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# CONTRIBUTION TO THE PALAEONTOLOGY OF THE LOWER CAMBRIAN WULFF RIVER FORMATION

BY

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WITH 2 FIGURES IN THE TEXT AND 7 PLATES

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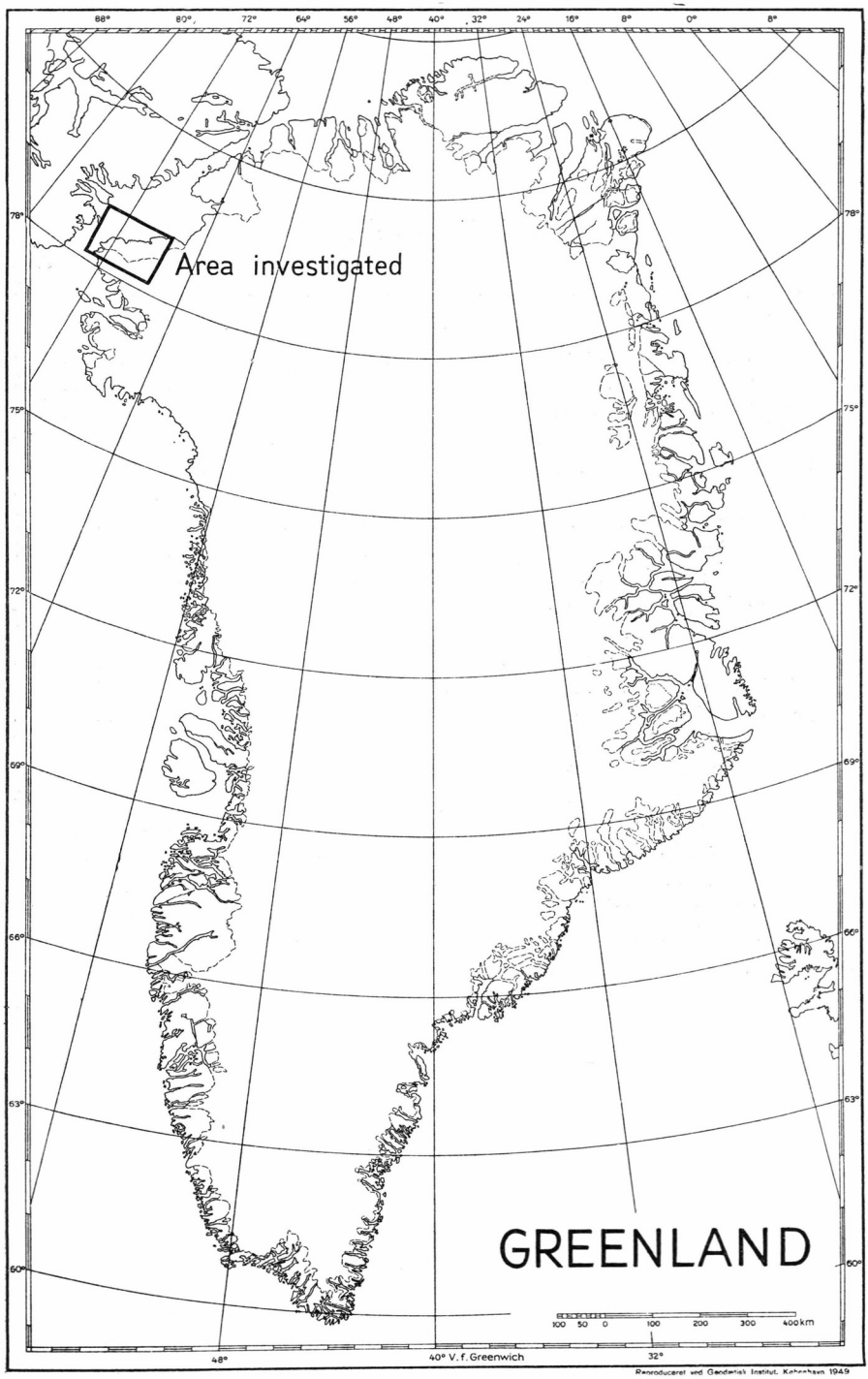


Fig. 1. Map of Greenland, showing the location of the region represented by the special map (fig. 2).

# PREFACE

The fossils described and discussed in the present paper was collected by Dr. J. C. TROELSEN of the Mineralogical and Geological Museum of the University of Copenhagen during visits to Inglefield Land in 1939 and 1941.

The writer is greatly indebted to Dr. TROELSEN for placing this interesting material at his disposal for study and publication.

The fossils are preserved in the Mineralogical and Geological Museum of the University of Copenhagen. All figures accompanying this paper are photographs taken by the writer. The prints, which were made with great care and ability by Mr. C. HALKIER, have been slightly retouched by the writer, when necessary in order to bring out characters which failed to appear in the photographs.

# INTRODUCTION

TROELSEN (1956) has characterized the Wulff River formation as follows: "The formation is known only from the north coast of Inglefield Land. It rests with normal erosional contact upon the Cape Ingersoll dolomite of the Thule formation (or group), and the contact toward the overlying Cape Kent limestone is also a simple disconformity. The formation is made up of alternating layers of grey hard limestone, grey calcareous sandstone, and very thin layers of conglomerate with small pebbles of limestone, quartz, and (according to L. KOCH, 1929) diabase and brown fossiliferous sandstone[1]). The combined thickness is 20—35 metres".

Before TROELSEN's material was studied, the known fauna was composed of the following species:

*Paterina lata* (POULSEN)[2])
*Obolus*? sp.
*Botsfordia caelata* (HALL)
*Acrothele*? *pulchra* POULSEN[2])
*Salterella expansa* POULSEN
— sp. ind.
*Strenuaeva*? *groenlandica* (POULSEN)
*Callavia breviloba* POULSEN[3])
*Olenellus arcticus* POULSEN[4])

TROELSEN's collection contains the following species:

*Kutorgina reticulata* POULSEN
*Salterella expansa* POULSEN
*Olenellus carinatus* n. sp.
— *laevis* n. sp.
— *troelseni* n. sp.

[1]) The occurrence of fossiliferous sandstone pebbles in the conglomerates was pointed out by the present writer (1927).

[2]) This species occurs in the brown sandstone pebbles, and, accordingly, must belong to an older stratigraphic unit (= Police Post limestone of Ellesmere Island).

[3]) Possibly referable to *Paedeumias*.

[4]) Probably referable to *Wanneria*.

*Paedeumias groenlandicus* n. sp.
— sp. ind.
— ? *macrophthalmus* n. sp.
— sp. ind.
*Holmia mirabilis* n. sp.
*Wanneria abnormis* n. sp.
— *inermis* n. sp.
— *mediocris* n. sp.
— *ruginosa* n. sp.
— *subglabra* n. sp.
— *troelseni* n. sp.
— ? sp.
*Bonnia arctica* n. sp.
Indeterminable fragments (mostly Olenellidae).

It deserves notice that TROELSEN's collection has only one species in common with the material described by the writer in 1927, viz. *Salterella expansa*. This remarkable difference may be explained as occurrence of two stratigraphically distinct faunules in the Wulff River formation, or it may be due to different lithological facies; the majority of the fossils described in 1927 was found in impure sandy limestone, whereas those collected by TROELSEN are confined to fairly pure limestone.

As pointed out by the writer (1932, 1956), the Wulff River formation is a probable stratigraphic equivalent of the Ella Island formation of East Greenland; the occurrence of *Kutorgina reticulata* in addition to several species of *Olenellus*, *Paedeumias*, and *Wanneria* confirms this view.

The distribution of the Wulff River fauna species in Greenland is as follows:

The material described in 1927 (POULSEN, 1927) originates from Wulffs Elv.

