A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. VII 1962 Nos. 1-2

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FAMENNIAN AND LOWER CARBONIFEROUS CYRTOSYMBOLINAE (TRILOBITA) FROM THE HOLY CROSS MOUNTAINS, POLAND

Abstract. — Famennian and Lower Carboniferous trilobites of the subfamily Cyrtosymbolinae (Proetidae) from the cephalopod biofacies of the Holy Cross Mountains (Góry Świętokrzyskie) are described. Of the 51 species described, 20 are new and 26 are identified only at the generic level. The variability and ontogenetic development of the species are investigated. Suggestions on the occurrence of proetid and phacopid trilobites in correlation with the type of lithofacies are made. An attempt is made to base the stratigraphy of Famennian and Lower Carboniferous beds on the trilobites here studied.

INTRODUCTION

The present paper is a study of the trilobite subfamily Cyrtosymbolinae Hupé, 1953 (Proetidae Salter, 1864) which occurs in the Famennian and Lower Carboniferous beds of the southern part of the Holy Cross Mountains (Góry Świętokrzyskie). Very few Proetidae have so far been recorded from these beds. Gürich (1901) reported in the Famennian beds at Zaremby and Karczówka the presence of the species *Proetus michalskii* = ? *Perliproetus michalskii* (Gürich, 1901) and (in 1896, 1901) that of *Dechenella pusilla* = *Cyrtosymbole* (*Cyrtosymbole*) *pusilla* (Gürich, 1896) in sediments of the same age at Psiarnia and Zaremby. ?*Perliproetus michalskii* has not been found by the writer. Czarnocki (1928) mentions that a species which he defines as „*Waribole* ex groupae *aequalis*" occurs in Lower Carboniferous beds at Gałęzice and Zaremby. Kościelniakowska (1959) records two species of Cyrtosymbolinae from the Famennian of the northern part of the Holy Cross Mountains: *Drevermannia (Drevermannia) schmidti* R. Richter, 1913, and *D.* (*Drevermannia*) *wzdolensis* n.sp. The latter species is, however, nomen nudum. The present paper is the first to describe the assemblage of Cyrtosymbolinae from the Famennian and Lower Carboniferous of the Holy Cross Mountains. Over 2000 specimens are considered; they were collected between 1948 and 1954 by the late Polish geologist Jan Czarnocki, by Dr Z. Kielan-Jaworowska and the present writer. They come from the following

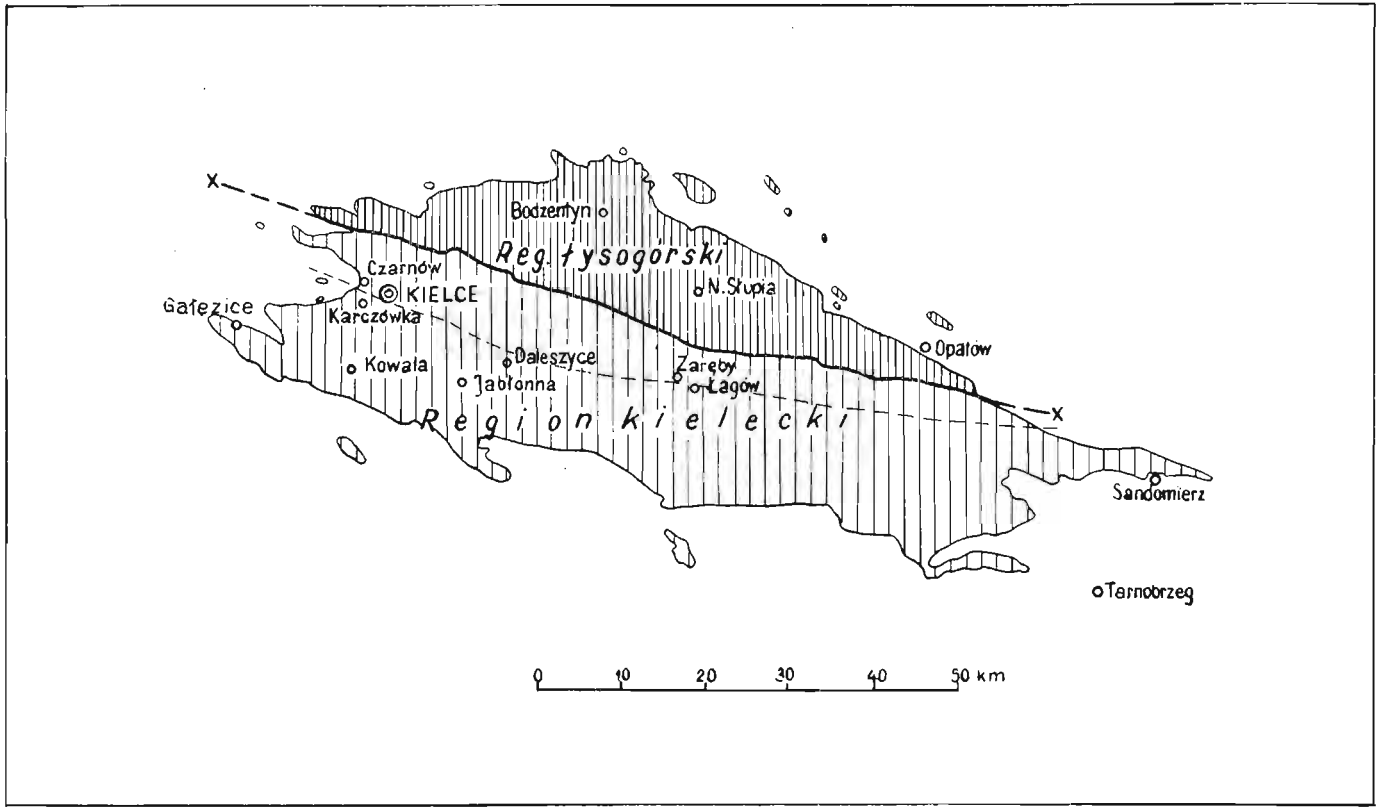


Fig. 1. — The map of Holy Cross Mountains (Góry Świętokrzyskie) facial regions. *X-X* Holy Cross dislocation, dividing Holy Cross Mountains into two regions. *Interrupted line* — maximal southern extension of Holy Cross facies (shale limestone facies) of Upper Famennian (after J. Czarnocki, 1957).

localities (fig. 1): Jabłonna — Famennian and Lower Carboniferous, collected by Kielan-Jaworowska; Gałęzice — Famennian and Lower Carboniferous, collected by Kielan-Jaworowska and the writer; Kowala — Famennian and Lower Carboniferous (ditto); Karczówka — Famennian and Lower Carboniferous, collected by Czarnocki; Czarnów — Famennian (ditto); Zaremby — Lower Carboniferous, collected by Kielan-Jaworowska and the writer; Łagów — Famennian, collected by Kielan-Jaworowska. 10 species and subspecies have been identified from the Famennian localities mentioned above, of which 7 are described as new forms. Some species, owing to inadequacy of the specimens, could only be doubtfully identified and these have been marked with successive letters of the alphabet, thus: *Cyrtosymbole* sp. *a* (comp. table 1), etc. The Lower Carboniferous trilobites described include 15 species, 13 of which are new (comp. table 1).

The writer carried out her research work at the Institute of Palaeozoology of the Polish Academy of Sciences in Warsaw between 1958 and 1961. It was preceded by studies of the Famennian Phacopidae from the same area (Osmólska, 1958). All the trilobites here described are the property of the Geological Institute and are deposited in the Museum of the Institute at 4 Rakowiecka street, Warsaw.

The writer gratefully acknowledges the help of the following persons: Dr. Z. Kielan-Jaworowska, under whose guidance the work was prepared, has given valuable suggestions, made available her collection of trilobites, and kindly translated into English a part of the Polish text. Professor Dr. R. Kozłowski's encouragement and criticism of the manuscript were very helpful. The authorities of the Geological Institute (Geological Survey) of Poland and Dr. M. Żelichowska, the curator of the Institute's Museum, kindly made available the fossil collections deposited in the Institute's Museum. Thanks are also due to British scientists: Dr. W. Dean, Dr. J. Temple, Mr. R. Tripp and Mr. A. Packard for revising the English text and for their critical remarks. In 1959/60, thanks to a grant from the Polish Academy of Sciences the writer was able to visit the Senckenberg Museum in Frankfurt/M. to make comparative studies of the Famennian and Lower Carboniferous trilobites from Poland with specimens described by R. and E. Richter from the Rhine Schiefergebirge and Thuringia. In 1961, also on a grant from the Polish Academy of Sciences, the writer visited Leningrad. At the Museum of VSEGEI in Leningrad she examined the collections of Famennian trilobites from the Ural and the Mugodzhary Hills, described by Maksimova (1955), and those of Lower Carboniferous trilobites from the Ural, the Kirghiz steppes, Kara-tau, Turkmen, the Kuznetsk and Donetz Basins, and Novaya Zemla, described by Veber (1932, 1933, 1937). Thanks are due to Dr. W. Struve of Frankfurt/M. and Dr. Z. A. Maksimova of Leningrad for making available the fossil collections in the

museums of these cities and for the courteous assistance during the writer's visit to Germany and the U.S.S.R.; to Dr. H. Żakowa of the Geological Institute, Warsaw, for the use of her unpublished paper, and to Dr. A. Urbanek of the Institute of Palaeozoology of Warsaw University, for his most helpful suggestions on the general problems of evolution. Miss M. Czarnocka kindly took the photographs, Mrs. K. Budzyńska made the drawings, and a part of the present work was translated into English by Mrs. J. Humnicka.

GENERAL PART

MATERIAL AND METHODS

The Famennian Cyrtosymbolinae described here occur in limestones as exoskeletons, which are mainly represented by undistorted detached cranidia, librigenae and pygidia. These are numerous and the collection totals over 1500 specimens. Young forms, mostly in the meraspis stage predominate, and these allow at least a description of the partial ontogeny of some species. Famennian Cyrtosymbolinae occur only exceptionally within shales of the uppermost Famennian strata at Kowala, and here they are badly preserved, being compressed, distorted and mostly without exoskeletons. The Lower Carboniferous Cyrtosymbolinae from the same area are encountered almost exclusively in argillaceous or siliceous shales. Complete specimens are rare, specimens with exoskeletons being found only in beds of the *Gattendorfia* zone at Jabłonna and Kowala. The greater part of the material, consisting of approx. 500 specimens, are internal moulds, sometimes external imprints. They provide a clue to the understanding of the outer morphology of the exoskeleton and its ornamentation. Trilobites from the shale beds also are largely distorted and compressed, with the exception of extremely small specimens, which are usually very satisfactorily preserved. Lower Carboniferous shales have yielded many young forms, which are described in the chapter on ontogeny (comp. p. 84). The few trilobite specimens obtained from the lower beds of the *Pericyclus* zone of Gałęzice have exoskeletons satisfactorily preserved in limestone lenses occurring within the shales. Needles and Burgess Vibro-Tool were used in the preparation of specimens.

TERMINOLOGY

The terminology used here is mainly that accepted in the Treatise on Invertebrate Palaeontology (1959). The symbols used for lateral lobes and furrows of the glabella are those introduced by Jaanusson (1956): *L* — lobus, *S* — sulcus. They are numbered from behind forwards. The

Table 1

Distribution of the Cyrtosymbolinae in the Famennian and Lower Carboniferous of the Holy Cross Mountains (Góry Świętokrzyskie), Poland

Species \ Locality	Jabłonna	Kowala	Gałęzice	Czarnów	Karczówka	Zaremby	Łagów	Remarks
1. *Cyrtosymbole (Cyrtosymbole) gotica* R. & E. Richter, 1926.	II*							also in the Rhine Schiefergebirge
2. *C. (C.) pusilla* (Gürich, 1896)		VI	III	III			III,IV	
3. *C. (C.) franconica primitiva* n. subsp.							III	together with *C. (C.) pusilla*
4. *C. (C.) franconica nova* n. subsp.	III?		III?					en masse at Galęzice
5. *C. (C.) franconica ?nova* n. subsp.	III?							1 librigena
6. *C. (C.)* cf. *franconica nova* n. subsp.	III?							2 pygidia
7. *C. (C.)* sp. *a.*			III					1 cranidium
8. *C. (C.)* sp. *b.*			III?					1 cranidium
9. *?Cyrtosymbole* sp. *c.*			III?					1 cranidium
10. *C. (Calybole) radiata* n. sp.	VI?							
11. *C. (Cal.) ?radiata* n. sp.	VI?							
12. *C. (Waribole) conifera* R. & E. Richter, 1926.	V?		V?		V?			en masse at Galęzice, also Rhine Schiefergebirge, Cornwall?
13. *C. (W.) abruptirhachis* R. & E. Richter, 1919.		VII						also in the Rhine Schiefergebirge
14. *C. (W.) octofera altera* n. subsp.	VI?							
15. *C. (W.) prima* n. sp.			IV?					
16. *C. (W.) secunda* n. sp.			V?					together with *C. (W.) conifera*
17. *C. (W.) granulata* n. sp.	VI?							
18. *C. (W.)* cf. *warsteinensis* R. & E. Richter, 1926.	VI?							1 damaged cranidium
19. *C. (W.)* cf. *phacomma* R. & E. Richter, 1926	VI?							1 librigena
20. *C. (W.)* sp. *a.*	VI?		VI?					
21. *C. (W.)* sp. *b.*	VI?							several young pygidia
22. *C. (Macrobole) laticampa* n. sp.	VII							together with *Diacoryphe strenuispina*
23. *C. (M.) ?laticampa* n. sp.	VII							
24. *C. (M.) brevispina* n. sp.						VIII		
25. *C. (M.)* cf. *brevispina* n. sp.						VIII		
26. *C. (M.) ?brevispina* n. sp.						VIII		
27. *C. (M.)* cf. *blax* R. & E. Richter, 1951.	VII							
28. *C. (?M.) differtigena* n. sp.					VII?			
29. *C. (Mirabole) kielanae* n. sp.					VII?			
30. *Drevermannia moravica minuta* n. subsp.	VII							together with *Diacoryphe strenuispina*
31. *Formonia convexa* n. sp.						VIII		
32. *?Formonia* sp.						VIII		
33. *Typhloproetus kozlowskii* n. sp.						VIII		
34. *Typhloproetus ?kozlowskii* n. sp.						VIII		2 librigenae
35. *?Typhloproetus angustigenalis* n. sp.						VIII		
36. *?Typhloproetus* sp.						VIII		1 librigena
37. *Diacoryphe strenuispina* n. sp.	VII							
38. *Liobolina praevia* n. sp.	VII							
39. *Liobolina apodemata* n. sp.						VIII		
40. *Liobole glabroides glabroides* R. & E. Richter, 1949.						VIII		also in the Rhine Schiefergebirge
41. *Liobole* cf. *coalescens* R. & E. Richter, 1949.						VIII		several pygidia
42. *Liobole zarembiensis* n. sp.						VIII		
43. *Liobole barilliformis* n. sp.						VIII		
44. *Liobole* sp. *a.*						VIII		several cranidia
45. *?Liobole* sp. *b.*						VIII		1 pygidium
46. *Liobole* sp. *c.*						VIII		numerous young cranidia
47. *Liobole* sp. *d.*						VIII		
48. *Trilobites* sp. *a.*						VIII		several pygidia
49. *Trilobites* sp. *b.*						VIII		1 fragment of young pygidium
50. *Trilobites* sp. *c.*						VIII		1 young pygidium

* Roman figures II to VI refer to successive Famennian zones. *Gattendorfia* zone (I) and *Pericyclus* zone (II) of the Lower Carboniferous have, for clearness, been marked with the Roman figures VII and VIII respectively.

direction in which measurements are made is indicated by abbreviations proposed by R. and E. Richter (1940): *tr.* — transversely and by Kielan (1960): *long.* — longitudinally. The occipital ring was not taken into consideration when measuring the length of glabella. The width of the glabella was measured at its base. The symbols of R. and E. Richter

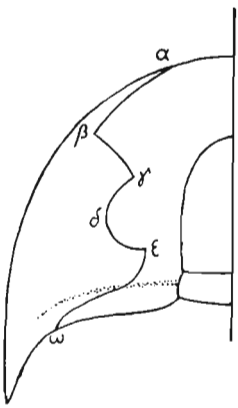


Fig. 2. — Diagram showing the course of the facial suture with turning points marked (after R. & E. Richter, 1949, p. 68).

(1949): α, β, γ, δ, ε, ω (fig. 2) are used to denote the turning points of the facial suture. The term: "larval notch" has been introduced to denote the incision in the posterior portion of the pygidial border which occurs on the pygidia of all the Famennian and Lower Carboniferous Cyrtosymbolinae, that have been examined, in early meraspis stages. The plates show most of the species described in this paper photographed from above. Text-figures are used for extremely small or badly preserved specimens, and for longitudinal and transverse profiles of the majority of forms studied. No profiles have been drawn of compressed or otherwise distorted specimens.

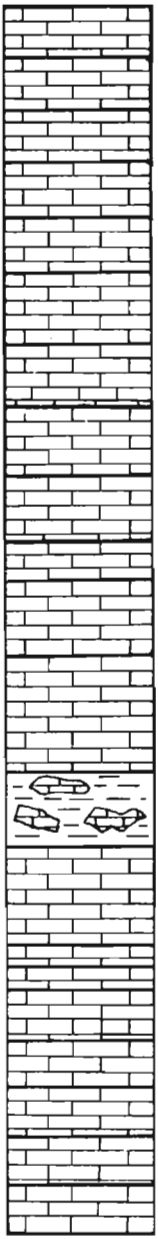
STRATIGRAPHY

No exhaustive study has ever been published on the stratigraphy of the Famennian and Lower Carboniferous beds in the Holy Cross Mountains. The work by Sobolew (1911) and by Gürich (1896, 1901) provides only a fragmentary picture and calls for fundamental revision. Czarnocki (1928, 1933, 1939, 1948, 1957) also investigated these sediments, intending to prepare a comprehensive Famennian stratigraphy, together with a description of the Famennian cephalopod fauna. His death, however, prevented its termination. Some research work on the stratigraphy of the Holy Cross Mountains has been done during the last few years by Kościelniakowska (1959) within the Famennian of that area, by Żakowa (1960, 1961, 1962) and Kwiatkowski (1959) within the Lower Carboniferous strata. Osmólska (1958) has worked out the Famennian Phacopidae of that area. It was the writer's original intention only to describe the trilobite family Proetidae from the cephalopod facies of the Famennian

and Lower Carboniferous beds of the Holy Cross Mountains. As previously pointed out by R. and E. Richter (1926, 1951), Pfeiffer (1954), and as confirmed in this paper, the Proetidae can prove very useful for stratigraphic studies. Unfortunately, however, most of the profiles have no stratigraphic description based on cephalopods, so the writer has been largely unable to give the zonation accurately, particularly where only new trilobite species were yielded. The Famennian and partly Lower Carboniferous stratigraphy given must therefore be considered as tentative and to be amended after the cephalopod fauna has been worked out in detail. This explains the interrogation marks placed in the chapter on systematics, after names of zones, which yielded trilobites. Among trilobites common both to Poland and Germany, and whose stratigraphic value is unquestionable, the only forms found here are: *Cyrtosymbole (Cyrtosymbole) gotica* R. & E. Richter, 1926, in the *Cheiloceras* zone (II) of the Famennian; *Cyrtosymbole (Waribole) conifera* R. & E. Richter, 1926, in the *Laevigites* zone (V) of the Famennian; *Cyrtosymbole (Waribole) abruptirhachis* (R. & E. Richter, 1919), in the *Gattendorfia* zone (VII) of the Lower Carboniferous; *Liobole glabroides glabroides* R. & E. Richter, 1949, in the *Pericyclus* zone (VIII) of the Lower Carboniferous.

Descriptions of outcrops

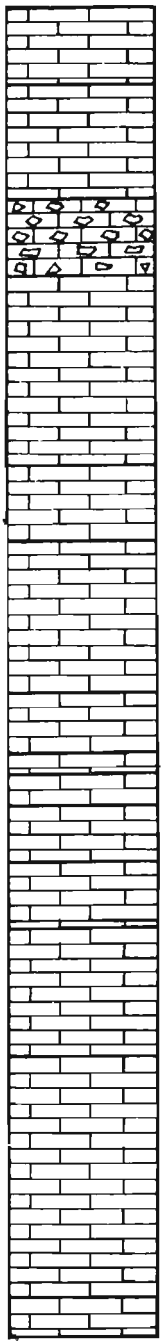
Jabłonna. The exposures yielding the material worked out in this paper were discovered by J. Czarnocki and lie within a wood on the north side of the high road from Kielce to Daleszyce, about 200 m N from the junction with the road from the village Kaczyn. J. Czarnocki told Z. Kielan-Jaworowska, in 1948, that the Famennian at Jabłonna contains all zones — from the *Cheiloceras* zone (II) to the *Wocklumeria* zone (VI). The lowermost Famennian beds here rest on the Frasnian. The Famennian is almost exclusively in the form of fine crystalline limestones of various hues of red. The uppermost beds only are sea-green or greyish in colour. The fauna is very rich in cephalopods, brachiopods, trilobites, corals; lamellibranchs and gastropods are sporadic, and exceptionally there are columnals of crinoids. Of the whole only the trilobites have been described. The *Wocklumeria* zones (VI) at Jabłonna are overlain by silicified shales of the Lower Tournaisian (*Gattendorfia* zone — VII). The material available to the writer from the Famennian excavation of Jabłonna is without trilobites in some beds (fig. 3), in which a section prepared by Czarnocki and Kielan-Jaworowska shows that they were present. These are the beds 10 to 12 and 21 to 26. The predominant species is *C. (Cyrtosymbole) gotica* R. & E. Richter, 1926, present in great numbers in bed 9. Young specimens of this species are likewise very numerous. No other trilobites



29	pale-green limestone	*Ph. granulatus* (very large specimens)
28	variegated limestone	trilobites absent
27	greenish-stained limestone	*Ph. granulatus*
26	bluish-grey limestone	trilobites indetermined
25	bluish-purple-grey limestone	
24	dark-red limestone	
23		
22	reddish-purple limestone	
21		
20		*C. (W.)* cf. *warsteinensis, Ph. granulatus, C. (W.) octofera altera, C. (W.)* cf. *phacomma, C. (Cal.) radiata, Ph. granulatus*
19		
18	red limestone	*C.(W.)octofera altera, C.(W.) granulata, C.(W.)* cf. *phacomma?, C.(W.)* cf. *warsteinensis, C.(W.)* sp. *b, C. (Cal.) radiata, C. (Cal.)? radiata, Ph. granulatus*
17	dislocation zone shales with limestone rubble	trilobites absent
16	red limestone with purple bands	
15	grey-purple limestone	
14	light-red limestone	*C. (W.) conifera*
13	grey-yellowish-purple limestone	*C. (C.)? franconica nova*
12	grey-purple limestone	trilobites indetermined *C. (C.) franconica nova* probably present
11		
10		
9	red-purple limestone	*C. (C.) gotica*

Fig. 3. — Famennian section from the excavation at Jabłonna near Borków (after J. Czarnocki). Scale 1 : 50.

have been collected from bed 9. Lamellibranchs are rather common, brachiopods are less frequent, while cephalopods occur only sporadically. In the writer's opinion, the presence in bed 9 of this trilobite species suggests that bed 9 corresponds to the *Cheiloceras* zone (II). As has already been mentioned, beds 10-12 have yielded indetermined trilobites. A few specimens of *C. (Cyrtosymbole) franconica nova* n. subsp. have, however, been found on the dumpheap, in reddish coloured limestones, which lithologically resemble bed 10. Another subspecies *C. (Cyrtosymbole) franconica exul* R. & E. Richter, 1926, is recorded from zone *Prolobites* (III) of Germany. Bed 13 has yielded one pygidium which closely resembles *C. (Cyrtosymbole) franconica nova*, but whose assignment is questionable. *C. (Waribole) conifera* R. & E. Richter, 1926, found in the next bed 14, is a species recorded from *Laevigites* zone (V) of Germany and England. It is not possible to identify *Postprolobites* zone (IV), because there is no discordance between beds 13 and 14 (the former representing perhaps still *Prolobites* zone). Hence beds 10-13 ought perhaps to be regarded together as an equivalent of *Prolobites* and *Postprolobites* zones (III and IV). Bed 14 contains, in addition to trilobites, numerous representatives of *Clymenia* in nest-like assemblages. No trilobites have been found in beds 15 and 16, while bed 17 consists of shales from the dislocation zone. Bed 18 contains a very rich trilobite assemblage, in which *Phacops granulatus* Münster, 1840, appears for the first time within this section, along with the Proetidae. The subspecies *C. (Waribole) octofera altera* n.subsp. suggests that *Wocklumeria* zone (VI) is present, in which *C. (Waribole) octofera octofera* R. & E. Richter, 1926, has been recorded in Germany. Fairly numerous *Clymenia* and two fragments of fish have also been found here. The trilobite assemblage in beds 19 and 20 resembles the one from bed 18, but is much smaller. As has already been mentioned above, beds 21-26 contain trilobites which have not been found in the material available to the writer. In bed 27 the only trilobite is *Ph. granulatus*. Bed 28 has none, while bed 29 (one of the uppermost Famennian strata) yielded a few huge specimens of *Ph. granulatus*, with cephalons almost 20 mm long (Osmólska, 1958). No trilobites have been found in any higher Famennian beds of this section. The siliceous shales, however, which rest on the Famennian and correspond in age to the Lower Tournaisian (*Gattendorfia* zone-VII), contain a rich trilobite assemblage, very different from the Famennian. Complete specimens are often encountered in it, in which the free librigenae lie apart from the cranidia, in the position occupied after moulting. This arrangement of the parts provides evidence both for the autochtonic character of the fauna and calm conditions in which sedimentation took place. The presence of the genera *Liobolina* R. & E. Richter, 1951 and *Diacoryphe* R. & E. Richter, 1951 suggests that these beds are referable to the *Gattendorfia* zone (VII) with *C. (Macrobole) laticampa* n.sp. and



14	light-brown limestones	
13	pale-green limestone	trilobites absent
12	limestone flow breccia	
11	grey-yellow limestone	*C. (W.)* sp. *a*, *Ph.granulatus*
10		
9		*C. (W.) conifera, Ph. granulatus*
8		
7		*C. (W.) conifera, C. (W.) secunda, Ph. granulatus*
6		trilobites absent
5	grey crinoidal limestone	*C. (W.) prima*
4	grey pink-stained limestone	*C. (C.) franconica nova, ?C.* sp. *c*
3	dark-grey, crinoidal pink-stained limestone	*C. (C.) franconica nova, C. (C.)* sp. *b*
2	black, bituminous limestone	*C. (C.) franconica nova*
1	light-grey limestone	*C. (C.) pusilla, C. (C.)* sp. *a*

Fig. 4. — Famennian section from the excavation at the foot of the northern side of the Ostrówka hill at Gałęzice. Scale 1 : 10.

Liobolina praevia n.sp., the predominant species in the assemblage. Some species are represented by young forms.

Gałęzice. In the western part of the village of Gałęzice the Famennian deposits are exposed, on the N side of the Ostrówka hill, about 200 m east of a hill called Todowa Grząba. Within the area of Gałęzice the Famennian persists on the northern sides of the Ostrówka and Besówka hills (Kwiatkowski, 1959) as rather fragmentary sheets of grey, sometimes pink-coloured, limestones. The Frasnian and the *Cheiloceras* zone (II) are missing, so that the *Prolobites zone* (III) rests directly on Givetian *Amphipora* limestones. The thickness of the Famennian here is greatly reduced and is slightly more than 2 m. According to Czarnocki (1928, 1948), all the *Clymenia* zones are present — from *Prolobites* zone (III) to *Wocklumeria* zone (VI); they are overlain by Tournaisian shales or by the Viséan. This is locally represented by Carboniferous limestone facies, and higher up as greywacke shales containing plant remains. The Famennian trilobites described come from the *Clymenia* beds on the Ostrówka hill. In the outcrop explored by the writer (fig. 4) it has only been possible to determine *Prolobites* (III) to *Laevigites* (V) zones with any certainty. But *Wocklumeria* zone (VI) is probably there, too. An unpublished petrographic analysis of these beds has been made at the writer's request by Mr. Rydzewski of the Geological Institute in Warsaw. It shows that beds 1-11, which petrographically constitute a homogeneous series of fossiliferous limestones of biomorphic structure and massive — mostly pell-mell — texture, contain large amounts of calcite organic remains. The matrix also contains unequally-crystalline calcite, whose crystals are often contaminated by ferro-clayey substances with a sporadic admixture of bituminous matter, whose content varies from bed to bed. Minor amounts of detritic minerals, such as quartz, chalcedony and biotite scales, are also present. The bed marked No. 12 is a bed transitional between the underlying fossiliferous limestones and the overlying fine-crystalline (sub-crypto-crystalline) limestones containing a meagre fauna. In Dr. Z. Kotański's opinion (personal communication), this bed is a flow-breccia which consists of angular fragments of fossiliferous limestone, up to a few centimetres in diameter. The fragments are cemented into fine-grained limestone, resembling that from the overlying beds 13 and 14. These are the last, unfossiliferous limestone beds within this section. Petrographically, they are made up of sub-crypto-crystalline calcite contaminated by ferro-clayey substances, with small amounts of quartz and chalcedony. Bed 14 shows a somewhat greater contamination by hydroferrous oxides.

The trilobites which are markedly few, first appear in bed 1. The species *C. (Cyrtosymbole) pusilla* (Gürich, 1896), which is not known from other sections earlier than the *Prolobites* zone (III), may possibly represent here the lower part of that zone, since higher up, in beds 2, 3

and 4 (probably also belonging to this zone) there is a mass occurrence of *C. (Cyrtosymbole) franconica nova* n. subsp. The subgenus *C. (Waribole)* represented by occasional specimens of *C. (Waribole) prima* n. sp., makes its first appearance in this profile in bed 5. In view of the fact that the oldest known species of this subgenus come from the *Postprolobites* zone (IV) and that *C. (Waribole) prima* exhibits primitive characters that bring it close to its ancestor (the subgenus *C. (Cyrtosymbole)*, it seems quite probable that bed 5 corresponds to the *Postprolobites* zone (IV). Bed 5 contains, besides trilobites, columnals of crinoids in great abundance. No trilobites have been found in bed 6, which probably belongs to the same zone as bed 5. Beds 7 to 10 are a homogeneous series in which there is a mass occurrence of the trilobite species *C. (Waribole) conifera* R. & E. Richter, 1926, an index form of the *Laevigites* zone (V). In bed 7 and in higher beds *Phacops granulatus* (Münster, 1840) and *C. (Waribole) secunda* n.sp. (the latter known only from bed 7) make their first appearance along with *C. (Waribole) conifera*. Of other faunas rather numerous *Clymenia* and a great abundance of very small gastropods should be mentioned. A few pygidia of *C. (Waribole)* sp. *a* have been collected in bed 11. This bed, together with its overlying beds 12-14, which are unfossiliferous except for some crinoid columnals, may perhaps correspond to the uppermost Famennian *Wocklumeria* zone (VI). Lenses of argillaceous coffee-coloured limestones occur in the reddish clayey argillaceous shales of Tournaisian age that rests on the Famennian (Czarnocki's outcrop east of the Ostrówka hill). The limestone lenses contain a very meagre fauna, but on the few trilobites collected, it has been possible to assign the beds to the *Pericyclus* zone (VIII). The species here present are the same as those encountered in great abundance in the *Pericyclus* zone (VIII) at Zaremby. Higher up black or variegated argillaceous and siliceous shales occur with lydites (Pawłowska, 1961).

Kowala. The excavations which have yielded the trilobites described by the writer, were made in a field of the Barwinek farm, south of the village of Kowala, about 2 km east from the Kielce-Busko railway road. The Famennian rests here on the Frasnian. The uppermost Famennian zones *Laevigites* (V) and *Wocklumeria* (VI) containing the Phacopidae: *Phacops wedekindi wedekindi* R. & E. Richter, 1926, and Proetidae: *Cyrtosymbole (Cyrtosymbole) pusilla* (Gürich, 1896), have been discovered in outcrops, excavated by J. Czarnocki and the writer, while the *Gattendorfia* zone (VII) is present in the excavation made by Z. Kielan-Jaworowska. The Famennian is here represented by reddish-coloured limestones. Only the uppermost beds are developed as marls and black bituminous shales (Czarnocki, 1933, 1939). According to the opinion of Czarnocki, which is confirmed by the present description of

trilobites, the Famennian and Carboniferous sediments at Kowala show a continuous interdigitation. The *Gattendorfia* zone (VII) which has been determined here on the presence of the trilobite species *C. (Waribole) abruptirhachis* (R. & E. Richter, 1919), occurs as pale-green marly shales.

Czarnów. Grey-yellowish marly limestones occur here on the high-road from Kielce to Karczówka. They contain the trilobite species: *Trimerocephalus caecus* (Gürich, 1896) and *C. (Cyrtosymbole) pusilla* (Gürich, 1896), fairly well represented. On these species the age of the limestone beds has been ascribed to the *Prolobites* zone (III).

Karczówka. Upper Famennian and Lower Carboniferous beds have been discovered here by J. Czarnocki in the field close to the village of Czarnów, on the highroad from Kielce to Karczówka. Since these beds were discovered on a dumpheap, it is hardly possible to determine their sequence. Several types of rocks have been distinguished on their lithology, some of which contain trilobites: 1) grey-pink or cherry-coloured limestones with *Tr. caecus* and *C. (Cyrtosymbole) pusilla,* and hence probably representing the *Prolobites* zone (III); 2) marly, white, greyish shales, with cherry-coloured stains, which yielded *Ph. wedekindi wedekindi* and *C. (Waribole) conifera* R. & E. Richter, 1926, and therefore correspond to the *Laevigites* zone (V) or the *Wocklumeria* zone (VI); 3) grey-pink, marly shale containing the trilobite *C. (Mirabole) kielanae* n.subgen., n.sp., which exhibits certain features that are typical of the Carboniferous Proetidae; 4) dark, cherry-coloured shales containing *C.(?Macrobole) differtigena* n.sp., which also displays some characters that have so far been recorded only in Carboniferous Proetidae. The Carboniferous character of the trilobites in the two last named types of rock suggests that they are the uppermost beds within this profile, already belonging to the Lower Carboniferous.

Łagów. According to Czarnocki (1928), the full sequence of the Famennian and Lower Carboniferous strata occurs in the vicinity of Łagów. The *Cheiloceras* zone (II) rests here on the Frasnian (I) and is developed as marly shales with limestone intercalations crowded with cephalopods. Higher up occurs the *Prolobites* zone (III) similarly developed. Great numbers of trilobite exoskeletons have been found in these beds, belonging to *Tr. caecus* (Gürich, 1896) and, somewhat higher up, to *C. (Cyrtosymbole) pusilla* (Gürich, 1896) and *C. (Cyrtosymbole) franconica primitiva* n.subsp. The *Postprolobites* zone (IV) is represented by black shales intercalated with bituminous limestones, which also yield *C. (Cyrtosymbole) pusilla.* The higher Famennian zones: *Laevigites* (V) and *Wocklumeria* (VI) are developed mainly as bituminous shales. The contact of the *Wocklumeria* zone (VI) with the *Gattendorfia* zone (VII) has not as yet been traced.

Zaremby near Łagów. Two trilobite localities have been discovered at Zaremby by J. Czarnocki, one of them in the exposure excavated by Z. Kielan-Jaworowska in a field of the Dziarmaga farm, about 8-10 m south from a small pond. The greenish, siliceous shales there (the Zaremby beds, according to Żakowa, 1962) correspond to the *Pericyclus* zone (VIII); they have yielded the species: *Liobole glabroides glabroides* R. & E. Richter, 1949 — an index form of that zone. The other trilobite locality at Zaremby occurs in a well of the Dziarmaga farm within chocolate-coloured marly shales, containing extremely small fossils. Trilobites characteristic of the *Pericyclus* zone (VIII) also occur here. In the opinion of Żakowa (1962) the Zaremby beds correspond in age to the Upper Tournaisian, while the higher beds in the well correspond to the Lower Viséan. Within the two Lower Carboniferous localities at Zaremby the trilobites have been preserved without exoskeleton. The external imprints are readily destroyed, so that the available specimens are represented only by internal moulds. Some of the species in the Zaremby beds are also represented by rather numerous young stages (probably the meraspis stage). Most of the large specimens are distorted. The beds here are very interesting palaeontologically, as they contain a trilobite assemblage rich both numerically and specifically (5 genera and 9 species). Two other facts are noteworthy: 1) the maximum development within these beds of the genus *Liobole* R. & E. Richter, 1949, which is represented by the greatest number of species and individuals; 2) the side by side presence of the genus *Liobole* and *Liobolina* R. & E. Richter, 1951, in beds of the same age. It has been demonstrated by R. and E. Richter (1951) that the para-chronological division of the Lower Carboniferous based on trilobites, coincides with that based on cephalopods (comp. table 2). The presence at Zaremby of the genus *Liobolina* within beds of the Upper Tournaisian (the *Pericyclus* zone[1]), and also of a few specimens in the well within the Lower Viséan beds (*Pericyclus* zone[1]), considerably extends the range of the stratigraphic distribution of the genus *Liobolina*. However, if account is taken of the particular character of the species *L. apodemata* n.sp. present here, which is very close to the genus *Liobole*, and probably also to a form intermediate between these genera, R. and E. Richter's (1951) division of the Lower Carboniferous, based on trilobites, may be accepted as essentially correct. It is, however, quite possible that relict species occur within beds younger than those, in which this genus attained its maximum development. A remarkably interesting assemblage of trilobites also occur in the beds from the Zaremby well. It consists almost exclusively of young individuals, which have pointed

[1] Upper Tournaisian beds are in systematic parts named as „lower beds of *Pericyclus* zone (VIII)", and Lower Viséan beds as „upper beds of *Pericyclus* zone (VIII)".

Table 2

Stratigraphic chart of the Famennian and Lower Carboniferous zones
(after Schindewolf, Schmidt, Wedekind, Richter)

Age	Stage		Zone	Division based on cephalopods	Division based on trilobites
Lower Carboniferous	Viséan	Upper	III (IX)	*Goniatites* (=*Glyphioceras*)	*Phillibole*
		Middle	II(VIII)	*Pericyclus*	*Liobole*
		Lower			
	Tournaisian	Upper			
		Lower	I(VII)*	*Gattendorfia*	*Liobolina*
Upper Devonian	Famennian	Upper	VI	*Wocklumeria*	*Calybole Waribole*
			V	*Laevigites*	
			IV	*Postprolobites*	
			III	*Prolobites*	*Cyrtosymbole* s. str.
		Lower	II	*Cheiloceras*	
	Frasnian		I	*Manticoceras*	

*For the sake of clarity and to distinguish from the Famennian zones — the Lower Carboniferous zones — the latter: *Gattendorfia* (I), *Pericyclus* (II), *Goniatites* (III), are marked with the Roman figures VII, VIII, IX.

anterior margins of the cranidia, and pygidia with marked larval notch (p. 84 — *Ontogeny*). On some specimens the librigenae occurs quite close to the cranidium, probably dropped there during moulting. Hence they may probably represent autochtonic specimens which had been laid down on undisturbed sea floor. The relatively few adult specimens, mostly of the genus *Liobole (L. zarembiensis* and other unidentified forms), as well as some *Liobolina (L. apodemata)* and *Cyrtosymbole (Macrobole)*, are all extremely small. The remaining fossils, largely brachiopods and ostracods, also seem to be exceptionally small. As far as the trilobite fauna is concerned, it is certainly less differentiated than that occurring in the Zaremby beds.

Comparison of the Famennian sections from Jabłonna and Gałęzice

The distance between the villages of Jabłonna and Gałęzice (Ostrówka hill), where the most complete Famennian sections have been found, is about 25 km. The two sections differ distinctly in lithology,

thickness of beds and faunal assemblages. As mentioned above, the Jabłonna section is more complete since it includes beds of the *Cheiloceras* zone (II), which are absent from Gałęzice, as well as the *Wocklumeria* zone (VI), which has been faunistically determined, but which does not seem, with certainty, to be present in the writer's exposure on the Ostrówka hill at Gałęzice. The *Wocklumeria* zone (VI) at Jabłonna is strongly developed, compared with other zones of this section, and those of the Gałęzice section. It is approx. 5 m thick, i.e. it equals the total thickness of all the other lower zones, whereas the thickness of the *Clymenia* beds of Gałęzice (beds 1-14) is only slightly more than 2 m. The Famennian section of Jabłonna consists of fine-crystalline limestones, nearly all of which are of a strong pink to reddish-purple colour, while the Gałęzice section is made up of grey, occasionally pink, fossiliferous limestones. In petrography the sea-green limestones of the uppermost beds of the Famennian section at Jabłonna (bed 29) somewhat resemble bed 13 at Gałęzice, which does not yield any trilobites. This is not, however, a sufficient argument for making direct correlation between these beds. As has been mentioned on p. 60, zone IV could not be identified within the Jabłonna section on the evidence of trilobites, since beds with *C. (Waribole) conifera* overlie those with *C. (Cyrtosymbole) franconica nova*. In contrast, the Gałęzice beds which yield these trilobites, are separated by beds in which two primitive species: *C. (Waribole) prima* n.sp. (bed 5) and *C. (Waribole) secunda* n.sp. (bed 7) occur one after the other. In the writer's opinion, these trilobites probably indicate zone IV and the lower portion of zone V. It is also noteworthy that *C. (Cyrtosymbole) franconica nova*, which occurs en masse at Gałęzice, is represented by very few specimens at Jabłonna. *C. (Waribole) conifera*, which is very frequent in both sections, occurs at Jabłonna in a clymenid assemblage, while at Gałęzice it is associated with crinoids, extremely numerous small gastropods, and somewhat rarer *Clymenia*. Within the same bed at Gałęzice the presence of *Phacops granulatus* has also been noted; it appears higher up at Jabłonna in beds with *C. (Waribole) octofera altera* and in other younger beds, probably corresponding to zone VI. These conspicuous differences in the extent and development of the two sections may be explained by the geographic position of the Jabłonna locality. It lies farther east than Gałęzice, hence it is nearer to the supposed area of denudation (map of the facial distribution of the Famennian in Poland — see Pajchlowa, 1959, 5/9). The red colouration of the Jabłonna limestones indicates extensive laterization and considerable transport of ferrous substances from the continent. The colour is observable almost from the beginning of the Famennian at Jabłonna, but appears much later at Kowala, which

is situated between Jabłonna and Gałęzice (J. Czarnocki, personal communication to Z. Kielan).

Correlation of the Gattendorfia zone trilobite beds in the Kielce region

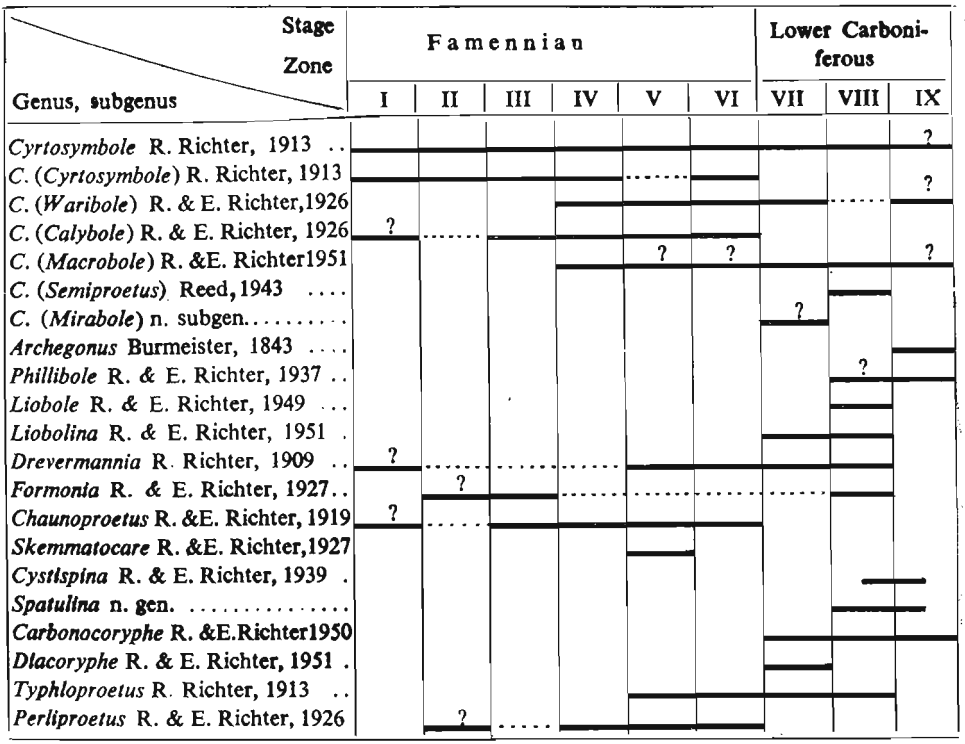
Since fossil remains are rather scarce in the Kielce region and on the whole are unsatisfactorily preserved, the rich assemblages of the trilobite subfamily Cyrtosymbolinae, which occur here, should prove very useful for stratigraphic investigations. In the course of studies on the trilobite fauna of the Lower Carboniferous age, the writer has noted that within the Lower Tournaisian (*Gattendorfia* zone-VII), which has been determined on the basis of trilobites, none of the forms from Kowala, Jabłonna and Karczówka occur in more than one locality. This may be explained either 1) by supposing that the particular contemporaneous trilobite assemblages occupied different ecological niches, or 2) that the particular trilobite assemblages occurred at different periods of time. The first does not seem very likely, since, in view of the small distances between the sites, it is difficult to imagine that not even single representatives of assemblage *A* had ever migrated into the ecological niche occupied by assemblage *B*. Moreover, conspecific specimens have indeed been collected from the Upper Tournaisian beds of both Gałęzice and Zaremby near Łagów, which lie at the opposite ends of the region here under consideration. At Gałęzice they occur in limestone lenses among argillaceous clayey shales, and at Zaremby in siliceous shales; therefore, it is highly probable that they had lived under somewhat different environmental conditions. The second supposition seems more plausible. It might reasonably be accepted that within the *Gattendorfia* zone (VII) the environmental conditions changed rapidly and, together with these, changed also the associated trilobite assemblages. The monotonous trilobite assemblage from Kowala *(C. (Waribole) abruptirhachis)*, phylogenetically closely approaching Famennian forms, is the oldest assemblage out of those described here.

STRATIGRAPHIC DISTRIBUTION AND GEOGRAPHIC RANGE OF THE SUBFAMILY CYRTOSYMBOLINAE HUPÉ, 1953

As shown in tables 3 and 4, the genus *Cyrtosymbole* (sensu lato) R. Richter, 1913, has the widest stratigraphic distribution within that subfamily. Its first appearance is recorded from the Frasnian (Teichert, 1943, 1949) and it occurs throughout the Famennian and Lower Carboniferous from nearly the whole of Europe, i.e. from Great Britain in the west to the eastern side of the Ural, and in Asia (in the Kazakh and Kirghiz Republics of the USSR), and also in Australia (Teichert, *l.c.*).

