

DET KONGELIGE DEPARTEMENT
FOR HANDEL, SJØFART, INDUSTRI, HÅNDVERK OG FISKERI

NORGES SVALBARD- OG ISHAVS-UNDERSØKELSER
LEDER: ADOLF HOEL

SKRIFTER OM SVALBARD OG ISHAVET

Nr. 52

THE DOWNTONIAN AND DEVONIAN
VERTEBRATES OF SPITSBERGEN

IV
SUBORDER *CYATHASPIDA*

BY
JOHAN KIÆR †
A PRELIMINARY REPORT
EDITED BY A. HEINTZ

WITH 12 FIGURES AND 11 PLATES



OSLO
I KOMMISJON HOS JACOB DYBWAD
1932

Results of the Norwegian expeditions to Svaibard 1906—1926 published in other series. (See Nr. 1 of this series.)

The results of the Prince of Monaco's expeditions (Mission Isachsen) in 1906 and 1907 were published under the title of 'Exploration du Nord-Ouest du Spitsberg entreprise sous les auspices de S. A. S. le Prince de Monaco par la Mission Isachsen', in *Résultats des Campagnes scientifiques*, Albert Ier, Prince de Monaco, Fasc. XL—XLIV. Monaco.

ISACHSEN, GUNNAR, Première Partie. Récit de voyage. Fasc. XL. 1912. Fr. 120.00.

With map: Spitsberg (Côte Nord-Ouest). Scale 1:100 000. (2 sheets.) Charts: De la Partie Nord du Foreland à la Baie Magdalena, and 'Mouillages de la Côte Ouest du Spitsberg. ISACHSEN, GUNNAR et ADOLF HOEL, Deuxième Partie. Description du champ d'opération. Fasc. XLI. 1913. Fr. 80.00.

HOEL, ADOLF, Troisième Partie. Géologie. Fasc. XLII. 1914. Fr. 100.00.

SCHETELIC, JAKOB, Quatrième Partie. Les formations primitives. Fasc. XLIII. 1912. Fr. 16.00.

RESVOLL HOLMSEN, HANNA, Cinquième Partie. Observations-botaniques. Fasc. XLIV. 1913. Fr. 40.00.

A considerable part of the results of the ISACHSEN expeditions in 1909 and 1910 has been published in *Videnskapsselskapets Skrifter. I. Mat.-Naturv. Klasse*, Kristiania (Oslo).

ISACHSEN, GUNNAR, Rapport sur l'Expédition Isachsen au Spitsberg. 1912, No. 15. Kr. 5,40.

ALEXANDER, ANTON, Observations astronomiques. 1911, No. 19. Kr. 0,40.

GRAARUD, AAGE, Observations météorologiques. 1913, No. 1. Kr. 2,40.

HELLAND-HANSEN, BJØRN and FRIDTJOF NANSEN, The sea west of Spitsbergen. 1912, No. 12. Kr. 3,60.

ISACHSEN, GUNNAR, The hydrographic observations. 1912, No. 14. Kr. 4,20.

With chart: Waters and anchorages on the west and north coast. Publ. by the Norw. Geogr. Survey, No. 198.

HOEL, A. et O. HOLTEDAHL, Les nappes de lave, les volcans et les sources thermales dans les environs de la Baie Wood au Spitsberg. 1911, No. 8. Kr. 4,00.

GOLDSCHMIDT, V. M., Petrographische Untersuchung einiger Eruptivgesteine von Nord-westspitzbergen. 1911, No. 9. Kr. 0,80.

BACKLUND, H., Über einige Olivinknollen aus der Lava von Wood-Bay, Spitzbergen 1911, No. 16. Kr. 0,60.

HOLTEDAHL, OLAF, Zur Kenntnis der Karbonablagerungen des westlichen Spitzbergens. I. Eine Fauna der Moskauer Stufe. 1911, No. 10. Kr. 3,00. II. Allgemeine stratigraphische und tektonische Beobachtungen. 1912, No. 23. Kr. 5,00.

HOEL, ADOLF, Observations sur la vitesse d'écoulement et sur l'ablation du Glacier Lilliehöök au Spitsberg 1907—1912. 1916, No. 4. Kr. 2,20.

VEGARD, L., L'influence du sol sur la glaciation au Spitsberg. 1912, No. 3. Kr. 0,40.

ISACHSEN, GUNNAR, Travaux topographiques. 1915, No. 7. Kr. 10,00.

With map: Spitsberg (Partie Nord-Ouest). Scale 1:200 000 (2 sheets).

GUNNAR ISACHSEN has also published: Green Harbour, in *Norsk Geogr. Selsk. Aarb.*, Kristiania, 1912—13, Green Harbour, Spitsbergen, in *Scot. geogr. Mag.*, Edinburgh, 1915, and Spitsbergen: Notes to accompany map, in *Geogr. Journ.*, London, 1915.

