the Upper Silurian of the Harz Mts. also shows a longer preglabellar field and pygidium with a narrower axis, broader lobes with ribs less curved backwards, and by longer and narrower marginal spines.

Occurrence. Přídolí Formation; especially abundant in the lower part (*Monograptus ultimus* Zone), particularly in purely carbonate (organodetrital) facies. Localities: Kosov and Jarov near Beroun (in the earlier collections these localities were both covered by the term Dlouhá hora or Koledník), Zadní Kopanina (the south-western wall of the quarry Horní Dezortův lom, occurrence together with Scharyia nympha sp. nov.), Srbsko-Na Bříči, Loděnice-Bubovice (ancient small quarries at the road), Řeporyje, etc.

Subfamily TROPIDOCORYPHINAE Přibyl 1946
Genus WOLAYELLA Erben 1966

Type species. Wolayella wolayae Erben 1966.

Wolayella ranuncula sp. nov.

Plate 19, figs. 12, 13; Plate 22, fig. 9; text-fig. 4

Derivation of name. From the Latin *ranuncula*, small frog.

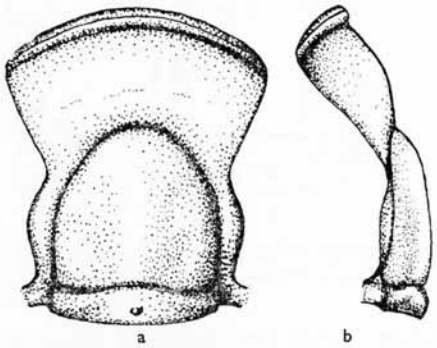
Holotype. Cranidium (ICh 3270) figured on Plate 22, fig. 9.

Type locality. Kosoř, quarry in Černá rokle.

Horizon. Upper part of the Lochkov Formation, early Lower Devonian (Upper Lochkovian).

Material. Seven cranidia preserved in limestone.

Description. Cranidium distinguished by a strong convexity, short glabella and long preglabellar field. Glabella roundedly subtrapezoidal in outline, anteriorly broadly rounded, gently arched. Its length (sag.) equals the maximum breadth at the occipital furrow. Dorsal furrows run around glabella in abaxially convex arches, showing a weak adax. bend in the anterior third only. Weakly impressed glabellar furrows: S_1 indicates the separation of the basal lobe which has a slight convexity of its own, very weak S_2 appears in the anterior third of the glabella. Owing to the gentler arching of lateral lobes L_1 and L_2, the frontomedian part of glabella is more prominent, and consequently, the glabella becomes roof-like with a weak longitudinal keel in the axis. Occipital furrow sharp, less impressed in the proximity of dorsal furrows. Occipital ring moderately arched with a small median tubercle and indistinctly separated occipital lobes. Preglabellar field long