The species described in the present paper have been found in the following localities:

*Kutorgina reticulata* POULSEN: W. of Blomsterbækken; south coast of Ella Ø (East Greenland).

*Salterella expansa* POULSEN: Marshall Bugt, locality 1—2; W. of Blomsterbækken; Wulffs Elv.

*Olenellus carinatus* n. sp.: W. of Blomsterbækken.
— *laevis* n. sp.: W. of Blomsterbækken.
— *troelseni* n. sp.: W. of Blomsterbækken.

*Paedeumias groenlandicus* n. sp.: Marshall Bugt, locality 2.
— sp. ind.: Marshall Bugt, locality 1; W. of Blomsterbækken.
— ? *macrophthalmus* n. sp.: Marshall Bugt, locality 1.

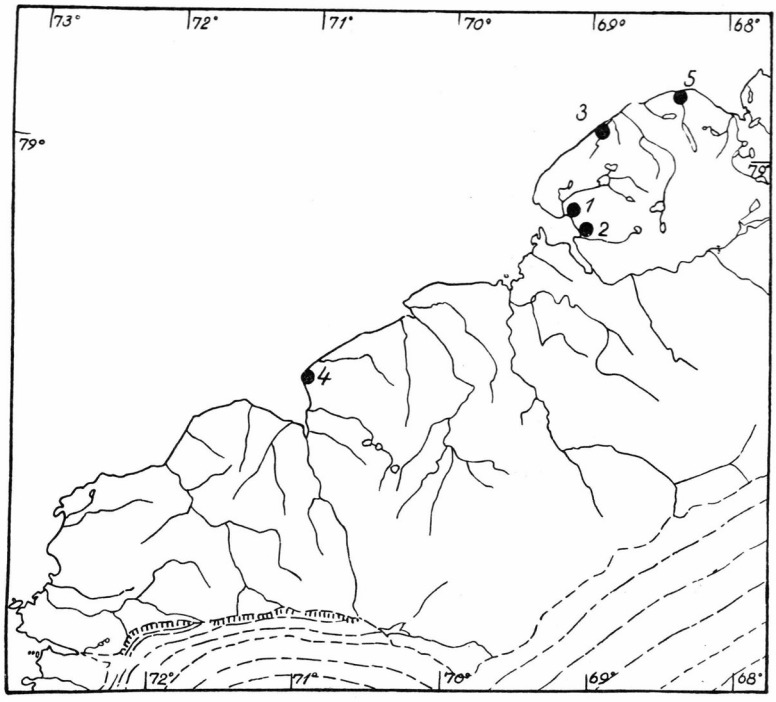


Fig. 2. Map, showing the localities in Inglefield Land from which the fossils of the Wulff River formation originate. 1—2: Marshall Bugt, localities 1—2; 3: W. of Blomsterbækken; 4: Kap Leiper; 5: Wulffs Elv.

*Holmia mirabilis* n. sp.: Marshall Bugt, locality 1.
*Wanneria abnormis* n. sp.: Kap Leiper.
— *inermis* n. sp.: Marshall Bugt, locality 1.
— *mediocris* n. sp.: Marshall Bugt, locality 1; W. of Blomsterbækken.
— *ruginosa* n. sp.: Kap Leiper; Marshall Bugt, locality 1.
— *subglabra* n. sp.: Marshall Bugt, locality 1.
— *troelseni* n. sp.: W. of Blomsterbækken.
— *?* sp.: Kap Leiper.
*Bonnia arctica* n. sp.: Marshall Bugt, locality 1—2.

## DESCRIPTIONS OF GENERA AND SPECIES

### Phylum **MOLLUSCOIDEA**

### Class **Brachiopoda.**

Order ***Atremata*** BEECHER, 1891, emend. SCHUCHERT 1897 and WALCOTT 1908.

Superfamily **KUTORGINACEA** WALCOTT & SCHUCHERT 1908.

Family **Kutorginidae** SCHUCHERT, 1893, emend. SCHUCHERT 1897 and WALCOTT 1908.

Genus ***Kutorgina*** BILLINGS, 1861.

*Kutorgina reticulata* POULSEN, 1932.

Pl. 1, fig. 1.

1932. *Kutorgina reticulata* POULSEN: Meddelelser om Grønland, vol. 87 (6), p. 28, pl. 6, figs. 4—10.

This species, which was hitherto known only from the Lower Cambrian Ella Island formation of East Greenland, is represented by a few ventral valves.

Remarks: As mentioned in connection with the original description (POULSEN, 1932, pp. 28—29), this species shows much resemblance to *Kutorgina perugata* WALCOTT, 1905, which has likewise coarse, irregularly spaced concentric lines and ridges of growth; it differs, however, from WALCOTT's species in having additional surface markings consisting of a very fine, almost microscopic network with hexagonal instead of rhomboidal meshes. The presence of a median fold on the dorsal valve of *Kutorgina reticulata* is a remarkable feature, which serves to distinguish this species from the hitherto known species of the genus *Kutorgina*. The East Greenland specimens are fragmentary and fail to give an idea of the outline of the valves. The ventral valve figured in this paper (pl. 1, fig. 1) shows an outline remarkably similar to that of *Kutorgina cingulata* (BILLINGS, 1861) as figured by WALCOTT (1912, pl. 5, fig. 1 j), and the resemblance is emphasized by the presence of a median sinus similar to that shown in WALCOTT's figure; the ventral sinus, however, may be entirely absent in many specimens of *Kutorgina cingulata*.

Dimensions of the figured specimen: Length about 6.5 mm; width 8.0 mm.

Locality: West of Blomsterbækken.

## Phylum **MOLLUSCA**

### Class **Cephalopoda?**

Family **Salterellidae** POULSEN, 1932.

Genus ***Salterella*** BILLINGS, 1861.

*Salterella expansa* POULSEN, 1927.

Pl. 1, figs. 2—3.

1927. *Salterella expansa* POULSEN: Meddelelser om Grønland, vol. 70 (2), p. 251, pl. 14, figs. 10—12.

Remarks: The new material contains several specimens of this species, some of which are well preserved so as to show surface markings consisting of low rounded annulations; the annulations are of about the same size as intervening spaces, and there are 3 of them in 1 mm. The specimen represented by pl. 1, fig. 2 is here designated as the holotype.

Locality: West of Blomsterbækken; Marshall Bugt, loc. 1 and 2.

## Phylum **ARTHROPODA**

### Class **Trilobita.**

Order ***Redlichiida*** RICHTER, 1932.

Suborder **OLENELLINA** RESSER, 1938.

Family **Olenellidae** VOGDES, 1893.

Subfamily **OLENELLINAE** VOGDES, 1893.

Genus ***Olenellus*** BILLINGS, 1861.

Three species, *Olenellus carinatus* n. sp., *Olenellus laevis* n. sp., and *Olenellus troelseni* n. sp., are referred to the genus *Olenellus* with some reservation, the material at hand being very fragmentary. They have many of the general characters of this genus, but they differ from typical species in having extremely long eyes and palpebral lobes, which are but slightly curved so as to reduce the intrapalpebral cheek region almost completely. It is possible that such species will be referred to new genera by future students with more complete material at their disposal.

*Olenellus carinatus* n. sp.

Pl. 1, figs. 9—10; pl. 2, fig. 4.

Material: Two fragmentary cephala.

