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CONTRIBUTION TO THE LOWER AND MIDDLE CAMBRIAN PALEONTOLOGY AND STRATIGRAPHY OF NORTHWEST GREENLAND

BY

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WITH 10 FIGURES IN THE TEXT AND 4 PLATES

С РУССКИМ РЕЗЮМÉ

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CONTENTS

Dedicated to my father,

professor Dr. CHRISTIAN POULSEN

Abstract

The material is from Northwest Greenland and consists of Lower and Middle Cambrian trilobites — order Redlichiida, order Corynexochida, and order Ptychopariida. Some previously known genera and species are discussed, and four new Middle Cambrian genera (two alokistocarid, one ptychopariid, one family uncertain) and nine new species are erected. Meraspid stages of *Glossopleura* are described. The Cape Kent limestone is correlated with the Upper *Olenellus* subzone. The former presence of the *Plagiura* — *Poliella* zone is suggested by fossiliferous pebbles in the basal conglomerate of the *Glossopleura* zone. The lower part of the Cape Russell member, belonging to the Cape Wood formation, is correlated with the *Glossopleura* zone. In this zone a *Glossopleura* faunule and a *Clavaspidella* faunule are distinguished. The upper part of the Cape Russell member and the Blomsterbæk limestone member are shown to be equivalent to the *Bathyuriscus* — *Elrathina* zone. Current Middle Cambrian Pacific-Atlantic correlation is discussed, and it is demonstrated that the *Glossopleura* zone is equivalent to upper part of the *Eccaparadoxides oelandicus* stage and lower part of the *Paradoxides paradoxissimus* stage. A tentative account of the Lower to Middle Cambrian history and paleogeography is presented. The localities and sections in Northwest Greenland are discussed.

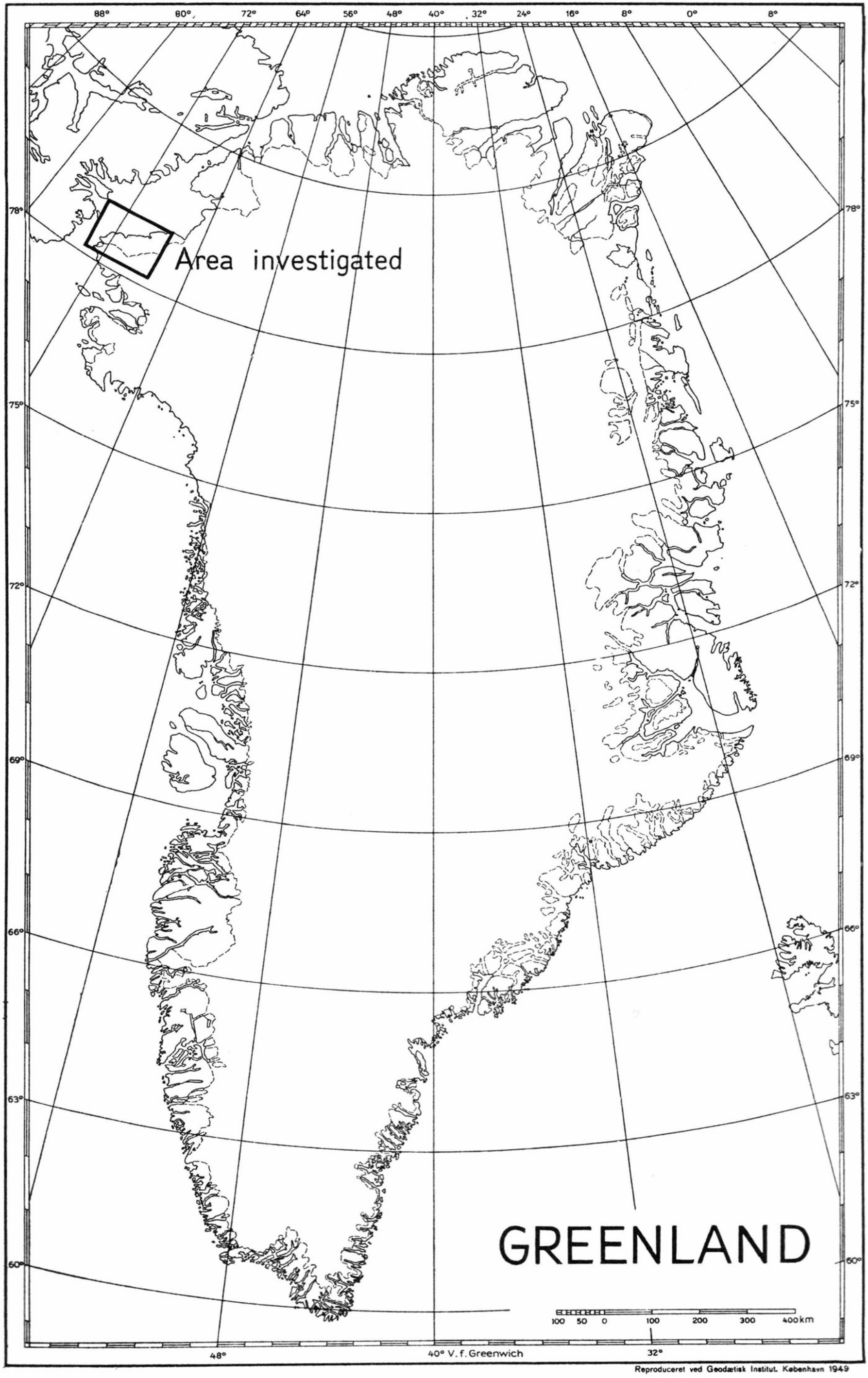

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Fig. 1. Map of Greenland, showing the location of the region represented by the special map (fig. 2).

INTRODUCTION

Most of the material, described and discussed in this paper, was collected by Dr. J. C. Troelsen, a member of the Danish Thule–Ellesmere Land Expedition 1939–1941. The author is greatly indepted to Dr. Troelsen for placing this interesting material at his disposal for study and publication.

The field work was carried out under extremely difficult conditions (Troelsen, 1950). Accordingly, the fossil material is not so comprehensive as desirable, but it nevertheless yields information on the stratigraphical range of the Lower- and Middle Cambrian in Northwest Greenland and promotes a closer correlation with the Cordilleran faunas.

The trilobites, originally described by C. Poulsen in 1927, have been restudied and are commented upon.

The author wishes to express his gratitude to his father, professor Dr. Christian Poulsen for much valuable advice and fruitful discussions during the work.

The author is very grateful to Mr. C. Halkier for carefully making prints of the photographs, to Mrs. R. Larsen for ably drawing the map, the correlation tables, and the diagram of the sections, and finally to Dr. J. P. Berrangé, who kindly read and corrected the manuscript.

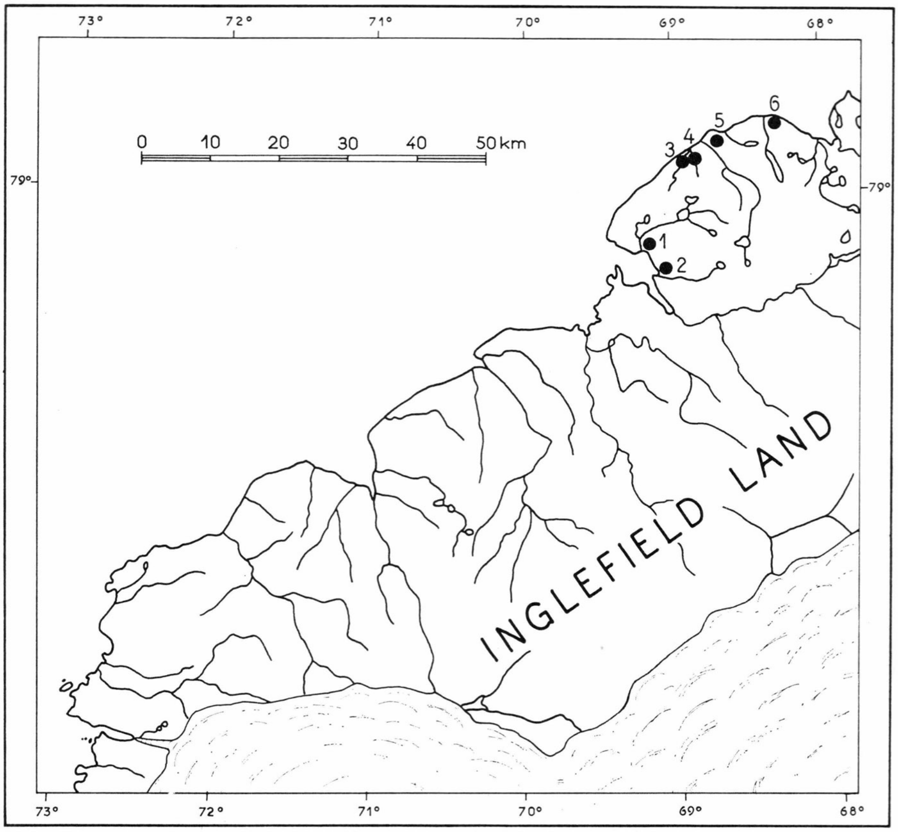

Fig. 2. Map, showing the localities in Inglefield Land from which the fossils of the Cape Kent limestone and the Cape Wood formation originate. 1–2: Marshall Bugt, locs. 1–2. 3: W. of Blomsterbækken; 4: E. of Blomsterbækken. 5: Kap Frederik VII. 6: Kap Kent. The locality at the R.C.M.P. Post on Bache Peninsula (Ellesmere Island) is not shown. See also map, text-fig. 1.

SYSTEMATIC PALEONTOLOGY

In this section all the species in the material are reported. Four new Middle Cambrian genera and nine new species are erected. Some previously known species are revised or discussed. Localities are shown on the maps, figs. 1–2. The reader is referred to Troelsen 1950 for a detailed description of the localities.

Taxa and terminology used for systematic descriptions in this paper are in accordance with "Treatise on Invertebrate Paleontology", part 0, Arthropoda 1 (edited by R. C. Moore, Univ. Kansas Press, 1959).

All trilobites described and figured are in the collections of the Mineralogical and Geological Museum of the University of Copenhagen.

DESCRIPTIONS OF GENERA AND SPECIES

LOWER CAMBRIAN

Class **CALYPTOPTOMATIDA** FISHER, 1962

Order **Hyolithida** MATTHEW, 1899

Suborder **Hyolithina** MATTHEW, 1899

Family Hyolithidae NICHOLSON, 1872

Genus ***Hyolithes*** EICHWALD, 1840

Type species: *Hyolithes acutus* EICHWALD

Hyolithes poulseni RESSER, 1938

1927. *Hyolithes billingsi* WALCOTT, C. POULSEN: Medd. om Grønland, vol. 70(2), p. 254, pl. 14, figs. 26–27.

1938a. — *poulseni* RESSER: Smithsonian Misc. Colls., vol. 97(10), p. 22.

Holotype: Complete specimen (MMH no. 2230), C. POULSEN 1927: Pl. 14, fig. 26. Designated by V. POULSEN, herein.

Material: A number of somewhat fragmentary shells.

Horizon and locality: Upper *Olenellus* subzone. Kap Frederik VII and west of Blomsterbækken.

Remarks: As pointed out by RESSER the Northwest Greenland species differs from *Hyolithes billingsi* in its wider apical angle.

Class **TRILOBITA** WALCH, 1771

Order **Redlichiida** RICHTER, 1933

Suborder **Olenellinae** RESSER, 1938

Family Olenellidae VOGDES, 1893

Genus ***Bristolia*** HARRINGTON, 1956

Type species: *Mesonacis bristolensis* RESSER

WALCOTT (1910), when describing several species of Olenellidae with subanterior cephalic spines, did not attach much importance to the position of these spines. RESSER (1928) recognized the specific value of the advanced genal spines. Later, LOCHMAN (1952) reduced this trait to have significance at the subspecific level only. HARRINGTON (1956) analysed the American species with advanced spines and concluded that the position and shape of the spines clearly had specific importance, as already recognized by RESSER. This was evident from the fact that no appreciable variation in position and shape could be observed, when several specimens of the same species were available. Furthermore, the presence of the advanced spines, considered together with other cephalic features, seemed to have real generic significance. On these criteria HARRINGTON was able to group olenellid genera with advanced spines in four genera: *Fremontella*, *Fremontia*, *Laudonia*, and *Bristolia.*

The two species of *Olenellus s. l.*, described by C. POULSEN, from the Cape Kent limestone clearly belong to *Bristolia.*

Bristolia groenlandica (POULSEN, 1927)

1927. *Olenellus groenlandicus* POULSEN: Medd. om Grønland, vol. 70(2), p. 254, pl. 14, figs. 28–31.

Holotype: External mould of cephalon (MMH no. 2233), C. POULSEN 1927: Pl. 14, figs. 29–30. Designated by V. POULSEN, herein.

Material: The two cephala originally described by C. POULSEN.

Horizon and locality: Upper *Olenellus* subzone. Kap Kent.

Discussion: The Northwest Greenland species resembles the type species, *Mesonacis bristolensis* RESSER, in the general outline of cephalon, in the convexity of the cephalic border, in the position of the spines, and in the somewhat pyriform frontal lobe of glabella, but differs in other respects. Some of the differences might suggest a generic distinction from other Olenellidae with advanced cephalic spines, but at present the author believes that such a distinction is unwarranted.

Bristolia groenlandica differs from the type species in having a slightly narrower cephalon, a strongly curved posterior border producing a softly rounded metagenal angle. The glabellar region of the Greenland species shows affinity to that of *Fremontella.* The glabella of *B. groenlandica* is less hourglass-shaped, and the segmentation is as in *Fremontella.* The palpebral lobes are as in *Bristolia* close to the glabella, but are situated more posteriorly. However, the peculiar segmentation found in *Bristolia bristolensis* and *B. insolens* may be partly due to deformation of the shale specimens.

The conclusion must be that although C. POULSEN's species in some respects approaches *Fremontella*, the cephalic characters primarily match the diagnosis of *Bristolia.*

Bristolia kentensis (POULSEN, 1927)

1927. *Olenellus kentensis* POULSEN: Medd. om Grønland, vol. 70(2), p. 255, pl. 14, fig. 32.

Holotype: External mould of cephalon (MMH no. 2235), C. POULSEN 1927: Pl. 14, fig. 32. Designated by V. POULSEN, herein.

Material: The cephalon originally described by C. POULSEN.

Horizon and locality: Upper *Olenellus* subzone. Kap Kent.

Remarks: The anterior and lateral border are missing in C. POULSEN's specimen, but the remaining parts of the cephalon demonstrate that the species must be closely related to *B. groenlandica*. The specimen shows the same type of curved posterior border producing a softly rounded metagenal angle without a spine. The dimensions of the lateral glabellar lobes and the position of the palpebral lobes also are the same. *Bristolia kentensis* differs from *B. groenlandica* in that the maximum width of the frontal lobe of glabella is situated at midline across frontal lobe. In *B. groenlandica* the maximum width of the frontal lobe is at the anterior margin. Furthermore the anterior transglabellar furrow in the latter is shallower.

Genus et sp. indet.

1927. *Olenellus sp. ind.* POULSEN: Medd. om Grønland, vol. 70(2), p. 256, pl. 15, fig. 1.

Material: Fragment of genal region (MMH no. 2236) originally described by C. POULSEN.

Horizon and locality: Upper *Olenellus* subzone. Kap Kent.

Remarks: The fragment of the genal region probably represents a new olenellid genus. C. POULSEN's specimen clearly belongs to a *Wanneria*-like type, the surface of which is finely reticulate. The entire glabella and the palpebral region are missing, but what is left shows that the palpebral lobes must be diminutive, situated extremely close to, or bordering upon the glabella. Thus the palpebral region must be very much like in two figured fragments referred to *Olenellus canadensis* (WALCOTT, 1910, pl. 38, figs. 4–5). The palpebral structure in WALCOTT's specimens, and supposedly present in the Greenland specimen, is remarkable and possibly of generic significance. WALCOTT's specimens (figs. 4–5) are apparently not conspecific with *Olenellus canadensis*.

Order **Corynexochida** KOBAYASHI, 1935

Family Dolichometopidae WALCOTT, 1916

Genus ***Dolichometopsis*** POULSEN, 1927

Type species: *Dolichometopsis resseri* POULSEN

When C. POULSEN established *Dolichometopsis*, a small detached pygidium was assigned to the type species. The genus evidently belongs to a group of dolichometopid genera, in which the cephala are practically identical, and, accordingly, a proper assignment of detached pygidia is crucial. RESSER (1939) did not accept C. POULSEN's assignment of the pygidium to the type species. In the Middle Cambrian of Idaho a number of species with dolichometopsid cranidia, according to RESSER, should be associated with large, *Kootenia*-like pygidia. Consequently he modified the original diagnosis.

RESSER's action was questioned by KOBAYASHI (1942, p. 150). He accepted C. POULSEN's original diagnosis and suggested that RESSER's species probably were not congeneric with the Northwest Greenland species. A similar point of view was favoured by RASETTI (1948a, p. 20). He stated that a new genus would be required for RESSER's species, unless they could be incorporated in *Ptarmigania*. Later RASETTI (1951, p. 178) established *Ptarmiganoides* to include species with a *Ptarmigania*-like cephalon and a *Kootenia*-like pygidium, this being the species referred to as *Dolichometopsis* by RESSER. RASETTI also emphasized the considerable age difference between the type species of *Dolichometopsis* and RESSER's species. Finally he stated that identical cranidia being associated with a great variety of pygidia are of common occurrence among the Dolichometopidae.

LOCHMAN (1952, pp. 131–132) made a complete restudy of the type species of *Dolichometopsis* and the Langston formation material referred to *Ptarmigania* and *Dolichometopsis*. She was able to demonstrate significant differences in the palpebral area of full-grown specimens, whereas these distinctions apparently fail to show in small holaspid cranidia. LOCHMAN concluded that *Dolichometopsis* was not present in the Langston material. The similarity between the small holaspid cranidia of the two genera was interpretated as indicating that *Ptarmigania* was the early Middle Cambrian descendant of the late Lower Cambrian *Dolichometopsis*. Concerning the pygidia, she agreed to C. POULSEN's original assignment of the pygidium.

KOBAYASHI (1936), from a Lower Cambrian fauna in the Mackenzie district, Canada, reported *Dolichometopsis*. However, his *Dolichometopsis humei* is possibly not congeneric with the type species. It differs from *Dolichometopsis* in the considerably larger palpebral lobes, in having a simple, unexpanded occipital ring, and in the posterior position of the genal spine, which in *Dolichometopsis* is well advanced. KOBAYASHI's species probably represents a closely related genus.

In a large sample of the Cape Kent limestone two small specimens of *Dolichometopsis septentrionalis* occur associated with several cranidia of *Inglefieldia porosa* and three fragmentary pygidia. The pygidia, even though badly preserved, are identified as the same type as the one referred to *Dolichometopsis*. In the author's opinion the mentioned fragmentary pygidia and the single pygidium assigned to *Dolichometopsis* are without any diagnostic features and may equally well be referred to *Dolichometopsis* or *Inglefieldia*. Unfortunately the material does not allow any definite conclusions.

Dolichometopsis must be regarded as a distinct genus, which is restricted to the Lower Cambrian.

Dolichometopsis resseri POULSEN, 1927

1927. *Dolichometopsis resseri* POULSEN: Medd. om Grønland, vol. 70(2), p. 258, pl. 16, figs. 2–11.
1927. — *minuta* POULSEN: Ibid., p. 258, pl. 16, fig. 16.

Holotype: Cranidium (MMH no. 2264), C. POULSEN 1927: Pl. 16, figs. 2–4. Designated by V. POULSEN, herein.

Material: Numerous cranidia and a few librigenae.

Horizon and locality: Upper *Olenellus* subzone. Marshall Bugt loc. 1 and loc. 2; west of Blomsterbækken; Kap Frederik VII.

Remarks: A restudy of the single specimen of *Dolichometopsis minuta* (MMH no. 2273) has shown that it is actually a young holaspis of *D. resseri*. In the mentioned specimen the anterior margin is damaged, but has been developed just as in the type species. Still in this specimen the lateral glabellar furrows are better defined than in full-grown specimens. TROELSEN's material clearly demonstrates that the lateral glabellar furrows gradually become more effaced during the growth of the individuals.

Dolichometopsis resseri is the most common of the two species occurring in Northwest Greenland.

Dolichometopsis septentrionalis POULSEN, 1927

1927. *Dolichometopsis septentrionalis* POULSEN: Medd. om Grønland, vol. 70(2), p. 258, pl. 16, figs. 13–15.

Holotype: Cranidium (MMH no. 2271), C. POULSEN 1927: Pl. 16, figs. 13–14. Designated by V. POULSEN, herein.

Material: Two cranidia.

Horizon and locality: Upper *Olenellus* subzone. West of Blomsterbækken.

Remarks: This apparently rare species is readily distinguished from *D. resseri* by the strongly curved palpebral lobes.

Order **Ptychopariida** SWINNERTON, 1915

Suborder **Ptychopariina** RICHTER, 1933

Superfamily **Ptychopariacea** MATTHEW, 1887

Family Ptychopariidae MATTHEW, 1887

Genus ***Poulsenia*** RESSER, 1936

Type species: *Solenopleura grönwalli* POULSEN

Poulsenia groenwalli (POULSEN, 1927)

1927. *Solenopleura grönwalli* POULSEN: Medd. om Grønland, vol. 70(2), p. 265, pl. 15, fig. 28.
1927. — *similis* POULSEN: Ibid., p. 265, pl. 15, fig. 26.
1927. — *bullata* POULSEN: Ibid., p. 266, pl. 15, fig. 25.
1927. — *borealis* POULSEN: Ibid., p. 266, pl. 15, fig. 27.
1936. *Poulsenia grönwalli* (POULSEN), RESSER; Smithsonian Misc. Colls., vol. 95(4), p. 26.
1936. — *similis* (POULSEN), RESSER: Ibid., p. 26.
1936. — *bullata* (POULSEN), RESSER: Ibid., p. 27.
1936. — *borealis* (POULSEN), RESSER: Ibid., p. 27.
1955. — *grönwalli* (POULSEN), RASETTI: Smithsonian Misc. Colls., vol. 128(2), p. 5.

Holotype: Cranidium (MMH no. 2261), C. POULSEN 1927: Pl. 15, fig. 27. Designated by V. POULSEN, herein.

Material: A number of cranidia.

Horizon and locality: Upper *Olenellus* subzone. Kap Frederik VII and Marshall Bugt loc. 1.

Remarks: On account of the lithology the layer, in which *Poulsenia groenwalli* occurs, has previously been regarded as a part of the Middle Cambrian sequence. In this connection attention should be called to the fact that the section at Kap Frederik VII is partly obscured by talus. In general, the Lower Cambrian Cape Kent limestone is referred to as being a yellowish-white, almost pure, oolitic limestone. However, TROELSEN (1940, p. 640) has shown that the upper 50 centimetres of the Cape Kent formation at Marshall Bugt is a brownish, non-oolitic, littoral limestone. Apparently the same conditions have been present at Kap Frederik VII. Undoubtedly it is an indication of the subsequent emergence.

The four species, erected by C. POULSEN in 1927, were based on minor differences, which in fact fall well within the limits of individual variation and of influence by the state of preservation.

RESSER maintained the four species as members of the genus *Poulsenia*. As pointed out, the species could hardly be related to *Solenopleura*.

RASETTI (1955, p. 5) suggested that the four species might be reduced to one. He also stated that the occurrence of *Poulsenia* is probably restricted to Northwest Greenland. The present writer wholly agrees to these suggestions.

The cranidia represented in TROELSEN's material are small, but perfectly match the diagnosis. Of special importance is the bifurcation of the posterior pair of lateral glabellar furrows.

Poulsenia is probably a descendant of *Inglefieldia*. This is further discussed below.

Family Alokistocaridae RESSER. 1939

Genus ***Inglefieldia*** POULSEN, 1927

Type species: *Inglefieldia porosa* POULSEN

Inglefieldia is typically alokistocaroid, possessing many of the cephalic characters of *Amecephalus* and *Alokistocare*. Some of these cephalic characters are common in members of the family with a wide distribution in the Middle Cambrian. However, the author believes that *Inglefieldia* is restricted to the Lower Cambrian. Furthermore the genus probably does not occur outside of Northwest Greenland.

LOCHMAN (1952) referred a *Glossopleura* zone species from Sonora, Mexico, to *Inglefieldia*. All of her specimens are somewhat distorted, and this may account for the incorrect assignment to *Inglefieldia*. Despite the poor state of preservation significant differences from the type species of *Inglefieldia* may be pointed out. The cranidia of the Mexican specimens are much narrower, and the preglabellar field is relatively wider (sag.) than in *Inglefieldia*. Characteristic of *Inglefieldia*, as already pointed out by C. POULSEN in his original diagnosis, is the slight backward turn of the anterior border furrow in front of glabella. All of C. POULSEN's figured specimens show this feature, which is also quite apparent in the present writer's supplementary material. LOCHMAN's species fails to show this important character, and undoubtedly will have to be excluded from the genus. In this connection the author will call attention to the fact that one of LOCHMAN's figured paratypes (USNM no. 115967, pl. 30, fig. 1) cannot be congeneric with the other figured specimens. Possibly the degree of distortion has been overrated. The paratype in question has a glabella of quite different proportions, being softly rounded anteriorly; the anterior border is upturned, the border furrow is not well-defined.

The characteristic backward expansion of the anterior border in *Inglefieldia* was emphasized by RESSER (1935, p. 36). In 1936 (p. 24) he stated that arbitrary limits would have to be set to separate *Inglefieldia* from *Kochiella* on the one side, and from *Antagmus* and *Poulsenia* on the other. RESSER (1937, p. 14) included *Ptychoparia perola* WALCOTT in *Inglefieldia*. LOCHMAN (1947, p. 62) transferred this species to *Antagmus*, and finally RASETTI (1951, p. 244) placed the Middle Cambrian "*Ptychoparia*" *perola* in *Syspacephalus*.

Therefore no Middle Cambrian species may be referred to *Inglefieldia*, and apparently no Lower Cambrian species outside of Northwest Greenland fit into the genus. This was accentuated by RASETTI (1955, p. 5).

As demonstrated below the present writer has reduced the number of species to four: *Inglefieldia porosa* and *I. venulosa*, *I. inconspicua*, and *I. affinis*. Listed in this order the cephalic characters change in a direction approaching those of *Poulsenia*, and the latter genus is probably a descendant of *Inglefieldia*. The proposed relationship may be supported by the fact that both genera appear to be endemic. The likewise endemic *Poulseniella* (p. 36) from the Cape Wood formation is in turn probably a Middle Cambrian descendant of *Poulsenia*.

Inglefieldia porosa POULSEN, 1927

1927. *Inglefieldia porosa* POULSEN: Medd. om Grønland, vol. 70(2), p. 261, pl. 15, fig. 18.
1927. — *planilimbata* POULSEN: Ibid., p. 262, pl. 15, fig. 19.
1927. — *groenlandica* POULSEN: Ibid., p. 262, pl. 15, fig. 21.
1927. — *thia* (WALCOTT), POULSEN: Ibid., p. 263, pl. 15, fig. 24 (partim).
1935. — *porosa* POULSEN, RESSER: Smithsonian Misc. Colls., vol. 93(5), p. 36.
1935. — *planilimbata* POULSEN, RESSER: Ibid., p. 36.
1935. — *groenlandica* POULSEN, RESSER: Ibid., p. 36.
1935. — *thia* POULSEN, non WALCOTT, RESSER: Ibid., p. 36.

Holotype: Internal mould of cranidium (MMH no. 2252), C. POULSEN 1927: Pl. 15, fig. 18. Designated by V. POULSEN, herein.

Material: A number of cranidia. A few, very poorly preserved pygidia may belong to this species.

Horizon and locality: Upper *Olenellus* subzone. West of Blomsterbækken; Marshall Bugt loc. 1 and loc. 2.

Remarks: C. POULSEN's species *Inglefieldia planilimbata*, *I. groenlandica*, and *I. thia* (WALCOTT) were based on single cranidia which, to the author, allowing for small individual variations in sculpture, fall well within the limits of *I. porosa*. RESSER (1935) reassigned *Inglefieldia thia*

(WALCOTT) to *I. thia* POULSEN, as the Greenland species was not congeneric with the Mt. Whyte species. *Ptychoparia thia* WALCOTT was later (RESSER, 1937, p. 20) made the type species of *Onchocephalus.*

Inglefieldia porosa differs from *I. inconspicua* and *I. affinis* in having a proportionally wider cranidium, a more pronounced backward expansion of anterior border mesially, and in the anterior sections of facial suture being more strongly diverging forward. *I. porosa* differs from *I. venulosa* in having a wider (sag.) preglabellar field.

The genal caeca in anterior area of fixigenae as well as the surface granulation may be more or less pronounced, apart from the differences between the external and internal surface markings. The porous test is also found in the other species of *Inglefieldia.*

The species commonly occurs at the mentioned localities.

Inglefieldia affinis POULSEN, 1927

1927. *Inglefieldia affinis* POULSEN: Medd. om Grønland, vol. 70(2), p. 264, pl. 15, fig. 23.
1935. New genus RESSER: Smithsonian Misc. Colls., vol. 93(5), p. 36.
1936. *Inglefieldia affinis* POULSEN, RESSER: Ibid., vol. 95(4), p. 24.

Holotype: Ventrally exposed cranidium (MMH no. 2257), C. POULSEN 1927: Pl. 15, fig. 23. Designated by V. POULSEN, herein.

Material: A single cranidium.

Horizon and locality: Upper *Olenellus* subzone. Marshall Bugt loc. 2.

Discussion: *Inglefieldia affinis* differs from the other species in having a narrower cranidium, a more prominent glabella, and a narrow (sag.) preglabellar field, anterior sections of facial suture almost parallel to the sagittal axis, and in the increased curvature of the anterior margin.