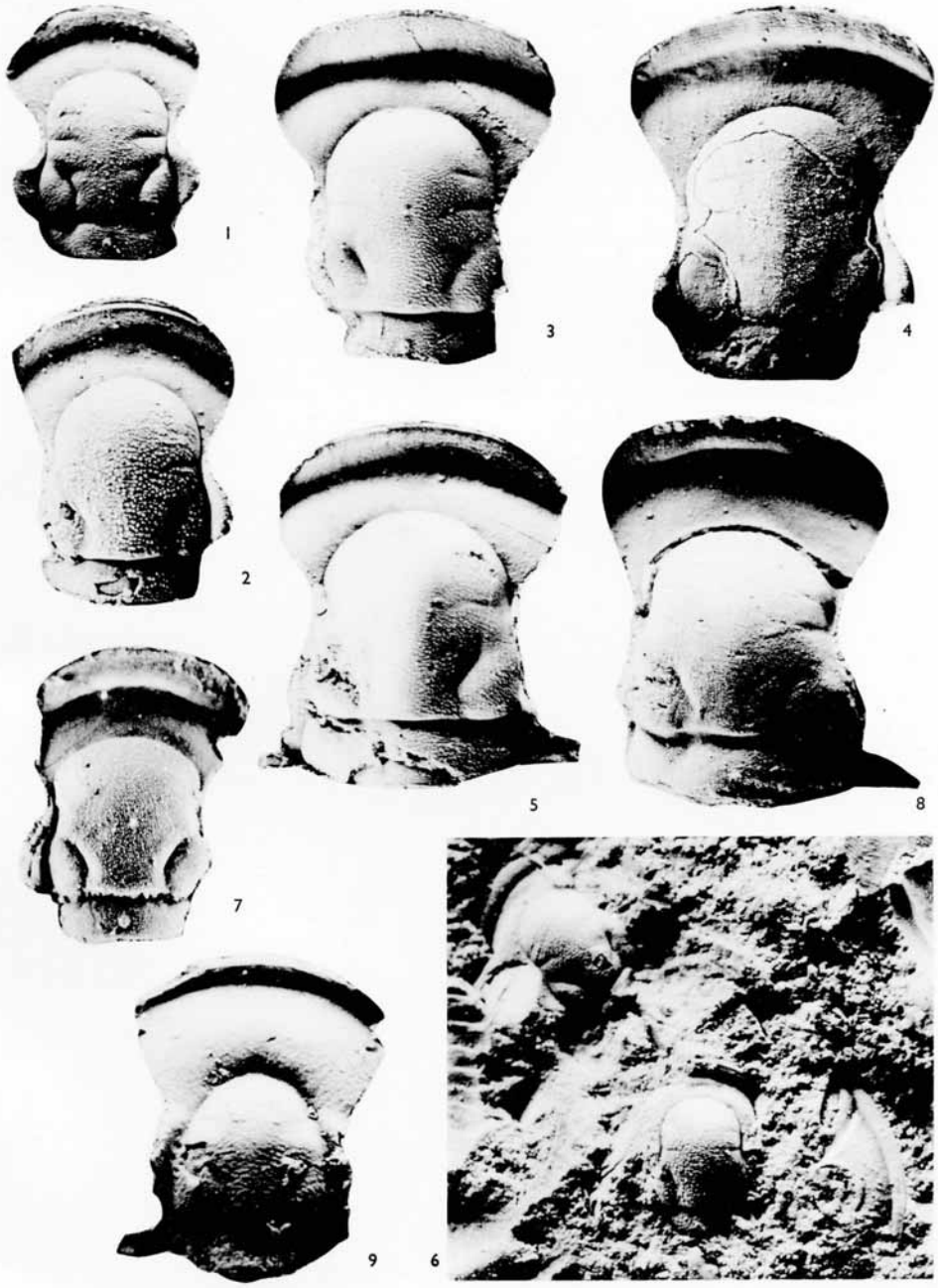
TEXT-FIG. 4. *Wolayella ranuncula* sp. nov., cranidium: *a*, dorsal view; *b*, lateral view from the left, ×11.

EXPLANATION OF PLATE 22

Figs. 1–6. *Prionopeltis striatus troilus* Hawle et Corda 1847; Přídolí Formation, Kosov (figs. 1–3, 5–6), Zadní Kopanina (fig. 4). 1, Cranidium of a younger specimen (ICh 3260); Kosov, ×10. 2, Cranidium of a specimen of normal size (ICh 3263); Kosov, ×10. 3, Cranidium of a larger specimen (ICh 3262); Kosov, ×10·5. 4, Cranidium of a large specimen (ICh 3265); Zadní Kopanina, ×10·5. 5, Cranidium (ICh 3261); Kosov, ×10·5. 6, Two cranidia and left free cheek of young specimens (ICh 3264); Kosov, ×12.

Figs. 7–8. *Prionopeltis striatus striatus* Hawle et Corda 1847; Kopanina Formation, Jarov. 7, Cranidium of a smaller specimen (ICh 3318), ×11. 8, Cranidium of a larger specimen (ICh 3317), ×11.

Fig. 9. *Wolayella ranuncula* sp. nov.; Upper Lochkovian, Kosoř. Cranidium, holotype (ICh 3270), × 11.