Table 3

Stratigraphic distribution of genera and subgenera of Proetidae within the cephalopod facies of the Famennian and the Lower Carboniferous*



*Partly after R. & E. Richter (1926, 1951)

The subgeneric forms of this genus: *Cyrtosymbole* (s. str.), *Waribole*, *Calybole*, *Macrobole*, *Semiproetus* — have a somewhat narrower stratigraphic distribution. The first named of these subgenera occurs chiefly within the Lower Famennian zones II and III (comp. table 4), but only two species: *C. (Cyrtosymbole) pusilla* (Gürich) and *C. (Cyrtosymbole) neptis* Chlupač occur in zone IV, while *C. (Cyrtosymbole) pusilla* is also found in zone VI. This subgenus is recorded from the south of France, where it is represented by only one species. It is more numerous in the Rhine Schiefergebirge (Dill Mulde), in eastern Thuringia, in Czechoslovakia, the Holy Cross Mountains, and on the western slopes of the Ural. Representatives of *Cyrtosymbole* s.str. are lacking in England and the northern Mugodzhary Hills, where the lower beds of the Famennian contain trilobites of the family Phacopidae Hawle & Corda, 1847. Their absence may probably be explained by the occurrence in this area of shale facies, which very rarely yield any Proetidae (comp. p. 80). The

Table 4

Specification of Famennian and Lower Carboniferous Proetidae described so far from the cephalopod facies

Genus, subgenus, species	Zone	Geographic distribution	Remarks
1	2	3	4
Cyrtosymbole (Cyrtosymbole) R. Richter, 1913	II—IV, VI	Eu, Au	*Cyrtosymbole* sp. cited from zone I in Australia
escoti (Koenen, 1886)	II	F	
gotica R. & E. Richter, 1926	II	R,S	
dillensis (Drevermann, 1901)	II	R	
crebra Perna, 1915	II	U	
gümbeli (R. Richter, 1913)	II	T	
incerta Perna, 1915	II	U	
fluctuosa Maksimova, 1955	II	U	
planilimbata R. & E. Richter, 1919	II	T	
nana R. Richter, 1913	III?	C	
franconica franconica R. & E. Richter, 1926	III?	T	
franconica exul R. & E. Richter, 1926	III	R	
franconica primitiva n. subsp.	III	S	
franconica nova n. subsp.	III?	S	
pusilla (Gürich, 1896)	III, IV, VI	S	The two only species of this subgenus that pass into zone IV
neptis, Chlupač, 1961	IV	C	
Cyrtosymbole (Calybole) R. & E. Richter, 1926	III—VI	Eu, Az	
calymmene R. Richter, 1913	III?, IV	R	
wildungensis R. Richter, 1912	G, VI	R, T	
antedistans R. & E. Richter, 1926	V, VI	R, T, M	
denckmanni R. & E. Richter, 1926	I?	R	
ussheri (Thomas, 1909)	G	B	
pantherina Maksimova, 1955	V	M	
radiata n. sp.	VI?	S	
gracilis R. & E. Richter, 1955	III	T	The two unquestionable species of this subgenus from zone III.
lenis Chlupač, 1961	III	C	

Legend:

A — Carnic Alps
Au — Australia
Az — Asia
B — Great Britain
C — Czechoslovakia
Eu — Europe
F — France
G — undivided Famennian zones V and VI
Kg — Kirghiz Republic (USSR)
M — Mugodzhary Hills
Nz — Novaya Zemla
R — Rhine Schiefergebirge
S — Holy Cross Mountains (Góry Świętokrzyskie)
Sp — Spain
Su — Sudeten Mountains
T — Thuringia
U — Ural Mountains

Table 4 (*continued*)

1	2	3	4
Cyrtosymbole (Waribole) R. & E. Richter, 1926	IV—IX?	Eu, Az	
warsteinensis R. & E. Richter, 1926	VI	R, Su, M?, S?, B?	
avita R. & E. Richter, 1919	G, IV	T, R, Su, M	
glacensis R. Richter, 1913	VI	Su	
buelensis R. & E. Richter, 1926	IV	R	
italica (Gortani, 1907)	G?	A, B?	
? dunhevedensis (Thomas, 1909)	V	B	
conifera R. & E. Richter, 1926	V, G	R, Su, S, B?	
octofera octofera R. & E. Richter, 1926	VI	R	
octofera altera n. subsp.	VI?	S	
phacomma R. & E. Richter, 1926	IV?, G?	R, S?	
eulenspigelia R. & E. Richter, 1926	V?, G	R	
wagneri Pfeiffer, 1954	IV	T	
prima n. sp.	IV?	S	
secunda n. sp.	V?	S	
granulata n. sp.	VI?	S	
abruptirhachis (R. & E. Richter, 1919)	VII	R, T	
porteri Goldring, 1955	VII	B	
baiburensis Veber, 1937	VII	Kg	
granifera Chlupač, 1961	VII?	C	
calamistrata Chlupač, 1961	V?	C	
?laevicauda (Sarres, 1857)	IX	R	
Cyrtosymbole (Macrobole) R. & E. Richter, 1951.	IV—IX?	Eu	
drewerensis R. & E. Richter, 1951	VII	R, T, B	The writer agrees with Selwood (1960) that *(M.) drewerensis longisuta* Richter & Richter is without taxonomic value and it fits into the variation range of *M. (M.) drewerensis.*
blax R. & E. Richter, 1951	VII	R, B?	
duodecimae R. & E. Richter, 1951	VII	T, B	
hercules R. & E. Richter, 1951	VII	R, B	
mulesi Goldring, 1955	VII	B	
vigilax Chlupač, 1961	VII	C	
oriens Chlupač, 1961	IV	C	
laticampa n. sp.	VII	S	
brevispina n. sp.	VIII	S	

Table 4 *(continued)*

1	2	3	4
? differtigena n. sp.	VII?	S	
? anglica (R. Richter, 1913)	G?, VII?	B, T, Su	
? bergica R. Richter, 1913	V	R, T?, B?	
? ogivalis R. & E. Richter, 1951	VII	R	
? culmica (R. & E. Richter, 1937)	IX	R	This species, referred by its authors to *Phillibole* seems to be closer to the subgenus *C. (Macrobole)* (see p.75).
Cyrtosymbole (Mirabole) n. subgen.	VII?	Eu	
kielanae n. sp.	VII?	S	
Cyrtosymbole (Semiproetus) Reed, 1943	VIII?	Eu	
twistonensis (Reed, 1943)	VIII?	B	
Archegonus Burmeister, 1843	IX	Eu	
aequalis (Meyer, 1831)	IX	R, Su	
Liobolina R. & E. Richter, 1951	VII, VIII	Eu	
nebulosa R. & E. Richter, 1951	VII	R, T	
submonstrans R. & E. Richter, 1951	VII	R, T	
praevia n. sp.	VII	S	
apodemata n. sp.	VIII	S	
Liobole R. & E. Richter, 1949	VIII	Eu, Az	
glabra glabra (Holzapfel, 1889)	VIII	R, C, B	
glabra hiemalis R. & E. Richter, 1949	VIII	R	
coalescens R. & E. Richter, 1949	VIII	R, S?	
trimeroides (Holzapfel, 1889)	VIII	R	
glabroides glabroides R. & E. Richter, 1949	VIII	R, S	
glabroides weberi (Přibyl, 1950)	VIII	U, Nz	
subaequalis (Holzapfel, 1889)	VIII	R	
castori (Barrois, 1879)	VIII	Sp	
testans Chlupač, 1961	VIII	C	
zarembiensis n. sp	VIII	S	
barilliformis n. sp	VIII	S	
polleni (Woodward, 1902)	VIII?	B	
Phillibole R. & E. Richter, 1937	IX	Eu	
aprathensis aprathensis R. & E. Richter, 1937	IX	R	
aprathensis moravica Přibyl, 1950	IX	C	
?nitida (Holzapfel, 1889)	VIII	R	This species differs distinctly from the other representatives of the genus in shape of glabella.
opatovicensis Přibyl, 1950	IX	C	

Table 4 (*continued*)

1	2	3	4
coddonensis (Woodward, 1902)	IX	B	
Drevermannia R. Richter, 1909	V—VIII	Eu, Au?, Az	sensu stricto; *Drevermannia* n. sp. cited from zone I in Australia.
schmidti R. Richter, 1913	V	F, R, T?, S S	
ninae Maksimova, 1955	V	M	
richteri Pfeiffer, 1959	VI	T	
pruvosti R. & E. Richter, 1939	VIII	Sp	
moravica moravica Chlupač, 1956	VIII	C	
moravica minuta n. subsp.	VII	S	
asperula Chlupač, 1961	V	C	
Formonia R. & E. Richter, 1927	II—VIII	Eu	Comp. p. 90
formosa (R. Richter, 1913)	II?	R	
globigenata (R. Richter, 1913)	II?	R	
scheldana Matern, 1927	III	R	
convexa n. sp	VIII	S	
Chaunoproetus R. & E. Richter, 1919	I?, III—VI	Eu, Az, Au.	*Chaunoproetus* cf. *palensis* cited from zone I in Australia.
palensis (R. Richter, 1913)	III, V, VI	R, T, Su, A, M, Au?	Cephalon determined as *Carnicia carnica* belongs to this species (Pfeiffer, 1954).
?eurycraspedon (R. Richter, 1913)	III?, IV	R	
?malvifrux R. & E. Richter, 1926	IV	R	
tietzei (R. & E. Richter, 1919)	V	R, T, Su, M	See Maksimova, 1955, p. 51.
kasakhstanicus Maksimova, 1955	V	M	
?plenus Maksimova, 1955	V	M	
?vinassai (Gortani, 1907)	?	A	According to R. Richter's pl. 23, fig. 3 (1913) this species is very close to *Ch. palensis*, and can not be included to genus *Cyrtosymbole*.
Skemmatocare R. & E. Richter, 1927	G	Eu	
elegans (Münster, 1842)	V, G	R, T, A	
Cystispina R. & E. Richter, 1939	VIII/IX	Eu	
cystispina R. & E. Richter, 1939	VIII/IX	R	

Table 4 (*continued*)

1	2	3	4
Spatulina n. gen	VIII-IX	Eu	see p.180.
spatulata (Woodward, 1902)	VIII/IX	B	
nasifrons (R. & E. Richter, 1939)	VIII	R	
Carbonocoryphe R. & E. Richter, 1950	VII, IX	Eu,	
bindemanni R. & E. Richter, 1950	IX	R	
emanueli R. & E. Richter, 1950	IX	R	
?ferruginea R. & E. Richter, 1950	IX	R	
egregia Chlupač, 1961	VII	C	
?subulifera (Veber, 1937)	IX?	U	(=*Typhloproetus (?) subuliferus;* Veber, 1937, pl. II, fig. 36: non pl. II[4] fig. 35).
Diacoryphe R. & E. Richter, 1951	VII	Eu	
pfeifferi R. & E. Richter, 1951	VII	T	
gloriola R. & E. Richter, 1951	VII	R	
strenuispina n. sp..	VII	S	
Typhloproetus R. Richter, 1913	V-VIII	Eu, Az	
microdiscus R. Richter, 1913	G	A	
pusillus (Münster, 1840)	G	T	
schindewolfi R. & E. Richter, 1919	V, G	Su, R?, M?	
ebersdorfensis (R. Richter, 1913)	V, G	Su, M	
costifusus R. & E. Richter, 1926	V	R, T	
oblongus (R. & E. Richter, 1919)	V	T	
kijensis Maksimova, 1955	V	M	
carintiacus (Drevermann, 1901)	V, VI?	A, M, R?	
subcarintiacus R. Richter, 1913	V, VI	F, R, T, Su, M	
gortanii (R. Richter, 1913)	V, VI	A, R?, Su?	
hemisphaericus Pfeiffer, 1959	VI	T	
saalfeldensis Pfeiffer, 1954	VI	T	
dietzi R. & E. Richter, 1951	VII	T	
kozlowskii n. sp.	VIII	S	
?angustigenalis n. sp.	VIII	S	
Perliproetus R. & E. Richter, 1926	III-VI	Eu, Az, Au	*Perliproetus* n. sp. cited from zone III in Australia.
marginatus (Münster, 1842)	VI	R, T, Su	
gradatus R. & Richter, 1926	VI	R	
catharinae Maksimova, 1955	III, V	U, M	
?münsteri (Reinh. Richter, 1869)	II?	T	
?michalskii (Gürich, 1901)	V?, VI?	S	

strong specific differentiation of this subgenus is borne out by an almost complete lack of overlap of species from one geographic area to another. *C. (Cyrtosymbole) gotica* R. & E. Richter, reported both from Dill Mulde and from the Holy Cross Mountains, is an exception.

The subgenus *Calybole* R. & E. Richter has not so far been reported in large numbers. It is known mostly from the upper beds of the

Famennian; few species have been recorded from zones III and IV, even from the Frasnian, but this stratigraphic assignment seems questionable (R. & E. Richter, 1926, p. 43). *Calybole* occurs mainly in the Rhine Schiefergebirge, e.g. at Dill Mulde and Kellerwald, in eastern Thuringia. Single species are known from Devon in England, from Moravia in Czechoslovakia, and from the Holy Cross Mountains in Poland. Very few species of this subgenus are known from the northern Mugodzhary Hills. Single species sometimes occur contemporaneously in a number regions. *C. (Calybole) antedistans* R. & E. Richter, described from the Rhine Schiefergebirge, Thuringia, and the northern Mugodzhary Hills, has the widest geographic distribution.

Among subgenera of *Cyrtosymbole s.lato, Waribole* R. & E. Richter, 1926, is the most numerous and specifically best developed. It is encountered in the Upper Famennian zones (IV-VI), higher up it passes into the Lower Carboniferous (zones VII and ?IX), but the assignment to this subgenus of the species *C. (Waribole) laevicauda* (Sarres), which occurs in zone IX, seems questionable. Several species of *Waribole* have been described from the Famennian and Lower Carboniferous deposits of England (Devon and Cornwall). Relatively numerous species are known from the Famennian and Carboniferous strata of the Rhine Schiefergebirge. In Thuringia the subgenus *Waribole* is rather rare. Several, exclusively Famennian species, are recorded from the Sudeten, while in the Holy Cross Mountains it is fairly abundant both in the Famennian and the Lower Carboniferous. A few species occur in the Famennian of the Carnic Alps, the northern Mugodzhary Hills and Czechoslovakia (Moravia), and also in the Lower Carboniferous of Moravia and the Kirghiz Republic (USSR). Certain other species of the subgenus have a very wide geographic distribution, ranging from England to the Mugodzhary Hills.

The subgenus *Macrobole* R. & E. Richter, 1951, is known chiefly from deposits of the lowermost Carboniferous — zone VII; only a few species have been recorded from the Famennian zone IV, and one from Carboniferous zone VIII. *C. (?Macrobole) culmica* (R. & E. Richter) from zone IX, which has up to now been referred to *Phillibole* R. & E. Richter, 1937, seems closer to the subgenus *Macrobole*. Hence, it is possible that, after its maximum development in the lowermost zone of the Lower Carboniferous, *Macrobole* persisted until the Upper Viséan. On the data at present available, the distribution of this subgenus seems to be confined to Western and Central Europe. Very probably it contains species of polyphyletic origin (comp. p. 99).

The genus *Liobolina* R. & E. Richter, 1951, which is chiefly yielded by zone VII, but is also sporadically encountered in younger deposits

of zone VIII, has not so far been found outside these areas. Four species are only included to this subgenus.

Its descendant, the genus *Liobole* R. & E. Richter, 1949, not encountered outside zone VIII, is more numerous (11 species) and more widely distributed. It has been described from England, the Rhine Schiefergebirge, Spain, Czechoslovakia, central Poland (Holy Cross Mountains and Kraków region), the Ural and Novaya Zemla (USSR). It has very few species overlapping in the different areas in which it is found. Therefore, it is interesting to note that one of them, *Liobole glabroides* R. & E. Richter, occurs over a wide area stretching from the Rhine Schiefergebirge to the Ural and Novaya Zemla *(L. glabroides glabroides* R. & E. Richter, 1949, and *L. glabroides weberi* (Přibyl, 1960)). In comparing the geographic distribution of *Liobolina* and *Liobole* it may reasonably be concluded that the rise and distribution of this line of Cyrtosymbolinae occurred within the Rhine Schiefergebirge. It might be stressed here that, up to now, *Liobole* is the only species of Cyrtosymbolinae, encountered both within the cephalopod facies and the coral-brachiopod facies (Carboniferous limestone facies). For example, *Liobole raclawicensis* (Jarosz, 1909) described from the vicinity of Kraków, and *L. glabroides weberi* (Přibyl) from the Urals and Novaya Zemla have been collected side by side with representatives of the family Phillipsidae Oehlert, which are known to occur exclusively within the Carboniferous limestone facies.

Phillibole R. & E. Richter, 1937, is the youngest genus of Cyrtosymbolinae and its occurrence is almost wholly confined to zone IX. Zone VIII has yielded the species *Ph. nitida* (Holzapfel), but its assignment to *Phillibole* seems somewhat uncertain. This genus apparently embraces species of various phylogeny and needs to be fundamentally revised. The species that have been assigned to it, are so far known only from Western and Central Europe.

Drevermannia (sensu stricto) R. Richter, 1909, contains only a few species which occur in the Upper Famennian zones V and VI, as well as in the Lower Carboniferous zones VII and VIII. In the Famennian this genus is known from France, the Rhine Schiefergebirge, Moravia, Thuringia, the Holy Cross Mountains and the northern Mugodzhary Hills; in the Lower Carboniferous from Spain (Minorca), the Rhine Schiefergebirge (*Drevermannia* sp. *e* R. & E. Richter, 1939), Czechoslovakia (Moravia) and the Holy Cross Mountains. In Australia this genus has been found in Frasnian deposits (Teichert, 1943, 1949).

So far the genus *Formonia* R. & E. Richter, 1927, contains only 4 species, three of which are known only from Famennian zones II and III, at Sessacker in Dill Mulde. *F. convexa* n.sp. the only Lower Carboniferous species of this genus described, comes from zone VIII of the

Holy Cross Mountains. In view of its very close affinities with the Famennian *F. globigenata* (R. Richter) these two forms, in spite of the great time interval that separates them, are undoubtedly congeneric.

The Upper Famennian genus *Chaunoproetus* R. & E. Richter, 1919, has a very wide geographic distribution, since it occurs in the Rhine Schiefergebirge, Thuringia, the Sudeten Mountains, the Carnic Alps and the northern Mugodzhary Hills, as well as in Australia (from zone III). It has not been reported from England or the Holy Cross Mountains. The species *Ch. palensis* (R. Richter) and *Ch. tiezei* R. & E. Richter have the widest geographic distribution since they occur in practically all of the areas just mentioned.

Typhloproetus R. Richter, 1913, is a genus with numerous species, which occurs mainly in Upper Famennian strata. One species only of this genus has so far been found in zone VII of the Lower Carboniferous of Thuringia, and one in zone VIII of the same age in the Holy Cross Mountains. *Typhloproetus* is widely distributed within the Upper Famennian; it is found in the Rhine Schiefergebirge, the Carnic Alps, France, Thuringia, the Sudeten and the northern Mugodzhary Hills. It has not so far been recorded from England or the Holy Cross Mountains. Some of its species have a particularly wide distribution.

Diacoryphe R. & E. Richter, 1951, a Lower Carboniferous genus (zone VII), contains very few species whose occurrence is confined to small geographic areas of Western and Central Europe.

Carbonocoryphe R. & E. Richter, 1950, is likewise a rare genus, which occurs in zones VIII and IX of the Lower Carboniferous of the Rhine Schiefergebirge and Czechoslovakia.

Genera consisting of less than 3 species have not been considered here (comp. table 4).

To sum up, it may be concluded that the subgenus *C. (Waribole)* has the greatest development of all forms of Cyrtosymbolinae; it contains 21 species and has the widest stratigraphic range (from zone IV to IX). Of these 21 species only two, i.e. 10 per cent, range through Western Europe to the eastern boundaries of Europe. An equally wide geographic distribution has also been noted in 4 species of the genus *Typhloproetus*, representing 28 per cent of the 14 known species of this genus. Conditions are similar within the genus *Chaunoproetus*. Of the 7 species described, two, i.e. also 28 per cent, are very widely distributed. It is especially noteworthy that both *Typhloproetus* and *Chaunoproetus*, which contain the greatest number of widely distributed species, are both blind genera. Adequate data concerning the trilobite fauna within such geographic areas as North Africa, Australia and the greater part of Asia, where the cephalopod facies is known, are unfortunately lacking. Therefore, the faunal comparison made above gives only a sketchy idea

of the stratigraphic range and geographic distribution of Famennian and Lower Carboniferous Cyrtosymbolinae. It merely suggests that: 1) very few genera of this family — *C. (Waribole), C. (Macrobole), Drevermannia, Formonia* and *Typhloproetus* — pass from the Famennian to the Lower Carboniferous. Those genera which did pass from the Famennian to the Lower Carboniferous must have possessed the ability to adapt themselves to changes in environmental conditions, favouring the blind forms. With the exception of the subgenus *C. (Waribole)* which had normal eyes, and that of *C. (Macrobole)* whose eyes were slightly reduced, all the remaining genera — *Drevermannia, Typhloproetus* and *Formonia* — passing from the Famennian into the Carboniferous, are blind forms; 2) not a single species has so far been found, common to both stages, and this confirms the earlier observations of R. and E. Richter (1951); 3) the older genera of this subfamily, i.e. *Cyrtosymbole* s.stricto and *Formonia*, display greater ability for differentiation. This is expressed by the almost complete lack of species common to more than one geographic area, even among those not distant from one another; 4) species with a wide distribution are not common within the group, in contrast to species of the associated cephalopod fauna.

FACIAL CONDITIONS WITHIN THE FAMENNIAN AND LOWER CARBONIFEROUS OF THE HOLY CROSS MOUNTAINS

The Holy Cross Mountains can be differentiated as far back as the Cambrian into two distinct palaeogeographic areas whose boundary roughly coincides with the general line of the Holy Cross dislocation (Czarnocki, 1957). They are the geosynclinal Łysogóry region with a tendency to subsidence and the intrageanticlinal Kielce region with the opposite tendency to uprising (fig. 1). Until the Famennian this boundary at the same time separated two different facial regions. The boundary between facial regions become shifted farther south of the dislocation line at the time of the Famennian. Thus two distinct facial areas become distinguishable within the palaeogeographic Kielce region which also constitute two tectonic units with axes running WNW—ESE. They are the Kielce—Łagów synclinorium, facially belonging to the Łysogóry region, and the Gałęzice—Daleszyce syncline. Within the Łysogóry region Famennian deposits were laid down in a deep-sea zone and they developed as clay-marly shales and limestones. These sediments have not as yet been sufficiently investigated. A similar facial development is encountered in deposits of the Kielce—Łagów synclinorium where a 100 m thick marly-clay series, intercalated by limestones, has been found extending from the *Cheiloceras* zone (II) to the *Wocklumeria* zone (VI). The fauna here is poor, chiefly consisting of the blind pha-

copid trilobites. The Proetidae are rather rare. The stratigraphic equivalent of these deposits, which have probably been formed within a deeper-sea zone, is a several metres thick *Clymenia* limestone series, formed on submarine rises (Pajchlowa, 1959) within the Gałęzice—Daleszyce syncline. Organisms occurred in great profusion, the faunal assemblage consisting chiefly of cephalopods, trilobites (mostly the Proetidae), crinoids, lamellibranchs, gastropods, brachiopods, corals from the Tetracoralla group, and fishes. Local stratigraphic gaps have been noted in this part of the Holy Cross Mountains. Within the Kielce region the Lower Carboniferous rests, usually concordantly, on the Famennian. The Tournaisian, both in the Kielce—Łagów synclinorium and the Gałęzice—Daleszyce syncline, is developed in the shale facies of the geosynclinal zone. Nevertheless, the presence of limestone intercalations in shales (Czarnocki, 1928; Bojkowski, 1960) in the Upper Tournaisian of the Gałęzice—Daleszyce syncline, indicates that the sea became shallower by successive steps. A further shallowing of the sea occurs during the Viséan and the limestones containing a coral-brachiopod fauna (Carboniferous limestone facies) are deposited at Gałęzice (Czarnocki, 1928; Kwiatkowski, 1959). Sediments of the shale facies continue to be laid down within the Kielce—Łagów synclinorium (Czarnocki, 1928; Żakowa, 1960, 1962; Żakowa & Pawłowska, 1961). Trilobites of the subfamily Cyrtosymbolinae predominate within the Tournaisian shale rocks of the Kielce region, where other fossils are scarce. During the Upper Viséan in this region a littoral facies of shale-greywackes develops which contains plant detritus. Upper Carboniferous deposits have not yet been recorded from the Holy Cross Mountains.

Both within Europe and outside it, cephalopods provide the basis for the stratigraphic division of a certain type of sediment. This cephalopod facies corresponds essentially to an open sea deposit. Another type of biofacies also occurs during the Tournaisian and the Viséan. This is the coral-brachiopod biofacies, representing a shallow-water type of deposit (shelf sea). The two biofacies just mentioned pass from the Famennian into the Dinantian where two lithofacies, not fully coincident with them, have been distinguished. They are the Culm and Carboniferous limestone lithofacies. The former consists of goniatite-bearing, shale deep-sea deposits, as well as of littoral sandy-greywacke rocks, where goniatites occur sporadically, while littoral organisms, i.e. lamellibranchs and brachiopods are abundant. On the other hand, the two biofacies mentioned above occasionally occur (Żakowa, 1958) within the same zone, as e.g. in the vicinity of Wałbrzych (Lower Silesia). Thus the term "Culm" is not accurate and always needs to be supplemented by a definition of the biofacies which represents the given deposits.

DEPENDENCE OF TRILOBITE FAUNAS ON FACIAL DEVELOPMENT

In her study of Famennian Phacopidae (Osmólska, 1958) from the southern belt of the Holy Cross Mountains, the writer had an opportunity of observing that the blind phacopid genera: *Trimerocephalus* McCoy, 1849, *Dianops* R. & E. Richter, 1923, *Ductina* R. & E. Richter, 1931, are almost the only fossils present within the Kielce syncline. The syncline occupies a NE situation in the Kielce region and its Famennian deposits are developed as clay-marly shales, containing thin limestone intercalations. While this trilobite assemblage sporadically yield a few Proetidae, there are exclusively normal-eyed Proetidae from the subgenera *C. (Cyrtosymbole)* R. Richter, 1913, *C. (Waribole)* R. & E. Richter, 1926, *C. (Calybole)* R. & E. Richter, 1926, found in the Gałęzice-Daleszyce syncline which occupies the SW part of the Kielce region. The Famennian strata here are developed as limestones, bearing a rich fauna of cephalopods and trilobites. Only two phacopid species of *Phacops* Emmrich, 1839, with well developed eyes, were found within the uppermost zones of the Famennian.

Łagów is the easternmost known trilobite locality in the Famennian of the southern belt of the Holy Cross Mountains, and may be regarded as a link between the NE and the SW portions. Deposits displaying mixed lithological features and containing a mixed trilobite fauna are present there. Zone III consists of limestones. Low down these are characterized by a mass occurrence of blind phacopid trilobites from the genus *Trimerocephalus*, while Proetidae of the subgenus *C. (Cyrtosymbole)*, with normal eyes, abound higher up. The subgenus *C. (Cyrtosymbole)* has also been found in zone IV, which consists of shale-limestone series with limestone intercalations. It is fairly numerous, but does not form large concentrations.

A site with mixed trilobite fauna has also been discovered in outcrops between Czarnów and Herby. There, in the marly-limestone zone III, single specimens of blind Phacopidae of the genus *Trimerocephalus* have been found in association with numerous Proetidae from the subgenus *C. (Cyrtosymbole)*. Higher up, in zone IV among black bituminous limestones, only blind Phacopidae from the genus *Dianops* have been found. These localities, containing a mixed trilobite fauna, are very sporadic within the Kielce syncline and are quite likely associated with some particularly restricted local conditions. The exclusive presence of blind Phacopidae mentioned above is typical for this region.

The facts observed here, provide conclusive evidence that the presence of eyes in Famennian trilobites depends on the facies in which they occur, i.e. the corresponding ecological conditions. The *Clymenia*

Correlation between the facial development and the reduction of eyes of the Famennian Phacopidae and Proetidae from Poland and U.S.S.R.

Region / Stage	Gałęzice Daleszyce Syncline	Kielce Syncline: Łagów		W Ural Mts.: Riauziak-River Region	W Ural Mts.: Ai-River Region	E Ural Mts.	N Mugodzhary Hills: Kos-Istek Region	N Mugodzhary Hills: Novosybirsk Region
VI	Waribole ○ Calybole ○ Phacops ○	?	?	?	?	?	?	?
V	Waribole ○ Phacops ○	?	?	Trimerocephalus ● Dianops ●	Trimerocephalus ● Dianops ●	Dianops ●	E: Dianops ● Drevermannia ● W: Waribole ○ Calybole ○ Typhloproetus ● Phacops ○ Dianops ● Chaunoproetus ●	?
IV	Waribole ○	Cyrtosymbole s. str. ○	Dianops ●	Phacops ○ Cryphops ◑	Phacops ○ Cryphops ◑	Phacops ○ Trimerocephalus ● Dianops ● Perliproetus ○ Chaunoproetus ●	Dianops ●	Trimerocephalus ● Phacops ○
III	Cyrtosymbole s. str. ○	Cyrtosymbole s. str. ○	Trimerocephalus ●			Dienstina ◑ Nephranops ◑		
II	Cyrtosymbole s. str. ○	Trimerocephalus ●	Trimerocephalus ●	Cyrtosymbole s. str. ○ Phacops ○	Trimerocephalus ● Dienstina ◑	Cyrtosymbole s. str. ○ Dienstina ◑ Nephranops ◑	Trimerocephalus ● Ductina ●	Trimerocephalus ● Ductina ●

Limestones; Clay limestones; Clay shales; ○ Normal eyes; ◑ Eyes partly reduced; ● No eyes

limestones in the Gałęzice-Daleszyce syncline, which contain normal-eyed Proetidae, suggest the presence in the Famennian of submarine rises (Pajchlowa, 1959). On these rises the fauna was always rich, characteristic of well illuminated open-sea waters. Within deeper waters surrounding the rises, where there is less light penetrating to the sea floor, thick series of clay-marly pelagic sediments were laid down, carrying an extremely meagre fauna, chiefly of blind Phacopidae.

It should also be emphasized that within the southern belt of the Holy Cross Mountains, the blind genera of Proetidae, such as: *Drevermannia, Chaunoproetus, Typhloproetus,* are absent from both the types of Famennian sediments, which have been mentioned above. They occur, however, in countries east and west of Poland. Most probably this is not a question of random occurrence, but may be associated with the prevailing environmental conditions. A correct definition of these conditions, solely on the basis of the trilobites, without taking other fossils into consideration, is hardly possible.

A relationship resembling that in the Holy Cross Mountains has been observed among the Famennian trilobites from the Ural and the northern Mugodzhary Hills described by Maksimova (1955), though it is not so clearly indicated (comp. table 5). A mixed trilobite fauna is here encountered within calcareous rocks (chiefly clay limestones) including both Phacopidae and Proetidae. The assemblage is characterized by the predominance (in number of specimens and genera) of forms, which have either slightly reduced (*Dienstina, Cryphops, Nephranops, Calybole (?)*), or normally developed eyes (*Phacops, Waribole, Cyrtosymbole* s.str., *Perliproetus),* over completely blind forms (*Trimerocephalus, Dianops, Typhloproetus, Chaunoproetus).* On the other hand, only blind Phacopidae (*Ductina, Trimerocephalus, Dianops)* and one blind species of Proetidae (*Drevermannia ninae* Maks.) have been found in the argillaceous deposits of the northern Mugodzhary Hills.

In a chapter dealing with the causes responsible for the reduction of eyes in Famennian trilobites, Maksimova (1955) stresses the evidence for the rather shallow, littoral character of deposits, which yielded her trilobites. For example, she quotes the presence in these deposits of land plant remains or of fossils of animal groups, that lived in well lighted waters. Maksimova considered that these facts indicate that reduction of the eyes is to be associated not with sea-depth, but with a form of life buried in mud on the sea bottom. In Maksimova's opinion, other causes may also lead to eye reduction.

Richter's (1913, 1956) speculations on the two causes of eye reduction, ascribe more probability to the hypothesis that life on the muddy bottom could be the decisive factor.

Within the southern belt of the Holy Cross Mountains limestones

were deposited in the shallow-water zone and argillaceous-marly shales in the deep-water zone. It is therefore hardly possible to determine, whether inadequately lighted sea bottom or life in a mud layer was the decisive factor in the formation of the meagre faunal assemblage, in which eyeless trilobites predominated. Observations on the Famennian sections from the Holy Cross Mountains and from the U.S.S.R. suggest two clear alternatives. Either the Proetidae were at that period a more „exacting" group as regards the conditions of environment, or (and this seems more probable) they were unable to compete with such trilobite forms as the Phacopidae, which were better adapted to the prevailing conditions of life. While the Phacopidae are encountered in limestone, as well as in entirely clay deposits, only one species of the Proetidae has been found in the Famennian strata of that type of rock. These relations were subject to radical changes during the Lower Carboniferous. At that stage, probably owing to the extinction of the Phacopidae, the Proetacea became very common both in Lower Carboniferous limestones and in argillaceous or siliceous shales of that age.

REMARKS ON THE RELATION BETWEEN VARIABILITY AND EXTINCTION OF LATE PALAEOZOIC PROETACEA SALTER, 1864

As some authors claim (Gheyselinck, 1937; Erben, 1958), with the late Palaeozoic Proetacea the question of symptoms of approaching extinction in this superfamily arises. Increase in spinosity and reduction of eyes are characters suggested by Erben (1958) among these symptoms. The present writer believes that a total increase in variability and intergrading of specific differences within a single assemblage should also be included. E. g. in the Lower Carboniferous beds of Zaremby a number of new species of Cyrtosymbolinae has been recorded. There is also a large number of specimens, which cannot be regarded as belonging to any species known from the bed, and sometimes even a generic attribution is very difficult. This is especially true of forms resembling the genera *Liobole* and *Typhloproetus*.

Gheyselinck (1937), when describing Permo-Carboniferous trilobites from the island of Timor, has noticed a variability of the described forms so great that, according to his opinion: „each specimen... could easily be considered as a representative of a new genus". He has regarded this phenomenon as "phylogerontic degeneration". R. and E. Richter (1951, p. 227) did not follow his opinion, considering that the variability recorded is a normal intraspecific variation, and only the lack of sufficient material could have led the author to an incorrect

interpretation. The present author partly agrees with that opinion. Nevertheless, so great a variability is a phenomenon often occurring in the critical moments of evolution. Thus it can, in some cases, precede the extinction of the group.

As has been shown by Simpson (1944, 1955), the great variability occurring in some lines before their extinction has nothing to do with the so-called "senile variability", but is connected with the fact, that when adequate environment tends to disappear, there may occur an increase in variability which is of an exploratory character. If the new, free environment is accessible for some line, there may occur a new radiation and development of a new group, or alternatively an extinction may take place.

This phenomenon may well be illustrated by the history of the Proetidae. The subfamily Cyrtosymbolinae has in Famennian times occupied the environment of the limestone cephalopod facies, and it appears that this could be the reason for the gradual restriction of the environmental range of the contemporaneous Phacopidae. The majority of the species of Cyrtosymbolinae are known from the latest cephalopod zones (V and VI). The change of environmental conditions in the realms of cephalopod facies, between the Famennian and Carboniferous, was connected with a sudden crisis in the evolution of the cyrtosymbolid line. Some representatives of this line, i.e. *Waribole, Macrobole, Typhloproetus* and perhaps *Perliproetus,* succeeded in penetrating into the new environment, representing a shelly cephalopod facies, and originated a new radiation. When in the Lower Carboniferous times this new environment again tended to disappear, there appeared a new exploration of this line into new adaptive zones. This last attempt was, however, not entirely successful, due to the fact that the only accessible environment, representing the Carboniferous limestone lithofacies, was already occupied by the other, may be, better adapted trilobite line — the Phillipsiidae. The presence in the Viséan, together with the Phillipsiidae, of a *Liobole,* which seems to have the greatest adaptability within the Cyrtosymbolinae, suggests that such exploratory attempts have been made.

REDUCTION OF EYES AND EXTINCTION OF THE PROETIDAE

Erben (1958), when analysing the changes in the course of the facial suture in the Proetidae (sensu R. & E. Richter and Struve, 1959), with regard to the reduction of the eyes, tried to connect this phenomenon with the extinction of trilobites in the Famennian and Lower Carboniferous. According to him, the reduction of the eyes was not the only

reason for extinction, but rather became a case of overspecialization and a symptom of a typolithic phase in proetid evolution. This seems, however, to be in contradiction to the fact that though in the Lower Carboniferous zones VII and VIII the number of blind trilobite genera increases considerably, in zone IX — i.e. just before the extinction of the group — the number of blind trilobite genera decreases. In fact the blind trilobite species (representatives of *Spatulina* and *Cystispina)* are not known from beds higher than the boundary of zones VIII and IX. In addition, new genera appear in zone IX, which show only slight specific differentiation, but are represented by a great number of specimens, all provided with eyes.

Genera with eyes	Genera mostly blind
VII zone	
C. (Waribole)	*Liobolina*
C. (Macrobole)	*Diacoryphe*
C. (Semiproetus)	*Typhloproetus*
C. (Mirabole)	*Drevermannia*
VIII zone	
Liobole	*Liobolina*
Carbonocoryphe	*Formonia*
C. (Macrobole)	*Drevermannia*
	Cystispina
	Spatulina
	Typhloproetus
IX zone	
Phillibole	*Spatulina*
Archegonus	*Cystispina*
Carbonocoryphe	
C. (Macrobole)?	
C. (Waribole)?	

GENERAL REMARKS ON THE ONTOGENY, MORPHOLOGY AND SYSTEMATICS OF THE CYRTOSYMBOLINAE HUPÉ

Ontogeny

Famennian and Lower Carboniferous trilobites investigated here have allowed the author to study some changes in the morphology of the exoskeleton during ontogenetic development. The observations were carried out on small (from 0.8 mm long) cranidia, librigenae and pygidia, originating from the moults and presumably representing meraspis and holaspis stages.

Young stages of the following species were investigated:

Cyrtosymbole (Cyrtosymbole) gotica R. & E. Richter, 1926 — Famennian (pl. II, fig. 1,2; text-pl. II, fig. 1-5),

C. (Cyrtosymbole) pusilla (Gürich, 1896) — Famennian (pl. I, fig. 1,4; text-pl. I, fig. 4-7),

C. (Cyrtosymbole) franconica nova n.subsp. — Famennian (pl. V, fig. 3,5),

C. (*Waribole*) *conifera* R. & E. Richter, 1926 — Famennian (pl. VIII, fig. 2, 4, 5, 7),

C. (Waribole) octofera altera n.subsp. — Famennian (pl. IX, fig. 1-3),

C. (Waribole) abruptirhachis (R. & E. Richter, 1919) — Carboniferous (text-pl. VII, fig. 1, 2, 4, 5),

C. (Macrobole) laticampa n.sp. — Carboniferous (pl. XI, fig. 1, 2),

C. (Macrobole) brevispina n.sp. — Carboniferous (pl. XIII, fig. 3-5),

?Formonia sp. — Carboniferous (pl. XVII, fig. 6-8),

Liobolina apodemata n.sp. — Carboniferous (pl. XV, fig. 10, 11),

Liobole zarembiensis n.sp. — Carboniferous (pl. XV, fig. 5-7),

Liobole sp. *c* — Carboniferous (pl. XV, fig. 3).

In cases where the given bed yielded only one trilobite species (as e.g. *Cyrtosymbole (Waribole) conifera)* there was no difficulty in making a specific attribution of the young forms revealed in the same bed. In cases where some species of the same genus occurred in one bed, the author took into consideration those morphological characters which appear sufficiently early on the exoskeleton, e.g. the diseppearance of the pleural and interpleural furrows on the pygidia in *Cyrtosymbole (Waribole) octofera altera*. The author is, however, aware that such cases present possibility of an error. The lack of entire exoskeletons did not allow the determination of the particular meraspis stages of the specimens studied, nor whether they are in the meraspis or early holaspis stage. In two cases only: *C. (Cyrtosymbole) gotica* and *C. (Cyrtosymbole) franconica nova* two fragments of the earliest meraspis stages were found, but they were rather too badly preserved to be properly studied (text-pl. II, fig. 1; text-pl. III, fig. 6).

The young stages of all the trilobites of the subgenera: *C. (Cyrtosymbole), C. (Waribole)* and *C. (Macrobole)* are characterized by a number of common features indicating their close relationship and permitting their attribution to the same genus. These features are: 1) the presence of a very wide (long.) preglabellar field, length of which diminishes during growth relative to the cranidial length; 2) the shape of the anterior margin of the cranidium, which in the young forms is strongly pointed and gradually becomes rounded during ontogeny. The presence of the pointed cranidium in the young forms is not connected here with the fusion of the anterior branches of the facial sutures at

the anterior cranidial margin — as is characteristic e.g. of the Asaphidae; 3) turning points α in young cranidia are situated close to each other, the distance between them increases during growth.

In ontogenetic development the shape of the glabella also changes, for in young forms it is narrow and long, often contracted half way along its length, and is vaulted transversely. In young forms the axial furrows and the posterior glabellar furrows (S_1) are deep, the latter reaching the occipital furrow. The occipital ring is wide (long.) and very convex in the middle part, tapering distally. The palpebral lobes, in spite of their shape and position in adult forms, are usually fairly wide in young individuals and are situated opposite midlength of the glabella, the turning points ε and γ are always situated far outward from the glabella.

Common features can similarly be observed in young pygidia. On two specimens in the meraspis stage (degree 0; text-pl. II, fig. 1; text-pl. III, fig. 6) the pygidia are surrounded by a very wide, flat and horizontal border, the remaining part of the pygidium being strongly vaulted, situated higher than the border. The posterior part of the border is incised, so that in the prolongation of the axis it is narrower (long.) than at the sides (tr.). During growth the border loses the character of a velum, becoming more convex (even in species where in adult forms the border is entirely obsolete); it is also situated lower than the remaining part of the pygidium. The larval notch gradually disappears. In older specimens the pleural region of the pygidium becomes more uniformly vaulted, and less distinctly separated from the border; the latter change occurs at first in the anterior part and subsequently in the posterior part of the pygidium. Larval notches seem to occur only in the transitory pygidia, with three to one first segments, distinctly delimited by interpleural furrows from the rest of the pygidium. In one specimen of *C. (Waribole) conifera* (pl. VIII, fig. 7) it was observed that the notch is already absent, the first segment being delimited from the rest of the pygidium by the interpleural furrow.

R. and E. Richter (1926) described the new species *Cyrtosymbole nepia* on one pygidium, supposing that this is a pygidium of a young representative of *C. (Waribole)*. Maksimova (1955) described a similar pygidium as *C. (Calybole?) nepia* R. & E. Richter. The forms in question are not conspecific, as the axis in the German pygidium is distinctly longer. The present author, who has at her disposal a number of larval pygidia, is of the opinion that R .and E. Richter were right in regarding the pygidium described by them as a larval form. The pygidia described by R. and E. Richter and by Maksimova are both larval forms and there is insufficient basis for erecting *Cyrtosymbole nepia*. Pygidia described by Maksimova, found together with the adult forms of *Cyrto-*

symbole (Calybole), may in fact belong to this subgenus, whereas those described by R. and E. Richter should rather be recorded as belonging to *C. (Waribole),* as they were always found with the adult representatives of this subgenus. In the Famennian zone VI of Jabłonna, yielding representatives of *C. (Calybole)* and *C. (Waribole),* young pygidia of both types were found. As *C. (Calybole)* was represented by one species only — *C. (Calybole) radiata* — pygidium similar to those described by Maksimova is regarded by the present author as belonging to this species. *C. (Waribole),* on the other hand, is represented by several species, but only one of them — *C. (Waribole) octofera altera* n.subsp. — displays features characteristic of some small pygidia. The remaining young pygidia, not recorded within this species, were described as *C. (Waribole)* sp. *b.*

With regard to the young pygidia with the larval notch here described, one should mention that similar small pygidia were noticed in other trilobite groups. E.g. Whittard (1961) described *Spirantyx calvarina* n.gen., n.sp. (Hapalopleuridae, Harrington & Leanza, 1957) on cranidia, and *Spirantyx* cf. *calvarina* on pygidia, found together with them, but adds: "..these possess an ogygid appearance but a median invagination of the posterior margin is a distinctive feature which suggests that they do not belong to that group of trilobites" (Whittard, 1961, p. 193, pl. 25, fig. 13). As the pygidia described by Whittard were small and provided with the larval notch on the posterior margin, characteristic of the young Cyrtosymbolinae, the present writer is of an opinion that they represent the young forms of *Spirantyx calvarina.* As the larval notch described above occurs in different trilobite lines, it cannot be treated as a feature of phylogenetic significance. It is more probable that it is connected with changes in the soft parts of the organism. The same seems to concern the characteristic point on the anterior cranidial margin. Both characters seem to be correlated, perhaps they fitted into each other when the young trilobite rolled up.

As mentioned above, young cranidia of the Carboniferous trilobites *Liobolina apodemata* n.sp. and *Liobole zarembiensis* n.sp. were also found. Young pygidia found in the same beds are similar to those of the genus *Cyrtosymbole* and most probably belong to *C. (Macroboie) brevispina* n. sp., yielded by the same beds. Young pygidia of *Liobolina apodemata* and *Liobole zarembiensis* are not known. On the smallest cranidium of *L.apodemata* (1.6 mm long; pl XV, fig. 10) the anterior cranidial margin is not pointed. The glabella, similarly to those of young *Cyrtosymbole,* is long, narrow, finger-shaped. Posterior lateral furrows (S_1), obsolete in adult specimens, are here fairly distinct. A characteristic feature, absent in adult *Cyrtosymbole,* is the presence

of a faint eye ridge, running obliquely through wide (tr.) fixigenae. Palpebral lobes are missing in young, as well as in adult forms. In the smallest cranidium of *L. zarembiensis* (1.9 mm long) the anterior cranidial margin is pointed, though not so distinctly as is characteristic of young *Cyrtosymbole* (pl. XV, fig. 5). Palpebral lobes, fairly distinct in adult specimens, are here very small, enlarging during growth. Also the course of the axial furrows changes during growth, as in the smallest cranidia they slightly diverge posteriorly, and become straight in adult forms. Also young forms are provided with the eye ridge, similar to the one in *L. apodemata*. The eye ridge also occurs in numerous small cranidia, identified here as *Liobolina* sp. c (pl XV, fig. 3), appearing in the younger beds of the same section. The eye ridge characteristic of *Liobolina*, connected with a rudimentary palpebral lobe, is similar to that of *Palpebralia* R. & E. Richter, 1927, known from Frasnian beds (*Manticoceras* zone — I).

Ornamentation

The exoskeleton is smooth, not ornamented, in some of the known Famennian and Lower Carboniferous trilobites of the Cyrtosymbolinae Hupé, namely: all Famennian species of *Typhloproetus* R. Richter, 1913, and the Lower Carboniferous line *Liobolina* R. & E. Richter, 1951, *Liobole* R. & E. Richter, 1949 and *Phillibole* R. & E. Richter, 1937. Otherwise the majority of species within the Cyrtosymbolinae have the exoskeleton distinctly ornamented and the ornamentation is more prominent on the cephalon than on the pygidium. Granulation is the most common type of ornamentation; tubercles may be spherical — as is characteristic of *C. (Cyrtosymbole) gotica* R. & E. Richter (pl. II, fig. 5), or cone-like — *C. (Cyrtosymbole) pusilla* (Gürich), (pl. I, fig. 7). Sometimes the tubercles are scale-like, flattened, directed posteriorly — *C. (Waribole)* cf. *warsteinensis* R. & E. Richter (pl. IX, fig. 8) and *C. (Waribole) conifera* R. & E. Richter (pl. VIII, fig. 8). Two other types of ornamentation were developed by fusion of neighbouring tubercles: reticulate, where the connected tubercles form prominent lines, surrounding irregular fields (e.g. *Cyrtosymbole (Cyrtosymbole) franconica nova* n.subsp.; pl. V, fig. 2), and papillar — where the fused tubercles are arranged as concentric lines, similar to the papillar lines on the finger-top (e.g. *C. (Waribole) conifera;* pl. VIII, fig. 1).

The subgenus *C. (Cyrtosymbole)* R. & E. Richter, 1926, has all the above types of ornamentation , no representative being smooth. The papillar ornamentation is so far known only in specimens from the Ural: *C. (Cyrtosymbole) crebra* Perna, 1915, and *C. (Cyrtosymbole) fluctuosa* Maksimova, 1955, while granulation is the most common type of ornamentation.

The subgenus *C. (Calybole)* R. & E. Richter, 1926, is characterized by reticulate ornamentation. Some species seem to be smooth, but it is possible that the ornamentation was not noticed on account of the extremely small size of the specimens.

Within the subgenus *C. (Waribole)* reticulate ornamentation was never recorded. The most common here is the scale-like ornamentation with sparse tubercles. Exceptions are the Lower Carboniferous species: *C. (Waribole) abruptirhachis* (R. & E. Richter), *C. (Waribole) porteri* Goldring, and *C. (Waribole) granifera* Chlupač, with dense granulation. The papillar or obsoleting ornamentation was also met within this subgenus. With regard to *C. (Macrobole)* R. & E. Richter, 1951, all species recorded here are characterized by a dense, fine granulation.

Two Carboniferous representatives of *Typhloproetus,* described up to now, are, by contrast with all Famennian forms, richly granulated.

The present author has noticed that within some species, described in this paper, the ornamentation may be different in different parts of the exoskeleton, e.g. the cranidium of *C. (Cyrtosymbole) franconica primitiva* n.subsp. has reticulate ornamentation, and the librigenae in some specimens are granulated, the tubercles being partly fused together. The same concerns the pygidia which are usually granulated in this subspecies (pl. IV, fig. 3), however one specimen has the axis and border reticulate. A similar phenomenon was observed in *C. (Cyrtosymbole) gotica,* where pygidium and cranidium are distinctly granulated, and about 50 per cent of the librigenae found have the reticulate ornamentation (pl. II, fig. 4).

Some representatives of Cyrtosymbolinae show other elements of ornamentation, besides those above mentioned. E.g. the ridge running through the librigena from the anterior part of the eye towards the border furrow, in *C. (Cyrtosymbole) pusilla* (pl. I, fig. 2) seems to the present author to be not merely an ornamental character, but a reflection of the internal structure of the animal. This may also be true of a pair of tubercles occupying the places of fossulae on the cephala of some cyrtosymbolid species, e.g. *C. (Cyrtosymbole) franconica primitiva* (pl. IV, fig. 1).

Systematic position of the Famennian and Lower Carboniferous Proetidae from the cephalopod biofacies

The Famennian and Lower Carboniferous proetid genera, known from the cephalopod biofacies (table 3), have been attributed by various authors to different systematic units. The account given below (table 6) is a review of the modern systematics of the group mentioned above.

Table 6

Modern trends in the classification of Famennian and Lower Carboniferous Proetidae Salter, 1864

R. & E. RICHTER (1933, 1951)	P. HUPÉ (1953)
Family **Proetidae** (Corda, 1847) Salter, 1864	Superfamily **Proetoidae** Hupé, 1953
Subfamily **Proetinae** (Corda, 1847) Salter, 1864	Family **Cyrtosymbolidae** Hupé, 1953
Cyrtosymbole (sensu lato) R. Richter, 1913	Subfamily **Cyrtosymbolinae** Hupé, 1953
Typhloproetus R. Richter, 1913	*Cyrtosymbole* (sensu lato) R. Richter, 1913
Chaunoproetus R. & E. Richter, 1919	*Cystispina* R. & E. Richter, 1939
Carnicia R. & E. Richter, 1927[1]	*Typhloproetus* R. Richter, 1913
Skemmatopyge R. & E. Richter, 1919[2]	*Phillibole* (s. lato) R. & E. Richter, 1937
Skemmatocare R. & E. Richter, 1927	*Carnicia* R. & E. Richter, 1927[1]
Drevermannia R. Richter, 1913 (sensu lato)	*Formosia(?)* R. & E. Richter, 1927[5]
Perliproetus R. & E. Richter, 1926	*Drevermannia* (s. stricto) R. Richter, 1913
Liobolina R. & E. Richter, 1951	Family **Proetidae** Hawle & Corda, 1847, Hupé, 1953
Liobole R. & E. Richter, 1949	Subfamily **Proetinae** Hawle & Corda, 1847, Hupé, 1953
Phillibole R. & E. Richter, 1937	*Perliproetus* R. & E. Richter, 1926
Cystispina R. & E. Richter, 1939	*Skemmatopyge(?)* R. & E. Richter, 1919[2]
Subfamily **Tropidocoryphinae** Přibyl, 1946	Family **Tropidocoryphidae** Přibyl, 1945
Carbonocoryphe R. & E. Richter, 1950	Subfamily **Tropidocoryphinae** Přibyl, 1945
Diacoryphe R. & E. Richter, 1951	*Carbonocoryphe* R. & E. Richter, 1950

The whole systematics of the Proetidae sensu lato has not been considered. The systematics used in the present paper is that of R. & E. Richter and W. Struve (1959). That seems to be the most useful, as it includes only the Famennian and Lower Carboniferous forms, connected with the cephalopod facies. The present author suggests, however, the following emendations:

1. Removal of the genus *Skemmatopyge*, which has been shown by Maksimova (1955) to be synonymous with *Chaunoproetus*.

2. Recognition (after Hupé, 1953, and Maksimova, 1955) of *Drevermannia* and *Formonia* as separate genera, and not subgenera, since the features which they have in common: the straight course of the facial suture and the short pygidial axis — could develop independently in separate genera.

3. Erection of a new genus *Spatulina* (related probably to *Liobolina*), to include two species thus far recorded within *Cystispina*: *Spatulina spatulata* (Woodward) and *S. nasifrons* (R. & E. Richter).

4. Erection of a new monotypical subgenus *Cyrtosymbole (Mirabole)* to include *C. (Mirabole) kielanae* n.sp.

The author agrees with the opinion of R. & E. Richter and W. Struve (1959) that some genera included within Cyrtosymbolinae are homeomorphic, however, as the ontogeny of only a few species is so

Table 6 (*continued*)

R. & E. RICHTER & W. STRUVE (1959)	Z. A. MAKSIMOVA (1960)[3]
Superfamily **Proetacea** Salter, 1864	Superfamily **Proetoidae** Hawle & Corda, 1847
Family **Proetidae** Salter, 1864	Family **Proetidae** Hawle & Corda, 1847
Subfamily **Cornuproetinae** R. & E. Richter, 1956	Subfamily **Proetinae** Hawle & Corda, 1847
?Perliproetus R. & E. Richter, 1926	*Semiproetus* Reed, 1943 [4]
Subfamily **Cyrtosymbolinae** Hupé, 1953	*Perliproetus* R. & E. Richter, 1926
Cyrtosymbole (s. lato) R. Richter, 1913	*Chaunoproetus* R. & E. Richter, 1919[2]
Archegonus Burmeister, 1843	Family **Tropidocoryphidae** Přibyl, 1945
Phillibole R. & E. Richter, 1937	Subfamily **Tropidocoryphinae** Přibyl, 1945
Liobole R. & E. Richter, 1949	*Carbonocoryphe* R. & E. Richter, 1950
Liobolina R. & E. Richter, 1950	*Diacoryphe* R. & E. Richter, 1951
Drevermannia (s. lato) R. Richter, 1913	Family **Cyrtosymbolidae** Hupé, 1953
Chaunoproetus R. & E. Richter, 1919	Subfamily **Cyrtosymbolinae** Hupé, 1953
Skemmatopyge R. & E. Richter, 1927	*Cyrtosymbole* (s. stricto) R. Richter, 1913
Skemmatocare R. & E. Richter, 1927	*Calybole* R. & E. Richter, 1926
Cystispina R. & E. Richter, 1939	*Waribole* R. & E. Richter, 1926
?Carbonocoryphe R. & E. Richter, 1950	*Macrobole* R. & E. Richter, 1951
?Diacoryphe R. & E. Richter, 1951	*Phillibole* R. & E. Richter, 1937
?Typhloproetus R. Richter, 1913	*Typhloproetus* R. Richter, 1937
	Liobolina R. & E. Richter, 1951
	Liobole R. & E. Richter, 1949
	Cystispina R. & E. Richter, 1939
	Subfamily **Drevermanninae** Maksimova, 1960
	Drevermannia (s. stricto) R. Richter, 1913
	Carnicia R. & E. Richter, 1927[1]
	Formonia R. & E. Richter, 1927[5]

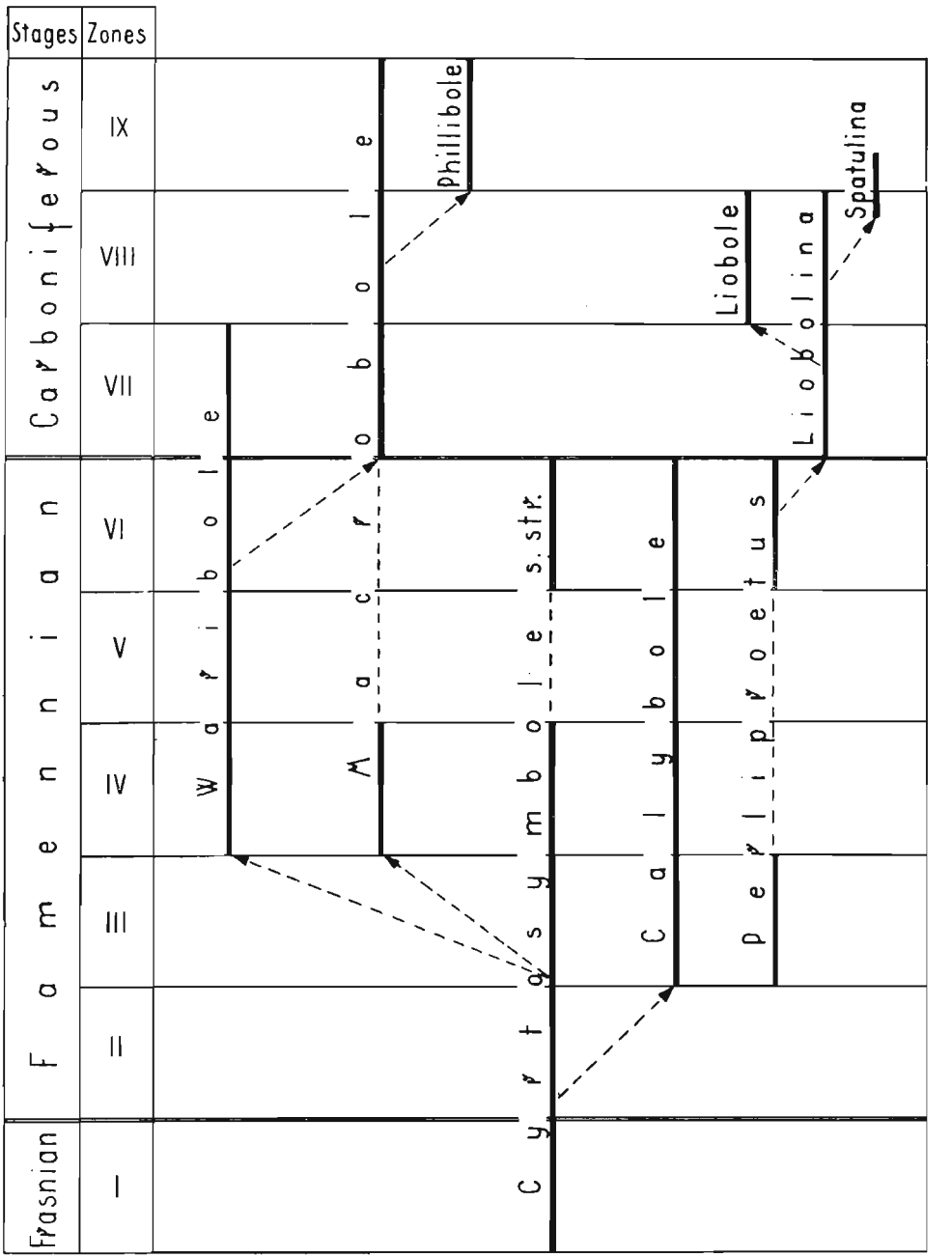
[1] Genus *Carnicia* is recently included into the genus *Chaunoproetus* (see Pfeiffer, 1954).
[2] Genus *Skemmatopyge* is recently included into the genus *Chaunoproetus* (see Maksimova, 1955).
[3] The classification of Maksimova (1960) differs from that established by the same author in 1955.
[4] Genus *Semiproetus* was regarded by R. & E. Richter and W. Struve (1959) as subgenus *Cyrtosymbole (Semiproetus)*.
[5] Genus *Formonia* (according to Hupé: *Formosia*) was regarded by R. & E. Richter and W. Struve (1959) as subgenus *Drevermannia (Formonia)*.

far known, it is for the time being impossible to construct systematics which could be regarded as natural.