RESSER expressed doubt as to the proper generic assignment of the species. The present writer accepts the assignment in view of the restricted number of genera found in the Cape Kent limestone. He believes that the basin at the time of deposition of the Cape Kent formation must have been practically isolated from the Cordilleran faunas, thus promoting the development of endemic genera. If this assumption is correct, one should expect to find a limited number of more or less closely related genera, and *Inglefieldia affinis* definitely possesses cephalic characters suggesting a close relationship to *Poulsenia.* The major difference is to be found in the development of the anterior border, which in *Poulsenia* is convex and delimited by a strongly curved anterior margin, whereas an essentially flat border with a flatly curved anterior margin is typical of *Inglefieldia affinis.* It should be noted that the anterior border in *Poulsenia* is backward expanded in front of glabella. Features possibly inherited from *Inglefieldia* are the variations in surface granulation and distinctness of genal caeca found in *Poulsenia.*

Inglefieldia inconspicua POULSEN, 1927

1927. *Inglefieldia inconspicua* POULSEN: Medd. om Grønland, vol. 70(2), p. 263, pl. 15, fig. 22.
1927. — *discreta* Poulsen: Ibid., p. 264, pl. 15, fig. 20.
1935. — *inconspicua* POULSEN, RESSER: Smithsonian Misc. Colls., vol. 93(5), p. 36.
1935. — *discreta* POULSEN, RESSER: Ibid., p. 36.

Holotype: Cranidium (MMH no. 2256), C. POULSEN 1927: Pl. 15, fig. 22. Designated by V. POULSEN, herein.

Material: A number of cranidia.

Horizon and locality: Upper *Olenellus* subzone. West of Blomsterbækken; Marshall Bugt loc. 1 and loc. 2.

Discussion: A restudy of C. POULSEN's species, *Inglefieldia inconspicua* and *I. discreta*, has shown that they should be regarded as only one species, which is distinguished by a relatively narrow cranidium as compared to that of the type species, further, by a less conspicuous mesial backward expansion of anterior border, and by the almost parallel-sided and anteriorly bluntly rounded glabella. Anterior sections of facial suture only slightly diverging forward. The author is of the opinion that the specific differences, indicated by C. POULSEN, fall well within the limits of individual variation, especially as possible effects from slight distortion must be considered.

The species is apparently rather common.

Inglefieldia venulosa (POULSEN, 1927).

1927. *Chancia venulosa* POULSEN: Medd. om Grønland, vol. 70(2), p. 264, pl. 16, fig. 1.
1935. *Inglefieldia venulosa* (POULSEN), RESSER: Smithsonian Misc. Colls., vol. 93(5), p. 36.

Holotype: Somewhat fragmentary cranidium (MMH no. 2263), C. POULSEN 1927: Pl. 16, fig. 1. Designated by V. POULSEN, herein.

Material: A few cranidia.

Horizon and locality: Upper *Olenellus* subzone. West of Blomsterbækken; Marshall Bugt loc. 1.

Remarks: When C. POULSEN assigned the species to *Chancia*, the genus was not well-delimited. Now *Chancia* is regarded as being restricted to the Middle Cambrian. RESSER (1935) without comment transferred the species to *Inglefieldia*. This action was justified, as the species in all respects comes within the limits of this genus. *I. venulosa* seems to be more closely related to *I. porosa* than to the other species. The genal caeca are pronounced, but this feature is probably dependant upon the size of the individual. *Inglefieldia venulosa* differs from the other species in the anterior border morphology. In *I. venulosa* the anterior cephalic margin is more strongly curved than the border furrow, and the anterior border consequently becomes narrower laterally. The preglabellar field is narrow (sag.), slightly less than half the width of anterior border. The border furrow gets shallower, when crossing the frontal area, which is provided with a low boss.

Genus ***Kochiella*** Poulsen, 1927

Type species: *Kochiella tuberculata* Poulsen

Kochiella is another ptychopariid type which has presented very much the same problems in handling as *Inglefieldia*, and again the type species is from Northwest Greenland. Four species, mainly based on cranidia, were established. The pygidia were unknown, but a single pygidium (MMH nos. 2274–75), which C. Poulsen referred to *Crepicephalus cf. cecinna* Walcott, was later assigned to *Kochiella tuberculata* by Resser (1935). This procedure was questioned by Rasetti (1951, p. 227), who stated that there was no certainty that the pygidium was correctly assigned to *Kochiella*, and thus the generic position of the pygidium remained unsettled. From the *Plagiura–Poliella* zone Rasetti had obtained a number of *Kochiella*-like cranidia, and, being unable to assign any pygidium to the cranidia, he suggested that the pygidium was probably small and featureless as in *Amecephalus*. If this could be ascertained, he further stated, *Amecephalus* would probably be the correct assignment for these cranidia, which were referred to *Kochiella*?.

Later, Rasetti (1955) concluded that possibly no Lower Cambrian genera outside of Greenland were referable to *Kochiella*, and for Middle Cambrian forms from the Cordilleran province, with similar features, no definite reference was possible, until a pygidium could be assigned with certainty to the genus.

The present writer is of the opinion that the pygidium, which C. Poulsen assigned to *Crepicephalus cf. cecinna*, was quite correctly transferred to *Kochiella tuberculata* by Resser. All evidence seems to indicate that the fauna of the Cape Kent limestone consists of a very limited number of genera. C. Poulsen's original material and the supplementary material, collected by Troelsen, contain only the four non-olenellid trilobite genera: *Dolichometopsis*, *Poulsenia*, *Inglefieldia*, and *Kochiella*. The pygidium in question would only fit into *Inglefieldia* or

Kochiella, and considering that the ornamentation consists of scattered, fairly large tubercles, only a reference to *Kochiella tuberculata* would appear reasonable.

RASETTI (1957) described additional fossils from the Middle Cambrian Mt. Whyte formation of the Canadian Rocky Mountains. Among these fossils are species of *Kochiella*? with tentatively assigned pygidia, which show an ornamentation similar to that of the cranidia. RASETTI concluded that, if the assignment of the two parts to one species should be confirmed, this form would probably have to be assigned to a new genus.

The author believes that RASETTI correctly matched cranidia and pygidia, and the species will have to be excluded from *Kochiella*. As will be demonstrated below, significant differences between *Kochiella* and the Mt. Whyte species may be pointed out. However, they are obviously closely related, and RASETTI's species may well be a Middle Cambrian descendant of *Kochiella* or a very closely related Lower Cambrian genus. The present writer believes *Kochiella* to be restricted to the Lower Cambrian. In view of the close relationship between *Kochiella* and the Cordilleran species it is very possible that *Kochiella* may occur in Lower Cambrian faunas of North America.

The cranidia of RASETTI's species *Kochiella*? *maxeyi* and *K.*? *gibbosa* differ from that of *Kochiella* in being much narrower, in the preglabellar field being more strongly convex, and in the equal width (sag.) of the preglabellar field and anterior border. RASETTI's species differ further in having an essentially flat (in *K.*? *gibbosa* somewhat convex) and upturned anterior border, delimited by an anterior border furrow, which is almost parallel to anterior margin of cranidium. In *Kochiella* the anterior border is mesially backward-expanded. The concavity of the anterior border in *Kochiella* is very distinctive. The posterior and anterior parts of the border are flat and horizontal. Only the middle strip is concave, thus creating the effect that the anterior border is provided with a wide and shallow, transverse furrow.

The bilobate pygidium of *Kochiella tuberculata* differs from the pygidium of *K.*? *maxeyi* in only the abaxial part of the pleural fields being backward-bent, and thus the marginal indentation behind the axis is relatively wide. In RASETTI's species the entire pleural fields are backward-bent, almost parallel to sagittal axis. The resulting lobes are elongate, only defined by a small and shallow marginal indentation.

As tentatively suggested by RASETTI, the species referred to *Kochiella*? *maxeyi* should more correctly be assigned to a new genus, and, as also stated, RASETTI's two species are probably not even congeneric. On the other hand, evident similarities between the Cordilleran species and *Kochiella* indicate a fairly close relationship. The similar features are found in the structure of the glabellar region, the backward-bent pleural fields in the pygidium, and the wide pygidial axis with a softly rounded terminal axial piece.

Two species, which RESSER referred to *Kochiella*, will have to be excluded from the genus. The cranidium of *Kochiella crito* (WALCOTT) (RESSER, 1935, p. 39) has a width and a glabellar region somewhat similar to *Kochiella*, but fails to show the characteristic backward turn of anterior border in front of glabella. Also, the anterior sections of facial suture in RESSER's Mt. Whyte species are slightly diverging forward, whereas in *Kochiella* they are converging forward, as seen from above. *Kochiella? pennsylvanica* (RESSER, 1938b, p. 84, pl. 3, fig. 13) is a narrower form, and the same differences as already noted, concerning the features of anterior border, are quite evident.

LOCHMAN (1956a) assigned a species from the Lower Cambrian *Elliptocephala asaphoides* fauna from eastern New York State to *Kochiella fitchi* (WALCOTT). The pygidium ascribed to the species is small and transverse, whereas the pygidium of *Kochiella* is bilobate and less transverse. The cranidium of the species differs from that of *Kochiella* in the anterior border becoming narrower laterally, in the anterior border being convex, in the occipital ring being more expanded mesially, and in the anterior sections of facial suture diverging forward. To the present writer the species clearly belongs to *Antagmus*. The characters of the anterior border especially suggest this possibility.

A restudy of C. POULSEN's material has caused the present writer to reduce the number of species of *Kochiella* from four to three. This is further confirmed by the specimens, collected by TROELSEN.

Kochiella tuberculata POULSEN, 1927

1927. *Kochiella tuberculata* POULSEN: Medd. om Grønland, vol. 70(2), p. 259, pl. 15, figs. 7–13.
1927. — *propinqua* POULSEN: Ibid., p. 260, pl. 15, fig. 16.
1927. *Crepicephalus cf. cecinna* WALCOTT (pygidium): POULSEN: Ibid., p. 267, pl. 16, figs. 17–18.
1935. *Kochiella tuberculata* POULSEN, RESSER: Smithsonian Misc. Colls., vol. 93(5), p. 39.
1935. — *propinqua* POULSEN, RESSER: Ibid., p. 39.
1935. — *tuberculata* POULSEN (pygidium), RESSER: Ibid., p. 39.

Holotype: Fragmentary cranidium (MMH no. 2245), C. POULSEN 1927: Pl. 15, fig. 10. Designated by V. POULSEN, herein.

Material: A number of cranidia and a few librigenae.

Horizon and locality: Upper *Olenellus* subzone. West of Blomsterbækken; Marshall Bugt loc. 1 and loc. 2.

Remarks: As mentioned in the discussion of the genus, all evidence indicates that RESSER correctly assigned the pygidium (MMH no. 2274), which C. POULSEN had referred to *Crepicephalus cf. cecinna*, to *Kochiella tuberculata.* To the original description of the pygidium the author would like to add that the specimen is more distinctly bilobate, than it appears from C. POULSEN's figures. Apart from differences in ornamentation it strongly resembles the unassigned pygidium, figured by C. POULSEN (pl. 16, fig. 19). This pygidium undoubtedly belongs to a species of *Kochiella.*

The author has carefully studied the two cranidia assigned to *Kochiella propinqua* and does not believe that this species is distinct from *K. tuberculata.* The differences seem to be well within the limits of individual variation.

Kochiella arcana POULSEN, 1927

1927. *Kochiella arcana* POULSEN: Medd. om Grønland, vol. 70(2), p. 260, pl. 15, fig. 17.

Holotype: External mould of cranidium (MMH no. 2251), C. POULSEN 1927: Pl. 15, fig. 17. Designated by V. POULSEN, herein.

Material: The single cranidium originally described by C. POULSEN.

Horizon and locality: Upper *Olenellus* subzone. Kap Kent.

Remarks: The species differs from *Kochiella tuberculata* and *K. gracilis* in having an almost parallelsided glabella, and in the greater width (sag.) of the anterior border producing a narrow preglabellar field.

Kochiella gracilis POULSEN, 1927

1927. *Kochiella gracilis* POULSEN: Medd. om Grønland, vol. 70(2), p. 260, pl. 15, figs. 14–15.

Holotype: Cranidium (MMH no. 2249), C. POULSEN 1927: Pl. 15, figs. 14–15. Designated by V. POULSEN, herein.

Material: The single cranidium originally described by C. POULSEN.

Horizon and locality: Upper *Olenellus* subzone. Kap Kent.

Remarks: The cranidium of *Kochiella gracilis* is relatively narrower than in *K. tuberculata* and *K. arcana* due to the elongate frontal area, and the preglabellar field is wider (sag.) than in these two species.

Kochiella sp.

1927. Genus et sp. indet. POULSEN: Medd. om Grønland, vol. 70(2), pl. 16, fig. 19.

Material: Pygidium (MMH no. 2276), originally figured by C. POULSEN.

Horizon and locality: Upper *Olenellus* subzone. Kap Kent.

Remarks: The bilobate structure of the pygidium, figured by C. Poulsen, is strikingly similar to that of the pygidium assigned to *Kochiella tuberculata*, apart from the absence of surface ornamentation. Considering the restricted number of non-olenellid genera in the Cape Kent limestone fauna, a reference to *Kochiella* seems to be reasonably safe.

MIDDLE CAMBRIAN

Class **TRILOBITA** Walch, 1771

Order **Corynexochida** Kobayashi, 1935

Family Dolichometopidae Walcott, 1916

Genus ***Clavaspidella*** Poulsen, 1927

Type species: *Clavaspidella sinupyga* Poulsen

It is generally believed that the occurrence of *Clavaspidella* is restricted to Northwest Greenland, and that Cordilleran species, referred to *Clavaspidella*, rightly belong to the closely related *Athabaskia* Raymond, 1928. Differences between the two genera were emphasized by Lochman (1952, p. 128). Features of *Clavaspidella ovaticauda n. sp.* (described below) necessitate some modifications of Lochman's differential diagnosis.

The pygidium of *Clavaspidella* differs from that of *Athabaskia* in possessing a shallow marginal indentation behind the axis, and in the pleural furrows being more faintly impressed on the border, terminating a little short of the margin.

The pygidium resembles that of *Athabaskia* in the absence of the border furrow. In the type species of *Clavaspidella* the sharp boundary between the pleural fields and the border creates the impression of a furrow being present. This illusion is further accentuated by the pleural furrows being deeper at the junction between border and pleural fields. In *Clavaspidella ovaticauda n. sp.* the boundary between the pygidial border and pleural fields is less sharp than in the type species.

Clavaspidella sinupyga Poulsen, 1927

1927. *Clavaspidella sinupyga* Poulsen: Medd. om Grønland, vol. 70(2), p. 277, pl. 17, figs. 19–22.

Holotype: Cranidium (MMH no. 2316), C. Poulsen 1927: Pl. 17, fig. 19, Designated by V. Poulsen, herein.

Material: Two pygidia.

Horizon and locality: *Glossopleura* zone. Marshall Bugt loc. 1.

Remarks: Surprisingly, this species, otherwise commonly occurring at Kap Frederik VII, is represented only at this one locality. Apparently TROELSEN, while collecting, did not hit the levels, at which the species tends to concentrate.

Clavaspidella ovaticauda n. sp.

Pl. 1, fig. 1

Holotype: Pygidium (MMH no. 9297), pl. 1, fig. 1, herein.

Material: Four pygidia.

Description: Pygidium elliptical in outline due to the strongly curved pleurae. Maximum width at midline across axis. Slightly tapered axis, two-thirds of the pygidial length, consisting of seven axial rings, with a rounded terminal axial piece extended into a postaxial ridge that tapers out on the middle of the border; ring furrows well-impressed, wide mesially. Axial furrows shallow. Pleural fields convex, moderately down-sloping; interpleural furrows obsolete; pleural furrows well-impressed, attaining maximum depth when crossing the boundary to the border, gradually dying out and terminating a little short of the margin. Border furrow obsolete. The wide, well-defined border flat and horizontal, with a shallow marginal indentation behind the axis.

Dimensions of holotype pygidium:

Length	10.0 mm
Maximum width	14.0 —
Width of axis at anterior margin	3.5 —

Horizon and locality: *Glossopleura* zone. Kap Frederik VII and Marshall Bugt loc. 1.

Discussion: The pygidium of *Clavaspidella ovaticauda n. sp.* differs from that of other known species of *Clavaspidella* in having a wider axis and strongly curved pleurae. It shows some resemblance to *Athabaskia* in possessing a relatively wide axis, the absence of a border furrow, and in the number of segments, but differs from *Athabaskia* in having faintly impressed pleural furrows on the border, dying out before reaching the margin, and finally by possessing a postaxial ridge and a marginal indentation behind the axis. Undoubtedly a close relationship exists between the two genera, and this relationship is now further emphasized by the new species, which holds an intermediate position.

Genus ***Glossopleura*** Poulsen, 1927

Type species: *Dolichometopus boccar* Walcott

In 1947 Lochman tried to establish a set of generic and specific standards. A definite, recognizable variation in any of the listed features should constitute respectively generic and specific valid distinctions.

One of the diagnostic generic features listed was: The definite presence or absence of lateral glabellar furrows, their number and direction. The importance of a careful handling of this feature was strongly emphasized, the possible influence by the state of preservation being pointed out.

The lateral glabellar furrows are obviously a fundamental structure, but nevertheless, the present writer cannot always recognize a definite variation in this feature as sufficient for a generic distinction. This viewpoint is based on the commonly found variation in the distinctness of the lateral glabellar furrows, disregarding effects of bad preservation.

The furrows may be differently developed in young and full-grown individuals of the same species. This feature is very well demonstrated by *Glossopleura walcotti* Poulsen. Young holaspides hardly show lateral glabellar furrows, whereas these are prominent in older individuals.

It is often seen in species with four pairs of lateral glabellar furrows that the first pair is faintly impressed, and very likely will not show in quite young holaspides. As many genera are established on basis of a few specimens, and as it is not always evident that these represent full-grown individuals, a generic distinction cannot be based on the lateral glabellar furrows only.

Another reason for caution is the frequent difference in distinctness of the furrows on the dorsal and ventral (internal) surface. Unfortunately it is rarely indicated in the literature, whether the fossil material represent true exoskeletons or internal, or external moulds. Thus thereis a possibility of misconceiving the proper qualities of the furrows.

However, the qualities of the lateral glabellar furrows may be valid as a diagnostic generic feature, when a sufficiently large material is at hand.

Glossopleura walcotti Poulsen, 1927

Pl. 1, figs. 2–4; text-figs. 3–4.

1927. *Glossopleura walcotti* Poulsen: Medd. om Grønland, vol. 70(2), pp. 268–269, pl. 16, figs. 20–30.
1927. — *expansa* Poulsen [partim]: Ibid., p. 269, pl. 16, fig. 32.
1927. — *longifrons* Poulsen [partim]: Ibid., p. 272, pl. 17, fig. 10.
1946. — *walcotti* Poulsen, Poulsen: Quart. Journ. Geol. Soc. London, vol. 102, p. 318.

Holotype: Cranidium (MMH no. 2277), C. POULSEN 1927: Pl. 16, fig. 20. Designated by V. POULSEN, herein.

Material: Numerous adult cranidia, pygidia, and librigenae. Also a number of meraspid cranidia and transitory pygidia in several stages.

Description:

Early meraspid stage

Pl. 1, fig. 2; text-fig. 3.

Cranidium round in outline. Length about 0.4 mm, width about 0.4 mm. Glabella with occipital ring consisting of five rings, separated by deep and wide transglabellar furrows; glabella slightly tapering forward until the frontal lobe, then expanded forward, reaching anterior margin. Axial furrows well-impressed.

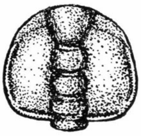

Fig. 3. Early meraspid cranidium of *Glossopleura walcotti.*

Anterior area of fixigenae essentially flat, down-sloping along the margin. Palpebral area of fixigenae large, strongly convex; the long palpebral lobes evenly curved, anteriorly continuing into faint eye ridges; palpebral furrows well-impressed. Posterior border furrow deep and wide.

Intermediate meraspid stage

Pl. 1, fig. 3; text-fig. 4.

Cranidium roughly semicircular in outline. Length from 0.7 to 0.8 mm, width from 0.8 to 1.0 mm. Glabella strongly expanded forward, reaching anterior margin. Transglabellar occipital furrow well-impressed.

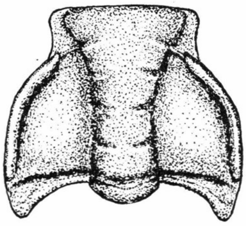

Fig. 4. *Glossopleura walcotti.* Intermediate meraspid stage.

Transglabellar furrows of previous stages reduced to normal lateral glabellar furrows. An extra pair of lateral glabellar furrows added anteriorly, opposite the eye ridges. Axial furrows well-impressed.

Anterior area of fixigenae flat, relatively more narrow than in previous stages; this is due to the pronounced inward-turning of the anterior ends of the palpebral lobes. Anterior margin but slightly curved. Palpebral area of fixigenae large, strongly convex; curved palpebral lobes continuing anteriorly into distinct eye ridges, joining glabella just opposite the anterior pair of lateral glabellar furrows; palpebral furrows deep and wide. Postero-lateral corners of the posterior area of fixigenae drawn into short blunt processes, directed backwards. Posterior border furrow well-impressed adaxially, almost obsolete at the lateral margin.

Late meraspid stage

Pl. 1, fig. 4.

Later meraspid cranidia are characterized by the still more pronounced inward-turning of the anterior ends of the palpebral lobes, the further reduction of anterior area of fixigenae, and the completed development of the lateral glabellar furrows, these being only faintly impressed. The late meraspid cranidia mainly differ from the holaspid ones in size.

Several transitory pygidia, associated with meraspid cranidia of *Glossopleura walcotti*, are referred to this species. The pygidia are regarded as transitory on account of their small size. Length 0.7 to 3.5 mm, width 1.2 to 4.5 mm. Apart from the size they match perfectly the original description of the adult pygidium.

Moderately tapered axis with rounded terminal axial piece extended into a postaxial ridge, which reaches posterior margin. Seven axial rings, defined by well-impressed furrows. Pleural fields convex, moderately down-sloping, indistinctly segmented. Well-defined border wide, concave, with a shallow marginal indentation behind the axis.

Horizon and locality: *Glossopleura* zone. Marshall Bugt loc. 1 and loc. 2; west and east of Blomsterbækken; R. C. M. P. Post on Bache Peninsula. Holaspides and some meraspid cranidia and pygidia in C. Poulsen's original material from Kap Frederik VII.

Discussion: C. Poulsen (1927) hesitantly assigned some pygidia to *Glossopleura expansa*. To the present writer these pygidia appear to fall well within the limits of *Glossopleura walcotti*.

The reference of the meraspid material to *Glossopleura walcotti* is based on the fact that the meraspides occur in samples associated exclusively with holaspides of this species.

Also included in this species are the pygidia originally referred to *Glossopleura longifrons* Poulsen (1927, p. 272, pl. 17, fig. 10). The pygidium figured by C. Poulsen is 5 mm wide and 3.5 mm long. It is identical to the transitory pygidia described above, the only exception being that the axis consists of eight well-defined rings. The present writer considers the occurrence of a transitory pygidium with eight instead of seven axial rings, as seen in the other transitory pygidia and the holaspid pygidia, to be an indication of multiple molts within the individual meraspid degrees. It has been demonstrated that indications of new segments may appear first in the axial region or in the pleural region, or simultaneously in both regions. As in the case of *Illaenus* (Troedsson, 1924, p. 224) and *Ceraurus* (Evitt, 1953, p. 44) new segments probably make their first appearance in the axial region in *Glossopleura walcotti*.

It is a regrettable fact that only little is known about the ontogeny of the members of order Corynexochida, as better information about the ontogeny of this group might be of importance for the classification within the group.

Meraspid cranidia of *Amphoton (Amphoton) deois* (Walcott) and *Amphoton (Fuchouia) manchuriensis* (Walcott) were figured by Walcott (1913, pl. 22, figs. 1d–e, and pl. 23, fig. 2d). No description was given.

Walcott also figured meraspid cranidia of *Corynexochus minor* (Walcott) (1916, pl. 55, fig. 6c), *Bonnaspis stephenensis* (Walcott) (1916, pl. 55, fig. 5b), and *Albertella bosworthi* (Walcott (1917a, pl. 7, fig. 3d). As before, no description was given.

The aforementioned meraspides were briefly mentioned by Kobayashi (1942, p. 186).

Lochman figured a meraspid cranidium of *Glossopleura leona* Lochman (1952, pl. 25, fig. 20). No description was given.

Meraspid cranidia of *Mendospidella digesta* (Leanza) were recorded by the present writer (V. Poulsen, 1958, p. 7, pl. 1, figs. 1–3).

In the material, collected by Troelsen, a meraspid cranidium of *Zacanthoides ulo n. sp.* is found. Even though poorly preserved, it shows anterior extremities of palpebral lobes in a position more advanced than in the holaspis (pl. 1, fig. 10).

Discarding the state of preservation and the mode of illustration, all the mentioned meraspid cranidia are strikingly similar in appearance, especially in the earlier stages. Particular generic or specific features cannot be expected to show up until in the later stages.

It appears that a great part of the larval development is completed at an intermediate meraspid stage, as demonstrated by the practically holaspid glabella. The author believes that the most important features in the meraspid development in this group are the abaxial growth of the posterior area of fixigenae, the receding or inward-turning of the anterior extremities of the palpebral lobes simultaneous with the reduction or growth of anterior area of fixigenae.

Most likely, a majority of members of order Corynexochida has a similar ontogeny, and, accordingly, a generic reference of isolated meraspid cranidia may be extremely difficult. Undoubtedly more difference may be found in the transitory pygidia. In *Glossopleura walcotti* the later transitory pygidium, apart from the size, is very similar to the holaspid pygidium.

Possibly multiple molts within the individual meraspid degrees, occasionally accompanied by the addition of segments to the transitory pygidium, are of common occurrence in the Corynexochida.

Glossopleura expansa POULSEN, 1927

1927. *Glossopleura expansa* POULSEN [partim]: Medd. om Grønland, vol. 70(2), p. 269, pl. 16, fig. 31.

Holotype: Fragmentary cranidium (MMH no. 2286), C. POULSEN 1927: Pl. 16, fig. 31. Designated by V. POULSEN, herein.

Material: A few cranidia.

Horizon and locality: *Glossopleura* zone. Marshall Bugt loc. 2 and west of Blomsterbækken.

Remarks: The pygidium of *Glossopleura expansa*, figured by C. POULSEN (1927, pl. 16, fig. 32), must be transferred to *Gl. walcotti*, as the insignificant differences do not exceed the individual variation, demonstrated by the latter species.

Glossopleura teres n. sp.

Pl. 1, fig. 5

Holotype: Ventrally exposed pygidium (MMH no. 9301), pl. 1, fig. 5, herein.

Material: One pygidium and one ventrally exposed pygidium, partly showing external cast.

Description: The pygidium is round, almost heart-shaped in outline due to the strongly backward-sloping pleurae. Axis slightly tapered, with rounded terminal axial piece extended into a short postaxial ridge that tapers out a little short of posterior margin; five or six axial rings delimited by shallow furrows, which become progressively fainter posteriorly. Axial furrows faint. Pleural fields convex, moderately downsloping; interpleural furrows increasingly faint posteriorly, distinctly crossing the border, terminating a little short of the lateral margin. Border furrow obsolete; well-defined border wide and concave.

Dimensions of holotype pygidium (cast):

Length	10.0 mm
Width at anterior margin	9.0 –
Maximum width (a little behind axial centre)	11.0 –
Length of axis	6.0 –
Width of axis at anterior margin	3.5 –

Horizon and locality: *Glossopleura* zone. West of Blomsterbækken.

Remarks: The pygidium of *Glossopleura teres n. sp.* is readily distinguished from those of other species of *Glossopleura* by the strongly backward-sloping pleurae.

Genus ***Poliellina*** POLETAEVA, 1936

Type species: *Poliellina lermontovae* POLETAEVA

Poliellina? sp.

Pl. 1, figs. 6–7

Material: External mould of a single, somewhat fragmentary cranidium (MMH no. 9302).

Description: Cranidium moderately convex sagittally and transversely, profile highest at frontal lobe of glabella. Glabella is evenly expanded forward, reaching anterior border furrow, accentuated by straight and well-impressed axial furrows; distinct fossulae are situated in the axial furrows just in front of the eye ridges. There are four pairs of lateral glabellar furrows; the three posterior pairs are short and wide, well-impressed, directed inward-backward, separated from axial furrows; anterior pair extremely shallow, transverse. Occipital ring is moderately wide, exsagittally of moderate length, mesially expanded and drawn into a short spine, and delimited by a wide, exsagittally well-impressed occipital furrow.

Frontal area is wholly dominated by a narrow (sag.), slightly upturned anterior border; anterior border furrow is shallow; anterior margin evenly curved.

Anterior area of fixigenae wide, essentially flat, down-sloping laterally; the flat anterior border is upturned; anterior border furrow wide and shallow. The incompletely preserved palpebral area of fixigenae is approximately half the width of adjacent portion of glabella, moderately convex, slightly down-sloping postero-laterally; palpebral furrows are effaced; curved palpebral lobes presumably of moderate length, upturned, and situated on posterior one-third line across glabella; prominent eye ridges arcuate and oblique, merged into anterior extremities of palpebral lobes, anteriorly joining glabella just behind the fossulae and first pair of lateral glabellar furrows. Posterior area of fixigenae is not preserved in the single specimen.

Anterior sections of facial suture slightly diverging forward, at anterior border turning inward-forward, cutting anterior margin moderately out at sides.

The surface, except furrows, is finely granulated, the granules forming a pattern of closely set, anastomosing lines.

Dimensions of the cranidium:

Length	9.0 mm
Maximum width between the eyes	10.0 –
Length of glabella	7.0 –
Width of glabella at base	4.0 –

Horizon and locality: *Bathyuriscus* — *Elrathina* zone. West of Blomsterbækken.

Discussion: The specimen evidently belongs to the group of dolichometopid genera, in which the presence of the pygidium is rather essential to a reliable generic or specific reference.

The specimen shows some resemblance to the cranidium of *Bathyuriscus* Meek, 1873, but differs in having a longer occipital ring with spine, in possessing shorter palpebral lobes, and in the greater width of the palpebral area.

Poliellina? sp. differs from *Poliella* Walcott, 1916, in having four pairs of lateral glabellar furrows, shorter palpebral lobes, and again in the greater width of the palpebral area.

Poliellina? sp. resembles *Poliellina* Poletaeva, 1936, in the general shape, the number of lateral glabellar furrows, the width of the palpebral area, and in the strongly curved palpebral lobes. However, the cranidium differs from that of the type species, *P. lermontovae*, in having a longer occipital ring, the slightly greater width of the palpebral area, and in the more strongly oblique eye ridges, joining glabella more anteriorly.