All the above publications have been collected into two volumes as *Expédition Isachsen au Spitsberg 1909—1910. Résultats scientifiques. I, II. Christiania 1916.*

As the result of the expeditions of ADOLF HOEL and ARVE STAXRUD 1911—1914 the following memoir has been published in *Videnskapsselskapets Skrifter. I. Mat.-Naturv. Klasse.*

HOEL, ADOLF, Nouvelles observations sur le district volcanique du Spitsberg du Nord. 1914, No. 9. Kr. 2,50.

The following topographical maps and charts have been published separately:

Bjørnøya (Bear Island). Oslo 1925. Scale 1:25 000. Kr. 10,00.

Bjørnøya (Bear Island). Oslo 1925. Scale 1:10 000. (In six sheets.) Kr. 30,00.

East Greenland, Eirik Raudes Land from Sofiasund to Youngsund. Oslo 1932. Scale 1:200 000. Kr. 5,00.

Chart of Bear Island. (No. S1). Oslo 1929. New edition 1932. Scale 1:40 000. Kr. 4,00.

Bear Island Waters. (No. S2). Oslo 1930. Scale 1:350 000. Kr. 5,00.

Spitsbergen. Chart, Bellsund—Forlandsrevet including Isfjorden. (No. S3). Oslo 1932. Scale 1:200 000. Kr. 5,00.

A preliminary edition of topographical maps on the scale of 1:50 000 covering the regions around Kings Bay, Ice Fjord, and Bell Sound, together with the map of Bear Island, scale 1:25 000, is published in:

Svalbard Commissioner [Kristian Sindballe], Report concerning the claims to land in Svalbard. Part I A, Text; I B, Maps; II A, Text; II B, Maps. Copenhagen and Oslo 1927. Kr. 150,00.

DET KONGELIGE DEPARTEMENT
FOR HANDEL, SJØFART, INDUSTRI, HÅNDVERK OG FISKERI

NORGES SVALBARD- OG ISHAVS-UNDERSØKELSER
LEDER: ADOLF HOEL

SKRIFTER OM SVALBARD OG ISHAVET

Nr. 52

THE DOWNTONIAN AND DEVONIAN
VERTEBRATES OF SPITSBERGEN

IV
SUBORDER *CYATHASPIDA*

BY
JOHAN KIÆR †
A PRELIMINARY REPORT
EDITED BY A. HEINTZ

WITH 12 FIGURES AND 11 PLATES



OSLO
I KOMMISJON HOS JACOB DYBWAD
1932

CONTENTS

	Page
Preface	5
I. Introduction	7
II. Systematical part	7
III. Description of Genera and Species	7
Suborder <i>Cyathaspida</i>	7
Terminology of the thermal skeleton	8
Tribe I. <i>Poraspidei</i>	12
Family 1. <i>Poraspidae</i> , nov. fam.	12
<i>Poraspis</i> nov. gen.	13
<i>Homalaspis</i> nov. gen.	14
Family 2. <i>Palaeaspidae</i> nov. fam.	15
Family 3. <i>Dinaspidae</i> nov. fam.	15
<i>Dinaspis</i> no. gen.	18
<i>Dictyaspis</i> nov. gen.	18
Family 4. <i>Anglaspidae</i> nov. fam.	19
<i>Anglaspis</i> JACKEL emend KIÆR	20
Family 5. <i>Ctenaspidae</i> KIÆR	20
Tribe II. <i>Cyathaspidei</i>	21
Family 1. <i>Cyathaspidae</i> nov. fam.	21
<i>Cyathaspis</i> LANKESTER	21
<i>Archegonaspis</i> JAEKEL	22
<i>Eoarchegonaspis</i> nov. gen.	24
Family 2. <i>Tolypaspidae</i> nov. fam.	24
<i>Tolypaspis</i> FR. SCHMIDT	25
Family 3. <i>Diplaspidae</i> nov. fam.	25
Family 4. <i>Traquairaspidae</i> nov. fam.	25
<i>Traquairaspis</i> nov. gen.	25

PREFACE

The decease of Professor JOHAN KIÆR, on October 31. 1931, left his great work on *Pteraspidian* fishes from Spitsbergen unfinished. During the last twenty-five years of his life he was occupied with these studies, and had gradually extended his investigations to a general revision of all *Pteraspidian* fishes throughout the world. Thanks to the kind liberality of the different foreign museums, he gathered in Oslo nearly all the originals of the older authors, and was thus able to restudy them and compare them with the enormous material from Spitsbergen. This material, which was collected on different Norwegian expeditions, contains between ten and fifteen thousand species of different *Pteraspidian* forms. Professor KIÆR'S plan was to publish three large monographs on *Cyathaspida*, *Psammosteida* and *Pteraspida*. In the last few years he worked most energetically with the *Cyathaspida*, and expected to finish this paper in the autumn of 1931. But unfortunately, illness interfered with his plans, and after his death the manuscript on the *Cyathaspida* was found unfinished.