Studies of the ontogenetic development of some species described here have shown that the subgenera *C. (Cyrtosymbole)*, *C. (Waribole)*, *C. (Macrobole)* and probably also *C. (Calybole)* are closely related. It seems therefore that they should not be treated as separate genera, as Maksimova (1960) has done. The true systematic position of the majority of Famennian and Lower Carboniferous trilobites, included within the Cyrtosymbolinae, could be determined by studies of their ontogenetic development. Judging from the rich material collected in the Holy Cross Mountains, the corresponding beds in the same facies in

Table 7

Tentative phylogeny of some Famennian and Lower Carboniferous proetid lines



Germany, Great Britain and U.S.S.R. should yield just as rich material. A large collection is however required.

Only a small part of the phylogenetic relations of the genera included within the Cyrtosymbolinae is clear. R. & E. Richter (1951) and Erben (1958) gave diagrams of the presumed phylogenetic development of the Proetidae. Dr. R. Goldring kindly informed the present writer that, according to him, the Carboniferous proetid genera, occurring in the Carboniferous limestone lithofacies, could derive from such Famennian genera as *Perliproetus* and *C. (Waribole),* both of which are characteristic of the cephalopod biofacies. This opinion seems quite convincing, and could probably be strengthened by examination of the Lower Carboniferous genera from the cephalopod shale lithofacies. The tentative phylogeny of some cyrtosymbolid lines (partly based on Erben, 1958) would than be like that on table 7.

SYSTEMATIC PART

DESCRIPTIONS

Superfamily **Proetacea** Salter, 1864
Family **Proetidae** Salter, 1864
Subfamily **Cyrtosymbolinae** Hupé, 1953
Genus *Cyrtosymbole* R. Richter, 1913
Subgenus *Cyrtosymbole (Cyrtosymbole)* R. Richter, 1913

Cyrtosymbole (Cyrtosymbole) pusilla (Gürich, 1896)
(pl. I, fig. 1-7; pl. II, fig. 7,8; pl .III; text-pl. I, fig. 1-7)

1896. *Dechenella pusilla* Gürich; G. Gürich, Das Paläozoicum..., p. 102, 373, 533; pl. 10, fig. 1 .
non 1901. *Dechenella pusilla* Gürich; G. Gürich, Nachträge..., pl. 15, fig .10.
1907. *Dechenella pusilla* Gürich; M. Gortani, Contribuzioni..., p. 40, pl. 2, fig. 33.
1913. *Cyrtosymbole? pusilla* Gürich; R. Richter, Beiträge..., p. 394, pl. 22, fig. 31.
non 1913. *Cyrtosymbole? pusilla* Gürich; R. Richer, Beiträge..., pl. 22, fig. 32.
1926. *Cyrtosymbole pusilla* (Gürich); R. & E. Richter, Die Trilobiten..., p. 61.

Neotype: I. G. 173.II.1a, cranidium — text-pl. I, fig. 1 a-b, and pl. I, fig. 3.
Type horizon: Famennian, *Postprolobites* zone (IV).
Type locality: Łagów, Holy Cross Mountains (Góry Świętokrzyskie), Poland.

Material. — 62 cranidia, 90 librigenae, 5 hypostomata, 70 pygidia from: *Prolobites* zone (III) of Łagów, Czarnów, Gałęzice; *Postprolobites* zone (IV) of Łagów; *Wocklumeria* zone (VI) of Kowala.

Dimensions (in mm) — see p. 94.

Diagnosis. — Axial furrows extend from posterior margin of occipital ring to first lateral glabellar furrows (S_1) parallel. Glabella broadest (tr.) at middle lateral lobes (L_2), then tapering forwards. Occipital ring of uniform width (long.), both medially and laterally, where there are slightly developed occipital lobes. Palpebral lobes narrow (tr.) and

I. G. Mus. cat. no.	173.II 1a	173.II 2	173.II 1b	173.II 8a	173.II 8b	173.II 24
Length of cranidium	5.6	—	—	5.5	—	3.2
Length of glabella	3.8	—	—	3.7	—	2.1
Width of glabella	3.5	—	—	2.9	—	1.9
Length of pygidium	—	7.1	2.4	—	6.0	—
Width of pygidium	—	9.2	3.7	—	8.9	—
Length of axis	—	5.2	1.4	—	5.0	—
Width of axis	—	2.9	0.9	—	2.2	—
I. G. Mus. cat. no.	171.II 23	173.II 7a	173.II 7b	173.II 12	171.II 70	171.II 76
Length of cranidium	—	8.9	—	—	1.6	1.8
Length of glabella	—	6.0	—	—	1.0	1.1
Width of glabella	—	5.2	—	—	0.7	0.7
Length of pygidium	1.5	—	8.2	6.5	—	—
Width of pygidium	2.8	—	12.0	8.0	—	—
Length of axis	1.1	—	7.0	4.5	—	—
Width of axis	0.5	—	4.2	2.9	—	—

elevated. Librigena nearly flat, with transverse ridge running from anterior end of eye to border furrow. Pygidium slightly elongate. Axis with twelve flat rings, the posterior margins of which curve backward mesially. Ten pairs of ribs on pleural lobes.

Description. — *Cephalon.* Glabella tapering forwards. Axial furrows extend parallel from posterior margin of occipital ring to first lateral glabellar furrows (S_1), when level with the middle lateral lobes (L_2) they bend outwards and then, from second glabellar furrows (S_2), converge forwards. Lateral glabellar furrows shallow. Posterior furrows (S_1) deepest, indistinctly bifurcated, usually not reaching occipital furrow. Middle (S_2) and anterior (S_3) furrows short, sometimes hardly visible. Occipital ring broad (long.), its lateral parts slightly detached from middle part. Occipital lobes weakly developed. Occipital furrow straight and shallow mesially, curving forwards and deepening laterally, but disappearing before reaching axial furrows. Preglabellar field extremely narrow (long.) with deep depression situated in front of glabella. Anterior border sharply upturned with three marginal lists. Anterior border furrow broad, shallow. Palpebral lobes narrow (tr.), elevated, extending from anterior third of posterior lateral lobes (L_1) to anterior glabellar furrows (S_3). Posterior branches of facial sutures divergent turning abruptly outwards near posterior border furrow; ε and γ close to axial furrows. Anterior branches long, slightly divergent. Posterior border convex. Posterior border furrow deep. In longitudinal profile occipital ring flat with prominent node; occipital furrow scarcely defined; posterior half of glabella is flat, but anterior half slopes gently to deep, narrow (long.) preglabel-

lar field; anterior border upturned. In transverse profile glabella low and flat; proximal third of palpebral lobes steeply inclined, becoming flat when level with top of glabella. Librigena flat, with slightly convex lateral border. Lateral border furrow shallow, broad. Visual lobe vertical with distinctly visible facets. Librigenal spine flat, its length approximately equal to width (tr.) of librigena from posterior end of eye to lateral border furrow.

Hypostoma elongate, strongly vaulted, with pair of short spines on posterior margin. Median body subdivided into anterior and posterior lobes.

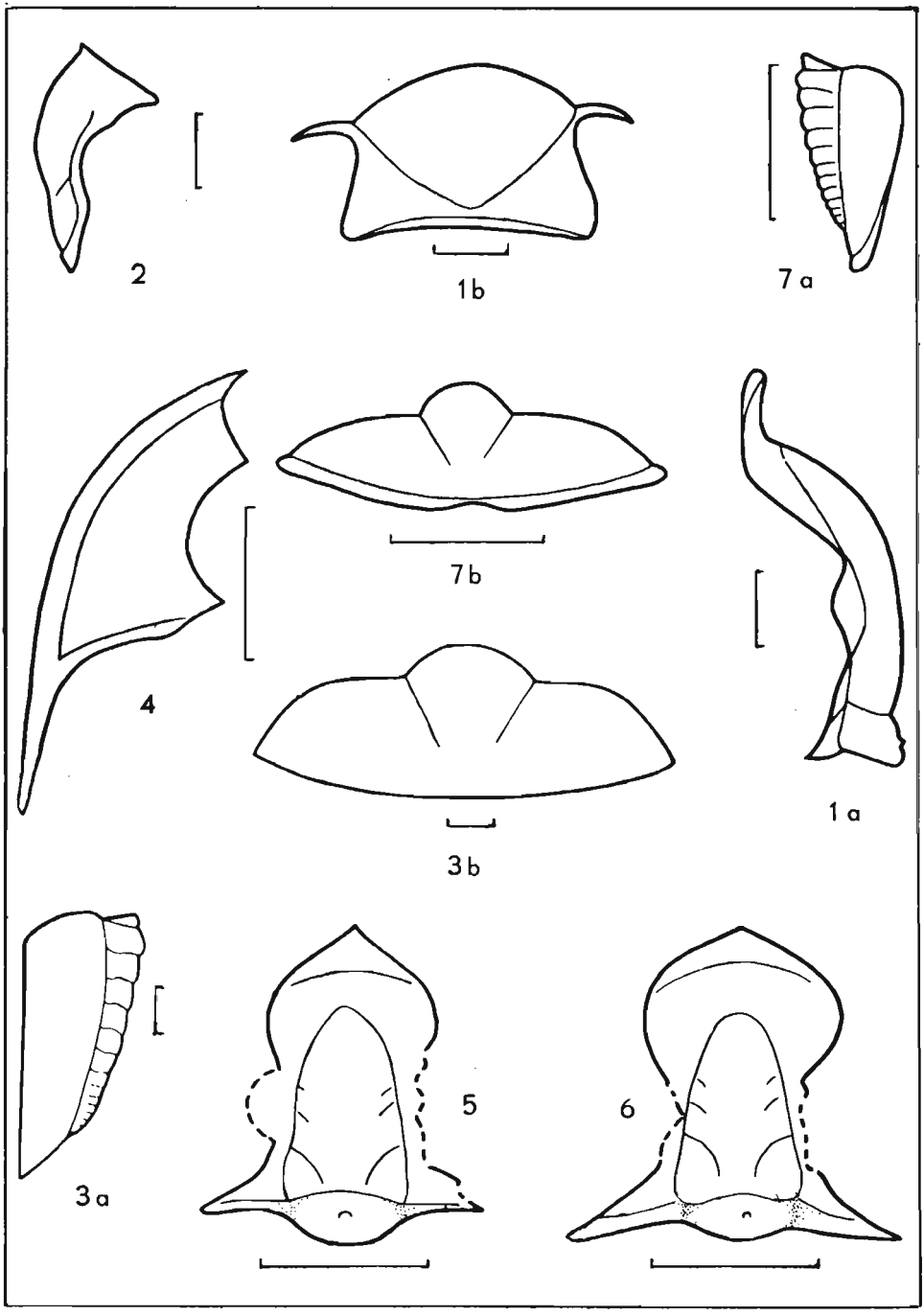
Thorax unknown.

Pygidium parabolic. Border flat and narrow, sometimes absent. Border furrow extremely shallow or lacking. Axis with twelve rings, narrow (tr.), tapering backwards. Postaxial ridge slightly developed. Axial furrows usually become obsolete posteriorly. Axial rings flat, broad (long.), their posterior margins curved backwards mesially. Each axial ring, from second to eighth, carries a pair of depressions. The first two pairs of depressions are situated close to anterior margins of rings, the next three are sited medially, whilst the last depressions are positioned near the posterior margins. Ten pairs of ribs scarcely visible on pleural lobes. Interpleural furrows faint. Pleural furrows shallow. Doublure narrow and convex. In longitudinal profile axis appears horizontal, merging without interruption into hind part of pygidium. In transverse profile axis is prominent, proximal half of pleural lobes horizontal, distal half bent gently downwards.

Ornamentation. The whole cephalon (except the border, a narrow band along each visual lobe and marginal parts of the librigena) is granulated. On each librigena a marked transverse ridge runs from anterior end of eye to lateral border furrow. Ornamentation of pygidium consists of tubercles which are more closely grouped on pygidial border.

Variation within the species concerns the following characters: 1) shape of glabella, usually parallel-sided, as far as posterior glabellar furrows (S_1), broadened at second lateral lobes (L_2) and then tapering forwards (pl. I, fig. 3,7). On some specimens glabella tapers forwards from occipital furrow (pl. I, fig. 6); 2) posterior lateral glabellar furrows (S_1) not reaching occipital furrow on some specimens (pl. I, fig. 3, 6, 7), but cutting off basal lobes (L_1) on others (pl. II, fig. 8); 3) shape of the palpebral lobes slightly elongate longitudinally or nearly semicircular; 4) shape of the axis slender on some specimens (pl. I, fig. 5, 6), but broad and poorly defined posteriorly on others (pl. II, fig. 7); 5) number of axial rings — twelve on specimens with slender axis (pl. I, fig. 5, 6), less (nine to ten) on specimens with broad axis (pl. II, fig. 7).

TEXT-PL. I



Ontogeny. — Length of smallest known cranidium of *Cyrtosymbole (Cyrtosymbole) pusilla* 1.6 mm (text-pl. I, fig. 5). Anterior margin of cranidium pointed. Border flat and horizontal. Border furrow shallow and faintly marked. Width (long.) of preglabellar field equal to length (long.) of palpebral lobe. Axial furrows deep and broad (tr.) becoming deeper in front of glabella. Glabella long, slender with three distinct pairs of lateral furrows. Basal lobes (L_1) defined. Occipital ring broad (long.), prominent mesially, with large node; width approximately equal to one fifth of glabellar length. Occipital furrow deep at dorsal furrows. Palpebral lobes weakly curved and long (long.); their posterior ends level with posterior lateral furrows (S_1) and their anterior ends elevated. Posterior branches of facial sutures long and strongly divergent, ε and γ far from axial furrows. Anterior branches long, at first slightly divergent, then becoming convergent. In transverse profile glabella is narrow and strongly vaulted; axial furrows are deep and broad (tr.); palpebral lobes flat, as broad as glabella but set lower. In successive growth stages the following changes were observed: glabella becomes progressively less slender and axial furrows both shallower and narrower (tr.); preglabellar field becomes relatively shorter (long.); ε and γ are situated nearer to the axial furrows; palpebral lobes are situated farther back; anterior branches of facial sutures reaching anterior margin of cranidium farther from midline; cranidium becomes less pointed anteriorly; middle part of occipital ring less prominent. In transverse profile glabella becomes gradually flatter and wider (tr.); palpebral lobes incline steeply to the level of the glabella. Young pygidia differ markedly from those of adult forms. The smallest, well preserved specimen (length 1.5 mm; pl. I, fig. 1), is nearly semicircular, not vaulted, with narrow (tr.) and convex border distinctly notched medially. Border furrow present. Axis narrow (tr.), prominent, with ten rings visible, reaches nearly to the border furrow. Postaxial ridge, interpleural and pleural furrows pass across border.

Text-Pl. I

Cyrtosymbole (Cyrtosymbole) pusilla (Gürich)

Fig. 1. Cranidium, neotype: *a* lateral view, *b* anterior view (IG 173.II. 1a).
Fig. 2. Hypostoma, lateral view (IG 171.II.75).
Fig. 3. Pygidium: *a* lateral view, *b* posterior view (IG 173.II.2).
Fig. 4. Young librigena, dorsal view (IG 173.II.3).
Fig. 5. Young cranidium, dorsal view (IG 171.II.70).
Fig. 6. Young cranidium, dorsal view (IG 171.II.76).
Fig. 7. Young pygidium: *a* lateral view, *b* posterior view (IG 173.II.23).

Fig. 1, 3, 4, 7: Łagów, Famennian, *Postprolobites* zone (IV).
Fig. 2, 5, 6: Czarnów, Famennian, *Prolobites* zone (III).

(Scales = 1 mm)

Ornamentation consists of minute tubercles. The other preserved young pygidium (length 2.4 mm; pl. I, fig. 4) is still not vaulted, the border is wider (tr.) and flat, and the median notch is absent. Border furrow distinct. Postaxial ridge crosses border, but interpleural and pleural furrows reach only as far as border furrow. In further stages the pygidium becomes vaulted, the border less distinct and the border furrow is absent. Axis in young stages is sharply defined posteriorly, but subsequently becomes less prominent, when the axial furrows are obsolete posteriorly. The distance between the border and axis is proportionately greater in adult specimens.

Discussion. — *Cyrtosymbole (Cyrtosymbole) pusilla* (Gürich) differs from all the hitherto known Famennian representatives of Cyrtosymbolinae by a different pygidium with an axis of twelve rings. The number of axial rings in the majority of species recorded within *Cyrtosymbole* sensu lato is from eight to ten. The Lower Carboniferous subgenus *Cyrtosymbole (Semiproetus)* Reed is very similar to *C. (Cyrtosymbole) pusilla*. In the type species of this subgenus *C. (Semiproetus) twistonensis* (Reed) the axis is the longest in the whole group, with thirteen rings and the postaxial ridge present. The posterior margins of axial rings have a characteristic sigmoid course. The next future common to both species are paired depression on both sides of axial rings, corresponding to the pygidial apodemes. There are also some, though not so striking resemblances in the structure of the cephala of *C. (Cyrtosymbole) pusilla* and *C. (Semiproetus) twistonensis*. They concern the occipital ring, which widens towards the periphery, in *C. (Cyrtosymbole) pusilla* being even slightly inflated; the shape of the glabella, slightly contracted in the anterior part; and lastly the course of the lateral glabellar furrows. Differences concern: 1) the palpebral lobe which in *C. (Cyrtosymbole) pusilla* is wide (tr.) and strongly curved, whereas in *C. (Semiproetus) twistonensis* is narrow (tr.) and only slightly curved; 2) the position of the visual lobe, which in *C. (Cyrtosymbole) pusilla* is large and vertically situated, whereas in *C. (Semiproetus) twistonensis* it is small and nearly horizontal. They indicate that the two species in question should be assigned to different though closely related subgenera. The close relationship of the above discussed species seems to be demonstrated also by the fact that *C. (Cyrtosymbole) pusilla* alone among the representatives of *Cyrtosymbole (Cyrtosymbole)* occurs above the Famennian zone III. This species has been so far found only in the Holy Cross Mountains, in the Famennian zones III, IV, VI, occurring up to the Famennian-Carboniferous boundary. One should also stress that the specimens occurring in the Famennian zone III are usually characterized by pygidia typical of *C. (Cyrtosymbole)*, with a shorter axis with eight to ten rings (pl. II, fig. 7) and only in some of them is the axis composed of twelve

rings (pl. I, fig. 6), whereas all the pygidia from zones IV and VI are characterized by the longer axis (pl. I, fig. 5). One should mention that no differences were observed in the structure of cephala and librigenae.

Consideration of the facts discussed above makes the present writer aware that the Carboniferous line of Cyrtosymbolinae may not have been derived from the subgenus *Cyrtosymbole (Waribole)* — as it was accepted by R. & E. Richter (1951) and Erben (1958), but directly from *C. (Cyrtosymbole),* through forms similar to *C. (Cyrtosymbole) pusilla* (see table 7). If one accepts the evolutionary line of Carboniferous Cyrtosymbolinae according to the scheme: *C. (Cyrtosymbole)* → *C. (Waribole)* → *C. (Macrobole)* one would have to suppose that the eye migrated at first backwards *(C. (Cyrtosymbole)* → *C. (Waribole))* and than, forwards again *(C. (Waribole)* → *C. (Macrobole)).* Such an evolution is theoretically not impossible, but does not seem likely. *C. (Cyrtosymbole) pusilla,* on the other hand, is very similar to *C. (Cyrtosymbole) gotica* R. & E. Richter (see discussion on p. 102).

Cyrtosymbole (Cyrtosymbole) gotica R. & E. Richter, 1926

(pl. II, fig. 1-6; text-pl. II, fig. 1-8)

1926. *Cyrtosymbole (Cyrtosymbole) gotica* R. & E. Richter; R. & E. Richter, Die Trilobiten..., p. 31, pl. 2, fig. 15 a-c.

Material. — 29 cranidia, 37 librigenae, 3 hypostomata, 46 pygidia, 1 specimen of meraspis from *Cheiloceras* zone (II)? of Jabłonna.

Dimensions (in mm):

I. G. Mus. cat. no.	172.II 2	172.II 246	172.II 270	172.II 265	172.II 286a
Length of cranidium	5.2	—	—	—	—
Length of glabella	3.2	—	—	—	—
Width of glabella	3.0	—	—	—	—
Length of pygidium	—	3.9	6.0	1.8	1.4
Width of pygidium	—	6.2	9.0	3.1	2.5
Length of axis	—	3.1	4.9	1.6	1.2
Width of axis	—	1.9	3.0	0.7	0.6
I. G. Mus. cat. no.	172.II 271	172.II 158	172.II 157	172.II 287	172.II 263
Length of cranidium	—	1.8	1.5	1.4	1.4
Length of glabella	—	1.0	0.9	0.8	0.7
Width of glabella	—	0.8	0.5	0.4	0.4
Length of pygidium	0.9	—	—	—	—
Width of pygidium	1.5	—	—	—	—
Length of axis	0.7	—	—	—	—
Width of axis	0.3	—	—	—	—

Description. — *Cephalon.* Glabella tapering forwards. Middle (S_2) and anterior (S_3) lateral glabellar furrows short and feeble. Posterior lateral furrows (S_1) deep, bifurcate, not reaching occipital furrow, which deepens and curves forwards laterally. Middle part of occipital ring wide and high, its distal ends both narrower and set lower. Preglabellar field narrow (long.), with deep depression marked in front of glabella. Anterior border distinct, with four lists. Palpebral lobes somewhat elevated and narrow (tr.), reaching from anterior lateral furrows (S_3) to anterior third of posterior lateral lobes (L_1); ε and γ close to axial furrows. Posterior branches of facial sutures near axial furrows and slightly divergent. Anterior branches almost parallel to midline. In longitudinal profile occipital ring stands little higher than glabella; occipital furrow shallow; glabella flat for two thirds of its length, the frontal part plunging steeply to the deep depression of the preglabellar field; anterior border upturned. In transverse profile, glabella gently vaulted; axial furrows well defined; palpebral lobes steeply inclined for proximal third of their breadth (tr.), and then becoming horizontal. Librigena steeply sloping from vertically situated visual area to well marked, wide (tr.) lateral border furrow. Lateral border prominent, with four lists. Posterior border furrow deep, fused with lateral border furrow and passing onto librigenal spine. Length of latter approximately equal to one third of length (long.) of librigena.

Hypostoma elongate, its median body strongly vaulted and weakly subdivided into posterior and anterior lobes. Near anterior margin, median body is laterally compressed, with two shallow depressions on either side. Posterior margin with pair of spines.

Thorax unknown.

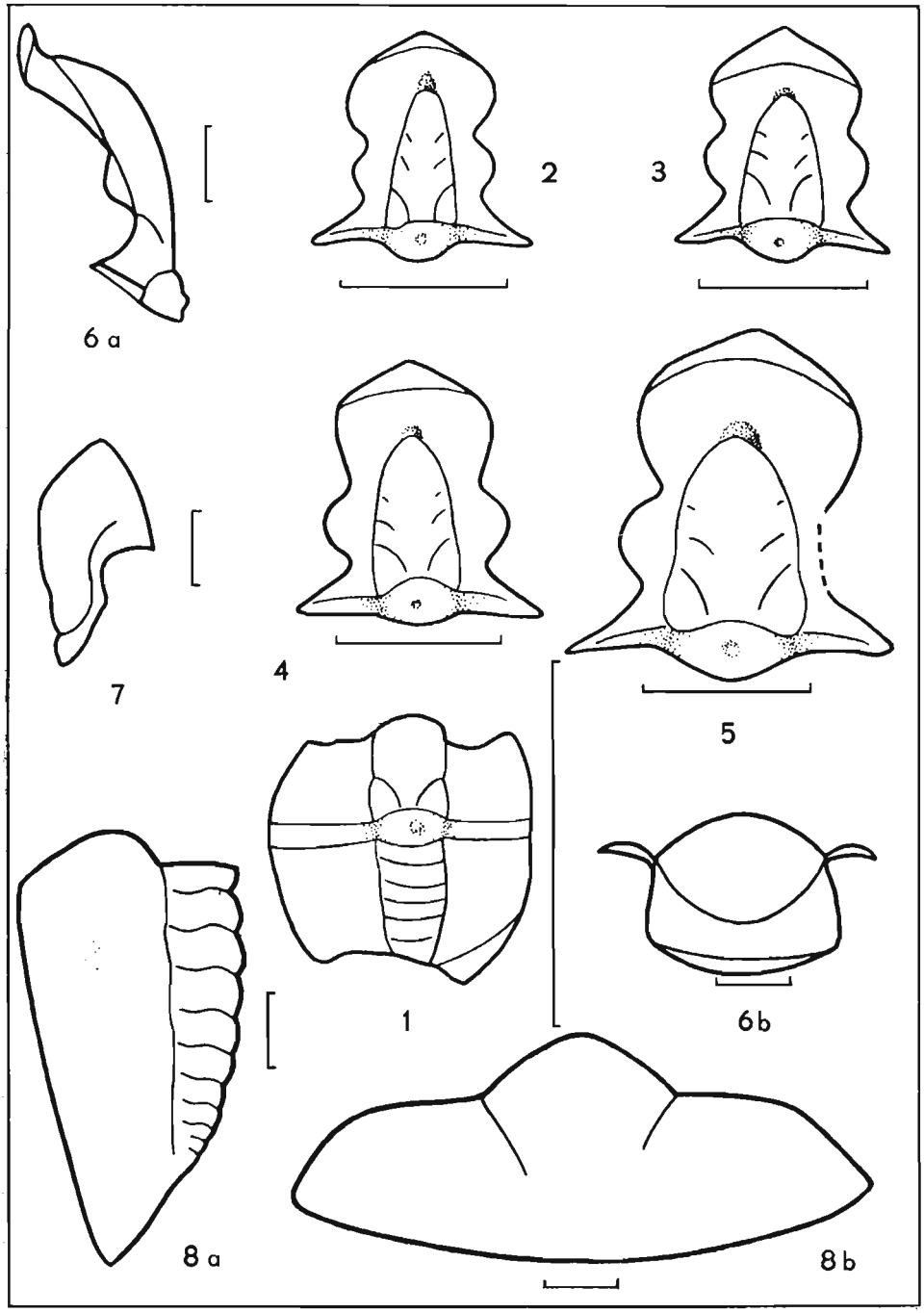
Pygidium nearly semicircular, usually with poorly defined border. Border furrow shallow, broad. Axis prominent, wide (tr.) slightly tapering backwards, often produced into postaxial ridge, with ten to eleven axial rings. On each axial ring, from second to eighth, is a pair of depressions which merge together forming a longitudinal furrow along either side of the axis. On pleural lobes are seven flat ribs. Interpleural furrows narrow (long.) but well defined, deepening in border furrow. Pleural furrows wide (long.) Doublure narrow, convex. In longitudinal profile, axis horizontal, sloping gently towards, and merging with posterior margin of pygidium. In transverse profile, axis broad (tr.) and prominent; pleural lobes strongly vaulted.

Ornamentation. Glabella and palpebral lobes coarsely granulate. Tubercles on occipital ring smaller and sparser than those of glabella. Preglabellar field and anterior part of fixigenae sparsely covered by minute granulation. Librigena coarsely granulate. Pygidium covered with densely arranged tubercles.

Ontogeny. — The smallest specimen, consisting of nearly the entire exoskeleton in the early meraspis stage (text-pl. II, fig. 1), is about 0.8 mm long. It is badly preserved, but one can see that the posterior glabellar furrows (S_1) reach the occipital furrow, cutting off the basal lobes (L_1). Occipital ring very wide (long.) and convex in the middle part, tapering strongly laterally; occipital node conspicuous. Posterior border furrow distinct. Pygidial border wide and flat, situated much lower than the remaining part of pygidium. The smallest cranidium in the author's collection (1.4 mm long; text-pl. II, fig. 2) has a very long, narrow glabella, gently tapering anteriorly, with three pairs of lateral glabellar furrows, the posterior ones (S_1) cutting off the basal lobes (L_1). Occipital ring prominent, wide (long.) in the middle part, tapering laterally. Preglabellar field wide (long.) with a deep depression in front of glabella. Anterior margin of cranidium distinctly pointed; ε and γ situated far from axial furrows. Anterior as well as posterior branches of facial sutures strongly divergent. In the later ontogenetic stages (text-pl. II, fig. 3-5) glabella becomes less slender, the posterior glabellar furrows (S_1) do not reach the occipital furrow and the points ε and γ migrate towards the axial furrows, point ε moving at the same time slightly posteriorly. The length of the smallest pygidium found is 1.4 mm (pl. II, fig. 1). Axis long and narrow (tr.) with eleven rings. The first and second interpleural furrows reach the pygidial margin, and therefore this pygidium may be regarded as a transitory one. On the pleural lobes there are eleven ribs, the last seven arranged radially. Interpleural as well as pleural furrows narrow, distinct. Distinct flat pygidial border with a conspicuous larval notch present. Pygidial border directed horizontally and situated much lower than the remaining part of the pygidium, which is also flat. Pygidium measuring 1.8 mm (pl. II, fig. 2), wider (tr.) and shorter (long.) than the one described above, and there are no thoracic segments delimited by interpleural furrows. Axis highly convex, less slender with eleven rings. On the pleural lobes eight ribs. Pleural furrows deeper and more distinct than the interpleural ones. Border convex, level with the remaining part of pygidium. Larval notch not present. Later, in ontogenetic development (pl. II, fig. 3, 6) pygidia become more vaulted, and pygidial border, which is at first convex, delimited by distinct border furrow, becomes not differentiated from the remaining part of pygidium. At the same time position of the pygidial border, which is at first horizontal, changes and the border of the oldest pygidia becomes entirely oblique.

Variation within this species is not great, and concerns only the ornamentation of the librigenae which usually are granulated; on some specimens however the granules fuse together and the ornamentation becomes reticulate (pl. II, fig. 4).

TEXT-PL. II



Discussion. — R. & E. Richter (1926) described from the *Cheiloceras* zone (II) Rhine Schiefergebirge a cranidium of *C. (Cyrtosymbole) gotica.* The material from the Holy Cross Mountains has for the first time allowed the author to describe the remaining parts of the exoskeleton, as well as some growth stages of this species. The Polish specimens differ from the type specimen in the following features: 1) anterior part of glabella less sharply pointed; 2) four parallel lists on the anterior border, in contrast to the German forms, with two to three only; 3) points ε and γ closer to the axial furrows; 4) anterior branches of the facial sutures less divergent; 5) in the transverse profile, glabella much more vaulted.

The species described is similar to *C. (Cyrtosymbole) pusilla* Gürich. In both species the shape of the glabella, the course of the lateral glabellar furrow and the position of the palpebral lobes — are similar. Moreover, both of them have the characteristic depression of the preglabellar field in front of the glabella. There are also some similarities in the pygidium, the pygidial axis in both the species discussed here being longer than in the other species recorded within this subgenus. The differences between *C. (Cyrtosymbole) gotica* and *C. (Cyrtosymbole) pusilla* concern: 1) the shape of the occipital ring, wide at the ends in *C. (Cyrtosymbole) pusilla* and tapering laterally in *C. (Cyrtosymbole) gotica;* 2) the shape of the border, which in *C. (Cyrtosymbole) pusilla* is indistinct and in *C. (Cyrtosymbole) gotica* is prominent; 3) the anterior branches of the facial sutures, which are more divergent in *C. (Cyrtosymbole) pusilla;* 4) the transverse ridge characteristic of the librigena of *C. (Cyrtosymbole) pusilla,* is lacking in *C. (Cyrtosymbole) gotica,* and only a slight vestige of it was observed in one specimen; 5) the hypostoma in *C. (Cyrtosymbole) gotica* is more vaulted longitudinally, and the

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Text-Pl. II

Cyrtosymbole (Cyrtosymbole) gotica R. & E. Richter

Fig. 1. Fragment of meraspis degree O, dorsal view (IG 172.II.286b).

Fig. 2-5. Young cranidia, dorsal view (*2* — IG 172.II.263, *3* — IG 172.II.287, *4* — IG 172.II.157, *5* — IG 172.II.158).

Fig. 6. Cranidium: *a* lateral view, *b* anterior view (IG 172.II.2).

Fig. 7. Hypostoma, lateral view (IG 172.II.272).

Fig. 8. Pygidium: *a* lateral view, *b* posterior view (IG 172.II.246).

Fig. 1-8: Jabłonna, Famennian, *Cheiloceras* zone (II)?

(Scales = 1 mm)

side depressions near the anterior margin are lacking in *C. (Cyrtosymbole) pusilla;* 6) shape of pygidium, which in the above described species is shorter, with an axis composed of eleven rings, whereas in *C. (Cyrtosymbole) pusilla* there are twelve rings; 7) the ornamentation composed of small granules in *C. (Cyrtosymbole) pusilla* and of larger ones in *C. (Cyrtosymbole) gotica.* There are also some small differences in ontogenetic development. Small cranidia in *C. (Cyrtosymbole) gotica* are more pointed anteriorly. Small pygidia in stages without larval notch are in *C. (Cyrtosymbole) pusilla* provided with a flat border (pl. I, fig. 4), whereas in *C. (Cyrtosymbole) gotica* border on small pygidia is narrow and convex.

Such characters, as the greater number of axial rings in *C. (Cyrtosymbole) gotica,* as well as the occurrence of the oriment[2] of the transverse ridge on the librigena in a specimen from the *Cheiloceras* zone (II), could lead, in the present writer's opinion, to the conclusion that this species is ancestral to *C. (Cyrtosymbole) pusilla,* occurring in the *Prolobites* zone (III) of the Holy Cross Mountains. On the other hand, if this is accepted, it is difficult to explain why *C. (Cyrtosymbole) pusilla* was not found in zone III in Jabłonna, in the lower beds of which *C. (Cyrtosymbole) gotica* occurs in great abundance.

Cyrtosymbole (Cyrtosymbole) franconica primitiva n.subsp.

(pl. III; pl. IV, fig. 1-4; text-pl. III, fig. 1-2)

Holotype: No. I. G. 173. II. 10a; pl. IV, fig. 1 (cranidium).
Type horizon: Famennian *Prolobites* zone (III).
Type locality: Łagów, Holy Cross Mountains, Poland.
Derivation of name: primitiva — the most primitive subspecies in *franconica* group.

Diagnosis. — Glabellar outline pear-shaped. Anterior border almost absent. Occipital ring not tapering laterally. Palpebral lobes narow (tr.). Librigena more or less steep with weakly marked ridge surrounding eye. Pygidium flat, nearly semicircular. Border not differentiated from pleural lobes. Axis with eight to nine rings; five to six ribs on pleural lobes. Ornamentation present on cranidium in form of anastomosing ridges; librigena and pygidium covered by tubercles sometimes fused together to produce anastomosing ridges.

Material. — 21 cranidia, 7 damaged librigenae, 18 pygidia, from *Prolobites* zone (III) of Łagów.

Dimensions (in mm) — see p. 105.

Description. — *Cephalon.* Glabella pear-shaped, tapering between extremely faint lateral furrows S_3. Middle lateral furrows (S_2) also short

[2] *Oriment* = incipient stage (Abel, O. Paläobiologie und Stammgeschichte, p. 257. Jena 1929.

I. G. Mus. cat. no.	173.II. 10a	173.II. 10b
Length of cranidium	2.7	—
Length of glabella	1.8	—
Width of glabella	1.5	—
Length of pygidium	—	2.98
Width of pygidium	—	4.6
Length of axis	—	2.1
Width of axis	—	1.4

and indistinct. Posterior lateral furrows (S_1) slightly deeper, bifurcating and not reaching occipital furrow. In axial furrows a pair of small, low tubercles in position of fossulae. Preglabellar field broad (long.) with small depression in front of glabella. Anterior border weakly defined. Border furrow indistinct. Occipital ring broad (long.) distally, and occipital furrow deepens near axial furrows. Palpebral lobes narrow (tr.), flat or sometimes concave medially extending from anterior half of first lateral glabellar lobes (L_1) to third lateral furrows (S_3). Posterior branches of facial sutures short; ε and γ near axial furrows; anterior branches long; both slightly divergent. In longitudinal profile, occipital ring stands as high as glabella; occipital furrow moderately deep; glabella flat, gently inclined towards broad (long.), slightly concave, preglabellar field; anterior border slightly raised. Glabella flat, wide (tr.) in transverse profile; axial furrows distinct; palpebral lobes not higher than glabella. Librigena more or less steep. Ridge surrounding eye generally weakly developed, but distinct on some specimens. Visual area poorly known. Lateral border with four lists. Lateral border furrow broad and shallow. Posterior border furrow deep. Complete librigenal spine unknown.

Hypostoma and *thorax* unknown.

Pygidium parabolic in outline, surrounded by flat, broad rim which is defined only by backward bending of anterior bands of ribs. No border furrow. Axis short (long.) wide (tr.), rounded posteriorly, with eight to nine rings which are flat on exoskeleton, but raised on internal mould. Axial furrows shallow. Five to six ribs visible. Pleural furrows deep and wide (long.). Interpleural furrows faint but distinct. Anterior bands of ribs prominent, bent slightly back distally and longer (tr.) than posterior bands. Pygidial and cranidial doublure wide (long.) and convex. In longitudinal profile, axis inclines gently backwards, distinctly delimited from flat, posterior part of pygidium. In transverse profile, axis low and broad (tr.); pleural lobes slightly vaulted.

Ornamentation. Glabella, occipital ring, part of fixigenae and librigena covered by reticulate pattern of ridges. Preglabellar field, anterior

part of fixigenae and pygidium granulate. Two librigenae have ornamentation consisting of minute tubercles fusing together in some places to form the reticulate pattern of ridges. The same phenomenon has been observed on the axis of one pygidium.

Variation within the species concerns the following characters: 1) shape of the glabella broad and short on some specimens, but slender on others; 2) ornamentation of the librigenae, which are covered by more or less distinct reticulate pattern of ridges; 3) degree of prominence of the ridge surrounding the eye, this appears to be connected with the character of the ornamentation of librigena, and is best developed on the distinctly reticulate specimens; 4) ornamentation of the pygidium — almost all specimens are granulate, but the axis of one is distinctly reticulate; 5) pygidial margin — usually this is not provided with a border, but two pygidia have a distinct flat rim, formed by the stronger bending back of the anterior bands of the pleural ribs.

Discussion. — The above described subspecies is very interesting on account of its primitive character, in comparison with the other representatives of *franconica* group (see discussion on p. 111).

C. (Cyrtosymbole) franconica primitiva was found in Łagów zone III, in beds yielding moreover only different parts of the exoskeleton of *C.(Cyrtosymbole) pusilla* in great abundance (pl. III). *C. (Cyrtosymbole) franconica primitiva* differs from *C. (Cyrtosymbole) pusilla* in being much smaller, having narrower (tr.) palpebral lobes, with reticulate ornamentation of the cephalon, and lastly the pygidial structure which in *C. (Cyrtosymbole) franconica primitiva* is shorter and has a shorter axis. The similarities concern the pear-shaped glabella found also in some specimens of *C. (Cyrtosymbole) pusilla*, and the structure of the occipital ring which does not taper laterally in either species.

R. & E. Richter (1919) described a pygidium recorded as *C. (Cyrtosymbole) franconica* which is similar in shape to the pygidium of *C. (Cyrtosymbole) franconica primitiva*, and has not differentiated border. No traces of ornamentation were observed in the German specimen. Same authors later described (1926) a new subspecies *C. (Cyrtosymbole) franconica exul*. The pygidium of this subspecies is similar to that in *C. (Cyrtosymbole) franconica franconica*, differing in the presence of a slightly differentiated border, formed by the posterior extremities of the ribs, which are curved posteriorly. Pygidium in *C. (Cyrtosymbole) franconica exul* is granulated, whereas the cephalic ornamentation is reticulate. In the subspecies *exul* the same character of ornamentation occurs as in a new subspecies described here. The pygidia of both subspecies are very similar, differing only in a less differentiated border in the new subspecies.

Cyrtosymbole (Cyrtosymbole) franconica nova n.subsp.
(pl. V, fig. 1-6; text-pl. III, fig. 3-6)

Holotype: No. I. G. 170.II.59; pl. V. fig. 2; text-pl. III, fig. 3 (cranidium).
Type horizon: Famennian *Prolobites* zone (III)?
Type locality: Gałęzice, Holy Cross Mountains, Poland.
Derivation of name: nova — new subspecies of *franconica* group.

Diagnosis. — Frontal part of glabella strongly convex. Palpebral lobes semicircular, broad (tr.). Occipital ring slightly narrower (long.) laterally. Librigena steeply declined, with distinct ridge surrounding eye. Pygidium vaulted, slightly elongated, with border developed. Axis with nine to ten rings, seven to eight ribs on pleural lobes. Reticulate ornamentation present on surface of cephalon and pygidium.

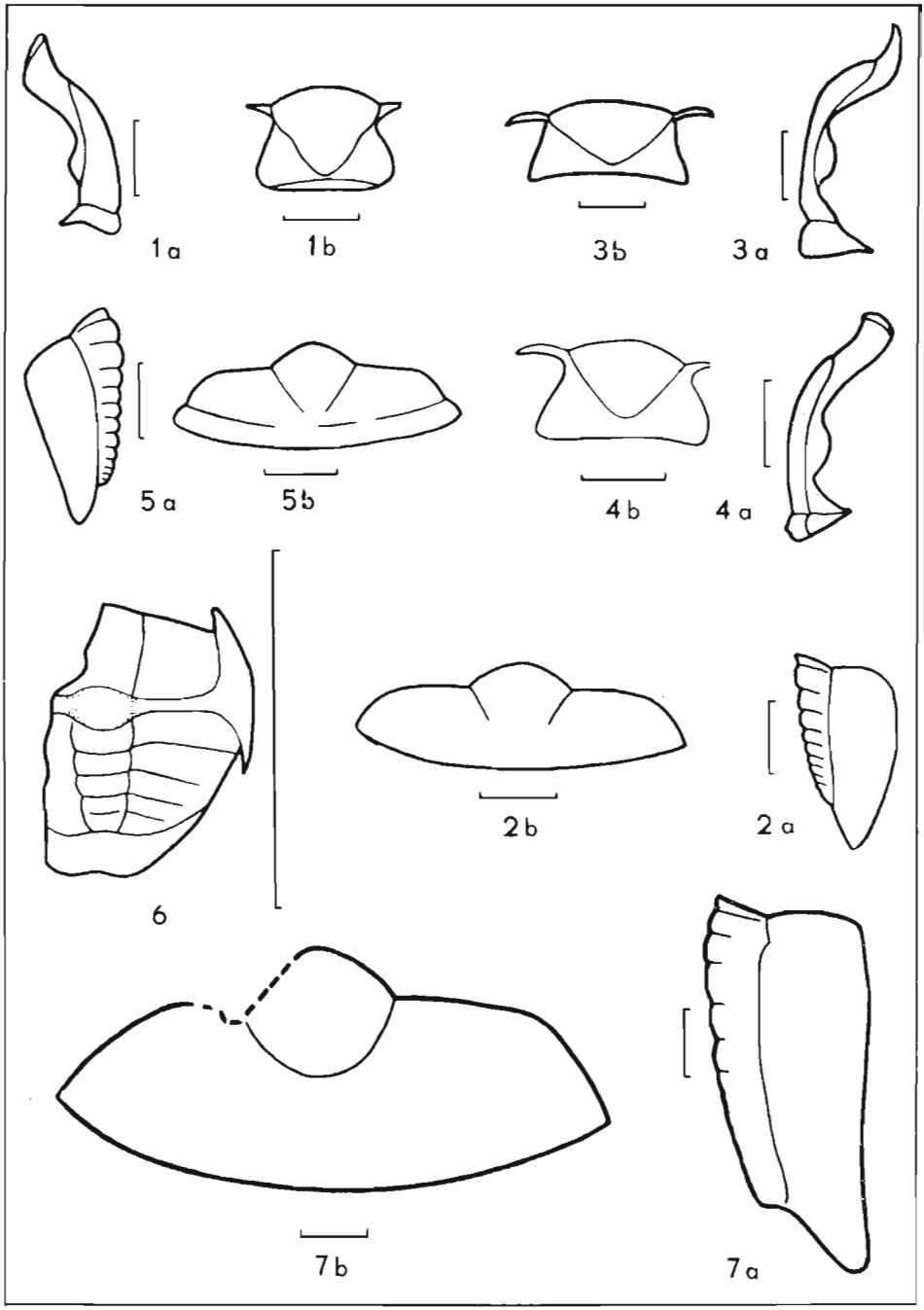
Material. — 180 cranidia, 83 librigenae, 300 pygidia, 7 hypostomata, 1 specimen of meraspis from *Prolobites* zone (III)? of Gałęzice and Jabłonna.

Dimensions (in mm):

I. G. Mus. cat. no.	170.II. 61	170.II. 59	170.II. 95	170.II. 122	170.II. 121	170.II. 411
Length of cranidium	2.8	3.7	3.5	—	—	—
Length of glabella	1.9	2.3	2.3	—	—	—
Width of glabella	1.3	1.9	1.6	—	—	—
Length of pygidium	—	—	—	1.4	4.0	2.8
Width of pygidium	—	—	—	2.5	6.3	4.3
Length of axis	—	—	—	1.2	3.2	2.3
Width of axis	—	—	—	0.6	1.9	1.2

Description. — *Cephalon.* Glabella slightly pear-shaped, contracted between shallow lateral furrows S_3. S_2 and S_1 are deeper, the latter bifurcating and sometimes reaching the occipital furrow. Axial furrows deep. Occipital ring strongly convex, becoming slightly narrower laterally. Occipital furrow deep. Preglabellar field narrow (long.); small depression in front of glabella. Anterior border flat. Border furrow weakly defined. Palpebral lobes strongly curved, broad (tr.) and concave in central part, reaching from anterior half of lateral glabellar lobes (L_1) to lateral furrows S_3; ε and γ close to axial furrows. Posterior and anterior branches of facial sutures strongly divergent. Librigena slopes down steeply from ridge, surrounding vertically situated visual area, to distinct lateral border furrow. Lateral border with four to five longitudinal lists. Posterior border furrow deep. Length of librigenal spine approximately equal to that of eye. In longitudinal profile, occipital ring stands a little

TEXT-PL. III



higher than glabella; occipital furrow deep; dorsal surface of glabella flat for three quarters of its length, then slopes down abruptly to the lower situated preglabellar field; anterior border flat and steeply inclined. In transverse profile glabella is gently convex; axial furrows deep; palpebral lobes as high as glabella.

Hypostoma similar to that of *Proetus*, but more elongated, its central body less vaulted and posterior border with only two spines.

Thorax unknown.

Pygidium nearly semicircular with narrow convex border. Border furrow present, but reaches only to first interpleural furrows. Axis long (long.), prominent, tapering backwards, with nine to eleven rings. First three ring furrows become markedly deeper just before reaching axial furrows. Five to six distinct ribs. Pleural furrows deep; interpleural furrows shallower but well pronounced. Anterior bands of ribs extend onto pygidial border. Pygidial doublure narrow (long.), convex. In longitudinal profile, axis slopes gently backwards reaching almost to border furrow; axial rings prominent. In transverse profile, axis is markedly higher than the vaulted pleural lobes.

Ornamentation of cephalon and pygidium reticulate. Central part of palpebral lobes, anterior part of fixigenae, preglabellar field and anterior border covered with minute tubercles.

Variation (studied on abundant material) is not great. With regard to the structure of cranidium one can recognize two forms: slender and wide. In the first of them (pl. V, fig. 1) glabella is comparatively narrow, with posterior glabellar furrows (S_1) not reaching the occipital furrow, and with a distinct anterior border. In the second form (pl. V, fig. 2;

Text-Pl. III

Cyrtosymbole (Cyrtosymbole) franconica primitiva n.subsp.

Fig. 1. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 173.II.10a).

Fig. 2. Pygidium: *a* lateral view, *b* posterior view (IG 173.II.10b).

Cyrtosymbole (Cyrtosymbole) franconica nova n.subsp.

Fig. 3. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 170.II.59).

Fig. 4. Young cranidium: *a* lateral view, *b* anterior view (IG 170.II.61).

Fig. 5. Pygidium: *a* lateral view, *b* posterior view (IG 170.II.411).

Fig. 6. Fragment of meraspis, degree 0, dorsal view (IG 170.II.60).

Cyrtosymbole (Cyrtosymbole) cf.*franconica nova* n.subsp.

Fig. 7. Pygidium: *a* lateral view, *b* posterior view (IG 172.II.300a).

Fig. 1, 2: Łagów, Famennian, *Prolobites* zone (III).
Fig. 3-6. Gałęzice, Famennian, *Prolobites* zone (III)?
Fig. 7: Jabłonna, Famennian, *Prolobites* zone (III)?

(Scales = 1 mm)

text-pl. III, fig. 3) glabella is wide, being widest at the level of the middle glabellar lobes (L_2), broadly rounded anteriorly. Posterior glabellar furrows nearly reach the occipital furrow, cutting off the basal lobes (L_1). Anterior border is only slightly differentiated. In the pygidia, two forms (wide and slender) were not identified, and only in some pygidia is the axis longer, with eleven rings. As the forms with wide glabella occur only among the largest specimens, and are more common than the slender forms (within the same length of cranidium), one can presume that they represent the older, maturer specimens.

Ontogeny. — Among the young forms which are not numerous, one much damaged entire specimen was found, probably in meraspis stage degree 1 (text-pl. III, fig. 6). It is about 1 mm long. On this specimen short (long.) librigenal spines are visible, and there is a wide, flat pygidial border, widest in the middle part, with a distinct larval notch. The border is situated horizontally, lower than the remaining part of the pygidium. The smallest cranidium found (2.8 mm long; pl. V, fig. 3; text-pl. III, fig. 4) has slender glabella, tapering anteriorly, and the palpebral lobes, the width (tr.) of which is equal to half that of the glabella (tr.) With regard to the adult specimens, it differs in having wide (tr.) palpebral lobes, the points ε and γ situated farther away from the axial furrows, longer anterior branches of the facial sutures and lastly in wider (long.) preglabellar field.

In the longitudinal profile of the young cranidium, glabella is more flat, and the anterior margin is less upturned. The smallest pygidium found (1.4 mm long; pl. V, fig. 5) is preserved as an internal mould, with the damaged axis. Pygidial border is narrow and flat, with a slight larval notch, situated below the level of the remaining parts of the pygidium. Anterior two or three interpleural furrows reach the pygidial margin, separating distinctly two or three segments.

Discussion. — The new subspecies here described is closely related to *C. (Cyrtosymbole) franconica exul* R. & E. Richter, differing in the following characters: 1) glabella, which in subspecies *exul* is subtriangular, in our subspecies is more elongated and rounded anteriorly; the specimen figured by R. & E. Richter (1926, pl. 2, fig. 17 A) is somewhat intermediate in glabellar shape between our slender and wide forms; 2) palpebral lobes are in both subspecies situated in the same places, but in the subspecies *nova* they are wider (tr.); 3) the outline of pygidia is similar, but the axis is composed in subspecies *exul* of nine rings and there is no differentiated border, whereas in subspecies *nova* axis has ten to eleven rings and there is a distinct, convex border. There is also a difference in the ornamentation of pygidia, which in subspecies *nova* is reticulate, whereas in subspecies *exul* pygidium is granulate, and only near the margin the granules fuse together to form the reticulation. Otherwise, the longitudinal profile of cranidia, course of the

posterior glabellar furrows (S_1), the ornamentation of cephala — are in both subspecies identical.