Most strongly *Poliellina? sp.* resembles *Poliellina powersi* (Walcott), which was tentatively transferred from *Bathyuriscus* (*Poliella*) to *Poliellina* by Kobayashi (1942). The single specimen, figured by Walcott and later by Kobayashi, shows a cranidium, in which all preserved parts and surface ornamentation are almost identical to those of *Poliellina? sp.*, with the possible exception that the occipital ring in *Poliellina powersi* is somewhat shorter, only provided with a node instead of a short spine.

Possibly *Poliellina powersi* and *Poliellina? sp.* represent a new genus, closely related to *Bathyuriscus* and *Poliellina*, but so far too little is known to confirm this. The remarkable position of the fossulae just in front of the eye ridges, level to the first pair of lateral glabellar furrows, may be of value in a generic distinction.

Poliellina powersi, so far known only from the Meagher limestone in Montana, belongs to the *Bathyuriscus* — *Elrathina* assemblage. *Poliellina? sp.* occurs at the same level, being associated with *Glyphaspis perconcava* Poulsen, *Gl. parkensis* Rasetti, and *Acrocephalops gibber* Poulsen.

Genus **Polypleuraspis** Poulsen, 1927

Type species: *Polypleuraspis solitaria* Poulsen

Polypleuraspis solitaria Poulsen, 1927

1927. *Polypleuraspis solitaria* Poulsen: Medd. om Grønland, vol. 70(2), p. 270, pl. 16, figs. 37–38.

1927. *Glossopleura longifrons* Poulsen [partim]: Ibid., p. 272, pl. 17, figs. 8–9.

Holotype: Complete pygidium (MMH no. 2292), C. Poulsen 1927: Pl. 16, figs. 37–38. Designated by V. Poulsen, herein.

Material: A number of cranidia and pygidia.

Horizon and locality: *Glossopleura* zone. Marshall Bugt loc. 2; west of Blomsterbækken; R. C. M. P. Post on Bache Peninsula.

Remarks: In the collection one sample contains a number of pygidia belonging to *Polypleuraspis solitaria*, being associated with a corresponding number of undoubtedly related cranidia, answering the description of *Glossopleura longifrons*. Accordingly, these cranidia must be transferred to *Polypleuraspis*. This conclusion is supported by the more complete generic diagnosis offered by Rasetti (1951, p. 176) on basis of complete exoskeletons. The cranidia, originally referred to *Glossopleura longifrons*, wholly comply with the emended diagnosis of *Polypleuraspis*.

As mentioned earlier in the discussion on the meraspides of *Glossopleura walcotti*, the small pygidium, originally referred to *Glossopleura longifrons*, must be regarded as a transitory pygidium of *Gl. walcotti*. A few, slightly larger pygidia, also referred to *Gl. longifrons*, must on similar grounds be transferred to *Gl. walcotti*.

Thus the species *Glossopleura longifrons* can no longer be maintained.

Genus **Prosymphysurus** Poulsen, 1927

Type species: *Prosymphysurus kochi* Poulsen

Prosymphysurus kochi Poulsen, 1927

1927. *Prosymphysurus kochi* Poulsen: Medd. om Grønland, vol. 70(2), p. 279, pl. 17, figs. 15–18.

Holotype: Cranidium (MMH no. 2313), C. Poulsen 1927: Pl. 17, fig. 16. Designated by V. Poulsen, herein.

Material: One cranidium and one pygidium.

Horizon and locality: *Glossopleura* zone. Marshal Bugt loc. 1.

Family Dorypygidae KOBAYASHI, 1935

Genus ***Kootenia*** WALCOTT, 1888

Type species: *Bathyuriscus* (*Kootenia*) *dawsoni* WALCOTT

Kootenia cf. billingsi RASETTI, 1948

Pl. 1, fig. 8

Material: One poorly preserved pygidium, and two ventrally exposed pygidia, partly showing cast of external surface.

Horizon and locality: *Bathyuriscus* — *Elrathina* zone. West of Blomsterbækken.

Remarks: Apparently the pygidia are very similar to the specimens, figured by RASETTI (1948b, pl. 49, figs. 15–19), with the exception of being somewhat smaller, and the posterior pair of spines being more poorly developed.

In the figured pygidium, 9 mm long and 16 mm wide, the posterior pair of spines measures only 1 mm in length. In a slightly larger pygidium the posterior spines are 3.5 mm long. It is possible that the difference in size between the posterior pair and the rest of the spines is progressively diminished during the growth of the individual.

Variations in the development of the posterior pair of spines being present, changes in this feature alone can hardly justify a specific distinction.

The fine granulation, supposed to be present, cannot be observed on account of the state of preservation.

The pygidia are found associated with *Glyphaspis perconcava* and *Glyphaspis parkensis* RASETTI.

Kootenia resseri (POULSEN, 1927)

1927. *Dorypyge resseri* POULSEN: Medd. om Grønland, vol. 70(2), p. 267, pl. 16, figs. 33–35.

1937. *Kootenia resseri* (POULSEN), RESSER: Smithsonian Misc. Colls., vol. 95(22), p. 15.

Holotype: External mould of pygidium (MMH no. 2290), C. POULSEN 1927: Pl. 16, fig. 35. Designated by V. POULSEN, herein.

Material: A single, fragmentary pygidium.

Horizon and locality: *Glossopleura* zone. R. C. M. P. Post on Bache Peninsula.

Remarks: RESSER, without comments, reassigned the species to *Kootenia*. Evidently the reference to *Kootenia* was justified, as the pygidia possess a distinctly marked border and subequally dimensioned marginal spines.

In Northwest Greenland *Kootenia resseri* and *Kootenia obliquespina* (POULSEN) are the only species, which have been referred to *Dorypyge*, and the presence in this faunal assemblage of *Dorypyge*, as now defined, is not probable.

Family Zacanthoididae SWINNERTON, 1915

Genus ***Fieldaspis*** RASETTI, 1951

Type species: *Fieldaspis furcata* RASETTI

Fieldaspis sp.

Pl. 1, fig. 9

Material: A single, somewhat fragmentary pygidium (MMH no. 9304).

Description: The pygidium is slightly wider than long, subquadrate in outline, except for the deep marginal indentation behind the axis. Axis occupying two-thirds of the pygidial length, prominent, slightly tapered, with a rounded terminal axial piece extended into a short postaxial ridge that reaches the indented posterior margin; four or five axial rings defined by shallow furrows. Axial furrows are shallow. Pleural fields are convex, moderately down-sloping, indistinctly segmented. Border is wide and concave, strongly bilobate.

Surface of test finely granulated.

Dimensions of the pygidium:

Length	4.5 mm
Width at anterior margin	4.0 –
Maximum width (a little behind axial centre)	5.0 –
Length of axis	3.0 –
Width of axis at anterior margin	1.0 –

Horizon and locality: *Plagiura* — *Poliella* zone. Limestone pebble in the basal conglomerate of the *Glossopleura* zone, west of Blomsterbækken.

Remarks: The pygidium is in good agreement with that of the type species, but differs in having a more slender axis and a more strongly curved lateral margin.

TROELSEN's material contains two loose pebbles, collected west of Blomsterbækken at a level slightly below the *Glossopleura* zone. The pebbles contain *Amecephalus troelseni n. sp.* and *Kochaspis? sp.* Judging from the lithology of these samples, they, like *Fieldaspis sp.*, most likely originate from the basal conglomerate of the *Glossopleura* zone.

Genus ***Zacanthoides*** Walcott, 1888

Type species: *Zacanthoides romingeri* Resser, 1942

Zacanthoides ulo n. sp.

Pl. 1, fig. 10

Holotype: Cranidium (MMH no. 9305), pl. 1, fig. 10 (partim), herein.

Material: A single cranidium, and a poorly preserved, ventrally exposed meraspid cranidium.

Description: Glabella is two-thirds the length of cranidium, fairly convex in both directions, profile highest at midpoint, parallel-sided; there are four pairs of lateral glabellar furrows, separated from the axial furrows, first and second pair shallow and faintly impressed, converging forward, third and fourth pair well-impressed, longer, converging backward. Occipital furrow well-impressed throughout; the occipital ring is of usual proportions, mesially expanded, posteriorly with a median node. Axial furrows well-defined, gradually passing into an indistinct preglabellar furrow.

Frontal area wide; preglabellar field narrow (sag); anterior border furrow is shallow and ill-defined, parallel to anterior margin; the anterior border is well-developed, convex, slightly upturned, anterior margin flatly curved.

Anterior area of fixigenae flat, horizontal, expanded forward, with wide and shallow corner furrows parallel to anterior sections of facial suture. Palpebral area of fixigenae three-fourths the width of glabella, slightly convex, and situated almost entirely behind midpoint of glabella; the palpebral lobes are of medium length, curvature increasing posteriorly, anterior corners joining glabella a little in front of midpoint of glabella; palpebral furrows are wide, deeply impressed. Posterior area of fixigenae is not preserved, presumably down-sloping.

Anterior sections of facial suture starting extremely close to the axial furrows at anterior ends of palpebral lobes, strongly diverging forward at an angle of about 60° to the axial line of cranidium, crossing half of anterior border, then curving inward-forward, cutting anterior margin moderately out at sides.

The surface of the test is apparently smooth.

The associated meraspid cranidium (pl. 1, fig. 10) is probably about 2.5 mm long. Frontal area and posterior area of fixigenae are not preserved. The preserved parts exhibit all the characteristics of the holaspis, with the only exception that the anterior extremities of palpebral lobes join glabella more anteriorly. Possibly *Zacanthoides* has an ontogeny very similar to that of *Glossopleura* (see discussion on meraspides of *Glossopleura walcotti*, pp. 28–29).

Dimensions of holotype cranidium:

Length	6.0 mm
Width at anterior margin	6.0 –
Maximum width between the eyes	6.0 –
Length of glabella	4.0 –
Width of glabella at base	2.5 –

Horizon and locality: *Bathyuriscus — Elrathina* zone. Marshall Bugt loc. 1.

Remarks: The specific name, *ulo*, refers to the frontal area of the new species being shaped like an ulo — the eskimo flensing knife.

As the pygidium is unknown, the characters of the cranidium might suggest a reference to *Prozacanthoides* RESSER, 1937. The type species of this genus is of Lower Cambrian age. From the Lower Cambrian, according to RASETTI (1951, p. 142), there seems to be a gap in the stratigraphical distribution of this trilobite type; later, in the Middle Cambrian similar forms appear, some very much like the Lower Cambrian *Prozacanthoides*, others with the characters of the typical *Zacanthoides*. *Prozacanthoides* is probably restricted to the Lower Cambrian, and as the new species is of young Middle Cambrian age (*Bathyuriscus — Elrathina* zone), the present writer prefers a reference to *Zacanthoides*.

Zacanthoides ulo n. sp. differs from other species of this genus in the extreme posterior position of the palpebral area and in the proportions of the frontal area. *Zacanthoides divergens* RASETTI possesses a similar frontal area, but differs in the position of the palpebral lobes and in having a slightly forward expanded glabella.

Order **Ptychopariida** SWINNERTON, 1915

Suborder **Ptychopariina** RICHTER, 1933

Superfamily **Ptychopariacea** MATTHEW, 1887

Family Ptychopariidae MATTHEW, 1887

Genus ***Poulseniella*** *n. gen.*

Type species: *Poulseniella groenlandica n. sp.*

Diagnosis: Antagmine type of cranidium. Glabella tapering forward, rounded anteriorly; three pairs of lateral glabellar furrows. Occipital region of common type. Frontal area wide (sag.); preglabellar field narrow. Anterior border well-defined, essentially flat, upturned; anterior border furrow practically straight, shallow, almost extinct in front of glabella. Anterior margin evenly curved. Anterior and palpebral area of fixigenae rather strongly convex. Eye ridges arcuate and oblique. Genal caeca present. Palpebral lobes short, situated behind midline across glabella. Posterior area of fixigenae presumably of moderate width (tr.); posterior border furrow deep and wide. Anterior sections of facial suture almost parallel to sagittal axis. The rest of the dorsal exoskeleton is unknown.

Stratigraphical range: *Glossopleura* zone.

Discussion: *Poulseniella n. gen.* is of the general antagmine type, and, accordingly, it shows similarities to a multitude of genera. However, it differs significantly in possessing a flat, upturned anterior border, delimited by a practically straight border furrow which makes a slight backward turn in front of glabella, where it becomes almost effaced.

Poulseniella n. gen. most closely resembles the Lower Cambrian *Poulsenia* (see discussion on *Poulsenia*, pp. 15 and 16), but differs from the latter in characters of the frontal area and in possessing a smooth occipital ring, with no indication of a node. The new genus is probably derived from *Poulsenia*, or a very closely related form, and may well be restricted to Northwest Greenland.

Also included in the new genus is *Poulsenia crassilimbata* (POULSEN, 1927).

Poulseniella groenlandica n. sp.

Pl. 2, figs. 1–6; text-fig. 5

Holotype: Ventrally exposed cranidium (MMH no. 9306), pl. 2, figs. 1–3, herein.

Material: A few, ventrally exposed cranidia.

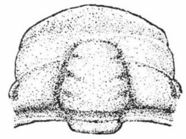

Fig. 5. Cranidium of *Poulseniella groenlandica n. gen. et n. sp.*

Description: The cranidium is slightly wider than long, subtrapezoidal. Glabella tapering forward, softly rounded anteriorly, moderately convex in both directions, profile highest a little in front of midpoint. Axial furrows are wide and well-impressed, preglabellar furrow shallow, almost obsolete. There are three straight and moderately deep pairs of lateral glabellar furrows; anterior pair transverse, the two posterior pairs directed inward-backward, all separated from the axial furrows. The occipital ring is short (sag.), moderately wide; occipital furrow is wide and well-impressed throughout.

Frontal area is moderately wide (sag.), with a faint pattern of scattered genal caeca; preglabellar field narrow; anterior border is wide and flat, upturned, delimited by a shallow border furrow, which makes a slight backward turn in front of glabella; anterior margin evenly curved.

Anterior area of fixigenae rather strongly convex, wide, down-sloping laterally, with genal caeca as described above; flat anterior border upturned, becoming progressively narrower in abaxial direction due to curvature of anterior margin and practically straight course of border furrow, which simultaneously gets deeper laterally. Palpebral area of fixigenae rather strongly convex, two-thirds the width of adjacent portion of glabella, down-sloping postero-laterally; palpebral furrows are shallow, almost obsolete; the short, curved palpebral lobes are situated entirely behind midline across glabella; the prominent eye ridges are oblique, adaxially tapering out, terminating at axial furrows opposite anterior pair of lateral glabellar furrows. Posterior area of fixigenae not well-preserved in any of the specimens; posterior border furrow is wide and deeply impressed; judging from *Poulseniella crassilimbata* (POULSEN), the posterior area is probably moderately wide (tr.).

Anterior sections of facial suture almost parallel to sagittal axis, as seen from above, at anterior border turning inward-forward, cutting anterior margin moderately out at sides.

Apparently the test, apart from genal caeca, is quite smooth.

The rest of the dorsal exoskeleton is unknown.

Dimensions of holotype cranidium (cast):

Length	5.5 mm
Maximum width between the eyes	7.0 –
Length of glabella	3.5 –
Width of glabella at base	3.0 –
Width of preglabellar field	0.2 –
Mesial width of anterior border	1.0 –

Horizon and locality: *Glossopleura* zone. East of Blomsterbækken.

Discussion: As mentioned in the discussion on the generic relationships, it is difficult to compare *Poulseniella n. g.* to any genus outside Northwest Greenland. The resemblance to the Lower Cambrian *Poulsenia* was also mentioned. The resemblance pertains to a number of characters. It is interesting that *Poulsenia* displays the same pattern of genal caeca, although it is fainter than in *Poulseniella n. gen.*

As brought to attention, the new genus differs from *Poulsenia* in frontal area characters and furthermore in having a smooth occipital ring without any indication of a node.

Poulseniella n. gen. is most likely derived from *Poulsenia* and is possibly restricted to Northwest Greenland. The specimens of the new genus are associated with *Glossopleura walcotti.*

Poulseniella crassilimbata (POULSEN, 1927)

1927. *Elrathia? crassilimbata* POULSEN: Medd. om Grønland, vol. 70(2), p. 274, pl. 17, figs. 5–6.

1937. *Poulsenia crassilimbata* (POULSEN), RESSER: Smithsonian Misc. Colls., vol. 95(22), p. 23.

Holotype: Cranidium (MMH no. 2303), C. POULSEN 1927: Pl. 17, figs. 5–6. Designated by V. POULSEN, herein.

Material: The two cranidia, described by C. POULSEN. The species is not represented in TROELSEN's material.

Horizon and locality: *Glossopleura* zone. Kap Frederik VII.

Remarks: C. POULSEN's species was based on two cranidia, which were referred with reservation to *Elrathia*, as the genus was then not properly delimited. According to modern concepts, a reference to *Elrathia* must be left out of consideration, as the Greenland species differs significantly with regard to the preglabellar morphology.

RESSER (1937, p. 23) transferred the species to *Poulsenia.* However, this genus is supposedly restricted to the Lower Cambrian.

The species strongly resembles *Poulseniella groenlandica n. g. et n. sp.* in a majority of features, including the pattern of genal caeca. However, *Poulseniella crassilimbata* differs from the type species in possessing a convex anterior border, a slightly wider preglabellar field, and in having a mesially expanded occipital ring.

Genus ***Ptychoparella*** POULSEN, 1927

Type species: *Ptychoparella brevicauda* POULSEN

Ptychoparella brevicauda POULSEN, 1927

1927. *Ptychoparella brevicauda* POULSEN: Medd. om Grønland, vol. 70(2), p. 280, pl. 17, figs. 26–28.

1927. *Elrathia? groenlandica* POULSEN: Ibid., p. 274, pl. 17, fig. 7.

Holotype: Cranidium (MMH no. 2323), C. POULSEN 1927: Pl. 17, fig. 26. Designated by V. POULSEN, herein.

Material: A few cranidia.

Horizon and locality: *Glossopleura* zone. West of Blomsterbækken; east of Blomsterbækken; Kap Frederik VII.

Remarks: After a restudy of the two cranidia, originally referred to *Elrathia? groenlandica* by C. POULSEN, the present writer is convinced that they belong to *Ptychoparella brevicauda*. The cranidia are smaller than that of the type species, but are identical to it in all respects, and are regarded as young holaspides.

Reference of Lower Cambrian ptychopariids to *Ptychoparella*, as first done by RESSER and later by LOCHMAN, is probably unjustified. In this respect, the author heartily agrees to the objections of RASETTI (1955, p. 7), who advocated that the use of *Ptychoparella* should be confined to the type species, until the genus is better known.

Family Alokistocaridae RESSER, 1939

Genus ***Alokistocare*** LORENZ, 1906

Type species: *Ptychoparia subcoronata* HALL & WHITFIELD

Alokistocare pronum n. sp.

Pl. 2, figs. 7–9

Holotype: Fragmentary cranidium (MMH no. 9308), pl. 2, figs. 7–9, herein.

Material: A single, somewhat fragmentary cranidium.

Description: Cranidium subquadrate. Glabella is half of cranidial length, moderately convex in both directions, profile highest posteriorly, tapering forward, softly rounded anteriorly. Axial furrows and preglabellar furrow are well-impressed. There are three pairs of lateral glabellar furrows, separated from axial furrows; first and second pair are short and shallow, transverse; posterior pair is directed inward-backward, well-impressed, getting wider adaxially. The occipital ring is moderately long and wide; occipital furrow mesially expanded, of moderate depth.

Frontal area is wide (sag.), one-third of cranidial length; the wide preglabellar field is strongly inclined; concave anterior border wide, almost horizontal, delimited by a distinct, but narrow and shallow border furrow, which is more flatly curved than the anterior margin of cranidium. Preglabellar boss extremely faint, ill-defined, appearing as a slight change in convexity of the preglabellar field anteriorly and border posteriorly.

Anterior area of fixigenae wide, strongly inclined anteriorly, downsloping laterally; anterior border furrow less shallow than in front of glabella; concave anterior border slightly narrower laterally, moderately inclined. Palpebral area of fixigenae only partly preserved, of moderate convexity; palpebral lobes and furrows are not preserved, probably situated on midline across glabella; the oblique eye ridges are faint. Posterior area of fixigenae is not preserved.

Anterior sections of facial suture diverging forward, turning inward-forward at anterior border, cutting anterior margin out at sides.

The surface of the test is smooth.

Dimensions of holotype cranidium:

Length	7.0 mm
Maximum width between the eyes	about 6.5 mm
Length of glabella	3.5 mm
Width of glabella at base	3.0 —
Width of preglabellar field	0.8 —
Mesial width of anterior border	1.5 —

Horizon and locality: *Glossopleura* zone. Kap Frederik VII.

Discussion: The preglabellar morphology of the new species definitely places it among the Alokistocaridae. The wide, concave anterior border and the presence of a boss, even though faint, support a reference to *Alokistocare. Alokistocare pronum n. p.* differs from other species of this genus in the strongly inclined frontal area. It also differs in the development of the lateral glabellar furrows, the posterior pair being unusually wide. On the other hand, the differences could hardly justify a differentiation at the generic level.

Genus ***Amecephalus*** Walcott, 1924

Type species: *Ptychoparia piochensis* Walcott, partim

Howell (1959, Ptychopariinae, in Treatise on Invertebrate, Paleontology, part 0, Arthropoda 1. Univ. Kansas Press) follows Resser in regarding *Amecephalus* as a junior synonym of *Alokistocare*. However, the present writer recognizes *Amecephalus* and *Alokistocare* as distinctly separate, but closely related genera (see also Rasetti, 1951, p. 203). As pointed out by the present writer (V. Poulsen, 1958, p. 11), *Amecephalus* is generally distinguished by an essentially flat and moderately wide (sag.) anterior border, and a moderately curving anterior margin of cephalon. Characteristic of *Alokistocare* is the concave, upturned anterior border, occupying about half of the frontal area. The preglabellar boss, seen in *Alokistocare* and several other members of Alokistocaridae, is probably totally absent in *Amecephalus*. The anterior border of *Amecephalus cleora* (Walcott) (Walcott, 1917b, p. 74) is somewhat similar to that of *Alokistocare*, but the preglabellar boss is absent in the former.

Some confusion about the true nature of the genus *Amecephalus* has arisen from the fact that the specimens, originally referred to the type species, *Ptychoparia piochensis* WALCOTT, in fact represent *Alokistocare* as well? The differences were recognized by WALCOTT, but they were ascribed to the effects of individual variation, and later to the relative proportions in small and large individuals (see also STOYANOW, 1952).

It is of importance that the two genera apparently occur at separate stratigraphical levels. *Amecephalus* could well be regarded as diagnostic of the *Plagiura* — *Poliella* zone, whereas *Alokistocare* occurs predominantly in the *Glossopleura* zone and the *Bathyuriscus* — *Elrathina* zone.

Amecephalus troelseni n. sp.

Pl. 2, figs. 10–11

Holotype: Ventrally exposed cranidium (MMH no. 9309), pl. 2, figs. 10–11, herein.

Material: A ventrally exposed, somewhat fragmentary, but otherwise well-preserved cranidium.

Description: Glabella is half the length of cranidium, moderately convex in both directions, profile highest a little behind midpoint, tapering forward, softly rounded anteriorly. There are four short and wide pairs of lateral glabellar furrows, separated from axial furrows; first pair well-impressed, directed inward-forward, second pair faintly impressed, almost transverse, the two posterior pairs deeply impressed, converging backward. Occipital region is only preserved laterally; occipital furrow wide, well-impressed laterally, apparently more shallow mesially. Axial furrows and preglabellar furrow are distinct, of moderate width.

Frontal area about one-third the length of cranidium; preglabellar field wide, slightly inclined, with closely set, irregular, anastomosing caeca; anterior border about one-third the width of frontal area, flat and slightly upturned; border furrow wide and shallow, ill-defined, parallel to the flatly curved anterior margin of cranidium.

Anterior area of fixigenae wide and flat, slightly inclined, with a coarser pattern of caeca. Palpebral area of fixigenae of approximately the same width as adjacent portion of glabella, of low convexity, slightly upturned, with ill-defined caeca; palpebral lobes are not well-preserved, apparently moderately long, arcuate, situated posterior to midline across glabella, continuing forward into prominent eye ridges at almost right angles to glabella, joining glabella at first pair of lateral furrows; palpebral furrows are wide and well-impressed. Posterior area of fixigenae not entirely preserved, wide (tr.), moderately long, slightly down-sloping; posterior border furrow is deep and wide.

Anterior sections of facial suture slightly diverging forward, running almost straight to anterior border furrow, then softly curving inward-forward, cutting anterior margin well out at sides. Posterior sections of facial suture strongly diverging backward, cutting posterior margin far out at sides.

The test is smooth, apart from pattern of caeca.

Dimensions of holotype cranidium (cast):

Length	about 15.0 mm
Width at posterior margin	about 25.0 —
Maximum width between the eyes	17.0 —
Length of glabella	7.5 —
Width of glabella at base	7.0 —
Width of preglabellar field (sag.)	3.0 —
Mesial width of anterior border	2.0 —

Horizon and locality: *Plagiura — Poliella* zone. Limestone pebble, probably originating from the basal conglomerate of the *Glossopleura* zone, west of Blomsterbækken.

Remarks: Of the species referred to *Amecephalus* the new species shows greatest resemblance to *Amecephalus agnesensis* (Walcott, 1912), especially when comparing it to the cranidium of *A. agnesensis* figured by Walcott 1917b (pl. 13, figs. 5a–b). However, *Amecephalus troelseni n. sp.* differs in the more irregular caeca, in the anterior border being more upturned, the more prominent eye ridges, the glabella being softly rounded anteriorly, and finally in the greater width of the posterior area of fixigenae.

The specimen was collected from the scree, slightly below the *Glossopleura* zone level, west of Blomsterbækken. The cranidium is situated in a light-coloured limestone pebble of irregular outline, this pebble again is embedded in a darker glauconitic limestone. The lithology suggests that the rock fragment probably originated from the basal conglomerate of the *Glossopleura* zone. In another similar loose fragment from the same locality Troelsen collected the specimen of *Kochaspis? sp.* This will be discussed in more details in the stratigraphical section.

Genus ***Elrathiella*** Poulsen, 1927

Type species: *Elrathiella obscura* Poulsen

Elrathiella obscura Poulsen, 1927

1927. *Elrathiella obscura* Poulsen: Medd. om Grønland, vol. 70 (2), p. 276, pl. 17, fig. 35.

1946. *Elrathia? sp.* Poulsen: Quart. Journ. Geol. Soc. London, vol. 102, p. 316, pl. 20, fig. 4.

Holotype: Cranidium (MMH no. 2332), C. POULSEN 1927: Pl. 17, fig. 35 (the specimen to the right). Designated by V. POULSEN, herein.

Material: A number of cranidia.

Horizon and locality: *Bathyuriscus — Elrathina* zone. West of Blomsterbække; Marshall Bugt loc. 1.

Remarks: *Elrathiella* definitely belongs to the ptychopariid stock, which is characteristic of the young Middle Cambrian formations. The exact stratigraphical position of the type species, *E. obscura*, has been uncertain, as the species was originally found in a layer without any other fossils. Now, TROELSEN's collections show that *Elrathiella obscura* occurs associated with *Glyphaspis parkensis* RASETTI. Accordingly, it will be safe to refer the species to the *Bathyuriscus — Elrathina* zone.

The four millimetres long cranidium referred to *Elrathia? sp.* by C. POULSEN in 1946, should be included in *E. obscura*. The cranidium undoubtedly represents a young holaspis, but, apart from the difference in size, the cranidium is in complete agreement with the diagnosis of *E. obscura*. The specimen in question originated from the R.C.M.P. Post on Bache Peninsula. It is associated with *Blainiopsis* POULSEN, and this genus belongs to the *Bathyriscus — Elrathina* zone.

Genus ***Nanoqia*** *n. gen.*

Type species: *Nanoqia arctica n. sp.*

Diagnosis: Cranidium subquadrate. Pyriform glabella tapering forward, rounded anteriorly, highest posteriorly, dropping to very low anteriorly. Four pairs of shallow lateral glabellar furrows. Occipital ring mesially expanded. Frontal area wide (sag.), with faint indication of a boss; anterior border well-defined, wide; anterior margin strongly curved. Palpebral area of fixigenae half the width of glabella on midline; palpebral lobes situated back of midline across glabella. Anterior sections of facial suture diverging forward, then from anterior border furrow turning inward-forward. The rest of the dorsal exoskeleton is unknown.

Stratigraphical range: *Glossopleura* zone.

Discussion: *Nanoqia n. gen.* must be placed among the Alokistocaridae. This may be deduced from the features of the frontal area. The proportions of the preglabellar field and anterior border are typically alokistocarid, and this is further emphasized by the faint boss.

The cranidia cannot be referred to any of the previously known alokistocarid genera. The new genus exhibits a combination of characters from several genera, but is distinguished by possessing a strongly pyriform glabella.

The name of the genus is derived from nanoq, the eskimo name for the polar bear.

Nanoqia arctica n. sp.

Pl. 3, figs. 1–3; text-fig. 6

Holotype: Ventrally exposed cranidium (MMH no. 9310), pl. 3, figs. 1–3, herein.

Material: Two ventrally exposed cranidia, partly showing external surface.

Description: Cranidium subquadrate. The distinctly pyriform glabella is about half the length of cranidium, tapering forward, rounded anteriorly; convexity of glabella is moderate transversely, more strong sagittally, with profile highest posteriorly, dropping to very low anteriorly. Four short pairs of very shallow, but distinct lateral glabellar furrows, separated from axial furrows, third and posterior pair converging backward. Occipital ring moderately long and wide, mesially expanded, delimited by a wide and shallow occipital furrow. Axial furrows and preglabellar furrow are narrow, but well-impressed.

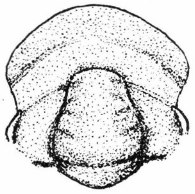

Fig. 6. Cranidium of *Nanoqia arctica n. gen. et n. sp.*

The preglabellar field is half the length of frontal area, slightly inclined, with faint and ill-defined boss; anterior border furrow is wide and shallow, mesially almost effaced on account of the boss, parallel to the anterior margin; the anterior border is half the length of frontal area, flat, with the same inclination as the preglabellar field; anterior margin of cranidium is strongly curved.