As Professor KIÆR'S pupil, collaborator and friend I have been charged with the completion of his great work. At first glance the manuscript appeared to be nearly complete, but a more careful examination has shown that there is still much work left, which it will take a relatively long time to finish. Therefore, after a conference with Mrs. JOHAN KIÆR and Docent A. HOEL, I have decided to prepare this preliminary report at once, so as to give a short comprehensive view of Professor KIÆR'S work, to introduce his systematic divisions, and to establish priority to the names he proposed.

This report is thus only a short abstract of his *Cyathaspida* paper. It includes only the definitions for the Suborders, Tribes and Families, the species merely mentioned without any diagnosis. Nearly all definitions are directly taken from his manuscript, and only absolutely necessary additions are made. Also the majority of the illustrations are prepared under the direction of Professor KIÆR himself.

Paleontological Museum, Oslo.

June 1932.

A. Heintz.

I. INTRODUCTION

The material described in this paper is collected on eight Norwegian expeditions to Spitsbergen: In 1906, 1907, 1909 and 1910, led by G. ISACHSEN; 1911 and 1912, led by A. HOEL and A. STAXRUD; and in 1925 and 1928, led by TH. VOGT. All specimens were found in the deposits on the West side of Red Bay, in Northern Spitsbergen, which must be regarded as belonging to the Downtonian and is known under the name of the "Red-Bay series".

II. SYSTEMATICAL PART

According to the author's investigations, the ancient group of fishes which LANKESTER in 1869 called *Heterostraci* must be regarded as an Order and can be divided in the following manner:

Order *Heterostraci*.

Suborder I: *Psammosteida*

Suborder II: *Cyathaspida*

Suborder III: *Pteraspida*

Together with another Order *Thelodonti* they compose the second group of the *Agnatha* animals — the *Diplorhina*. The first group is *Monorhina* with two Orders *Osteostraci* and *Cyclostoma*.

In the following the suborder *Cyathaspida* will be described.

III. DESCRIPTION OF GENERA AND SPECIES

Suborder Cyathaspida.

The name *Cyathaspida* (but not *Palaeaspida* JAEKEL) has been chosen as the name for this suborder, as *Cyathaspis* was the first species to be described (LANKESTER 1869) and must therefore be regarded as the type genus.

It is quite difficult to make an elaborate diagnosis of this suborder. The following characters are, however, common to all *Cyathaspida* and distinguish them from the suborder *Pteraspida* and *Psammosteida*.

1. The orbits are not surrounded by the dorsal shield, but they only form semicircular notches on it.
2. The large oblong branchial plate situated between the dorsal and ventral shields is quite detached.
3. The dentin ridges, forming the surface of the dermal skeleton, are smooth, not crenated as in the *Pteraspids*.

According to the non-division or division into several parts of the dorsal shields the suborder *Cyathaspida* can be divided into two tribes:

In the one, the *Poraspidei*, the dorsal shield is completely undivided and the diverse parts of the shield are merged without defined demarcations. In the other, the *Cyathaspidei*, the surface of the dorsal shield is divided into four portions by distinct limits in the dentin layer.

The *Cyathaspida* appear for the first time in the upper part of the Silurian, then continue throughout the Downtonian and disappear with this series. The astonishingly rich layers in Red Bay in Northern Spitsbergen contain, however, only forms pertaining to the *Poraspidei*. As regards the *Cyathaspidei*, there exist only the few collections from older localities (especially in Scotland).

Terminology of the dermal skeleton.

The armour of the front part of the body consists in the majority of *Cyathaspida* chiefly of four parts: A large vaulted dorsal shield, a corresponding ventral shield, and two intermediate elongated plates, one on each side — the branchial plates. (Fig. 1).

In the *Poraspidei* the dorsal shield can be divided into three parts: 1. Rostral, 2. Branchial and 3. Postbranchial. (Fig. 1 A and B.) The Pineal area is placed on the limit between the Rostral and the Branchial parts. On the side of the shield can be seen the Pre-orbital process, the Orbital notch, the Branchial sinus and the Lateral lobe (postbranchial). Between the Preorbital processes there is developed, below the anterior margin of the rostral part, a distinct Maxillar brim forming the upper limit of the mouth opening. On the inside of the dorsal shield are clearly seen impressions of different organs: seven branchial impressions and seven marginal branchial impressions on each side, the pineal impression on the median line and impressions after nasal sacs, brain and the angularly placed semicircular canals. (Fig. 2 a, Pl. III, 3; Pl. VI, 1.)