The subspecies *nova* differs from *C. (Cyrtosymbole) franconica primitiva* n.subsp. in having the glabella broadly rounded anteriorly, the tubercles in the anterior part of the axial furrows (in the places usually occupied by fossulae) less prominent, the occipital ring tapering laterally, the preglabellar field narrower (long.), the palpebral lobes narrower (tr.) and lastly the librigena flatter, with less curved outline. The greatest differences concern pygidia, especially the ornamentation, which in subspecies *primitiva* is granular, whereas in subspecies *nova* reticulate. The number of axial rings in subspecies *primitiva* is nine, whereas in *nova* there are ten to eleven. The border which is not differentiated in subspecies *primitiva*, is well developed in *nova*.

C. (Cyrtosymbole) franconica nova was found in the Famennian zone III in Jabłonna and Gałęzice; in Gałęzice it is present in the beds numbered 2 to 4, overlying bed 1 in which there occurs *C. (Cyrtosymbole) pusilla*. In Łagów *C. (Cyrtosymbole) pusilla* occurs together with *C. (Cyrtosymbole) franconica primitiva*. It seems then likely that *C. (Cyrtosymbole) franconica primitiva* occurred earlier than *C. (Cyrtosymbole) franconica nova*. This would be in concordance with the existence of those morphological features regarded here as primitive in subspecies *primitiva* by comparison with the subspecies *nova*. The primitive features are: 1) ornamentation intermediate between granular and reticulate (in some pygidia, cf. pl. IV, fig. 3); 2) the narrow (tr.) palpebral lobes which in subspecies *nova* become very wide, the widest within the *franconica* group.

In ornamentation subspecies *exul* represents the same developmental stage as subspecies *primitiva*. But in such other morphological characters as size of palpebral lobes, shape of occipital ring, commencement of differentation of the pygidial border, it seems to be intermediate between the subspecies *primitiva* and *nova*.

Cyrtosymbole (Cyrtosymbole) franconica ?nova n.subsp.
(pl. IV, fig. 7)

Material. — One librigena from the *Prolobites* zone (III)? of Jabłonna.

Discussion. — One librigena differs from the other librigenae recorded as subspecies *nova* in the lack of the librigenal spine, in place of which there is an irregular, tubercle-like thickening. The longitudinal lists on the lateral border, which on the typical specimens continue onto genal spine, here end at the level of the posterior border furrow. Otherwise, the shape and ornamentation is as in subspecies *nova*. The present author is of the opinion that the librigena in question most

probably belongs to the subspecies *nova* and represents a specimen of which the genal spine was broken off during life together with the soft tissue, soon after moulting, and cicatrized before the next moult.

Cyrtosymbole (Cyrtosymbole) franconica cf. *nova*
(pl. V, fig. 7,8; text-pl. III, fig. 7)

Material. — 1 young and 1 adult pygidium from the *Prolobites* zone (III)? of Jabłonna.

Dimensions (in mm):

	No. IG 172.II.300a
Length of pygidium	5,5
Width of pygidium	8,3
Length of axis	4,2
Width of axis	2,6

Description. — Outline of pygidium parabolic, border convex, delimited by shallow border furrow. Pygidial axis in posterior part distinctly differentiated with nine rings. Furrows between the rings, deep laterally, shallowing medially. On the pleurae seven convex ribs. Interpleural furrows narrow (tr.), faintly expressed, deeper only at the border furrow. Pleural furrows distinct, wider (tr.) In longitudinal profile axis nearly horizontal, at the posterior end sharply bent downwards, and distinctly delimited from the posterior part of pygidium which gently slopes downwards. In transverse profile the axis prominent, pleurae vaulted. Young pygidium 0.9 mm long (pl. V, fig. 8), found in the same piece of rock as the adult specimen, has a distinct larval notch, and four first pleurae are delimited by interpleural furrows and produced into spines. Ornamentation on the adult pygidium reticulate.

Discussion. — The pygidium described here has an ornamentation identical with pygidia of the subspecies *nova* and a similarly developed border; it differs however in shorter and more slender axis which in longitudinal profile is more distinctly delimited from the remaining part of the pygidium.

Cyrtosymbole (Cyrtosymbole) sp. *a*
(text-pl. IV, fig. 1)

Material. — Internal mould of 1 cranidium from *Prolobites* zone (III)? of Gałęzice.

Dimensions (in mm):

	No. IG 170.II.508
Length of cranidium	4.8
Length of glabella	3.0
Width of glabella	2.7

Description. — Glabella conical with three pairs of distinct lateral furrows. Occipital ring broad (long.), band-like. Preglabellar region narrow (long.). No border. Anterior margin of cranidium upturned. Palpebral lobes short (long.), strongly curved. Posterior branches of

facial sutures long, parallel to axial furrows; ε and γ close to axial furrows. Anterior branches of facial sutures moderately divergent. In longitudinal profile, glabella gently arched; preglabellar region slightly concave. In transverse profile glabella nearly flat; axial furrows deep; palpebral lobes horizontal, placed lower than glabella.

Hypostoma, thorax and *pygidium* unknown.

Discussion. — The species described above bears some resemblance to *C. (Cyrtosymbole) gotica* R. & E. Richter, but differs in the following characters: 1) glabella narrower (tr.) and more elongate, flatter in transverse profile; 2) occipital ring band-like; 3) posterior branches of facial sutures parallel to axial furrows. *C. (Cyrtosymbole) pusilla* (Gürich) has been found in the same bed. *C. (Cyrtosymbole)* sp. *a* differs from the latter chiefly in the shape of the glabella and in the course of the posterior branches of the facial sutures.

Cyrtosymbole (Cyrtosymbole) sp. *b*
(pl. IV, fig. 5,6; text-pl. IV, fig. 2)

Material. — 1 damaged cranidium, 1 fragment of pygidium, probably of the same species, from *Prolobites* zone (III)? of Gałęzice.

Dimensions (in mm):

No. IG 170.II.512	
Length of cranidium	4.2
Length of glabella	2.8
Width of glabella	2.1

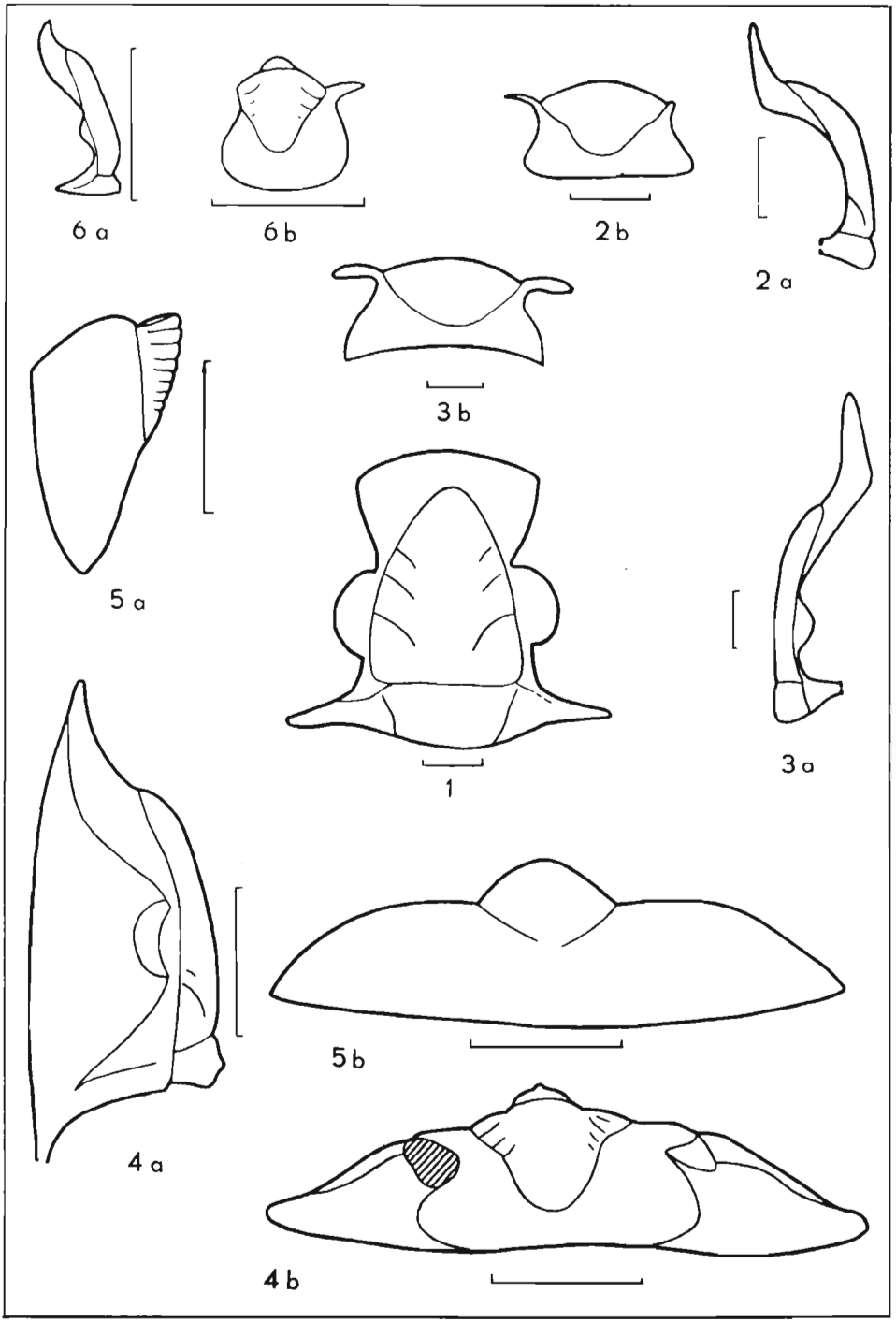
Description. — Glabella tapering forwards, not rounded anteriorly. Posterior glabellar furrows (S_1) long, reaching occipital furrow. Middle and anterior (S_2 and S_3) furrows short, faint. In axial furrows there is a pair of small, low tubercles in position of fossulae. Preglabellar region concave, its length (long.) almost equal to half length (long.) of glabella. No anterior border. Depression on fixigena opposite and also affecting median part of palpebral lobe. Latter nearly reaches from anterior glabellar furrow (S_3) to occipital furrow. Posterior branches of facial sutures short; ε and γ close to axial furrows. Anterior branches of facial sutures long and divergent. In longitudinal profile, glabella arched, sharply delimited from slightly concave preglabellar region. In transverse profile, glabella flat, higher than palpebral lobes.

Ornamentation. Surface of glabella and anterior part of fixigenae reticulate; palpebral lobes and middle part of preglabellar region finely granulated; frontal part of preglabellar region smooth.

Hypostoma and *thorax* unknown.

The fragmentary *pygidium,* found in the same bed, probably belongs to the species described above. It is characterized by ill-defined posterior end of the axis, with pronounced postaxial ridge. Posterior part

TEXT-PL. IV



of pygidium broad (long.) and flat. Indications of segmentation extremely faint. Pygidial doublure wide. Ornamentation not visible.

Discussion. — The cranidium here described is very similar to that of *C. (Cyrtosymbole) franconica primitiva*. In both forms the glabella tapers forwards and there are two distinct tubercles in the anterior part of the axial furrows. The differences concern: 1) the shape of the glabella which in *C. (Cyrtosymbole) franconica primitiva* is distinctly pear-shaped, whereas in *C. (Cyrtosymbole)* sp. *b* it tapers moderately anteriorly; 2) in *C. (Cyrtosymbole)* sp. *b* the palpebral lobes are wider (tr.) and longer (long.); 3) the preglabellar field is wider (long.); and 4) the anterior branches of the facial sutures are longer. The ornamentation of glabella in both forms is reticulate, and while the ornamentation of the palpebral lobes in *C. (Cyrtosymbole) franconica primitiva* is also reticulate, it is slightly granular in *C. (Cyrtosymbole)* sp. *b*. The form described here differs from the other species recorded within subgenus *C. (Cyrtosymbole)* in having a wide (long.) preglabellar field and larger, differently-shaped palpebral lobes. The two fragments do not allow the author to describe the cranidium as a new species, but it should be emphasized that it differs markedly from all representatives of the subgenus *C. (Cyrtosymbole)*.

?Cyrtosymbole sp. *c*

(pl. IV, fig. 8; text-pl. IV, fig. 3)

Material. — 1 cranidium from *Prolobites* zone (III)? of Gałęzice.

Dimensions (in mm):

	No. IG 170.II.514
Length of cranidium	5.2
Length of glabella	2.9
Width of glabella	2.2

Text-Pl. IV

Cyrtosymbole (Cyrtosymbole) sp. *a*

Fig. 1. Cranidium, dorsal view (IG 170.II.508).

Cyrtosymbole (Cyrtosymbole) sp. *b*

Fig. 2. Cranidium: *a* lateral view, *b* anterior view (IG 170.II.512).

?Cyrtosymbole sp. *c*

Fig. 3. Cranidium: *a* lateral view, *b* anterior view (IG 170.II.514).

Cyrtosymbole (Calybole) radiata n.sp.

Fig. 4. Cephalon, holotype: *a* lateral view, *b* anterior view (IG 172.II.4).

Fig. 5. Pygidium, holotype: *a* lateral view, *b* posterior view (IG 172.II.4).

Cyrtosymbole (Calybole) ?radiata n.sp.

Fig. 6. Young cranidium: *a* lateral view, *b* anterior view (IG 172.II.6).

Fig. 1-3: Gałęzice, Famennian, *Prolobites* zone (III)?

Fig. 4-6: Jabłonna, Famennian, *Wocklumeria* zone (VI)?

(Scales = 1 mm)

Description. — Glabella slim, gently tapering forwards. Posterior glabellar furrows (S_1) nearly reaching occipital furrow and thus almost isolating basal lobes (L_1), each S_1 extending about one third of the way across the glabella. Middle lateral furrows (S_2) short and shallow; anterior furrows (S_3) hardly visible. Preglabellar region extremely wide (long.), elevated along the anterior part od glabella. No border or border furrow. Occipital furrow deep, turning slightly forwards near axial furrows. Occipital ring broad (long.). Palpebral lobes strongly curved as long (long.) as wide (tr.) and concave in central part. Posterior branches of facial sutures short, divergent; ε closer to axial furrows than γ. Anterior branches very long, diverging forwards then bending inwards and cutting the anterior margin of cranidium not far from each other. In longitudinal profile occipital ring convex; occipital furrow deep; glabella flat, sloping gently down to very broad (long.) preglabellar region which rises gently forwards. In transverse profile glabella flat; axial furrows deep; palpebral lobes as high as glabella.

Hypostoma, thorax and *pygidium* unknown.

Ornamentation of glabella and anterior part of fixigenae reticulate. Preglabellar region and palpebral lobes smooth.

Discussion. — *?Cyrtosymbole* sp. *c* cannot be assigned to one of the known species of *Cyrtosymbole*. There are some similarities between the form described here and the cranidia of the slender form of *C. (Cyrtosymbole) franconica nova* n.subsp. However in the subspecies *nova* glabella is less slender and the palpebral lobes longer, reaching anteriorly S_3, whereas in *?Cyrtosymbole* sp. *c* they reach only S_2. In both forms the same reticulate ornamentation occurs. There are some features which make the assignment of this form to the genus *Cyrtosymbole* (or even to the subfamily Cyrtosymbolinae) doubtful. The features not occurring within the Cyrtosymbolinae are: 1) the extremely wide (long.) preglabellar region, 2) the elevation of the anterior part of the fixigenae (along the glabella), and the very long anterior branches of the facial sutures which at first diverge forwards and then bend inwards. A similar construction of the anterior part of the cranidium occurs in the family Tropidocoryphinae Přibyl, 1946, on the other hand the long glabella and wide (tr.) palpebral lobes are not found in the Tropidocoryphinae and are characteristic of the genus *Cyrtosymbole*.

Subgenus *Cyrtosymbole (Calybole)* R. & E. Richter, 1926

The subgenus *Cyrtosymbole (Calybole)* containing 9 species is one of the most uniform taxonomic units within the Cyrtosymbolinae. The species assigned to it are characterized by small dimensions and elongate, usually pear-shaped glabellae with distinct posterior lateral furrows (S_1).

The group presents some signs of specialization such as: 1) graduated series towards the radial pattern of pygidium, followed by shortening of the pygidial axis; 2) thinning of the exoskeleton, and widening of the doublure connected with this; 3) straightening of the facial sutures and reduction of the eyes.

The latter tendency does not seem, however, to be linked with the former features, as e.g. in *Cyrtosymbole (Calybcle) radiata* n.sp. where the pygidium has a distincly radial arrangement; the exoskeleton is very thin and the doublure very wide, whilst the eyes are large and the palpebral lobes strongly curved. In the pygidial structure one observes a distinct convergence with such trilobite lines as Tropidocoryphinae Přibyl, 1946, and Thysanopeltidae Hawle & Corda, 1847, for both of them have the distinct radial pattern of pygidium, short axis and wide doublure. The representatives of the subgenus *C. (Calybole)* occur chiefly in Famennian zones V and VI. The most primitive and less specialized form within this group seems to be *C. (Calybole) calymmene* R. Richter, 1913. R. and E. Richter (1926) quote this species from the Famennian zones III or IV. It would then be one of the oldest species within this subgenus. The *C. (Calybole) gracilis* R. & E. Richter, 1955, described from the Famennian zone III, is the second oldest species within this group and is characterized by nearly straight facial sutures and nearly complete reduction of the palpebral lobes, and also by a glabella with distinctly forwards taper. This pattern is found only in *C. (Calybole) denckmanni* R. & E. Richter which is the third species of the Famennian zone III (R. & E. Richter, 1955). In all the remaining species the glabella is pear-shaped, tapering forwards. The pygidium *C. (Calybole) gracilis* figured by R. and E. Richter (1955, pl. 2, fig. 12 a-b) belongs, judging from the slight notch on the posterior edge, to a young specimen. It seems that *C. (Calybole) gracilis* and *C. (Calybole) denckmanni* stay beyond the main evolutionary line of the genus *C. (Calybole),* for though "old" species they are at the same time characterized by some features found in species which appear later in time.

Cyrtosymbole (Calybole) radiata n.sp.

(pl. VI, fig. 1-5; text-pl. IV, fig. 4,5)

Holotype: No. IG 172.II.4; pl. VI, fig. 5; text-pl. IV, fig. 4-5.
Type horizon: Famennian, *Wocklumeria* zone (VI)?
Type locality: Jabłonna, Holy Cross Mountains, Poland.
Derivation of name: radiata — from radially arranged pleural ribs.

Material. — 1 slightly disarticulated exoskeleton including hypostoma, 4 cranidia, 1 hypostoma, 6 librigenae, 6 pygidia from *Wocklumeria* zone (VI)? of Jabłonna.

Dimensions (in mm):

IG Mus. cat. no.	172.II.2	172.II.4	172.II.11	172.II.3
Length of cranidium	2.4	2.4	—	—
Width of cephalon	—	3.8	—	—
Length of glabella	1.5	1.6	—	—
Width of glabella	1.2	1.1	—	—
Length of pygidium	—	1.9	1.8	2.6
Width of pygydium	—	3.3	2.9	4.3
Length of axis	—	1.2	1.1	1.4
Width of axis	—	0.7	0.5	1.0
Width (long.) of pygidial doublure	—	0.6	—	0.7

Diagnosis. — Cephalon subsemicircular, slightly vaulted transversely. Border distinct, upturned. Glabella elongate, tapering forwards, contracted between S_3. Lateral glabellar furrows deeply incised. Palpebral lobe distinctly curved in outline, placed opposite midlength of glabella. Posterior and anterior branches of facial sutures strongly divergent. Eye moderately large. Pygidium with radially arranged ribs. Pygidial and cephalic doublure very broad. Ornamentation in form of fine, reticulating ridges.

Description. — Cephalon subsemicircular, vaulted transversely. Paradoublural line distinctly marked. Glabella tapering forwards, with slightly pointed front, contracted between S_3. Three pairs of lateral glabellar furrows deeply incised, so as to divide glabella into three longitudinal parts, of which median is more convex than lateral. S_1 deep, directed backwards, almost reaching occipital furrow. S_2 and S_3 shorter, deep, directed somewhat backwards. Occipital ring broad (long.), tapering slightly laterally, with prominent node. Occipital furrow distinct, deepened near axial furrows. Preglabellar field wide (long.). Anterior border flat, slightly upturned. Palpebral lobes distinct, placed opposite midlength of glabella; ε and γ distant from axial furrows. Posterior and anterior branches of facial sutures strongly divergent. Librigena with short, sharply pointed librigenal spine and moderately large, obliquely situated eye. In longitudinal profile occipital ring high, with prominent node; occipital furrow deeply incised; glabella gently arched; preglabellar field very broad (long.), steeply sloping forwards; anterior border sligthly upturned. In transverse profile cephalon gently vaulted; glabella flat, divided into three parts, a little higher than palpebral lobes. Doublure broad, flat.

Hypostoma narrow (tr.), elongate, slightly convex.

Thoracic pleurae pointed, their number unknown.

Pygidium subsemicircular, axis short (long.) occupies somewhat more than half of pygidial length (long.). Eight to nine convex rings. Postaxial ridge present. Nine radially arranged ribs. Interpleural and pleural furrows at first very distinct, then becoming obsolete, but ribs become thickened lists reaching pygidial margin. Anterior bands of ribs prominent. No pygidial border. In longitudinal profile axis slowly sinking posteriorly. In transverse profile axis high; pleural lobes vaulted. Pygidial doublure broad with nine terrace lines. Inner margin of doublure reaches end of axis. Exoskeleton extremely thin, covered by fine reticulation. Ornamentation not visible on pygidium.

Ontogeny. — The young specimens are only represented by fragments of two pygidia (pl. VI, fig. 1, 2). They show, however, that the radial arrangement of ribs is observable very early. Larval notch present on younger pygidium.

Discussion. — The new species described above differs from *Cyrtosymbole (Calybole) antedistans* R. & E. Richter, 1926, in having the glabella more convex in transverse profile, the axial furrows more deeply incised, so that the sides of glabella appear situated lower; the pygidium, in longitudinal as well as in transverse profile, is flatter, pygidial axis shorter and the pygidial border is absent. In its pygidial structure the new species resembles that of *C. (Calybole) denckmanni* R. & E. Richter, 1926, having the same ratio of axial length to total length of pygidium. However the pleural ribs are in the new species more prominent, and there is no flattening of the pygidial margin, characteristic of *C. (Calybole) denckmanni.* There are striking differences between the cranidia of both species: the anterior border in *C. (Calybole) radiata* is more strongly upturned, the glabella is more convex with three pairs of lateral glabellar furrows, and slightly contracted between S_3. There are also some similarities between the pygidium of the new species and that of *C. (Calybole) gracilis* R. & E. Richter, 1955, but the radiate pattern of pygidium is more distinctly expressed in the Polish form. *C. (Calybole) radiata* is the only representative of the subgenus *Calybole* with a wide doublure other than *C. (Calybole) denckmanni.* This feature as well as the entire pygidial structure brings the new species close to the genus *Carbonocoryphe* R. & E. Richter, 1950. In pygidial structure *C. (Calybole) radiata* shows distinct convergence with the Tropidocoryphinae Přibyl line.

Cyrtosymbole (Calybole) ?radiata n.sp.

(pl. VI, fig. 6; text-pl. IV, fig. 6)

Material. — 2 cranidia from *Wocklumeria* zone (VI)? of Jabłonna.

Dimensions (in mm):

IG Mus. cat. no.	172.II.6a	172.II.6b
Length of cranidium	1.4	—
Length of glabella	0.9	1.1
Width of glabella	0.6	0.7

Description. — Glabella elongate, finger-shaped, somewhat contracted when level with S_3, slightly tapering forwards. First lateral furrows S_1 deeply incised, nearly reaching the occipital furrow. The middle ones (S_2) and anterior (S_1) more faint, shorter. Distinct tubercules in the axial furrows in the place usually occupied by fossulae. Occipital ring very wide medially, with occipital node, tapering laterally. Occipital furrow straight, deep. Length of preglabellar field equal to that of the occipital ring (long.). Anterior border slightly developed, anterior border furrow shallow. Palpebral lobes strongly curved, very wide (tr.) equal to one half of glabellar width. Posterior margin of the palpebral lobes situated slightly in front of S_1, anterior ones extending from behind forwards $^3/_4$ of the glabellar length; ε and γ situated far from the axial furrows. Anterior and posterior branches of the facial sutures strongly divergent. In longitudinal profile the occipital ring high and wide (long.), occipital furrow deep; glabella strongly vaulted; preglabellar field concave; anterior border slightly upturned. In transverse profile glabella moderately convex; palpebral lobes slightly inclined, wide (tr.).

Discussion. — Judging from their dimensions, the specimens described here represent young cranidia. The course of the facial sutures, with the points ε and γ situated far from the axial furrows, as well as the wide (tr.) palpebral lobes would agree with this. Only two cyrtosymbolid subgenera: *Cyrtosymbole (Calybole)* and *Cyrtosymbole (Waribole)* occurs in the same beds besides these cranidia; it seems then reasonable to assign them to one of these two genera. As the longitudinal as well as the transverse profile of the described cranidia are very similar to those characteristic of the *Cyrtosymbole (Calybole) radiata* n.sp. being here the only representative of subgenus *Calybole*, it seems quite probable that the described cranidia represent the young forms of this species and they are tentatively referred to it. This would mean that the ontogenetic development of *Calybole* is comparable with that of the subgenera *C. (Cyrtosymbole)*, *C. (Waribole)* and *C. (Macrobole)*.

Subgenus Cyrtosymbole (Waribole) R. & E. Richter, 1926

Cyrtosymbole (Waribole) conifera R. & E. Richter, 1926

(pl. VIII; text-pl. V, fig. 1, 2)

1926. *Cyrtosymbole (Waribole) conifera* R. & E. Richter; R. & E. Richter, Die Trilobiten..., p. 53, pl. 3, fig. 37-40.

Material. — 1 complete cephalon, 133 cranidia, 120 librigenae, 10 hypostomata, 230 pygidia from Famennian *Laevigites* zone (V)? of Gałęzice, Jabłonna and Karczówka.

Dimensions (in mm):

IG Mus. cat. no.	170.II. 521	172.II. 21	170.II. 515	170.II. 517	170.II. 518
Length of cranidium	5.6	4.9	5.2	2.6	1.6
Width of cephalon	8.0	—	—	—	—
Length of glabella	4.0	3.0	3.2	1.8	0.9
Width of glabella	3.1	2.5	2.9	1.3	0.6

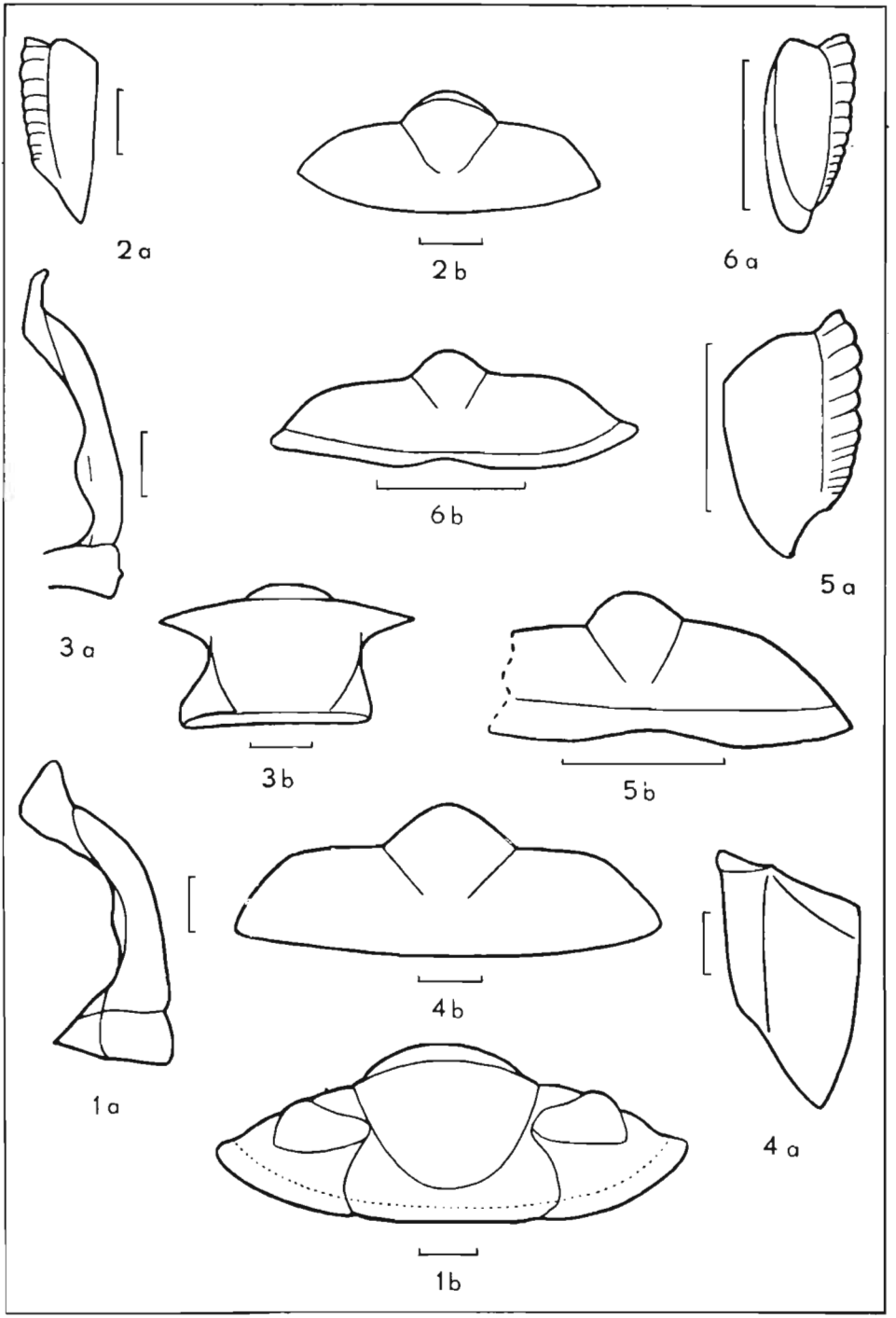
IG Mus. cat. no.	170.II. 519	170.II. 520	170.II. 522	170.II. 523
Length of pygidium	4.5	2.0	1.7	1.2
Width of pygidium	6.0	3.2	2.7	1.8
Length of axis	3.2	1.7	1.4	0.9
Width of axis	1.9	0.9	0.6	0.4

Description. — *Cephalon.* Glabella slightly elongate, broadly rounded anteriorly. Lateral glabellar furrows extremely faintly developed. Occipital ring broad (long.), band-like. Occipital furrow shallow, deepened at distal ends. Preglabellar field narrower (long.) than occipital ring (long.). Anterior border nearly flat, slightly upturned. Border furrow faint. Palpebral lobes distinctly curved with posterior ends near occipital furrow; ε and γ close to axial furrows. Posterior and anterior branches of facial sutures strongly divergent. In longitudinal profile glabella horizontal, sloping gently down in front; anterior border slightly upturned. In transverse profile glabella nearly flat; axial furrows shallow; palbebral lobes as low as glabella or somewhat lower, horizontally situated. Librigena with slightly marked border furrow. Lateral border flat, broad (tr.). Visual area large, but low. Librigenal spine flat. Its length (long.) nearly equal to length (long.). of librigena.

Hypostoma narrow (tr.), elongate, with broad lateral border.

Pygidium subsemicircular with slightly marked border. Axis long, not reaching border, with ten to eleven rings. Postaxial ridge present. On pleural lobes six flat ribs visible. Interpleural furrows faint, only near border furrow deepened. Pleural furrows narrow, near axial furrows obsolete. In longitudinal profile axis gently sloping down posteriorly; its end clearly delimited from hinder part of pygidium. In transverse

TEXT-PL. V



profile axis broad (tr.), low; pleural lobes gently vaulted. Doublure narrow, convex.

Ornamentation consists of densely spaced, flattened tubercles, resembling scales. Ornamentation most strongly developed on glabella, the scale-like tubercles are here connected together and form concentric lines. These are not pronounced on pydigium.

Variation within the species concerns the following characters: 1) width (tr.) of palpebral lobes which can be narrow (tr.) as in pl. VIII, fig. 6, or even very broad (tr.) as in pl. VIII, fig. 1; 2) course of posterior branches of facial sutures which can be divergent (pl. VIII, fig. 1, 6) as in typical forms, or parallel to axial furrows as in *C. (Macrobole)* R. & E. Richter, but without palpebral lobes shifted so far forwards (pl. VIII, fig. 8); 3) ornamentation may be more or less strongly developed (pl. VIII, fig. 1, 6).

Ontogeny. — Immature individuals have broad (long.) preglabellar field, elongate glabella rounded frontally, with deep posterior glabellar furrows (S_1). Occipital ring tapering laterally, in central part broad and very convex, with large occipital node. Palpebral lobes very broad (tr.); ε and γ far from axial furrows, ε further from axial furrows than γ. Posterior and anterior branches of facial sutures strongly divergent. The youngest known pygidium (length 1.2 mm; pl. VIII, fig. 4) is slightly convex, especially in hinder part, and surrounded by a flat, broad border, with distinct larval notch. Axis narrow (tr.), not reaching border, with ten rings. On pleural lobes nine segments visible, with posterior bands broader (long.) than anterior. Interpleural furrows narrow, the first four reaching pygidial margin. Pleural furrows shorter (tr.). On an older pygidium (length 1.7 mm; pl. VIII, fig. 5) there is no larval notch, axis is closer to the border which is flat, but nearly level with the rest of the pygidium. Two first interpleural furrows reach pygidial margin.

Text-Pl. V

Cyrtosymbole (Waribole) conifera R. & E. Richter

Fig. 1. *a* Cranidium, lateral view, *b* cephalon, anterior view (IG 170.II.521).

Fig. 2. Pygidium: *a* lateral view, *b* posterior view (IG 170.II.519).

Cyrtosymbole (Waribole) octofera altera n.subsp.

Fig. 3. Cranidium: *a* lateral view, *b* anterior view (IG 172.II. 141).

Fig. 4. Pygidium: *a* lateral view, *b* posterior view (IG 172.II.25).

Fig. 5. Young pygidium: *a* lateral view, *b* posterior view (IG 172.II.56).

Cyrtosymbole (Waribole) sp. *b*

Fig. 6. Young pygidium: *a* lateral view, *b* posterior view (IG 172.II.23).

Fig. 1, 2: Gałęzice, Famennian, *Laevigites* zone (V)?

Fig. 3-6: Jabłonna, Famennian, *Wocklumeria* zone (VI)?

(Scales = 1 mm)

Discussion. — In comparison with the representatives of the same species, described by R. and E. Richter (1926) from Germany, the Polish forms differs in having the preglabellar field slightly wider (long.), more axial rings (ten) in pygidium, glabella more vaulted longitudinally, as well as transversely, anterior branches of the facial sutures more strongly divergent.

Cyrtosymbole (Waribole) abruptirhachis (R. & E. Richter, 1919)
(pl. X, fig. 2,3; text-pl. VII, fig. 1-6)

1951. *Cyrtosymbole (Waribole) abruptirhachis* (R. & E. Richter, 1919): R. & E. Richter, Der Beginn..., p. 233, pl. 1, fig. 1-6; pl. 5, fig. 46; text-fig. 2 (with previous synonymy).

Material. — 19 cranidia, 23 librigenae, 7 hypostomata, 11 pygidia from *Gattendorfia* zone (VII) of Kowala.

Dimensions (in mm):

IG Mus. cat. no.	173.II. 32	173.II. 34	173.II. 36	173.II. 37	173.II. 38
Length of cranidium	3.9	—	1.3	1.0	—
Length of glabella	2.8	—	0.8	0.6	—
Width of glabella	2.0	—	0.6	0.3	—
Length of pygidium	—	1.6	—	—	1.1
Width of pygidium	—	3.1	—	—	1.4
Length of axis	—	1.3	—	—	0.7
Width of axis	—	0.8	—	—	0.3

Description. — *Cephalon.* Glabella elongate, broadly rounded frontally. Posterior glabellar furrows (S_1) deeply incised, middle (S_2) and anterior (S_1) faint. Occipital ring wide (long.) not tapering laterally. Occipital furrow convex forwards in the middle part and then swinging again anteriorly at the axial furrows. Preglabellar field slightly narrower (long.) than the occipital ring. Anterior border upturned. Palpebral lobes narrow (tr.) and short (long.); γ situated closer to the axial furrows than ε. Anterior and posterior branches of facial sutures strongly divergent. Length of the cranidial part of the posterior border more or less equal to $^2/_3$ width (tr.) of the glabella. Librigenae with the border strongly upturned, delimited by the deep border furrow. Visual lobe low, librigenal spine fairly long, narrow (tr.).

Hypostoma elongate, strongly convex ventrally. Posterior margin with sharply pointed postero-lateral angles. Border flat, wide (tr.). The middle part distinctly divided into anterior and posterior lobes.

Pygidium semicircular, with a convex border. Pygidial axis wide (tr.) with ten rings. On pleural lobes six ribs. Anterior bands of ribs forming

tubercle-like thickenings at border furrow. Interpleural and pleural furrows narrow (tr.). In longitudinal profile posterior end of pygidial axis sloping down steeply.

Ornamentation. Cephalon densely covered with small high granules. On the pygidium ornamentation also granular, but more fine.

Ontogeny. — The smallest cranidium found (1 mm long; text-pl. VII, fig. 1) is strongly pointed anteriorly. Glabella long, narrow, finger-shaped, with posterior glabellar furrows (S_1) deeply incised, nearly reaching occipital furrow. Occipital ring wide medially, tapering laterally. Width (long.) of preglabellar field greater than that of occipital ring (long.). Anterior border nearly flat, wide. Palpebral lobes slightly curved, situated opposite L_3; ε and γ far from axial furrows. Anterior branches of facial sutures long, slightly divergent, cutting anterior border not far from each other. Posterior branches long, strongly divergent. Cranidium (1.3 mm long; text-pl. VII, fig. 2) has the anterior margin slightly pointed, and forwards tapering glabella. Palpebral lobes more curved than in the cranidium described above (text-pl. VII, fig. 1) and shifted further backwards, opposite L_2; ε and γ far from axial furrows. Posterior branches of facial sutures more divergent, anterior ones cut the anterior border further away from each other than in the described above cranidium. The smallest pygidium found is slightly longer (long.) than 1 mm (text-pl. VII, fig. 5), with a narrow (tr.), axis composed of six rings. Border flat, wide, with a larval notch, sited horizontally, below the remaining part of pygidium.

Discussion. — The specimens from the Holy Cross Mountains differ from the type specimen from Germany in having the glabella slightly longer and the occipital ring not tapering laterally (this difference may, however, be due to the flattening of the Polish forms), palpebral lobes slightly narrower (tr.), pygidial border more convex, granules on the cephalon larger. However the common features such as the glabella broadly rounded anteriorly, the sigmoid course of the occipital furrow, the ridge on the librigena along the visual surface, and especially, the characteristic pattern of the pygidial ribs with tubercle-like thickenings in their distal part, and the longitudinal profile of the pygidium indicate that the Polish specimens are conspecific with those from Germany. The differences seem to be due to the different state of preservation of the German and Polish specimens.

Cyrtosymbole (Waribole) octofera altera n.subsp.
(pl. IX, fig. 1-6; text-pl. V, fig. 3-5)

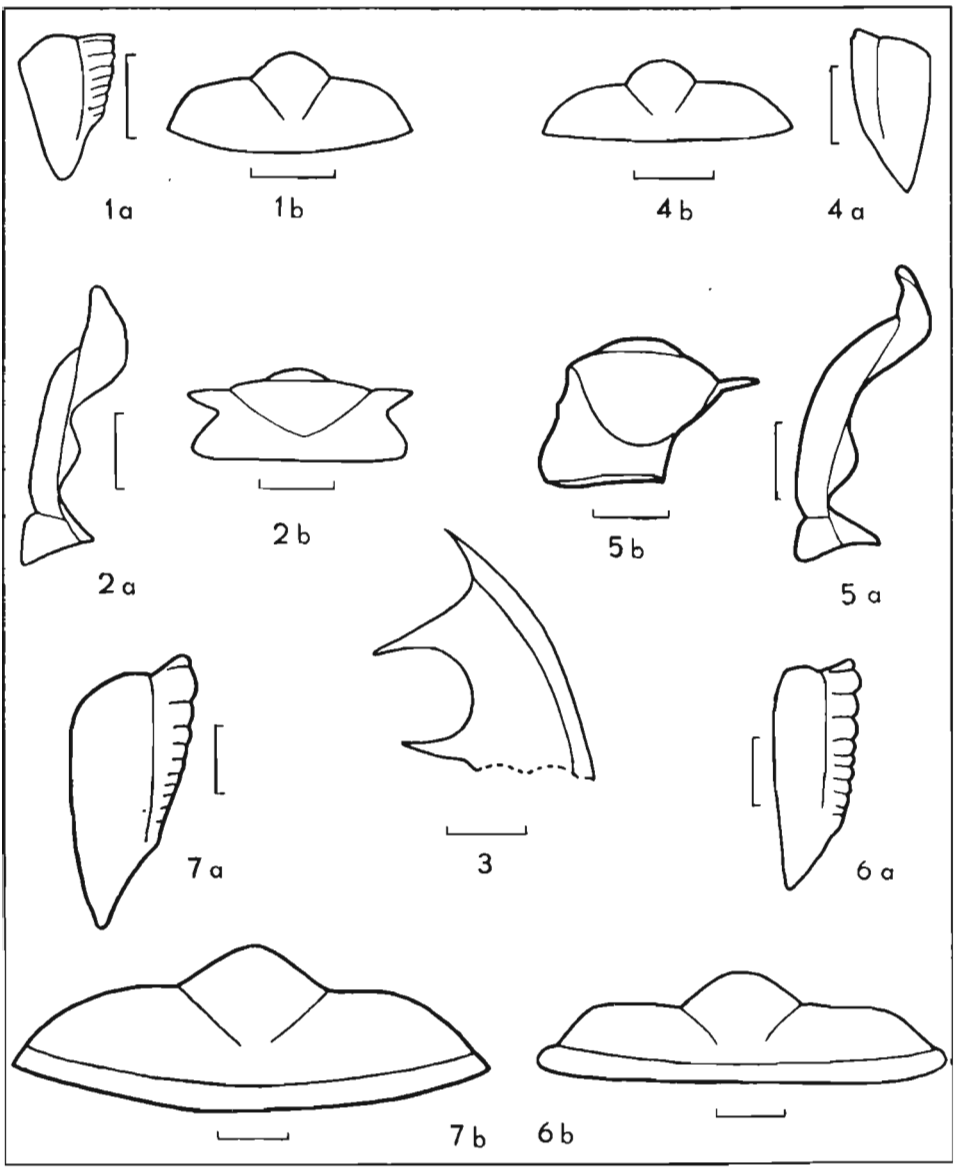
Holotype: No. IG 172.II.184; pl. IX, fig. 5; text-pl. V, fig. 3.

Type horizon: Famennian, *Wocklumeria* zone (VI)?

Type locality: Jabłonna, Holy Cross Mountains, Poland.

Derivation of name: altera — different; new subspecies different from *C. (Waribole) octofera octofera* R. & E. Richter, 1926.

TEXT-PL. VI



(Explanation-on the next page)

Diagnosis. — Glabella slightly pointed at front. Axial furrows obsolete opposite palpebral lobes. Posterior angles of glabella and ends of occipital ring slope abruptly downwards.

Material. — 17 cranidia, 4 librigenae, 30 pygidia from *Wocklumeria* zone (VI)? of Jabłonna.

Dimensions (in mm):

IG Mus. cat. no.	172.II. 184	172.II. 180	172.II. 172	172.II. 138
Length of cranidium	3.7	—	2.2	1.8
Length of glabella	2.6	—	1.5	1.1
Width of glabella	1.2	—	0.9	0.7
Length of pygidium	—	3.8	—	—
Width of pygidium	—	5.6	—	—
Length of axis	—	2.5	—	—
Width of axis	—	1.6	—	—
IG Mus. cat. no.	172.II. 54	172.II. 183	172.II. 141	172.II. 24
Length of cranidium	—	—	5.2	—
Length of glabella	—	—	3.8	—
Width of glabella	—	—	2.7	—
Length of pygidium	1.8	1.4	—	0.9
Width of pygidium	3.1	2.2	—	2.1
Length of axis	1.4	1.1	—	0.7
Width of axis	0.8	0.6	—	0.3

Description. — *Cephalon.* Glabella slightly pointed anteriorly, broadest between palpebral lobes, contracted behind γ. On some specimens 3 pairs of extremely shallow lateral furrows visible. Posterior angles of

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Text-Pl. VI

Cyrtosymbole (Waribole) sp. *a*

Fig. 1. Pygidium: *a* lateral view, *b* posterior view (IG 172.II.142).

Cyrtosymbole (Waribole) granulata n. sp.

Fig. 2. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 172.II.31).

Fig. 3. Fragment of librigena, dorsal view (IG 172.II.85).

Fig. 4. Pygidium: *a* lateral view, *b* posterior view (IG 172.II.74).

Cyrtosymbole (Waribole) prima n. sp.

Fig. 5. Cranidium: *a* lateral view, *b* anterior view (IG 170.II.525).

Fig. 6. Pygidium, holotype: *a* lateral view, *b* posterior view (IG 170.II.524).

Cyrtosymbole (Waribole) secunda n. sp.

Fig. 7. Pygidium, holotype: *a* lateral view, *b* posterior view (IG 170.II.542).

Fig. 1-4. Jabłonna, Famennian, *Wocklumeria* zone (VI)?
Fig. 5, 6: Gałęzice Famennian, *Postprolobites* zone (IV)?
Fig. 7. Gałęzice, Famennian, *Laevigites* zone (V)?

(Scales = 1 mm)

glabella slope strongly to occipital furrow. Axial furrows obsolete opposite palpebral lobes, becoming distinct anteriorly. Occipital ring maintaining width (long.) laterally, sloping strongly outwards. Occipital furrow narrow, distinct. Anterior border flat, with two to three lists, its width (long.) about one half of width (long.) of occipital ring. Preglabellar field slightly narrower (long.) than anterior border. Palpebral lobes very long, broad; ε and γ close to axial furrows. Posterior and anterior branches of facial sutures strongly divergent. In longitudinal profile occipital ring slightly lower than glabella; glabella flat, gently sloping forwards; preglabellar field narrow (long.); anterior border upturned. In transverse profile glabella and palpebral lobes are level. Librigena with long visual surface of eye, lateral border indistinct. Librigenal spine moderately long.

Hypostoma and *thorax* unknown.

Pygidium parabolic, with faintly marked, flat border. Axis almost parallel-sided, with rounded extremity. Nine rings distinctly visible. Postaxial ridge present. Pleural lobes with only four lobes clearly marked. First four pleural and interpleural furrows clear cut. In longitudinal profile pygidial axis horizontally situated, postaxial field sloping down.

Ornamentation. Glabella, occipital ring and librigena covered with minute, scale-like tubercles. Such tubercles occur also on posterior margins of pygidial rings.

Variation within the species concerns the following characters: 1) anterior part of glabella, which may be pointed or slightly rounded; 2) lateral glabellar furrows, which may be absent or indistinctly marked; 3) ornamentation, which is obsolete on some specimens, in which the exoskeleton is smooth and shiny.

Ontogeny. — The smallest illustrated cranidium (length 2.2 mm; pl. IX, fig. 1) has anterior margin of cranidium strongly curved, border furrow distinct and preglabellar field narrow (long.). Glabella almost parallel-sided, slightly pointed at front. Axial furrows distinctly marked. Occipital ring narrow (long.), not tapering laterally, sloping outwards. Occipital furrow deep at extremities. Posterior angles of glabella slope down towards occipital furrow. Four pairs of lateral glabellar furrows visible. Palpebral lobes long, broad, with shallow crescentic furrows along their outer margins; ε and γ further from axial furrows than in adult forms. The smallest known pygidium, probably belonging to this species (length 0.9 mm; pl. IX, fig. 2), is almost rectangular, with a flat, broad horizontal border, lower than rest of pygidium. Larval notch present. Axis slender reaching posterior border; seven axial rings. Six segments on pleural lobes clearly separated by interpleural furrows. Pleurae terminate in short free points. Pleural furrows broad, shallow.

Larger pygidium (length 1.4 mm; pl. IX, fig. 3) has border less flat and nearly level with rest of pygidium. Axis shorter, and produced into postaxial ridge. Larval notch present. Only the first pleural segments clearly separated, on rest of pleural lobes of pygidium segmentation becoming obsolete.

Discussion. — A comparison of *C. (Waribole) altera altera* R. & E. Richter, 1926, with *C. (Waribole) octofera altera* n.sp. has shown the following differences:

	C. (Waribole) octofera octofera	*C. (Waribole) octofera altera*
Anterior border	narrow (long.), strongly upturned	broad (long.), slightly upturned
Axial furrows opposite palpebral lobes	distinct	obsolete
Posterior angles of glabella	slightly inclined posteriorly	steeply sloping posteriorly
Lateral parts of occipital rings	gently inclined laterally	strongly inclined laterally
Librigena	with longitudinal ridge	no longitudinal ridge

The above cited differences, observed in all specimens, call for the erection of a new subspecies *C. (Waribole) octofera altera*. The Polish subspecies is closely related to *C. (Waribole) octofera octofera*, but seems to be more specialized. One should also mention that the young cranidium of *C. (Waribole) octofera altera* (pl. IX, fig. 1) is more similar to the subspecies *octofera* than the adult forms, which indicates that the Polish form may be descendant of *C. (Waribole) octofera octofera*.

Cyrtosymbole (Waribole) prima n.sp.
(pl. VII, fig. 1-3; text-pl. VI, fig. 5,6)

Holotype: No. IG 170.II.524; pl. VII, fig. 3 (pygidium); text-pl. VI, fig. 6.

Type horizon: Famennian, *Postprolobites* zone (IV)?

Type locality: Gałęzice, Holy Cross Mountains, Poland.

Derivation of name: prima — the earliest species of *C. (Waribole)* known in Poland.

Diagnosis. — Glabella broad, tapering forwards, without furrows. Anterior border very narrow (long.), strongly upturned. Occipital ring slightly tapering laterally. Palpebral lobes very wide (tr.). Librigena with strongly upturned lateral border and large eye. Pygidium with

narrow, convex border. Ornamentation consists of tubercles occurring on some parts of exoskeleton.

Material. — 3 damaged cranidia, 1 damaged librigena, 1 fragment of hypostoma, 10 pygidia from *Postprolobites* zone (IV)? of Gałęzice.

Dimensions (in mm):

IG Mus. cat. no.	170.II. 525	172.II. 524	172.II. 527	172.II. 529
Length of cranidium	5.4	—	—	—
Length of glabella	3.9	—	—	—
1/2 of glabellar width	1.5	—	—	—
Length of pygidium	—	4.0	5.0	2.9
Width of pygidium	—	6.0	8.1	4.5
Length of axis	—	3.1	3.5	2.0
Width of axis	—	2.0	2.4	1.2

Description. — Glabella squat, slightly contracted at midlength, unfurrowed. Occipital ring not tapering laterally, occipital furrow deep. Preglabellar field as wide (long.) as occipital ring. Anterior border very narrow, strongly upturned, with three lists. Palpebral lobes strongly curved, wide (tr.), close to occipital furrow; ε and γ near axial furrows, but ε nearer. Posterior branches of facial sutures very short, divergent. Anterior branches longer, slightly divergent. Cranidial part of posterior border long (tr.). In longitudinal profile occipital ring slopes gently down to occipital furrow; glabella vaulted; preglabellar field slightly concave; anterior border flat; steeply inclined. In transverse profile glabella almost flat; axial furrows distinctly marked; palpebral lobes elevated, not higher than glabella. Librigena with strongly upturned lateral border. Visual area large and inclined at an angle of about 35° to vertical. Lenses very small, hardly visible.

Hypostoma poorly preserved, with very prominent lateral border, near anterior wing.

Thorax unknown.

Pygidium subsemicircular, with narrow, convex border. Border furrow wide, in prolongation of axis extremely shallow. Axis broad (tr.), slightly tapering posteriorly, with at least nine flat rings. Postaxial ridge faint. Ring furrows marked only in middle part and near axial furrows curving backwards mesially. Pleural regions faintly furrowed, with four ribs visible. Interpleural and pleural furrows narrow, distinct near border furrow, becoming very shallow towards the axial furrows. In longitudinal profile axis almost horizontal, with first ring more convex

than others; postaxial part of pleural region slopes gently to pygidial margin. In transverse profile axis prominent, pleural lobes horizontal outwards to two-thirds of its width (tr.), then bent abruptly down. Pygidial doublure narrow, convex.