CHLUPAČ, Silurian/Devonian trilobites

(sag.), its length = two-thirds of the length of glabella, having convexity of its own sloping anteriorly. The anterior border furrow broad and incised, anterior border narrow, wall-like, upraised, with one or two weak parallel lines. Facial sutures: anterior branch long, divergent at an angle of 20° to the sag. axis, β narrowly rounded, γ and ϵ at a certain, almost equal distance from the dorsal furrows. Palpebral lobe long (exsag.), narrow, only slightly curved abax.

Sculpture on glabella, occipital ring, and preglabellar field, fine scale-like ridges mostly parallel to the anterior margin of cranidium. On glabella, the ridges on the frontomedian part form anteriorly curved arches, on the lateral lobes, they run rather transversely. In the site of the assumed tropidium on the preglabellar field, some of the ridges are more prominent, but the tropidium proper is not developed as a continuous line (e.g. ICh 3270, ICh 3271).

Measurements (in mm)

Cranidium (ICh 3270)—Holotype: length 4·5; length of glabella 2·0; maximum breadth of glabella 2·0.
Cranidium (ICh 3273)—Paratype 3·8; 1·8; 1·8.

Remarks. The assignment to *Wolayella* Erben is based especially on the shape of glabella, the course of dorsal furrows and configuration of preglabellar field and palpebral lobes. Our species differs from *W. wolayae* Erben 1966 and *W. maura* Alberti 1966 in the vaulting of glabella (particularly signs of S_1 and S_2 and the keel-like convexity of frontomedian part), longer preglabellar field without any pronounced tropidium and in a much finer ridge sculpture. A long similarly inflated preglabellar field can be observed in the single cranidium described by Přibyl (1966) as *Unguliproetus globosus* Přib., which, however, has a considerably convex and oval glabella without visible glabellar furrows, a weak anterior border furrow and a broader border.

From the Lochkovian, a single pygidium of tropidocoryphid character was described by Barrande (1872) as *Proetus heteroclytus* Barr. (see remarks to *Tropidocare index* sp. nov.), later it was tentatively assigned to *Tropidocoryphe* Novák, but Alberti (1969, p. 326) has recently excluded it from this genus. As from the Upper Lochkovian no other tropidocoryphid trilobite has so far been known, it could be assumed that the pygidium described by Barrande could be conspecific with *Wolayella ranuncula* sp. nov. This possibility has not so far been supported by any find of pygidia of *Wolayella*; therefore, for the sake of objectivity, the cranidia at the present state of knowledge are to be designated by a separate name.

Occurrence. W. ranuncula sp. nov. has so far been known from the Radotín and Kosoř facies of the Upper Lochkovian (*Monograptus hercynicus* Zone), from the localities Kosoř (ancient quarries in the north-western slope of the gorge Černá rokle) and Velká Chuchle–Přídolí (sections described by Chlupáč 1953).

Subfamily SCHARYIINAE Osmólska 1957

Genus SCHARYIA Přibyl 1946

Type species. Proetus micropygus Hawle et Corda 1847.

Scharyia nympha sp. nov.

Plate 23, figs. 1–6; text-fig. 5

Derivation of name. From the Latin *nympha*, goddess of spring.

Holotype. Cranidium (ICh 3237) figured on Plate 23, fig. 2.

Type locality. Zadní Kopanina, Barrandian Basin.

Horizon. Lower part of the Přídolí Formation, Upper Silurian.

Material. Ten selected cranidia, 30 pygidia, several free cheeks preserved in limestones.