In the *Cyathaspidei* the dorsal shield can be divided as follows:

1. A Rostral part — comprising the anterior portion only of the rostral part in the *Poraspidei*.

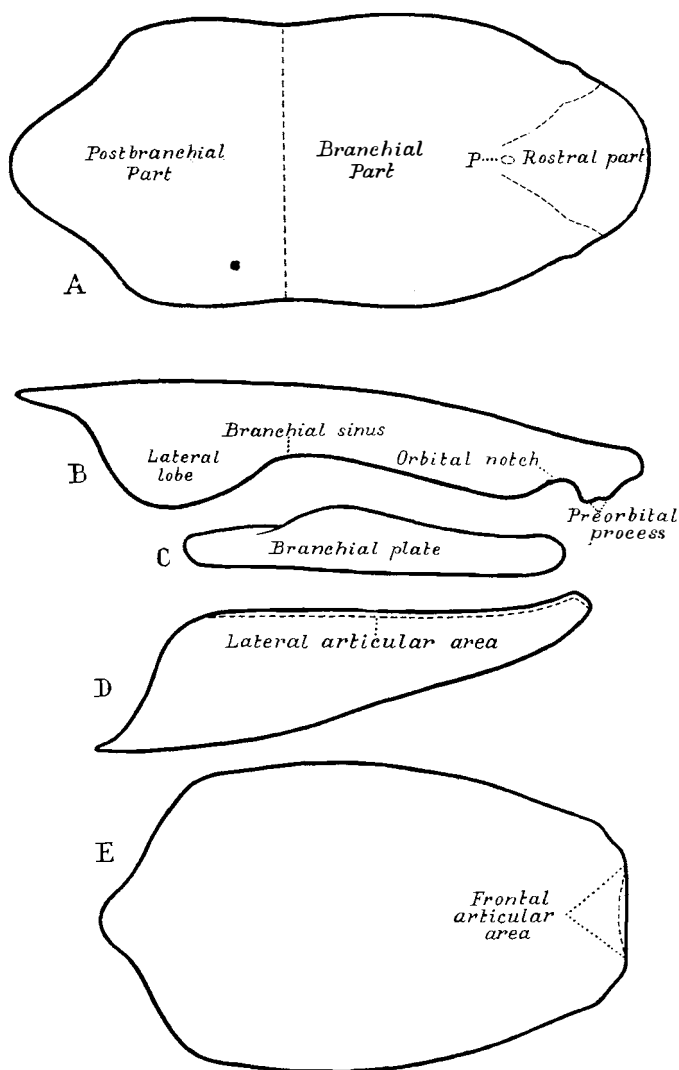


Fig. 1. *Poraspis polaris* n. gn. & sp. An outline drawing, showing the nomenclature of the different parts of the dermal skeleton. Ca. $\times 2\frac{1}{2}$.

2. The Central disc — comprising both the median portion of the branchial, the whole postbranchial, and the hind portion of the rostral part in *Poraspidei*.

3. The two elongated Lateral parts — which embrace anteriorly the orbital notches and correspond with the lateral portions of the branchial part in *Poraspidei*. (Fig. 3.)

The Ventral shield in all *Cyathaspida* shows no divisions. On the front and side margins can be seen Articular areas — the place where the mouth plates and the branchial plate were attached respectively (Fig. 1 D and E). The inside of the shield in some forms

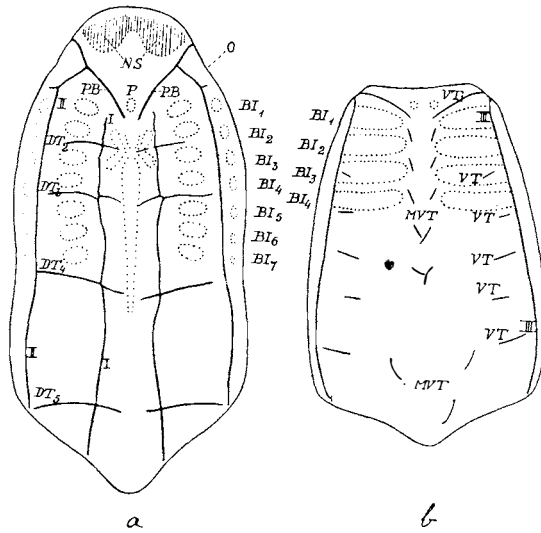


Fig. 2. *Poraspis polaris* n. gn. & sp. An outline drawing, showing the position of the impressions on the inside of the dorsal (a) and the ventral (b) shields and the course of the sensory canals. Ca. $\times 1^{1/2}$.

shows anteriorly four or five pairs of longish branchial impressions, in front of which is commonly seen a small median impression (Fig. 2 b).

The Branchial plate was placed between the dorsal and the ventral shields (Fig. 1, C). On the posterior portion of its upper margin is seen an incurvation, which bounded the gill opening below.