Ornamentation on cephalon, middle part of occipital ring, posterior border and middle part of librigena granular. On pygidium tubercles arranged chiefly along the posterior margins of axial rings, in their central parts, and in front of the interpleural furrows. Pygidial border finely granular. On the smallest known pygidium (length 2.9 mm) tubercles more densely distributed, and the characteristic arrangement of tubercles is not so distinct.

Discussion. — The cranidium described here is somewhat like *C. (Waribole) conifera* R. & E. Richter; the resemblances concern the shape of glabella and occipital ring, and the course of the facial sutures. The differences between the discussed species are however quite distinct and concern the border, which in *C. (Waribole) prima* is more prominent and upturned, as well as the palpebral lobes which in the transverse profile are in the new species more distinctly delimited from the glabella and steply inclined. The further differences concern the librigenae, the visual area of which is more convex in *C. (Waribole) prima* than in *C. (Waribole) conifera*, and the pygidial structure. The pygidium described above differs from pygidia of the remaining representatives of the subgenus *Waribole* and somewhat resembles the pygidia of *C. (Cyrtosymbole)* in having a convex border and being comparatively long (with respect to width). On the other hand, the nearly unfurrowed pleural lobes occurring in *C. (Waribole) prima* are also a feature common in the subgenus *Waribole* and rare in *C. (Cyrtosymbole)*. The similar pygidial structure is one which occurs also in *C. (Waribole) beulensis* which R. and E. Richter described from the *Postprolobites* zone (IV) of Germany[3]. The Polish species occurs also early in the Famennian zone III or IV. Both species in question seem to be closely related to the subgenus *C. (Cyrtosymbole)*, as some features of their pygidial structure are preserved, which are characteristic of the latter subgenus, from which they presumably derive. Cranidia of both species compared here are different however, that of *C. (Waribole) prima* — like the one characteristic of the subgenus *Waribole*, whereas the cranidium of *C. (Waribole) beulensis* is different from all the known species within the Famennian Cyrtosymbolinae.

[3] The data published by R. and E. Richter (1926, p. 51, 240) suggest to the present author that there is a mistake in the explanations to plates 3, fig. 30-33 in this paper, where the stratigraphic range of the species is recorded as: „Gon.-St.".

Cyrtosymbole (Waribole) secunda n.sp.
(pl. VII, fig. 4-7; text-pl. VI, fig. 7)

Holotype: No. IG 170.II.542; pl. VII, fig. 5; text-pl. VI, fig. 7 (pygidium).
Type horizon: Famennian, *Laevigites* zone (V)?
Type locality: Gałęzice, Holy Cross Mountains, Poland.
Derivation of name: secunda — the second successive species of C. *(Waribole)* in Famennian beds of Gałęzice.

Diagnosis. — Palpebral lobes triangular, in middle part depressed. Librigena with sharp longitudinal ridge. Eye large. Pygidium with slightly marked border and flat doublure. Exoskeleton coarsely granular.

Material. — 3 fragments of cranidia, 3 librigenae, 4 pygidia from *Laevigites* zone (V)? of Gałęzice.

Dimensions (in mm):

IG Mus. cat. no.	170.II.542	170.II.549
Length of pygidium	4.5	1.6
Width of pygidium	7.1	2.7
Length of axis	3.8	1.4
Width of axis	2.0	0.7

Description. — Glabella plump. Three pairs of lateral furrows weakly marked. Occipital ring broad (long.) distally. Palpebral lobes broad (tr.) triangular, close to occipital furrow, in middle part depressed; ε and γ close to axial furrows. Librigena with strongly marked lateral border furrow, narrow, prominent lateral border and a sharp, longitudinal ridge. Eye large situated obliquely on librigena. Lenses very small, hardly visible. Librigenal spine partly broken in all specimens, but probably thin.

Hypostoma and *thorax* unknown.

Pygidium subsemicircular with indistinctly marked border. Axis with at least nine rings, rounded posteriorly, reaching border. Ring furrow distinct. On pleural lobes seven convex ribs. Pleural furrows deep, interpleural furrows fine, neither reaching pygidial margin. Pygidial doublure flat. In longitudinal profile axis horizontal with prominent rings, merging without interruption into postaxial part of pygidium. In transverse profile axis prominent; pleural lobes strongly vaulted.

Ornamentation. Cranidium and pygidium coarsely granulate. On librigena tubercles occur only on lateral and posterior border, and posterolateral part of exoskeleton.

In the same beds, in Gałęzice, one young pygidium (length 1.6 mm; pl. VII, fig. 7) has been found. It is transversely elongated, with a flat, narrow border and convex ribs. The interpleural furrows are still

distinct. The first segment is clearly separated from the rest of the pygidium. Larval notch absent. The pygidium is densely granulate.

Discussion. — In the beds yielding *C. (Waribole) secunda* n.sp. there occur rare specimens of *C. (Waribole) conifera* R. & E. Richter. Both species differ markedly. The new species has the wider (tr.) palpebral lobes, with a distinct depression in the middle part. The librigena of the new species is also quite different in having a sharp ridge surrounding the visual lobe. The latter is sited obliquely with regard to the surface of the librigena, whereas in *C. (Waribole) conifera* it lies nearly horizontally. The shape of adult pygidia is closely comparable, only the pygidial axis being in *C. (Waribole) secunda* less sharply delimited from the remaining part of the pygidium. Young pygidia (older stages without the larval notch) are less similar, that of *C. (Waribole) secunda* being wider and having a narrower border. The most conspicuous difference between the species in question is the ornamentation which in the new species is more distinct, simply granular, whereas in *C. (Waribole) conifera* the granules are scale-like, arranged into concentric pattern. *C. (Waribole) secunda,* on the other hand, resembles *C. (Waribole) prima* n.sp. The latter species occur in the older beds, probably equivalent to zone IV. It is characterized by a comparatively shorter (long.) and wider (tr.) librigena, with an indistinct ridge surrounding the visual lobe. The visual lobe in *C. (Waribole) prima* is situated more horizontally than in *C. (Waribole) secunda.* The shape of the pygidia in both species similar, but the pygidial axis in *C. (Waribole) secunda* is longer, reaching the border, which is here less prominent than in *C. (Waribole) prima.* The ornamentation in *C. (Waribole) prima* in also granular, the granules are however less prominent, spaced on some parts of the exoskeleton only. The similarities in cranidia are the features characteristic of the entire subgenus *Waribole.*

Cyrtosymbole (Waribole) granulata n.sp.
(pl. VI, fig. 7,8; text-pl. VI, fig. 2-4)

Holotype: No. IG 172.II.31; pl. VI, fig. 8; text-pl. VI, fig. 2, (cranidum).
Type horizon: Famennian, *Wocklumeria* zone (VI)?
Type locality: Jabłonna, Holy Cross Mountains, Poland.
Derivation of name: granulata — ornamentation granular.

Diagnosis. — Glabella tapering forwards, with feebly marked lateral furrows. Preglabellar field wide (long.) Palpebral lobes large and broad (tr.); γ far from axial furrows. Cranidium finely and sparsely granulate.

Material. — 2 nearly complete cranidia, 1 damaged librigena, 4 pygidia probably belonging to this species from *Wocklumeria zone* (VI)? of Jabłonna.

Dimensions (in mm):

IG Mus. cat. no.	172.II.31	172.II.74
Length of cranidium	3.7	—
Length of glabella	3.0	—
Width of glabella	1.9	—
Length of pygidium	—	2.2
Width of pygidium	—	3.3
Length of axis	—	1.5
Width of axis	—	0.9

Description. — *Cephalon.* Glabella tapering forwards slightly pear-shaped. Axial furrows and three pairs of lateral glabellar furrows shallow. Anterior border narrow (long.), upturned. Border furrow indistinct. Preglabellar field twice as wide (long.) as anterior border. Palpebral lobes rounded in outline, broad (tr.), unusualy long, reaching almost from occipital furrow to anterior third of length of glabella. They are somewhat concave; ε close to axial furrows, γ in front of anterior glabellar furrow (S_3), distant from axial furrows; γ more outwards than ε. Anterior branches of facial sutures short, first strongly divergent, then gently bent outwards; β broadly rounded. In longitudinal profile glabella weakly convex; preglabellar field broad (long.); anterior border upturned. In transverse profile glabella flat, almost not separated from palpebral lobes. A fragment of librigena has been found, which because of the course of its facial suture can be included in this species. Lateral border narrow, lateral border furrow faint.

Hypostoma and *thorax* unknown.

Pygidium subsemicircular. Border indistinctly defined. Axis with ten or eleven rings, its apex poorly delimited; postaxial ridge present. On pleural lobes four ribs weakly marked. Pleural and interpleural furrows faint. In longitudinal profile axis merges without interruption into the postaxial region of pygidium. In transverse profile axis narrow, high; pleural lobes vaulted.

Ornamentation on cranidium, librigena and pygidium consists of very fine, widely dispersed tubercles. Two to three irregular lists visible on cranidial border. One list of same character marked on upper part of pygidial margin. The pygidia are attributed to this species on account of the similar ornamentation.

Discussion. — Cranidium of *C. (Waribole) granulata* n.sp. differs from all the hitherto described representatives of *C. (Waribole)* in the size of the palpebral lobes, the posterior edges of which are situated close to the occipital furrow, as in the remaining representatives of the subgenus; the anterior edges reach the anterior third of the glabellar length, in front of the third lateral glabellar furrows (S_3). The long

palpebral lobes are characteristic of the species *C. (Waribole) octofera* R. & E. Richter, 1926, and *C. (Waribole) phacomma* R. & E. Richter, 1926, but in these species they are not so wide (tr.) as in the new species described here. The large distance between the anterior edges of the palpebral lobes (γ) and the axial furrows, is also a character not so far known in *C. (Waribole)*. The longitudinal as well as transverse flattening of the cranidium, characteristic of *C. (Waribole) granulata*, is common to the representatives of *C. (Waribole)*. The pygidium here described is typical of this subgenus and is characterized by lack of a distinct border and the obsolete interpleural and pleural furrows. A very similar pygidium occurs in *C. (Waribole) octofera altera* n.subsp. The differences concern mainly the shape of the axis, which in *C. (Waribole) granulata* is more slender and less sharply delimited posteriorly from the postaxial part of the pygidium, as well as the ornamentation, which in the species described above is granular, whereas in *C. (Waribole) octofera altera* the granules are flattened, scale-like in apperance. On account of the length of the palpebral lobes, shallow axial and lateral glabellar furrows and the shape of pygidium, *C. (Waribole) granulata* seems to be most closely related to the *octofera*-group, including *C. (Waribole) octofera octofera*, *C. (Waribole) octofera altera* and *C. (Waribole) phacomma*. The *octofera*-group seems to differ markedly from the remaining representatives of *C. (Waribole)* in the characters of its cranidium.

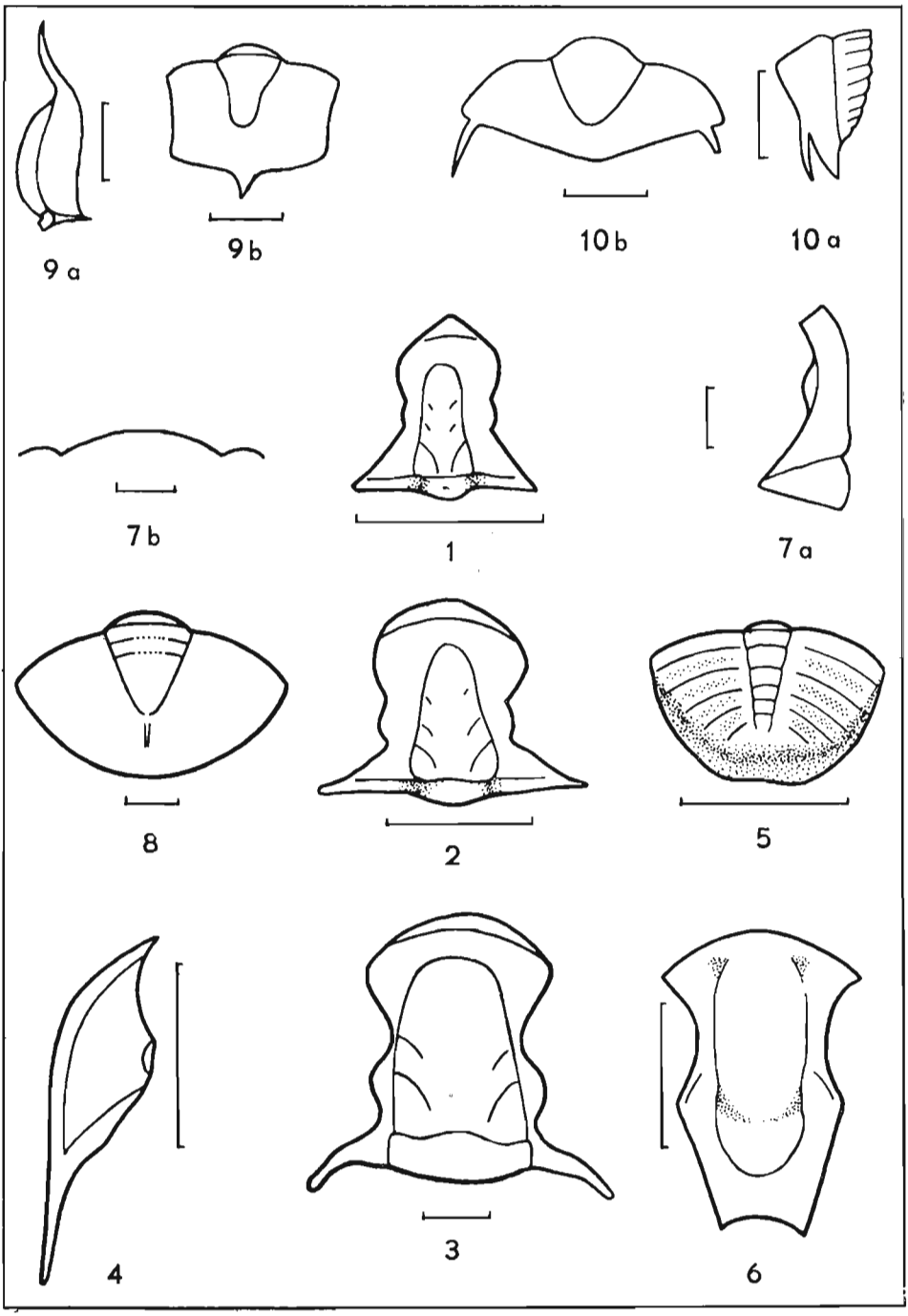
Cyrtosymbole (Waribole) cf. *warsteinensis* R. & E. Richter, 1926
(pl. IX, fig. 8; text-pl. VII, fig. 7)

Material. — 1 damaged cranidium from *Wocklumeria* zone (VI)? of Jabłonna.

Description. — Three pairs of lateral glabellar furrows faintly marked. Occipital ring tapering laterally. Palpebral lobes triangular, concave in middle part; ε and γ close to axial furrows. In longitudinal profile glabella slightly convex. In transverse profile glabella convex; axial furrows deep; palpebral lobes as high as glabella. Ornamentation on cranidium granular.

Discussion. — The specimen here described resembles *C. (Waribole) warsteinensis* R. & E. Richter in the shape of its palpebral lobes and in having shallow and faint posterior glabellar furrows (S_1). Also the transverse profiles are similar. The differences concern the occipital ring, which in *C. (Waribole) warsteinensis* widens (long.) towards the axial furrows, whereas it tapers in the cranidium described here. The specimen from the Holy Cross Mountains is distinctly ornamented with small granules, covering the cranidium (except the surface of the wide lateral glabellar furrows), whereas in the specimens described by R. and E. Richter the exoskeleton is smooth.

TEXT-PL. VII



Cyrtosymbole (Waribole) cf. *phacomma* R. & E. Richter, 1926
(pl. IX, fig. 9)

Material. — 1 damaged librigena from the *Wocklumeria* zone (VI)? of Jabłonna.

Discussion. — The specimen found is characterized by the presence of a fine longitudinal ridge, surrounding the visual lobe and becoming obsolete backwards. The area occupied by the visual lobe (not preserved in the specimen described) very long. The similar long visual lobe, surrounded by a ridge, occurs in *C. (Waribole) phacomma* R. & E. Richter, in the latter species however the ridge is more sharply marked and reaches the posterior border furrow. The lateral border, which in German specimens is not developed, here occurs in the posterior part of the librigena, passing forwards into a slightly concave marginal area. The granular ornamentation, characteristic of the German form, occurs also in the Polish specimen, but covers only the librigenal surface as far as the ridge. The exoskeleton surrounding the visual lobe is smooth. The librigena described here is also similar to that of *C. (Waribole) secunda* n.sp., but differs in having a ridge that is not so prominent, a less well developed border and more dense granulation.

Text-Pl. VII

Cyrtosymbole (Waribole) abruptirhachis R. & E. Richter

Fig. 1,2. Young cranidia, dorsal view (*1* — IG 173.II.37, *2* — IG 173.II.36).

Fig. 3. Cranidium, dorsal view (IG 173.II.32).

Fig. 4. Young librigena, dorsal view (IG 173.II.747).

Fig. 5. Young pygidium, dorsal view (IG 173.II.38).

Fig. 6. Hypostoma, dorsal view (IG 173.II.35).

Cyrtosymbole (Waribole) cf. *warsteinensis* R. & E. Richter

Fig. 7. Fragment of cranidium: *a* lateral view, *b* transverse profile (IG 172.II.30).

Diacoryphe strenuispina n. sp.

Fig. 8. Pygidium, dorsal view (IG 173.II.323).

Formonia convexa n. sp.

Fig. 9. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 173.II.561).

?Formonia sp.

Fig. 10. Pygidium: *a* lateral view, *b* posterior view (IG 173.II.559).

Fig. 1-6: Kowala, Carboniferous, *Gattendorfia* zone (VII).

Fig. 7: Jabłonna, Famennian, *Wocklumeria* zone (VI)?

Fig. 8. Jabłonna, Carboniferous, *Gattendorfia* zone (VII).

Fig. 9, 10: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

(Scales = 1 mm)

Cyrtosymbole (Waribole) sp. *a*

(pl. IX, fig. 7; text-pl. VI, fig. 1)

Material. — 4 pygidia from *Wocklumeria* zone (VI)? of Jabłonna, 2 pygidia from the same zone of Gałęzice.

Dimensions (in mm):

	No. IG 172.II.142
Length of pygidium	2.4
Width of pygidium	3.9
Length of axis	2.0
Width of axis	0.9

Description. — Pygidium semicircular, border not differentiated. Pygidial axis wide (tr.), short (long.), tapering backwards, with nine rings. Ring furrows in middle part convex posteriorly, bent posteriorly again at axial furrows. On the pleural lobes six to seven convex ribs. Pleural furrows deep, wide, interpleural furrows narrow, distinct. Anterior bands of ribs more convex and wider (long.) than posterior ones. In the longitudinal profile axis prominent, situated horizontally, in the posterior part distinctly delimited from postaxial part of pygidium. In transverse profile, axis as well as pleural lobes strongly vaulted.

Ornamentation composed of small, densely spaced granules.

Discussion. — The pygidia here described resemble those of *C. (Waribole) octofera octofera* R. & E. Richter, in the slightly radial arrangement of the pleural ribs, the anterior bands of which are more prominent and longer (long.) than the posterior ones. The differences concern the shape of the pygidial axis, which here strongly tapers posteriorly, being subtriangular, and the ornamentation composed of pointed, densely spaced granules which in *C. (Waribole) octofera octofera* are scale-like and flat. The ring furrows are sigmoid in the pygidia described here, but not so in *C. (Waribole) octofera octofera.* In longitudinal profile the postaxial part of the pygidium is longer and more downwards sloping in *C. (Waribole) octofera octofera* than in *C. (Waribole)* sp. *a.* Also in transverse profile the two forms differ in the shape of their pleural lobes, which in *C. (Waribole) octofera octofera* are more flat.

The pygidia described here at the same time resemble those of *Perliproetus marginatus* (Münster), and the similarities concern the radial arrangement of ribs and the sigmoid course of the ring furrows. However the shape of the pygidia and their longitudinal and transverse profiles are different. Also the number of axial rings is smaller in *P. marginatus* and the ornamentation is developed as sparsely spaced hemispheric granules.

Cyrtosymbole (Waribole) sp. *b*
(pl. VII, fig. 8; text-pl. V, fig. 6)

Material. — 3 pygidia from *Wocklumeria* zone (VI)? of Jabłonna.
Dimensions (in mm):

No. IG 172.II.23	
Length of pygidium	1.6
Width of pygidium	2.5
Length of axis	1.3
Width of axis	0.5

Discussion. — Three pygidia from *Wocklumeria* zone? of Jabłonna are young forms in the meraspis stage, judging from their small dimensions, the larval notch and the well preserved and distinctly separated first pleural segments .The pygidium figured in pl. VII, fig. 8 is subtriangular, has twelve axial rings and eleven pleural segments, the three first being distinctly delimited by interpleural furrows, reaching the pygidial margin. R. & E. Richter (1926) and Maksimova (1955) described similar pygidia from Famennian (see discussion on p. 86) as *Cyrtosymbole nepia* presuming that they were the larval forms .

Subgenus *Cyrtosymbole (Macrobole)* R. & E. Richter, 1951
Cyrtosymbole (Macrobole) laticampa n.sp.
(pl. XI, fig. 1-5)

Holotype: No. IG 173.II.344; pl. XI, fig. 5 (cranidium).
Type horizon: Carboniferous, *Gattendorfia* zone (VII).
Type locality: Jabłonna, Holy Cross Mountains, Poland.
Derivation of name: latus — broad, *campus* — field; because of broad (long.) preglabellar field.

Diagnosis. — Glabella elongate slightly tapering anteriorly. Occipital ring wide (long.). Preglabellar field as wide (long.) as occipital ring. Anterior border flat. Palpebral lobes narrow (tr.) situated half way along the glabellar length. Librigena with long spine, reaching pygidium. Pygidium parabolic, axis wide (tr.), sharply tapering posteriorly.

Material. — 3 nearly entire specimens, 2 cephala, 13 cranidia, 9 librigenae, 4 hypostomata, 22 pygidia from *Gattendorfia* zone (VII) of Jabtonna.

Dimensions (in mm) — see p. 140.

Description. — Glabella elongate, slightly tapering and pointed forwards. 3 pairs of faint lateral glabellar furrows. Posterior (S_1) bifurcated, not reaching the occipital furrow. Middle (S_2) and anterior (S_3) short, convex forwards. Occipital furrow divided into three parts, middle one convex forwards, and lateral one directed obliquely forwards. Occipital ring wide (long.), not tapering laterally. Preglabellar field wide (long.), its width being equal to that of occipital ring (long.) or slightly wider. Anterior border furrow faint. Palpebral lobes narrow (tr.), strongly curved; ε and γ far from axial furrows. Posterior branches of facial sutures,

IG Mus. cat. no.	173.II. 262	173.II. 344	173.II. 271	173.II. 345	173.II. 371	173.II. 348	173.II. 350
Length of entire specimen	—	—	10.0	—	—	—	—
Length of cephalon	5.0	4.9	4.1	3.3	2.4	—	—
Width of cephalon	7.9	—	7.3	—	—	—	—
Length of glabella	3.3	3.1	2.7	2.0	1.5	—	—
Width of glabella	2.4	2.5	2.1	1.7	0.9	—	—
Length of librigenal spine	—	4.7	—	—	—	—	—
Length of pygidium	—	—	2.2	—	—	2.4	1.2
Width of pygidium	—	—	4.6	—	—	4.7	1.9
Length of axis	—	—	1.7	—	—	1.9	0.9
Width of axis	—	—	1.4	—	—	1.6	0.5

from posterior border furrow to ε parallel to axial furrows, anterior branches divergent; β broadly rounded. In longitudinal profile glabella convex. Librigena with indistinct lateral border. Posterior border furrow deep. Librigenal spine very long, reaching pygidium. Visual lobe not preserved. Hypostoma elongate with transversely convex central body and flat border.

Thorax with nine segments. Thoracic pleurae pointed.

Pygidium parabolic, without border. Axis wide (tr.), occupying nearly one third of pygidial width, strongly tapering posteriorly, convex transversely. Eight to nine axial rings, delimited by shallow ring furrows. Pleural and interpleural furrows faint.

Ornamentation as small granules sparsely spaced on preglabellar field, densely on remaining part of cranidium. On librigenae and pygidium ornamentation finer with sparsely spaced granules.

Ontogeny. — The smallest cranidium found (not figured, 1.2 mm long) is pointed anteriorly. Glabella very slender, preglabellar field wider (long.) than occipital ring (long.). Cranidium (figured in pl. XI, fig. 2) is slightly older (2.4 mm long) and less pointed anteriorly. Glabella slender, axial furrows wide (tr.), shallowing forwards. Lateral glabellar furrows very fine. Occipital ring tapering distally. Distance of γ from axial furrows equal to one-third of basal glabellar width, ε slightly closer to axial furrows. Posterior and anterior branches of facial sutures slightly divergent. Palpebral lobes somewhat curved, sited opposite midlength of glabella. The smallest pygidium found (1. 2 mm long; pl. XI, fig. 1) has narrow (tr.) axis with ten axial rings. Larval notch present. Eight segments on pleural lobes, first four distinctly delimited by interpleural furrows and produced into short, free spines. Border distinguishable only in postaxial part of pygidium, wide and flat.

Discussion. — *C. (Macrobole) laticampa* n.sp. differs from all hitherto described species of this subgenus in having wide (long.) preglabellar field. R. & E. Richter (1951) described *C. (Macrobole) duodecimae* on poorly preserved material, from which a more detailed comparison with other species is not possible. The reconstruction given by the authors (R. & E. Richter, 1951, pl. 5, fig. 49) does not appear to the present author entirely correct. This concerns especially the course of the posterior branches of the facial sutures; in all the specimens examined by the present author in the Senckenberg Museum, these are parallel to the axial furrows, and on reaching the posterior border furrow bent sharply outwards, whereas in the reconstruction they are shown as diverging steadily away from the axial furrows, between the turning points ε and ω. The cranidium of *C. (Macrobole) laticampa* is characterized by similar course of the posterior branches of the facial sutures, as in specimens of *C. (Macrobole) duodecimae.*

The ornamentation preserved on the cranidia is in both species identical. Differences concern: 1) the preglabellar field with a width (long.) in *C. (Macrobole) duodecimae* equal to half that of the occipital ring (long.), whereas in the new species it is equal to the occipital ring; 2) length (long.) of the palpebral lobes, the anterior edges of which (γ) in *C. (Macrobole) duodecimae* are situated opposite the anterior glabellar furrows (S_3), whereas in the new species they are in front of S_3. The posterior margins of the palpebral lobes (ε) are in both species situated in the same places. There are also differences in the pygidia, for in *C. (Macrobole) duodecimae* there is a postaxial ridge (absent in *C. (Macrobole) laticampa),* the pleural and interpleural furrows are less distinct in *C. (Macrobole) laticampa* than in the former species. The librigenae in the subgenus *Macrobole* are thus far known only in one species, viz. *C. (Macrobole) blax* R. & E. Richter, 1951, and they have a rounded outline. *C. (Macrobole) laticampa* has the characteristic librigena of the genus *Cyrtosymbole,* produced into a librigenal spine, which is equal to the cranidial length and reaches as far back as the anterior margin of the pygidium. *C. (Macrobole) laticampa* is also somewhat similar to *C. (Waribole) granifera* Chlupač, 1961, described from Moravia. Similarities concern the flat anterior border, wide (long.) preglabellar field and the ornamentation. Differences concern the position of the palpebral lobes, situated close to the occipital furrow, in *C. (Waribole) granifera,* and the shape of the glabella which in the latter species tapers less and is broadly rounded anteriorly.

Cyrtosymbole (Macrobole) ?laticampa n.sp.
(pl. XI, fig. 7; text-pl. VIII, fig. 3)

Material. — 3 cranidia from *Gattendorfia* zone (VII) of Jabłonna.

Dimensions (in mm):

	No. IG 173.II.372
Length of cranidium	2.3
Length of glabella	1.3
Width of glabella	1.4

Discussion. — In the beds yielding *C. (Macrobole) laticampa* three cranidia were found, differing from the latter species in the following characters: 1) glabella shorter, with lateral glabellar furrows deeply incised, the posterior ones (S_1) reaching the occipital furrow; 2) preglabellar field nearly twice as broad (long.) as the occipital ring (long.); 3) anterior border narrower (long.), prominent; 4) palpebral lobes shorter (long.), situated between S_1 and S_3, strongly curved; 5) posterior and anterior branches of the facial sutures from points ε and γ strongly divergent (pl. XI, fig. 7), or with posterior branches along parallel for a short distance to the axial furrows, and then strongly divergent backwards (text-pl. VIII, fig. 3). It is not impossible that these differences are caused by a strong deformation of the cranidia, which are shortened and widened. In such a case the preglabellar field should be narrower than in the typical forms, but this is not the case.

Cyrtosymbole (Macrobole) brevispina n.sp.

(pl. XIII, fig. 2-9; text-pl. VIII, fig. 1,2)

Holotype: No. IG 173.II.39; pl. XIII, fig. 6; text-pl. VIII, fig. 1 (cranidium).
Type horizon: Carboniferous, *Pericyclus* zone (VIII).
Type locality: Gałęzice, Holy Cross Mountains, Poland.
Derivation of name: brevis — short, *spina* — spine; librigena with short spine.

Diagnosis. — Glabella broadly rounded in front. Anterior border convex. Occipital ring with occipital lobes. Anterior branches of facial sutures short, strongly divergent. Librigena with short spine. Pygidium with axis rapidly tapering backwards. Eleven axial rings. Postaxial ridge faint. Surface of cranidium densely covered with minute granules.

Material. — Internal moulds of 30 cranidia, 7 librigenae, 60 pygidia from lower beds of *Pericyclus zone* (VIII) of Zaremby, and 1 testate cranidium from *Pericyclus* zone of Gałęzice.

Dimensions (in mm):

IG Mus. cat. no.	173.II. 39	173.II. 384	173.II. 382	173.II. 378	173.II. 381	173.II. 710	173.II. 478
Length of cranidium	4.5	4,5	2,8	2.4	—	—	—
Length of glabella	3.1	3.2	1.8	1.6	—	—	—
Width of glabella	2.6	2.5	1.3	1.1	—	—	—
Length of pygidium	—	—	—	—	2.2	2.0	1.6
Width of pygidium	—	—	—	—	3.5	3.2	2.2
Length of axis	—	—	—	—	1.8	1.7	1.3
Width of axis	—	—	—	—	1.2	0.9	0.7

Description. — *Cephalon.* Glabella elongate, between S_3 slightly contracted, broadly rounded in front. Three pairs of lateral glabellar furrows marked on moulds only. Posterior (S_1) not reaching occipital furrow. Occipital ring broad (long.), flat, not tapering laterally, with occipital lobes slightly marked on moulds. Occipital furrow deep. Preglabellar field narrow (long.). Anterior border furrow faint. Anterior border convex, slightly upturned. Palpebral lobes narrow (tr.), curved, situated slightly behind midlength of glabella. ε and γ broadly rounded, distant from axial furrows. Posterior branches of facial sutures parallel to axial furrows, anterior branches short, divergent; δ situated further out than β. Posterior border short (tr.), convex. In longitudinal profile occipital ring flat; glabella gently arched, preglabellar field narrow, concave; anterior border slightly upturned. In transverse profile glabella gently vaulted; axial furrows incised; palpebral lobes lower than glabella. Librigena with slightly marked lateral border. Librigenal spine short, sharply pointed.

Hypostoma and *thorax* unknown.

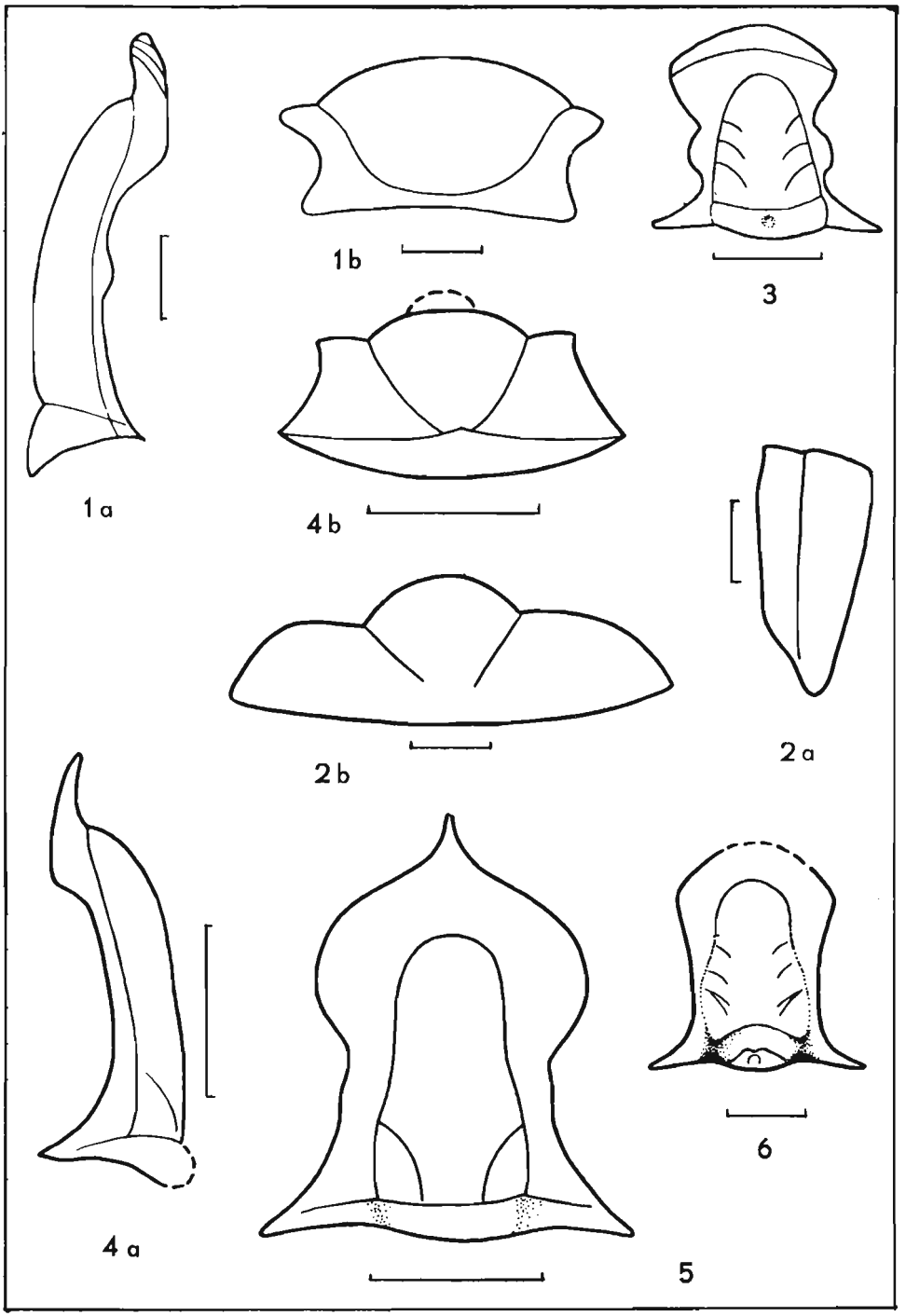
Pygidium subsemicircular, without border. Axis with eleven rings. On pleural lobes seven ribs visible. Axis broad (tr.), rapidly tapering backwards, with postaxial ridge. Pleural furrows deep, broad. Interpleural furrows weakly marked, somewhat extending laterally. In longitudinal profile axis of pygidium strongly arched, sloping backwards; in transverse profile axis and pleural lobes vaulted.

Ornamentation. Surface of cranidium densely covered with minute granules. Surface of librigena and pygidium unknown.

Ontogeny. — Length of smallest known cranidium 2,4 mm (pl. XIII, fig. 4). During growth the following changes can be observed: 1) glabella becomes less slender, its frontal part more rounded; 2) lateral glabellar furrows (S_1) at first deep and reaching occipital furrow, later become shallower and shorter; 3) anterior margin of cranidium in young specimens strongly pointed, gradually becomes more rounded; 4) palpebral lobes become more strongly curved. The youngest known pygidium (length 1,6 mm) has a very broad, flat rim and a larval notch distinctly marked, the axial furrows are very shallow and only deepened at the interpleural furrows, the pleural furrows are not marked. It has four axial rings and three to four pleural segments. The first three pleurae pointed. The oldest known pygidium (length 2,2 mm; pl. XIII. fig. 9) has slender axis with eleven rings. Seven pleural segments on pleural lobes.

Discussion. — *C. (Macrobole) brevispina* n.sp. shows some resemblance with *C. (Macrobole) duodecimae* R. & E. Richter, 1951. These concern the palpebral lobes which are in both species wider (tr.) than in the remaining species of this subgenus. *C. (Macrobole) vigilax* Chlupač, 1961, has

TEXT-PL. VIII



palpebral lobes of similar shape, but differs distinctly in having a shorter glabella, and in the divergent course of the posterior branches of the facial sutures. *C. (Macrobole) brevispina* and *C. (Macrobole) vigilax* have the same ornamentation. Some resemblances exist between the new species and *C. (Macrobole) blax* R. & E. Richter, 1951, especially with regard to the shape of the glabella and an occipital ring with developed occipital lobes. The German species differs, however, in possessing a narrower (long.) preglabellar field, convex anterior border and a librigena with rounded angle. The latter is in *C. (Macrobole) brevispina* produced into a sharp, short spine, and both fixigenae and palpebral lobes are wider (tr.). The pygidia in both species mentioned are similar in longitudinal and transverse profiles, but they have different proportions, as the pygidia of the Polish species are shorter and wider. Other resemblances to *C. (Macrobole) brevispina* are in the similarly shaped pygidia of *C. (Macrobole) duodecimae,* which have distinctly marked interpleural and pleural furrows and a short postaxial ridge. *C. (Macrobole) brevispina* differs from the latter species in having eleven axial rings, whereas in *C. (Macrobole) duodecimae* there are eight to nine rings.

Cyrtosymbole (Macrobole) ?brevispina n.sp.
(pl. X, fig. 1)

Material. — Fragment of internal mould of 1 pygidium from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Description. — Eleven axial rings. Pleural segments produced into short spines. Interpleural furrows narrow, pleural furrows wide .

Text-Pl. VIII

Cyrtosymbole (Macrobole) brevispina n. sp.

Fig. 1. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 173.II.39).

Fig. 2. Pygidium: *a* lateral view, *b* posterior view (IG 173.II.710).

Cyrtosymbole (Macrobole) ?laticampa n. sp.

Fig. 3. Cranidium, dorsal view (IG 173.II.372).

Typhloproetus kozlowskii n. sp.

Fig. 4. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 173.II.500).

Typhloproetus cf. *kozlowskii* n. sp.

Fig. 5. Cranidium, dorsal view (IG 173.II.554).

?Typhloproetus angustigenalis n. sp.

Fig. 6. Cranidium, holotype, dorsal view (IG 173.II.498).

Fig. 1, 2, 4-6: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

Fig. 3: Jabłonna, Carboniferous, *Gattendorfia* zone (VII).

(Scales = 1 mm)

Discussion. — The mentioned pygidium, preserved as an internal mould is interesting on account of the presence of seven short spines along the margin. As the fragmentary pygidium is fairly large (about 2.5 mm long), it is unlikely that the pleurae produced into spines could represent the future thoracic segments, and the pygidium should not be interpreted as a transitory pygidium. Shape of axis and character of interpleural and pleural furrows show that the pygidium could be recorded within *C. (Macrobole) brevispina.*

Cyrtosymbole (Macrobole) cf. *brevispina* n.sp.
(pl. XIII, fig. 1)

Material. — Internal moulds of 7 cranidia from upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.741
Length of cranidium	2.0
Length of glabella	1.3
Width of glabella	0.8

Description. — Glabella finger-shaped. Posterior glabellar furrows (S_1) strongly incised. Occipital ring tapering laterally. Width of preglabellar field (long.) equal to that of occipital ring (long.) in its middle part. Border furrow faint. Anterior border flat, slightly upturned. Anterior margin of cranidium produced into short spine. Fixigenae wide (tr.), palpebral lobes narrow (tr.), slightly curved; ε and γ situated far from axial furrows. Posterior branches of facial sutures long, parallel to axial furrows. Anterior branches as long as posterior, slightly divergent, β very broadly rounded.

Discussion. — The cranidia here described derive from the same locality as *C. (Macrobole) brevispina* n.sp., but are found in younger beds. Because of such larval characters as the anteriorly pointed cranidium, the posterior glabellar furrows (S_1) deeply incised, reaching the occipital furrow and the laterally tapering occipital ring, the author considers that the cranidia described represent the young stages. They however differ in comparison with the young cranidia of *C. (Macrobole) brevispina*, of the same length, in having the glabella broadly rounded anteriorly (whereas it is slightly pointed in typical forms), the wider (long.) preglabellar field, equal to the width (long.) of the occipital ring, the short spine on the anterior margin of the cranidium (which in typical forms is merely a point), and the shorter palpebral lobes (long.). In beds yielding young cranidia of *C. (Macrobole)* cf. *brevispina* the adult forms are very rare and among them no representative of *C. (Macrobole)* was found. That is why it is difficult to venture an opinion as to whether the differences observed are caused by the different specific attribution, or

lie within the range of intraspecific variation; or lastly whether they are caused by differences in the state of preservation.

Cyrtosymbole (Macrobole) cf. *blax* R. & E. Richter, 1951
(pl. XIII, fig. 10)

Material. — 4 cranidia from *Gattendorfia* zone (VII) of Jabłonna. Dimensions (in mm):

No. IG 173.II.349	
Length of cranidium	4.3
Length of glabella	2.9
Width of glabella	2.8

Discussion. — These cranidia found in the Holy Cross Mountains have an ornamentation identical with *C. (Macrobole) blax* from Germany, consisting of small, densely spaced granules; the course of the facial sutures and also the convex anterior border delimited from the glabella by a narrow (long.) preglabellar field are similar. The differences concern the shape of the glabella, which at the level of S_3 is slightly contracted, and the width of the fixigenae, which in *C. (Macrobole)* cf. *blax* are slightly wider. A specimen examined by the present writer in the Senckenberg Museum No. SMF X 1442g (R. & E. Richter, 1951, pl. 2, fig. 17), which was identified by R. and E. Richter as *C. (Macrobole) blax?*, has a similarly shaped glabella that is slightly contracted between S_3; it is about twice as long as the cranidia from the Holy Cross Mountains, and also larger than the remaining German specimens. It seems that the differences may be due merely to intraspecific variation, and that both the Polish and the German specimens in question are in fact conspecific.

Cyrtosymbole (?Macrobole) differtigena n.sp.
(pl. XII, fig. 3-5; text-fig. 5 *B*)

Holotype: No. IG 171.II.77c; pl. XII, fig. 5 (pygidium).
Type horizon: Carboniferous, *Gattendorfia* zone (VII)?
Type locality: Karczówka, Holy Cross Mountains, Poland.
Derivation of name: differtus — stuffed, *gena* — cheek; librigenal angle thickened.

Diagnosis. — Glabella elongate, tapering forwards, with rounded front. Occipital ring broad (long.), band-like. Preglabellar field absent. Anterior border narrow (long.), upturned. Palpebral lobes narrow (tr.) at midlength of glabella. Librigena broad (tr.) with postero-laterally elongated, swollen angle. Visual surface small, low. Pygidium parabolic without border. Axis wide (tr.), strongly tapering backwards, with nine rings.

Material. — Internal and external moulds of 2 cranidia, 3 librigenae, 2 pygidia from *Gattendorfia* zone (VII)? of Karczówka.

Dimensions (in mm):

IG Mus. cat. no.	171.II.77b	171.II.77c
Length of cranidium	3.9	—
Length of glabella	2.9	—
Width of glabella	2.4	—
Length of pygidium	—	4.2
Width of pygidium	—	7.3 (?)
Length of axis	—	3.3
Width of axis	—	2.9 (?)

Description. — *Cephalon.* Glabella elongate, slightly tapering forwards, with anterior part rounded. Occipital ring wide (long.), not tapering laterally. Posterior glabellar furrows (S_1) distinct, middle (S_2) and anterior (S_3) obsolete. No preglabellar field. Border narrow, upturned. Palpebral lobes narrow, situated opposite midlength of glabella, slightly curved; ε and γ close to axial furrows. Posterior branches of facial sutures long, slightly divergent, anterior branches similarly long, divergent. Librigena wide, with strongly curved lateral outline. Genal angle elongated postero-laterally, inflated distally, with sharply pointed tip. La-

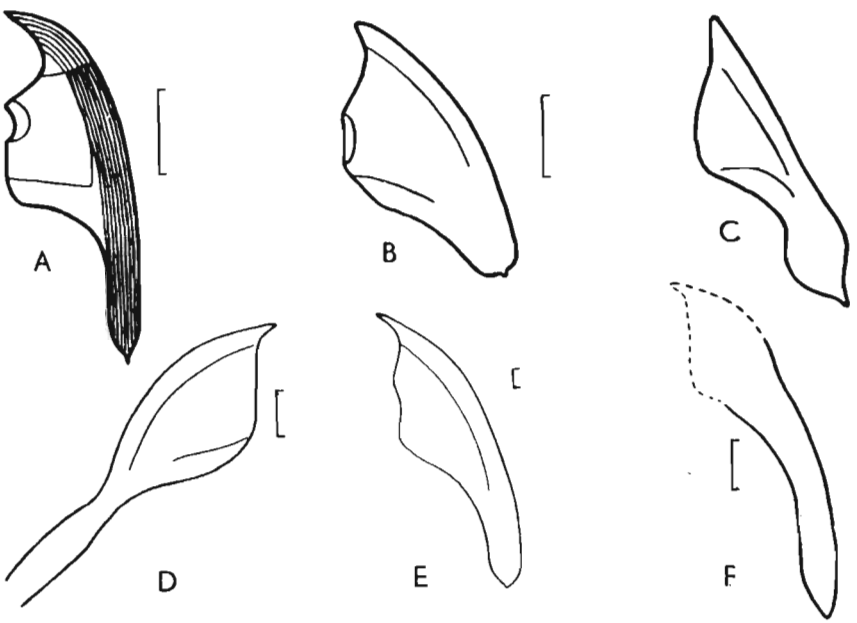


Fig. 5. — Librigenae with "*Cystispina*"-like librigenal spine: *A Diacoryphe strenuispina* n.sp., Holy Cross Mts., Poland; *B Cyrtosymbole (?Macrobole) differtigena* n.sp., Holy Cross Mts., Poland; *C Cystispina cystispina* R. & E. Richter, Harz, Germany (after R. & E. Richter, 1939); *D Formonia convexa* n.sp., Holy Cross Mts., Poland; *E Spatulina spatulina* (Woodward), England; *F Spatulina nasifrons* (R. & E. Richter), Harz, Germany. (Scales = 1 mm)

teral border in anterior part of librigena narrow (tr.), strongly upturned, disappearing posteriorly. Posterior border convex. Eye small, low.

Hypostoma and *thorax* unknown.

Pygidium with parabolic outline, border not differentiated. Axis wide (tr.), short, sharply tapering posteriorly, not reaching posterior pygidial margin. In longitudinal profile axis not delimited from remaining part of pygidium. Nine axial rings with sigmoid posterior margins. Three ribs on the pleural lobes. Pleural and interpleural furrows extremely fine.

Discussion. — The species described above has the cranidium typical of the subgenus *C. (Macrobole)*, with a glabella tapering forward, deeply incised, wide (long.) posterior glabellar furrows (S_1), occipital ring not tapering laterally and narrow palpebral lobes situated opposite midlength of the glabella. The pygidium is also similar to that of *C. (Macrobole) duodecimae* R. & E. Richter and *C. (Macrobole) laticampa* n.sp., but the librigena of the new species is quite different from those occurring in the representatives of *C. (Macrobole)*, having an elongated, inflated genal angle. A comparison of the external and internal moulds of the librigena shows that there was no thickening of the exoskeleton and that between the dorsal exoskeleton and the doublure there was an empty space, filled up, perhaps, by soft tissue or gas.

R. and E. Richter (1939) described a new genus, *Cystispina*, from the boundary of the *Pericyclus* (VIII) and *Goniatites* (IX) zones of Kellerwald. It is characterized by the presence of librigenal spines with inflated ends, similar to those occurring in *C. (?Macrobole) differtigena*. The only representative of this genus (comp. p. 180), *Cystispina cystispina* R. & E. Richter, 1939, has a quite different cephalic pattern from that of *C. (?Macrobole) differtigena*. In *C. cystispina* the wide glabella is bluntly rounded off, the facial sutures have no trace of palpebral lobes, and the fixigenae are wide (tr.). A somewhat differently developed, but also inflated, spine occurs in *Spatulina* n.gen. (comp. p. 180) and their presence has been ascertained by the present author in the genus *Diacoryphe* R. & E. Richter, 1951; they are probably also present in *Formonia* R. & E. Richter, 1927 (see discussion on p. 157/158).

Subgenus *Cyrtosymbole (Mirabole)* nov.

Type species: Cyrtosymbole (Mirabole) kielanae n. sp.

Derivation of name: mirus — wonderful, *symbole* — suture; because of unusual course of facial suture in genus *Cyrtosymbole*.

Diagnosis. — Glabella elongate, slightly tapering forwards, with rounded front. Glabellar furrows slightly marked. Occipital ring not tapering (long.) laterally. No lateral occipital lobes. Palpebral lobes poorly defined, slightly behind midlength of glabella. Fixigenae broad

(tr.). Frontal area broad (long.). No anterior border or anterior border furrow. Anterior outline of cranidium strongly curved. Posterior branches of facial sutures long and slightly divergent. Anterior branches of facial sutures from γ to β short and divergent, from β to α very long, convergent. Visual surface of eye large and only slightly convex. Librigenal spine long, pointed. Pygidium semicircular with indistinctly marked border. Axis strongly tapering backwards with ten distinct rings. Six ribs on pleural lobes. Interpleural and pleural furrows well marked.

Occurrence. — Carboniferous, *Gattendorfia* zone (VII)? of Karczówka, Poland.

Discussion. — The new subgenus is erected to include a single species: *C. (Mirabole) kielanae* n.sp. *C. (Mirabole)* is closely related to *C. (Waribole)* R. & E. Richter, 1926, the common characters being: 1) elongate glabella, tapering forwards and with a rounded front; 2) occipital ring not tapering (long.) distally; 3) librigena with pointed spine and a large, slightly convex eye; 4) all the characters of the pygidium.

The new genus differs from *C. (Waribole)* in: 1) poorly defined palpebral lobes, distant from occipital furrow; 2) broad (tr.) fixigenae; 3) great distance of ε and γ from axial furrows; 4) course of posterior branches of facial sutures.

The course of the facial sutures of *C. (Mirabole)* is similar to that of *Liobole* R. & E. Richter, 1949. *C. (Mirabole)* differs from *Liobole* in: 1) lack of occipital lobes; 2) course of anterior branches of facial sutures; 3) a shorter pygidium with distinctly marked interpleural and pleural furrows. *C. (Mirabole)* can be regarded as a genus with *Liobole*-like cranidium and *Waribole*-like pygidium, though this does not mean, of course, that *C. (Mirabole)* is closely related to *Liobole*. The similar course of the facial sutures in these two genera must be regarded only as convergence.

Cyrtosymbole (Mirabole) kielanae n.sp.

(pl. X, fig. 7)

Holotype: No. IG 171.II.78a; pl. X, fig. 7*a* (cranidium).

Type horizon: Carboniferous, *Gattendorfia* zone (VII)?

Type locality: Karczówka, Holy Cross Mountains, Poland.

Derivation of name: in honour of Polish palaeontologist Dr Zofia Kielan-Jaworowska.

Diagnosis. — As for subgenus.

Material. — Internal and external moulds of 3 cranidia, 4 librigenae, 4 pygidia from *Gattendorfia* zone (VII)? of Karczówka.

Dimensions (in mm):

IG Mus. cat. no.	171.II.78a	171.II.78b	171.II.78c
Length of cranidium	3.3	—	2.1
Length of glabella	2.4	—	1.6
Width of glabella	1.9	—	0.8
Length of pygidium	—	1.6	—
Width of pygidium	—	2.4	—
Length of axis	—	1.3	—
Width of axis	—	0.8	—

Description. — *Cephalon.* Glabella tapering forwards, long, with rounded front. Three pairs of lateral glabellar furrows faintly marked. Occipital ring broad (long.), not tapering distally, without lateral occipital lobes. Occipital furrow deep, in middle part convex forwards. Axial furrows weakly incised, deepened in front of glabella. Anterior border absent. Frontal area broad (long.) slightly convex. Fixigenae very broad (tr.). Palpebral lobes weakly curved, situated slightly behind midlength of glabella; ε and γ broadly rounded, distant from axial furrows. Posterior branches of facial sutures divergent, long. Anterior branches strongly divergent and very short to β, from β to *a* long, convergent. Distance *a*—*a* small. In longitudinal profile occipital ring higher than glabella, with prominent node; occipital furrow deeply incised; glabella almost flat, gently sloping down to frontal area. In transverse profile glabella almost flat, palpebral lobes rising somewhat outwards. Librigena narrow (tr.), flat, with moderately long spine. Visual surface of eye large and slightly convex. Doublure of cephalon broad.