Description. Glabella conical, tapering anteriorly, narrowly rounded anteriorly; convexity of glabella sag. moderate, tr. steeper. Of glabellar furrows, only S_1 in the posterior third of glabella weakly impressed. Dorsal furrows sharp, converging anteriorly, markedly deepening in the posterior part and before the frontal lobe. In the anterior $\frac{1}{4}$ of glabella they are gently curved adax.—this appears as constriction of the foremost part of glabella. Occipital furrow deep, uniformly incised during its whole course. Occipital ring moderately tapering laterally, highly arched, with prominent median tubercle near the posterior margin. Preglabellar field sag. long ($\frac{2}{3}$ of the length of glabella), sloping anteriorly. Anterior border furrow sharp and narrow during its whole course. Anterior border narrow, gently wall-like upraised, with one or two parallel lines near the anterior margin. Anterior part of fixed cheeks falling antero-laterally, broad (tr.). Palpebral lobe large, strongly curved abax., separated from the remaining part of the fixed cheeks by a furrow, more incised backwards, parallel to sag. axis. The posterior part of fixed cheek not preserved. Facial suture: Anterior branch considerably divergent (at an angle of approx. 35° to sag. axis), β narrowly rounded, γ fairly distant from dorsal furrows, ϵ at a lesser, nevertheless considerable, distance. Surface of cranidium, except for the anterior border, carries prominent tubercles of unequal size and individually variable spacing (cf. difference between cranidium figured on Pl. 23, fig. 1, and that in fig. 2). In some specimens, the strikingly larger granules on glabella are arranged into longitudinal rows. A conspicuous row of granules rims the palpebral lobe.

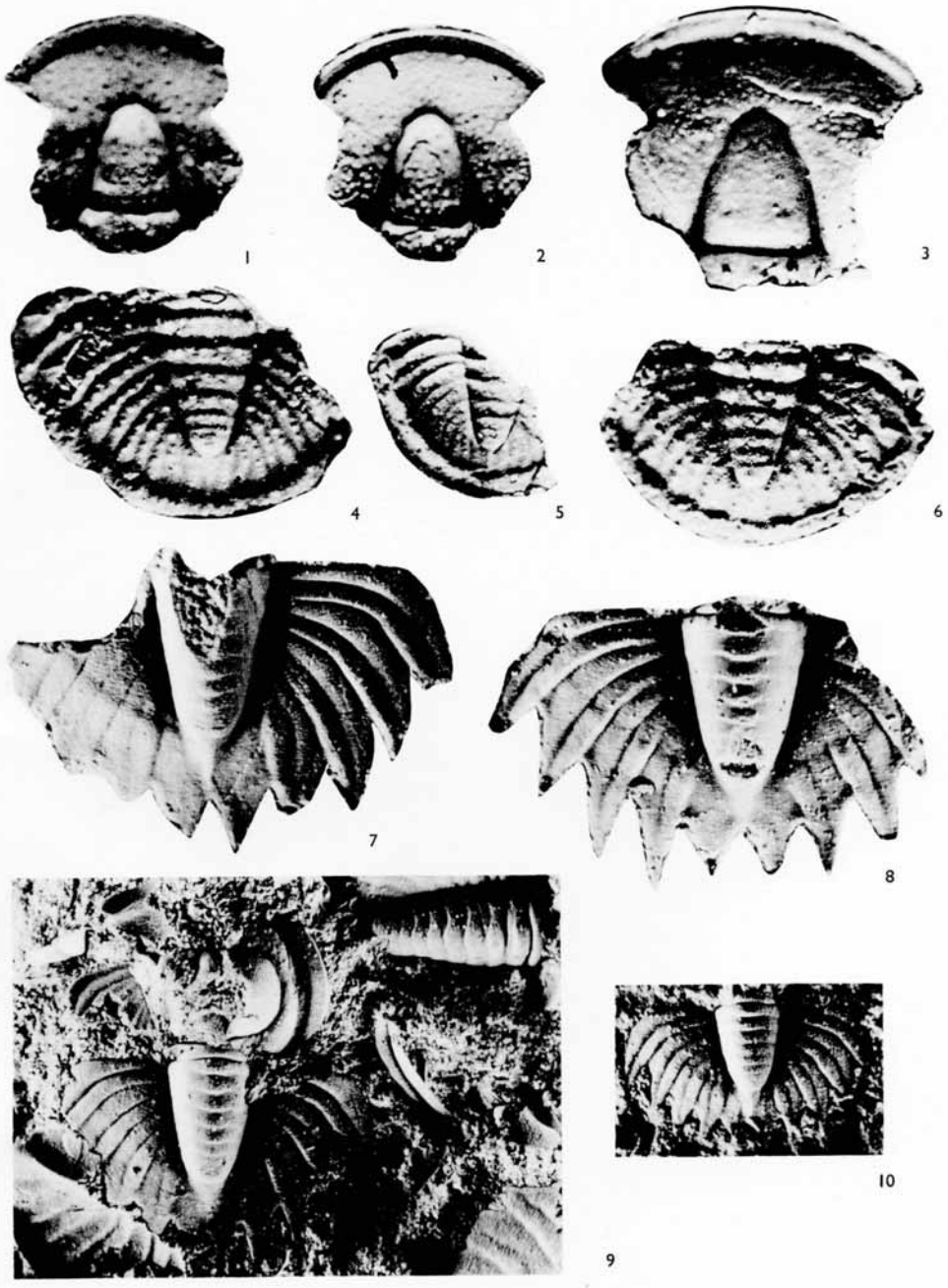
The free cheeks show a relatively broad inflated genal field, deep anterior and posterior border furrows and a markedly separated lateral border. Genal spines rather short, with a longitudinal depression. Eyes large, convex (visual surface not preserved). On genal field sparse prominent granules.