Anterior area of fixigenae wide, slightly convex, inclined, downsloping laterally. Palpebral area of fixigenae approximately half the width of adjacent portion of glabella, moderately convex; the palpebral lobes are moderately long, arcuate, situated on posterior one-third line across glabella, continuing forward into slender, arcuate and oblique eye ridges that join glabella midways between the first and second pair of lateral glabellar furrows; the palpebral furrows are wide and well-impressed.

Posterior area of fixigenae not entirely preserved, probably moderately long and wide; posterior border furrow deep and wide.

Anterior sections of facial suture diverging forward, running almost straight to anterior border furrow, crossing half of the border, then curving inward-forward, cutting anterior margin well out at sides.

The surface of the test is finely granulated.

Dimensions of holotype cranidium (cast):

Length	10.0 mm
Maximum width between the eyes	10.0 —
Length of glabella	5.0 —
Width of glabella at base	5.0 —
Width of preglabellar field	1.5 —
Mesial width of anterior border	1.5 —

Horizon and locality: *Glossopleura* zone. Kap Frederik VII.

Discussion: *Nanoqia arctica n. gen. et n. sp.* appears to be most closely related to *Kistocare* Lochman, 1948. It resembles *Kistocare* in the general shape of the cranidium, in the proportions of the frontal area, the width of the palpebral area, the position of the palpebral lobes, and finally in the surface granulation. However, the new genus differs distinctively from *Kistocare* in possessing a faint boss, and first of all in having a pyriform glabella.

Genus ***Phymaspis*** *n. gen.*

Type species: *Phymaspis dignata n. sp.*

Diagnosis: Cranidium subquadrate. Glabella tapering forward, rounded anteriorly, moderately convex in both directions, profile highest at posterior one-third line across glabella; three pairs of faint lateral glabellar furrows. Occipital ring simple. Frontal area wide, with prominent transverse boss that is half the width (tr.) of cranidium; anterior border fairly well-defined and wide; anterior margin moderately curved. Palpebral area of fixigenae half the width of glabella at midline; palpebral lobes situated posterior to midline across glabella. Anterior sections of facial suture slightly diverging forward, posterior sections strongly diverging backward. Posterior area of fixigenae moderately wide, well-furrowed. The rest of the dorsal exoskeleton is unknown.

Stratigraphical range: *Bathyuriscus* — *Elrathina* zone.

Discussion: The new genus is probably safely grouped with the *Elrathiella* — *Elrathina* stock, but differs from other members of this group and the rest of the Alokistocaridae in possessing a prominent preglabellar boss, appearing like a transverse bar. *Phymaspis n. gen.* in some respects resembles *Mexicella* Lochman, 1948 (see discussion below).

The importance of using ventral structures in the classification of trilobites was emphasized by Rasetti (1951, p. 140; 1952, pp. 885–897). The present writer is of the opinion that dorsal cephalic structures, reflecting features of the ventral side, should be considered equally important. In this connection the frontal area is of interest. The author believes that the width of the preglabellar field, the presence or absence of a preglabellar boss, notable variations in the course of anterior border furrow most likely are related to the width of the doublure, the size and shape and eventually the position of the hypostoma. Anyhow, *Phymaspis n. gen.* is well-differentiated from other Alokistocaridae on account of the transverse preglabellar boss.

Phymaspis dignata n. sp.

Pl. 3, figs. 4–6; text-fig. 7

Holotype: Fragmentary cranidium (MMH no. 9311), pl. 3, figs. 4–6, herein.

Material: A single, not wholly preserved cranidium.

Description: Cranidium is subquadrate, moderately convex both ways. Glabella is a little more than half the length of cranidium, tapering forward, rounded anteriorly, moderately convex sagittally and transversely, profile highest at posterior one-third line across glabella. Three pairs of lateral glabellar furrows converging backward, separated from axial furrows; posterior pair more deeply impressed than the two anterior pairs.

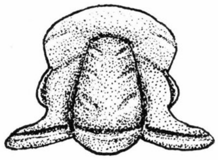

Fig. 7. Cranidium of *Phymaspis dignata n. gen. et n. sp.*

Occipital furrow is wide and well-impressed; occipital ring moderately long and wide, slightly expanded mesially. Axial furrows narrow, but deep; preglabellar furrow narrow and shallow.

Frontal area one-fourth the length of cranidium; preglabellar field is half the width (sag.) of frontal area, wholly dominated by a prominent transverse boss, which is half of cranidial width; the boss curves around the frontal lobe of glabella, almost reaching the eye ridges, mesially covering half of the anterior border, parallel to the anterior margin of the cranidium; anterior border furrow is shallow and moderately wide, becoming almost effaced when crossing the preglabellar boss; anterior border essentially flat, slightly inclined; anterior margin rather strongly curved.

Anterior area of fixigenae wide and flat, down-sloping, with faint anastomosing caeca; anterior border and border furrow well-defined. Palpebral area of fixigenae about half the width of adjacent portion of glabella, of low convexity, practically horizontal; the palpebral lobes are slightly arcuate, of medium length, situated a little behind midline across glabella, continuing forward into slender, slightly arcuate and oblique eye ridges that join glabella at the first pair of lateral glabellar furrows; the palpebral furrows are narrow, moderately impressed. Posterior area of fixigenae moderately long and wide, down-sloping laterally; posterior border furrow is deep and wide.

Anterior sections of facial suture slightly diverging forward, running almost straight to anterior border furrow, then turning strongly inward-forward, cutting anterior margin not far out at sides. Posterior sections of common type.

The surface of the test, apart from the faint caeca, is quite smooth.

Dimensions of holotype cranidium:

Length	5.0 mm
Width at posterior margin	7.0 —
Maximum width between the eyes	4.5 —
Length of glabella	3.0 —
Width of glabella at base	2.5 —
Width of preglabellar field	0.5 —
Mesial width of anterior border	0.7 —
Length (tr.) of preglabellar boss	3.0 —
Width (sag.) of preglabellar boss	0.8 —

Horizon and locality: *Bathyuriscus — Elrathina* zone. Marshall Bugt loc. 1.

Discussion: The transverse preglabellar boss, occupying half of the cranidial width, is the outstanding feature of *Phymaspis dignata n. gen et n. sp.* A somewhat similar type of boss is demonstrated by *Mexicella* LOCHMAN, 1948. In *Mexicella*, according to LOCHMAN, the frontal median bulge is apparently caused by an increase in convexity of one part of the frontal area. The bulge is absent in immature cranidia and very inconspicuous in *Mexicella stator* (WALCOTT). In other respects the new genus differs from *Mexicella* in having a wider anterior border and a more moderately curved anterior margin of cranidium. The two genera occur at separate stratigraphical levels. Whether *Phymaspis* *n. gen.* is more closely related to *Mexicella* than to other members of Alokistocaridae cannot be ascertained.

Superfamily **Crepicephalacea** KOBAYASHI, 1935

Family Crepicephalidae KOBAYASHI, 1935

Genus ***Kochaspis*** RESSER, 1935

Type species: *Crepicephalus liliana* WALCOTT

Kochaspis? sp.

Pl. 3, fig. 7

Material: A single external mould of a fragmentary pygidium (MMH no. 9312).

Description: The axis is slightly tapered, occupying four-fifths of the pygidial length, with rounded terminal axial piece, width a little less than one-third of pygidial width at anterior margin; there are five axial rings, defined by wide and well-impressed furrows. Axial furrows wide and shallow. Pleural fields of low convexity, slightly down-sloping; the interpleural furrows become increasingly faint posteriorly. The border furrow is obsolete; the border is without traces of segmentation, flat, slightly down-sloping at the posterior margin, otherwise horizontal. The border is narrow anteriorly, from midline across axis widening, extended into a pair of flat, long and wide spines that curve outward-backward and then inward-backward. Posterior margin between spines straight.

Dimensions of pygidium (cast):

Length	5.0 mm
Width at anterior margin	8.0 –
Maximum width (at posterior margin)	11.0 –
Width of axis at anterior margin	2.5 –

Horizon and locality: *Plagiura* — *Poliella* zone. From loose rock fragment, collected slightly below the *Glossopleura* zone level, at the locality west of Blomsterbækken

Remarks: It is a characteristic feature in *Kochaspis* that the pleurae continue in the border, turning backward and thereby forming the spines. The pygidium from Blomsterbækken does not show any indication of pleural structures passing onto the border. The absence of these structures may well be related to the state of preservation. Apart from this, the pygidium differs from all known species of *Kochaspis* in the development of the spines.

It shows some resemblance to the pygidium of *Kochaspis maladensis* RESSER, 1939 (p. 57, pl. 13, figs. 9–12), but differs in having a more slender axis, a more prominent border, a straight posterior margin, and more arcuate spines, which originate more anteriorly.

The nature of the pygidium does not permit a reliable generic reference. Probably the pygidium belongs to *Kochaspis*, although there is a possibility of referring it to an eventual, closely related form, substituting *Kochaspis*. In any event it probably belongs to the same stratigraphical level as *Fieldaspis sp.* and *Amecephalus troelseni n. sp.* The loose specimen originates from the same locality, and, to the author, it surely represents a lower Middle Cambrian type. This will be more thoroughly discussed in the stratigraphical section.

Superfamily **Solenopleuracea** ANGELIN, 1854

Family Solenopleuridae ANGELIN, 1854

Genus ***Solenopleurella*** POULSEN, 1927

Type species: *Solenopleurella ulrichi* POULSEN

Solenopleurella ulrichi POULSEN, 1927

1927. *Solenopleurella ulrichi* POULSEN: Medd. om Grønland, vol. 70(2), p. 269, pl. 16, fig. 36.

Holotype: Cranidium (MMH no. 2291), C. POULSEN 1927: Pl. 16, fig. 36. Designated by V. POULSEN, herein.

Material: A single, well-preserved cranidium.

Horizon and locality: *Glossopleura* zone. West of Blomsterbækken.

Remarks: The species was based on a single cranidium, two millimetres long and three millimetres wide. The supplementary cranidium from TROELSEN's collections is of the same size, and the species is probably rather small.

Superfamily **Anomocaracea** POULSEN, 1927

Family Anomocaridae POULSEN, 1927

Genus ***Glyphaspis*** POULSEN, 1927

Type species: *Asaphiscus? capella* WALCOTT

TROELSEN's material seems to indicate that the genus is restricted to the *Bathyuriscus* — *Elrathina* zone.

Glyphaspis parkensis Rasetti, 1951

Pl. 3, figs. 8–9

1951. *Glyphaspis parkensis* Rasetti: Smithsonian Misc. Colls., vol. 116(5), p. 224, pl. 34, figs. 5–7.

Material: Numerous cranidia and pygidia, partly as moulds.

Horizon and locality: *Bathyuriscus* — *Elrathina* zone. West of Blomsterbækken; Marshall Bugt loc. 1; Kap Frederik VII.

Remarks: It is interesting to see that a Cordilleran species occurs abundantly in Northwest Greenland. The specimens match perfectly Rasetti's description. The genal caeca are characteristic, much more conspicuous than in *Glyphaspis perconcava* Poulsen. The latter is also a dominant species in Northwest Greenland. The two species are easily separated, as the pygidium of *Glyphaspis perconcava* differs in having a shallow marginal indentation behind the axis; the cranidium differs in being narrower, and the frontal area shorter than in *Gl. parkensis*. Apart from this there seems to be a difference in size, the cranidia and pygidia of *Glyphaspis parkensis* being on the average twice the size of those of *Gl. perconcava.*

Rasetti's specimens of *Glyphaspis parkensis* are somewhat distorted and flattened, whereas the material from Northwest Greenland is less affected. Evidently there is some variation in the width-length ratio of the pygidia, as it appears from the specimens, figured by Rasetti. It should be noted that the frontal lobe of glabella may be less truncate than described by Rasetti. Only some of the present writer's specimens show this feature; others exhibit a more rounded frontal lobe of glabella.

Glyphaspis parkensis occurs together with *Gl. perconcava*, *Acrocephalops gibber* Poulsen, *Blainiopsis holtedahli* Poulsen, and other forms belonging to the *Bathyuriscus* — *Elrathina* zone.

Glyphaspis perconcava Poulsen, 1927

1927. *Glyphaspis perconcava* Poulsen: Medd. om Grønland, vol. 70(2), p. 273, pl. 17, figs. 3–4.

Holotype: Cranidium (MMH no. 2301), C. Poulsen 1927: Pl. 17, fig. 3. Designated by V. Poulsen, herein.

Material: Numerous cranidia and pygidia.

Horizon and locality: *Bathyuriscus* — *Elrathina* zone. West of Blomsterbækken; Marshall Bugt loc. 1; Kap Frederik VII.

Remarks: In a majority of samples this species occurs associated with *Acrocephalops gibber* Poulsen, and it is also commonly seen together with *Glyphaspis parkensis* Rasetti and *Blainiopsis* Poulsen.

In 1927 C. POULSEN established the species on scarce material collected in boulders at Kap Frederik VII. On account of the lithology the samples were believed to have originated from the level of the *Glossopleura* assemblage. However, it is quite evident from TROELSEN's material that Glyphaspis does not occur together with the *Glossopleura* fauna. In fact all the limestone types of the *Glossopleura* zone may be encountered in the *Bathyuriscus—Elrathina* zone. At that time C. POULSEN could not do otherwise considering the available data. This was unfortunate, as proper information as to the exact vertical range of some of the genera would have been useful for the correlation of Middle Cambrian faunas.

The two species of *Glyphaspis* occurring in Northwest Greenland are readily distinguished, as mentioned when discussing *Gl. parkensis*.

Superfamily **Asaphiscacea** RAYMOND, 1924

Family Asaphiscidae RAYMOND, 1924

Genus ***Blainiopsis*** POULSEN, 1946

Type species: *Blainiopsis holtedahli* POULSEN

Blainiopsis holtedahli POULSEN, 1946

1913. *Ptychoparia sp.* HOLTEDAHL: Rep. Second Norw. Arc. Exp. "Fram" 1898–1902, no. 28, pl. 4, fig. 2.

1946. *Blainiopsis holtedahli* POULSEN: Quart. Journ. Geol. Soc. London, vol. 102, p. 312, pl. 19, figs. 10–15.

Material: A few cranidia, thoracic segments.

Horizon and locality: *Bathyuriscus — Elrathina* zone. West of Blomsterbækken; R. C. M. P. Post on Bache Peninsula.

Remarks: *Blainiopsis* occurs west of Blomsterbækken in a layer also containing *Glyphaspis parkensis* RASETTI. Accordingly, the *Blainiopsis* zone of C. POULSEN may be correlated with the *Bathyuriscus — Elrathina* zone or part hereof.

Blainiopsis benthami POULSEN, 1946

1913. ?*Ptychoparia sp.* HOLTEDAHL: Rep. Second Norw. Arc. Exp. "Fram" 1898–1902, no. 28, pl. 4, fig. 3.

1946. *Blainiopsis benthami* POULSEN: Quart. Journ. Geol. Soc. London, vol. 102, p. 314, pl. 19, fig. 16 and pl. 20, figs. 1–2.

Material: A few cranidia.

Horizon and locality: *Bathyuriscus — Elrathina* zone. West of Blomsterbækken.

Remarks: Same occurrence as *Blainiopsis holtedahli*.

Superfamily **Norwoodiacea** WALCOTT, 1916

Family Bolaspididae HOWELL, 1959

Genus ***Acrocephalops*** POULSEN, 1927

Type species: *Acrocephalops gibber* POULSEN

Acrocephalops was established on the basis of a couple of extremely characteristic cranidia, collected from loose boulders at Kap Frederik VII, and supposed to have originated from the *Glossopleura* level. However, TROELSEN's material clearly demonstrates that the genus, which is common, does not belong to the *Glossopleura* assemblage. *Acrocephalops* is associated with *Glyphaspis parkensis* RASETTI and *Gl. perconcava* POULSEN.

The diagnostic feature in *Acrocephalops* is the frontal area morphology. *Acrocephalops* possesses a well-defined, prominent preglabellar boss, around which the narrow anterior border makes a forward turn.

RESSER (1935, p. 3) erroneously reduced the characters of the anterior border to be of importance only at the specific level, and three southern Appalachian species with evenly curved anterior borders were included in the genus. The procedure has had unfortunate consequences. HUTCHINSON (1952, p. 100), when describing an Atlantic fauna from Cape Breton Island, referred one of the species to *Acrocephalops*. He realized that if the forward bend of the anterior border in front of glabella was generically diagnostic, the Cape Breton species would have to be excluded from the genus. HUTCHINSON favoured RESSER's viewpoint, and *Acrocephalops matthewi* was erected. As this would be the only genus in the assemblage with affinities to the Pacific province, a closer analysis of the species should have been made.

HUTCHINSON's species differs from the type species, *Acrocephalops gibber*, in possessing a uniform, evenly curved anterior border without a forward bend. It further differs in having a well-impressed anterior border furrow of varying depth in contrast to the uniformly shallow furrow in *Acrocephalops gibber*. In the Cape Breton species the preglabellar boss is laterally bordered by two shallow furrows that extend forward-outward from the antero-lateral corners of glabella. This feature is absent in the type species. The palpebral lobes in *Acrocephalops gibber* are situated more posteriorly.

In the present writer's opinion the Cape Breton species may safely be excluded from *Acrocephalops*.

LOCHMAN & WILSON (1958, p. 325) did not question the reference of the Cape Breton species to *Acrocephalops* and stated that "the early appearance of *Acrocephalops* suggests that it is not correctly placed in the Bolaspididae". As it now has been proved that the type species occurs exclusively in the *Bathyuriscus — Elrathina* zone, a reference to the Bolaspididae is quite reasonable.

Acrocephalops gibber POULSEN, 1927

1927. *Acrocephalops gibber* POULSEN: Medd. om Grønland, vol. 70(2), p. 275, pl. 17, figs. 1–2.

Holotype: Cranidium (MMH no. 2300), C. POULSEN 1927: Pl. 17, fig. 2. Designated by V. POULSEN, herein.

Material: Numerous cranidia.

Horizon and locality: *Bathyuriscus — Elrathina* zone. West of Blomsterbækken; Marshall Bugt loc. 1; Kap Frederik VII.

Remarks: *Acrocephalops gibber* occurs associated with *Glyphaspis parkensis* and *Gl. perconcava.* It has not been possible to assign any pygidium to the species, and the genus very likely is micropygeous.

Superfamily and family uncertain

Genus ***Fastigaspis*** *n. gen.*

Type species: *Fastigaspis princeps n. sp.*

Diagnosis: Cranidium ptychopariid. Glabella tapering forward, rounded anteriorly, moderately convex, profile highest at midpoint; three pairs of short and shallow lateral glabellar furrows. Occipital ring mesially expanded, drawn into a pointed node. Frontal area wide, totally dominated by the flat anterior border, which has a backward bend in front of glabella, and which is anteriorly projected into a short, rounded spine or process; border furrow is wide and moderately deep laterally, mesially narrow and shallow, coincident with the preglabellar furrow; anterior margin of cranidium slightly concave on both sides of anterior process. Palpebral area of fixigenae half the width of adjacent portion of glabella; palpebral lobes situated slightly behind midline across glabella; eye ridges oblique. Posterior area of fixigenae well-furrowed, moderately long and wide. Anterior sections of facial suture slightly diverging forward, from the middle of anterior border turning inward-forward. The rest of the dorsal exoskeleton is not known. The surface of the test is provided with scattered, coarse granules.

Stratigraphical range: *Bathyuriscus — Elrathina* zone.

Discussion: On account of its significant preglabellar morphology *Fastigaspis n. gen.* cannot as yet be placed in any of the existing Middle Cambrian trilobite families. It represents a definitely young type, which was to become very common in Upper Cambrian faunas. On the basis of the general morphology the new genus might be referred to the Dokimocephalidae, and in that case it would be most closely related to *Dokimocephalus* WALCOTT, 1924, and *Burnetiella* LOCHMAN, 1958. However, *Fastigaspis n. gen.* differs distinctively from the members of this family in possessing a reduced preglabellar field, caused by the backward expanded anterior border. Furthermore the members of the Dokimocephalidae make their first appearance at the Franconian stage, evidently as a result of an evolutionary burst in response to critical biofacies changes. Accordingly, a relationship between the new genus and the Dokimocephalidae would seem rather unlikely.

The new genus might have crepicephalid affinities. Unfortunately the pygidium is unknown. The occurrence of *Kochaspis? sp.* earlier in the sequence in Northwest Greenland might suggest the presence of a crepicephalid stock all through the Middle Cambrian, but the available material does not permit any conclusions with regard to this possibility.

The appearance of a young type like *Fastigaspis n. gen.*, definitely alien to the *Bathyuriscus* — *Elrathina* assemblage, possibly indicates that some changes in biofacies had already begun in areas outside Northwest Greenland.

Fastigaspis princeps n. sp.

Pl. 3, figs. 10–16; text-fig. 8

Holotype: Cranidium (MMH no. 9317), pl. 3, fig. 14, herein.

Material: A single cranidium, and a number of badly preserved cranidia, embedded in arenaceous limestone.

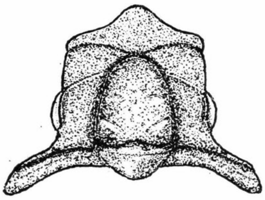

Fig. 8. Cranidium of *Fastigaspis princeps n. gen. et n. sp.*

Description: Cranidium ptychopariid, anteriorly acute. Glabella is moderately convex both ways, three-fifths of the cranidial length, tapering forward, softly rounded anteriorly, profile highest at midpoint. There are three short and shallow pairs of lateral glabellar furrows, separated from axial furrows; anterior pair is directed inward-forward, second pair transverse, posterior pair directed inward-backward, more deeply impressed than the other pairs. The occipital ring is moderately long and wide, mesially expanded and drawn into a pointed node; occipital furrow narrow laterally and deeply impressed, mesially expanded and more shallow. Axial furrows are wide and deeply impressed; preglabellar furrow is narrow and shallow.

Frontal area mesially wide, wholly dominated by the flat anterior border, which has a backward bend in front of glabella, and which is anteriorly projected into a short, rounded spine or process; anterior border furrow is wide and moderately deep laterally, mesially narrow and shallow, coincident with the preglabellar furrow; the anterior margin of the cranidium is somewhat concave on both sides of the anterior process.

Anterior area of fixigenae wide and convex, inclined; anterior border furrow well-impressed; anterior border is flat, abaxially tapering. Palpebral area of fixigenae half the width of adjacent portion of glabella, more strongly convex exsagittally than transversely; palpebral lobes are moderately long, arcuate, situated slightly behind midline across glabella, anteriorly continuing into prominent, oblique eye ridges, which join glabella at the first pair of lateral glabellar furrows; palpebral furrows wide and shallow. Posterior area of fixigenae moderately long and wide, laterally curving slightly backward; the posterior border furrow is wide and well-impressed.

Anterior sections of facial suture slightly diverging forward, turning inward-forward at anterior border; posterior sections of facial suture strongly diverging backward; approximately parallel to the posterior margin of the cranidium, from posterior border furrow curving backward, cutting posterior margin well out at sides.

The surface of the test is provided with scattered, coarse granules.

Dimensions of largest cranidium (cast):

Length		14.0	mm
Width at posterior margin	about	22.0	–
Maximum width between the eyes		15.0	–
Length of glabella		9.0	–
Width of glabella at base		7.0	–
Mesial width of anterior border		4.0	–

Horizon and locality: *Bathyuriscus — Elrathina* zone. Kap Frederik VII.

Remarks: As mentioned above, the generic relationships of *Fastigaspis n. gen.* are unknown. It occurs in samples together with *Glyphaspis perconcava.*

The occipital node is inconspicuous in young holaspides (see the holotype).

LOWER- AND MIDDLE CAMBRIAN STRATIGRAPHY OF NORTHWEST GREENLAND

Summary of previous work

When the Lower- and Middle Cambrian faunas in Northwest Greenland were first described by C. POULSEN in 1927, only little was known about their stratigraphical position and their affinities to other faunas. Later, C. POULSEN (1946, 1958) and TROELSEN (1940, 1950, 1956), and recently COWIE (1961) have added to the knowledge of the Lower- and Middle Cambrian formations and their faunas.

The fauna of the Lower Cambrian Wulff River formation, underlying the Cape Kent limestone, has been described by C. POULSEN (1927, 1946, and 1958) and will not be further discussed in the present paper.

The original material was collected by Dr. LAUGE KOCH under extremely difficult conditions. The Lower Cambrian material from the Cape Kent limestone, described by C. POULSEN in 1927, was collected from the fine section at Kap Kent. Despite the limited number of genera present in the limestone C. POULSEN was able to conclude that the Cape Kent formation should be correlated with the Mt. Whyte formation of British Columbia and Alberta. The Middle Cambrian material consisted partly of samples from the lower part of the Cape Wood formation and partly of loose, fossiliferous rock fragments, collected on the beach at Kap Frederik VII. The upper part of the section here was inaccessible, as the coastal cliffs are vertical. However, the upper part was apparently lithologically different from the lower part, and, accordingly, loose rock fragments of a type similar to that of the upper part, collected on the beach, were ascribed to the upper horizons. C. POULSEN correlated the Cape Wood formation with the Cordilleran Stephen formation. On top of the Cape Wood formation followed the Pemmican River formation and the Cape Frederik VII formation, which were supposed to be of Upper Cambrian or Ozarkian age. The Pemmican River formation contains only specimens of *Elrathiella*, the affinities of which were unknown. The Cape Frederik VII formation was characterized by *Prosymphysurus*, *Ptychoparella*, and *Clavaspidella*; these genera were all collected from loose rock fragments.

KOBAYASHI (1936) described a Lower Cambrian fauna from the Mackenzie district of Canada. In the fauna *Dolichometopsis* and *Chancia* were represented. The *Chancia* horizon and the *Dolichometopsis* horizon of the Mackenzie Valley were correlated with the Cape Kent limestone in Inglefield Land and the upper Mt. Whyte formation in British Columbia. As demonstrated earlier in the present paper (p. 12), KOBAYASHI's species of *Dolichometopsis* may have to be excluded from the genus.

In 1939–1940 TROELSEN, a member of the Danish Thule Ellesmere Land Expedition, collected additional material. In a preliminary report (1940) he stated that the uppermost part of the Cape Kent limestone at Marshall Bugt is developed as a brownish, non-oolitic limestone representing a littoral facies, which most likely is absent at Kap Kent. On Bache Peninsula a sequence of unfossiliferous, oolitic limestone, underlying the *Glossopleura* zone beds, was correlated with the Cape Kent limestone. He also stated that in Inglefield Land there seemed to be a gradual transition from the *Glossopleura* beds to the layers containing *Blainiopsis*. The Middle Cambrian sequence varies in vertical and horizontal direction, consisting of glauconitic and quartzose limestone, and massive or thin-bedded limestone. The Cape Wood formation was divided into a *Glossopleura* zone and a younger *Blainiopsis* zone.

In 1946 C. POULSEN described material from Bache Peninsula, collected by BENTHAM on the Oxford University Expedition to Ellesmere Land 1934–1935. He recognized TROELSEN's correlation of the unfossiliferous, oolitic limestone with the Cape Kent limestone. The Middle Cambrian Cape Wood formation in Ellesmere Land and in Northwest Greenland was divided into three zones: The *Glossopleura* zone, the *Elrathiella* zone, and at the top the *Blainiopsis* zone. *Clavaspidella* had previously been found associated with *Glossopleura*, and, accordingly, the Cape Frederik VII formation was referred to the Middle Cambrian, clearly representing an equivalent to part of the Stephen formation (RESSER, 1935, p. 20). The Pemmican River formation was not found on Bache Peninsula. *Elrathiella*, the sole genus in this formation in Inglefield Land, was believed to range from late Middle Cambrian to early Upper Cambrian. WHITEHOUSE (1939) had already described species of *Elrathiella* from the Upper Cambrian Pituri sandstones of Queensland, Australia. He considered the "*Elrathiella* stage" as approximately equivalent to the *Orusia lenticularis* zone. TROELSEN, however, was of the opinion that the level of the Pemmican River formation (the *Elrathiella* horizon) in Northwest Greenland must be found between the *Glossopleura* horizon and the *Blainiopsis* horizon.

In 1950 TROELSEN reported that the fossils in the Cape Kent limestone are generally only visible on weathered surfaces. Most of the collection therefore had been secured from talus blocks, and, accordingly, it has not been possible to determine, whether more than one faunule was represented within the formation. As to the Middle Cambrian he concluded that the strata in Northwest Greenland and on Bache Peninsula should be regarded as only one formation with two members. The Cape Wood formation thus consisted of the Cape Russel member (including the *Glossopleura* horizon and the *Elrathiella* horizon of C. POULSEN) and the Blomsterbæk limestone member, which was equivalent to C. POULSEN's *Blainiopsis* horizon. The lower and upper contacts of the formation, and also of the members, were well-defined and marked by simple disconformities. After a detailed description of the sections at the different localities TROELSEN was able to demonstrate that the Pemmican River formation and the Cape Frederik VII formation would have to be abandoned.

KURTZ, MCNAIR & WALES (1952) described the Cambro-Ordovician section on the southeastern coast of Devon Island, Arctic archipelago. The *Olenellus* and *Dolichometopsis* faunas in that area are evidently separate. Thus the Rabbit Point sandstone contains olenellids, and the lower part of the Bear Point limestone, on account of *Dolichometopsis*, was correlated with the Cape Kent limestone in Inglefield Land and on Bache Peninsula. According to KURTZ, MCNAIR & WALES the fauna in the lower part of the Bear Point limestone also contains representatives of the *Albertella* zone of LOCHMAN, 1948. Unfortunately they did not list the genera from the limestone. They concluded that the Cape Kent limestone should be referred to the late Lower Cambrian and early Middle Cambrian. That part of the Bear Point limestone overlying the *Dolichometopsis* horizon was reported to contain members of the *Glossopleura* zone fauna. It is interesting that the Bear Point limestone contains numerous thin, flat pebble conglomerates and clastic zones indicating a shallow water environment of deposition with numerous periods of non-deposition.

In 1956 TROELSEN maintained the Lower Cambrian age of the Cape Kent limestone and also the division of the Cape Wood formation into two members, as defined in 1950.