Description: Cephalon approximately semicircular in outline, moderately convex. Glabella about 1.7 times as long as wide, reaching anterior border furrow, moderately convex, slightly contracted at base of palpebral lobes, defined by narrow axial furrows, with 3 pairs of narrow, shallow, oblique glabellar furrows; anterior and posterior pair of glabellar furrows reaching axial furrows; inner ends of anterior pair united with middle pair by a pair of shallow longitudinal furrows so as to form a small central glabellar lobe. Occipital furrow deep at sides, quite effaced at axial line. Occipital ring as long and as wide as posterior glabellar segment, with a small median node at posterior margin. Palpebral lobes extremely long, terminating opposite to centre of occipital ring, slightly curved so as to reduce intrapalpebral cheek regions almost completely. Extraocular cheek regions slightly wider than glabella, moderately convex, with a slightly curved keel extending backwards from anterior end of eyes to posterior border furrow. Anterior and lateral border furrow wide; posterior border furrow narrow. Cephalic border fairly narrow, moderately convex. Posterior margin curving obliquely backwards from axial furrows to base of genal spines, without metagenal spines. Size of genal spines unknown. External surface of test smooth.

Dimensions of holotype:

| | | |
|---|---|---|
| Axial length of cephalon | about | 11.0 mm |
| Width of cephalon | — | 19.0 - |
| Length of glabella (exclusive of occipital ring) | | 7.5 - |
| Maximum width of glabella | | 4.5 - |
| Maximum distance between eyes | | 8.0 - |

Locality: West of Blomsterbækken.

Remarks: *Olenellus carinatus* is easily distinguished from the hitherto described species of the genus *Olenellus* by its extremely long palpebral lobes and the presence of a curved keel on the cheeks.

*Olenellus laevis* n. sp.

Pl. 1, fig. 11.

Material: A fragmentary cephalon.

Description: Cephalon practically semicircular in outline, moderately convex. Glabella twice as long as wide, occupying about one-fifth of the width of cephalon, cylindrical, moderately convex, defined

by narrow axial furrows; glabellar furrows broad and shallow, at right angles to axial line, the two posterior pairs developed as transglabellar furrows. Occipital furrow broad and shallow, faint across axial line. Occipital ring as long (sag.) as posterior glabellar segment, but slightly wider, with a small median node at posterior margin. Palpebral lobes long, terminating at occipital furrow, moderately curved, situated close to glabella so as to reduce intrapalpebral cheek region almost completely. Extraocular cheek portion about twice as wide as glabella. Border furrow narrow. Cephalic border narrow, strongly convex. Posterior margin without metagenal spines. Length of genal spines unknown. External surface smooth.

Dimensions:

| | |
|---|---|
| Axial length of cephalon | 6.5 mm |
| Width of cephalon | 12.0 - |
| Length of glabella (exclusive of occipital ring) | 5.0 - |
| Width of glabella | 2.5 - |
| Maximum distance between eyes | 5.0 - |

Locality: West of Blomsterbækken.

Remarks: Within the group of species mentioned on page 10 *Olenellus laevis* is distinguished by its slender, almost perfectly cylindrical glabella with glabellar furrows at right angles to axial line and by its narrow, prominent cephalic border.

### *Olenellus troelseni* n. sp.

Pl. 2, figs. 1—3.

Material: Two fragmentary cephala.

Description: Cephalon approximately semicircular in outline, strongly convex. Glabella about 1.5 times as long as wide, subcylindrical, defined by shallow axial furrows, with short, slightly expanded, indistinctly defined frontal lobe encroaching on anterior border and 3 pairs of very broad, shallow, somewhat oblique glabellar furrows; anterior and posterior pair of glabellar furrows transglabellar, debouching into axial furrows; middle pair separated from axial furrows by confluent lateral portions of adjacent glabellar lobes. Occipital furrow narrow, deep at sides, quite effaced at axial line. Occipital ring short (sag.), as wide as posterior glabellar segment. Palpebral lobes very long, slightly curved, situated close to glabella so as to reduce intrapalpebral cheek regions almost completely. Extraocular cheek regions posteriorly of about the same width as frontal glabellar lobe. Anterior and lateral cephalic border almost flat, of medium width, slightly increasing in

width posteriorly, defined by shallow border furrow; posterior border narrow at axial furrows, increasing in width towards genal angles. Posterior margin backward-curved from axial furrow to metagenal spines. Metagenal spines well-defined, but extremely short, situated opposite to junction of lateral and posterior border furrows. Genal spines rapidly tapering from a fairly broad base. External surface smooth to the naked eye, but a very delicate granulation is visible under a strong lens; in places where the test has been removed from the cheeks, the natural cast of the interior shows extremely fine, irregular, inosculating lines.

Dimensions of holotype:

| | |
|---|---|
| Axial length of cephalon (estimated) | about 17.0 mm |
| Width of cephalon | 33.0 - |
| Length of glabella (exclusive of occipital ring) | 14.0 - |
| Maximum width of glabella | 9.0 - |
| Maximum distance between eyes | 15.0 - |

Locality: West of Blomsterbækken.

Remarks: As already mentioned (p. 10) *Olenellus troelseni* belongs to a group of species characterized by their long eyes and palpebral lobes, which are but slightly curved so as to reduce intrapalpebral cheek regions almost completely. Other remarkable features of this species are the wide glabella and the short, indistinctly defined frontal glabellar lobe encroaching on anterior border.

## Genus ***Paedeumias*** Walcott. 1910.

### *Paedeumias groenlandicus* n. sp.

Pl. 2, figs. 5—6.

Material: A fragmentary cephalon.

Description: Cephalon approximately semicircular in outline, moderately convex. Glabella about 1.25 times as long as wide, occupying about one-fourth of the width of cephalon, slightly convex, somewhat contracted at posterior glabellar furrow, with acute, triangular frontal lobe; anterior pair of glabellar furrows faintly marked; middle pair shallow, separated from axial furrows by confluent distal parts of adjacent lateral glabellar lobes; posterior pair fairly well impressed, united so as to form a transglabellar furrow. Occipital furrow deeply impressed at sides, quite effaced at axial line. Occipital ring of about the same size as adjacent glabellar segment. Palpebral lobes moderately curved. Preglabellar median ridge faintly marked. Border furrow narrow, moderately impressed. Posterior cephalic border extending obliquely backward from

occipital ring to genal angles. Genal and metagenal spines, and surface markings not preserved.

Dimensions:

| | | |
|---|---|---|
| Axial length of cephalon | about | 11.0 mm |
| Width of cephalon | — | 19.0 - |
| Length of glabella (exclusive of occipital ring) | | 7.0 - |
| Maximum width of glabella | | 5.6 - |
| Maximum distance between eyes | | 8.8 - |

Locality: Eastern coast of Marshall Bugt.

Remarks: This species is easily distinguished from other species of the genus *Paedeumias* by its acute, almost perfectly triangular frontal glabellar lobe.

*Paedeumias* sp. ind.

Pl. 2, fig. 7; pl. 3, fig. 1.

A couple of fragmentary specimens representing one or two species differ clearly from *Paedeumias groenlandicus*; however, specific determination is not possible until better material can be obtained.

Locality: West of Blomsterbækken; Marshall Bugt, locality 1.

*Paedeumias*? *macrophthalmus* n. sp.

Pl. 3, figs. 2—4.

Material: Two fragmentary glabellas with palpebral lobes.

Remarks: The material at hand is not fit for an adequate specific description; there cannot be much doubt, however, that the preserved parts of glabella exhibit characters normally present in *Bristolia* HARRINGTON, 1956, and frequently present in *Paedeumias* WALCOTT, 1910, especially the contraction of glabella at posterior glabellar furrows. The first mentioned genus, however, must be left out of consideration, the palpebral lobes of the Greenland specimens being very long. They differ from the hitherto known species of *Paedeumias* in having more strongly curved palpebral lobes, each of these almost forming a semicircle so as to define an intrapalpebral cheek region almost equal in width to the contracted part of glabella.

Locality: Marshall Bugt, locality 1.

Subfamily **HOLMIINAE** HUPÉ, 1953.

Genus ***Holmia*** MATTHEW, 1890.

*Holmia mirabilis* n. sp.

Pl. 3, figs. 5—8.