Pygidium half-elliptical in outline with an arched axis rapidly tapering backwards, composed of 7–8 complete rings (plus articulation half-ring). The axis terminates at a considerable distance from the posterior margin, running out into a postaxial ridge

EXPLANATION OF PLATE 23

Figs. 1–6. *Scharyia nympha* sp. nov.; Lower Přídolian, Zadní Kopanina. 1, Cranidium (ICh 3236), ×25. 2, Cranidium, holotype (ICh 3237), ×22. 3, Cranidium (ICh 3209), ×23. 4, Pygidium (ICh 3231), ×24. 5, Pygidium (ICh 3234), ×18. 6, Pygidium (ICh 3232), ×33.

Figs. 7–10. *Prionopeltis striatus troilus* Hawle et Corda 1847; Lower Přídolian, Kosov (figs. 7, 9-10), Řeporyje (fig. 8). 7, Pygidium (ICh 3259), ×11. 8, Pygidium (ICh 3268), ×11. 9, Pygidia and uncomplete cranidium (ICh 3264), ×9. 10, Pygidium of a young specimen (ICh 3258), ×11.



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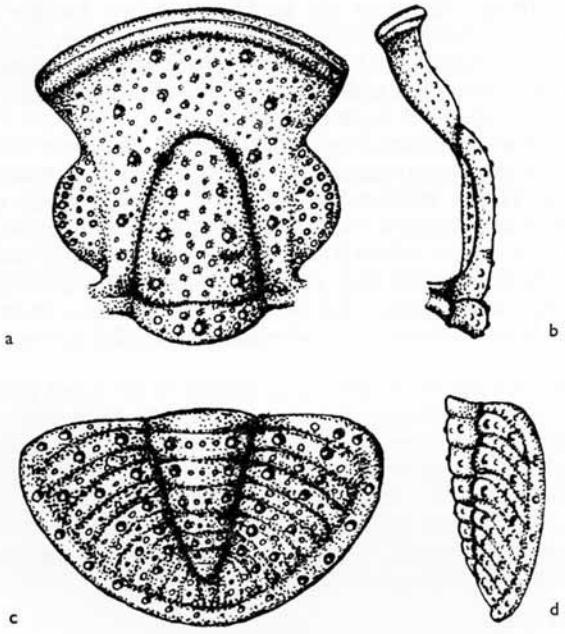
rapidly tapering backwards. Ring furrows deep and wide. On the rings, prominent granules are developed, of which the larger, in the lateral parts of the rings, are arranged into 2–3 rows on both sides of the axis. Pygidial lobes fall relatively steeply towards the border, carrying 5–6 ribs separated by sharp PF. IPF almost equally incised as PF, divide the ribs in their whole course into two bands, in the anterior ribs the anterior band being broader than posterior. On the ribs, prominent granules of unequal size



TEXT-FIG. 5. *Scharyia nympha* sp. nov.: *a*, cranidium, dorsal view; *b*, cranidium, lateral view from the left; *c*, pygidium, dorsal view; *d*, pygidium, lateral view from the right. All figures ×30.

are developed. The major of them, similarly as those on the axis, are arranged into longitudinal rows; analogous sparse granules also occur on the border. Border furrow weak, represented by a depression in which PF and IPF die out. The border relatively narrow, distinctly differentiated from the lobes, weakly wall-like upraised.