COWIE (1961) discussed the fauna of the Cape Kent limestone and concluded, contrary to KURTZ, MCNAIR & WALES, that the limestone formation belonged entirely to the Lower Cambrian. He also reported that *Poulsenia* occurs in the upper part of the Ella Island formation in Central East Greenland and concluded that the upper part of this formation is equivalent in age to the Cape Kent limestone and that both represent the younger part of the Upper Olenellus subzone of the Lower Cambrian. The Wulff River formation, underlying the Cape Kent limestone, was supposed to be equivalent to the lower part of the Ella Island formation and part of the Bastion formation. As to the Middle Cambrian, COWIE's investigations further confirmed that the unstable conditions during sedimentation affected the entire region.

Fauna of the Lower Cambrian Cape Kent limestone

The thickness of the Cape Kent limestone varies between 10 and 20 metres, and the faunal evidence seems to indicate that only one faunule is present in the sequence. The fauna of the limestone comprises following species:

Bristolia groenlandica
— *kentensis*
Dolichometopsis resseri
— *septentrionalis*
Hyolithes poulseni
Inglefieldia affinis
— *inconspicua*
— *porosa*
— *venulosa*
Kochiella arcana
— *gracilis*
— *tuberculata*
— *sp.*
Olenellid genera and spp. indet.
Poulsenia groenwalli

The total number of determinable genera is six, of which only *Hyolithes* and *Bristolia* are known with certainty outside of Greenland. However, *Kochiella* might be expected to occur in some Lower Cambrian faunas in North America.

The author believes that the fauna of the Cape Kent limestone formation was possibly only in the early stages communicated with the Cordilleran faunas. The basin subsequently became isolated, and an endemic, cratonic fauna evolved. Thus *Poulsenia* is probably a descendant of *Inglefieldia.* It is very interesting that COWIE (1961, p. 25) reported the occurrence of *Poulsenia* in the upper part of the Ella Island formation. If the assignment to *Poulsenia* is correct, then communication between Northwest Greenland and Central East Greenland must still have existed at the time of the Cape Kent limestone.

The assignment by KURTZ, MCNAIR & WALES of the Cape Kent limestone to the late Lower Cambrian and early Middle Cambrian is evidently quite unwarranted. In Inglefield Land the olenellid genera and non-olenellid genera occur together, as originally stated by C. POULSEN.

Cowie (1961) reaffirmed the Lower Cambrian age of the Cape Kent limestone.

C. Poulsen (1932) believed that the Cape Kent limestone corresponded to a hiatus in the East Greenland sequence above the level of the Ella Island formation. C. Poulsen (1932, 1956) and Troelsen (1956) tentatively correlated the Wulff River formation with the Ella Island formation, supposedly only slightly younger than the Bastion formation, as these formations apparently had several species in common. The present writer believes that Cowie correctly correlated the Cape Kent limestone with the upper part of the Ella Island formation, and the Wulff River formation with the lower part of the Ella Island formation and part of the Bastion formation.

The Cape Kent limestone supposedly belonged to the Upper *Olenellus* subzone in the Pacific standard section, and the Wulff River formation was placed in the Lower *Olenellus* subzone.

By the association of olenellid and non-olenellid genera the Cape Kent limestone may safely be referred to the Upper Olenellus subzone. C. Poulsen (1958) demonstrated that two distinct faunules might possibly be represented in the Wulff River formation. Thus it is possible that this formation belongs partly to the Upper — and partly to the Lower *Olenellus* subzone, in which case the upper part of the Wulff River formation might be correlated with the lower part of the Ella Island formation in East Greenland, and the lower part of the Wulff River formation with the upper part of the Bastion formation.

Middle Cambrian faunas in Northwest Greenland

General statement

In 1927 C. Poulsen made a comparison between the fauna of the Cape Wood formation and the Stephen formation mainly based on the genera *Glossopleura* and *Glyphaspis*. Walcott in a series of publications had previously described Middle Cambrian Cordilleran faunas. Later work by Resser, Deiss, Lochman, Howell, Rasetti, and others has confirmed that the Northwest Greenland fauna is most closely related to the Cordilleran faunas. In this respect the Middle Cambrian of Alberta and British Columbia, as described by Rasetti (1951), is of special importance.

Troelsen's material was collected from well exposed sections through the sequence. A few specimens collected from loose rock fragments will be carefully discussed. Apparently the fossils are concentrated at distinctly separate levels, and additional collections would undoubtedly result in an increase in the number of species, but, unfortunately, this region is rather inaccessible.

The material may readily be divided into two main faunas belonging to the *Glossopleura* zone and to the *Bathyuriscus — Elrathina* zone. A tentative distinction between faunules is presented below. Text fig. 9 shows a table of the divisions of the Northwest Greenland Middle Cambrian.

Fauna of the *Plagiura-Poliella* zone

The basal conglomerate of the Cape Wood formation follows on top of the Lower Cambrian Cape Kent formation. The conglomerate contains elements of the *Glossopleura* assemblage. At the locality west of Blomsterbækken three species require special attention. Here, 110 metres above sea level, at the lowermost level where *Glossopleura* elements occur, a specimen of *Fieldaspis sp.* was collected. A loose pebble containing *Amecephalus troelseni n. sp.* was collected at the same level. Still at the same locality, 40 metres above sea level, a loose rock fragment with *Kochaspis? sp.* was found.

Evidently the three species do not belong in the *Glossopleura* assemblage. The appearance of the rock samples, in which the three specimens are embedded, suggests that they most likely originated from the basal conglomerate of the *Glossopleura* zone. The specimens are embedded in flat, angular pebbles of a dense grayish limestone, which in turn is embedded in a glauconitic and quartzose limestone. This is the only locality, at which fauna elements, supposedly older than the *Glossopleura* fauna, have been found. At Blomsterbækken, according to TROELSEN (1950, p. 44), the Lower Cambrian Cape Kent limestone is overlain by 20 metres of gray or greenish sandstone with poorly preserved fossils. The sandstone passes gradually into the overlying limestone in which the *Glossopleura* fauna appears. At the other localities the *Glossopleura* elements are found in the basal layers following immediately on top of the Cape Kent limestone. TROELSEN describes the basal *Glossopleura* bed at the locality west of Blomsterbækken as a flaggy or thin-bedded, somewhat arenaceous, gray limestone. In the present writer's opinion the basal *Glossopleura* bed at this locality is conglomeratic. The conglomeratic structure of the bed is obscured by the pronounced irregularities in the overlying sediments.

The above statements favour the following conclusions: The calcareous sandstone overlying the Cape Kent limestone at Blomsterbækken might well be of early Middle Cambrian age. The specimens of *Fieldaspis Amecephalus*, and *Kochaspis?* suggest the former presence of the *Plagiura — Poliella* zone. Part hereof must have been developed as a gray dense limestone. The thickness of the beds was supposedly inconsiderable. The *Plagiura — Poliella* zone may also have been present at other localities, but during the break in sedimentation, corresponding to the

Albertella zone, it may have been removed by erosion leaving only a few remnants to be included in the transgressional conglomerate of the *Glossopleura* zone at Blomsterbækken.

In the author's opinion the reference of the specimen to *Fieldaspis* is definitely valid. All evidence seems to indicate that this genus is restricted to the *Plagiura* — *Poliella* zone. The pygidium of *Kochaspis? sp.* is only referred to this genus with reservation. Characteristic for the pygidium of *Kochaspis* are the broad pleurae curving back into base of the spines. This feature, perhaps due to the bad state of preservation, cannot be observed in the external pygidial mould found at Blomsterbækken. On the other hand it might belong to a closely related genus substituting *Kochaspis*, as in the case of *Clavaspidella* substituting the Cordilleran *Athabaskia.*

In Alberta and British Columbia, according to RASETTI (1951, p. 92), *Kochaspis* is apparently restricted to the *Plagiura* — *Poliella* zone. In general the genus is supposed to range through most of the Middle Cambrian, but a revision would very likely show that *Kochaspis* is restricted to the early Middle Cambrian. The exact vertical range of *Amecephalus* has not been established, but the genus evidently culminated at the time of the *Plagiura* — *Poliella* zone.

It seems reasonably safe to conclude that the specimens of *Fieldaspis*, *Amecephalus*, and *Kochaspis?* must be remnants of the *Plagiura* — *Poliella* zone. The following hiatus ranges from the *Plagiura* — *Poliella* zone to the lower part of the *Glossopleura* zone. In Alberta and British Columbia the fossiliferous beds of the *Albertella* zone are separated from the *Plagiura* — *Poliella* zone by a considerable sequence of unfossiliferous limestone or dolomite, and, as might be expected, the *Albertella* zone has only few elements in common with the *Plagiura* — *Poliella* zone.

No specimens referable to genera diagnostic of the *Albertella* zone have been found, and this zone was probably never developed in Northwest Greenland.

Fauna of the *Glossopleura* zone

The presence of the *Glossopleura* zone has been known for a long time, but the true nature of the assemblage has been obscured by the fact that a number of species have been erroneously referred to this zone. When TROELSEN in 1950 divided the Cape Wood formation into two members, these were well-defined, separated by a break in sedimentation and a thin basal conglomerate. The basal Cape Russell member supposedly corresponded to the *Glossopleura* zone, and the overlying Blomsterbæk limestone member to C. POULSEN's *Blainiopsis* zone, which was believed to be of younger Middle Cambrian age.

A careful study of the vertical distribution of the species in the sections has convinced the author that the boundary between the *Glossopleura* zone and the *Bathyuriscus — Elrathina* zone is to be found within the Cape Russell member. This is supported by the association of genera and their vertical distribution in the Cordilleran region. In this connection the abundantly occurring *Glyphaspis parkensis* RASETTI is of special interest. This species is found associated with *Glyphaspis perconcava*, *Elrathiella*, *Acrocephalops*, *Blainiopsis* and others, at levels definitely separate from levels containing the *Glossopleura* fauna.

As known at present the *Glossopleura* fauna comprises the following species:

Alokistocare pronum n. sp.	*Clavaspidella* faunule
? *Amecephalina mirabilis*	
Clavaspidella ovaticauda n. sp.	
— *platyrrhina*	
— *quinquesulcata*	
— *sinupyga*	
? *Kootenia obliquespina*	
Nanoqia arctica n. gen et n. sp.	
Prosymphysurus kochi	
Glossopleura expansa	*Glossopleura* faunule
— *sulcata*	
— *teres n. sp.*	
— *walcotti*	
Kootenia resseri	
Polypleuraspis solitaria	
Poulseniella crassilimbata	
— *groenlandica n. gen. et n. sp.*	
Ptychoparella brevicauda	
Solenopleurella ulrichi	

Some of the species listed above are not represented in TROELSEN's material. *Amecephalina*, *Kootenia obliquespina*, *Clavaspidella platyrrhina*, *Cl. quinquesulcata*, *Glossopleura sulcata*, and *Poulseniella crassilimbata*, all described by C. POULSEN in 1927, were found in loose boulders. *Poulseniella crassilimbata* and the two mentioned species of *Clavaspidella* may safely be referred to the faunules on account of their association with other species of the same genera. *Amecephalina* and *Kootenia obliquespina* are tentatively placed in the *Clavaspidella* faunule.

LOCHMAN & WILSON (1958, p. 325) refer to *Dorypyge* as an exclusively arctic genus appearing in the *Glossopleura* assemblage from Northwest Greenland. However, *Dorypyge* does not occur in this region. As a result of revision (Resser, 1937) all the specimens are now referred to *Kootenia.*

Several of the listed genera are most likely restricted to Northwest Greenland.

The *Glossopleura* faunule

The distribution of species within the *Glossopleura* zone indicates that two faunules may be distinguished.

The basal *Glossopleura* faunule contains predominantly only two genera: *Glossopleura* and *Polypleuraspis. Glossopleura* in several samples occurs associated with *Polypleuraspis* and in one instance with *Ptychoparella.* On Bache Peninsula pygidia of *Kootenia resseri* have been found in this faunule. *Kootenia*, *Ptychoparella*, *Poulseniella*, and *Solenopleurella* are extremely scarce, whereas *Glossopleura* and *Polypleuraspis* are abundant.

Glossopleura and *Polypleuraspis*, according to Rasetti (1951, p. 98), alone constitute the fauna of the *Glossopleura* zone in Alberta and British Columbia. It is possible that only the lower part of the *Glossopleura* zone is represented in that region. In this connection it is interesting to note that Rasetti (1951, p. 108) suggested that an unconformity was present within the Stephen formation in the region.

In Northwest Greenland the beds with the *Glossopleura* faunule are developed at Kap Frederik VII, at Marshall Bugt loc. 2, at Blomsterbækken, and are also found at Bache Peninsula. The faunule is missing, or has been overlooked, at Marshall Bugt loc. 1 (see also the discussion at the end of the section: Remarks on localities and sections).

The *Clavaspidella* faunule

This faunule comprises the species listed above. Characteristic genera are: *Clavaspidella* and *Prosymphysurus.* Considering that *Clavaspidella* is clearly substituting the Cordilleran *Athabaskia*, which in the cratonic biofacies is restricted to the *Glossopleura* zone, there cannot be any doubt that the *Clavaspidella* faunule belongs to the *Glossopleura* zone.

As mentioned above, the author believes that the part of the *Glossopleura* zone, corresponding to the *Clavaspidella* faunule, may well be missing in Alberta and British Columbia.

Both faunules occur in limestones of similar lithology. During the Middle Cambrian Northwest Greenland belonged to the cratonic realm. Characteristic is the absence of representatives of the families Oryctocephalidae, Ogygopsidae, and Pagetidae. According to Lochman & Wilson (1958, p. 320) the oldest Middle Cambrian assemblages in the Cordilleran shelf sites belong to the *Glossopleura* zone. The abrupt appearance of the families in the cratonic realm supposedly reflects the late start in sedimentation rather than any evolutionary trend. As demonstrated above, the Middle Cambrian sedimentation in Northwest Greenland began at the time of the *Plagiura — Poliella* zone, but was probably of only short duration.

Fauna of the *Bathyriscus-Elrathina* zone

The following species are restricted to the *Bathyuriscus — Elrathina* zone:

Acrocephalops gibber
Blainiopsis benthami
— *holtedahli*
Elrathiella obscura
Fastigaspis princeps n. gen. et n. sp.
Glyphaspis parkensis
— *perconcava*
Kootenia cf. billingsi
Phymaspis dignata n. gen. et n. sp.
Poliellina? sp.
Zacanthoides ulo n. sp.

Apparently this zone in Northwest Greenland contains a slightly smaller number of species than the *Glossopleura* zone, but generally the number of specimens is larger than that found in the *Glossopleura* zone.

The vertical distribution of the species in the sections has been studied, but at present a distinction between eventual faunules is impossible. The predominant genera, *Glyphaspis* and *Acrocephalops*, seem to be uniformly distributed throughout the sequence. *Elrathiella* shows a tendency to concentrate in the upper part. *Blainiopsis* may be a representative of an upper faunule, as the occurrence of this genus is restricted to layers above the intrazonal conglomerate, which separates the Cape Russell member and the Blomsterbæk limestone member of the Cape Wood formation.

Truly miogeosynclinal representatives are missing. *Kootenia cf. billingsi* is of interest because it shows affinity to the Middle Cambrian boulder fauna in the Canadian conglomerates of Quebec. RASETTI (1948b) has demonstrated that this fauna is related to the Cordilleran faunas. The boulders contain elements covering a range from early to late Middle Cambrian. Many of the boulders contain only a single species, and, accordingly, an exact correlation is impossible. *Kootenia billingsi* occurs unaccompanied in conglomerate boulders at Ville Guay. Assuming that the Greenland species is correctly identified, the Ville Guay species probably belongs to the *Bathyuriscus — Elrathina* zone.

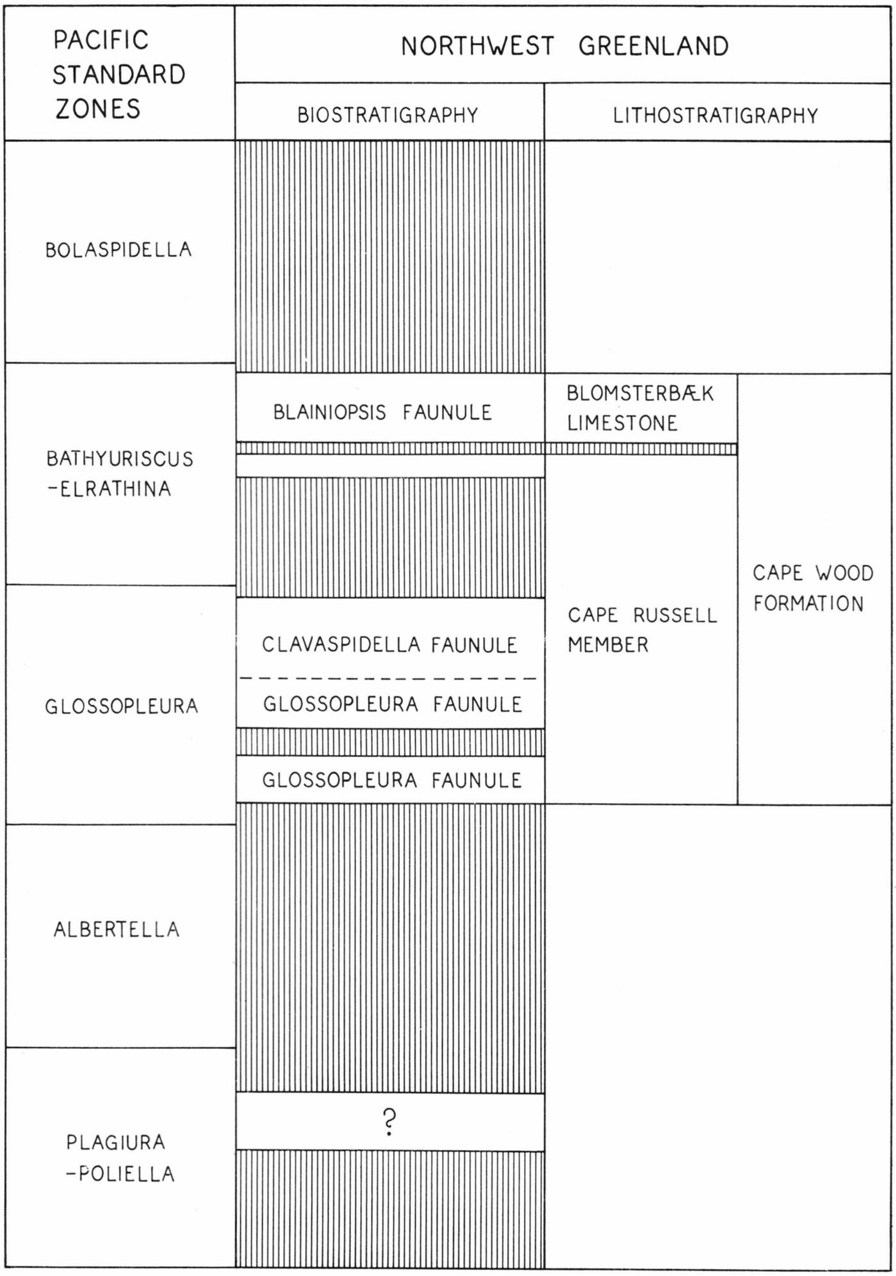

Fig. 9. The Middle Cambrian of Northwest Greenland.

MIDDLE CAMBRIAN PACIFIC – ATLANTIC CORRELATION

On several occasions attempts have been made to correlate the Pacific and Atlantic Middle Cambrian faunas. Especially HOWELL has gathered evidence with a bearing on this problem. However, the present writer is of the opinion that at present only the correlation of the upper Middle Cambrian may be considered valid. Important conclusions have been based on species which have been incorrectly identified, and of which the exact stratigraphical position is unknown.

HOWELL (1937) described the *Centropleura vermontensis* fauna from the St. Albans formation of northwestern Vermont. The Atlantic genera *Centropleura* and *Elyx* were found associated with Pacific elements. A few pygidia were referred to *Glyphaspis*, but the present writer believes that a generic reference of isolated pygidia of this general type is unreliable. Most interesting is the unmistakable occurrence of *Bolaspidella*. HOWELL & DUNCAN (1939, p. 5) correctly considered the *Centropleura vermontensis* fauna to be of late Middle Cambrian age, and it was regarded as slightly younger than the *Paradoxides forchhammeri* fauna.

C. POULSEN (1960, p. 38), when discussing a *Bolaspidella* fauna from Mendoza, Argentina, pointed out that in the Scandinavian area of continuous sedimentation the *Paradoxides forchhammeri* stage represents the very top of the Middle Cambrian, and the youngest zone of this stage, the *Lejopyge laevigata* zone, is followed without hiatus by the basal Upper Cambrian *Agnostus pisiformis* zone. In view of this fact C. POULSEN further stated that the youngest possible Acado-Baltic equivalent to the St. Albans formation would have to be the *Lejopyge laevigata* zone. As *Centropleura vermontensis* appeared to be most closely related to species in the Scandinavian *Jincella brachymetopa* zone, and as species of *Elyx* are absent above this zone, the *Centropleura vermontensis* fauna should be regarded as a stratigraphical equivalent to the *Jincella brachymetopa* zone. Thus the youngest Middle Cambrian, the *Lejopyge laevigata* zone, is not represented in Vermont.

The present writer concurs with LOCHMAN & WILSON in regarding the *Bolaspidella* subzone at the top of the highest Middle Cambrian faunizone as demonstrating the ideal transition fauna, composed of the last genera of Middle Cambrian trilobite families associated with the first genera of the rising new families. Considering this, in conjunction with the Scandinavian transition from Middle- to Upper Cambrian, the present writer believes that the Middle Cambrian *Bolaspidella* zone should probably be correlated with the *Jincella brachymetopa* zone and the *Lejopyge laevigata* zone of the *Paradoxides forchhammeri* stage. The basal *Triplagnostus lundgreni* — *Goniagnostus nathorsti* zone of this stage then must correspond to at least the upper part of the *Bathyuriscus* — *Elrathina* zone.

HOWELL & MASON (1938) tried to establish a correlation between the Pacific and Atlantic realms on basis of a Middle Cambrian *Paradoxides* fauna from Manuels, southeastern Newfoundland. In this fauna they recognized "*Ptychoparia*" *rogersi* as a species of *Ehmania*. Furthermore the associated *Dawsonia* supposedly occurred also in southern Nevada in beds containing *Amecephalus* (= "*Strotocephalus*") and *Kootenia*. Accordingly, the Lower *Paradoxides bennetti* zone was correlated with the upper part of the *Glossopleura* zone (in the modern sense), and the Upper *Paradoxides bennetti* zone supposedly was equivalent to the *Bathyuriscus* — *Elrathina* zone. As the *Paradoxides bennetti* fauna might be correlated with the *Eccaparadoxides oelandicus* fauna, the Atlantic sequence would then contain a hiatus corresponding to the *Plagiura* — *Poliella* zone, the *Albertella* zone, and part of the *Glossopleura* zone.

Dawsonia, with the present knowledge, must be regarded as being restricted to the Atlantic realm, and WHEELER (1941) demonstrated that "*Ptychoparia*" *rogersi* had erroneously been referred to *Ehmania*. Originally the holotype was incorrectly described and figured by WALCOTT. The species was made type species of a new genus, *Braintreella*.

In fact there was no basis for the Atlantic-Pacific correlation, but it was maintained in the Cambrian correlation chart (HOWELL, et al., 1944).

HUTCHINSON (1952), describing the Middle Cambrian trilobites from Cape Breton Island, referred a species to *Acrocephalops* (see discussion earlier in this paper, p. 53). The species is associated with *Paradoxides abenacus* and thus belongs to the *Paradoxides hicksi* assemblabe. Accordingly, HUTCHINSON suggested that the *Paradoxides hicksi* beds of the Atlantic realm might be older than shown in the correlation chart of HOWELL and others. HUTCHINSON tentatively proposed a correlation with the *Glossopleura* zone. However, he did not change the correlations merely on this one line of evidence, but indicated that the probability of a change should be kept in mind by future workers.

The present writer has shown that *Acrocephalops* is most likely restricted to the *Bathyuriscus* — *Elrathina* zone. Thus the *Paradoxides* *hicksi* beds would become slightly younger, if the Cape Breton species had been correctly identified. However, the species in question must be excluded from *Acrocephalops.* HUTCHINSON (1956) presented a correlation table showing the *Paradoxides hicksi* beds correlated with the "*Bolaspis — Glyphaspis*" zone. He cautiously stated that the correlation should be considered tentative, as there was no new evidence from Eastern Canada bearing on this problem.

HOWELL (1943) referred a species from the Cloud Rapids formation to *Glyphaspis.* However, this species, on account of the preglabellar features, will probably have to be excluded from the genus. Based on this species the Cloud Rapids assemblage was tentatively correlated with the Cape Wood fauna of Northwest Greenland, then believed to belong exclusively to the *Glossopleura* zone. The Treytown Pond formation is slightly younger than the Cloud Rapids formation. Undoubtedly they both belong to the *Bathyuriscus — Elrathina* zone. This viewpoint is supported by the occurrence of a fauna, similar to the Cloud Rapids assemblage, found by HOWELL in the lower limestones of the March Point formation at St. George Peninsula. The assemblage occurs below a *Bolaspidella* fauna, which was described by LOCHMAN (1938). Accordingly, the eventual hiatus between the March Point formation and the Treytown Pond formation must be much less significant than formerly believed.

LOCHMAN & WILSON (1958) apparently maintained an Atlantic-Pacific correlation based on the results of HOWELL, HUTCHINSON, and others. They stated that sedimentation did not begin in the Acado-Baltic region until the middle Middle Cambrian. They introduced a *Catadoxides* stage as an equivalent to the *Plagiura — Poliella* zone, the *Albertella* zone and the lower part of the *Glossopleura* zone.

The beds from Avalon Peninsula, Newfoundland, containing *Catadoxides* are generally referred to the Lower Cambrian, and the present writer agrees with this. Important in this connection is the probable disconformity between the manganese beds, containing *Paradoxides bennetti*, and the underlying bed with *Catadoxides.* The disconformity, which is inconspicuous in most sections, was demonstrated by HUTCHINSON (1956, p. 295, and 1962, pp. 19–21). He further stated that the presence of the disconformity could also be inferred from the faunal break at this horizon.

The present writer attaches much importance to this disconformity. *Catadoxides* is a very remarkable genus, known only from Newfoundland. The size is definitely paradoxidid, but the morphology of the cephalon and of the bilobate pygidium strongly resembles that of the Protolenidae, and *Catadoxides*, to the author, also represents a truly Lower Cambrian type. Species of *Paradoxides* occur in the manganese beds immediately following the disconformity. The evolutionary distance between the primitive *Catadoxides* and the advanced *Paradoxides* indicates that the disconformity at the base of the Chamberlains Brook formation should most correctly be regarded as interformational. The supposed vertical range of the hiatus would justify a reference of the *Catadoxides* beds to the upper part of the Lower Cambrian *Protolenus* zone. The present writer is of the opinion that the hiatus is equivalent to a part of the *Plagiura* — *Poliella* zone.

As demonstrated above, the basal *Triplagnostus lundgreni* — *Goniagnostus nathorsti* zone of the *Paradoxides forchhammeri* stage should most likely be correlated with the upper part of the *Bathyuriscus* — *Elrathina* zone. The present writer tentatively suggests that the *Paradoxides paradoxissimus* stage must be correlated with the lower part of the *Bathyuriscus* — *Elrathina* zone and most of the *Glossopleura* zone.

In the Pacific realm the *Glossopleura* zone is the first to obtain the maximum geographical range, from Argentina to Northwest Greenland. Thus a regional transgression of major importance is evident. Consequently connections with other regions allowing migration of adaptable trilobite genera were established. In this connection the widespread occurrence of the extracratonic *Dorypyge* is of interest. As mentioned earlier, *Dorypyge* is not represented in Northwest Greenland, but it makes its first appearance in the Cordilleran miogeosynclinal sites at the time of the *Glossopleura* zone. It does not occur in eastern North America. LOCHMAN & WILSON stated that the distribution of this asiatic genus suggests a preference for the outer edge of the intermediate biofacies. In Scandinavia the genus makes its first appearance on the island of Bornholm. *Dorypyge* is here represented by two species from the *Paradoxides paradoxissimus* stage, one from the basal *Triplagnostus gibbus* zone and the other from the *Hypagnostus parvifrons* zone.

In Siberia *Dorypyge* appears in the *Oryctocephalus* zone. KOBAYASHI (1943) divided the Middle Cambrian of Siberia into six zones. In ascending order these are: *Erbia* zone (*Erbia* = *Paratollaspis* KOBAYASHI, 1943 (obj.)), *Tollaspis* zone, *Oryctocephalus* zone, *Ciceragnostus* zone, *Centropleura* zone, and *Solenoparia* zone. KOBAYASHI suggested the alliance of the *Tollaspis* zone fauna with the *Glossopleura* fauna in Northwest Greenland. However, he admitted that there was no real faunal evidence to support this correlation. The present writer is of the opinion that the *Oryctocephalus* zone may be correlated with the *Glossopleura* zone. The *Centropleura* zone evidently belongs to the *Paradoxides forchhammeri* stage, corresponding to the lower part of the *Bolaspidella* zone. The overlying *Solenoparia* zone would accordingly be equivalent to the *Lejopyge laevigata* zone, corresponding to the upper part of the *Bolaspidella* zone. The *Ciceragnostus* zone would of necessity have to be equivalent to at least part of the *Bathyuriscus — Elrathina* zone, corresponding to upper part of the *Paradoxides paradoxissimus* stage and lowermost part of the *Paradoxides forchhammeri* stage. *Ciceragnostus* and the associated *Phalacroma* are not diagnostic zone fossils, but attained a maximum of development in this time interval. In Siberia the upper Middle Cambrian belongs to the Atlantic realm, and the *Oryctocephalus* zone is the last of the zones with Pacific affinities. The present writer believes that in view of the possible correlations of the zones above it, the *Oryctocephalus* zone might well be correlated with the *Glossopleura* zone. If this is correct, then *Dorypyge* makes its first apperance in the Siberian sequence at a level corresponding to the *Glossopleura* zone. The *Tollaspis* zone and the basal *Erbia* zone would then fall within the *Eccaparadoxides oelandicus* stage, corresponding to the *Albertella* zone and part of the *Plagiura — Poliella* zone. The Pacific affinities appear from the occurrence of *Kootenia* in both zones. The *Tollaspis* zone is distinguished by containing a number of species of *Poliellina*. Outside of Asia this genus is known only from the Meagher limestone in Montana belonging to the *Bathyuriscus — Elrathina* zone. A single specimen from the same zone in Northwest Greenland is referred to *Poliellina* with hesitation, and as pointed out (p. 31), the specimen from Greenland and the Meagher limestone specimen most likely represent a new genus closely related to *Bathyuriscus* and *Poliellina*. Thus the correlation of the *Tollaspis* zone with the *Albertella* zone, and the *Erbia* zone with the *Plagiura — Poliella* zone must be regarded as quite tentative.