Material: Two somewhat fragmentary cephala, representing different developmental stages.

Description of holotype: Cephalon twice as wide as long (exclusive of genal spines), moderately convex. Glabella 1.4 times as long as wide, clavate, with strongly expanded frontal lobe extending to anterior border furrow, and 3 well marked glabellar furrows; anterior and middle pair of glabellar furrows at right angles to longitudinal axis of glabella, the latter united so as to form a transglabellar furrow; posterior pair oblique, transglabellar. Occipital furrow well impressed throughout. Occipital ring a little wider (trans.) than adjacent glabellar segment. Palpebral lobes prominent, evenly curved, terminating opposite to occipital furrow. Intrapalpebral cheek regions half as wide as posterior part of glabella; extraocular cheek regions fairly narrow. Border furrow broad, deeply impressed. Cephalic border moderately convex, narrow in front of glabella, increasing considerably in width towards genal angles; posterior border somewhat narrower than lateral border, without metagenal spines (or these not preserved). Metagenal angles situated just behind eyes. Genal angles well advanced, with fairly long, wide, gradually tapering, slightly curved, obliquely backward-directed genal spines in almost direct continuation of lateral border. Surface markings consisting of delicate, raised, inosculating lines forming a network with irregular meshes on glabella and cephalic border and regular ones on other parts of cephalon.

Dimensions of holotype:

| | |
|---|---|
| Axial length of cephalon | 6.5 mm |
| Width of cephalon (exclusive of genal spines) | 12.0 - |
| Width of cephalon (inclusive of genal spines) | 20.0 - |
| Length of glabella (exclusive of occipital ring) | 5.7 - |
| Width of glabella across frontal lobe | 4.0 - |
| Width of glabella at base | 2.5 - |
| Maximum distance between eyes | 8.0 - |

The younger developmental stage differs from the holotype mainly in having less advanced, more backward-directed genal spines.

Locality: Marshall Bugt, locality 1.

Remarks: The genera of the subfamily Holmiinae have subcylindrical to more or less clavate glabella with 3 pairs of glabellar

furrows, and, in accordance with their narrow anterior part of thorax, their metagenal angles are situated fairly close to the occipital ring, most frequently just behind the eyes. In these respects the Greenland species agrees very well with the Holmiinae, and it is therefore placed in this subfamily. It is referred to the genus *Holmia*, the type species of which (*H. kjerulfi* (LINNARSSON, 1871)) appears to be a close relative. It differs from *H. kjerulfi* in having narrower posterior part of glabella, shorter, more expanded frontal glabellar lobe, posterior cephalic border more forward-curved resulting in more advanced genal spines. The fact that metagenal spines have not been observed is without importance with regard to the generic reference, since f. inst. the genus *Olenellus* is known to include species with metagenal spines in the holaspid stage as well as species without these spines.

## Subfamily **WANNERIINAE** HUPÉ, 1953.

### Genus ***Wanneria*** WALCOTT, 1910.

*Wanneria* is at present the only olenellid genus which can be safely referred to the subfamily Wanneriinae. In addition to the type species, *Wanneria walcottana* (WANNER, 1901), relatively few species are safely referable to this genus; these are *W. logani* (WALCOTT, 1910), *W. occidens* WALCOTT, 1913, "*Wanneria* (?)" LOCHMAN, 1954, *W. nathorsti* POULSEN, 1932, *W. ellae* POULSEN, 1932, and "*W.* cf. *walcottana*" described and figured by SCHWARZBACH in 1939. All these species have metagenal angles remote from occipital ring, i. e. nearer to genal angles than to occipital ring, a character which serves to distinguish cephala of Wanneriinae from those of Holmiinae. It appears from a comparative study of the mentioned species that the width of the cephalic border, the length of the palpebral lobes, and the width of the extraocular cheek regions may vary considerably.

The new Greenland material contains cephala of five species which agree fairly well with the conception of the genus *Wanneria* as outlined above, and in addition to these an aberrant species (*W. inermis* n. sp.), which differs from typical species in having wider glabella, very narrow extraocular cheek regions, and advanced genal angles with tiny rudiments of genal spines.

#### *Wanneria abnormis* n. sp.

Pl. 7, figs. 1—4.

Material: A fragmentary cephalon.

Description: Cephalon semicircular in outline, strongly convex. Glabella about 1.3 times as long as wide, occupying about one-third of

the width of cephalon, clavate, with expanded, strongly inflated frontal lobe, and 3 pairs of glabellar furrows developed as transglabellar furrows; anterior glabellar furrow indistinctly marked, almost effaced; middle and posterior glabellar furrows very wide and deeply impressed. Occipital furrow wide, deeply impressed at sides. Occipital ring not preserved. Palpebral lobes strongly and evenly curved, fairly long, terminating opposite to occipital furrow. Extraocular cheek regions fairly narrow. Border furrow well impressed, with row of small pits in anterior and lateral part[1]). Cephalic border moderately convex, of medium width. Surface markings consisting of delicate, raised, inosculating lines forming a network with regular meshes on greater part of glabella and near genal angles; on cephalic border the meshes are oblong and irregular; on anterior slope of frontal glabellar lobe and on anterior and palpebral regions of cheeks the raised lines become thickened resulting in formation of oblong comma-shaped impressions.

Dimensions:

| | |
|---|---|
| Axial length of cephalon (estimated) | 6.5 mm |
| Width of cephalon | 10.8 - |
| Length of glabella (exclusive of occipital ring) | 4.6 - |
| Width of glabella across frontal lobe | 3.5 - |
| Width of glabella at base | 2.0 - |
| Maximum distance between eyes | 6.4 - |

Locality: Kap Leiper.

Remarks: This species is easily distinguished from other species of the genus *Wanneria* by its strongly inflated frontal glabellar lobe, wide, deeply impressed middle and posterior transglabellar furrows, and surface markings.

### *Wanneria inermis* n. sp.

Pl. 4, figs. 1—11.

Material: Six cephala.

Description: Cephalon approximately semicircular in outline, strongly convex. Glabella 1.2—1.3 times as long as wide, slightly contracted in the middle, with expanded, strongly inflated frontal lobe overhanging anterior border in mature specimens; glabellar furrows to the number of 3, transglabellar, deeply impressed at sides. Occipital furrow wide, deeply impressed throughout. Occipital ring narrow (sag.) and wide (trans.), with small median node at posterior margin. Palpebral lobes prominent, moderately curved, fairly long, terminating opposite

[1]) Several species of *Wanneria* show such pits in the border furrow.

to occipital furrow. Extraocular cheek regions very narrow. Border furrow well impressed, with row of small pits in anterior and lateral part. Cephalic border narrow, fairly convex. Genal angles somewhat advanced, with tiny rudiments of genal spines. Surface markings consisting of relatively coarse reticulation with central tubercles in the meshes; reticulation regular on glabella and cheeks, irregular and with oblong meshes on cephalic border.

| Dimensions: | I | II | III | IV (Holotype) | |
|---|---|---|---|---|---|
| Axial length of cephalon | 3.2 | 4.0 | 6.4[1]) | 8.0 | mm |
| Width of cephalon | 4.8 | 7.2 | 10.4[1]) | 12.4 | - |
| Length of glabella (exclusive of occipital ring) | 2.6 | 3.8 | 5.6[1]) | 6.7 | - |
| Width of glabella across frontal lobe | 2.0 | 3.0 | 4.6 | 5.0 | - |
| Width of glabella in the middle | 1.0 | 1.7 | ? | 3.2 | - |
| Width of glabella at base | 1.2 | 2.0 | ? | 3.4 | - |
| Maximum distance between eyes | 3.4 | 4.8 | 7.0[1]) | 8.6 | - |

Locality: Marshall Bugt, locality 1.