Hypostoma and *thorax* unknown.

Pygidium semicircular, with indistinctly marked border. Axis rapidly tapering posteriorly with ten rings. First two ring furrows deeper and wider (long.) than others. On pleural lobes six flat ribs. Interpleural and pleural furrows fine, but distinct. In longitudinal profile axial rings distinctly pronounced and convex; postaxial field flat. In transverse profile axis and pleural lobes gently vaulted; axial furrows incised.

Ornamentation. Surface of cephalon densely covered with very fine scale-like tubercles, arranged in concentric lines; tubercles along the outer margin of cephalon pointed. The largest pygidium is smooth, but smaller ones are covered with pointed tubercles.

Ontogeny. — One of 4 pygidia found in Karczówka (0.9 mm long) is smaller than the remaining ones, and provided with the larval notch. Similar notches were observed in young specimens assigned to other subgenera of *Cyrtosymbole*.

Discussion. — The species here described resembles *C. (Waribole) conifera* R. & E. Richter, 1926. Similarities concern the shape of the glabella, and occipital ring, the size and position of the visual lobe,

as well as the ornamentation. The pygidium of the new species is similar to those of some representatives of *C. (Waribole)* and *C. (Macrobole)*. The most characteristic feature of the new species is the course of the facial sutures, which does not occur among the Upper Devonian representatives of Cyrtosymbolinae and resembles that of the Lower Carboniferous genus *Liobole* R. & E. Richter, 1949. The new species also somewhat resembles the Viséan species *Archeagonus aequalis* Meyer, 1831. Similarities here concern the pygidial structure, the shape of the librigena, and also some similarities in the course of the facial sutures, the posterior branches of which are in *A. aequalis* divergent, as in our species, and the palpebral lobes are situated behind the midlength of the glabella. The differences however are very marked and they concern the shape of the glabella, which in *A. aequalis* is longer and more strongly pointed anteriorly, and the occipital ring which in *A. aequalis* is provided with the lateral occipital lobes, that do not occur in our species.

As to the facial sutures of the new species, distance γ—β of the anterior branches is shorter than β—α, whereas in *A. aequalis* it is vice versa. The stratigraphic zone yielding *C. (Mirabole) kielanae* could not be defined with any certainty. Czarnocki supposed (personal information) that it corresponds to the passage beds between the Famennian and the Carboniferous.

Genus *Typhloproetus* R. Richter, 1913

Typhloproetus kozlowskii n.sp.

(pl. XVII, fig. 2; text-pl. VIII, fig. 4)

Holotype: No. IG 173.II.500; pl. XVII, fig. 2; text-pl. VIII, fig. 4 (cranidium).
Type horizon: Carboniferous, *Pericyclus* beds (VIII).
Type locality: Zaremby, Holy Cross Mountains, Poland.
Derivation of name: in honour of eminent Polish palaeontologist Professor Roman Kozłowski.

Diagnosis. — Anterior outline of cranidium pointed. Glabella vaulted transversely, tapering forwards and contracted at its midlength. Posterior lateral glabellar furrows (S_1) cut off basal lobes (L_1). Occipital ring tapering distally. Palpebral lobes poorly developed with oblique, vestigial eye-ridge. Fixigenae broad (tr.). Posterior and anterior branches of facial sutures strongly divergent. Exoskeleton minutely granulated.

Material. — 10 internal moulds of cranidia, 1 damaged external mould of cranidium from lower and upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.500
Length of cranidium	3.0
Length of glabella	2.0
Width of glabella	1.2

Description. — Cranidium strongly pointed frontally. Glabella slender, finger-shaped, contracted medially. Axial furrows deeply incised. Two pairs of lateral glabellar furrows are visible, S_1 cut off the basal lobes (L_1), which occupy less than one-third of the total width (tr.) of the glabella. S_2 very short and indistinct. Occipital ring tapers laterally. Occipital furrow straight and distinct. Preglabellar field broad (long.), concave. Anterior margin prominent and upturned. Palpebral lobes poorly developed, situated behind midlength of glabella. Fixigenae with trace of oblique eye-ridge. δ closer to axial furrows than β. Posterior branches of facial sutures short and strongly divergent. Anterior branches long, at first strongly divergent, becoming long and convergent after crossing broadly rounded β. In longitudinal profile occipital ring stands as high as glabella; occipital furrow distinct; glabella horizontal, sloping gently down; preglabellar field broad (long.) and concave; anterior border upturned. In transverse profile glabella strongly vaulted, axial furrows deeply incised, palpebral lobes horizontal.

Ornamentation. On one fragment of external mould of cranidium ornamentation was observed, consisting of fine granules, densely grouped on the glabella and less densely on the fixigenae.

Ontogeny. — The young specimens have a more pointed anterior cranidial margin and glabella with more rounded front, the latter being also more strongly vaulted transversely than in adult specimens.

Discussion. — *Typhloproetus kozlowskii* n.sp. differs from the remaining representatives of this genus in having the axial furrows strongly incised and the cranidium strongly pointed frontally. It differs from the single Carboniferous species so far known (*Typhloproetus dietzi* R. & E. Richter, 1951) in having 1) a different course of the anterior branches of the facial sutures, which from point β to α are longer, 2) the palpebral lobes more distinct, with an oblique eye ridge, 3) the cranidium more pointed frontally, and 4) the finger-like shape of glabella. The resemblances concern here the longitudinal and transverse profiles. The new species resembles very much the Famennian *Typhloproetus subcarintiacus* R. Richter, 1913, and *T. schindewolfi* R. & E. Richter, 1919. *T. kozlowskii* resembles *T. subcarintiacus* in the shape of the glabella and the course of the anterior branches of the facial sutures. In the presence of palpebral lobes and the eye ridge it resembles *T. schindewolfi* (the specimen figured by R. & E. Richter, 1926, pl. 4, fig. 53A, as *T. schindewolfi?* with traces of the eye ridges, lies, according to the present author, within the range of infraspecific variation). Pfeiffer (1959) descibed from the *Wocklumeria* zone (VI) *T. hemisphaericus,* resembling *T. kozlowskii* in the contracted glabella. The palpebral lobes of Pfeiffer's species are however shorter (long.), and the anterior as well as the posterior branches of the facial sutures are slightly diver-

gent. *T. kozlowskii* resembles also *Cyrtosymbole (Calybole) antedistans* R. & E. Richter, 1926, from the *Wocklumeria* zone (VĪ) in shape of glabella, similar course of the facial sutures and the shape of the palpebral lobes.

Typhloproetus ?kozlowskii n.sp.
(pl. XVII, fig. 1)

Material. — Internal moulds of 2 librigenae from the lower beds of *Pericyclus* zone (VIII) of Zaremby.

Discussion. — In the beds yielding the cranidia described above as *T. kozlowskii* n.sp. there were found two librigenae, which judging from the course of the facial sutures, which is very slightly bent around the palpebral lobe, and long and strongly divergent anteriorly, seem to be conspecific with the cranidia. The surface of the visual lobe is not preserved. The librigena is characterized by a wide (tr.) flat doublure with some longitudinal lists.

Typhloproetus cf. *kozlowskii* n.sp.
(text-pl. VIII, fig. 5)

Material. — Internal mould of 1 cranidium from upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.554
Length of cranidium	2.8
Length of glabella	1.9
Width of glabella	1.0

Discussion. — The cranidium differs from the holotype in possessing a short, clearly pronounced spine on the anterior margin of the cranidium, and less divergent anterior branches of the facial suture. Lack of more abundant material of *Typhloproetus kozlowskii* n.sp. makes it impossible to determine, whether this cranidium can be included within the variation range of this species.

?Typhloproetus angustigenalis n.sp.
(pl. XVII, fig. 9; text-pl. VIII, fig. 6)

Holotype: No. IG 173.II.498; text-pl. VIII, fig. 6 (cranidium).
Type horizon: Carboniferous, *Pericyclus* zone (VIII).
Type locality: Zaremby, Holy Cross Mountains, Poland.
Derivation of name: angustus — narrow, *gena* — cheek; because of narrow fixigenae.

Diagnosis. — Anterior margin of cranidium strongly curved. Glabella pear-shaped with three pairs of lateral glabellar furrows weakly marked. Axial furrows from occipital furrow to S_3 extremely faint, deepened

forwards. Occipital ring tapering distally. Preglabellar field almost as broad (long.) as occipital ring. Fixigenae very narrow (tr.). Facial sutures almost straight, slightly divergent forwards. No palpebral lobes.

Material. — Internal moulds of 3 cranidia from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

IG Mus. cat. no.	173.II.498	173.II.497
Length of cranidium	3.5	3.8
Length of glabella	2.5	2.6
Width of glabella	1.7	1.9

Description. — Cranidium with strongly curved anterior outline. Glabella pear-shaped, broadly rounded anteriorly. Axial furrows from occipital furrow to S_3 faintly marked, deepened forwards. Three pairs of short lateral glabellar furrows weakly developed. Posterior lateral furrows (S_1) bifurcate. Occipital ring narrowing laterally. Preglabellar field broad (long.), concave. Anterior border slightly upturned. Fixigenae extremely narrow (tr.) sloping forwards without palpebral lobes. Facial sutures almost straight, slightly divergent forwards. In longitudinal profile occipital ring stands as high as glabella; occipital furrow incised; glabella straight except for steeply sloping front; preglabellar field broad (long.), concave; anterior border slightly upturned; fixigena slopes forwards. In transverse profile glabella slightly convex; axial furrows extremely shallow; fixigenae flat, horizontal.

Discussion. — The three cranidia in the author's collection differ quite considerably, though the common features, such as the character of the axial furrows, shallowing at two-thirds of their length, the narrow fixigenae steeply sloping forwards, and the lack of the palpebral lobes, do not allow one to record them as different species. Facial sutures in two specimens are slightly divergent forwards (text-pl. VIII, fig. 6), whereas in the third specimen they are quite straight up to the point β (pl. XVII, fig. 9). The glabella of the holotype is slightly contracted, with the lateral glabellar furrows more deeply incised, both these features not occurring in the remaining specimens. Straight facial sutures and the narrow fixigenae, steeply sloping forwards, occur in some species of *Liobolina* R. & E. Richter, 1951. However, the quite different shape of the glabella, which tapers anteriorly, the wide (long.) preglabellar field, and the structure of the occipital ring, show that we are dealing here rather with convergence than with true relationship. The above characters show the resemblances with the genus *Typhloproetus*, which covers the species characterized by the slight divergence of the

facial sutures anteriorly (*T. hemisphaericus* Pfeiffer, 1959, and *T. schindewolfi* R. & E. Richter, 1926). Against the assignment of the above species to *Typhloproetus* are the narrow fixigenae and the slender glabella. The type specimen (text-pl. VIII, fig. 6) is also very similar to *Palpebralia brecciae* R. Richter, 1913, occurring in the Frasnian zone (I). The difference in stratigraphic range between the above discussed species indicates that the similarities here observed may more probably be due to convergence, than to true relationship.

?Typhloproetus sp.
(pl. XVI, fig. 6)

Material. — Internal mould of 1 librigena from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Discussion. — The librigena found in the beds yielding the cranidia of *T. angustigenalis* n.sp., on account of the nearly straight course of the facial suture, could be tentatively assigned to the same species. The librigena is characterized by the border being very faintly developed and produced backwards into the long genal spine. The doublure of the genal spine is very convex. The librigena has a very small visual area.

Genus *Formonia* R. & E. Richter, 1927

Formonia convexa n.sp.
(pl. XVII, fig. 3-5; text-pl. VII, fig. 9: text-fig. 6, *1*)

Holotype: No. IG 173.II.561; pl. XVII, fig. 3; text-pl. VII, fig. 9 (cranidium).
Type horizon: Carboniferous, *Pericyclus* zone (VIII).
Type locality: Zaremby, Holy Cross Mountains, Poland.
Derivation of name: convexa — arched; because of cranidium strongly arched in longitudinal profile.

Diagnosis. — Cephalon strongly arched longitudinally, with frontal spine. Glabella long and narrow, tapering forwards. Axial furrows shallow. Only posterior lateral glabellar furrows (S_1) present. Fixigenae broad (tr.). No palpebral lobes. Facial sutures straight. Librigena broad (tr.) with unusually long librigenal spine. No eye present and there is no distinct border.

Material. — Internal moulds of 8 cranidia and 3 damaged librigenae from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

IG Mus. cat. no.	173.II.473	173.II.561
Length of cranidium	8.0	2.1
Length of glabella	5.1	1.4
Width of glabella	3.4	1.0

Description. — *Cephalon* semicircular without border. Glabella

slender, tapering forwards, rounded frontally. Axial furrows shallow. Faintly marked posterior lateral glabellar furrows (S_1) cut off basal lobes (L_1). Middle (S_2) and anterior (S_3) lateral glabellar furrows absent. Occipital ring uniformly broad (long.) with median node. Occipital furrow deep. Preglabellar region, twice as broad as occipital ring (long.), strongly concave. Median spine on anterior margin of cranidium. Fixigenae strongly vaulted longitudinally, almost as broad (tr.) as glabella

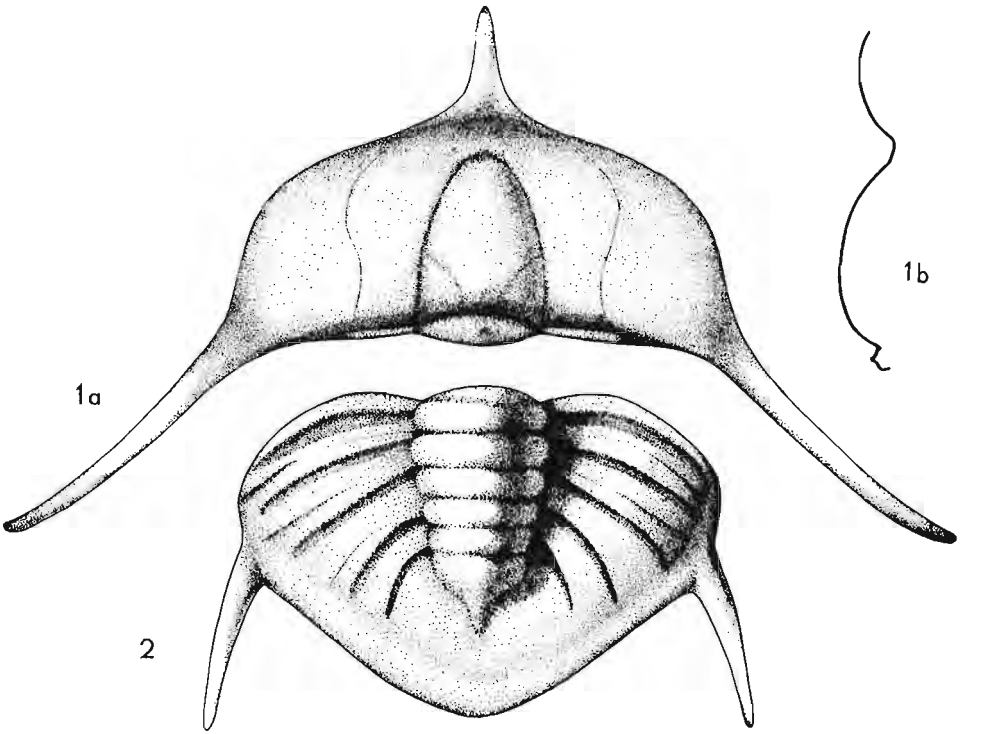


Fig. 6. — *1 Formonia convexa* n.sp., reconstruction: *a* dorsal view, *b* longitudinal profile. *2 ?Formonia* sp., reconstruction.

at its base. Facial sutures straight, slightly convergent posteriorly. No palpebral lobes. Width (long.) of cranidial part of posterior border equal to about one-third that of the occipital ring. In longitudinal profile occipital ring prominent; glabella strongly arched; preglabellar field concave; frontal spine almost as long as glabella, strongly arched. In transverse profile glabella and fixigenae flat and low. Librigena broad, flat, with steeply sloping backwards posterior part. No eye. Librigenal spine extremely long, directed out and backwards runs first up and then slopes down. Its internal mould is in form of a thin roll, but on external mould librigenal spine is broad (tr.), narrowing near the base, with slightly "*Cystipina*" aspect (see text-fig. 5 *D*).

Discussion. — The new species described here was assigned to the genus *Formonia* on account of the striking resemblance to *Formonia*

globigenata R. Richter, 1913, which is characterized by a similar shape of glabella, posterior lateral glabellar furrows (S_1) very faintly marked, similar development of the cranidial part of the posterior border, and by the strong longitudinal convexity of the cranidium. The distinct differences concern the anterior border, which in *F. globigenata* is strongly upturned, whereas in *F. convexa* the anterior border is not developed, and the long, arched spine. In longitudinal profiles the species in question differ in the convexity of their cranidia, as in *Formonia globigenata* the fixigenae are most convex in the anterior part, and in *F. convexa* in the posterior part. The librigenae are unknown in *F. globigenata*, and in another representative of this genus (*F. formosa* R. Richter, 1913) they are narrow (tr.), provided with short spines, while in the Polish species they are comparatively wide (tr.), produced into the extremely long librigenal spines. Such long spines have not hitherto been observed in any Upper Famennian or Lower Carboniferous representatives of the Proetidae. Similarly directed, long librigenal spines occur in the Cambrian *Strenuella (Comluella)*, which Hupé (1953) placed within the Strenuellinae. Thus the occurrence of such a type of genal spine in *F. convexa* could be interpreted as an "atavistic" feature.

In spite of the fact that the cranidia and librigenae described here were found separately, in the same beds, the present author has no doubt that they are conspecific, because the course of the facial sutures is identical and because both parts have the very characteristic feature of sloping down at the back. *Formonia convexa* resembles the remaining species of this genus (e.g. *F. formosa* R. & E. Richter, 1927, and *F. scheldana* Matern, 1927), only in the course of the facial sutures and the development of the cranidial part of the posterior border. The three hitherto known representatives of *Formonia* were yielded by the oldest Famennian zones — *Cheiloceras* (II) and *Prolobites* (III) of the Rhine Schiefergebirge. The fourth species described here is found in the Upper Tournaisian (*Pericyclus* zone VIII). There is then a long time interval between the species.

?Formonia sp.

(pl. XVII, fig. 6-8; text-pl. VII, fig. 10; text-fig. 6,2)

Material. — Internal moulds of 3 pygidia from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

IG Mus. cat. no.	173.II.439	173.II.559	173.II.437
Length of pygidium	2.1	1.8	1.4
Width of pygidium	3.6	2.9	2.4
Length of axis	1.5	1.3	1.2
Width of axis	1.2	1.1	0.7
Length of pygidial spines	1.1	0.8	0.4

Description. — *Pygidium* subtriangular with pair of postero-lateral spines. Axis short and broad (tr.), V-shaped, with six or seven axial rings. Four ribs on pleural lobes. In longitudinal profile the axis is high, with prominent rings, but the postaxial area is flat. In transverse profile the axis appears vaulted, and the pleural lobes are gently arched.

Discussion. — The three pygidia found in Zaremby most probably, from their dimensions, represent late meraspis or early holaspis stages, with the largest pygidium found representing an adult specimen. In the smallest pygidium (1.4 mm long; pl. XVII, fig. 6) the pleurae of the third segment are produced into spines; the pygidium (1.8 mm long; pl. XVII, fig. 7) is provided with a pair of spines on the second segment, and the largest (representing presumably the adult one; pl. XVII, fig. 8) has a pair of spines on the first segment. In all three the length of the spines is more or less equal to half the length of the pygidium, which shows that the spines do not disappear with growth of the pygidium, but grow themselves. The migration of the pygidial spines forward is most probably connected with the separation of the successive thoracic segments from the transitory pygidium. The pygidia described here somewhat resemble pygidia of the known representatives of *Formonia* R. & E. Richter, 1927. To the features characteristic of *Formonia* belong: short axis, strongly vaulted transversely, with prominent rings, and convex ribs on the pleural lobes. On the other hand, in the known representatives of *Formonia* there are no spines on the pygidia, which are semicircular and not triangular, as are the pygidia described here. The other feature, differentiating the present pygidia from the known *Formonia* species, is the lack of the convex border and the very slightly transversely vaulted pleural lobes. *Formonia* is a very rare genus, recorded thus far from the Lower Famennian only. It seems reasonable to assume that in the Lower Carboniferous *Formonia* could be represented by a spiecies, differing distinctly from the type species (*Formonia formosa* R. Richter, 1913). R. and E. Richter (1951) and Erben (1959) interpreted some morphological features occurring in late proetids as "atavism" (ie. the secondary eye-ridge, migration of eyes towards anterior border, etc.). It seems to the present writer that the occurrence of the postero-lateral spines in the pygidia described here, which very much resemble those occurring in the Ordovician *Ceratopyge* Hawle & Corda, 1847 (family Ceratopygidae Linnarsson, 1869) could also be interpreted as "atavism".

In the beds yielding the pygidia described here, cranidia and librigenae described as *F. convexa* n.sp. were found. Most probably the cranidia and pygidia in question are conspecific, for this is also supported by the presence of spines both in the pygidia and cranidia (frontal spine; comp. text-fig. 6, *1, 2*).

Genus *Drevermannia* R. Richter, 1909

Drevermannia moravica minuta n.subsp.

(pl. X, fig. 4-6; text-fig. 7)

Holotype: No. IG 173.II.356; pl. X, fig. 5 (nearly complete cephalon).
Type horizon: Carboniferous, *Gattendorfia* zone (VII).
Type locality: Jabłonna, Holy Cross Mountains, Poland.
Derivation of name: minuta — very small, because of minute dimensions.

Diagnosis. — Glabella elongate, finger-shaped. Posterior lateral furrows (S_1) cut off basal lobes (L_1). Facial sutures with faintly marked palpebral lobes. Fixigenae broad (tr.). Anterior and posterior branches of facial sutures slightly divergent. Librigena with short spine. No eye. Pygidium semicircular, with slightly convex, narrow border.

Material. — 1 nearly complete dorsal shield, 2 nearly complete cephala, 18 cranidia, 10 librigenae, 4 pygidia from *Gattendorfia* zone (VII) of Jabłonna.

Dimensions (in mm):

IG Mus. cat. no.	173.II.357	173.II.356	173.II.744	173.II.368	173.II.365
Length of complete dorsal shield	5.7	—	—	—	—
Length of cephalon	2.2	1.6	2.4	1.7	—
Width of cephalon	—	—	—	2.3	—
Length of glabella	—	1.1	1.7	1.5	—
Width of glabella	—	0.7	1.1	0.6	—
Length of pygidium	2.1	—	—	—	1.7
Width of pygidium	2.3	—	—	—	2.9
Length of axis	1.9	—	—	—	1.4
Width of axis	0.5	—	—	—	0,8

Description. — *Cephalon* nearly semicircular. Glabella long, finger-shaped. Axial furrows deeply incised. Posterior lateral glabellar furrows (S_1) deep, cut off basal lobes (L_1). Middle (S_2) and anterior (S_3) lateral furrows weakly developed. Occipital ring very broad (long.) and convex mesially tapers and lowers distally. Lateral occipital lobes slightly developed. Occipital furrow deep, bent anteriorly in middle part. Anterior border convex, narrow (long.). Preglabellar field as wide as anterior border. Fixigenae broad (tr.) with slightly marked palpebral lobes, situated at midlength of glabella. Posterior and anterior branches of facial sutures divergent. Posterior border slightly developed. In longitudinal profile occipital ring as high as glabella; occipital furrow deeply incised; glabella horizontal, except for steeply sloping front; preglabellar field very narrow (long.); anterior border upturned. In transverse profile

glabella strongly convex; axial furrows deep; fixigenae convex, lower than glabella; librigena slightly vaulted.

Hypostoma and number of thoracic segments unknown.

Pygidium semicircular with slightly convex, narrow border. Axis narrower than pleural lobes, does not reach pygidial border. Nine convex axial rings. Eight ribs visible on pleural lobes. Interpleural and pleural furrows distinctly marked. In longitudinal profile pygidial axis horizontal, postaxial region steeply sloping backwards. In transverse profile axis narrow (tr.), convex; proximal half of pleural lobes horizontal, distal half slopes steeply down. Ornamentation of cranidium consists of small, widely dispersed tubercles.

Ontogeny. — The smallest cephalon (1.7 mm long; text-fig. 7 *B*) has an elongate, cylindric glabella with two distinct pairs of lateral glabellar furrows. Front of cranidium not pointed. Facial sutures with slightly marked palpebral lobes. Fixigenae narrower than glabella. Librigenae with short spines. The smallest pygidium (1.4 mm long) has a long, narrow axis, pleural lobes strongly vaulted, situated above the flat, horizontal border, provided with a larval notch.

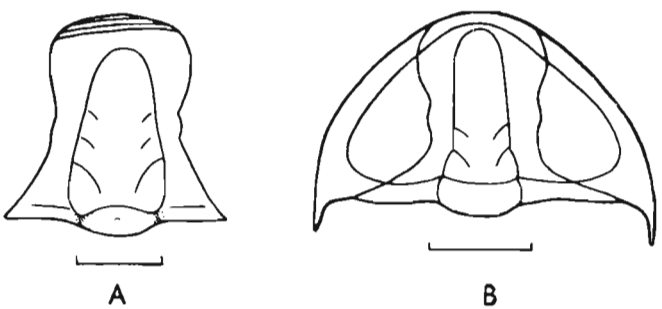


Fig. 7. — *Drevermannia moravica minuta* n.subsp.; *A* cranidium, dorsal view (IG 173.II.744), *B* young cephalon, dorsal view (IG 173.II.368). (Scales = 1 mm).

Discussion. — Chlupač (1956) described from the *Pericyclus* zone (VIII) of Moravia a new species *Drevermannia moravica*. The Polish subspecies described here is somewhat older stratigraphically, found in the assemblage of trilobites such as *Liobolina* and *Diacoryphe*, indicating *Gattendorfia* zone (VII). The present subspecies differs from *D. moravica moravica* only very slightly, in the presence of slightly pronounced palpebral lobes, in having lateral occipital lobes less distinctly marked and glabella narrower in front. In the beds yielding *D. moravica minuta* a new species, *Liobolina praevia*, was found, the young form of which are extremely similar to *D. moravica minuta*. The glabella in these

young forms (of *L. praevia)* is of identical shape with *D. moravica minuta,* the facial sutures have a similar course with slightly marked palpebral lobes. The fixigenae are somewhat narrower(tr.) in *Liobolina praevia* and the occipital ring narrower (long.) medially. The librigena has a similar shape, but differs in the lack of spine in *L. praevia.* The young pygidia of both species have similar transverse and longitidinal profiles and differ in the presence of an indistinct border and more distinct furrows between the axial rings, and on the pleural lobes in *D. moravica minuta.*

Genus *Liobolina* R. & E. Richter, 1951

Liobolina submonstrans R. & E. Richter, 1951, is the most primitive and the earliest representative of the genus, occurring somewhat earlier than *L. nebulosa* R. & E. Richter, 1951 (cf. R. & E. Richter, 1951, table A). *L. submostrans* shows some similarities to the Upper Famennian genus *Perliproetus* R. & E. Richter, 1926. R. and E. Richter (1951, table B) noted the possibility of phylogenetic relation between *Liobolina* and *Perliproetus,* accepting however that it is more likely that *Liobolina* originated from *Cyrtosymbole (Waribole)* R. & E. Richter, 1926, through species similar to *C. (Waribole) glacensis* (R. Richter). *C. (Waribole) glacensis* is a species imperfectly known, represented thus far by two damaged cranidia, one librigena and one pygidium, and is characterized by an elongate, cylindrical glabella different from *Liobolina.* If, on the other hand, one compares *L. submonstrans* and *Perliproetus marginatus* (Münster), striking resemblances are revealed in the proportions and shape of the glabella, the size and position of the palpebral lobes, and longitudinal profiles of the cephala. All these similarities could hardly be interpreted as due to convergence, and seem, in the present author's opinion, to be due to relationship (see table 7). The presumed relationship between the genera discussed here would be supported by their stratigraphic range, as *Perliproetus* occurs in the *Wocklumeria* zone (VI) and *Liobolina* in *Gattendorfia* zone (VII). The differences between *Liobolina* and *Perliproetus* concern the pygidial structure: the pygidia of *Liobolina* have indistinct pleural and interpleural furrows, and are longer than those of *Perliproetus* which are distinctly furrowed and have ribs on the pleural lobes radially arranged. The number of axial rings in *Perliproetus* varies, and it seems that the radial arrangement of the pleural ribs is secondary, thus the differences in pygidial structure can not be regarded as of much significance.

Liobolina apodemata is the most recent representative of the genus and it occurs in the *Pericyclus* zone (VIII). It differs distinctly from the remaining representatives of *Liobolina,* but recalls *Liobole* R. & E.

Richter, 1949, in such features as elongate glabella and wide (tr.) fixigenae. R. and E. Richter (1951) supposed that *Liobole* derives from *Liobolina*. The present author is of the same opinion since the resemblance of *L. apodemata* to *Liobole* supports the supposition. *L. apodemata* can not be regarded as an intermediate form between the genera *Liobolina* and *Liobole,* but seems to represent a species closely related to such intermediate form. On the other hand, *L. apodemata,* being the youngest representative of the genus (stratigraphically), is similar to the genus *Spatulina* n.gen (see p. 180), occurring on the boundary of the *Pericyclus* (VIII) and *Goniatites* (IX) zones. It is especially similar to *Spatulina spatulata* (Woodward, 1902), the similarities between *L. apodemata, S. spatulata* and *S. nasifrons* (R. & E. Richter, 1949) concerning both the cranidium and the pygidium, allow one to assume that the genera in question are related phylogenetically (see table 7).

Liobolina praevia n.sp.
(pl. XII, fig. 2)

Holotype: No. IG 173.II.63; pl. XII, fig. 2 (complete dorsal shield).
Type horizon: Carboniferous, *Gattendorfia* zone (VII).
Type locality: Jabłonna, Holy Cross Mountains, Poland.
Derivation of name: praevius — previous; species preceding *Liobolina apodemata* n. sp.

Diagnosis. — Cephalon semicircular with nearly subquadrate glabella. Fixigenae very narrow (tr.). Axial furrows obsolete. Occipital furrow slightly incised. No palpebral lobes. Librigena with rounded genal angle and without eye. Pygidium semicircular with broad (tr.) axis, poorly delimited posteriorly. Ring furrows, interpleural and pleural furrows obsolete. Pleural lobes somewhat vaulted.

Material. — 8 complete dorsal shields, 25 cranidia, 29 librigenae, external mould of 1 hypostoma, 32 pygidia from *Gattendorfia* zone (VII) of Jabłonna.

Dimensions (in mm):

	No. IG 173.II.63
Length of complete dorsal shield	18.8
Length of cephalon	5.3
Length of glabella	4.0
Width of glabella	3.5
Length of pygidium	4.8
Width of pygidium	9.0
Length of axis	3.8
Width of axis	2.6

Description. — *Cephalon* semicircular, with nearly subquadrate glabella reaching anterior border. Axial furrows obsolete. Lateral glabellar

furrows not developed. Occipital ring flat, not tapering distally. Occipital furrow straight and well marked. Anterior border slightly convex, narrow (tr.). Anterior margin of cranidium almost straight. No preglabellar field. Fixigenae narrower (tr.) than occipital ring (long.). No palpebral lobes. Facial sutures straight. Posterior branches, behind posterior border furrow, directed sharply outwards. Anterior branches faintly divergent. In longitudinal profile occipital ring flat; occipital furrow incised; glabella flat, sloping steeply down in front; no preglabellar field; anterior border narrow (long.). In transverse profile glabella together with fixigenae forms a weak, uniform vault. Librigena with rounded genal angle. Lateral border weakly developed. No eye.

Hypostoma elongate, broad (tr.), longitudinally slightly vaulted, with a pair of short spines on posterior margin.

Thorax with eight segments. Ends of pleurae rounded, directed slightly forwards. Pleural furrows weak. Articulating facets broad. Pleural doublures bear rounded bosses, which are more strongly developed on central segments.

Pygidium semicircular without furrows. Axis broad (tr.), tapering gently backwards, axial furrows becoming obsolete posteriorly, no border. In longitudinal profile pygidium sloping down in an even curve from front to back. In transverse profile axis weakly convex; axial furrows impressed; pleural lobes vaulted. Doublure of pygidium convex, narrow, steeply inclined. Surface of exoskeleton smooth.

Ontogeny. — The smallest cranidium (1.8 mm long) has an elongate glabella with distinct axial furrows, occipital ring convex medially and tapering laterally, anterior border more prominent than in the adult forms, and width of fixigenae corresponding to one-third that of glabella. Palpebral lobes very slightly marked. Librigena with an indistinct border and slightly pointed librigenal angle. No distinct eye. The smallest pygidium (2.3 mm long) is distinctly vaulted in transverse and longitudinal profiles. Pleural and interpleural furrows nearly obsolete.

Discussion. — R. and E. Richter (1939) described from Harz two cranidia as *Phillibole?* sp. *(l.c.*, fig. 22, 23). Both cranidia belong, in the present writer's opinion, without doubt to the genus *Liobolina* R. & E. Richter. One, figured in fig. 22, is very similar to *L. praevia* described above. The only difference concerns the cranidial part of the posterior border, which in *L. praevia* is longer (tr.). In the specimen figured by R .and E. Richter (1939, fig. 23) the glabella is more elongate and the occipital ring wider (long.) in its median part. The differences may be due to deformation. Because of this deformation it is very difficult to decide whether they are conspecific with *L. praevia* n.sp. This species differs from *L. apodemata* n.sp. occurring in the *Pericyclus* zone (VIII) of the Holy Cross Mountains in having narrower fixigenae and a sub-

rectangular glabella. Common for both species is the lack of the palpebral lobe. The course of the facial sutures is similar, being more divergent forwards in *L. apodemata*, and the anterior part of the fixigenae being wider (tr.). *Liobolina nebulosa* R. & E. Richter, 1951, occurring in the *Gattendorfia* zone (VII) of the Rhine Schiefergebirge, has a similarly shaped glabella to *L. praevia* and similarly narrow fixigenae. It differs from *L. praevia* in having a pygidium strongly vaulted in longitudinal profile and more distinct furrows on the pleural lobes. The characteristic granulation occurring in the middle part of the occipital ring in *L. nebulosa* does not occur in *L. praevia*.

Liobolina apodemata n.sp.

(pl. XII, fig. 1; XV, fig. 9-11; XVI, fig. 5; text-pl. IX, fig. 1-3)

Holotype: No. IG 173.II.40; pl. XV, fig. 9; text-pl. IX, fig. 1 (cranidium).
Type horizon: Carboniferous, *Pericyclus* zone (VIII).
Type locality: Gałęzice, Holy Cross Mountains, Poland.
Derivation of name: apodemata — because of apodema-like process on ventral surface of posterior margin of occipital ring.

Diagnosis. — Glabella cylindrical, unfurrowed. Axial furrows becoming obsolete posteriorly. Occipital furrow extremely faint. Posterior border furrow absent. A pair of apodema-like processes, developed on ventral surface of posterior margin of occipital ring. Palpebral lobes lacking. In longitudinal profile glabella flat for most of its length, sloping down at front. Pygidium parabolic. Border faintly marked. Axis flat, broad (tr.) only well pronounced in posterior part, with at least ten rings. Pleural lobes sloping posteriorly, vaulted transversely.

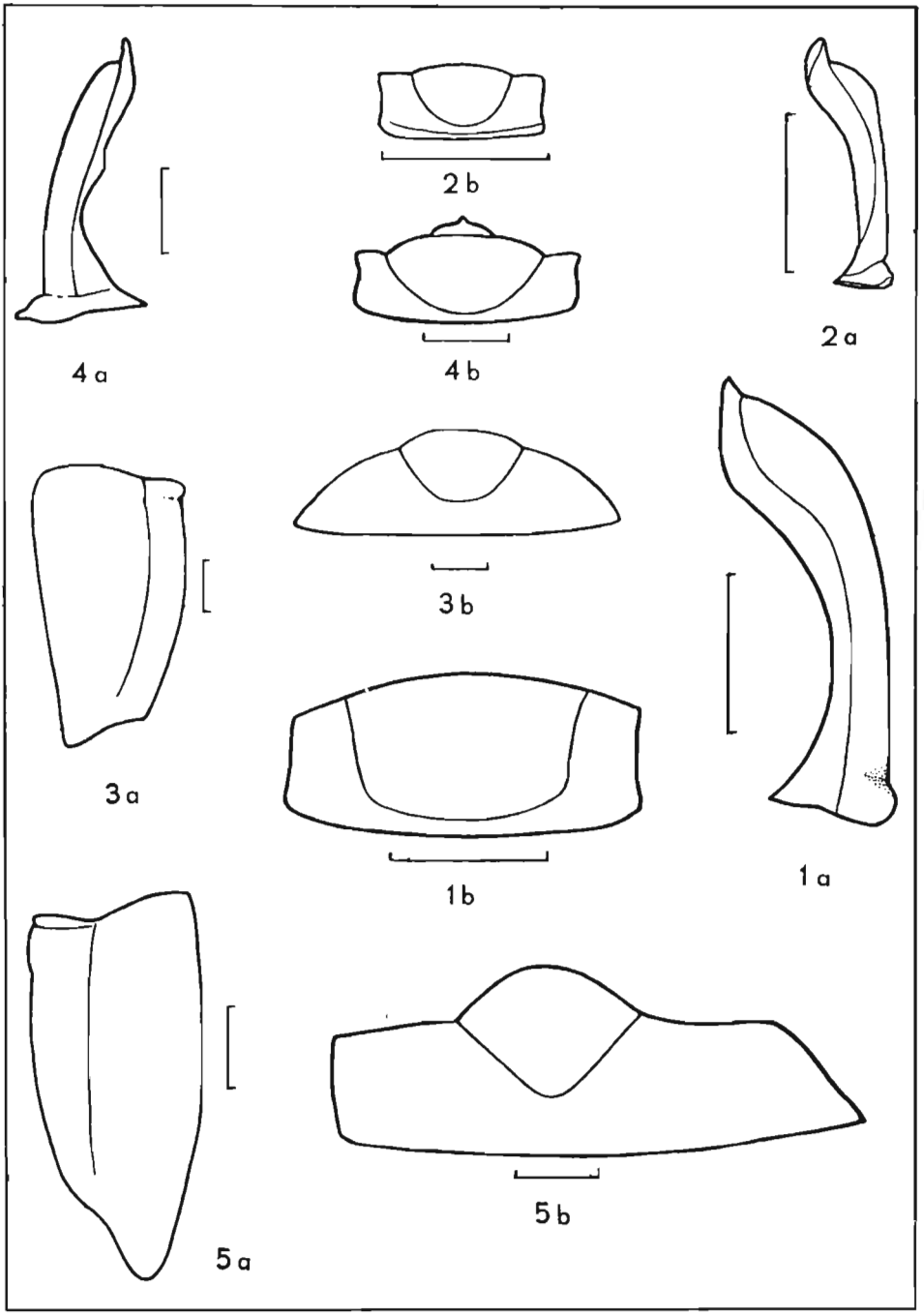
Material. — 1 testate cranidium, internal moulds of 12 cranidia and 6 pygidia from lower and upper beds of *Pericyclus* zone (VIII) of Gałęzice and Zaremby.

Dimensions (in mm):

IG Mus. cat. no.	173.II 423	173.II 422	173.II 40	173.II 421	173.II 420	173.II 432	173.II 433
Length of cranidium	8.0	4.9	2.6	2.0	1.6	—	—
Length of glabella	6.0	4.0	2.0	1.5	1.2	—	—
Width of glabella	4.9	3.1	1.4	0.8	0.8	—	—
Length of pygidium	—	—	—	—	—	7.0	5.2
Width of pygidium	—	—	—	—	—	10.0	8.2
Length of axis	—	—	—	—	—	6.5	4.3
Width of axis	—	—	—	—	—	3.5	2.5

Description. — Glabella cylindrical, with broadly rounded front, unfurrowed. Axial furrows not incised, marked as dark lines, front of glabella strongly demarcated by steeper slope of fixigenae. Occipital ring

TEXT-PL. IX



flat, broad (long.) not tapering laterally. Occipital furrow hardly visible, slightly deepening distally. On ventral surface of posterior margin of occipital ring, near axial furrows, a pair of apodema-like processes is developed. Preglabellar field absent. Frontal area very narrow (long.), flat, laterally becoming somewhat concave. Fixigenae narrow (tr.). Their width equal to about one-fourth of glabellar width (tr.). No palpebral lobes. Facial sutures almost straight, rapidly divergent only behind occipital furrows. Cranidial part of posterior border short (tr.), posterior border furrow absent. In longitudinal profile occipital ring slightly higher than glabella; occipital furrow marked only as extremely faint depression; glabella horizontal, gently sloping down at front; frontal area narrow (tr.), flat. In transverse profile glabella and fixigenae weakly, uniformly vaulted.

Librigena, *hypostoma* and *thorax* unknown.

Pygidium parabolic, with narrow border, faintly marked. Axis nearly as broad (tr.) as pleural lobes, with at least ten flat rings. Rings furrows faintly marked. Tip of axis strongly elevated above pleural region. Pleural lobes slope steeply laterally and posteriorly. In longitudinal profile axis almost horizontal, its tip strongly elevated above downward sloping postaxial region. In transverse profile axis broad (tr.), flat, uniformly vaulted with pleural lobes. Surface of exoskeleton smooth, mat.

Internal moulds of cranidia (pl. XII, fig. 1). Glabella parallel-sided, axial furrows shallow, occipital ring broad (long.), sloping forward to occipital furrow, with central node near posterior margin. A pair of deep holes, corresponding to strongly developed apodema-like processes, present close to posterior extremities of axial furrows. Occipital furrow shallow, slightly deepened distally. Four pairs of lateral glabellar furrows faintly marked. S_1 long, bending strongly backwards. L_1 very long. Their length (long.) almost twice the width (long.) of occipital ring. S_2 and S_3 curved, short, S_4 marked only as shallow pits. Posterior borders curving strongly backwards projected beyond posterior margin of occipital ring.

Text-Pl. IX

Liobolina apodemata n.sp.

Fig. 1. Cranidium, holotype: *a* lateral view, *b* anterior view (IG 173.II.40).

Fig. 2. Young cranidium: *a* lateral view, *b* anterior view (IG 173.II.420).

Fig. 3. Pygidium: *a* lateral view, *b* posterior view (IG 173.II.431).

Liobole zarembiensis n.sp.

Fig. 4. Young cranidium: *a* lateral view, *b* anterior view (IG 173.II.613).

Fig. 5. Pygidium: *a* lateral view, *b* posterior view (IG 173.II.41).

Fig. 1-5: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

(Scales = 1 mm)

Ontogeny. — The length of the smallest known cranidium (pl. XV, fig. 10) is 1.6 mm. It is characterized by an upturned anterior margin and concave, narrow (long.) frontal area. Glabella slim, parallel-sided, with rounded front and weakly marked lateral glabellar furrows. Occipital ring convex, slightly tapering distally, with centrally situated node. Occipital furrow straight, well defined with deepened lateral parts. Axial furrows shallow, distinct. Holes corresponding to processes on ventral surface of posterior margin of occipital ring not marked. Fixigenae arched longitudinally with weakly developed eye ridges running obliquely backwards from S_3 to lateral margin of fixigenae. Facial sutures straight divergent only near extremities. On larger cranidium (length 2.0 mm; pl. XV, fig. 11; text-pl. IX, fig. 2) axial furrows faintly defined, occipital ring weakly convex, with node close to posterior edge of occipital ring. Faintly marked holes at posterior extremities of axial furrows. Eye ridges well marked. A cranidium, 4.5 mm in length, already has the typical adult appearance (deep holes at posterior extremities of axial furrows, very broad (long.) occipital furrow, and forwards sloping occipital ring with node near posterior margin), but still retains the faint eye ridge.

Discussion. — The internal moulds of the cranidia differ from the testate specimen in the following details: 1) occipital ring, flat on external surface, slopes up from the occipital furrow to the posterior margin in the internal mould; 2) occipital node, low and situated on middle of occipital ring of the testate specimen, is prominently placed on the posterior edge of the cranidium in internal moulds; 3) axial furrows do not deepened at their posterior extremities on the external surface, on the internal mould they deepen here into a pair of deep holes. This means that: a) the thickness of the integument decreases towards the middle of the occipital ring, and is very thin on the node; b) the integument is very thick along the posterior margin of the cranidium (as is usual in the genus *Liobole*); c) a pair of processes is developed on the posterior extremities of the axial furrows, on the internal surface of the test. Such a construction of the occipital ring has, of course, its explanation in the mechanics of the exoskeleton. Probably, it has something to do with the junction between cephalon and thorax. A similar construction of occipital ring is found in the Ordovician genus *Dimeropyge* Öpik, 1937. R. and E. Richter (1951) erected the genus *Liobolina,* including two species: *L. submonstrans* R. & E. Richter, 1951, and *L. nebulosa* R. & E. Richter, 1951. *L. apodemata* n.sp. differs from both species mentioned here by having a very faint occipital furrow and by the lack of palpebral lobes. In longitudinal profile *L. apodemata* is identical with *L. submonstrans,* having the fixigenae more strongly vaulted, however. *L. apodemata* recalls

L. submonstrans in the shape of the glabella and the degree of obsolescence of the lateral glabellar furrows, but the longitudinal profiles of both cranidia are different, as in *L. apodemata* the cranidium is nearly flat, whereas in *L. nebulosa* it is convex. The pygidium of the new species recalls that of *L. submonstrans* in the shape of the axis and in longitudinal profile. *L. apodemata* differs from *L. praevia*, described here from the *Gattendorfia* zone of the Holy Cross Mountains, in having a more elongate glabella, wider (tr.) fixigenae, anterior branches of the facial sutures more strongly divergent, wide (long.) occipital ring and shallower occipital furrow. The pygidium of *L. apodemata* is elongate, and semicircular in *L. praevia*. *L. apodemata* occurs later than any other representative of this genus, being found in the trilobite assemblage with *Liobole glabroides glabroides* R. & E. Richter, 1949, and other species of this genus, which defined the age of these beds as *Pericyclus* zone. The remaining species of *Liobolina* occur in the *Gattendorfia* zone (VII).

Genus *Liobole* R. & E. Richter, 1949

Liobole glabroides glabroides R. & E. Richter, 1949

(pl. XIV, fig. 6; pl. XVI, fig. 1)

1949. *Phillibole (Liobole) glabroides* R. & E. Richter, R. & E. Richter, Die Trilobiten..., p. 82, pl. 2, fig. 23-26; pl. 3, fig. 30-35; pl. 4, fig. 40; pl. 5, fig. 42.

Material. — Internal moulds of 3 cranidia and 4 librigenae from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.567
Length of cranidium	16.3
Length of glabella	12.9
Width of glabella	9.2

Discussion. — The Polish specimens of this species differ from the German material from Belecke (R. & E. Richter, 1949, pl. 3, fig. 24, 25) only in the more divergent posterior branches of the facial sutures. The apparent differences compared with the holotype (R. & E. Richter, 1949, pl. 3, fig. 30), e.g. the more cylindrical shape of the glabella and the lack of any narrowing opposite S_3 in the Polish specimens, are probably due to the poor state of preservation.

Liobole zarembiensis n.sp.

(pl. XIV, fig. 1,2; XV, fig. 5-8; XVI, fig. 2,3; text-pl. IX, fig. 4,5)

Holotype: No. IG 173.II.610; pl. XV, fig. 8 (internal mould of cranidium).
Type horizon: Carboniferous, *Pericyclus* zone (VIII).
Type locality: Zaremby, Holy Cross Mountains, Poland.
Derivation of name: zarembiensis — found in Zaremby.

Diagnosis. — Glabella nearly parallel-sided, slightly conctracted between S_3. Anterior margin of cranidium slightly upturned. Frontal area narrow (long.), concave. No border or border furrow. Palpebral lobes gently curved, long, slightly in front of midlength of glabella. Posterior border very long (tr.), curving backwards.

Material. — Internal moulds of 45 cranidia and 60 pygidia from lower and upper beds of *Pericyclus zone* (VIII) of Zaremby, 1 testate pygidium from the same zone of Gałęzice.

Dimensions (in mm):

IG Mus. cat. no.	173.II. 611	173.II. 612	173.II. 610	173.II. 608	173.II. 614	173.II. 613	173.II. 606	173.II. 575
Length of cranidium	9.5	6.5	5.0	4.1	3.2	2.6	1.9	—
Length of glabella	6.5	5.2	3.8	3.3	2.8	1.8	1.4	—
Width of glabella	4.9	4.1	2.7	2.2	1.9	1.2	0.7	—
Length of pygidium	—	—	—	—	—	—	—	14.5
Width of pygidium	—	—	—	—	—	—	—	20.0
Length of axis	—	—	—	—	—	—	—	12.9
Width of axis	—	—	—	—	—	—	—	6.6

Description. — Glabella well defined, almost parallel-sided, a little contracted between anterior lateral furrows S_3. Three pairs of lateral glabellar furrows distinct. Occipital ring broad (long.), high, with prominent median node on posterior margin. Occipital lobes strongly marked. Occipital furrow broad, with distinctly marked division into three parts. Frontal area narrow (long.), concave. No border or border furrow. Anterior margin of cranidium upturned. Fixigenae broad (tr.). Palpebral lobes narrow (tr.), gently curved, slightly in front of midlength of glabella. Their length (long.) equal to length (long.) of basal lobes (L_1); ε and γ broadly rounded, far from axial furrows; β broadly rounded; nearer axial furrows than δ. Posterior borders unusually long (tr.), and curving backwards, their ends projecting beyond posterior margin of occipital ring. Posterior branches of facial sutures long, run parallel to axial furrows at first, then diverge backwards and bend outwards. Anterior branches of facial sutures short, divergent at first then turning inwards and cutting anterior margin of cranidium almost opposite axial furrows. In longitudinal profile occipital ring higher than glabella, with very prominent node; occipital furrow incised; glabella gently arched, frontal area narrow (long.), concave, anterior margin of cranidium upturned. In transverse profile glabella slightly vaulted, higher than flat palpebral lobes.

Librigena, *hypostoma* and *thorax* unknown.

Pygidium, probably belonging to this species, subsemicircular, with faintly marked border. Axial furrows deep. Axis long, prominent, ending

just in front of border, occupying one-third of width (tr.) of pygidium. Thirteen to fourteen flat rings. On pleural lobes only first rib visible. In longitudinal profile axis horizontal, with distinctly limited end; postaxial region gently sloping down. In transverse profile axis and pleural lobes strongly vaulted, separated by deeply incised, broad (tr.) axial furrows. Doublure narrow, convex, steeply inclined.

Variation within the species concerns the following characters: 1) palpebral lobes are usually situated slightly before midlength of glabella, but on some specimens they are further forwards (pl. XIV. fig. 1); 2) posterior branches of facial sutures generally run parallel to axial furrows at first, but in a few cases they are strongly divergent posteriorly after passing ε (pl. XIV, fig. 2); 3) glabella is usually long, cylindrical, sometimes contracted slightly between lateral glabellar furrows S_3, but on one specimen it is shorter contracted distinctly between S_3 (pl. XIV, fig. 1).

Ontogeny. — The smallest known cranidium (length 1.9 mm; pl. XV. fig. 5) possesses a slightly pointed anterior margin, somewhat upturned; frontal area concave as in adult specimens. Occipital ring convex, tapering laterally. Occipital furrow deepened near axial furrows. Glabella slender, elongate, broadest across basal lobes, then narrowing, parallel-sided with rounded front. Three pairs of short lateral glabellar furrows; posterior (S_1) cutting off basal lobes. Their width (tr.) is less than one-third of basal width (tr.) of glabella. Palpebral lobes indistinctly marked, short (long.), opposite midlength of glabella. Posterior borders long (tr), their ends not projecting beyond posterior margin of occipital ring. Posterior branches of facial sutures, between posterior border furrows and ε parallel to axial furrows, and between γ and β as long as anterior branches; β sharply marked, nearer axial furrows than δ. In the next known growth stage (length 2.6 mm; pl. XV, fig. 6) anterior margin of cranidium is still somewhat pointed, but the glabella has the shape typical of adult specimens — nearly parallel-sided, not expanded at the base. Posterior lateral furrows (S_1) cutting off less than one-third width (tr.) of the glabella. Occipital ring only faintly tapering laterally. Occipital furrow divided into three parts. Palpebral lobes longer than on preceding specimen, but also indistinctly marked. Posterior branches of facial sutures parallel to axial furrows at first, then becoming divergent posteriorly. Anterior branches shorter, divergent; β somewhat rounded in the same line as δ. The next known growth stages show stronger curving of palpebral lobes (δ situated more outwards than β) and projection of the posterior border beyond the posterior margin of occipital ring. Cranidia have a broadly rounded anterior margin, width (tr.) of basal lobes (L_1) equal to one-third width of glabella.