The *Oryctocephalus* zone has been tentatively correlated (Endo, 1956) with the Taitzuan stage in Manchuria, part of the Rinson stage in North Korea, part of the Taiki group in South Korea, the Upper Changhsian stage in North China, the Chinchiamiao limestone in Central China, the *Manchuriella* beds in South China and Indo-China, and finally with the *Parararia-Yorkella* zone in South Australia. In the Taitzuan stage, the Rinson stage, and the Upper Changhsian stage, all belonging to the Hwangho basin, *Dorypyge* is a characteristic genus.

According to Daily (1956) the *Parararia-Yorkella* zone cannot be maintained. *Parararia* and *Yorkella* are trilobite genera of uncertain affinities, and Daily refers the sequence containing these genera to the Lower Cambrian.

The Middle Cambrian of Queensland is distinguished by being initiated by a *Redlichia* fauna (Öpik, 1956a, p. 8). Generally *Redlichia* is regarded as being exclusively Lower Cambrian, but Öpik has found *Redlichia* associated with *Peronopsis*, and he refers the *Redlichia* faunas of Queensland and the Northern Territory to the lower Middle Cambrian. The South Australian *Redlichia* fauna from Kangaroo Island is still regarded as being of Lower Cambrian age. In the Northern Territory the *Redlichia* beds are followed, without any break in sedimentation, by beds containing a fauna, which definitely belongs to the upper part of the *Eccaparadoxides oelandicus* stage or lower *Paradoxides paradoxissimus* stage. Accordingly, the *Redlichia* beds must here belong to the Middle Cambrian. The present writer is of the opinion that the environment at the time of lower Middle Cambrian might have presented an ecological niche, which for a short while allowed the survival of *Redlichia.* The *Redlichia* fauna in Queensland merges into the succeeeding *Xystridura — Dinesus* fauna occurring in the same formation.

The *Xystridura* fauna, apart from the endemic *Xystridura*, also contains *Pagetia*, *Peronopsis*, *Oryctocephalus*, *Eodiscus?*, and other genera. This fauna and a similar fauna from the Sandover beds in the Northern Territory were correlated with the Spence shale fauna and/or the Ptarmigania fauna of Utah, U. S. A. The correlation of the Australian *Xystridura* fauna with the *Albertella — Glossopleura* zone transition fauna seems well founded. On the basis of agnostids, especially *Triplagnostus gibbus*, Öpik has been able to correlate the *Xystridura* fauna with the upper part of the *Eccaparadoxides oelandicus* stage and the lower part (*Triplagnostus gibbus* zone) of the *Paradoxides paradoxissimus* stage in the Scandinavian sequence.

In the Queensland sequence, the *Xystridura* fauna occurs immediately above layers with *Redlichia chinensis*, and Öpik suggested an early Middle Cambrian age for beds in Eastern Asia containing the same species. In North Korea, according to Saito (1934), *Redlichia chinensis* beds are followed by the Middle Cambrian "*Ptychoparia*" beds containing *Oryctocephalus*, *Pagetia*, and *Peronopsis.* Öpik regards these beds as equivalents to the *Xystridura* fauna.

Thus the lowermost part of the Taitzuan stage (*Anomocarella — Ptychoparia* zone) of the Hwangho basin may be correlated with the transition fauna from the *Albertella* zone to the *Glossopleura* zone and with the transition from the *Eccaparadoxides oelandicus* stage to the *Paradoxides paradoxissimus* stage, and the present writer believes that the *Oryctocephalus* zone in Siberia (Kobayashi, 1943) also belongs at this level.

The Queensland *Xystridura — Dinesus* beds are followed by the Inca Creek formation and the contemporaneous Currant Bush limestone, in both of which agnostids are dominant. According to Öpik (1956a, p. 18) there is an overlap in the vertical range of *Triplagnostus gibbus* and *Ptychagnostus atavus*; *Ptychagnostus punctuosus* occurs at the top. Consequently, the Inca Creek formation and the Currant Bush limestone are equivalent to the remaining part of the *Paradoxides paradoxissimus* stage, corresponding to the upper part of the *Glossopleura* zone and most of the *Bathyuriscus — Elrathina* zone. The V-Creek limestone, overlying the Currant Bush limestone, contains *Goniagnostus nathorsti* and *Lejopyge laevigata rugifera*, and, accordingly, the V-Creek limestone may be referred to the *Paradoxides forchhammeri* stage.

The net result of the above discussion is that there seems to be circumstantial evidence indicating that the *Eccaparadoxides oelandicus* stage, the *Paradoxides paradoxissimus* stage, and the *Paradoxides forchhammeri* stage together cover the same span of time as the Middle Cambrian faunizones of the Pacific realm.

The correlations preferred by the present writer are presented in table 1, plate 4.

LOWER- AND MIDDLE CAMBRIAN HISTORY AND PALEOGEOGRAPHY

In late Lower Cambrian the fauna of the Wulff River formation shows some affinity to the Atlantic realm. After an interruption in the sedimentation Northwest Greenland then, at the close of the Lower Cambrian, became a part of the Pacific realm. If, as reported by Cowie (1961), *Poulsenia* really occurs in Central East Greenland, then the communication between Northwest and East Greenland was not totally interrupted at the time of deposition of the Cape Kent limestone.

The Cape Kent limestone is rather uniform, commonly oolitic, and deposition in a relatively deep sea has been suggested (C. Poulsen, 1927). However, the present writer believes that the sedimentation took place in rather shallow water outside the littoral zone. This is also in better agreement with Cowie's statement that rapid variations in the sedimentary environment prevailed in the southwestern part of the area, where intraformational conglomerates and glauconite occur with a proportion of pelitic material. Greater stability is evident in the west- and northeast areas, which, nevertheless, cannot have been too far away from the coastline.

Bache Peninsula and Inglefield Land supposedly belonged to a basin partly isolated from the Franklinian geosyncline. Towards the end of the Lower Cambrian a regression set in, and the coastline presumably moved to the west. The upper 50 to 100 centimetres of the Cape Kent limestone at Marshall Bugt and at Kap Frederik VII are a brownish, non-oolitic littoral limestone, only yielding specimens of *Poulsenia.*

Following a hiatus, a transgression of supposedly short duration set in from the northwest at the time of the *Plagiura* — *Poliella* zone, and a pure, gray limestone was deposited. The sea receded from the area during the time of the *Albertella* zone, and during this interval erosion removed the *Plagiura* — *Poliella* zone beds.

As to be expected in a cratonic facies at the extreme boundary of a marine province, the zonal development is rather incomplete. However, the large regional transgression at the time of the *Glossopleura* zone resulted in the deposition of a considerable sequence of limestone and arenaceous limestone with glauconite. At several localities the basal layer is a conglomerate. This conglomerate has yielded pebbles with remnants of the *Plagiura* — *Poliella* zone fauna. Other pebbles contain *Glossopleura* and *Polypleuraspis*. The two genera are also found in the matrix, and thus the *Glossopleura* zone must have been initiated by two transgressions, separated by a brief break in sedimentation allowing erosion of the basal *Glossopleura* bed. The second transgression resulted in a prolonged submergence. At the R. C. M. P. Post on Bache Peninsula the *Glossopleura* zone is developed as gray limestone and dolomite. Here only the basal stratum contains *Glossopleura* fauna elements, whereas the rest of the sequence appears to be devoid of fossils. C. POULSEN (1946) referred a librigena from the basal stratum to *Clavaspidella? sp.* However, in the opinion of the present writer the free cheek more likely belongs to *Polypleuraspis*.

The transgression from northwest possibly soon passed the area west of the Kane Basin on its way eastward, and this part of the depositional basin quickly attained a depth, which did not allow accumulation of trilobite exoskeletons. In Inglefield Land, east of the Kane Basin, the sedimentation took place in the littoral zone or just outside. The lithologically heterogeneous sequence suggests frequent oscillations of the coastline.

The remarkably similar lithology of the *Glossopleura* zone sequence at Devon Island indicates that the unstable conditions at that time affected a large area. COWIE (1961) stated that the unstable conditions are definitely evident from the clastic and chemical deposition, accompanied at frequent intervals by brecciation and formation of conglomerates. Deepening besides shallowing of the sea during this period is suggested by the presence of shales.

On account of the variations, eventual minor breaks in the sedimentation cannot be ascertained. The contents of rounded quartz and glauconite probably originated from reworked sandstone or arenaceous limestone of unknown age. The more scarce angular quartz and feldspar came from the arkose and Rensselaer Bay sandstone belonging to the Eo-Cambrian? Thule formation.

The *Clavaspidella* faunule succeeded the *Glossopleura* faunule. It is unknown, whether or not they are separated by a break. The presence in both faunules of genera, which are supposed to be endemic, might suggest that the communication with typical Cordilleran faunas was rather restricted.

At the close of the time of the *Glossopleura* zone a regression occurred. The simple disconformity between the *Glossopleura* zone and the *Bathyuriscus* — *Elrathina* zone is presumably rather inconspicuous in the sections, but the compass of the hiatus nevertheless most likely corresponds to a large part of the *Bathyuriscus* — *Elrathina* zone. Already the lowermost bed, in which the fauna of this zone occurs, has yielded specimens of *Glyphaspis parkensis*. According to Rasetti (1951) this species is probably restricted to the *Parkaspis endecamera* faunule, which is the youngest faunule recognized in the upper Stephen formation at Park Mountain. In Northwest Greenland *Glyphaspis parkensis* is represented throughout the *Bathyuriscus* — *Elrathina* zone sequence.

The occurrence of the Cordilleran species and *Kootenia cf. billingsi*, with affinity to a fauna in eastern North America, is regarded as an indication of a less restricted communication with other faunas, and the maximal Middle Cambrian transgression was probably reached here at the close of the time of the *Bathyuriscus* — *Elrathina* zone. After a while the sea withdrew from the area, and the following transgression deposited the Blomsterbæk limestone. The unconformity is accentuated by the presence of five centimetres of transgressional conglomerate. The hiatus supposedly covers only a short span of time, as the Blomsterbæk limestone fauna contains the same species of *Glyphaspis* and *Acrocephalops*, as does the sequence below the unconformity. *Blainiopsis* occurs exclusively above the unconformity, and the fauna of the Blomsterbæk limestone may eventually be differentiated as a *Blainiopsis* faunule.

On Bache Peninsula the *Bathyuriscus* — *Elrathina* zone sequence below the unconformity is probably missing. In the ravine at the R. C. M. P. Post the sequence overlying the basal *Glossopleura* faunule is apparently unfossiliferous. The Blomsterbæk limestone with the *Blainiopsis* fauna succeeds the well-defined disconformity.

At the localities, where the Blomsterbæk limestone has been observed, its thickness ranges from two to five metres, and the sedimentation at that time was probably of short duration. Regression set in, and the hiatus above the *Bathyuriscus* — *Elrathina* zone covers the *Bolaspidella* zone and the entire Upper Cambrian. The next submergence occurred in the Ordovician.

REMARKS ON LOCALITIES AND SECTIONS

Troelsen (1950) has given detailed descriptions of the different sections indicating the levels, at which the *Glossopleura* zone assemblage occurs. As a consequence of the revised stratigraphy these indications cannot any longer be considered valid. Therefore a few minor corrections and comments are necessitated. The corrected sections are also shown in a diagram, text fig. 10.

Bache Peninsula (R. C. M. P. Post): At the localities on Bache Peninsula the *Glossopleura* faunule alone represents the *Glossopleura* zone fauna, as apparently only the basal bed of the Cape Russell member is fossiliferous. The member consists of gray limestone and cavernous dolomite. At one of the two localities the upper part of the member has been eroded away, and the Blomsterbæk limestone is missing. At the other locality the overlying Blomsterbæk limestone, separated from the Cape Russell member by a simple disconformity, consists of five metres of thin-bedded gray limestone with subordinate layers of arenaceous limestone and limestone conglomerates. Of the *Bathyuriscus* — *Elrathina* zone fauna only the *Blainiopsis* faunule from the Blomsterbæk limestone is represented. Text-fig. 10 shows only one of the Bache Peninsula sections. In this section the boundary between the Cape Kent limestone and the *Glossopleura* bed is situated 219 metres above sea level. The Blomsterbæk limestone occurs between the 245 and 250 metre contours.

Marshall Bugt loc. 1: As in the rest of Inglefield Land the beds are almost horizontal. The boundaries of the Cape Russell member are found respectively at 240 and 325 metres above sea level. The boundary between the *Glossopleura* zone and the *Bathyuriscus* — *Elrathina* zone is tentatively placed at a level 290 metres above sea level. The *Glossopleura* zone fauna (*Clavaspidella* faunule) has been found at 280 metres, and the lowermost fossiliferous level of the *Bathyuriscus* — *Elrathina* zone with specimens of *Elrathiella* and *Glyphaspis parkensis* occurs at 300 metres above sea level. As no further information is available the boundary is arbitrarily set at 290 metres. At 325 metres specimens of

Glyphaspis and *Acrocephalops* have been collected, and this part of the section still belongs to the *Bathyuriscus* — *Elrathina* zone. The upper part of the section belongs to the Cass Fjord formation, and thus the Blomsterbæk limestone is probably absent.

Marshall Bugt loc. 2: The Cape Russell member occurs between the 315 and 395 metre contours. At the 350 and 365 metre levels specimens from the *Glossopleura* faunule were collected. *Prosymphysurus*, mentioned by Troelsen, does not occur. Also, between 315 metres and 345 metres members of the *Glossopleura* faunule are present. At this locality the sequence containing the *Glossopleura* faunule is then about 50 metres thick. That part of the section from 365 metres to the top at 395 metres above sea level has not yielded any fossils. Possibly the unfossiliferous sequence corresponds to beds with the *Clavaspidella* faunule. At a few other localities the *Clavaspidella* faunule beds measure about 40 metres in thickness.

Blomsterbækken: The upper boundary of the Lower Cambrian Cape Kent formation is at 90 metres of altitude. Above this follows, according to Troelsen (1950), a gray or greenish arenaceous limestone with poorly preserved fossils. At 110 metres the *Glossopleura* faunule occurs, and the previously discussed specimens of *Amecephalus* and *Fieldaspis* were found at the same level. Between 115 metres and 135 metres the *Bathyuriscus* — *Elrathina* zone fauna occurs. The Blomsterbæk limestone with species of *Glyphaspis* and *Blainiopsis* is found between the 135 and 137 metre contours. A covered interval, a few metres thick, above 137 metres possibly also belongs to the Blomsterbæk limestone. This limestone is initiated by a thin basal conglomerate with angular fragments of the underlying limestone. The boundary between the *Glossopleura* zone and the *Bathyuriscus* — *Elrathina* zone must be situated between 110 and 115 metres, and the author tentatively places it at 114 metres above sea level.

It is interesting that the *Clavaspidella* faunule is absent. Whether beds with this faunule have been removed by erosion, or were never developed, is not known. The lowermost 20 metres of the section above the Cape Kent limestone is only tentatively referred to the *Glossopleura* zone. The occurrence of supposed *Plagiura* — *Poliella* zone elements in the conglomeratic layer directly above suggests that the underlying beds may be of older Middle Cambrian age.

Kap Frederik VII: The accessible part of the section is somewhat obscured by talus (Troelsen, 1950, p. 46). According to Troelsen the Cape Russell member occurs from about 120 metres to about 170 metres above sea level. While collecting, he numbered the fossiliferous layers of the Cape Russell member from 1 to 6, and the altitudes of the fossiliferous levels must be regarded as proximate estimates.

TROELSEN's layer no. 1 is a brownish limestone. The layer has previously been regarded as belonging to the Middle Cambrian sequence, but the occurrence solely of *Poulsenia* indicates a Lower Cambrian age. In 1940 he reported that the upper 50 centimetres of the Cape Kent limestone at Marshall Bugt was of a lithology identical to that of the *Poulsenia* bed at Kap Frederik VII. Accordingly, the Lower-Middle Cambrian boundary must be raised from about 120 metres to 130 metres.

The next fossiliferous level, TROELSEN's layer no. 2, occurs at about 140 metres. This layer contains only the new genus *Nanoqia* and *Alokistocare pronum n. sp.* Layer no. 3, at about 160 metres, yielded *Clavaspidella ovaticauda n. sp.* Thus TROELSEN must have overlooked levels with the *Glossopleura* faunule, or perhaps they are covered by talus. In any case, C. POULSEN (1927) reported numerous specimens of *Glossopleura* and *Polypleuraspis* (= "*Glossopleura longifrons*"), collected from boulders on the beach at this locality. The present writer believes that the *Glossopleura* faunule level is to be found from about 130 metres to 140 metres (between TROELSEN's layers 1 and 2). The remaining 10 metres of the Cape Russell member, above layer no. 3 (160 metres), containing TROELSEN's layers 4–6, belong to the *Bathyuriscus — Elrathina* zone, as all three layers are distinguished by species of *Glyphaspis* and *Acrocephalops*. Accordingly, the boundary between the *Glossopleura* zone and the *Bathyuriscus — Elrathina* zone is to be found between layers 3 and 4 at approximately 163 metres above sea level. At the top the Blomsterbæk limestone is missing, the *Bathyuriscus — Elrathina* zone fauna being overlain by the Cass Fjord formation at 170 metres above sea level.

It is remarkable that the *Glossopleura* faunule and the *Clavaspidella* faunule apparently only occur together at Kap Frederik VII, and possibly at Marshall Bugt loc. 2. It might be suggested that the *Glossopleura* faunule and the *Clavaspidella* faunule represent different facies from one and the same time interval. On the other hand, both faunules occur in limestone and arenaceous limestones of identical lithology. The environment at the time of deposition was typically cratonic. As the coastline at that time has supposedly been subjected to frequent oscillations, the subsequent changes in depth and other factors, governing the ecological facies, ought to have resulted in an alternating distribution of the faunules within the different sections, but as stated above, this is not the case. However, one must keep in mind that some fossiliferous levels may have been overlooked, and the occurrence of both faunules together at several more of the known localities, or in areas not yet investigated, is still possible. As mentioned above, the upper, apparently unfossiliferous part of the section at Marshall Bugt loc. 2 may belong to the *Clavaspidella* faunule interval.

The evidence at hand causes the author to conclude that the *Glossopleura* faunule and the *Clavaspidella* faunule belong in the same ecological facies, and, accordingly, there must be an age difference between the faunules. The conglomerate near the base of the *Glossopleura* faunule bed at Blomsterbækken contains *Glossopleura* faunule elements and the older elements, *Fieldaspis* and *Amecephalus*. This indicates that, as the *Glossopleura* transgression was the first, it had the chance of reworking older Middle Cambrian deposits. However, it is more important that, in the author's opinion, the *Glossopleura* faunule at Kap Frederik VII may be safely referred to a level below the *Clavaspidella* faunule. In several other regions, within the Pacific realm, *Glossopleura* appears in the lowermost faunules of the *Glossopleura* zone, and from the Arrojos formation at the Sonoran Difuntos Hills, Mexico, Lochman (1952, p. 74, and 1956b, p. 536) has demonstrated the unmistakable presence of a transition fauna containing upper *Albertella* zone genera, associated with *Glossopleura leona*, which continues into higher beds.

The conclusion must be that the *Glossopleura* faunule is the oldest element in the *Glossopleura* zone fauna in Northwest Greenland.

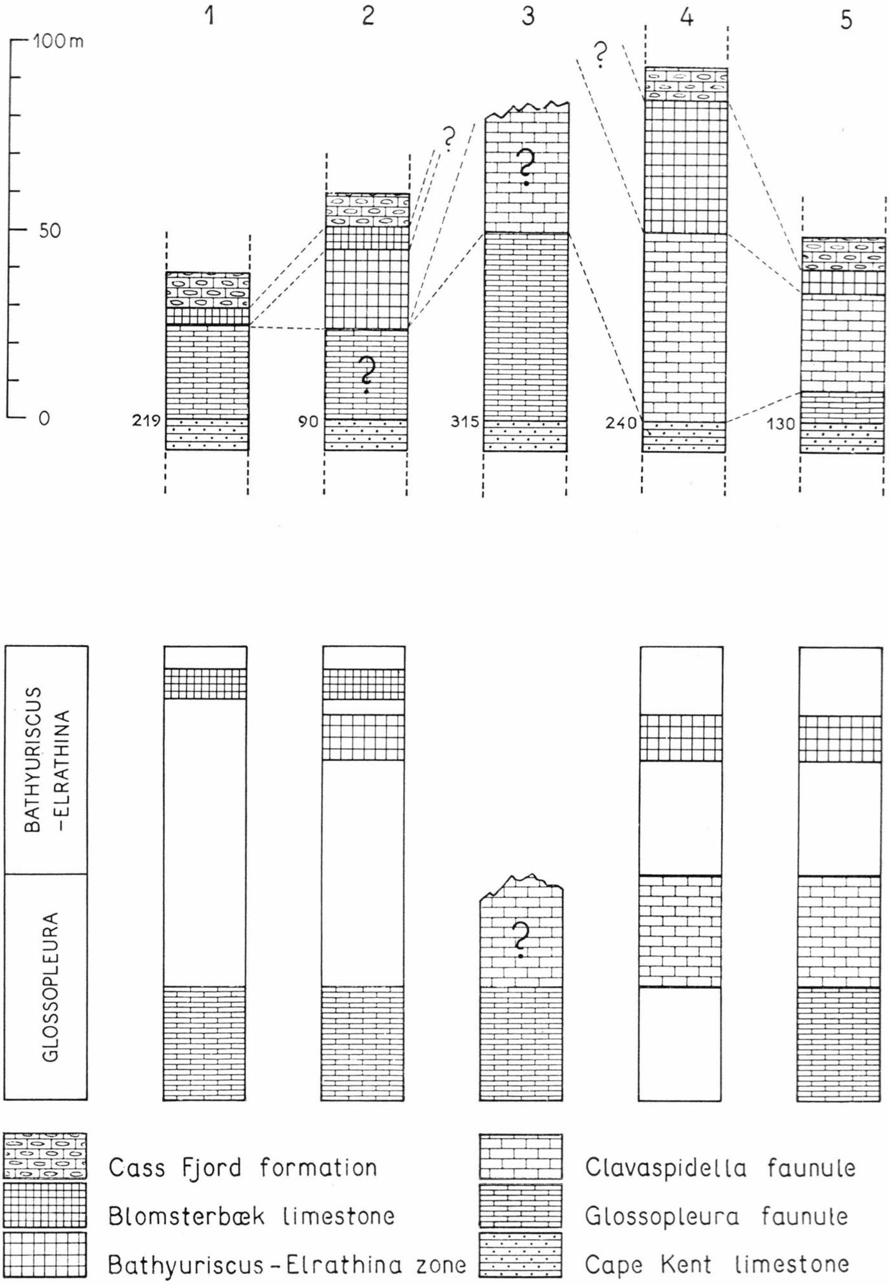

Fig. 10. Middle Cambrian sections. 1: Bache Peninsula; 2: Blomsterbække; 3: Marshall Bugt loc. 2; 4: Marshall Bugt loc. 1; 5: Kap Frederik VII. Altitudes in metres of Lower-Middle Cambrian boundary indicated by numbers at base of the columns. Below: Correlation between Cordilleran Middle Cambrian standard zones and the same sections as above.

DANSK SAMMENDRAG

Det nedre- og mellemkambriske materiale af fossiler, der ligger til grund for denne afhandling, er indsamlet 1939–1941 af Dr. J. C. Troelsen. Endvidere har forfatteren foretaget en revision af et ældre materiale, som er beskrevet af C. Poulsen i 1927. De nordvestgrønlandske lokaliteter, hvorfra fossilerne stammer, er angivet på kortene fig. 1 og 2.

Systematisk Palæontologi

I dette afsnit er foretaget en revision af trilobitarterne fra Inglefield Land og Bache Peninsula. Fire nye mellemkambriske trilobitslægter (to alokistocaride, een ptychopariid, samt een af ubekendt familie) og ni nye arter opstilles. Meraspide stadier af *Glossopleura* beskrives (tekstfigur 3–4; tavle 1, fig. 2–4), og larveudviklingen af familie Dolichometopidae diskuteres (side 27–29).

Faunaen i Cape Kent-kalken

Mægtigheden af Cape Kent-kalken varierer mellem 10 og 20 meter, og den indeholder tilsyneladende kun een faunule. Samtlige arter fra kalken er anført side 60–61. Af de nævnte slægter er kun *Hyolithes* og *Bristolia* med sikkerhed kendt udenfor Grønland.

Cape Kent-faunaen var antagelig kun indledningsvis forbundet med de cordilleriske faunaer. Bassinet blev hurtigt isoleret, og en endemisk fauna opstod. Cowie (1961) anfører, at *Poulsenia* også optræder i den øvre del af Ella Ø formationen i Østgrønland. Således må der have været en forbindelse mellem Inglefield Land og det centrale Østgrønland.

Cape Kent-kalken tænkes at svare til den øvre del af Ella Ø formationen. Wulff River formationen, som underlejrer Cape Kent-kalken, svarer til den nedre del af Ella Ø formationen og den øvre del af Bastion formationen. Både Cape Kent-kalken og Wulff River formationen kan henføres til Øvre *Olenellus* subzone, dog hører muligvis en del af Wulff River formationen til Nedre *Olenellus* subzone.

Den mellemkambriske fauna i Nordvestgrønland

Faunaen i *Plagiura–Poliella* zonen

Den mellemkambriske Cape Wood formation, som overlejrer Cape Kent-kalken, indledes de fleste steder af et basalkonglomerat. På lokaliteten vest for Blomsterbækken er i konglomeratet fundet et enkelt eksemplar af *Fieldaspis sp.*, *Amecephalus troelseni n. sp.* samt løstliggende på et lidt lavere niveau et eksemplar af *Kochaspis? sp.* Alt tyder på, at disse eksemplarer må betragtes som erosionsrester fra *Plagiura–Poliella* zonen. Lagene fra denne zone tænkes iøvrigt at være fjernet i tidsrummet svarende til *Albertella* zonen.

Faunaen i *Glossopleura* zonen

Tilstedeværelsen af *Glossopleura* zonen i Nordvestgrønland har været kendt længe; men en erkendelse af faunaens sande natur har været umuliggjort af det forhold, at et antal trilobitslægter urigtigt er blevet henført til denne zone. Troelsen (1950) delte Cape Wood formationen i to veldefinerede led, som var adskilt af en sedimentationsafbrydelse og et tyndt basalkonglomerat. Det underste Cape Russell led mentes at svare til *Glossopleura* zonen, og det overlejrende Blomsterbæk-kalk led blev parallelliseret med C. Poulsen's *Blainiopsis* zone, som ansås for at høre til yngre Mellemkambrium.

Forfatteren til det foreliggende arbejde har omhyggeligt studeret den vertikale fordeling af arterne i de forskellige profiler. Undersøgelserne viser, at grænsen mellem *Glossopleura* zonen og *Bathyuriscus–Elrathina* zonen må findes indenfor Cape Russell leddet. Denne opfattelse er også i overensstemmelse med den vertikale udbredelse af tilsvarende faunaer i den cordilleriske region. Af særlig interesse er, at *Glyphaspis parkensis* Rasetti optræder i Inglefield Land sammen med *Glyphaspis perconcava*, *Elrathiella*, *Acrocephalops* og *Blainiopsis*. De lige nævnte former, hørende til *Bathyuriscus-Elrathina* zonen, optræder altid i niveauer, som er tydeligt adskilt fra niveauer indeholdende *Glossopleura* faunaen.

Samtlige arter fra *Glossopleura* zonen er anført side 64. Den vertikale fordeling af arterne angiver tilstedeværelsen af to adskilte faunuler indenfor *Glossopleura* zonen. Den underste *Glossopleura* faunule er karakteriseret først og fremmest ved slægterne *Glossopleura* og *Polypleuraspis*, der begge er repræsenteret af mange eksemplarer. Sjældne elementer i denne faunule er *Kootenia resseri*, *Ptychoparella*, *Poulseniella* og *Solenopleurella*. Ifølge Rasetti er *Glossopleura* og *Polypleuraspis* alene om at repræsentere *Glossopleura* zonen i Alberta og British Columbia. Det er da muligt, at kun den nederste del af *Glossopleura* zonen, svarende til *Glossopleura* faunulen er udviklet her. I denne forbindelse er det interessant, at Ra-

SETTI (1951, side 108) antyder den mulige tilstedeværelse af en sedimentationsafbrydelse indenfor Stephen formationen.

Clavaspidella faunulens arter er anført side 64. Denne faunule optræder i kalksten og sandede kalksten, som ganske svarer til sedimenterne indeholdende *Glossopleura* faunulen. Begge faunuler tilhører den kratoniske biofacies, og det samme gælder iøvrigt også for *Bathyuriscus-Elrathina* zonen. Den manglende repræsentation af familierne Oryctocephalidae, Ogygopsidae og Pagetidae er i denne forbindelse uhyre karakteristisk.

Faunaen i *Bathyuriscus-Elrathina* zonen

Trilobitarterne fra denne zone er anført side 66. Tilsyneladende indeholder *Bathyuriscus-Elrathina* zonen færre arter end *Glossopleura* zonen; til gengæld er antallet af individer gennemgående større.

Det er ikke muligt med sikkerhed at skelne mellem flere faunuler i *Bathyuriscus-Elrathina* zonen. De helt dominerende slægter *Glyphaspis* og *Acrocephalos* synes at være jævnt fordelt gennem lagserien. *Elrathiella* viser en tendens til at koncentrere sig i zonens øvre lag, og *Blainiopsis* optræder udelukkende over det intrazonale konglomerat, der adskiller Blomsterbæk-kalken fra Cape Russell leddet. Muligvis kan Blomsterbæk-kalken siges at være karakteriseret ved en *Blainiopsis* faunule.