Of other smaller plates in *Poraspidei* a little Suborbital plate is known, which limited the orbital notches inferiorly. (Pl. V, 2.) Also mouth plates are known in one form. They are arranged on the same principle as the mouth plates in *Pteraspis*¹.

To characterize the single forms the following measures and indexes for the dorsal shield are used (see fig. 4). Length (L) and Breadth (B) and Breadth-length index (BL Ind.) = $\frac{\text{breadth}}{\text{length}} \times 100$. Pineal length (PL), Rostral length (RL) (it is the distance from the anterior margin to a line between the orbital notches OB). Rostral index (R Ind.) = $\frac{\text{rostral length}}{\text{total length}} \times 100$.

Behind the armour the body was covered with scales (fig. 5, fig. 11). They form marked segmentally arranged rings, each one consisting of six scales: one median dorsal (md.), two pairs lateral (1 lt and 2 lt)

¹ J. KIÆR: The Structure of the Mouth of the Oldest Known Vertebrates, Pteraspids and Cephalaspids. *Palaeobiologica*. Bd. I. 1928.

and one median ventral (mv.) scale. The shape and relative size of the single scales vary widely in different forms.

On the caudal fin, which has been of a hypocercal type, the large lateral scales were broken up into smaller ones (Fig. 11). Other unpaired and paired fins are entirely missing.

The dermal skeleton shows under the microscope the following four layers: Basal, cancellated, reticular and dentin layers. (Pl. III, 4.)

The lateral line system is very strongly developed. The system consists of parallel longitudinal lines and transverse commisures, which have a fixed relation to the brain, sense organs, and gills. On the dorsal shield are developed: A pair of median dorsal lines (Fig. 2, I), a pair of lateral dorsal lines (Fig. 2, II) and five transverse commisures (Fig. 2, DT_2 — DT_5), which could be more or less completely developed. The first one lying just behind the pineal organ is most frequently indistinct. A portion, of it, along with the anterior part of the median dorsal line, formed two pineal branches (Fig. 2, PB). The lateral dorsal line sends out a short branch just behind the orbit; it continues on the inner side to the pineal branches.

On the ventral shield are developed: The lateral ventral lines (Fig. 2, III) and a series of transversal commisures. The foremost, going from the anterior corner, is abruptly in the median portion (Fig. 2, VT_1). The others are more reduced and form only a short lateral transversal line (Fig. 2, VT) and a short median line (Fig. 2, MVT), lying in pairs on the median part of the shield. The lateral line system shows a rather rich variation in different families of the *Poraspidei*. In the *Cyathaspidei* it is not yet quite ascertained.

In many cases two different forms were found, differing from each other only in breadth. Very probably this is dimorphism of one kind or another (e. g. sexual). These different forms are in this paper called *angusta* (narrow) (Pl. I) and *lata* (broad) (Pl. II).

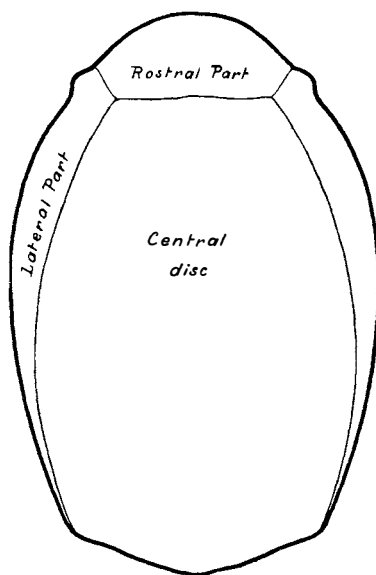


Fig. 3. *Archegonaspis* sp. An outline drawing, showing the position of the different parts of the dorsal shield.

Ca. $\times 2$.

Tribe I. *Poraspidei*.

The surface of the dorsal shield in this tribe is always pronouncedly entire and undivided. The rib pattern on the rostral part is, however, often characteristic and extends right back to the pineal branches. The lateral line system is always strongly developed.

The first previously described genus belonging to this tribe is *Holaspis* (LANKESTER 1873). As this name was preoccupied, A. S. WOODWARD placed this genus under CLAYPOLE's genus *Palaeaspis*. According to the author's investigations, however, "*Holaspis*" pertains to a widely different and distinct type, which is called *Poraspis*. Thus *Poraspis* becomes the type genus for the whole tribe. The numerous species hitherto known may be assigned to five families: *Poraspidæ*, *Palaeaspidæ*, *Dinaspidæ*, *Anglaspidae* and *Ctenaspidæ*.

The *Poraspidei* occur in the European regions solely in the Downtonian. In North America, on the other hand, there have been found some forms in Silurian horizons (Salina).

Family 1. *Poraspidæ*, nov. fam.

This family must be regarded as the type family. Its representatives occur in the Red-Bay series in Spitsbergen in a very great number of both species and individuals.