Measurements (in mm)

	Length of cranidium	*Length of glabella*
Cranidium (ICh 3237)	1·7	0·8
Cranidium (ICh 3236)	1·5	0·7
Cranidium (ICh 3209)	1·9	1·0
Pygidium (ICh 3231)	length 1·5	maximum breadth 2·4 (approx.)
Pygidium (ICh 3235)	1·2	2·2

Remarks and relations. Scharyia micropyga micropyga (Hawle et Corda 1847) from the lower part of the Kopanina Formation differs especially in the glabella more conspicuously tapering anteriorly with well-visible glabellar furrows and a much finer uniform granulation of carapace. The pygidium is broader, its axis tapering more rapidly backwards, reaching more closely to the posterior margin, its PF and IPF are less impressed, its border furrow is deeper, and the sparser granules on the carapace are smaller in size, or even are absent on some specimens. The early Lower Devonian *Scharyia angusta* Přibyl 1966 from the Lochkovian has a broader glabella rapidly tapering anteriorly with well-perceptible glabellar furrows (S_1 deeply incised) and finer granulation. The pygidial axis has more rings (8–9), lateral lobes show a stronger convexity of their own, ribs are less arched, PF and IPF are substantially less incised, the surface of the pygidial carapace is almost smooth.

The younger Lower Devonian *Scharyia vesca* Přibyl 1966 from the Pragian agrees with our species in coarsely granulated cranidium, its glabella, however, is broader and the anterior border furrow unsharp (the only one known cranidium of this species is otherwise preserved as a negative only, not permitting a comparison in details); the pygidium of *Sch. vesca* has an axis of 9 rings, tapering more rapidly backwards, broader border furrow and quite sporadic large granules. *Sch. brevispinosa* Přibyl 1967 from the boundary beds between the Lower and Middle Devonian has a lesser number of ribs on pygidial lobes, broader border and a denticulate posterior margin.

Occurrence. Scharyia nympha sp. nov. is abundant in the basal part of the Přídolí Formation (*Monograptus ultimus* Zone) at the locality Zadní Kopanina (the southern wall of the so-called Upper Dezort's quarry). It is concentrated in the beds of grey, granular, finely organodetrital limestones with a rich trilobite fauna, especially *Prionopeltis striatus troilus* H. et C., and the very abundant index graptolite *Monograptus ultimus* Per. It is probable that the described species also occurs in the Upper Přídolian (*Monograptus transgrediens* Zone); locality Loděnice-Bubovice and Karlštejn (yard of the house no. 132 on the left bank of the river Berounka).

Family ODONTOPLEURIDAE Burmeister 1843
Subfamily MIRASPIDINAE Richter et Richter 1917
Genus CERATOCEPHALA Warder 1838

Type species. Ceratocephala goniata Warder 1838.

Ceratocephala lochkoviana sp. nov.

Plate 24, figs. 1–8; text-fig. 6

1886 *Acidaspis vesiculosa*: Novák, pp. 17 and 21.
1962 *Ceratocephala (C.) vesiculosa*: Přibyl et Vaněk, p. 44.

Derivation of name. Name derived from the Lochkovian Stage.