Discussion. — *Liobole zarembiensis* n.sp. described above is in some features somewhat intermediate between the two German representa-

tives of *Liobole*, viz. *L. subaequalis* (Holzapfel) from Erdbach and *L. glabroides glabroides* R. & E. Richter from Bilstein. The table below compares the cranidia of three species in question. Pygidia were not taken into account, as they do not differ distinctly.

	L. glabroides glabroides	*L. zarembiensis*	*L. subequalis*
Frontal area	flat	concave	flat
Shape of glabella	tapering forwards, distinctly contracted between S_3	nearly parallel-sided, slightly contracted between S_3	slightly tapering
Lateral glabellar furrows	four, distinctly visible	three, distinctly visible	absent, or extremely faint
Occipital furrow	divided into three parts	divided into three parts	almost straight
Occipital ring	with occipital lobes	with occipital lobes	without occipital lobes
Longitudinal profile of glabella	horizontal, with steeply sloping front	horizontal, with steeply sloping front	gently inclined down forwards, anterior part not very steep
Palpebral lobes	opposite midlength of glabella, short	slightly in front of midlength of glabella, long, gently curved	slightly in front of midlength of glabella, long
β	sharply marked	rounded	rounded
$\beta - \delta$	β more distant from axial furrows than δ	β closer axial furrows than δ	β as distant from axial furrows as δ
Posterior branches of facial sutures	parallel to axial furrows	between midlength of basal lobes and ε parallel to axial furrows, then divergent	between midlength of basal lobes and ε parallel to axial furrows, then divergent
Posterior border	long(tr.), not projecting beyond posterior margin of occipital ring	long (tr.), projecting beyond posterior margin of occipital ring	long (tr.), projecting beyond posterior margin of occipital ring

Liobole barilliformis n.sp.

(pl. XIV, fig. 5)

Holotype: No. IG 173.II.679; pl. XIV, fig. 5 (cranidium).

Type horizon: Carboniferous, *Pericyclus* zone (VIII).

Type locality: Zaremby, Holy Cross Mountains, Poland.

Derivation of name: barilliformis — barrel-shaped, from the shape of the glabella.

Diagnosis. — Glabella broad, barrel-shaped. Three pairs of glabellar furrows strong. Occipital ring arched transversely. Cranidium broadly rounded anteriorly. Palpebral lobes opposite midlength of glabella. Fixigenae sloping backwards.

Material. — Internal moulds of 4 cranidia from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.679
Length of cranidium	8.2
Length of glabella	6.8
Width of glabella	4.6

Description. — Glabella widens slowly forwards for half its length, then slightly narrows anteriorly, with broadly rounded front. Three pairs of lateral glabellar furrows well marked. Posterior (S_1) bifurcate, middle (S_2) nearly as long as preceding, but not reaching axial furrows, anterior (S_3) shorter, more distant from axial furrows than S_2. Axial furrows faintly marked. Occipital ring very high in middle part, then steeply sloping distally. Occipital furrow wide (long.), shallow, with lateral parts curved forwards, deeper. No border or border furrow. Frontal area narrow (long.), flat. Fixigenae broad (tr.), from S_1 to posterior border strongly inclined downwards. Palpebral lobes opposite midlength of glabella. Posterior branches of facial sutures parallel to axial furrows at first, then diverging posteriorly. Anterior branches very short, divergent; ε and γ broadly rounded; δ more outwards than β, both sharply marked. In longitudinal profile occipital ring higher than glabella, with prominent node; occipital furrow broad (long.) and shallow, profile of glabella flat, strongly curved down in front to a flat, horizontal frontal area. In transverse profile glabella vaulted and higher than flat horizontal palpebral lobes.

Librigena, *hypostoma, thorax* and *pygidium* unknown.

Discussion. — *Liobole barilliformis* n.sp. is similar to *L. zarembiensis* n.sp. in the course of the facial sutures, the position of the palpebral lobes and the lateral glabellar furrows. The differences concern the shape of the glabella, which in *L. zarembiensis* is elongate, the axial furrows being almost parallel, whereas in *L. barilliformis* it is shorter and barrel-shaped. The characteristic features of the two new species are the strong downwards slope of the occipital ring distally, and the downwards inclination posteriorly of the fixigenae. Such features among representatives of the *Liobole* occur only in *L. coalescens* R. & E. Richter, 1949. The occipital and posterior border furrows which are nearly obsolete in *L. coalescens*, are very shallow in *L. barilliformis*. The differences concern the position of the palpebral lobes which in *L. coalescens* are shifted more forward, the longitudinal profile which in the new species is more flat than in *L. coalescens*, and the transverse profile: in *L .coa-*

lescens the glabella, palpebral lobes and fixigenae form a continuous arch, whereas the glabella is higher than the palpebral lobes in *L. barilliformis*. The cranidia of *L. coalescens* described by R. and E. Richter (1949) were preserved as exoskeletons, whereas the new species described here is known from internal moulds only. May be the differences between the exoskeletons of both species would be smaller. In the beds yielding *L. barilliformis* there occur pygidia similar to those of *L. coalescens*, described here as *Liobole* aff. *coalescens*. It is possible that the cranidia of *L. barilliformis* and the pygidia in question are conspecific.

Liobole aff. *coalescens* R. & E. Richter, 1949
(pl. XVI, fig. 4; text-fig. 8)

Material. — Internal moulds of 9 pygidia from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.657
Length of pygidium	15.3
Width of pygidium	20.0
Length of axis	14.5
Width of axis	6.8

Description. — *Pygidium* parabolic, without border. Axial furrows faintly marked. Axis long, flat, with fifteen to sixteen rings, posterior margins of which are curved forwards mesially. On pleural lobes only

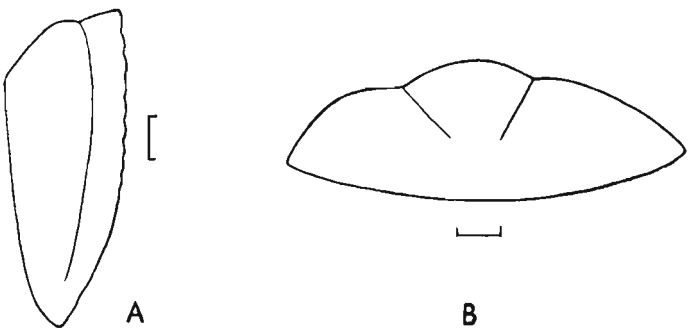


Fig. 8. — *Liobole* aff. *coalescens* R. & E. Richter; pygidium: *A* lateral view, *B* posterior view (IG 173.II.657). (Scales = 1 mm).

first half-rib visible. In longitudinal profile axis horizontal with prominent tip; postaxial region flat, slightly sloping backwards. In transverse profile pygidium somewhat vaulted, axis not demarcated from pleural lobes. Doublure gently convex.

Discussion. — Polish specimens differ from *L. coalescens* described by R. and E. Richter in the following features: 1) the pygidium is less

vaulted; 2) the doublure is slightly convex, whereas in the German forms it is strongly convex and directed nearly perpendicularly to the pygidial surface. In the beds yielding *L.* aff. *coalescens* no cranidia of the same species were found. This may be due to the fact that cranidia are on the whole less common than pygidia, or as stated on p. 174, the pygidia might be conspecific with the cranidia of *L. barilliformis* n.sp.

Liobole sp. *a*
(pl. X, fig. 8)

Material. — Internal moulds of 3 cranidia from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

No. IG 173.II.637	
Length of cranidium	5.2
Length of glabella	4.0
Width of glabella	2.9

Description. — Glabella slightly tapering with almost obtuse front. Axial furrows faintly defined. Lateral glabellar furrows weakly developed. Occipital ring with well marked lateral occipital lobes. No border or border furrow. Frontal area very narrow (long.). Palpebral lobes lacking. Posterior branches of facial sutures parallel to axial furrows, anterior branches slightly divergent; β rounded. Fixigenae broad (tr.). In longitudinal profile the occipital ring stands as high as the glabella; the latter is horizontal sloping down frontally to narrow (long.), flat, frontal area. In transverse profile glabella slightly vaulted, fixigenae flat.

Discussion. — The cranidia described above are very interesting on account of the entire lack of palpebral lobes. This feature, unknown in *Liobole,* is common in the genus *Liobolina.* Also the trend towards the disappearance of the lateral glabellar furrows and the broadly rounded front of the glabella, characteristic of *Liobole* sp. *a,* are common in the genus *Liobolina.* However the remaining features characterizing *Liobole* sp. *a,* such as the presence of the occipital lobes, and wide (tr.) fixigenae, are characteristic of *Liobole.* On account of the scantiness of the material, which is poorly preserved, it is impossible to venture an opinion whether the similarities between the form described here and *Liobolina* are due to their close relationship.

?Liobole sp. *b*
(pl. XIV, fig. 4)

Material. — Internal mould of 1 pygidium from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.562
Length of pygidium	5.1
Width of pygidium	7.5
Length of axis	4.2
Width of axis	2.9

Description. — *Pygidium* parabolic, without border. Axis narrow (tr.) with thirteen well defined rings. Six ribs visible on pleural lobes. Interpleural furrows faint, pleural furrows wide, distinctly marked. Doublure flat, broad. In longitudinal profile axis horizontal with well defined tip. Postaxial region sloping slightly down backwards. In transverse profile axis narrow (tr.), high, pleural lobes gently vaulted.

Discussion. — The pygidium described here differs from the known representatives of *Liobole* in having a convex axis with distinct rings and in having interpleural and pleural furrows on the pleural lobes.

Liobole sp. *c*
(pl. XV, fig. 3)

Material. — Internal moulds of 38 cranidia from upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.745
Length of cranidium	0.9
Length of glabella	0.6
Width of glabella	0.4

Description. — Glabella tapering forwards with rounded front. Three pairs of lateral glabellar furrows deep, short; posterior (S_2) cut off basal lobes. Occipital ring slightly tapers distally. Preglabellar field narrow (long.). Anterior border upturned. Fixigenae broad, eye ridge distinct. Palpebral lobes short (long.), opposite midlength of glabella, triangular. Posterior branches of facial sutures long, strongly divergent, anterior branches shorter, divergent.

Discussion. — The cranidia described here are similar to the young cranidia of *L. zarembiensis* n.sp. in the shape of the glabella with distinct, cut off basal lobes, and in the shape and position of the palpebral lobes provided with eye ridges. These features and the small dimensions of the cranidia allow one to assume that we are dealing with the young forms of *Liobole*. As the glabella is shorter, the fixigenae are wider (tr.) and the posterior branches of the facial sutures more strongly divergent than is characteristic of *L. zarembiensis*, the cranidia in question must be considered as belonging to a different species. But since older cranidia of them are not known (the beds yielding them contain only adult specimens of *L. zarembiensis* in small numbers), they must be recorded for the time being as *Liobole* sp. *c*.

Lioboie sp. *d*

(pl. XV, fig. 4)

Material. — Internal moulds of 17 cranidia from upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.743
Length of cranidium	1.5
Length of glabella	1.0
Width of glabella	0.6

Description. — Cranidium pointed anteriorly. Glabella slightly finger-shaped. Posterior lateral glabellar furrows (S_1) deep, cutting off basal lobes. Occipital ring broad (long.) and convex mesially, tapering distally. Preglabellar field as broad (long.) as occipital ring. Anterior border slightly upturned. Fixigenae broad (tr.) with developed eye-ridge. Palpebral lobes narrow (tr.), slightly curved approximately opposite midlength of glabella; ε and γ indistinctly marked. Anterior and posterior branches of facial sutures divergent.

Discussion. — The young cranidia described here have been assigned to the genus *Liobole* on account of their similarities — as far as the shape of glabella and the presence of a distinct eye ridge go — with the young cranidia of *L. zarembiensis* n.sp. The specific characters are not yet distinctly pronounced in these young stages of cranidia, so that it is impossible to decide to which species they should be assigned.

Genus *Diacoryphe* R. & E. Richter, 1951

Diacoryphe strenuispina n.sp.

(pl. XI, fig. 6; XII, fig. 6, 7; text-pl. VII, fig. 8; text-fig. 5 *A*)

Holotype: No. IG 173.II.332; pl. XII, fig. 6 (cranidium).

Type horizon: Carboniferous, *Gattendorfia* zone (VII).

Type locality: Jabłonna, Holy Cross Mountains, Poland.

Derivation of name: strenuus — strong, *spina* — spine; because of thick librigenal spine.

Diagnosis. — Axial furrows poorly marked. Occipital furrow faint. Preglabellar field broad (long), slightly concave. Palpebral lobes very narrow (tr.) opposite midlength of glabella. Librigena with small eye and strong, thick librigenal spine.

Material. — 1 damaged complete dorsal shield, 2 damaged cephalons, 3 cranidia, 1 hypostoma, 7 librigenae, 2 pygidia from *Gattendorfia* zone (VII) of Jabłonna.

Dimensions (in mm) — see p. 178.

Description. — *Cephalon.* Glabella tapering forwards, with slightly rounded front. Axial furrows extremely faint. Occipital ring narrow (long.), not tapering distally. Occipital furrow very shallow. Preglabellar field concave, twice as wide (long.) as occipital ring. Anterior border

IG Mus. cat. no.	173.II. 331	173.II. 332	173.II. 325	173.II. 323
Length of cranidium	9.8	4.0	3.9	—
Length of glabella	6.4	2.7	2.6	—
Width of glabella	5.2	1.8	—	—
Length of pygidium	—	—	—	2.6
Width of pygidium	—	—	—	3.9
Length of axis	—	—	—	1.7
Width of axis	—	—	—	2.3

somewhat upturned, with three to four lists. Fixigenae narrow (tr.), palpebral lobes, situated opposite midlength of glabella, slightly curved, narrow (tr.). Posterior branches of facial sutures parallel to axial furrows. Anterior branches between γ and β long, divergent, between β and *a* long, convergent; β broadly rounded. Distance *a*—*a* small. Posterior border flat, very short (tr.).

Librigena narrow (tr.), flat, with sharply marked border and very small, low visual area. Librigenal spine thick, strong, with pointed tip. Its length equal approximately to that of glabella. Librigenal doublure broad, very convex.

Hypostoma of cyrtosymbolid type. *Thorax* poorly known. *Pygidium* semicircular with short, nearly triangular axis. Seven axial rings. Postaxial ridge slightly marked. Ribs on pleural lobes hardly visible.

Discussion. — The genus *Diacoryphe* R. & E. Richter, 1951, included two species up till now: *D. pfeifferi* R. & E. Richter, 1951 (type species) and *D. gloriola* R. & E. Richter, 1951. *D. strenuispina* n.sp. described here has small but distinct eyes, and wide and strong librigenal spines, similar to those occurring in *Spatulina* n.gen. (see p. 180). Both features distinguish the new species from *D. pfeifferi*. The cranidial structure is similar however in both species. The cranidium of the Polish species differs only in having distinct, though narrow (tr.) palpebral lobes which are absent in *D. pfeifferi*. The pygidium of the new species is similar to that in *D. pfeifferi*, differing in having narrower (tr.) pleural lobes and a less prominent postaxial ridge. *D. gloriola* is so far known as a single cranidium only. The new species differs from it in having less distinct axial and lateral glabellar furrows. The resemblances of both species concern the shape of their palpebral lobes, points γ being however in *D. strenuispina* situated further away from the axial furrows than in *D. gloriola*.

Trilobites sp. *a*

(pl. XIV, fig. 3)

Material. — Internal moulds of 4 damaged pygidia from lower beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.566
Length of pygidium	6.6
1/2 width of pygidium	6.8
Length of axis	4.8
Width of axis	4.1

Description. — *Pygidium* very broad (tr.) and short (long.). Pygidial margin upturned. Axis as broad as pleural lobe, with eight rings and well defined tip. Axial rings flat. Ring furrows shallow, deepened near axial furrows. Postaxial region approximately twice as broad (long.) as axial ring (long.). No pleural and interpleural furrows on pleural lobes. Surface of internal mould finely and densely granulated.

Discussion. — The pygidium described here cannot be assigned to any known Carboniferous genus on account of lateral elongation (tr.) and its characteristic upturned pygidial margin.

Trilobites sp. *b*

(pl. XV, fig. 2)

Material. — 1 fragment of internal mould of small pygidium from upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.745
Length of pygidium	1.5

Description. — *Pygidium.* Axis with seven rings. On pleural lobes pleurae distinctly separated with pointed ends.

Discussion. — The fragmentary pygidium represents (judging from its small dimensions and the presence of distinctly separated pleurae with pointed ends) a transitory pygidium. The beds yielding the pygidium contain different genera of Cyrtosymbolinae *(Cyrtosymbole (Macrobole), Typhloproetus, Liobolina, Liobole),* so that it is impossible to decide to which of the above genera the pygidium should be assigned.

Trilobites sp. *c*

(pl. XV, fig. 1)

Material. — 1 internal mould of small pygidium from upper beds of *Pericyclus* zone (VIII) of Zaremby.

Dimensions (in mm):

	No. IG 173.II.746
Length of pygidinum	1.0
Width of pygidium	1.5

Description. — Pygidium nearly triangular. Axis narrow (tr.), tapering backwards, with six rings. Interpleural furrows narrow. Pleural furrows broad. Each pleura with elongate spine.

Discussion. — Judging from the small dimensions the pygidium described represents a transitory one. Since long pleural spines do not occur in the ontogenetic development of the representatives of Cyrtosymbolinae yielded by the same beds, it is not possible to assign it to any known genus within this subfamily. *Trilobites* sp. *c* differs from that described as *Trilobites* sp. *b* in having much longer pleural spines.

NOTES ON THE GENUS *CYSTISPINA*

A subgenus *Cystispina* was established by R. and E. Richter (1939) and, with some hesitation, included in the genus *Phillibole*. R. and E. Richter believed that the new subgenus could reasonably be erected on the following characters: 1) presence of inflated librigenal spines, 2) narrow, slightly tapering pygidial axis, distant from posterior margin.

The species which these authors referred to the subgenus are: *C. cystispina* R. & E. Richter, 1939, *C. spatulata* (Woodward, 1902), *C. nasifrons* R. & E. Richter, 1949.

Prentice (1960, p. 272, pl. 12, fig. 2) mentioned that still another species from that genus had been found by him. In his opinion, it was close to *C. spatulata* (Woodward), but he never gave it a name. The species *C. spatulata* and *C. nasifrons*, as well as the one collected by Prentice, form a very uniform group indeed. In addition to a similar structure of the librigenal spines[4], the group is distinguished by affinities in the structure of the cranidium, which is characterized by: 1) absence of preglabellar field, 2) cylindrical glabella, 3) faintly indicated dorsal furrows, 4) very narrow (tr.) fixigenae (about one-tenth of glabellar width) which slope abruptly forwards.

In *C. cystispina* which is a type species of that genus, the structure of the cranidium differs a lot from *C. spatulata* and *C. nasifrons*. Its distinguished features are: 1) preglabellar field as long (long.) as the occipital ring (long.); 2) wide (tr.) glabella tapering forward, somewhat pear-shaped; 3) distinct dorsal furrows, 4) width of fixigenae equal to about one-fifth of glabellar width (tr.). The librigenal spines of

[4] An external mould of the librigena of *C.nasifrons*, not described or figured by R. & E. Richter, was discovered by the writer on specimen No. RX 1340 b in the collection of the Natur Museum Senckenberg in Frankfurt/M. The librigenal spine of this species is shown in text-fig. 5*F* of the present paper.

C. cystispina have the same tendency, as *C. spatulata* and *C. nasifrons*, to become inflated, but they differ in their mode of development. The possession of certain minor characters of pygidial structure in common (stressed by R. & E. Richter in their subgeneric diagnosis (1939, p. 103)), does not provide an adequate basis for uniting *C. cystispina* with *C. spatulata* and *C. nasifrons*, all the more since their pygidia are generally in a bad state of preservation.

Some species with swollen librigenal spines have also been found in the Lower Carboniferous deposits of the Holy Cross Mountains at Jabłonna, Karczówka and Zaremby. On their cranidial structure and the course of facial sutures they have however been referred by the writer, to the distinct genera: *Formonia* (p. 156, pl. XVII, fig. 3), *C. (?Macrobole)* (p. 147, pl. XII, fig. 4), *Diacoryphe* (p. 177, pl. XI, fig. 6; pl. XII, fig. 6, 7). All of these forms are Lower or Upper Tournaisian in age, in contrast to the English and German Viséan forms mentioned above. The fact that a similar type of librigenal spine may occur independently in various genera of Cyrtosymbolinae during the Lower Carboniferous (text-fig. 5), is evidence that the character expresses convergence in adaptation to a particular mode of life. As has been previously stressed, the species *C. spatulata* and *C. nasifrons* have numerous characters in common; hence the erection of a separate genus — *Spatulina* nov. — to accomodate them, on recognition of *Phillipsia spatulata* Woodward, 1902 as the type species, seems correct.

The species identified by Prentice (1960, p. 272) is probably also referable to the genus *Spatulina*. This genus is distinguished by the close resemblance of cranidial structure to species that belong to *Liobolina (L. apodemata)*. It is very likely that *Liobolina* is closely related to *Spatulina* through forms approaching *L. apodemata* (see table 7). *Cystispina cystispina* which, as already mentioned, has a cephalon of completely different structure, displays certain resemblance with the genus *Drevermannia* R. Richter, 1909. However, in view of the likelihood that *Drevermannia* is not a natural systematic unit (R. & E. Richter, 1926, 1939) and that this similarity may merely be an expression of convergence, the recognition of *Cystispina* as an independent unit, not connected with *Phillibole*, seems more correct.

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Warszawa, November 1961

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HALSZKA OSMÓLSKA

CYRTOSYMBOLINAE (TRILOBITA) FAMENU I DOLNEGO KARBONU GÓR ŚWIĘTOKRZYSKICH

Streszczenie

WSTĘP

W pracy niniejszej opisano trylobity z rodziny Proetidae Salter, 1864, podrodziny Cyrtosymbolinae Hupé, 1953, występujące w warstwach famenu i dolnego karbonu południowej części Gór Świętokrzyskich. Z obszaru tego znane były dotychczas jedynie bardzo nieliczne Proetidae.

Zgromadzony materiał, obejmujący ponad 200 okazów, pochodzi z następujących miejscowości: Jabłonna, Kowala, Gałęzice, Czarnów, Karczówka, Zaremby i Łagów (por. fig. 1 na s. 54). Materiał ten został zebrany przez J. Czarnockiego, dr Z. Kielan-Jaworowską i częściowo przez autorkę. Wszystkie punkty występowania famenu i dolnego karbonu w południowej części Gór Świętokrzyskich zostały odkryte przez J. Czarnockiego, który także sporządził nieopublikowany profil famenu w Jabłonnie, na którym oparła się autorka niniejszego opracowania (zob. s. 59). W niektórych przypadkach autorka korzystała z cennych informacji J. Czarnockiego, dotyczących geologii omawianego obszaru, a przekazanych jej przez dr Z. Kielan-Jaworowską.

Z famenu wymienionych wyżej miejscowości opisano 10 gatunków i podgatunków, w tym 7 nowych, a z dolnego karbonu — 15 gatunków, z których 13 uznano za nowe (por. tabela 1 — str. 56/57).

MATERIAŁ

Cyrtosymbolinae fameńskie występują w wapieniach, z zachowanymi pancerzami, przeważnie jako niezdeformowane, oddzielne kranidia, policzki i pygidia; częste były także formy młode, w stadium meraspis. Wyjątkowo, w warstwach najwyższego famenu Kowali, Cyrtosymbolinae występują w łupkach i są źle zachowane. W dolnym karbonie opisane tu trylobity znajdowane były prawie wyłącznie w łupkach ilastych lub, rzadziej, krzemionkowych. Całe okazy występują rzadko. W niektórych tylko warstwach (poziom *Gattendorfia* w Jabłonnie i Kowali) trylobity zachowane są z pancerzami. Większość materiału stanowią ośródki wewnętrzne, rzadziej natomiast odciski zewnętrzne, pozwalające na poznanie zewnętrznej morfologii pancerza i jego ornamentacji. Trylobity z łupków są najczęściej zdeformowane i spłaszczone, z wyjątkiem okazów bardzo małych, które są zazwyczaj dobrze zachowane. W łupkach dolnego karbonu znajdowane były często również młode formy, które opisane zostały w rozdziale dotyczącym ontogenezy (por. s. 84, 192). Tylko nieliczne trylobity karbońskie, pochodzące z soczewek wapiennych, występujących w łupkach poziomu *Pericyclus* w Gałęzicach, są zachowane z pancerzami.

STRATYGRAFIA

Stratygrafia utworów famenu i dolnego karbonu na obszarze Gór Świętokrzyskich nie została dotychczas wyczerpująco opracowana. Prace Sobolewa (1911) i Güricha (1896, 1901) dają jedynie fragmentaryczny obraz i wymagają gruntownej rewizji. Badania nad stratygrafią tych utworów prowadził Czarnocki (1928, 1933, 1948, 1957), jednakże praca tego badacza, która zawierała opracowanie fauny głowonogów famenu oraz miała być syntezą stratygrafii tego piętra, nie została, w związku ze śmiercią autora, ukończona. W latach ostatnich badania nad stratygrafią tego obszaru podjęli: Kościelniakowska (1959) dla famenu, Żakowa (1960, 1961, 1962) i Kwiatkowski (1959) dla dolnego karbonu. Z famenu tego obszaru opracowane zostały trylobity Phacopidae (Osmólska, 1958). Zadaniem autorki niniejszej rozprawy było jedynie opracowanie trylobitów Proetidae, występujących w facji cefalopodowej famenu i dolnego karbonu. Mogą one — jak zauważyli już R. & E. Richter (1926, 1951) oraz Pfeiffer (1954), a co zostało i tu potwierdzone — oddać duże usługi stratygrafii. Jednakże brak opartego na głowonogach stratygraficznego opracowania większości cytowanych tu profilów uniemożliwiał często autorce określenie poziomów stratygraficznych, szczególnie wówczas, gdy występowały w nich wyłącznie nowe gatunki trylobitów. Z tego też względu podana tu stratygrafia utworów fameńskich, a częściowo i dolno-karbońskich, nie może być uznana za ostateczną i autorka liczy się z możliwością pewnych jej zmian. Z trylobitów, wspólnych z obszarem Niemiec, których wartość stratygraficzna nie budzi wątpliwości, występują tu jedynie: *Cyrtosymbole* (*Cyrtosymbole*) *gotica* R. & E. Richter, 1926 — w poziomie cheilocerasowym (II), (*C. Waribole*) *conifera* R. & E. Richter, 1926 — w poziomie lewigitesowym (V), *C. (Waribole) abruptirhachis* (R. & E. Richter, 1919) — w poziomie gattendorfiowym (VII), (por. tabela 2 na s. 66) i *Liobole glabroides glabroides* R. & E. Richter, 1949 — w poziomie pericyklusowym (VIII), (por. tab. 2).

OPISY ODSŁONIĘĆ

Jabłonna. Przekopy, które dostarczyły materiału do niniejszego opracowania, usytuowane były w lesie, po północnej stronie szosy Kielce—Daleszyce, ok. 200 m na północ od miejsca, do którego dochodzi droga ze wsi Kaczyn. Zdaniem Czarnockiego (ustna informacja, przekazana Z. Kielan-Jaworowskiej w r. 1948), famen w Jabłonnie obejmuje wszystkie poziomy, od cheilocerasowego (II) do woklumeriowego (VI). Najniższe warstwy famenu leżą tu na franie. Famen jest wykształcony prawie wyłącznie w postaci drobnokrystalicznych wapieni, o zabarwieniu czerwonawym, w różnych odcieniach. Tylko warstwy najwyższe są seledynowe lub szarawe. Całkowita miąższość profilu famenu wynosi tu ok. 10 m. (por. fig. 3 na s. 59). Bardzo bogata fauna obejmuje: głowonogi, brachiopody, trylobity, korale, rzadziej małże i ślimaki. Fauna ta, poza trylobitami, nie została dotychczas opracowana. Nad warstwami woklumeriowymi (VI) w Jabłonnie leżą łupki skrzemionkowane, kostkowe dolnego turneju (poziom *Gattendorfia* — VII). W warstwach poziomu gattendorfiowego znaleziono liczne trylobity.

Gałęzice. Przekop przez utwory famenu został wykonany w zachodniej części Gałęzic, na północnym zboczu wzgórza Ostrówka, ok. 200 m na wschód od pagórka zwanego Todową Grządą. Famen na obszarze Gałęzic zachowany jest w postaci niewielkich płatów, występujących na północnych zboczach wzgórz Ostrówka i Besówka (Kwiatkowski, 1959) i wykształcony jest jako szare, niekiedy różowe wapienie. Brak tu franu i poziomu cheilocerasowego, tak że poziom prolobitesowy spoczywa bezpośrednio na wapieniach amfiporowych żywetu. Grubość famenu jest tu bardzo zredukowana i wynosi nieco powyżej 2 m. Według Czarnockiego (1928, 1948) występują tu wszystkie poziomy klymeniowe, od *Prolobites* do *Wocklumeria*. Nad nimi leżą łupki turneju i wizen, miejscami wykształcony w facji wapienia węglowego, a wyżej jako łupki szarogłazowe ze szczątkami roślinnymi. Opracowane tu trylobity fameńskie pochodzą z warstw klymeniowych na Ostrówce. Na ich podstawie udało się wydzielić poziomy od *Prolobites* do *Laevigites*. Obecność poziomu *Wocklumeria* jest prawdopodobna, chociaż nie udokumentowana występowaniem trylobitów (por. fig. 4 na s. 61).

Kowala. Przekopy, z których pochodzą opisane tu trylobity, wykonane zostały na polu gospodarza Barwinka, na południe od wsi Kowala i ok. 2 km na wschód od torów linii kolejowej Kielce–Busko. Famen spoczywa tu na franie. W przekopach, wykonanych przez J. Czarnockiego i autorkę, stwierdzono obecność najwyższych poziomów famenu: *Laevigites* (V) i *Wocklumeria* (VI), z trylobitami: Phacopidae — *Phacops wedekindi wedekindi* R. & E. Richter, 1926, i Proetidae — *Cyrtosymbole (Cyrtosymbole) pusilla* (Gürich, 1896), w przekopie zaś wykonanym przez Z. Kielan-Jaworowską stwierdzono obecność poziomu *Gattendorfia* (VII). Famen wykształcony tu jest w postaci wapieni o zabarwieniu czerwonym. Tylko najwyższe warstwy są wykształcone jako margle i czarne łupki palne (Czarnocki, 1933, 1939). Zdaniem Czarnockiego, potwierdzonym przez opracowanie fauny trylobitów w niniejszej pracy, w Kowali występuje stopniowe, ciągłe przejście między osadami famenu i dolnego karbonu. Poziom *Gattendorfia*, określony tu na podstawie obecności trylobita *Cyrtosymbole (Waribole) abruptirhachis* (R. & E. Richter, 1919), wykształcony jest w postaci marglistych, jasnozielonych łupków.

Czarnów. Przy drodze między Kielcami i Karczówką występują szaro-żółtawe wapienie ilaste, z trylobitami: *Trimerocephalus caecus* (Gürich, 1896) i *Cyrtosymbole (Cyrtosymbole) pusilla* (Gürich, 1896), reprezentowanymi dość licznie. Na podstawie podanych gatunków, wiek tych warstw określono jako odpowiadający poziomowi *Prolobites* (III).

Karczówka. Warstwy górnego famenu i dolnego karbonu występują tu w studni przy drodze między Kielcami i Karczówką, w pobliżu wsi Czarnów. Ponieważ warstwy te zostały stwierdzone na hałdzie, trudno ustalić ich następstwo. Wyróżniono kilka typów litologicznych skał, z których pewne zawierały trylobity: 1) wapienie szaro-różowe lub wiśniowe, z *Tr. caecus* i *C. (Cyrtosymbole) pusilla*,

a więc reprezentujące zapewne poziom *Prolobites* (III); 2) łupki margliste białe, szarawe, z wiśniowymi plamami, w których znaleziono *Ph. wedekindi wedekindi* i *C. (Waribole) conifera* R. & E. Richter, 1926, a zatem odpowiadające poziomowi *Laevigites* (V) lub *Wocklumeria* (VI); 3) szaro-różowy łupek marglisty z trylobitem *C. (Mirabole) kielanae* n.subgen., n.sp., o zaznaczonych pewnych cechach typowych dla Proetidae karbońskich; 4) łupek ciemny, wiśniowy, z *C. (?Macrobole) differtigena* n.sp., który to gatunek również ma pewne cechy, znane dotychczas tylko u Proetidae karbońskich. Na podstawie karbońskiego charakteru trylobitów, występujących w dwu ostatnich typach skał, można przypuścić, że tworzą one najwyższe w tym profilu warstwy, należące już do karbonu dolnego.

Łagów. Według Czarnockiego (1928), w okolicach Łagowa występuje pełny profil famenu i dolnego karbonu. Poziom *Cheiloceras* (II) spoczywa tu na franie (I) i jest wykształcony w postaci łupków marglistych, z wkładkami wapieni przepełnionych głowonogami. Wyżej leży podobnie wykształcony poziom *Prolobites* (III). W wapieniach tego poziomu znaleziono masowe nagromadzenia pancerzy trylobitów: *Tr. caecus* oraz nieco wyżej *C. (Cyrtosymbole) pusilla* i *C. (Cyrtosymbole) franconica primitiva* n.subsp. Poziom *Postprolobites* (IV) wykształcony jest w postaci czarnych łupków, z wkładkami bitumicznych wapieni, w których również stwierdzono obecność *C. (Cyrtosymbole) pusilla*. Wyższe poziomy famenu — *Laevigites* (V) i *Wocklumeria* (VI) — wykształcone są przeważnie jako łupki, niekiedy bitumiczne. Kontakt poziomu *Wocklumeria* (VI) i *Gattendorfia* (VII) nie został dotychczas uchwycony.

Zaremby k. Łagowa. Trylobity w Zarembach zostały znalezione w dwóch punktach. Jednym z nich jest przekop wykonany przez Z. Kielan-Jaworowską na polu gospodarza Dziarmagi, usytuowany 8—10 m na południe od niewielkiej sadzawki. W zielonkawych łupkach krzemionkowych górnego turneju (warstwy zarembiańskie — według Żakowej, 1962), odpowiadających dolnej części poziomu *Pericyclus* (VIII), znaleziono gatunek *Liobole glabroides glabroides* R. & E. Richter, 1949, przewodni dla tego poziomu. Drugi punkt z fauną trylobitową w Zarembach stanowią warstwy łupków marglistych, o barwie czekoladowej, z bardzo drobną fauną, znalezione w studni na podwórzu u gospodarza Dziarmagi. Występują tu także trylobity, charakterystyczne dla poziomu *Pericyclus* (VII). Warstwy te, według Żakowej (1962), odpowiadają dolnemu wizenowi. W warstwach zarembiańskich niektóre gatunki trylobitów reprezentowane są bardzo licznie, także przez młode stadia (prawdopodobnie meraspis). Warstwy te są bardzo interesujące pod względem paleontologicznym, ponieważ zawierają bardzo różnorodny i bogaty ilościowo zespół trylobitów, reprezentowany przez 5 rodzajów i 9 gatunków. Oprócz tego, na podkreślenie zasługują dwa fakty: 1) największy rozwój w wymienionych warstwach rodzaju *Liobole* R. & E. Richter, 1949, reprezentowanego przez największą liczbę gatunków i osobników; 2) obecność rodzaju *Liobole* i *Liobolina* R. & E. Richter, 1951, obok siebie, w warstwach tego samego wieku.

PORÓWNANIE PROFILÓW FAMENU W JABŁONNIE I GAŁĘZICACH

Miejscowości, z których pochodzą najpełniejsze serie famenu — Jabłonna i Gałęzice (Ostrówka) — oddalone są od siebie o ok. 25 km, a profile ich różnią się bardzo wyraźnie, zarówno petrograficznie, jak i miąższościami warstw oraz zespołami faunistycznymi w odpowiadających sobie poziomach. Te różnice w wykształceniu obu profilów są, być może, związane z faktem, iż, w stosunku do Gałęzic, Jabłonna położona jest bardziej na wschód, a zatem bliżej przypuszczalnego obszaru denudacji (Pajchlowa, 1959). Czerwony kolor wapieni Jabłonny wskazuje zatem na silną lateryzację i przynoszenie dużych ilości substancji żelazistych z lądu. Zabarwienie to, które w Jabłonnie występuje niemal od początku famenu, w Kowali leżącej między Jabłonną i Gałęzicami pojawia się znacznie później (ustna informacja J. Czarnockiego, udzielona Z. Kielan-Jaworowskiej).

KORELACJA WARSTW Z TRYLOBITAMI W POZIOMIE *GATTENDORFIA* REGIONU KIELECKIEGO

Wobec ubóstwa skamieniałości w dolnym karbonie Gór Świętokrzyskich oraz ich złego najczęściej stanu zachowania, duże usługi mogą oddać stratygrafii występujące tu często bogate zespoły trylobitów z podrodziny Cyrtosymbolinae. W czasie badań nad fauną trylobitów dolnego karbonu stwierdzono uderzający fakt, że w poziomie *Gattendorfia* (VII) — dolny turnej, oznaczonym na podstawie trylobitów, w żadnym z omawianych stanowisk (Kowala, Jabłonna, ?Karczówka) nie znaleziono powtarzających się form. Można to tłumaczyć: 1) zajmowaniem przez określone zespoły trylobitów w tym samym czasie różnych nisz ekologicznych, 2) występowaniem różnych zespołów trylobitów w różnych okresach czasu (w obrębie jednego poziomu). Pierwsze z tych wyjaśnień wydaje się mało prawdopodobne, ponieważ trudno przypuszczać, że przy niewielkich odległościach dzielących te stanowiska ani razu nie zdarzył się przypadek przemieszczenia się pojedynczych przedstawicieli zespołu *A* do niszy zajmowanej przez zespół *B*. Ponadto, w warstwach górnego turneju Gałęzic i Zaremb k. Łagowa, a więc stanowisk leżących na przeciwległych krańcach omawianego regionu, znaleziono te same gatunki, przy czym w Gałęzicach występowały one w soczewkach wapienia ilastego, zaś w Zarembach — w łupkach krzemionkowych, a więc można przyjąć z dużym prawdopodobieństwem, że żyły one w nieco odmiennych warunkach środowiskowych. Bardziej zadowalające wydaje się drugie wyjaśnienie, przy czym można by przyjąć, że warunki ekologiczne w poziomie *Gattendorfia* zmieniały się dość szybko i równie szybko zmieniały się związane z nimi zespoły trylobitów. Wydaje się, że monotonny i filogenetycznie bliski formom fameńskim zespół trylobitów z Kowali *(Cyrtosymbole (Waribole) abruptirhachis)* jest najstarszym spośród rozpatrywanych w tej pracy.

ZALEŻNOŚĆ FAUNY TRYLOBITOWEJ OD FACJI

Opisując Phacopidae fameńskie z południowej części Gór Świętokrzyskich (Osmólska, 1958) autorka zwróciła uwagę na fakt, że w synklinie kieleckiej, zajmującej płn.-wschodnią część regionu kieleckiego, w której osady famenu wykształcone są w postaci łupków ilasto-marglistych z cienkimi wkładkami wapieni, występują wyłącznie ślepe Phacopidae z rodzajów *Trimerocephalus* McCoy, 1849, *Dianops* R. & E. Richter, 1923 i *Ductina* (R. & E. Richter, 1931). W zespole tym sporadycznie tylko pojawiają się nieliczne Proetidae. Natomiast w synklinie gałęzicko-daleszyckiej, zajmującej płd.-zachodnią część tego regionu, gdzie famen wykształcony jest w postaci wapieni, z obfitą fauną głowonogową i trylobitową, występują wyłącznie Proetidae z normalnie rozwiniętymi oczami, należące do podrodzajów: *C. (Cyrtosymbole)* R. Richter, 1913, *C. (Waribole)* R. & E. Richter, 1926 i *C. (Calybole)* R. & E. Richter, 1926, zaś z Phacopidae występują tylko dwa gatunki: *Phacops* Emmrich, 1839, z dobrze rozwiniętymi oczami (w najwyższych poziomach famenu). Brak natomiast w obu wymienionych wyżej typach osadów fameńskich ślepych rodzajów Proetidae, jak: *Drevermannia* R. Richter, 1909, *Chaunoproetus* R. & E. Richter, 1919, *Typhloproetus* R. Richter, 1913, występujących zarówno na wschód, jak i na zachód od omawianego obszaru.

Zaobserwowane fakty nie pozwalają wątpić, że istnieje zależność między obecnością oczu u trylobitów fameńskich a facją, a więc odpowiadającymi jej warunkami ekologicznymi. Wapienie klymeniowe z Proetidae o oczach normalnych, występujące w synklinie gałęzicko-daleszyckiej, wskazują na istnienie tu w famenie progów podmorskich (Pajchlowa, 1959), w których rejonie występowała bogata fauna dobrze naświetlonego morza otwartego. W otaczających te progi głębszych partiach morza, o gorzej naświetlonym dnie, osadzały się grube kompleksy ilasto-marglistych osadów pelagicznych, z bardzo ubogą fauną, w której stosunkowo liczne są jedynie ślepe Phacopidae.

Takie samo zjawisko jak w Górach Świętokrzyskich, chociaż mniej wyraźnie zaznaczone (por. tabela 5 — str. 80/81), obserwuje się wśród opracowanych przez Maksimową (1955) trylobitów fameńskich Uralu i północnych Mugodżarów. W utworach wapiennych tego okresu (głównie wapienie ilaste) występuje fauna mieszana, złożona zarówno z Phacopidae, jak i Proetidae, przy czym zespół ten charakteryzuje się przewagą ilościową (ilość okazów i rodzajów) form z oczami nieco zredukowanymi: *Dienstina, Cryphops, Nephranops, C. (Calybole)* (?), lub normalnie rozwiniętymi: *Phacops, C. (Waribole), C. (Cyrtosymbole), Perliproctus,* — nad formami zupełnie ślepymi: *Trimerocephalus, Dianops, Typhloproetus, Chaunoproetus.* W utworach ilastych natomiast, występujących w północnych Mugodżarach, znaleziono wyłącznie ślepe Phacopidae *(Ductina, Trimerocephalus, Dianops)* i jeden gatunek Proetidae (*Drevermannia ninae* Maksimova) również ślepy. Maksimowa (1955), w rozdziale poświęconym przyczynom występowania redukcji oczu u trylobitów fameńskich, podkreśla, że pewne fakty — jak obecność w osadach szczątków roślin lądowych lub przedstawicieli grup zwierząt występujących w wodach naświetlonych — wskazują na przybrzeżny charakter osadów, zawierających

opisane przez tę autorkę trylobity. Zdaniem Maksimowej, wskazuje to na związek redukcji oczu z życiem w warstwie przydennego mułu, nie zaś z głębokością morza. Nie wyklucza jednak przy tym, że redukcja oczu mogła być spowodowana rozmaitymi przyczynami. R. Richter (1913, 1956), rozważając obie przyczyny redukcji oczu, przyjmuje, że życie w warstwie przydennego mułu mogło istotnie spowodować redukcję oczu. Ponieważ w południowej części Gór Świętokrzyskich, w strefie płytszej, osadzały się wapienie, zaś w głębokiej łupki ilasto-margliste, trudno zdecydować, który z dwóch czynników: słabe naświetlenie dna, czy też jego zamulenie, zadecydował o istnieniu ubogiego zespołu fauny, w którym dominowały trylobity pozbawione oczu.

UWAGI O ZALEŻNOŚCI MIĘDZY ZMIENNOŚCIĄ A WYGASANIEM PÓŹNOPALEOZOICZNYCH PROETIDAE

W grupie późnopaleozoicznych Proetidae obserwuje się szereg zjawisk, które — zdaniem niektórych autorów (Gheyselink, 1937; Erben, 1961) — są symptomami zbliżającego się wymarcia trylobitów. Do tych objawów zaliczyć można m.in. uderzająco dużą zmienność gatunkową, obserwowaną także w niektórych zespołach trylobitów w późnym paleozoiku. W Górach Świętokrzyskich zjawisko to można zaobserwować szczególnie wyraźnie na materiale z dolnego karbonu (poziom *Pericyclus*) w Zarembach. Charakterystyczną cechą wspomnianego zespołu jest duża ilość gatunków dotychczas nie znanych. Liczne są także okazy, które — mimo zadowalającego stanu zachowania — trudno zaliczyć do któregoś z występujących obok siebie gatunków. Niekiedy sprawia też trudność nawet określenie ich przynależności rodzajowej. Zjawisko wzrastającej zmienności gatunkowej w krytycznych momentach ewolucji było obserwowane także i w innych grupach zwierzęcych. Niekiedy poprzedza ono moment wygaśnięcia szczepu. Jak wykazał Simpson (1944, s. 214; 1955, s. 291), zjawisko to nie ma nic wspólnego z tzw. „zmiennością starczą", lecz związane jest z faktem, że przy kurczeniu się i zanikaniu odpowiedniego środowiska może wystąpić zwiększenie zmienności, która ma charakter eksploracyjny. Jeśli nowe, wolne środowisko jest dostępne dla którejś linii, może nastąpić ponowna radiacja i powstanie nowej grupy. W przeciwnym przypadku następuje wygaśnięcie.

Zjawisko to ilustrują dość dobrze fakty, zaobserwowane w historii Proetidae. Podrodzina Cyrtosymbolinae w famenie opanowała środowisko, odpowiadające wapiennej facji cefalopodowej. Na ostatnie poziomy tego piętra (V i VI) przypada największa ilość znanych gatunków Cyrtosymbolinae. Zmianie warunków środowiskowych obszarów, objętych facją cefalopodową, jaka nastąpiła na przełomie famenu i dolnego karbonu, towarzyszy również wyraźny kryzys w ewolucji Cyrtosymbolinae. Nielicznym przedstawicielom tej grupy (podrodzaje: *Macrobole, Waribole;* rodzaje: *Drevermannia, Typhloproetus*) udało się jednak przeniknąć do tego nowego środowiska i opanować je, dając początek ponownej radiacji. Gdy z kolei w młodszym, dolnym karbonie środowisko to, odpowiadające biofacji cefalopodowej, zaczęło zanikać, wystąpiła ponowna próba szukania nowych, wolnych areałów. Ta faza ewolucji Cyrtosymbolinae odpowiada wspomnianemu

na wstępie gwałtownemu zwiększeniu się zmienności. W tym przypadku próba ta nie została uwieńczona całkowitym powodzeniem. Powodem tego, jak się wydaje, mogło być opanowanie jedynego dostępnego środowiska, odpowiadającego litofacji wapienia węglowego, przez inną grupę Proetacea — Phillipsiidae, zapewne lepiej przystosowaną i mogącą z powodzeniem konkurować z Cyrtosymbolinae. Że próby opanowania tego środowiska były czynione, świadczy obecność w wizenie, w litofacji wapienia węglowego, obok Phillipsiidae, rodzaju *Liobole*, który zapewne odznaczał się największą w podrodzinie Cyrtosymbolinae zdolnością przystosowywania się.

REDUKCJA OCZU A WYGASANIE PROETIDAE

Zdaniem niektórych autorów (Erben, 1958), obserwowana dość często u późnopaleozoicznych Proetidae stopniowa redukcja oczu, początkowo adaptatywna, z czasem staje się hyperspecjalizacją i jest objawem tzw. typolitycznej fazy ewolucji tej grupy. Pogląd ten wydaje się być sprzeczny z faktem, że —aczkolwiek istotnie w poziomach VII i VIII ilość rodzajów ślepych jest wyraźnie większa — w poziomie IX, a więc tuż przed wygaśnięciem Proetidae, liczba ślepych rodzajów maleje, zaś obok zachowanych nielicznych form z oczami, pojawiają się nowe rodzaje, słabo wprawdzie zróżnicowane, lecz o dużej ilości osobników, które także mają zachowany płat wzrokowy oka (por. s. 84).

OGÓLNE UWAGI DOTYCZĄCE ONTOGENEZY, MORFOLOGII I SYSTEMATYKI CYRTOSYMBOLINAE HUPÉ

Zgromadzone tryiobity fameńskie i dolno-karbońskie Gór Świętokrzyskich dały możność prześledzenia pewnych zmian, zachodzących w morfologii pancerza podczas rozwoju ontogenetycznego. Materiał dla tych obserwacji stanowiły małe (od 0,8 mm) kranidia, policzki i pygidia, pochodzące z wylinek osobników, reprezentujące prawdopodobnie stadium meraspis i holaspis, a należące do następujących gatunków:

Cyrtosymbole (Cyrtosymbole) gotica R. & E. Richter, 1926 — famen (pl. II, fig. 1, 2; text-pl. II, fig. 1-5),

C. (Cyrtosymbole) pusilla (Gürich, 1896) — famen (pl. I, fig. 1,4; text-pl. I, fig. 4-7),

C. (Cyrtosymbole) franconica nova n.subsp. — famen (pl. V, fig. 3, 5),

C. (Waribole) conifera R. & E. Richter, 1926 — famen (pl. VIII, fig. 2, 4, 5, 7),

C. (Waribole) octofera altera n.subsp. — famen (pl. IX, fig. 1-3),

C. (Waribole) abruptirhachis R. & F. Richter, 1919 — karbon (text-pl. VII, fig. 1, 2, 4, 5),

C. (Macrobole) laticampa n.sp. — karbon (pl. XI, fig. 1, 2),

C. (Macrobole) brevispina n.sp. — karbon (pl. XIII, fig. 3-5),

?Formonia sp. — karbon (pl. XVII, fig. 6-8),

Liobolina apodemata n.sp. — karbon (pl. XV, fig. 10, 11),

Liobole zarembiensis n.sp. — karbon (pl. XV, fig. 5-7),

Liobole sp. *c* — karbon (pl. XV, fig. 3).

W wyniku przeprowadzonych badań stwierdzono, między innymi, że najmłodsze znalezione stadia meraspis przedstawicieli Cyrtosymbolinae charakteryzują się zaostrzonym z przodu kranidium oraz pygidium z zaznaczonym wcięciem larwalnym, występującym na limbusie, w przedłużeniu osi pygidialnej. Obie wymienione cechy zanikają w czasie wzrostu osobników.

W rozprawie niniejszej poczyniono również pewne obserwacje, dotyczące ornamentacji pancerza. Przyjęta przez autorkę systematyka zgodna jest w zasadzie z systematyką zastosowaną przez R. & E. Richter i W. Struve w „Treatise on Invertebrate Paleontology" (1959). Podano także poglądy autorki na filogenezę niektórych rodzajów podrodziny Cyrtosymbolinae (por. tabela 7 na s. 92).

W części systematycznej opisano 51 form, z których 20 stanowi nowe gatunki lub podgatunki, zaś 26 oznaczonych zostało tylko do rodzaju. Poniżej podano diagnozy wszystkich nowych gatunków i podgatunków oraz jednego podrodzaju.

Cyrtosymbole (Cyrtosymbole) franconica primitiva n.subsp.
(pl. III; IV, fig. 1-4; text-pl. III, fig. 1, 2)

Diagnoza. — Zarys glabelli gruszkowaty. Limbus przedni słabo zaznaczony. Pierścień potyliczny nie zwężający się ku bokom. Płaty powiekowe wąskie (tr.). Policzek ruchomy dość stromy, ze słabo zaznaczonym kantem otaczającym oko. Pygidium płaskie, prawie półkoliste. Limbus nie odgraniczony od płatów pleuralnych. Oś ma 8-9 pierścieni. 5-6 żeber na płatach pleuralnych. Ornamentacja cranidium w postaci siatkowatej. Policzek ruchomy i pygidium pokryte guzkami, niekiedy zlewającymi się i tworzącymi ornamentację siatkowatą.

Cyrtosymbole (Cyrtosymbole) franconica nova n.subsp.
(pl. V, fig. 1-6; text-pl. III, fig. 3-6)

Diagnoza. — Przednia część glabelli silnie wypukła. Płaty powiekowe półkoliste, szerokie (tr.). Pierścień potyliczny lekko zwężający się ku bokom. Policzek ruchomy stromo opadający ku dołowi, z wyraźnym kantem otaczającym oko. Pygidium silnie sklepione, nieco wydłużone, z zaznaczonym limbusem. Oś ma 9-10 pierścieni. Na płatach pleuralnych 7-8 żeber. Ornamentacja siatkowata, zaznaczona na powierzchni cefalonu i pygidium.

Cyrtosymbole (Calybole) radiata n.sp.
(pl. VI, fig. 1-5; text-pl. IV, fig. 4, 5)

Diagnoza. — Cefalon półkolisty, lekko sklepiony poprzecznie. Limbus przedni podciągnięty ku górze. Glabella wydłużona, zwężająca się ku przodowi, między S_3 przewężona. Bruzdy boczne głęboko wcięte. Płaty powiekowe o silnie wygiętym zarysie, umieszczone w połowie długości glabelli. Przednie i tylne gałęzie szwów twarzowych silnie dywergentne. Oczy dość duże. Pygidium z promieniście ułożonymi żebrami. Duplikatura cefalonu i pygidium bardzo szeroka. Ornamentacja delikatna, siatkowata.