Remarks: This species differs from the hitherto known species of the genus *Wanneria* in having more convex cephalon, wider glabella, strongly inflated frontal glabellar lobe, extremely narrow extraocular cheek regions, narrow, more convex cephalic border, well-defined metagenal angles, and tiny rudiments of genal spines.

### *Wanneria mediocris* n. sp.

Pl. 5, figs. 1—5.

Material: Three cephala.

Description: Cephalon semicircular in outline, moderately convex. Glabella about 1.3 times as long as wide, occupying about one-third of the width of cephalon, moderately convex, clavate, with expanded frontal lobe; 3 pairs of glabellar furrows developed as transglabellar furrows, deeply impressed at sides, shallow at axial line; middle pair of glabellar furrows separated from axial furrows by confluent lateral parts of adjacent lateral glabellar lobes. Occipital furrow deeply impressed at sides, effaced at axial line. Occipital ring slightly convex (sag.), with small median node at posterior margin. Palpebral lobes prominent, moderately and evenly curved, terminating opposite to occipital furrow. Border furrow shallow, with row of small pits in anterior and lateral part. Cephalic border moderately convex, of medium width. Posterior cephalic margin obliquely backward-curved from occipital ring to genal

[1]) Estimated.

angles. Genal spines of medium length, rapidly tapering from a broad base. Surface markings consisting of fine inosculating lines forming a regular network with central tubercles in the meshes on glabella and cheek regions inside the border, the latter having irregular oblong meshes without tubercles.

| Dimensions: | I (Holotype) | II | |
|---|---|---|---|
| Axial length of cephalon | 9.0[1]) | — 8.0 | mm |
| Width of cephalon | 16.0 | —15.0 | - |
| Length of glabella (exclusive of occipital ring) | 7.0 | — 6.3 | - |
| Width of glabella across frontal lobe | 5.3 | — 5.0 | - |
| Width of glabella at base | 4.0 | — 3.0 | - |
| Maximum distance between eyes | 9.0 | — 8.0 | - |

Locality: West of Blomsterbækken; Marshall Bugt, locality 1.

Remarks: The cephalon of this species is fairly similar to that of *Wanneria walcottana* (WANNER), the type species of *Wanneria*, from which it differs in having much longer eyes and palpebral lobes. It appears to be most closely related to *W. nathorsti* POULSEN from the Ella Island formation of East Greenland, but it is easily distinguished from that species by its moderately convex frontal glabellar lobe and longer, more strongly curved palpebral lobes.

### *Wanneria ruginosa* n. sp.

Pl. 6, figs. 1—5.

Material: Four more or less fragmentary cephala.

Description: Cephalon approximately semicircular in outline, moderately convex. Glabella about 1.4 times as long as wide, moderately convex, clavate, with fairly long, expanded frontal lobe and 3 pairs of glabellar furrows developed as transglabellar furrows, though shallow at axial line. Occipital furrow deeply impressed at sides, effaced at axial line. Occipital ring as wide (sag.) as adjacent glabellar segment and a little wider (trans.) than base of glabella. Palpebral lobes very prominent, moderately and evenly curved, very long, terminating at posterior border furrow, and almost touching occipital ring. Extraocular cheek regions narrow. Border furrow deeply impressed. Anterior and lateral cephalic border wide, moderately convex; posterior border narrow at axial furrows, increasing in width towards genal angles. Posterior margin obliquely backward-curved from occipital ring to genal angles. Genal spines of medium length, rapidly tapering from a broad

[1]) Estimated.

base. Surface markings consisting of scattered tubercles and fine inosculating lines forming a pattern of irregular wrinkles.

Dimensions of holotype:

| | |
|---|---|
| Axial length of cephalon | about 6.5 mm |
| Width of cephalon | 9.5 - |
| Length of glabella (exclusive of occipital ring) | 4.8 - |
| Width of glabella across frontal lobe | 3.6 - |
| Width of glabella at base | 2.3 - |
| Maximum distance between eyes | 6.0 - |

Localities: Marshall Bugt, locality 1; Kap Leiper.

Remarks: The following combination of characters serves to distinguish this species from the hitherto known species of *Wanneria*: The extremely long eyes and palpebral lobes, the narrow extraocular cheek regions, and the irregularly wrinkled surface.

### *Wanneria subglabra* n. sp.

Pl. 6, figs. 6—8.

Material: A fragmentary cephalon.

Description: Cephalon approximately semicircular, moderately convex. Glabella 1.3 times as long as wide, moderately convex, clavate, with relatively short, strongly expanded frontal lobe. Glabellar furrows well impressed at sides, almost effaced at axial line; middle glabellar furrows practically perpendicular to axial line. Occipital furrow well impressed at sides, shallow at axial line. Occipital ring narrow (sag.), equal in width (trans.) to adjacent glabellar segment. Palpebral lobes moderately prominent, evenly curved, very long, extending to posterior border furrow, with terminations remote from occipital ring, defining fairly large intrapalpebral cheek regions. Extraocular cheek regions of medium width. Border furrow well impressed, with row of pits in anterior and lateral part. Cephalic border narrow, fairly convex. Posterior margin almost perpendicular to axial line. Genal spines of medium length, slightly outward-directed, in direct continuation of lateral border. Surface markings consisting of an extremely delicate system of wrinkles, only visible by means of high-power lens.

Dimensions:

| | |
|---|---|
| Axial length of cephalon | 3.3 mm |
| Width of cephalon (exclusive of genal spines) | 6.6 - |
| Width of cephalon (inclusive of genal spines) | 7.0 - |
| Length of glabella (exclusive of occipital ring) | 2.6 - |
| Width of glabella across frontal lobe | 2.0 - |
| Width of glabella at base | 1.2 - |
| Maximum distance between eyes | 3.3 - |

Locality: Marshall Bugt, locality 1.

Remarks: The following combination of characters serves to distinguish this species from the hitherto known species of *Wanneria*: The short, excessively expanded frontal glabellar lobe, the very long eyes and palpebral lobes, the direction of genal spines, and the extremely delicate surface markings.

*Wanneria troelseni* n. sp.

Pl. 5, figs. 6—9.

Material: A somewhat fragmentary cephalon.

Description: Cephalon fairly convex, with approximately parabolic antero-lateral outline. Glabella about 1.25 times as long as wide, fairly convex, clavate, with strongly expanded frontal lobe, and 3 pairs of wide, well impressed glabellar furrows developed as transglabellar furrows. Occipital furrow very wide, deeply impressed throughout. Occipital ring equal in width (sag.) to adjacent glabellar segment, a little wider (trans.) than base of glabella, with small median node at posterior margin. Palpebral lobes not preserved. Eyes fairly long, moderately curved, with posterior terminations opposite to occipital furrow. Extraocular cheek regions of medium width. Border furrow deeply impressed, with row of small pits in anterior and lateral part. Cephalic border fairly narrow except posterior part of lateral border and lateral part of posterior border, which become increasingly wide toward genal angles. Posterior cephalic margin evenly backward-curved from occipital ring to genal angles. Genal spines of medium length, rapidly tapering from a very broad base. Surface markings consisting of a fairly regular network with central tubercles in the meshes; cephalic border with numerous tubercles, but apparently without network.

Dimensions:

| | | |
|---|---|---|
| Axial length of cephalon | 4.4 | mm |
| Width of cephalon | 7.6 | - |
| Length of glabella (exclusive of occipital ring) | 3.5 | - |
| Width of glabella across frontal lobe | 2.8 | - |
| Width of glabella at base | 1.6 | - |
| Maximum distance between eyes | 4.2 | - |

Locality: West of Blomsterbækken.

Remarks: This species is easily distinguished from the hitherto known species of *Wanneria* by the swelling of cephalic border at genal angles, the very rapidly tapering genal spines, and the surface markings of cephalic border.