Som i *Glossopleura* zonen mangler egentlige miogeosynklinale repræsentanter i *Bathyuriscus-Elrathina* zonens lag. *Kootenia cf. billingsi* er interessant ved affiniteten til konglomeratfaunaen ved Quebec. Dette ordoviciske konglomerat, som er omtalt af RASETTI i flere afhandlinger, indeholder rullesten af mellemkambrisk alder. Nogle af rullestenene indeholder kun en enkelt art, hvorfor en eksakt korrelation kan være vanskelig at foretage. Dette gælder også for *Kootenia billingsi*; men ud fra artens optræden i Nordvestgrønland kan den givetvis henføres til *Bathyuriscus-Elrathina* zonen.

Både *Kootenia cf. billingsi* og *Glyphaspis parkensis* antyder, at forbindelsen med andre faunaer udenfor Grønland har været mere åben i *Bathyuriscus-Elrathina* zonens tid; men denne forbindelse har sikkert kun været af kort varighed.

Tekstfigur 9, side 67, skildrer i skematisk form udviklingen af det nordvestgrønlandske Mellemkambrium.

Mellemkambrisk Pacifisk – Atlantisk korrelation

Ved flere lejligheder har det været forsøgt at tilvejebringe en korrelation mellem pacifiske og atlantiske faunaer i Mellemkambrium. Især HOWELL har bidraget til at samle materiale, der kunne kaste lys over dette problem. Forfatteren til det foreliggende arbejde er dog af den mening, at kun de yngste mellemkambriske faunaer er tilfredsstillende korreleret. Vigtige slutninger har været baseret på forkert bestemte trilobitslægter, hvis stratigrafiske position endda i nogle tilfælde ikke er velafgrænset.

Centropleura vermontensis faunaen, beskrevet af HOWELL (1937) fra Vermont, er interessant ved at indeholde *Centropleura* sammen med *Elyx* og *Bolaspidella*. HOWELL betragtede faunaen som værende en smule yngre end *Paradoxides forchhammeri* faunaen.

C. POULSEN (1960, side 38) diskuterede en *Bolaspidella* fauna fra Mendoza, Argentina. Han påpegede, at i Skandinavien er overgangen fra Mellemkambrium til Øvre Kambrium ganske jævn, og at den yngste mulige ækvivalent til *Centropleura vermontensis* faunaen måtte være *Lejopyge laevigata* zonen. Da imidlertid Vermont faunaen syntes at være nærmest beslægtet med former fra *Jincella brachymetopa* zonen, og da *Elyx* i Skandinavien ikke forekommer over denne zone, må Vermont faunaen parallelliseres med *Jincella brachymetopa* zonen.

I den pacifiske provins er der tale om en ideel overgang fra Mellemkambrium til Øvre Kambrium. *Bolaspidella* findes endnu i nederste Øvre Kambrium. Ud fra de ovennævnte betragtninger mener forfatteren, at det vil være forsvarligt at korrelere *Bolaspidella* zonen med den atlantiske *Jincella brachymetopa* zone og *Lejopyge laevigata* zone. Følgelig må *Paradoxides forchhammeri* etagens nederste zone, *Triplagnostus lundgreni-Goniagnostus nathorsti* zonen, under alle omstændigheder svare til i det mindste den øvre del af *Bathyuriscus-Elrathina* zonen.

HOWELL & MASON (1938) korrelerede en *Paradoxides bennetti* fauna fra Manuels, Newfoundland, med *Glossopleura* zonen og *Bathyuriscus-Elrathina* zonen. Sammenligningen var baseret på forekomsten af *Ehmania* og *Dawsonia*. Som påvist af WHEELER (1941) kan „*Ptychoparia*" *rogersi* ikke henføres til *Ehmania*. Det vides nu også, at *Dawsonia* er begrænset til den atlantiske provins og altså ikke, som antaget af HOWELL og MASON, forekommer i Nevada. Da *Paradoxides bennetti* faunaen er en ækvivalent til *Eccaparadoxides oelandicus* faunaen, skulle den atlantiske provins ifølge den lige omtalte korrelation indeholde en lakune svarende til *Plagiura-Poliella* zonen, *Albertella* zonen og en del af *Glossopleura* zonen.

Efter at WHEELER (1941) havde gjort „*Ptychoparia*" *rogersi* til typeart for en ny slægt *Braintreella*, var der ikke noget reelt grundlag for den atlantisk-pacifiske korrelation; men denne blev alligevel opretholdt i det kambriske korrelationsskema (HOWELL med flere, 1944). HUTCHINSON (1952) beskrev fra Cape Breton Island en fauna hørende til *Paradoxides hicksi* selskabet. Fra denne fauna anførte han en art af den pacifiske *Acrocephalops*. Da *Acrocephalops* mentes at høre hjemme i *Glossopleura* zonen, foreslog HUTCHINSON, at *Paradoxides hicksi* faunaen kunne være lidt ældre end angivet i det kambriske korrelationsskema fra 1944.

Forfatteren til det foreliggende arbejde påviser, at den grønlandske typeart for *Acrocephalops* kun findes i *Bathyriscus-Elrathina* zonen. Desuden er side 53 gjort rede for, at HUTCHINSON's art slet ikke kan henføres til *Acrocephalops.*

HOWELL (1943) henførte en art fra Cloud Rapids formationen til *Glyphaspis.* Arten må dog antagelig udelukkes fra denne slægt. Cloud Rapids selskabet blev sammenlignet med den nordvestgrønlandske Cape Wood formations fauna, som da mentes udelukkende at tilhøre *Glossopleura* zonen. Der er for nærværende forfatter ingen tvivl om, at Cloud Rapids formationen og den lidt yngre Treytown Pond formation begge må henføres til *Bathyuriscus-Elrathina* zonen, og at den eventuelle lakune under March Point formationen, som indeholder en *Bolaspidella* fauna, følgelig er mindre betydelig end tidligere antaget.

Tilsyneladende opretholdt LOCHMAN & WILSON (1958) en atlantisk-pacifisk korrelation baseret på HOWELL's resultater. De udtalte, at sedimentationen ikke begyndte i den acado-baltiske region før den midterste del af Mellemkambrium. I det atlantiske skema indførte de en *Catadoxides* etage som ækvivalent til *Plagiura-Poliella* zonen, *Albertella* zonen og den nedre del af *Glossopleura* zonen.

Lagene med *Catadoxides* fra Avalon Peninsula, Newfoundland, regnes i almindelighed for at være af nedrekambrisk alder, et synspunkt som også deles af nærværende forfatter. *Catadoxides* har en paradoxidid størrelse, men minder bortset herfra meget om Protolenidae. Der er således et udviklingsmæssigt stort spring fra *Catadoxides* til *Paradoxides.* HUTCHINSON (1956, 1962) har påvist en sedimentationsafbrydelse mellem *Catadoxides*-lagene og de overlejrende *Paradoxides*-lag. Forfatteren til det foreliggende arbejde mener, at sedimentationsafbrydelsen ligger på grænsen mellem Nedre Kambrium og Mellemkambrium, og at den svarer til den nedre del af *Plagiura-Poliella* zonen.

Som vist ovenfor svarer den nederste del af *Paradoxides forchhammeri* etagen, *Triplagnostus lundgreni-Goniagnostus nathorsti* zonen, til den øvre del af *Bathyuriscus-Elrathina* zonen. Forfatteren foreslår, at *Paradoxides paradoxissimus* etagen parallelliseres med den nedre del af *Bathyuriscus-Elrathina* zonen og det meste af *Glossopleura* zonen.

I den pacifiske provins er *Glossopleura* zonen den første til at nå den maksimale geografiske udbredelse fra Argentina til Nordvestgrønland. Der er her tale om en regional transgression af stor betydning, og man må tænke sig, at der er blevet etableret havforbindelser, som har tilladt visse tolerante trilobitslægter at migrere til andre områder. Forfatteren regner det for sandsynligt, at en slægt som *Dorypyge* de fleste steder dukker op i *Glossopleura* zonens tid. Dette gælder under alle omstændigheder i den cordilleriske region. I det baltiske område ses *Dorypyge* første gang på Bornholm i nederste del af *Paradoxides paradoxissimus* etagen (*Triplagnostus gibbus* zonen).

I Sibirien forekommer *Dorypyge* i *Oryctocephalus* zonen. KOBAYASHI (1943) delte Sibiriens Mellemkambrium i seks zoner. Disse er nedefra: *Erbia* zonen (*Erbia* = „*Paratollaspis*“), *Tollaspis* zonen, *Oryctocephalus* zonen, *Ciceragnostus* zonen, *Centropleura* zonen og *Solenoparia* zonen. KOBAYASHI mente, at der kunne være et slægtskab mellem *Tollaspis* faunaen og *Glossopleura* faunaen i Nordvestgrønland; dog indrømmede han, at der ikke forelå noget faunistisk vidnesbyrd. Forfatteren til det foreliggende arbejde mener indirekte at kunne korrelere *Oryctocephalus* zonen med *Glossopleura* zonen. De tre yngste zoner i Sibiriens Mellemkambrium hører til den atlantiske provins og kan uden videre henføres til *Paradoxides forchhammeri* etagen. *Centropleura* zonen må givetvis svare til den nedre del af *Bolaspidella* zonen, og den overlejrende *Solenoparia* zone må ækvivalere *Lejopyge laevigata* zonen, svarende til den øvre del af *Bolaspidella* zonen. Den nederste af de tre zoner, *Ciceragnostus* zonen, må da nødvendigvis svare til i det mindste en god del af *Bathyuriscus-Elrathina* zonen. *Oryctocephalus* zonen er den sidste af de sibiriske zoner med pacifisk affinitet. Ud fra den mulige korrelation af de overlejrende atlantiske zoner er det særdeles tænkeligt, at *Oryctocephalus* zonen ækvivalerer *Glossopleura* zonen. Ifølge forfatterens opfattelse falder *Tollaspis* zonen og *Erbia* zonen da indenfor *Eccaparadoxides oelandicus* etagen, som må svare til *Albertella* zonen og en del af *Plagiura-Poliella* zonen.

ENDO (1956) har foreslået *Oryctocephalus* zonen korreleret med Taitzuan etagen i Manchuriet, en del af Rinson etagen i Nordkorea, en del af Taiki gruppen i Sydkorea, Øvre Changhsian etage i Nordkina, Chinchiamiao-kalken i det centrale Kina, og *Manchuriella* -lagene i det sydlige Kina og Indo-Kina.

I Taitzuan etagen, Rinson etagen og Øvre Changhsian etage, alle hørende til Hwangho-bassinet, er arter af *Dorypyge* karakteristiske.

I Queensland og Northern Territory, Australien, optræder i nederste Mellemkambrium en fauna indeholdende *Redlichia* associeret med *Peronopsis* (ÖPIK, 1956a, side 8). Denne fauna går jævnt over i *Xystridura-Dinesus* faunaen, hvis slægter synes at tillade en korrelation med overgangen fra *Albertella* zonen til *Glossopleura* zonen. Samtidig angiver *Xystridura* faunaens indhold af agnostider (især *Triplagnostus gibbus*), at denne fauna svarer til øverste del af *Eccaparadoxides oelandicus* etagen og nederste del af *Paradoxides paradoxissimus* etagen i det skandinaviske område.

I Queensland optræder *Xystridura* faunaen umiddelbart over lag med *Redlichia chinensis*, og ÖPIK har foreslået en mellemkambrisk alder for østasiatiske aflejringer indeholdende samme art. Ifølge SAITO (1934) overlejres *Redlichia chinensis*-lagene i Nordkorea af „*Ptychoparia*"-lag med *Oryctocephalus*, *Pagetia* og *Peronopsis*. Öpik anser disse lag for at ækvivalere *Xystridura*-lagene i Queensland.

Således kan den nederste del af Taitzuan etagen (*Anomocarella-Ptychoparia* zonen) fra Hwangho-bassinet korreleres med overgangen fra *Albertella* zonen til *Glossopleura* zonen og samtidig med overgangen fra *Eccaparadoxides oelandicus* etagen til *Paradoxides paradoxissimus* etagen Forfatteren antager, at også *Oryctocephalus* zonen i Sibirien hører til på dette niveau.

I Queensland tilhører lagserien over *Xystridura -Dinesus* zonen den resterende del af *Paradoxides paradoxissimus* etagen samt *Paradoxides forchhammeri* etagen.

Sammenfattende kan det siges, at den mellemkambriske atlantisk-pacifiske korrelation skal ændres, således at de tre atlantiske etager tilsammen dækker det samme tidsinterval som de pacifiske zoner.

De af forfatteren foretrukne korrelationer fremgår af tavle 4.

Nedre- og mellemkambrisk Palæogeografi

Faunaen i den unge nedrekambriske Wulff River formation har atlantisk affinitet. Efter en sedimentationsafbrydelse blev Nordvestgrønland derpå en del af den pacifiske provins, og Cape Kent-kalken aflejredes. Hvis *Poulsenia*, som anført af Cowie (1961), virkelig optræder i Østgrønland, må der endnu på dette tidspunkt have bestået en forbindelse op til Nordvestgrønland. Cape Kent-kalkens ringe antal slægter tyder på delvis isolering fra de cordilleriske faunaer, og karakteristisk i denne forbindelse er, at flertallet af formerne fra Inglefield Land synes at være endemiske.

En ny sedimentationsafbrydelse fulgte, kun afbrudt af en formodentlig kortvarig transgression fra nordvest i *Plagiura-Poliella* zonens tid. Havet trak sig atter tilbage i tidsrummet svarende til *Albertella* zonen. Først *Glossopleura* transgressionen resulterede i betydelige aflejringer. Denne zones basalkonglomerat indeholder de fåtallige rester af *Plagiura-Poliella* zonen og desuden bemærkes, at *Glossopleura* optræder såvel i rullesten som i konglomeratets mellemmasse. Dette betyder, at *Glossopleura* zonen må være indledt af to transgressioner adskilt af en kort sedimentationsafbrydelse. Aflejringen fandt sted i littoralzonen eller lige udenfor. Det meget heterogene lagserie tyder på hyppige oscillationer af kystlinien. De samme ustabile betingelser var gældende over et stort område. Lagserien ved Devon Island viser ganske tilsvarende uregelmæssigheder (Kurtz, McNair & Wales, 1952).

På grund af ureglemæssighederne kan eventuelle mindre sedimentationsafbrydelser ikke konstateres, og det vides således ikke, om *Clava-*

spidella faunulen ved en lakune er adskilt fra den underlejrende *Glossopleura* faunule.

Grænsen mellem *Glossopleura* zonen og *Bathyuriscus-Elrathina* zonen er ikke iøjnefaldende i profilerne og kan reelt kun erkendes gennem faunaskiftet i lagene. Ikke desto mindre repræsenterer denne grænse en sedimentationsafbrydelse af en vis størrelse, idet allerede de nederste lag af den yngre zone indeholder *Glyphaspis parkensis*. Ifølge RASETTI (1951) er denne art begrænset til *Parkaspis endecamera* faunulen, der er den yngste kendte faunule i den øvre del af Stephen formationen ved Park Mountain. I Nordvestgønland forekommer arten gennem hele den tilstedeværende del af *Bathyuriscus-Elrathina* zonen.

Forekomsten af *Glyphaspis parkensis* og *Kootenia cf. billingsi* tyder på en mere åben forbindelse til andre faunaer og det står sikkert i forbindelse med, at den mellemkambriske transgression nåede sit maksimum her ved slutningen af *Bathyuriscus-Elrathina* zonens tid. Den yngste del af denne zones lag i Nordvestgrønland, Blomsterbæk-kalken, er adskilt fra zonens nedre lag af en kortvarig sedimentationsafbrydelse, som er markeret ved et tyndt konglomerat.

Lagene på Bache Peninsula svarer godt til aflejringerne i Inglefield Land. Dog er kun det nederste lag fra *Glossopleura* zonen fossilførende. Af *Bathyuriscus-Elrathina* zonens lag er kun Blomsterbæk-kalken udviklet.

Efter aflejringen af Blomsterbæk-kalken trak havet sig tilbage og den efterfølgende lakune omfatter *Bolaspidella* zonen og hele Øvre Kambrium. Den næste transgression fandt sted i Ordovicium.

Bemærkninger om lokaliteter og profiler

TROELSEN (1950) har givet en detailleret beskrivelse af de forskellige profiler og har angivet de niveauer, hvor *Glossopleura* zonens fauna optræder. Efter at faunaernes vertikale distribution nu er blevet revideret er nogle supplerende bemærkninger og ændringer blevet nødvendige. I skematisk form fremgår de foreslåede ændringer af tekstfigur 10.

Bache Peninsula (R.C.M.P. Post): Kun det basale lag af Cape Russell leddet er fossilførende (*Glossopleura* faunulen). Nederste del af *Bathyuriscus-Elrathina* zonen mangler, og kun Blomsterbæk-kalken med *Blainiopsis* faunulen er repræsenteret. I det profil, som er vist i figur 10, ligger grænsen mellem Cape Kent-kalken og *Glossopleura* zonen 219 meter over havet. Blomsterbæk-kalken findes mellem 245 og 250 meter.

Marshall Bugt lokalitet 1: Som i det øvrige Inglefield Land er lagene næsten horisontale. Grænserne for Cape Russell leddet ligger i henholdsvis 240 og 325 meters højde. Grænsen mellem *Glossopleura* zonen og *Bathyuriscus-Elrathina* zonen må ligge i ca. 290 meters højde. Blomsterbæk-kalken mangler tilsyneladende på denne lokalitet.

Marshall Bugt lokalitet 2: Cape Russell leddet optræder mellem 315 og 395 meter. De nederste 50 meter af lagserien indeholder *Glossopleura* faunulen. Fra den resterende del foreligger ikke fossiler og denne del korreleres tentativt med *Clavaspidella* faunulens lag.

Blomsterbækken: Overgrænsen for Cape Kent-kalken ligger i 90 meters højde. Ved 110 meter optræder *Glossopleura* faunulen, og fra dette niveau stammer også *Amecephalus* og *Fieldaspis*, som begge må være rester fra *Plagiura-Poliella* zonen. Lagene mellem 90 meter og 110 meter kan muligvis tilhøre ældre Mellemkambrium. Forfatteren har desværre ikke rådet over fossiler fra dette afsnit. Grænsen mellem *Glossopleura* zonen og *Bathyuriscus-Elrathina* zonen må ligge omkring 114 meter over havet. Blomsterbæk-kalkens undergrænse ligger ved 135 meter. Således mangler tilsyneladende lag svarende til *Clavaspidella* faunulen.

Kap Frederik VII: Profilet er tildels skjult af nedstyrtet materiale. Cape Russell leddet optræder fra ca. 120–170 meter over havet. TROELSEN's fossilførende lag nr. 1 har tidligere været regnet til Mellemkambrium, men må på grund af indholdet udelukkende af *Poulsenia* henføres til Nedre Kambrium. *Glossopleura* faunulen er ikke fundet faststående i profilet og er muligvis skjult af nedstyrtet materiale. I det materiale, som blev beskrevet af C. POULSEN i 1927, findes talrige eksemplarer af *Glossopleura* og *Polypleuraspis* (= „*Glossopleura longifrons*") indsamlet fra løse blokke på stranden under profilet. *Glossopleura* faunulen må høre hjemme mellem 130 og 140 meter. Grænsen mellem *Glossopleura* zonen og *Bathyuriscus-Elrathina* zonen ligger ca. 163 meter over havet. Blomsterbæk-kalken mangler. Fra 170 meters højde følger den ordoviciske Cass Fjord formation.

Det er interessant at *Glossopleura* faunulen og *Clavaspidella* faunulen kun optræder sammen ved Kap Frederik VII og muligvis ved Marshall Bugt lokalitet 2. De to faunuler kan ikke tænkes at repræsentere samtidige biofacies og fordelingen af fossilerne ved Kap Frederik VII angiver tydeligt at *Glossopleura* faunulen må være ældst. Dette passer også med, at *Glossopleura* faunuler ses at indlede *Glossopleura* zonen i andre områder af den pacifiske provins. LOCHMAN (1952, 1956b) har endda fra Sonora, Mexico, påvist *Glossopleura* i en overgangsfauna mellem *Albertella* zonen og *Glossopleura* zonen.

РЕЗЮМÉ

Нижне и средне-кембрийский материал окаменелостей, положенный в основу настоящего труда, был собран доктором J. C. Troelsen в 1939–1941 г.г. Кроме того, автором настоящего труда был проведен пересмотр старого материала, описанного C. Poulsen в 1927 г. Северо-западные местности в Гренландии, откуда происходят данные окаменелости, указаны на картах, рис. 1 и 2.

СИСТЕМАТИЧЕСКАЯ ПАЛЕОНТОЛОГИЯ

В этом разделе проведен пересмотр видов трилобита из Inglefield Land и Bache Peninsula. Выдвигаются четыре новых средне-кембрийских родов трилобитов (два алокистокарида, один птихопариид и один из неизвестного семейства) и девять новых видов. Описываются мераспидные стадии *Glossopleura* (рис. с текстом 3–4; табл.1, рис. 2–4) и рассматривается развитие личинок семейства *Dolichometopidae* (стр. 27–29).

ФАУНА В ИЗВЕСТНЯКЕ CAPE KENT

Мощность известняка Cape Kent варьирует между 10 и 20 метрами, причем он, повидимому, содержит только одну фаунулу. Все виды известняка указаны на стр. 60–61. Из отмеченных родов лишь *Hyolithes* и *Bristolia* известны с точностью вне пределов Гренландии.

Фауна *Cape Kent* была, по всей вероятности, лишь первоначально связана с кордильерскими фаунами. Данный бассейн был быстро изолирован, а затем возникла эндемическая фауна. Cowie (1961) указывает, что *Poulsenia* встречается также в верхней части свиты о. Ella Ø в Восточной Гренландии. Таким образом, существовала, вероятно, связь между Inglefield Land и центральной частью Восточной Гренландии.

Можно предполагать, что известняк Cape Kent соответствует верхней части свиты о. Ella Ø. Свита Wulff River, слои которой находятся под известняком Cape Kent, соответствует нижней части свиты о. Ella Ø и верхней части свиты Bastion. Как известняк Cape Kent, так и свиту Wulff River можно отнести к подзоне Верхнего *Olenellus*, однако, некоторая часть свиты Wulff River, относится, возможно, к подзоне Нижнего *Olenellus*.

СРЕДНЕ-КЕМБРИЙСКАЯ ФАУНА В СЕВЕРО-ЗАПАДНОЙ ГРЕНЛАНДИИ

Фауна в зоне *Plagiura* — *Poliella*.

Средне-кембрийская свита Cape Wood, слои которой находятся над известняком Cape Wood, начинается в большей части мест с базального конгломерата. В местности к западу от Blomsterbækken в конгломерате был найден отдельный экземпляр *Fieldaspis sp.*, *Amecephalus troelseni n. sp.*, а также экземпляр *Kochaspis? sp.*, свободно расположенный на более низком уровне. Все указывает на то, что эти экземпляры следует рассматривать как остатки эрозии из зоны *Plagiura* — *Poliella*. Пожалуй, можно считать, что пласты из этой зоны исчезли в период, соответствующий зоне *Albertella*.

Фауна в зоне *Glossopleura*.

Уже давно известно, что в северо-западной Гренландии существует зона *Glossopleura*; однако, выяснение истинного характера фауны было невозможным, в виду того обстоятельства, что несколько родов трилобита были отнесены к этой зоне. Troelsen (1950) подразделял свиту Cape Wood на две точно определенные пачки, которые были разделены друг от друга прекращением седиментации и тонким базальным конгломератом. Считали, что нижняя пачка Cape Russell соответствовала зоне *Glossopleura*, а расположенная сверху пачка известняка Blomsterbæk была представлена как параллель зоне *Blainiopsis* C. Poulsen'a, которую относили к более молодому среднему кембрию.

Автор настоящего труда тщательно изучал вертикальное распределение видов в различных профилях. Исследования показывают, что граница между зоной *Glossopleura* и зоной *Bathyuriscus* — *Elrathina* должна, по всей вероятности, находиться в пачке Cape Russell. Эта точка зрения соответствует также вертикальному распространению соответствующих фаун в кордильерском районе. Особый интерес представляет то обстоятельство, что *Glyphaspis parkensis* Rasetti встречается в Inglefield Land вместе с *Glyphaspis perconcava*, *Elrathiella*, *Acrocephalops* и *Blainiopsis*. Указанные выше формы, относящиеся к зоне *Bathyuriscus* — *Elrathina*, встречаются всегда на уровнях, очень ясно отделенных от уровней, содержащих фауну *Glossopleura.*

Все виды из зоны *Glossopleura* приведены на стр. 64. Вертикальное распределение видов показывает наличие двух отдельно друг от друга расположенных фаунул в зоне *Glossopleura.* Нижняя фаунула *Glossopleura* характеризуется, прежде всего, родами *Glossopleura* и *Polypleuraspis*, которые оба представлены многими экземплярами. Редкими элементами в этой фаунуле являются *Kootenia resseri*, *Ptychoparella*, *Poulseniella* и *Solenopleurella.*

Согласно Rasetti, только *Glossopleura* и *Polypleuraspis* представляют зону *Glossopleura* в Alberta и British Columbia. Очень возможно поэтому, что здесь развита только нижняя часть зоны *Glossopleura*, соответствующая фаунуле *Glossopleura.* В этой связи интересно отметить, что Rasetti (1951, стр. 108) намекает на возможное прекращение седиментации в свите Stephen.

Виды фаунулы *Clavaspidella* указаны на стр. 64. Эта фаунула встречается в известняке и в песчаных известняках, что полностью соответствует седиментам, которые содержат фаунулу *Glossopleura.* Обе фаунулы принадлежат к кратоническим биофациям, причем то же самое можно сказать и о зоне *Bathyuriscus — Elrathina.* В этой связи является весьма характерным отсутствие представителей семейств *Oryctocephalidae*, *Ogygopsidae* и *Pagetidae.*

Фауна в зоне *Bathyuriscus — Elrathina.*

Виды трилобитов из этой зоны указаны на стр. 66. Повидимому, зона *Bathyuriscus — Elrathina* содержит меньше видов, чем зона *Glossopleura* но, с другой стороны, число индивидов, в общем и целом, больше.

Многие фаунулы в зоне *Bathyuriscus — Elrathina* невозможно с точностью отличить друг от друга. Преобладающие роды *Glyphaspis* и *Acrocephalops*, повидимому, равномерно распределены по серии слоев. *Elrathiella* показывает тенденцию к концентрации в верхних слоях зоны, а *Blainiopsis* встречается исключительно в межзональном конгломерате, отделяющем известняк Blomsterbæk от пачки Cape Russell. Возможно, пожалуй, сказать, что известняк Blomsterbæk характеризуется фаунулой *Blainiopsis.*

Так же, как в зоне *Glossopleura*, в слоях зоны *Bathyuriscus — Elrathina* отсутствуют настоящие миогео-синклинальные представители.

Kootenia cf. *billingsi* представляет интерес своей афиннитивностью в конгломератную фауну под Quebec. Этот ордовикский конгломерат, о котором Rasetti упоминает в нескольких трудах, содержит валуны средне-кембрийского века. Некоторые из валунов содержат только один отдельный вид, поэтому трудно будет провести точную корреляцию. Это касается также *Kootenia billingsi*; но, судя по появлению этого вида в Северо-западной Гренландии, его несомненно можно отнести к зоне *Bathyuriscus — Elrathina.*

Как *Kootenia* cf. *billingsi* так и *Glyphaspis parkensis* показывают, повидимому, что связь с другими фаунами вне пределов Гренландии была более открытой в период зоны *Bathyuriscus — Elrathina*; однако, эта связь продолжалась, по всей вероятности, очень недолго.

Рисунок с текстом 9, стр. 67, отражает в схематической форме развитие северо-западно-гренландского среднего кембрия.

СРЕДНЕ-КЕМБРИЙСКАЯ ТИХООКЕАНСКО-АТЛАНТИЧЕСКАЯ КОРРЕЛЯЦИЯ

В нескольких случаях были сделаны попытки установить корреляцию между тихоокеанской и атлантической фаунами в среднем кембрии. В частности, Howell содействовал сбору материала, который мог осветить эту проблему. Автор настоящего труда придерживается, однако, того мнения, что лишь самые молодые средне-кембрийские фауны коррелированы удовлетворительно. Многие важные выводы были основаны на неправильно определенных родах трилобитов, стратиграфическая позиция которых в некоторых случаях даже не точно ограничена.

Фауна *Centropleura vermontensis*, описанная Howell (1937), Vermont, интересна тем, что она содержит *Centropleura* вместе с *Elyx* и *Bolaspidella.* Howell рассматривал эту фауну как немного более молодую, чем фауна *Paradoxides forchhammeri.*

C. Poulsen (1960, стр. 38) подвергал дискуссии фауну из Mendoza, Аргентина. Он подчеркивал, что в Скандинавии переход от среднего кембрия к верхнему кембрию является совершенно равномерным, и что самый молодой возможный эквивалент фауне *Centropleura vermontensis* является, следовательно, зона *Lejopyge laevigata.* В виду того, что фауна Vermont представляется самой родственной к формам из зоны *Jincelle brachymetopa* и в виду того, что *Elyx* не встречается в Скандинавии по этой зоне, то фауну Vermont следует поставить параллельно с зоной *Jincella brachymetopa.*

В тихоокеанской провинции речь идет об идеальном переходе от среднего кембрия к верхнему кембрию. *Bolaspidella* встречается еще в нижней части верхнего кембрия. Исходя из указанных выше соображений, автор настоящего труда считает, что будет обоснованным коррелировать зону *Bolaspidella* с атлантической зоной *Jincella brachymetopa* и с зоной *Lejopyge laevigata.* Нижняя зона яруса *Paradoxides forchhammeri*, зона *Triplagnostus lundgreni — Goniagnostus* *nathorsti* должны, следовательно, при всех обстоятельствах соответствовать, во всяком случае, верхней части зоны *Bathyuriscus — Elrathina.*

HOWELL и MASON (1938) коррелировали фауну *Paradoxides bennetti* из Manuels, Ньюфаундленд, с зоной *Glossopleura* и зоной *Bathyuriscus — Elrathina.* Сравнение было основано на месторождении *Ehmania* и *Dawsonia.* Как было доказано WHEELER (1941), "*Ptychoparia*" *rogersi* нельзя отнести к *Ehmania*. Сейчас также известно, что месторождение *Dawsonia* ограничено атлантической провинцией и, следовательно, не встречается в Nevada, как полагают HOWELL и MASON. В виду того, что фауна *Paradoxides bennetti* является эквивалентом фауне *Eccaparadoxides oelandicus*, атлантическая провинция, согласно только что указанной корреляции, содержит, повидимому, лакуну, соответствующую зоне *Plagiura — Poliella*, зоне *Albertella* и некоторой части зоны *Glossopleura.*

После того, как WHEELER (1941) превратил "*Ptychoparia*" *rogersi* в генотип новому роду *Braintrella*, то не осталось никакой реальной основы для атлантическо-тихоокеанской корреляции; однако, эта корреляция все же отмечалась в кембрийской корреляционной схеме (HOWELL и др., 1944). HUTCHINSON (1952) описывал из Cape Breton Island фауну, относящуюся к обществу *Paradoxides hicksi.* Из этой фауны он выдвинул вид тихоокеанского *Acrocephalops.* В виду же того, что *Acrocephalops* как предполагалось, относится к зоне *Glossopleura*, HUTCHINSON предложил фауну *Paradoxides hicksi* считать немного старше, чем это указано в кембрийской корреляционной схеме от 1944 г.