Cyrtosymbole (Waribole) octofera altera n.subsp.
(pl. IX, fig. 1-6; text-pl. V, fig. 3-5)

Diagnoza. — Glabella z przodu nieco zaostrzona. Bruzdy osiowe przy płatach powiekowych zanikające. Tylne kąty glabelli oraz krańce pierścienia potylicznego silnie obniżone.

Cyrtosymbole (Waribole) prima n.sp.
(pl. VII, fig. 1-3; text-pl. VI, fig. 5, 6)

Diagnoza. — Glabella szeroka, zwężająca się ku przodowi. Bruzdy boczne nie zaznaczone. Limbus przedni bardzo wąski (long.), silnie podgięty ku górze. Pierścień potyliczny lekko zwężający się ku bokom. Płaty powiekowe bardzo szerokie (tr.). Policzek ruchomy z silnie podgiętym ku górze limbusem bocznym i dużym okiem. Pygidium otoczone wąskim, wypukłym limbusem. Guzkowata ornamentacja pokrywa niektóre części pancerza.

Cyrtosymbole (Waribole) secunda n.sp.
(pl. VII, fig. 4-7; text-pl. VI, fig. 7)

Diagnoza. — Płaty powiekowe trójkątne, w części środkowej zagłębione. Policzek ruchomy z zaznaczonym ostrym kilem, przebiegającym wzdłuż dużego oka. Pygidium z lekko zaznaczonym limbusem i płaską duplikaturą. Pancerz pokryty dość dużymi guzkami.

Cyrtosymbole (Waribole) granulata n.sp.
(pl. VI, fig. 7, 8; text-pl. VI, fig. 2-4)

Diagnoza. — Glabella zwężająca się ku przodowi, z lekko zaznaczonymi bruzdami bocznymi. Pole preglabellarne szerokie (long.). Płaty powiekowe duże i szerokie (tr.); γ daleko odsunięte od bruzd osiowych. Guzki na pancerzu delikatne i rzadko rozrzucone.

Cyrtosymbole (Macrobole) laticampa n.sp.
(pl. XI, fig. 1-5)

Diagnoza. — Glabella wydłużona, lekko zwężająca się ku przodowi. Pierścień potyliczny szeroki (long.). Pole preglabellarne równe, szerokości (long.) pierścienia potylicznego. Limbus przedni płaski. Płaty powiekowe wąskie (tr.), położone w połowie długości glabelli. Policzek ruchomy, z długim, sięgającym pygidium kolcem. Zarys pygidium paraboliczny, oś szeroka (tr.), gwałtownie zwężająca się ku tyłowi.

Cyrtosymbole (Macrobole) brevispina n.sp.
(pl. XIII, fig. 2-9; text-pl. VIII, fig. 1, 2)

Diagnoza. — Glabella z przodu szeroko zaokrąglona. Limbus przedni wypukły. Pierścień potyliczny z zaznaczonymi płatami potylicznymi. Przednie gałęzie

szwów twarzowych krótkie, silnie dywergentne. Policzek ruchomy z krótkim kolcem. Oś pygidialna, gwałtownie zwężająca się ku tyłowi, ma jedenaście pierścieni. Listewka zaosiowa słabo zaznaczona. Kranidium pokryte gęstą, drobną granulacją.

Cyrtosymbole (?Macrobole) differtigena n.sp.
(pl. XII, fig. 3-5; text-fig. 5 *B*)

Diagnoza. — Glabella wydłużona, zwężająca się ku przodowi, jej przód zaokrąglony. Pierścień potyliczny szeroki (long.), nie zwężający się dystalnie. Pola preglabellarnego brak. Limbus przedni wąski, podgięty ku górze. Płaty powiekowe wąskie (tr.), w połowie długości glabelli. Policzek ruchomy szeroki (tr.), jego postero-lateralny kąt wydłużony, wydęty. Powierzchnia wzrokowa mała, niska. Pygidium o zarysie parabolicznym, bez limbusa. Oś szeroka (tr.), silnie zwężająca się ku tyłowi, ma dziewięć pierścieni.

Cyrtosymbole (Mirabole) n.subgen.

Diagnoza. — Glabella wydłużona, z przodu zaokrąglona, z lekko zaznaczonymi bruzdami bocznymi. Pierścień potyliczny nie zwężający się (long.) dystalnie. Płaty powiekowe niewyraźnie zaznaczone, nieco poza połową długości glabelli. Policzki stałe szerokie (tr.). Region preglabellarny szeroki (tr.). Limbusa przedniego brak. Tylne gałęzie szwów twarzowych długie i nieco dywergentne. Przednie gałęzie szwów twarzowych od γ do β krótkie i dywergentne, od β do α bardzo długie, konwergentne. Powierzchnia wzrokowa oka duża i tylko nieznacznie wypukła. Kolec policzkowy długi, zaostrzony. Pygidium półkoliste, z niewyraźnie zaznaczonym limbusem. Oś, silnie zwężająca się ku tyłowi, ma dziesięć wypukłych pierścieni. Sześć żeber na płatach pleuralnych. Bruzdy pleuralne i interpleuralne wyraźne.

Cyrtosymbole (Mirabole) kielanae n.sp.
(pl. X, fig. 7)

Diagnoza — jak dla podrodzaju.

Typhloproetus kozlowskii n.sp.
(pl. XVII, fig. 2; text-pl. VIII, fig. 4)

Diagnoza. — Kranidium z przodu zaostrzone. Glabella silnie sklepiona poprzecznie, w połowie swej długości przewężona. Tylne bruzdy boczne (S_1) odcinają płaty bazalne (L_1). Pierścień potyliczny zwężający się dystalnie. Płaty powiekowe niewyraźnie wyodrębnione, z zaznaczonym szczątkowym waleczkiem ocznym. Policzki stałe szerokie (tr.). Przednie i tylne gałęzie szwów twarzowych silnie dywergentne. Pancerz pokryty drobnymi guzkami.

?Typhloproetus angustigenalis n.sp.
(pl. XVII, fig. 9; text-pl. VIII, fig. 6)

Diagnoza. — Zarys przedniego brzegu kranidium silnie wygięty. Glabella kształtu gruszkowatego, z trzema parami bruzd bocznych. Bruzdy osiowe, od bruzdy potylicznej do S_3, bardzo słabo widoczne, ku przodowi pogłębiają się. Pierścień potyliczny zwęża się ku bokom. Pole preglabellarne niemal równe szerokością (long.) pierścieniowi potylicznemu (long.). Policzki stałe bardzo wąskie (tr.). Szwy twarzowe niemal proste, ku przodowi nieco dywergentne. Płatów powiekowych brak.

Formonia convexa n.sp.
(pl. XVII, fig. 3, 4; text-pl. VII, fig. 9; text-fig. 6, *1*)

Diagnoza. — Cefalon w profilu podłużnym silnie wypukły. Na przednim brzegu kranidium dość długi, łukowato wygięty kolec. Glabella długa, wąska, zwężająca się ku przodowi. Bruzdy osiowe płytkie. Tylko tylne bruzdy boczne (S_1) zaznaczone. Policzki stałe szerokie (tr.). Płatów powiekowych brak. Szwy twarzowe proste. Policzek ruchomy szeroki (tr.), z niezwykle długim kolcem. Oczu brak.

Drevermannia moravica minuta n.subsp.
(pl. X, fig. 4-6; text-fig. 7)

Diagnoza. — Glabella wydłużona, kształtu palcowatego. Tylne bruzdy boczne (S_1) odcinają płaty bazalne (L_1). Płaty powiekowe słabo zaznaczone. Policzki stałe szerokie (tr.). Przednie i tylne gałęzie szwów twarzowych lekko dywergentne. Policzek ruchomy z krótkim kolcem. Oczu brak. Pygidium półkoliste, z lekko wypukłym, wąskim limbusem.

Liobolina praevia n.sp.
(pl. XII, fig. 2)

Diagnoza. — Cefalon półkolisty. Glabella prawie prostokątna. Policzki stałe bardzo wąskie (tr.). Bruzdy osiowe zanikające. Bruzda potyliczna nieco wcięta. Płatów powiekowych brak. Policzek ruchomy z zaokrąglonym kątem tylnym. Oczu brak. Pygidium półkoliste, z szeroką (tr.) osią, niewyraźnie odgraniczoną w tylnej części od reszty pygidium. Bruzdy między pierścieniami osi oraz bruzdy pleuralne i interpleuralne niewidoczne. Płaty pleuralne lekko sklepione.

Liobolina apodemata n.sp.
(pl. XII, fig. 1; XV, fig. 9-11; XVI, fig. 5; text-pl. IX, fig. 1-3)

Diagnoza. — Glabella kształtu walcowatego. Bruzdy boczne nie zaznaczone. Bruzdy osiowe widoczne tylko w przedniej części kranidium. Bruzda potyliczna bardzo słabo zaznaczona. Tylnej bruzdy brzeżnej brak. Na wewnętrznej powierzchni

tylnej krawędzi pierścienia potylicznego umieszczona para wyrostków, przypominających apodemy. Płatów powiekowych brak. Pygidium kształtu parabolicznego. Limbus słabo zaznaczony. Oś płaska, szeroka (tr.), jej tylna część wyraźnie oddzielona od reszty pygidium. Płaty pleuralne ku tyłowi opadające, poprzecznie silnie sklepione.

Liobole zarembiensis n.sp.
(pl. XIV, fig. 1, 2; XV, fig. 5-8; XVI, fig. 2, 3; text-pl. IX, fig. 4, 5)

Diagnoza. — Glabella prawie prostokątna, nieco przewężona między S_3. Przedni brzeg kranidium nieco podgięty ku górze. Region preglabellarny wąski (long.), wklęsły. Limbusa brak. Płaty powiekowe lekko zakrzywione, długie (long.), nieco przesunięte ku przodowi. Limbus tylny bardzo długi (tr.), zagięty ku tyłowi.

Liobole barilliformis n.sp.
(pl. XIV, fig. 5)

Diagnoza. — Glabella szeroka, kształtu baryłkowatego. Trzy pary bruzd bocznych wyraźnie zaznaczone. Pierścień potyliczny poprzecznie wypukły. Kranidium z przodu szeroko zaokrąglone. Płaty powiekowe w połowie długości glabelli. Policzki stałe, silnie obniżające się ku tyłowi.

Diacoryphe strenuispina n.sp.
(pl. XI, fig. 6; XII, fig. 6, 7; text-pl. VII, fig. 8; text-fig. 5 *A*)

Diagnoza. — Bruzdy osiowe słabo zaznaczone. Bruzda potyliczna płytka. Pole preglabellarne szerokie (long.), nieco wklęsłe. Płaty powiekowe bardzo wąskie (tr.), umieszczone w połowie długości glabelli. Policzek ruchomy z małym okiem i silnym grubym kolcem.

ГАЛЬШКА ОСМУЛЬСКА

CYRTOSYMBOLINAE (TRILOBITA) ИЗ ФАМЕНА И НИЖНЕГО КАРБОНА СВЕНТОКРЖИСКИХ ГОР (ПОЛЬША)

Резюме

ВВЕДЕНИЕ

Настоящая заметка посвящена трилобитам семейства Proetidae Salter 1864, подсемейства Cyrtosymbolinae Hupé, 1953, выступающим в слоях фамена и нижнего карбона южной части Свентокржиских Гор. Из фамена авторша описала 10 видов и подвидов, из которых 7 признала новыми. Нижне-карбонские трилобиты этого района отнесены к 15 видам, среди которых 13 новых.

ХАРАКТЕРИСТИКА ОТЛОЖЕНИЙ ФАМЕНА И НИЖНЕГО КАРБОНА СВЕНТОКРЖИСКИХ ГОР

Отложения фамена Свентокржиских Гор выступают в двух палеогеографических районах — северном и южном (фиг. 1 на стр. 54), в которых они различно развиты. В северном районе выступают отложения мощностью в несколько сот метров, сланцевато-известковые, с убогой фауной, среди которой чаще всего попадались слепые трилобиты семейства Phacopidae (Осмульска, 1958). В южном районе Свентокржиских Гор, в синклинали Галензице-Далешице, выступает комплекс мощностью в несколько метров климениевых известняков, образовавшихся на подморских порогах (Пайхлёва, 1959), с очень обильной фауной, среди которой многочисленные трилобиты, относящиеся к подсемейству Cyrtosymbolinae. Отложения этого типа были найдены, между прочим, в Галензицах, Ковали, Яблонне и в Лагове, из которых то местностей описаны тут трилобиты фамена. В Галензицах (фиг. 4 на стр. 61) и в Ковали установлено выступание только верхнего фамена (от III горизонта до VI), в Яблонне же (фиг. 3 на стр. 59) и окрестностях Лагова выступает полный профиль фамена (от II горизонта до VI).

На фамене залегает вообще согласно карбон, образованный в фации илистых или кремнистых сланцев, с очень убогой фауной, среди которой наиболее обильно представлены трилобиты. На их основе удалось установить наличие в южной части Свентокржиских Гор нижнего турне (горизонт VII, см. таб. 1 — стр. 56/57), равно как верхнего турне и нижнего визе (горизонт VIII, см. таб. 1).

ЗАВИСИМОСТЬ ТРИЛОБИТОВОЙ ФАУНЫ ОТ ФАЦИИ

Описывая Phacopidae из южной части Свентокржиских Гор (Осмульска, 1958) авторша имела уже возможность обратить внимание на факт, что в келецкой синклинали, где отложения фамена образованы в виде сланцевато-известняковой фации, выступают исключительно слепые Phacopidae родов *Trimerocephalus* R. & E. Richter, *Dianops* R. & E. Richter, *Ductina* R. & E. Richter. В этой совокупности появляются лишь спорадически немногочисленные Proetidae. Между тем, как в галензицко-далешицкой синклинали, где фамен образован фацией климениевых известняков, выступают почти исключительно Proetidae, с хорошо развитыми глазами, а Phacopidae выступающие в самых верхних горизонтах фамена представлены только двумя видами рода *Phacops* Emmrich, равным образом с хорошо развитыми глазами. Замеченное явление не вызывает сомнения, что существует зависимость между наличием глаз а фацией, и следовательно отвечающими ей экологическими условиями.

Климениевые известняки, содержащие Proetidae с хорошо развитыми глазами, соответствуют, по всей вероятности, отложениям открытого моря хорошо освещенного, и являются повидимому менее глубокими осадками, чем грубые комплексы илисто-мергелистых отложений.

Сопоставляя фаменские трилобиты Свентокржиских Гор и Урала, а также северных Мугоджар (Перна, 1915; Максимова, 1955), авторша заметила, что уста-

новленное выше явление можно также наблюдать на территории С.С.С.Р., однако отмечается оно менее отчетливо (см. таб. 5 — стр. 80/81). В известняковых образованиях фамена (главным образом илистых известняков) выступает смешанная фауна, состоящая равным образом из Proetidae, как и Phacopidae, причем совокупность эта характеризуется количественным преобладанием форм с глазами — над формами слепыми. Между тем, в илистых отложениях (северные Мугоджары) найдено искючительно слепые Phacopidae и один вид Proetidae — тоже слепой. Максимова (1955), рассматривая причины редукции глаз у трилобитов, признала, что следует их связывать главным образом с заилением дна, принимая однако возможность воздействия в то же время и других факторов среды. По Р. Рихтеру (1913), главной причиной редукции глаз у трилобитов была большая глубина и связанное с этом слабое освещение дна. Ввиду того, что в Свентокржиских Горах в более мелких зонах отлагались известняки, а в более глубоких илистые осадки, — трудно решить, который из двух рассматриваемых факторов играл тут решающую роль.

Следует подчеркнуть, что в Свентокржиских Горах не найдено до сих пор родов слепых Proetidae, как *Drevermannia, Chaunoproetus, Typhloproetus* — выступающих равно как к востоку, так и к западу от этого района.

ЗАМЕЧАНИЯ О ЗАВИСИМОСТИ МЕЖДУ ИЗМЕНЧИВОСТЬЮ А ВЫМИРАНИЕМ PROETIDAE ПОЗДНЕГО ПАЛЕОЗОЯ

Материал нижне-карбонских трилобитов Cyrtosymbolinae из местности Зарэмбы, характеризующийся сильной изменчивостью и вызывающий подчас трудности в определении систематической принадлежности некоторых форм, может вызвать мысль о существовании какой то связи между этой изменчивостью а наступающим вымиранием этого подсемейства. По мнению авторши, вымирание это не было вызвано автогенетическими причинами, а единственно только изменением среды.

РЕДУКЦИЯ ГЛАЗ А ВЫМИРАНИЕ PROETIDAE

Из количественного сопоставления родов с глазами и родов в большинстве случаев слепых (см. стр. 84) следует, что нельзя считать редукцию глаз как проявление „филогеронтизма". В самом верхнем горизонте нижнего карбона (VIII) число родов слепых отчетливо уменьшается, а появляются новые роды, с довольно хорошо развитыми глазами.

ОБЩИЕ ЗАМЕЧАНИЯ КАСАЮЩИЕСЯ ОНТОГЕНЕЗА, МОРФОЛОГИИ И СИСТЕМАТИКИ CYRTOSYMBOLINAE HUPÉ

В онтогенетическом развитии трилобитов, относящихся к подсемейству Cyrtosymbolinae, в более поздних его стадиях, можно наблюдать ряд изменений происходящих в морфологии отдельных частей панцыря (текст — пл. I, фиг. 4-7,

II, фиг. 1-5; VII, фиг. 1, 2, 4, 5; пл. I, фиг. 1, 4; II, фиг. 1-2; V, фиг. 3, 5; VIII, фиг. 2, 4, 5, 7; IX, фиг. 1-3; XI, фиг. 1, 2; XIII, фиг. 3-5).

ЗАМЕЧАНИЯ О СИСТЕМАТИЧЕСКОМ ПОЛОЖЕНИИ ОПИСАННЫХ ФОРМ

Авторша приняла, за малыми исключениями, систематику предложенную P. & E. Рихтер и E. Струве (1959), равно как привела сопоставление более новых воззрений на систематическое положение фаменских и нижне-карбонских родов, относимых к семейству Proetidae Salter, 1846 (см. таб. 6 — стр. 90/91).

В систематической части приведено описание 5 известных видов трилобитов, 20 новых видов и подвидов, а также 26 форм, не обозначенных как виды, принимал во внимание отсутствие достаточно обильного материала. Выделено также один новый подрод *Cyrtosymbole (Mirabole)* n. subgen., представленный пока что одним типичным видом: *C. (Mirabole) kielanae*, а также новый род *Spatulina* n. gen., охватывающий некоторые формы, относимые до сих пор к роду *Cystispina* R. & E. Richter, 1939. Материал касающийся Cyrtosymbolinae Свентокржиских Гор дал возможность расширить радиус стратиграфического выступания некоторых родов, как *Formonia* R. & E. Richter, 1927, известного до сих пор из среднего фамена (горизонт III), а найденного также в нижнем карбоне (горизонт VIII), и *Liobolina* R. & E. Richter, 1951, известную только из горизонта VII, а выступающую тоже в Свентокржиских Горах, в горизонте VIII.

ДИАГНОЗЫ

C. (Cyrtosymbole) franconica primitiva n. subsp.
(пл. III; IV, фиг. 1-4; текст-пл. III, фиг. 1, 2)

Обрис глабели грушевидный. Передний край слабо выражен. Затылочное кольцо не суживающееся к бокам. Глазные крышки узкие (tr.). Подвижная щека довольно обрывистая, со слабо выраженной граней, окаймляющей глаз. Хвостовой щит плоский, почти полукруглый. Краевая кайма не отграничена от плевральных лопастей. Ось с 8-9 кольцами. На плевральных лопастях 5-6 ребер. Орнаментация кранидия в виде сетчатости. Подвижная щека и хвостовой щит покрыты бугорками, иногда сливающимися и создающими сетчатую орнаментацию.

C. (Cyrtosymbole) franconica nova n. subsp.
(пл. V, фиг. 1-6; текст-пл. III, фиг. 3-6)

Передняя часть глабели сильно выпуклая, глазные крышки полукруглые, широкие (tr.). Затылочное кольцо слегка суживается к бокам. Подвижная щека круто опадающая книзу, с отчетливой граней окружающей глаз. Хвостовой щит прочно сводчатый, несколько удлинен, с отчетливой краевой каймой. Ось имеет 9-10 колец. На плевральных лопастях 7-8 ребер. Орнаментация сетчатая, отмеченная на поверхности головного и хвостового щитов.

Cyrtosymbole (Calybole) radiata n. sp.
(пл. VI, фиг. 1-5; текст-пл. IV, фиг. 4, 5)

Головной щит полукруглый, поперек слегка сводчатый. Передняя краевая кайма отчетлива, подогнута кверху. Глабель удлиненная, суживающаяся к переду; между боковыми бороздами S_3 сужена. Боковые борозды глабели глубоко врезаны. Глазные крышки, с сильно изогнутым очертанием, расположены на уровне половины длины глабели. Передние и задние ветви лицевых швов сильно дивергентны. Глаза довольно большие. Хвостовой щит с радиально расположенными ребрами. Дублюра головного и хвостовго щитов очень широкая. Орнаментация тонкая, сетчатая.

C. (Waribole) octofera altera n. subsp.
(пл. IX, фиг. 1-6; текст-пл. V, фиг. 3-5)

Глабель спереди несколько заострена. Осевые борозды при глазных крышках атрофируются. Задние углы глабели, равно как края затылочного кольца, сильно обнижены.

C. (Waribole) prima n. sp.
(пл. VII, фиг. 1-3; текст-пл. VI, фиг. 5, 6)

Глабель широкая, суживающаяся к переду. Боковые борозды невыражены. Передняя краевая кайма очень узкая (long.), сильно загнута кверху. Затылочное кольцо слегка суживающееся на бока. Глазные крышки очень широкие (tr.). Подвижная щека с сильно загнутым кверху боковым лимбом и большим глазом. Хвостовой щит окаймлен узкой, выпуклой краевой каймой. Бугорковатая орнаментация покрывает некоторые части панцыря.

C. (Waribole) secunda n. sp.
(пл. VII, фиг. 4-7; текст-пл. VI, фиг. 7)

Глазные крышки треугольные, углублены в срединной части. Подвижная щека с выраженным острым килом, пробегающим вдоль большого глаза. Хвостовой щит с выраженной слегка краевой каймой и тонкой дублюрой. Панцырь покрыт довольно большими бугорками.

C. (Waribole) granulata n. sp.
(пл. VI, фиг, 7, 8; текст-пл. VI, фиг. 2-4)

Глабель суживающаяся к переду, со слегка выраженными боковыми бороздами. Преглабельное поле широкое (long.). Глазные крышки большие и широкие (tr.). γ далеко отодвинуты от спинных борозд. Бугорки на панцыре нежные и редко разбросанные.

C. (Macrobole) laticampa n. sp.
(пл. XI, фиг. 1-5)

Глабель удлиненная, слегка суживающаяся к переду. Затылочное кольцо широкое (long.). Преглабельное поле равно ширине (long.) затылочного кольца. Передняя краевая кайма плоская. Глазные крышки узкие (tr.), расположены в половине длины глабели. Подвижная щека с длинным, достигающим хвостового щита, шипом. Обрис хвостового щита параболический, ось широкая (tr.), стремительно суживающаяся к заду.

C. (Macrobole) brevispina n. sp.
(пл. XIII, фиг. 2-9; текст-пл. VIII, фиг. 1, 2)

Глабель спереди широко округлена. Передняя краевая кайма выпуклая. Затылочное кольцо с выраженными затылочными лопастями. Передние ветви лицевых швов короткие, сильно дивергентны. Подвижная щека с коротким шипом. Осевая часть хвостового щита, стремительно суживающаяся к заду, имеет 11 колец. Осевая полоска слабо выражена. Кранидий покрыт густой, мелкой грануляцией.

C. (?Macrobole) differtigena n. sp.
(пл. XII, фиг. 3-5; текст-фиг. 5 *B*)

Глабель удлиненная, суживающаяся к переду; ее перед округлен. Затылочное кольцо широкое (long.), не суживающееся дистально. Преглабельное поле отсутствует. Передняя краевая кайма узкая, подогнута кверху. Глазные крышки узкие (tr.), в половине длины глабели. Подвижная щека широкая (tr.), ее постлятеральный угол удлинен, вспучен. Зрительная поверхность мала, низка. Хвостовой щит параболического очертания, без каймы. Ось широкая (tr.), сильно суживающаяся к заду, насчитывает десять колец.

Cyrtosymbole (Mirabole) n. subgen.

Глабель удлиненная, спереди заокруглена, с намеченными слегка боковыми бороздками. Затылочное кольцо не суживающееся (long) дистально. Глазные крышки выражены неясно, несколько вне половины длины глабели. Неподвижные щеки широкие (tr.). Преглабельный район широкий (tr.). Передней каймы нет. Задние ветви лицевых швов длинные и несколько дивергентные. Передние ветви лицевых швов от γ до β короткие и дивергентные, а от β до α очень длинные и конвергентные. Зрительная поверхность глаза большая и только незначительно выпуклая. Шип щеки длинный, заостренный. Хвостовой щит полукруглый, с неотчетливо выраженной каймой. Ось сильно суживающаяся к заду, имеет 10 выпуклых колец. На плевральных лопастях 6 ребер. Плевральные и интерплевральные борозды отчетливы.

C. (Mirabole) kielanae n. sp.
(пл. X, фиг. 7)

Диагноз — как для подрода.

Typhloproetus kozlowskii n. sp.
(пл. XVII, фиг. 2; текст-пл. VIII, фиг. 4)

Кранидий спереди заостренный. Глабель крепко поперечно сводчатая, в половине своей длины сужена. Задние боковые борозды (S_1) отсекают базальные лопасти (L_1). Затылочное кольцо суживающееся дистально. Глазные крышки неотчетливо обособлены, с отмеченным остаточным глазным валиком. Подвижные щеки широкие (tr.). Передние и задние ветви лицевых швов сильно дивергентны. Панцырь покрыт мелкими бугорками.

? *Typhloproetus angustigenalis* n. sp.
(пл. XVII, фиг. 9; текст-пл. VIII, фиг. 6)

Передний край кранидия сильно изогнут. Глабель грушевидной формы, с 3 парами боковых борозд. Спинные борозды очень слабо различимы от затылочной борозды до S_3, к переду углубляются. Затылочное колько суживается к бокам. Преглабельное поле почти что равно по ширине (long.) затылочному кольцу (long.). Неподвижные щеки очень узки, (tr.). Лицевые швы почти прямые, к переду несколько дивергентны. Глазных крышек нет.

Formonia convexa n. sp.
(пл. XVII, фиг. 3, 4; текст-пл. VII, фиг. 9; текст-фиг. 6, 1)

Головной щит в продольном профиле сильно выпуклый. На переднем краю кранидия довольно длинный, изогнутый дугообразно шип. Глабель длинная, узкая, суживающаяся к переду. Спинные борозды неглубокие. Только задние боковые борозды (S_1) выражены. Неподвижные щеки широкие (tr.). Глазных крышек нет. Лицевые швы прямые. Подвижная щека широкая (tr.), с необыкновенно длинным шипом. Глаз нет.

Drevermannia moravica minuta n. subsp.
(пл. X, фиг. 4-6; текст-фиг. 7)

Глабель удлиненная, пальцевидной формы. Задние боковые борозды (S_1) отсекают базальные лопасти (L_1). Глазные крышки слабо выражены. Неподвижные щеки широкие (tr.). Передние и задние ветви лицевых швов слегка дивергентны. Подвижная щека с коротким бугорком. Глаз нет. Хвостовой щит полукруглый, со слабо выпуклой, узкой каймой.

Liobolina praevia n. sp.
(пл. XII, фиг. 2)

Головной щит полукруглый. Глабель почти прямоугольная. Неподвижные щеки очень узкие (tr.). Спинные борозды исчезающие. Подвижная щека с за-

округленным задним углом. Глаз нет. Затылочная борозда несколько врезана. Глазных крышек нет. Хвостовой щит полушаровидный, с широкой (tr.) осью, неясно отграниченный сзади от остальной части хвостового щита. Борозды между кольцами оси, равно как плевральные и интерплевральные борозды, не видны. Плевральные лопасти слегка сводчатые.

Liobolina apodemata n. sp.

(пл. XII, фиг. 1; XV, фиг. 9—11; XVI, фиг. 5; текст-пл. IX, фиг. 1—3)

Глабель цилиндрической формы. Боковые борозды не выражены. Спинные борозды видимые только в передней части кранидия. Затылочная борозда очень слабо выражена. Задней краевой борозды нет. На внутренней поверхности заднего края затылочного кольца расположена пара отростков, напоминающих аподемы. Глазных крышек нет. Хвостовой щит параболической формы. Краевая кайма слабо выражена. Ось плоская, широкая (tr.), задняя ее часть отчетливо отделена от остальной части щита. Плевральные лопасти опадающие к заду, поперечно сильно сводчаты.

Liobole zarembiensis n. sp.

(пл. XIV, фиг. 1, 2; XV, фиг. 5-8; XVI, фиг. 2, 3; текст-пл. IX, фиг. 4, 5)

Глабель почти прямоугольная, несколько суженная между S_3. Передний край кранидия несколько подогнут кверху. Преглабельный район узкий (long.), вогнутый. Каймы нет. Глазные крышки слегка изогнутые, длинные (long.), несколько продвинуты к переду. Задняя кайма очень длинная (tr.), загнутая к заду.

Liobole barilliformis n. sp.

(пл. XIV, фиг. 5)

Глабель широкая, боченкообразной формы. Три пары боковых борозд ясно выражены. Затылочное кольцо поперечно выпуклое. Кранидий спереди широко заокруглен. Глазные крышки в половине длины глабели. Неподвижные щеки сильно понижаются к заду.

Diacoryphe strenuispina n. sp.

(пл. XI, фиг. 6; XII, фиг. 6, 7; текст-пл. VII, фиг. 8; текст-фиг. 5 *A*)

Спинные борозды слабо выражены. Затылочная борозда неглубокая. Преглабельное поле широкое (long), несколько вогнутое. Глазные крышки очень узкие (tr.), расположены в половине длины глабели. Подвижная щека с малым глазом и сильным, толстым шипом.

PLATES

Pl. I

Cyrtosymbole (Cyrtosymbole) pusilla (Gürich)
(see also pl. II, III)

Fig. 1. Young pygidium with larval notch (IG 173.II.23); × 17

Fig. 2. Librigena (IG 173.II.1c); × 5.

Fig. 3. Cranidium, neotype (IG 173.II.1a); × 6.6.

Fig. 4. Young pygidium without larval notch (IG 173.II.1b); × 13.

Fig. 5. Pygidium (IG 173.II.2); × 5.8.

Fig. 6. Cranidia and pygidia (IG 173.II.8a, b); × 5.5.

Fig. 7. Cranidium (IG 173.II.24); × 14.

Fig. 1-5 and 7: Łagów, Famennian, *Postprolobites* zone (IV).

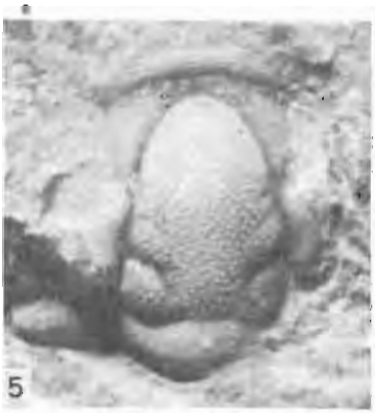
Fig. 6. Łagów, Famennian, *Prolobites* zone (III).

Phot. M. Czarnocka


1


8


2


5


3


6


4


7

Phot. M. Czarnocka

Pl. II

Cyrtosymbole (Cyrtosymbole) gotica R. & E. Richter

Fig. 1. Young pygidium with larval notch (IG 172.II.286a); × 16.

Fig. 2. Young pygidium without larval notch (IG 172.II.265); × 14.

Fig. 3. Pygidium (IG 172.II.246); × 8.7.

Fig. 4. Librigena (IG 172.II.256); × 5.

Fig. 5. Cranidium (IG 172.II.2); × 8.

Fig. 6. Pygidium (IG 172.II.270); × 6.

Cyrtosymbole (Cyrtosymbole) pusilla (Gürich)
(see also pl. I, III)

Fig. 7. Pygidium (IG 173.II.12); × 7.

Fig. 8. Fragment of cranidium (IG 172.II.4); × 5.

Fig. 1-6: Jabłonna, Famennian, *Cheiloceras* zone (II)?

Fig. 7-8: Łagów, Famennian, *Prolobites* zone (III).

Pl. III

Cyrtosymbole (Cyrtosymbole) pusilla (Gürich)
(see also pl. I, II)

C. (Cyrtosymbole) franconica primitiva n. subsp.
(see also pl. IV)

Cranidia, librigenae and pygidia. Łagów, Famennian, *Prolobites* zone (III), (IG 173.II.10); × 4.4.

Phot. M. Czarnocka

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6

Phot. M. Czarnocka

Pl. IV

Cyrtosymbole (Cyrtosymbole) franconica primitiva n. subsp.
(see also pl. III)

Fig. 1. Cranidium, holotype (IG 173.II.10a); × 16.

Fig. 2. Librigena (IG 173.II.11); × 10.

Fig. 3. Fragment of pygidium with marked change of ornamentation on pygidial axis (IG 173.II.10c); × 7.

Fig. 4. Pygidium with typical ornamentation (IG 173.II.10b); × 11.

Cyrtosymbole (Cyrtosymbole) sp. *b*

Fig. 5. Cranidium (IG 170.II.512); × 10.

Fig. 6. Fragment of pygidium (IG 170.II.513); × 7.3.

Cyrtosymbole (Cyrtosymbole) franconica ?nova n. subsp.

Fig. 7. Librigena with rounded genal angle (IG 172.II.188); × 10.

?Cyrtosymbole sp. *c*

Fig. 8. Cranidium (IG 170.II.514); × 8.6.

Fig. 1-4: Łagów, Famennian, *Prolobites* zone (III).

Fig. 5,6,8. Gałęzice, Famennian, *Prolobites* zone (III)?

Fig. 7. Jabłonna, Famennian, *Prolobites* zone (III)?

Pl. V

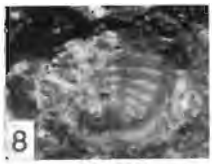
Cyrtosymbole (Cyrtosymbole) franconica nova n.subsp.

Fig. 1. Cranidium, slender form (IG 170.II.95); × 10.8.
Fig. 2. Cranidium, holotype (IG 170.II.59); × 13.
Fig. 3. Young cranidium (IG 170.II.61); × 17.
Fig. 4. Librigena (IG 170.II.58); × 10.
Fig. 5. Internal mould of young pygidium with larval notch (IG 170.II.122); × 14.
Fig. 6. Pygidium (IG 170.II.411); × 14.

Cyrtosymbole (Cyrtosymbole) franconica cf. *nova* n. subsp.

Fig. 7. Pygidium (IG.172.II.300a); × 5.5.
Fig. 8. Young pygidium (IG 172.II.300b); × 10,8.

Fig. 1-6: Gałęzice, Famennian, *Prolobites* zone (III)?
Fig. 7,8: Jabłonna, Famennian, *Prolobites* zone (III)?



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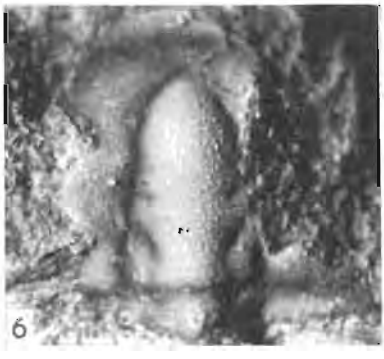

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Pl. VI

Cyrtosymbole (Calybole) radiata n. sp.

Fig. 1. Fragment of young pygidium with larval notch (IG 172.II.5); × 15.

Fig. 2. Fragment of young pygidium (IG 172.II.1); × 10.5.

Fig. 3. Fragment of cranidium (IG 172.II.2); × 18.

Fig. 4. Pygidium (IG 172.II.3); × 14.

Fig. 5. Nearly entire specimen, holotype (IG 172.II.4); × 15.

Cyrtosymbole (Calybole) ?radiata n. sp.

Fig. 6. Young cranidium (IG.172.II.6); × 30.

Cyrtosymbole (Waribole) granulata n. sp.

Fig. 7. Pygidium (IG 172.II.74); × 14.

Fig. 8. Cranidium, holotype (IG 172.II.31); × 11.6.

Fig. 1-8: Jabłonna, Famennian, *Wocklumeria* zone (VI)?

Pl. VII

Cyrtosymbole (Waribole) prima n. sp.

Fig. 1. Librigena (IG 170.II.526); × 11.

Fig. 2. Fragment of cranidium (IG 170.II.525); × 8.5.

Fig. 3. Pygidium, holotype (IG 170.II.524); × 9.5.

Cyrtosymbole (Waribole) secunda n. sp.

Fig. 4. Librigena (IG 170.II.541); × 8.7.

Fig. 5. Pygidium, holotype (IG 170.II.542); × 7.3.

Fig. 6. Fragment of cranidium (IG 170.II.543); × 15.

Fig. 7. Young pygidium without larval notch (IG 170.II.549); × 14.

Cyrtosymbole (Waribole) sp. *b*

Fig. 8. Young pygidium with larval notch (IG 172.II.23); × 13.

Fig. 1-3: Gałęzice, Famennian, *Postprolobites* zone (IV)?

Fig. 4-7: Gałęzice, Famennian, *Laevigites* zone (V)?

Fig. 8: Jabłonna, Famennian, *Wocklumeria* zone (VI)?


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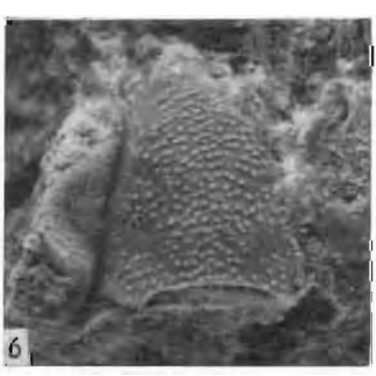
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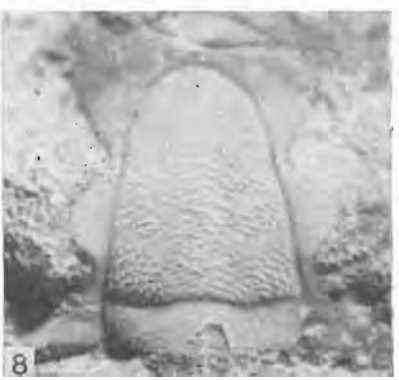
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Pl. VIII

Cyrtosymbole (Waribole) conifera R. & E. Richter

Fig. 1. Cranidium (IG 170.II.517); × 15.
Fig. 2. Young cranidium (IG 170.II.518); × 20.
Fig. 3. Librigena (IG 170.II.516); × 5.5.
Fig. 4. Young pygidium with larval notch (IG 170.II.523); × 19.
Fig. 5. Young pygidium without larval notch (IG 170.II.522); × 15.
Fig. 6. Cranidium (IG 172.II.21); × 8.
Fig. 7. Young pygidium without larval notch (IG 170.II.520); × 15.
Fig. 8. Cranidium (IG 170.II.515); × 8,6.
Fig. 9. Pygidium (IG 170.II.519); × 7.7.

Fig. 1-5, 7-9: Gałęzice, Famennian, *Laevigites* zone (V)?
Fig. 6: Jabłonna, Famennian, *Laevigites* zone (V)?

Pl. IX

Cyrtosymbole (Waribole) octofera altera n. subsp.

Fig. 1. Young cranidium (IG 172.II.172); × 14.

Fig. 2. Young pygidium with larval notch (IG 172.II.24); × 16.6.

Fig. 3. Young pygidium with larval notch (IG 172.II.183); × 18.5.

Fig. 4. Librigena (IG 172.II.144); × 12.

Fig. 5. Cranidium, holotype (IG 172.II.184); × 13.

Fig. 6. Pygidium (IG 172.II.180); × 8.6.

Cyrtosymbole (Waribole) sp. *a*

Fig. 7. Pygidium (IG 172.II.142); × 10.8.

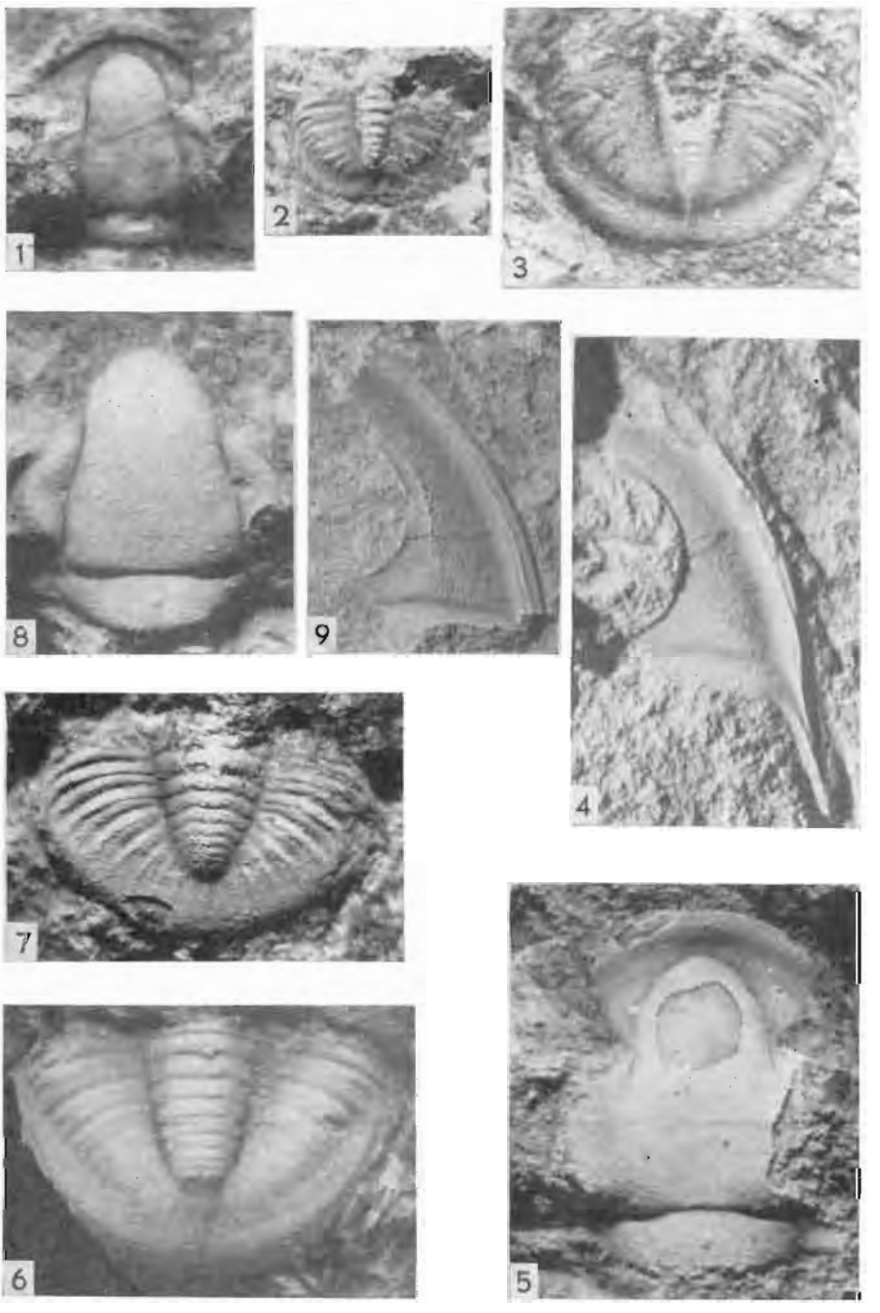
Cyrtosymbole (Waribole) cf. *warsteinensis* R. & E. Richter

Fig. 8. Fragment of cranidium (IG 172.II.30); × 8.5.

Cyrtosymbole (Waribole) cf.*phacomma* R. & E. Richter

Fig. 9. Fragment of librigena (IG 172.II.130); × 11.

Fig. 1-9: Jabłonna, Famennian, *Wocklumeria* zone (VI)?



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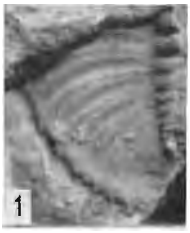
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Pl. X

Cyrtosymbole (Macrobole) ?brevispina n. sp.

Fig. 1. Fragment of internal mould of pygidium (IG 173.II.384a); × 10.

Cyrtosymbole (Waribole) abruptirhachis R. & E. Richter

Fig. 2. Librigena (IG.173.II.33); × 6.

Fig. 3. Pygidium (IG 173.II.34); × 14.

Drevermannia moravica minuta n. subsp.

Fig. 4. Pygidium (IG 173.II.365); × 15.

Fig. 5. Fragment of cephalon holotype (IG 173.II.356); × 16.

Fig. 6. Cranidium (IG 173.II.744); × 15.

Cyrtosymbole (Mirabole) kielanae n. sp.

Fig. 7. Internal moulds of cranidia (*a* holotype), librigenae and pygidia (IG 171.II. 78a,b,c); × 9.

Liobole sp. *a*

Fig. 8. Internal mould of cranidium (IG 173.II.673); × 6.

Fig. 1,8: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

Fig. 2,3: Kowala, Carboniferous, *Gattendorfia* zone (VII).

Fig. 4-6: Jabłonna, Carboniferous, *Gattendorfia* zone (VII).

Fig. 7: Karczówka, Carboniferous, *Gattendorfia* zone (VII)?

PI. XI

Cyrtosymbole (Macrobole) laticampa n. sp.

Fig. 1. Young pygidium with larval notch (IG 173.II.350); × 15.8.

Fig. 2. Young cranidium (IG 173.II.371); × 14.

Fig. 3. Cranidium (IG.173.II.345); × 15.

Fig. 4. Pygidium (IG 173.II.348); × 15.

Fig. 5. Cranidium and librigenae, holotype (IG 173.II.344); × 6,7.

Diacoryphe strenuispina n. sp.
(see also pl. XII)

Fig. 6. Hypostoma and fragment of ventral part of librigena (IG 173.II.326); × 6.

Cyrtosymbole (Macrobole) ?laticampa n. sp.

Fig. 7. Cranidium (IG 173.II.372); × 13.9.

Fig. 1-7: Jabłonna, Carboniferous, *Gattendorfia* zone (VII).


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Pl. XII

Liobolina apodemata n. sp.

(see also pl. XV, XVI)

Fig. 1. Internal mould of cranidium (IG 173.II.422); × 13.4.

Liobolina praevia n. sp.

Fig. 2. Entire specimen, holotype (IG 173.II.63); × 4,5.

Cyrtosymbole (?Macrobole) differtigena n. sp.

Fig. 3. External mould of librigena (IG 171.II.77a); × 5.5.

Fig. 4. External mould of cranidium (IG 171.II.77b); × 5.9.

Fig. 5. Internal mould of pygidium, holotype (IG 171.II.77c); × 6.

Diacoryphe strenuispina n. sp.

(see also pl. XI)

Fig. 6. Cranidium, holotype (IG 173.II.332); × 6.2.

Fig. 7. Fragment of internal mould of cephalon with exoskeleton partly preserved (IG 173.II.325); × 6.

Fig. 1: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

Fig. 2,6,7: Jabłonna, Carboniferous, *Gattendorfia* zone (VII).

Fig. 3-5: Karczówka, Carboniferous, *Gattendorfia* zone (VII)?

Pl. XIII

Cyrtosymbole (Macrobole) cf. *brevispina* n. sp.

Fig. 1. Internal mould of cranidium (IG 173.II.741); × 14.

Cyrtosymbole (Macrobole) brevispina n. sp.

Fig. 2. Internal mould of pygidium (IG 173.II.710); × 10.

Fig. 3. Internal mould of young pygidium with larval notch (IG 173.II.478); × 15.

Fig. 4. Internal mould of young cranidium (IG 173.II.378); × 13.

Fig. 5. Internal mould of young cranidium (IG 173.II.382); × 14.

Fig. 6. Cranidium, holotype (IG 173.II.39); × 9.3.

Fig. 7. Internal mould of cranidium (IG 173.II.384b); × 10.9.

Fig. 8. Internal mould of librigena (IG 173.II.377); × 6.

Fig. 9. Internal mould of pygidium (IG 173.II.381). × 14.5.

Cyrtosymbole (Macrobole) cf. *blax* R. & E. Richter

Fig. 10. Cranidium (IG 173.II.349); × 6.3.

Fig. 1-5, 7-9: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

Fig. 6: Gałęzice, Carboniferous, *Pericyclus* zone (VIII).

Fig. 10: Jabłonna, Carboniferous, *Gattendorfia* zone (VII).


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Pl. XIV

Liobole zarembiensis n. sp.
(see also pl. XV, XVI)

Fig. 1. Internal mould of cranidium (IG 173.II.612); × 6.
Fig. 2. Internal mould of cranidium (IG 173.II.608); × 11.

Trilobites sp. *a*

Fig. 3. Fragment of internal mould of pygidium (IG 173.II.566); × 6.

?Liobole sp. *b*

Fig. 4. Internal mould of pygidium (IG 173.II.562); × 6.4.

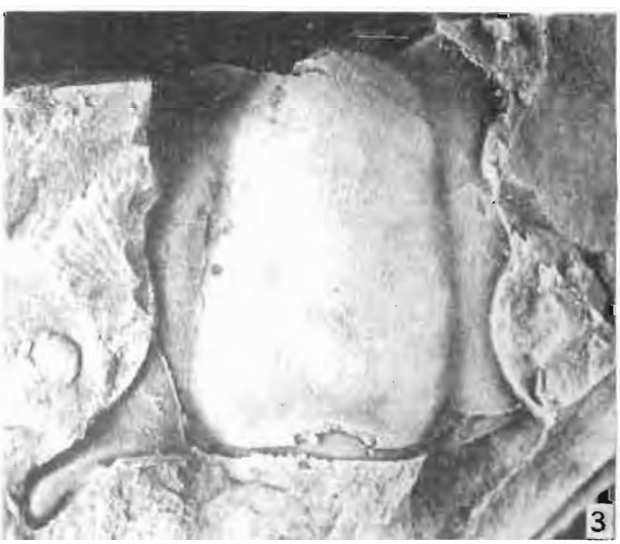
Liobole barilliformis n.sp.

Fig. 5. Internal mould of cranidium, holotype (IG 173.II.679.); × 6.

Liobole glabroides glabroides R. & E. Richter
(see also pl. XVI)

Fig. 6. Internal mould of cranidium (IG 173.II.567); × 3.2.

Fig. 1-6: Zaremby, Carboniferous, *Pericyclus* zone (VIII).



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Pl. XVI

Liobole glabroides glabroides R. & E. Richter

(see also pl. XIV)

Fig. 1. Fragment of internal mould of librigena (IG 173.II.576); × 4.

Liobole zarembiensis n. sp.

(see also pl. XIV, XV)

Fig. 2. Internal mould of pygidium (IG 173.II.575); × 2.9.

Fig. 3. Internal mould of cranidium (IG 173.II.611); × 6.

Liobole aff. *coalescens* R. & E. Richter

Fig. 4. Internal mould of pygidium (IG 173.II.657); × 2.9.

Liobolina apodemata n. sp.

(see also pl. XII, XV)

Fig. 5. Internal mould of pygidium (IG 173.II.431); × 13.

?Typhloproetus sp.

Fig. 6. Internal mould of librigena (IG 173.II.560); × 6.

Fig. 1-6: Zaremby, Carboniferous, *Pericyclus* zone (VIII).

Pl. XVII

Typhloproetus ?kozlowskii n. sp.

Fig. 1. Internal mould of librigena (IG 173.II.565); × 6.

Typhloproetus kozlowskii n. sp.

Fig. 2. Internal mould of cranidium, holotype (IG 173.II.500); × 11.

Formonia convexa n. sp.

Fig. 3. Internal mould of cranidium, holotype (IG 173.II.561); × 14.

Fig. 4. Internal mould of librigena (IG 173.II.558); × 3.6.

Fig. 5. Fragment of internal mould of cranidium (IG 173.II.473); × 5.

?Formonia sp.

Fig. 6. Internal mould of young pygidium (IG 173.II.437); × 15.

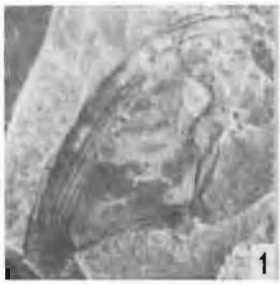
Fig. 7. Internal mould of young pygidium (IG 173.II.559); × 14.

Fig. 8. Internal mould of pygidium (IG 173.II.439); × 15.

?Typhloproetus angustigenalis n. sp.

Fig. 9. Internal mould of cranidium (IG 173.II.497); × 13.7.

Fig. 1-9: Zaremby, Carboniferous, *Pericyclus* zone (VIII).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