### *Wanneria*? sp.

Pl. 7, figs. 5—7.

Two fragmentary cephala probably representing a new species of *Wanneria* differ clearly from those of other species of this genus; further determination, however, must be considered unsafe until better material can be obtained.

Locality: Kap Leiper.

### Undetermined *Olenellidae*.

Pl. 7, figs. 8—11.

The material contains three specimens, which must remain undetermined until supplementary knowledge can be obtained.

The hypostoma (pl. 7, figs. 8—9) shows much resemblance to that of *Holmia* as figured by KIÆR (1916); the Greenland specimen differs, however, in having larger, laterally more expanded anterior lobe, better defined, laterally more projecting anterior wings, and more strongly curved anterior margin. Locality: Marshall Bugt, locality 2.

The cephalon (pl. 7, fig. 10) is fairly similar to Mexican specimens referred to *Olenellus truemani* WALCOTT, 1913 by LOCHMAN (1954), but the specimen is very small and probably immature, and, accordingly, it cannot be determined with certainty. Locality: Kap Leiper.

The specimen represented by pl. 7 fig. 11, is the cephalon of a young olenellid larva. Description: Cephalon slightly wider than long, rounded subquadrate in outline, moderately convex. Glabella cylindrical, with indistinctly defined frontal lobe. Intrapalpebral cheek regions of about the same width as glabella. Palpebral lobes moderately wide, evenly curved, forming together with frontal glabellar lobe approximately a semicircle. Extraocular cheek regions narrow, strongly sloping. Preglabellar field fairly wide, strongly concave. Cephalic border very narrow, almost flat. Genal spines very short and narrow, in direct continuation of lateral border. Metagenal spines short, obliquely outward-directed, tapering from a broad base.

Dimensions:

| | | |
|---|---|---|
| Axial length of cephalon | about | 0.50 mm |
| Width of cephalon | — | 0.57 - |
| Length of glabella (exclusive of occipital ring) | — | 0.35 - |
| Length of frontal area | — | 0.07 - |
| Maximum distance between eyes | — | 0.45 - |

Locality: Kap Leiper.

## Order ***Zacanthoidida*** Richter, 1932 (= Corynexochida Kobayashi 1935).

### Family **Dorypygidae** Kobayashi, 1935.

### Genus ***Bonnia*** Walcott, 1916.

*Bonnia arctica* n. sp.

Pl. 1, figs. 4—8.

Material: Two cranidia and two associated pygidia.

Description: Cranidium a little wider than long, fairly convex. Glabella about 1.3 times as long as wide, fairly convex, slightly clavate; posterior pair of glabellar furrows relatively deep, short, oblique; another pair short, fairly deep, transverse; there is just an indication of two anterior pairs. Occipital furrow deep throughout. Occipital ring of medium width (sag.), moderately elevated. Axial furrows wide and deep posteriorly and shallow anteriorly. Anterior border furrow wide and deep. Anterior border moderately convex. Fixed cheeks two-thirds the width of glabella at level of palpebral lobes, moderately convex, on the average sloping downward; palpebral lobes slightly less than half the glabellar length, curved, narrow; palpebral furrows wide, rather well impressed; posterior regions of fixed cheeks short, with wide, deep posterior border furrow.

Associated pygidium approximately semicircular in outline, fairly convex. Axis slightly less than one-third of the width, conical, strongly convex, rounded posteriorly, reaching border furrow, divided by decreasingly deep furrows into 5 rounded axial rings and a terminal, unsegmented section. Axial furrow shallow. Pleural regions convex, with 4 deep and wide pleural furrows. Border rather narrow, indistinctly defined by shallow border furrow, and furnished with a small spine at each of the anterior angles and a shallow indentation behind axis.

Surface of cranidium and pygidium smooth to the naked eye, but a very delicate, dense granulation is visible under a strong lens.

Dimensions of holotype:

| | | |
|---|---|---|
| Length of cranidium | 2.5 | mm |
| Width of cranidium at anterior end of palpebral lobes | 2.2 | - |
| Width of cranidium at posterior border | 3.1 | - |
| Maximum distance between eyes | 2.9 | - |
| Length of glabella (exclusive of occipital ring) | 1.7 | - |
| Width of glabella at ocular ridges | 1.3 | - |
| Dimensions of associated pygidium: | | |
| Length | 3.3 | - |
| Width | 5.2 | - |
| Width of axis (anteriorly) | 1.5 | - |

Remarks: The cranidium of this species shows much resemblance to those of *Bonnia parvula* (BILLINGS) (the type species) and *Bonnia busa* (WALCOTT), but it differs clearly from these species in having axial furrows effaced at anterior corners of glabella and much longer, more strongly curved palpebral lobes. The associated pygidium is especially characterized by the strongly sloping pleural regions and the deep, very wide pleural furrows.

Locality: Marshall Bugt, locality 1 and 2.

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Færdig fra trykkeriet den 2. juni 1958.

# PLATES

## Plate 1.

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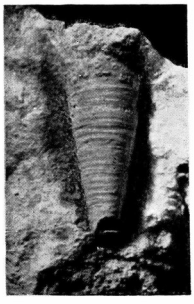

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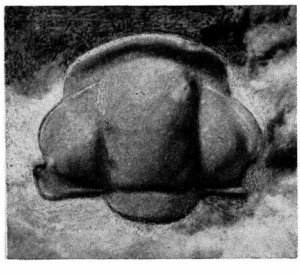

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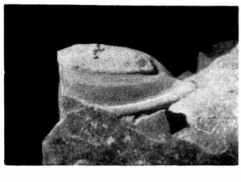

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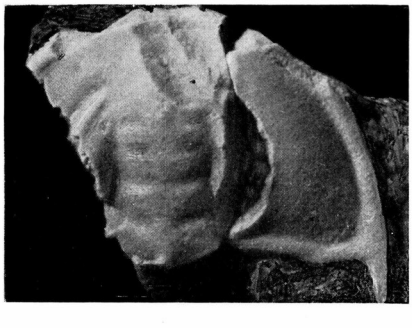

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## Plate 2.

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Fig. 1–3. *Olenellus troelseni* n. sp. ..... 12

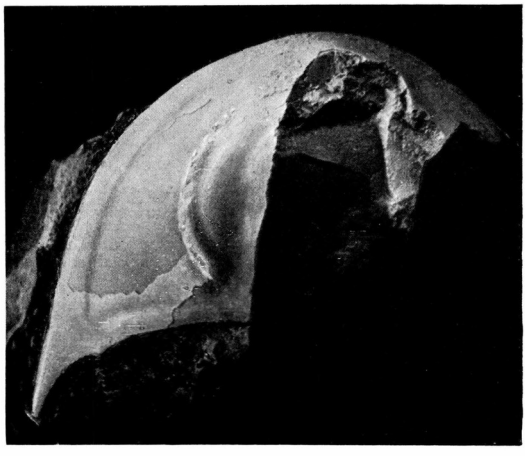
– 1–2. Dorsal and lateral view of fragmentary cephalon, × 2.5, W. of Blomsterbækken.

– 3. Dorsal view of fragmentary cephalon (cast), holotype, × 2.5, W. of Blomsterbækken.