The *Poraspidæ* comprise forms with elongated, faintly vaulted dorsal and ventral shields. The rostral part in front of the orbits somewhat narrowed. The maxillar brim well developed, often broad and flat. The postbranchial part long, with well developed anteriorly rounded lateral lobes. Posteriorly the dorsal shield somewhat drawn out, ending in a rounded, flat lobe. The branchial plates elongated and flat. The ventral shield with faintly curved sides and posteriorly less drawn out, but somewhat more pointed than the dorsal shield. The dentin ridges on the surface fine to comparatively broad, always flat and run on both shields in the main longitudinally, in details, however, with often strongly varied deviations. The rostral pattern with longitudinally or faintly fanwise arranged ridges in front, often with a narrower or broader marginal area, the ridges of which follow the anterior margin, often broken up into lesser portions and flat tubercles. Pineal macula frequently very marked.

The interior sides of the shields with very distinct impressions of the nasal sacs, the semicircular canals, several portions of the brain and the branchial organs. (Pl. III, 3.)

Only isolated body scales found. The median scales comparatively short, the dorsal ones rounded, the ventral ones sharply pointed, the lateral ones very long, rectangular.

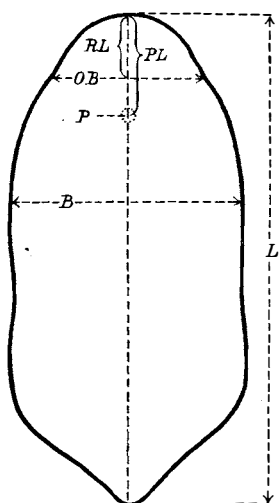


Fig. 4.

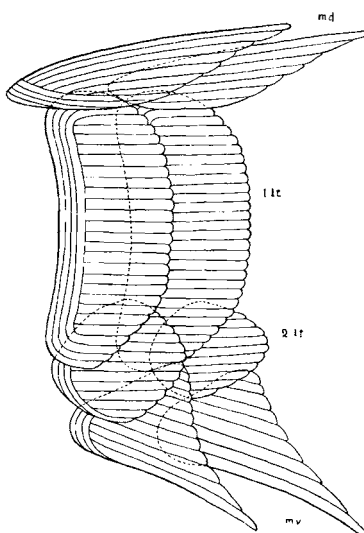


Fig. 5.

Fig. 4. *Poraspis* sp. An outline drawing of the dorsal shield, showing the measures for the dorsal shield. Fig. 5. *Anglaspis heintzi* n. g. & sp. Arrangement of the body scales.

The lateral line system regularly and normally developed in both shields (Fig. 2). Pineal branches marked. Numerous regularly arranged pores. Some of the longitudinal lines of the shields continue on the lateral body scale, only they are here broken up into quite short lines.

The *Poraspidae* have a wide distribution. They are known in numerous forms from different Downtonian regions in Europe.

They comprise the two genera *Poraspis* and *Homalaspis*.

Poraspis nov. gen.

(Fig. 1 & 2; Pl. I; Pl. II; Pl. III, 1, 2 & 3.)

Small to comparatively large forms having the rostral part often faintly contracted in front of the orbital notches. The branchial part somewhat bent out and the postbranchial comparatively long with well developed lateral lobes. Fine dentin ridges. The dermal skeleton has a faintly developed reticular layer, in most instances with comparatively narrow openings from the cancellae upwards into the pulpa canals. The pineal branches of the lateral line system have particularly large and conspicuous pores, and the median lines on the ventral shield are not coherent.

Besides the genotype *Poraspis (Holaspis) sericea* LANK. there are many other previously described forms belonging to this genus: *Cyathaspis sturi* v. ALT., *Cyathaspis barroisi* LERICHE and probably

also *Palaeaspis bitruncata* CLAYP. To these are now added a number of new species from Spitsbergen.

The genus *Poraspis* is present throughout the whole Red-Bay series in a number of forms characterizing very well the different horizons of this mighty series.

Eight new species are defined in all:

1. *Poraspis polaris* n. sp. (the most common species) (Fig. 1 & 2; Pl. I).
2. *Poraspis brevis* n. sp. (Pl. II).
3. *Poraspis intermedia* n. sp.
4. *Poraspis subtilis* n. sp.
5. *Poraspis elongata* n. sp.
6. *Poraspis rostrata* n. sp. (Pl. III, 1 & 2).
7. *Poraspis cylindrica* n. sp. (Pl. III, 3).
8. *Poraspis magna* n. sp.
9. *Poraspis sericea* LANK. (Genotype).
10. *Poraspis sturi* v. ALT.
11. *Poraspis barroisi* LERICH.

Homalaspis nov. gen.

(Fig. 6, Pl. IV, 1.)

Small forms with a short, broadly rounded rostral part, faintly developed branchial part, and a very short postbranchial part with brief postbranchial lobes. The dentin ridges comparatively broad and the surface unusually glossy.