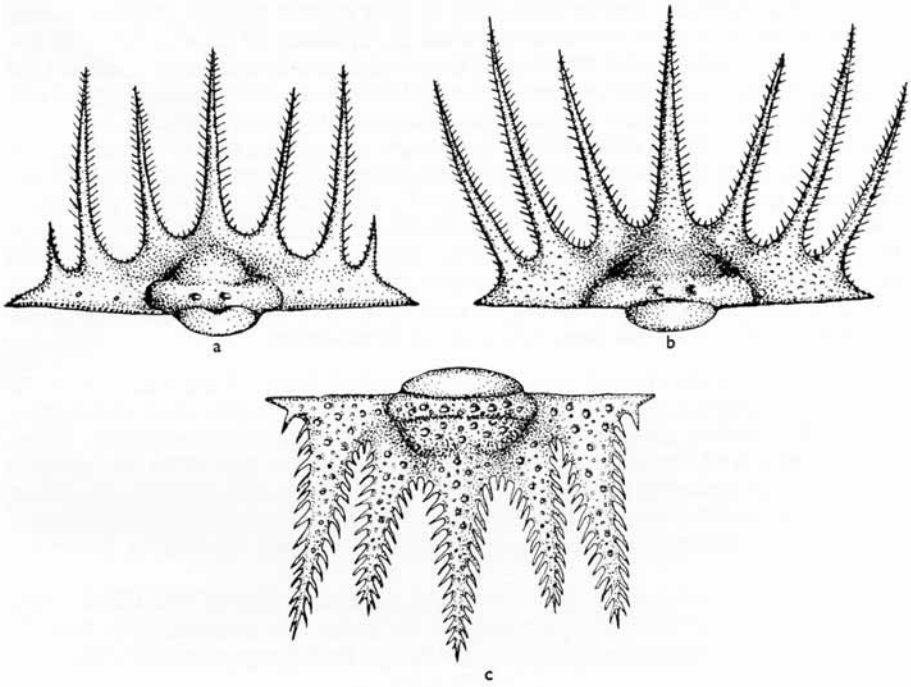
Holotype. Pygidium (ICh 3184) figures on Plate 24, fig. 8.

Type locality. Klonk near Suchomasty.

Horizon. Lower part of the Lochkov Formation (*Monograptus uniformis* Zone), early Lower Devonian.

Material. Forty cephala, 14 pygidia, some thoracic segments and one hypostome preserved in limestone.

Distinction. Carapace agrees in the main features with *C. vesiculosa* (Beyr.) the description of which was given by Bruton (1968). The differing features are as follows: median glabellar lobe is somewhat narrower and less convex (tr.), S_2 is more markedly incised, and wider than S_1, dorsal furrows are indicated by a weak but discernible depression, so that glabellar lobes do not fuse with fixed cheeks as completely as in *C. vesiculosa.*



TEXT-FIG. 6. Comparison of pygidia: *a*, *Ceratocephala verneuili* (Barrande); *b*, *Ceratocephala lochkoviana* sp. nov.; *c*, *Ceratocephala vesiculosa* (Beyr.). Dorsal views, about ×4.

In *C. lochkoviana*, granulation of cephalon varies; in addition to the specimens with close-set and prominent granulation resembling that of *C. vesiculosa* e.g. ICh 3183, ICh 3186, and ICh 3208 (Pl. 24, figs. 4, 5), there occur in the same beds specimens with substantially finer granulation where rather large granules are only sparsely disseminated e.g. ICh 3185, 3187 (Pl. 24, fig. 2). Between these two extremes, in the same layer, transitional types also exist e.g. ICh 3185 (Pl. 24, fig. 1) which furnish evidence that the variability is individual, appearing within the same species.

The pygidia of *C. lochkoviana* substantially differ from those of *C. vesiculosa*; they are distinguished by much narrower spines and finer 'barb-like' spinules, terminal axial ring distinctly separated from the median spine, and by finer granulation. The pygidium of *C. lochkoviana* in addition to median spine, also carries on both sides three spines of which the second is the longest, corresponding in breadth to the median one, the

third, outer spine, being strikingly smaller and shorter, but nevertheless longer than that in *C. vesiculosa*. Hypostome analogous to that of *C. verneuili* (Barrande), being, however, longer (sag.).

Remarks. In addition to *C. vesiculosa* (Beyr.) our species is closely related to the older *C. verneuili* (Barrande 1946) from the Kopanina Formation. The cephalons of *C. lochkoviana* differ from this species particularly in their coarser variable granulation and, in some cases, in a more prominently curved S_1. Pygidium of *C. lochkoviana* is distinguished by a fairly shorter third (outer) lateral spine and longer (sag.) terminal axial ring, flatter lateral lobes and less uniform granulation (in *C. lochkoviana*, a regular row of granules rims the anterior margin). The differences are shown in text-fig. 6.