– 4. *Olenellus carinatus* n. sp., dorsal view of fragmentary cephalon (cast), holotype, × 2.5, W. of Blomsterbækken ..... 11

– 5–6. *Paedeumias groenlandicus* n. sp., dorsal and lateral view of fragmentary cephalon (cast), holotype, × 2.5, eastern coast of Marshall Bugt ..... 13

– 7. *Paedeumias* sp. ind., fragmentary cephalon, × 10, W. of Blomsterbækken ..... 14



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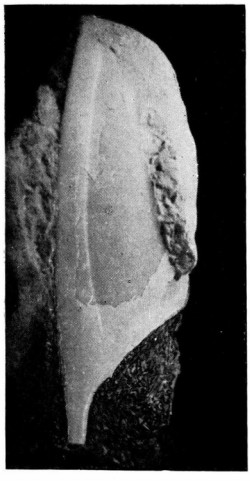

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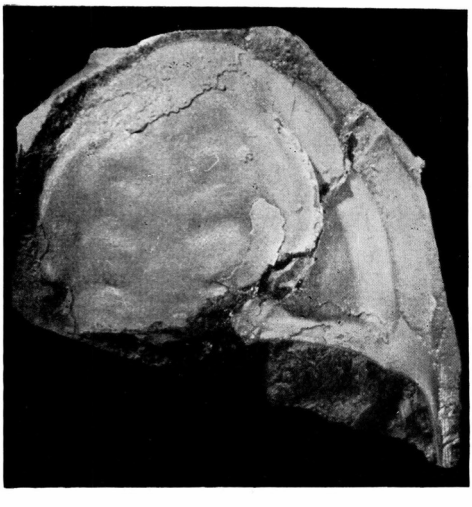

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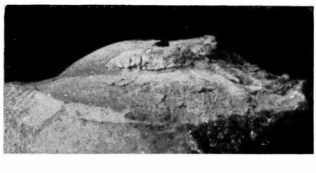

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## Plate 3.

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Fig. 1. *Paedeumias* sp. ind., fragment of cephalon, × 10, Marshall Bugt, locality 1 ..... 14

– 2–4. *Paedeumias? macrophthalmus* n. sp., Marshall Bugt, locality 1 .... 14

– 2. Central part of small cephalon, holotype, × 5.

– 3. Same specimen enlarged (× 8) to show surface markings.

– 4. Larger specimen, × 2.5.

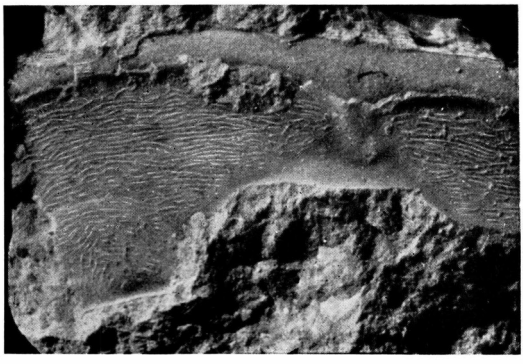
– 5–8. *Holmia mirabilis* n. sp., Marshall Bugt, locality 1 ..... 15

– 5. Dorsal view of two somewhat fragmentary cephala, representing different developmental stages; the larger specimen is the holotype; × 3.

– 6. Frontal view of holotype, × 3.

– 7. Part of glabella and palpebral lobes, enlarged (× 9) to show surface markings.

– 8. Part of cheek, enlarged (× 9) to show surface markings.



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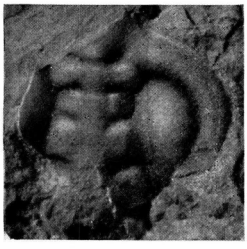

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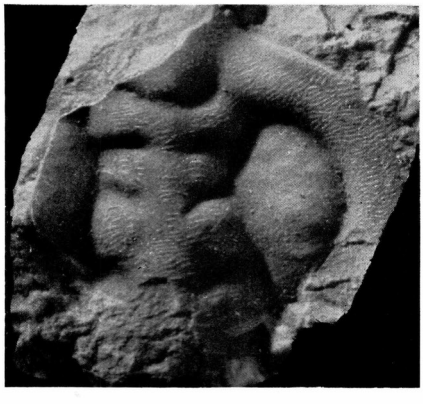

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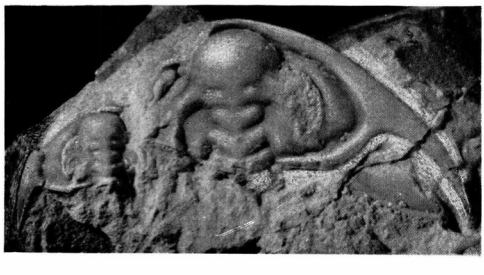

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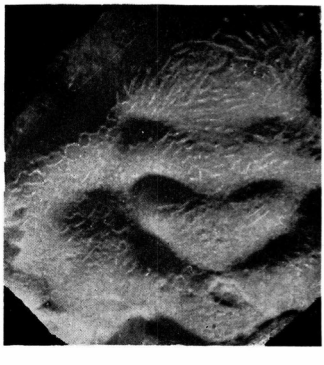

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## Plate 4.

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Fig. 1–11. *Wanneria inermis* n. sp., Marshall Bugt, locality 1 ..... 17

- 1–3. Dorsal, frontal, and lateral view of medium-sized, fairly complete cephalon, × 5.
- 4–5. Dorsal and lateral view of fairly large, fragmentary cephalon, × 5.
- 6–7. Cheek and glabella of same specimen, enlarged (× 10) to show surface markings.
- 8–10. Dorsal, lateral, and frontal view of large cephalon, holotype, × 5.
- 11. Dorsal view of small cephalon, × 5.

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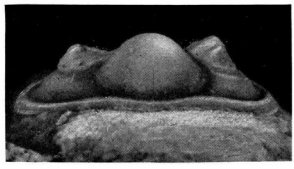

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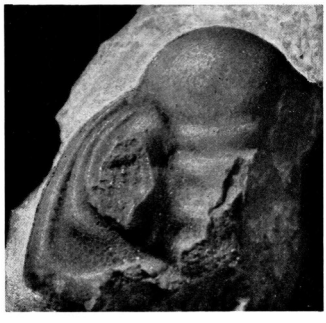

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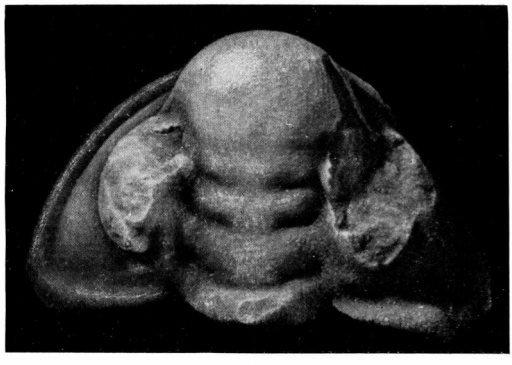

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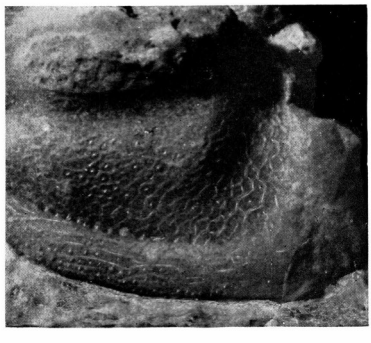

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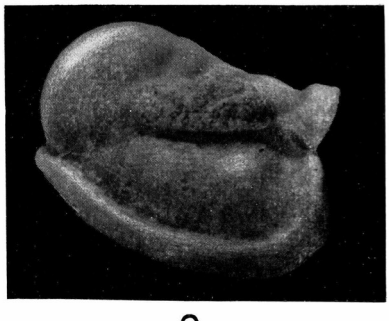

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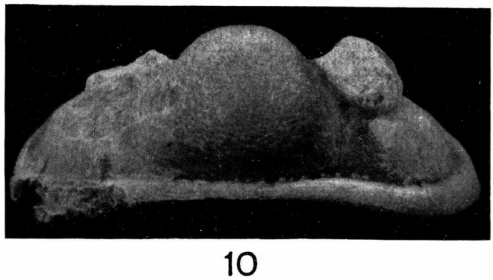

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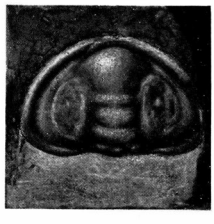

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## Plate 5.