Pineal macula broad and entirely flat. The dermal skeleton thin almost with wholly reduced reticular layer and with very broad openings from the cancellae upwards into the pulpa canals. The development of the lateral line system of the dorsal shield is distinguished by rudimental transverse commisures (Fig. 6). In the ventral shield the anterior transverse commisure and the four succeeding brief median lines are united into one continuous line. The pores of the pineal branches not particularly large. The genotype is *Homalaspis nitida* (P. M. O. D 156). (Pl. IV, 1.)

This new genus has not been found outside Spitsbergen, where it occurs abundantly in the Ben Nevis group. (Upper part of Red-Bay series.) Only one specimen and one variation are known:

Homalaspis nitida n. sp. (Geno and Holotype P. M. O. D 156; Pl. IV, 1), and *Homalaspis nitida* var. *robusta* n. var.

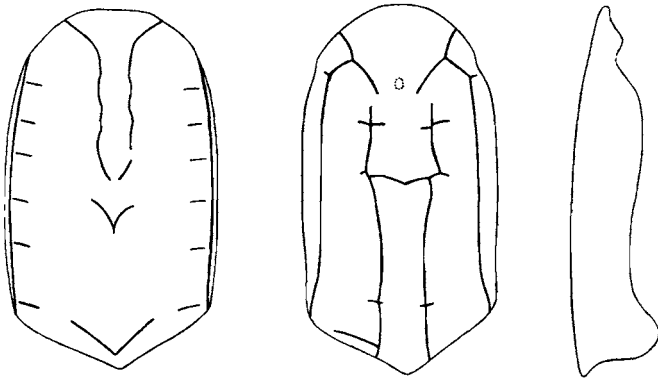


Fig. 6. *Homalaspis nitida* n. gn. & sp. The sensory canals on the ventral (1) and dorsal (2) shields. 3-dorsal shield, lateral view. Ca. $\times 2\frac{1}{2}$.

Family 2. *Palaeaspidae* nov. fam.

This exclusively American family comprises the genus *Palaeaspis* CLAYPOLE with two species *Palaeaspis americana* and *Palaeaspis bitruncata*. In spite of the investigations of CLAYPOLE, PATTEN, and BRYANT they are far from satisfactorily known. In the author's opinion these two species appear to resemble widely different European genera. (*Palaeaspis americana* with *Dinaspis* and *Palaeaspis bitruncata* with *Poraspis*). As the important structural features (e. g., development of maxillar brim and the lateral line system) are still unknown, it seems right to leave to the future the decision of these questions and provisionally to regard the American species as belonging to the same genus *Palaeaspis*, which represents a separate American family *Palaeaspidae*. This family is considerably older than all European *Poraspidei*. In fact it occurs in the median and lower portions of the Salina group which must presumably be equivalent to the lower Ludlow, while in Europe the real *Poraspidei* do not appear until the Downtonian.

As mentioned, the family *Palaeaspidae* contains only one genus *Palaeaspis* CLAYPOLE with two species *Palaeaspis americana* CLAYPOLE and *Palaeaspis bitruncata* CLAYPOLE.

Family 3. *Dinaspidae* nov. fam.

(Fig. 7, 8, 9 & 10, Pl. IV, 2 & 3; Pl. V; Pl. VI, 2 & 3.)

This family comprises small to comparatively large *Poraspidei*, with dorsal shields of fairly equal breadth. The rostral part is not sharply divided from the branchial and seems to be broad and short. But in reality the pineal organ is placed relatively far back, so that the rostral index is nevertheless very large (about 30). The postbranchial part is short, with brief downwardly curved lateral lobes which anteriorly are

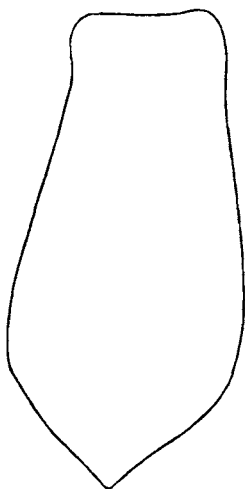


Fig. 7.

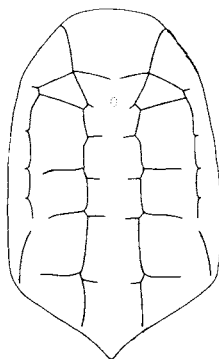


Fig. 8.

Fig. 7. *Dinaspis robusta* n. gn. & sp. Ventral shield, outline. Ca. \times 3.

Fig. 8. *Dinaspis robusta* n. gn. & sp. Dorsal shield, lateral line. Ca. \times 2.

abruptly truncated, in some forms almost hook-shaped. Posteriorly the shield is sharply pointed.