Автор настоящего труда доказывает, что гренландский генотип *Acrocephalops* встречается только в зоне *Bathyuriscus — Elrathina.* Кроме того, на стр. 53 объясняется, что вид HUTCHINSON ни в коем случае нельзя отнести к *Acrocephalops.*

HOWELL (1943) отнес вид свиты Cloud Rapids к *Glyphaspis.* Но этот вид, по всей вероятности, придется исключить из этого рода. Общество Cloud Rapids сравнивали с фауной северо-западно-гренландской свиты Cape Wood, которую в то время считали принадлежащей исключительно к зоне *Glossopleura.* Для автора настоящего труда не существует никакого сомнения в том, что свиту Cloud Rapids и немного более молодую свиту Treytown Pond следует отнести к зоне *Bathyuriscus — Elrathina*, и что возможная лакуна под свитой March Point которая содержит фауну *Bolaspidella*, является, поэтому менее важной, чем это предполагалось ранее.

LOCHMAN и WILSON (1958) придерживались, повидимому, атлантическо-тихоокеанской корреляции, основанной на результатах HOWELL. Они заявляли, что седиментация не начиналась в acadoбалтийском районе до середины среднего кембрия. В атлантической схеме они ввели ярус *Catadoxides* как эквивалент зоне *Plagiura — Poliella*, зоне *Albertella* и нижней части зоны *Glossopleura*.

Слои с *Catadoxides* из Avalon Peninsula в Ньюфаундленде, обычно относят к нижне-кембрийскому веку, причем автор настоящего труда придерживается такой же точки зрения. *Catadoxides* имеет парадоксидную величину, но, помимо этого, очень напоминает *Protolenidae*. Таким образом, от *Catadoxides* до *Paradoxides* имеется большой скачок в развитии. Hutchinson (1956, 1962) обнаружил прекращение седиментации между слоями *Catadoxides* и расположенными сверху слоями *Paradoxides*. Автор настоящего труда считает, что прекращение седиментации расположено на границе между нижним кембрием и средним кембрием, и что оно соответствует нижней части зоны *Plagiura — Poliella*.

Как указано выше, нижняя часть яруса *Paradoxides forchhammeri*, зона *Triplagnostus lundgreni — Goniagnostus nathorsti* соответствует верхней части зоны *Bathyuriscus — Elrathina*. Автор настоящего труда предлагает поставить ярус *Paradoxides paradoxissimus* параллельно нижней части зоны *Bathyuriscus — Elrathina* и большей части зоны *Glossopleura*.

В тихоокеанской провинции зона *Glossopleura* является первой, достигнувшей максимального географического распространения от Аргентины до северо-западной Гренландии. В этом отношении речь идет о региональной трансгрессии большого значения, и следует предполагать, что были установлены морские связи, допускавшие известные толерантные роды трилобитов к миграции в другие области. Автор настоящего труда считает вероятным, что такой род как *Dorypyge* в большинстве мест появляется в период зоны *Glossopleura*. Это касается, при всех обтоятельствах, кордильерского района. В прибалтийской области *Dorypyge* наблюдается впервые на Борнхольме в нижней части яруса *Paradoxides paradoxissimus* (зона *Triplagnostus gibbus*).

В Сибири *Dorypyge* встречается в зоне *Oryctocephalus*. Kobayashi (1943) подразделял средний кембрий Сибири на шесть зон. Снизу эти зоны будут следующими: зона *Erbia* (*Erbia* = "*Paratollaspis*"), зона *Tollaspis*, зона *Oryctocephalus*, зона *Ciceragnostus*, зона *Centropleura* и зона *Solenoparia*. Kobayashi считал, что между фауной *Tollaspis* и фауной *Glossopleura* в северо-западной Гренландии имеется, возможно, родство: однако, он признавал, что в этом отношении нет никакого фаунистического свидетельства. Автор настоящего труда считает, что косвенным образом можно коррелировать зону *Oryctocephalus* с зоной *Glossopleura*. Все три самые молодые зоны среднего кембрия в Сибири принадлежат к атлантической провинции и, безусловно, их можно отнести к ярусу *Paradoxides forchhammeri.* Зона *Centropleura* бесспорно соответствует нижней части зоны *Bolaspidella*, а расположенную сверху зону *Solenoparia* следует эквивалировать зоне *Lejopyge laevigata*, соответствующей верхней части зоны *Bolaspidella.* Самая нижняя из этих трех зон, а именно зона *Ciceragnostus*, должна, в таком случае, соответствовать хотя бы довольно большой части зоны *Bathyuriscus* — *Elrathina.* Зона *Oryctocephalus* является последней из сибирских зон с тихоокеанской аффинностью. Исходя из возможной корреляции расположенных сверху атлантических зон, весьма возможно представить себе, что зона *Oryctocephalus* эквивалирует зоне *Glossopleura.* По убеждению автора настоящего труда, зона *Tollaspis* и зона *Erbia* размещены, поэтому, в пределах яруса *Eccaparadoxides oelandicus*, который, вероятно, соответствует зоне *Albertella* и некоторой части зоны *Plagiura* — *Poliella.*

ENDO (1956) предложил коррелировать зону *Oryctocephalus* с ярусом Taitzuan в Манджурии, с некоторой частью яруса в Северной Корее, с некоторой частью серии Taiki в Южной Корее, с ярусом Верхнего Changhsian в Сев. Китае, с известняком Chinchiamiao в центральном Китае и слоями *Manchuriella* в Южном Китае и в Индокитае.

В ярусе Taitzuan, в ярусе Rinson и ярусе Верхнего Changhsian, которые принадлежат к бассейну Hwangho, виды *Dorypyge* являются характерными.

В Queensland и Northern Territory, в Австралии в нижнем среднем кембрии встречается фауна, содержащая Redlichia, ассоциированную с *Peronopsis* (ÖPIK, 1956a, стр. 8). Эта фауна равномерно переходит в фауну *Xystridura* — *Dinesus*, роды которой, повидимому, допускают корреляцию с переходом из зоны *Albertella* в зону *Glossopleura.* Одновременно, содержание агностидов (в особенности *Triplagnostus gibbus*) в фауне *Xystridura* указывает на то, что эта фауна соответствует верхней части яруса *Eccaparadoxides oleandicus* и нижней части яруса *Paradoxides paradoxissimus* в скандинавской области.

В Queensland фауна *Xystridura* встречается непосредственно над слоем *Redlichia chinensis* и ÖPIK предложил среднекембрийский век для восточно-азиатских отложений, содержащих тот же вид. Согласно SAITO (1934) над слоями *Redlichia chinensis* в Сев. Корее расположены слои "*Ptychoparia*" с *Oryctocephalus*, *Pagetia* и *Peronopsis.* ÖPIK считает эти слои эквивалентными слоям *Xystridura* в Queensland.

Таким образом, нижняя часть яруса (*Anomocarella* — *Ptychoparia*) из бассейна Hwangho может быть коррелирована с переходом из зоны *Albertella* в зону *Glossopleura* и, одновременно, с переходом от яруса *Eccaparadoxides oelandicus* к ярусу *Paradoxides paradoxissimus*. Автор полагает, что и зона *Oryctocephalus* в Сибири принадлежит к этому уровню.

В Queensland серия слоев над зоной *Xystridura* — *Dinesus* принадлежит к остаткам яруса *Paradoxides paradoxissimus* а также яруса *Paradoxides forchhammeri*.

В общем изложении можно сказать, что средне-кембрийскую атлантическо-тихоокеанскую корреляцию следует изменить с тем, чтобы все атлантические яруса вместе покрыли тот же интервал времени, как и тихоокеанские зоны.

Предпочитаемые автором настоящего труда корреляции указаны в схеме 1, табл. 4.

НИЖНЕ- И СРЕДНЕ-КЕМБРИЙСКАЯ ПАЛЕОГРАФИЯ

Фауна в молодой нижне-кембрийской свите Wulff River имеет атлантическую аффинитивность. После прекращения седиментации северо-западная Гренландия стала частью тихоокеанской провинции и произошло отложение известняка Cape Kent. Если же, как это указывает Cowie (1961) *Poulsenia* действительно встречается в восточной Гренландии, то следует предполагать, что еще в этот период времени существовала связь с северо-западной Гренландией. Небольшое число родов известняка Cape Kent свидетельствует о частичной изоляции от кордильерских фаун, причем характерным в этой связи является то, что большинство форм из Inglefield Land являются, как будто эндемическими.

Затем последовало новое прекращение седиментации, приостановленное только, по всей вероятности, краткосрочной трансгрессией с северо-запада в период зоны *Plagiura* — *Poliella*. Море снова отошло назад в период, соответствующий зоне *Albertella*. И лишь в результате трансгрессии *Glossopleura* получились значительные отложения. Базальный конгломерат этой зоны содержит немногочисленные остатки зоны *Plagiura* — *Poliella* и, кроме того, отмечается, что *Glossopleura* встречается как в валунах, так и в средней массе конгломерата. Это означает, что зона *Glossopleura* началась, повдимому, с двух трансгрессий, отделенных коротким прекращением седиментации. Отложение произошло в литоральной зоне или непосредственно вне ее. Крайне гетерогенная серия слоев свидетельствует о частых осцилляциях береговой линии. Такие же нестабильные условия существовали на протяжении большой области. Серия слоев под Devon Island показывает совершенно соответствующие нерегулярности (Kurtz, McNair & Wales, 1952).

В виду отмеченных нерегулярностей нельзя констатировать возможные небольшие прекращения седиментации и, таким образом, неизвестным является то обстоятельство, отделена ли фаунула *Clavaspidella* лакуной от расположенной внизу фаунулы *Glossopleura*.

Граница между зоной *Glossopleura* и зоной *Bathyuriscus — Elrathina* не бросается в глаза в профилях и, фактически, ее можно отметить только путем смены фауны в слоях. Тем не менее, эта граница представляет собой прекращение седиментации известной величины, в виду того, что уже самые низшие слои более молодой зоны содержат *Glyphaspis parkensis*. Согласно Rasetti (1951) этот вид ограничивается фаунулой *Parkaspis endecamera*, которая является самой молодой из известных фаунул в верхней части свиты Stephen у Park Mountain. В северо-западной Гренландии этот вид встречается на всем протяжении существующей части зоны *Bathyuriscus — Elrathina*.

Месторождение *Glyphaspis parkensis* и *Kootenia* cf. *billingsi* свидетельствует о более открытой связи с другими фаунами, а это объясняется, по всей вероятности, тем, что среднекембрийская трансгрессия достигла здесь своего максимума в конце периода зоны *Bathyuriscus — Elrathina*. Самая молодая часть слоя этой зоны в северо-западной Гренландии, известняк Blomsterbæk отделен от нижнего слоя зоны краткосрочным прекращением седиментации, отмеченным тонким конгломератом.

Слои на Bache Peninsula хорошо соответствуют отложениям в Inglefield Land. Однако, лишь нижний слой зоны *Glossopleura* несет в себе окаменелости. Из слоев зоны *Bathyuriscus — Elrathina* развит только известняк Blomsterbæk.

После отложения известняка Blomsterbæk море отступило назад, а последовавшая вслед за этим лакуна охватывает зону *Bolaspidella* и весь верхний кембрий. Следующая трансгрессия произошла в Ордовициуме.

НЕКОТОРЫЕ ЗАМЕЧАНИЯ ОТНОСИТЕЛЬНО МЕСТНОСТЕЙ И ПРОФИЛЕЙ

Troelsen (1950) дал детальное описание различных профилей и указал те уровни, на которых встречается фауна зоны *Glossopleura*. Таким образом, после пересмотра вертикальной дистрибуции этих фаун, сейчас стали необходимыми некоторые дополнения и изменения. В схематической форме предложенные изменения следуют из текста с рисунком 10.

Bache Peninsula (R. C. M. P. Post): Только базальный слой пачки Cape Russell несет в себе окаменелости (фаунула *Glossopleura*).

Нижняя часть зоны *Bathyuriscus — Elrathina* отсутствует, представлены лишь известняк Blomsterbæk с фаунулой *Blainiopsis*. В профиле, показанном на рис. 10, граница находится между известняком Cape Kent и зоной *Glossopleura* 219 метров над уровнем моря. Известняк Blomsterbæk встречается между 245 и 250 метрами.

Marshall Bugt lokalitet 1: Как и в прочей Inglefield Land здесь слои почти горизонтальные. Границы пачки Cape Russell находятся соответственно на высоте 240 и 325 метров. Граница между зоной *Glossopleura* и зоной *Bathyuriscus — Elrathina* находится, по всей вероятности, на высоте прибл. 290 метров. В этой местности известняк Blomsterbæk, повидимому, отсутствует.

Marshall Bugt lokalitet 2: Пачка Cape Russell появляется между 315 и 395 метрами. Самые нижние 50 метров серии слоев содержат фаунулу *Glossopleura*. От остальной части не сохранилось никаких окаменелостей, и эта часть коррелируется тентативно со слоем фаунулы *Clavaspidella*.

Blomsterbækken: Верхняя граница известняка Cape Kent находится на высоте 90 метров. На высоте 110 метров встречается фаунула *Glossopleura* и отсюда же происходят также *Amecephalus* и *Fieldaspis*, которые являются, очевидно, остатками от зоны *Plagiura — Poliella*. Слои между 90 и 110 метрами принадлежат, возможно, к более старому среднему кембрию. К сожалению, автор настоящего труда не располагал окаменелостями из этого участка. Вероятно, граница между зоной *Glossopleura* и зоной *Bathyuriscus — Elrathina* находится, примерно, на высоте 114 метров над уровнем моря. Нижняя граница известняка Blomsterbæk находится на высоте 135 метров. Таким образом, отсутствует, повидимому, слой, соответствующий фаунуле *Clavaspidella*.

Kap Frederik VII: Профиль частично скрыт обрушившимся материалом. Пачка Cape Russell встречается, примерно, на высоте 120–170 метров над уровнем моря. Несущий в себе окаменелости слой TROELSEN'а ранее был отнесен к среднему кембрию, но в виду содержания исключительно *Poulsenia*, его следует отнести к нижнему кембрию. Фаунулу *Glossopleura* не нашли твердостоящей в профиле, она, возможно, скрыта обрушившимся материалом. В материале, описанном C. POULSEN в 1927 г., встречаются многочисленные экземпляры *Glossopleura* и *Polypleuraspis* (= "*Glossopleura longifrons*"), собранные с блоков, свободно расположенных на берегу под профилем. Фаунула *Glossopleura* относится, к высоте между 130 и 140 метрами. Граница между зоной *Glossopleura* и зоной *Bathyuriscus — Elrathina* расположена, примерно, на высоте 163 метров над уровнем моря. Известняк Blomsterbæk отсутствует. С высоты 170 метров следует ордовицкая свита Cass Fjord.

Интересно то, что фаунула *Glossopleura* и фаунула *Clavaspidella* встречаются вместе только у Kap Frederik VII и, возможно, в местности 2 Marshall Bugt. Эти две фаунулы не могут все же, судя по всему, представлять одновременные биофации, и распределение окаменелостей у Kap Frederik VII ясно показывает, что фаунула *Glossopleura* является самой старшей. Это соответствует также тому, что фаунула *Glossopleura* положила начало зоне *Glossopleura* в других областях тихоокеанской провинции. LOCHMANN (1952, 1956b) даже в Sonora в Мексике указал на наличие *Glossopleura* в переходной фауне между зоной *Albertella* и зоной *Glossopleura*.

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Færdig fra trykkeriet den 28. januar 1964.

PLATES

Plate 1.

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Fig. 1. *Clavaspidella ovaticauda n. sp.* 24
Pygidium (MMH no. 9297) holotype, X 3. *Glossopleura* zone, Kap Frederik VII.

— 2–4. *Glossopleura walcotti* POULSEN 25
Meraspides. 2: Early meraspid cranidium (MMH no. 9298), X 30; 3: Intermediate meraspid stage, cranidium (MMH no. 9299), X 35; 4: Late meraspid pygidium (MMH no. 9300), X 15. *Glossopleura* zone, Kap Frederik VII.

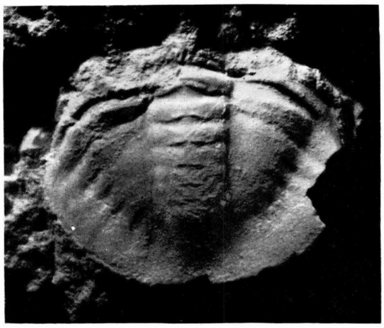
— 5. *Glossopleura teres n. sp.* 29
Pygidium (MMH no. 9301) (cast), holotype, X 3. *Glossopleura* zone, west of Blomsterbækken.

— 6–7. *Poliellina? sp.* 30
Lateral and dorsal view of cranidium (MMH no. 9302) (cast), X 3. *Bathyuriscus* — *Elrathina* zone, west of Blomsterbækken.

— 8. *Kootenia cf. billingsi* RASETTI 33
Pygidium (MMH no. 9303) (cast), X 3. *Bathyuriscus* — *Elrathina* zone, west of Blomsterbækken.

— 9. *Fieldaspis sp.* 34
Fragmentary pygidium (MMH no. 9304), X 3. *Plagiura* — *Poliella* zone, west of Blomsterbækken.

— 10. *Zacanthoides ulo n. sp.* 35
Cranidium (MMH no. 9305), holotype, X 3. In the lower right hand corner a fragmentary meraspid cranidium of the same species is seen. *Bathyuriscus* — *Elrathina* zone, Marshall Bugt loc. 1.



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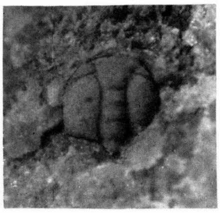

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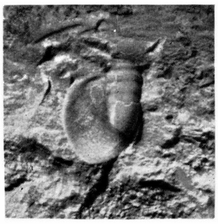

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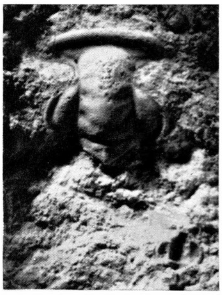

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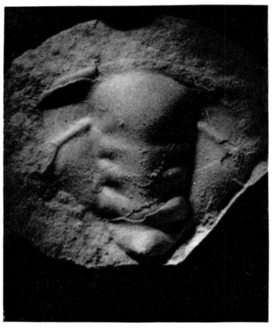

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Plate 2.

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Fig. 1–6. *Poulseniella groenlandica n. gen. et n. sp.* 37
1–3: Dorsal, lateral, and frontal view of cranidium (MMH no. 9306) (cast), holotype, X 3. 4–6: Dorsal, lateral, and frontal view of cranidium (MMH no. 9307) (cast), X 3. *Glossopleura* zone, east of Blomsterbække n.

— 7–9. *Alokistocare pronum n. sp.* 40
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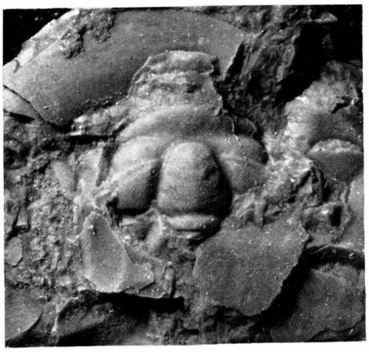
— 10–11. *Amecephalus troelseni n. sp.* 42
Dorsal and lateral view of cranidium (MMH no. 9309) (cast), holotype, X 3. *Plagiura* — *Poliella* zone, west of Blomsterbækken.



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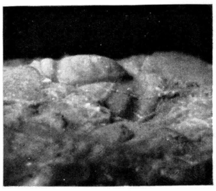

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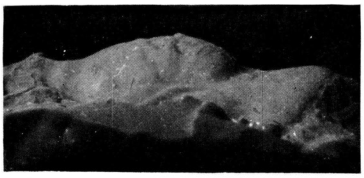

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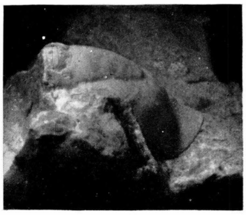

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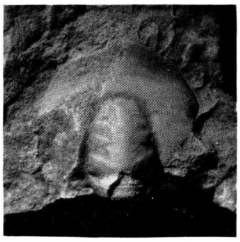

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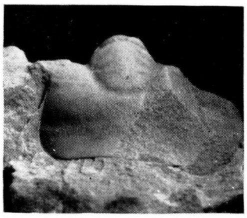

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Plate 3.

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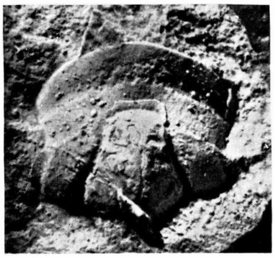
Fig. 1–3. *Nanoqia arctica n. gen. et n. sp.* 45
Dorsal, lateral, and frontal view of cranidium (MMH no. 9310) (cast), holotype, X 3. *Glossopleura* zone, Kap Frederik VII.

— 4–6. *Phymaspis dignata n. gen. et n. sp.* 47
Frontal, dorsal, and lateral view of fragmentary cranidium (MMH no. 9311), holotype, X 3. *Bathyuriscus* — *Elrathina* zone, Marshall Bugt loc. 1.

— 7. *Kochaspis? sp.* 49
Fragmentary pygidium (MMH no. 9312) (cast), X 3, *Plagiura* — *Poliella* zone, west of Blomsterbækken.

— 8–9. *Glyphaspis parkensis* Rasetti 51
8: Fragmentary cranidium (MMH no. 9313) (cast), X 3. 9: Pygidium (MMH no. 9314) (cast), X 3. *Bathyuriscus* — *Elrathina* zone, west of Blomsterbækken.

— 10–16. *Fastigaspis princeps n. gen. et n. sp.* 55
10–12: Frontal, lateral, and dorsal view of large cranidium (MMH no. 9315) (cast), X 3. 13: Fragmentary cranidium (MMH no. 9316), X 3. 14: Small cranidium (MMH no. 9317), holotype, X 3. 15: Fragmentary cranidium (MMH no. 9318), X 3. 16: Posterior area of fixigenae (MMH no. 9319), X 3. *Bathyuriscus* — *Elrathina* zone, Kap Frederik VII.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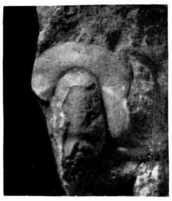
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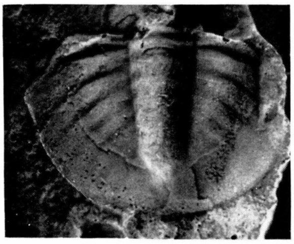
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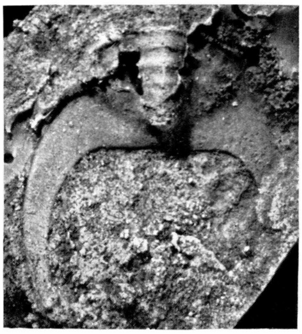
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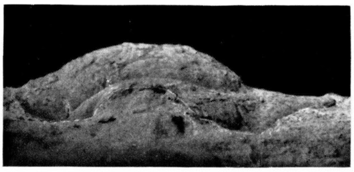
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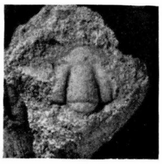
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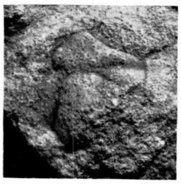
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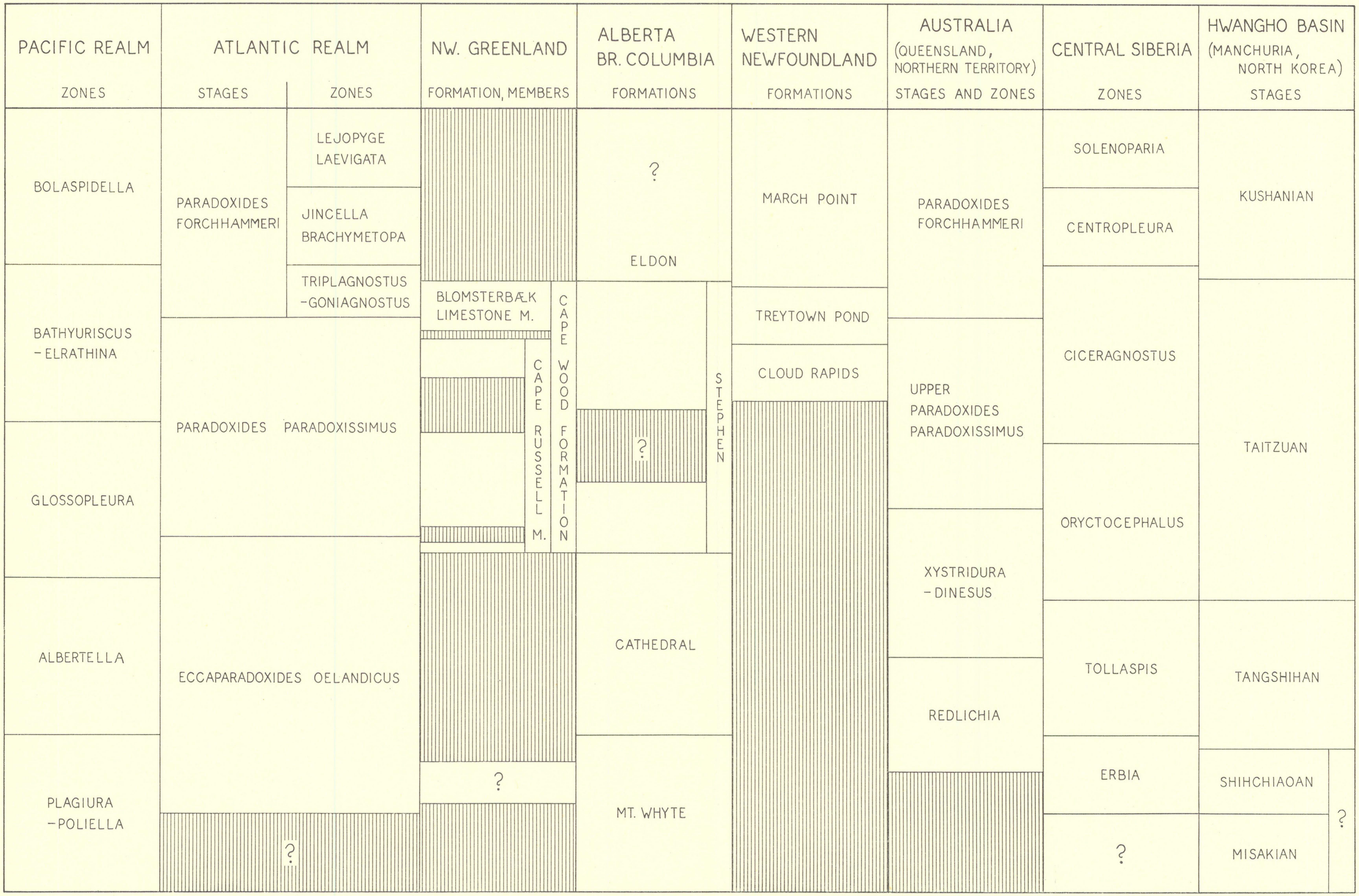
CORRELATION OF MIDDLE CAMBRIAN FAUNIZONES, STAGES, AND FORMATIONS



PACIFIC REALM	ATLANTIC REALM		NW. GREENLAND	ALBERTA BR. COLUMBIA	WESTERN NEWFOUNDLAND	AUSTRALIA (QUEENSLAND, NORTHERN TERRITORY)	CENTRAL SIBERIA	HWANGHO BASIN (MANCHURIA, NORTH KOREA)
ZONES	STAGES	ZONES	FORMATION, MEMBERS	FORMATIONS	FORMATIONS	STAGES AND ZONES	ZONES	STAGES
BOLASPIDELLA BATHYURISCUS - ELRATHINA GLOSSOPLEURA ALBERTELLA PLAGIURA - POLIELLA	PARADOXIDES FORCHHAMMERI PARADOXIDES PARADOXISSIMUS ECCAPARADOXIDES OELANDICUS ▥ ?	LEJOPYGE LAEVIGATA JINCELLA BRACHYMETOPA TRIPLAGNOSTUS -GONIAGNOSTUS PARADOXIDES PARADOXISSIMUS ECCAPARADOXIDES OELANDICUS ▥ ?	▥ BLOMSTERBÆK LIMESTONE M. — CAPE WOOD FORMATION ▥ CAPE RUSSELL M. (▥, ▥) — CAPE WOOD FORMATION ▥ ? ▥	? ELDON STEPHEN (▥ ?) CATHEDRAL MT. WHYTE	MARCH POINT TREYTOWN POND CLOUD RAPIDS ▥	PARADOXIDES FORCHHAMMERI UPPER PARADOXIDES PARADOXISSIMUS XYSTRIDURA - DINESUS REDLICHIA ▥	SOLENOPARIA CENTROPLEURA CICERAGNOSTUS ORYCTOCEPHALUS TOLLASPIS ERBIA ?	KUSHANIAN TAITZUAN TANGSHIHAN SHIHCHIAOAN ? MISAKIAN ?