Summarizing it can be stated that *C. lochkoviana* represents a certain connecting link between the older *C. verneuili* (Barr.) and the younger *C. vesiculosa*; this leads to the conclusion that *C. verneuili—C. lochkoviana—C. vesiculosa* form a direct phylogenic line to which the Wenlockian *C. barrandei* (Fletcher in Salter 1853)=*C. rara* (Barrande 1872) with a greater number of pygidial spines (9) may also belong. It should be noted that the differences in the individual species are more pronounced on pygidia, the cranidia, however, being very similar to each other. The finds of pygidia being not frequent, the above fact can cause difficulties in identification.

Occurrence. C. lochkoviana sp. nov. occurs in various facies of the Lochkovian, its typical representatives derive from the Radotín and Kosoř facies where they appear only rarely. However, the type locality, Klonk near Suchomasty, is an exception. There, *C. lochkoviana* is relatively abundant in the bed 95, in the upper part of the *Monograptus uniformis* Zone, occurring together with *Tropidocare index* sp. nov. Of further localities in the Lower Lochkovian, the following should be mentioned: Karlštejn-Budňanská skála, Karlík, Řeporyje, Nová Ves near Butovice, Holyně, Koukolova hora, etc. (Chlupáč 1970).

In the Upper Lochkovian, finds have been made especially in the Černá rokle gorge near Kosoř, from where no pygidium has so far been recognized, so that the specific identity, although very probable, has not yet been unequivocally proved.

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EXPLANATION OF PLATE 24

Figs. 1–8. *Ceratocephala lochkoviana* sp. nov.; Lower Lochkovian, Klonk (figs. 1–2, 4–8), Upper Lochkovian, Kosoř (fig. 3). 1, Cranidium (ICh 3185), ×3. 2, Cranidium (ICh 3187), ×3. 3, Cranidium (ICh 3207), ×2·5. 4, Cranidium (ICh 3186), ×3. 5, Cranidium (ICh 3183), ×4. 6, Hypostome (ICh 3182), ×8. 7, Pygidium (ICh 3188), ×5. 8, Pygidium, holotype (ICh 3184), ×4.

Fig. 9. *Prantlia* (*Tetinia*) *minuta* Přibyl et Vaněk 1962; pygidium (ICh 3304); Uppermost Přídolian, Holyně, ×9.

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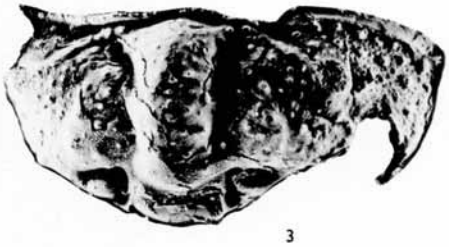

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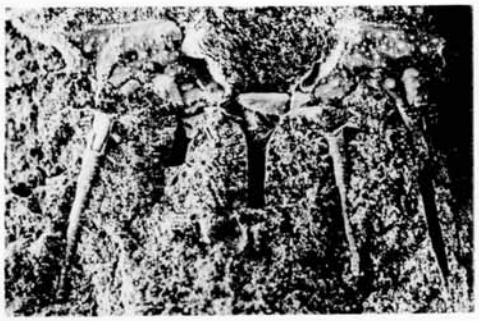

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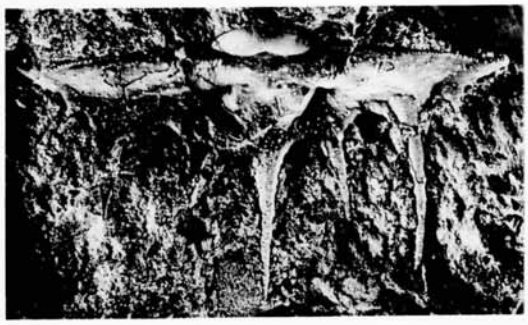

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Typescript received 18 June 1970