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Fig. 1–5. *Wanneria mediocris* n. sp. ..... 18
– 1–3. Dorsal, lateral, and frontal view of somewhat fragmentary cephalon, holotype, × 3, W. of Blomsterbækken.
– 4. Part of glabella and palpebral lobes of same specimen, enlarged (× 10) to show surface markings.
– 5. Almost complete, poorly preserved cephalon, × 3, Marshall Bugt, locality 1.
– 6–9. *Wanneria troelseni* n. sp., fragmentary cephalon, holotype, W. of Blomsterbækken ..... 21
– 6–8. Dorsal, lateral, and frontal view, × 5.
– 9. Surface markings, about × 9.

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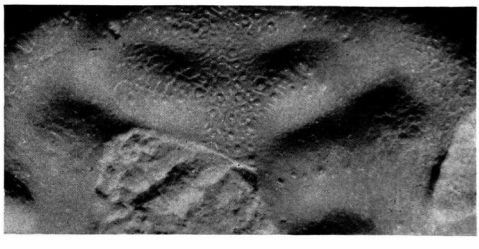

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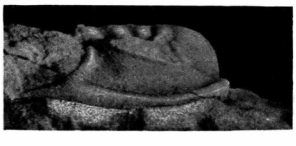

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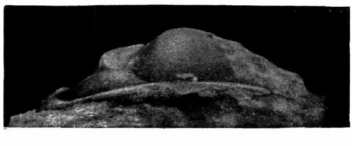

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## Plate 6.

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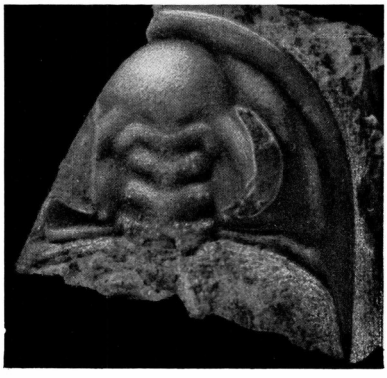
Fig. 1–5. *Wanneria ruginosa* n. sp., fragmentary cephalon, holotype, Marshall Bugt, locality 1 ..... 19

– 1–3. Dorsal, frontal, and lateral view, × 5.

– 4. Glabella, enlarged (× 10) to show surface markings.

– 5. Cheek, enlarged (× 10) to show surface markings.

– 6–8. *Wanneria subglabra* n. sp., dorsal, frontal, and lateral view of fragmentary cephalon, holotype, × 10, Marshall Bugt, locality 1 ... 20



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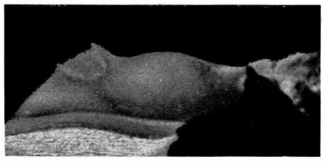

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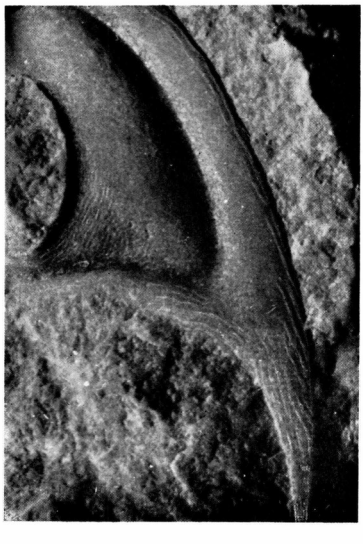

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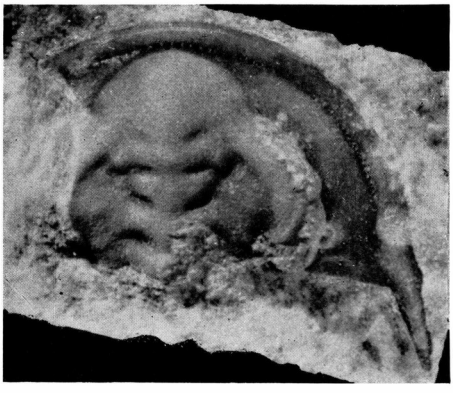

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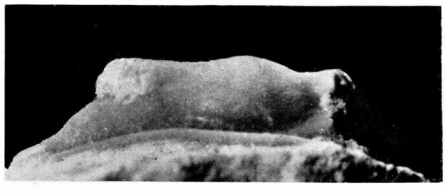

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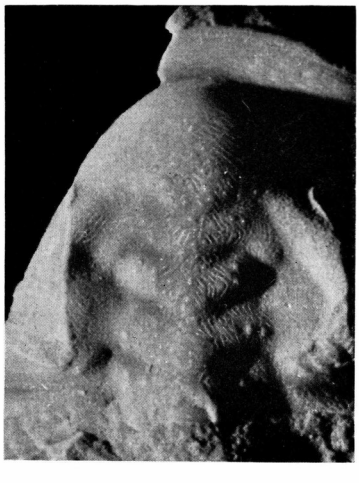

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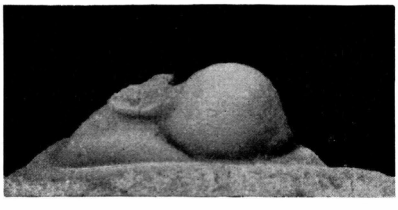

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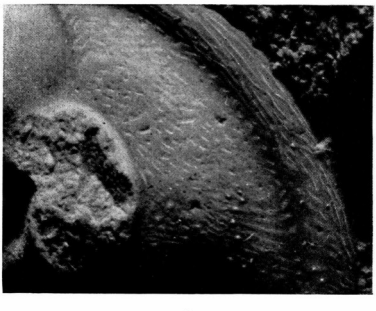

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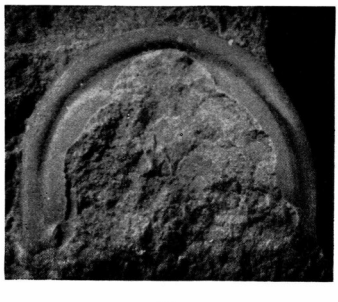

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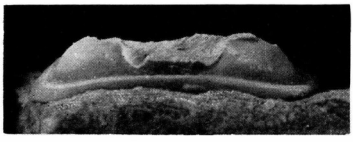

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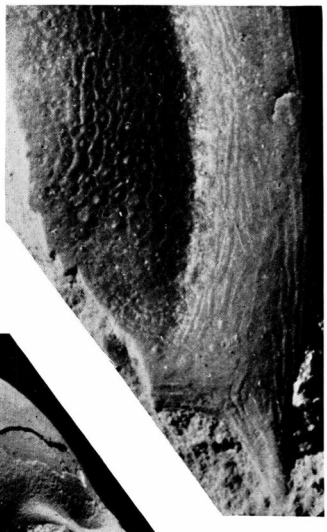

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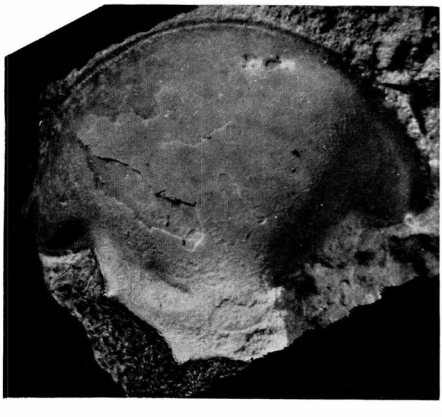

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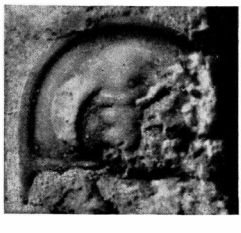

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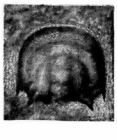

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