The dentin ridges on the surface are fine to comparatively broad, and run essentially longitudinal. But the rostral part forms an exception to this and shows a different pattern of the dentin ridges in both genera. The pineal macula is indistinct, often invisible, but always marked by the fact that the ridges near the pineal organ and somewhat backwards form an elliptical pattern.

On the inside of the dorsal shield, the branchial part shows a thickened lateral brim, which is most clearly seen on the natural casts. Just below the lateral margin the infra-marginal dentin ridges form a narrow lateral ridge. Correspondingly also below the margin of the uniformly curved rostral part, only a narrow maxillar ridge is developed, but not a maxillar brim as is the case in the *Poraspidæ*.

As for the rest, one sees weak impressions after the pineal organ and after the two semicircular canals, while the brain itself and the branchials have left only indistinct impressions or none whatever. The median portion of the rostral part does not show any impressions caused by the nasal sacs. Slight traces of such sacs are, however, found far back on the sides in front of the orbital notches. The natural casts therefore show anteriorly of the rostral part an absolutely even surface, a feature very characteristic of this family. The orbital notches have a markedly lateral position, and the eye opening seems to be directed slightly downwards. The ventral shield has a characteristic shape, with a deep incision for the branchial plate, in the anterior portion of its

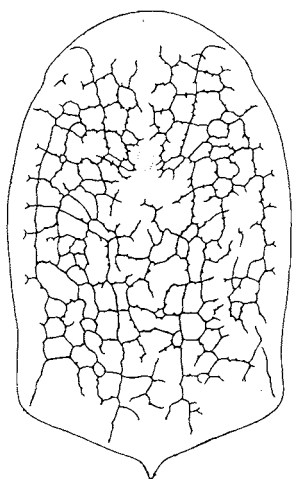


Fig. 9.

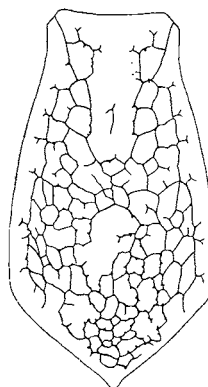


Fig. 10.

Fig. 9. *Dictyaspis complicata* n. gn. & sp. Dorsal shields, lateral lines network. Ca. $\times 2$.

Fig. 10. *Dictyaspis hoeli* n. gn. & sp. Ventral shield, lateral lines network. Ca. $\times 1\frac{1}{2}$.

lateral margin. Accordingly it is flat and narrow anteriorly, but backwards it becomes more and more vaulted. Most posteriorly it is strongly drawn out and pointed. (Pl. VI, 2 & 3). The branchial plate has been found, but its shape cannot be distinctly characterized. Below the orbits a large curved suborbital plate has been found (Pl. V, 2), whereas the plates in the mouth region are entirely unknown. The system of the scales in the body is also partially known. The median dorsal and ventral scales are equally developed and pointed. The lateral appear to be very elongated and arranged in two uniform, longitudinal rows, which are usually placed faintly angle-wise. (Pl. V.)

The development of the lateral line system is the most characteristic feature. This system in the older forms (*Dinaspis*, Fig. 8) very much resembles the one in the family *Poraspidae*, though with some essential deviations. Firstly, the dorsal median line runs unabruptly forwards, passing the pineal organ and then curving outwards toward the lateral margin in front of the eye notches. Thus the differentiated pineal branches are not developed, a fact which the author takes to be a primitive character. Secondly, in the rostral part occurs the transverse commisure in front of the pineal macula. Finally, there are approximations to anomalies with regard to the course of the single lines. This latter feature is further developed in the younger forms (*Dictyaspis*), in which the lines branch more and more and could form a most complex network both in the dorsal and ventral shields. (Fig. 9 and 10.)

The structure of the skeleton is comparatively primitive with narrow pulpa canals, a more strongly developed reticular layer than is usually seen in the *Poraspidei*, and more irregular concellae.

The *Dinaspidae* appear first in the upper horizons of Frænkelryggen (lower part of Red-Bay series), then continue into the upper horizons of Ben Nevis where they are fairly common. They form a remarkable family, which in some respects shows primitive features — in others is singularly specialized. This family seems to be fairly isolated, if a closer investigation does not reveal a nearer relationship to the American genus *Palaeaspis*, which it resembles with regard to some features.

Dinaspis nov. gen.

(Fig. 7 and 8; Pl. IV, 2 & 3.)

Small, broad, forms, the postbranchial part short and its declined lateral lobes abruptly truncated anteriorly, almost hook-shaped. The back of the shield in its posterior portion usually more or less angularly curved and farthest back drawn out into a short tip. The ventral shield most posteriorly drawn out uncommonly long. The rostral pattern formed either by transverse, curving ridges or by ribs arranged into whirls. The lateral lines somewhat irregular and sometimes broken off, still they form a plain system consisting of the typical longitudinal lines and transverse commisures.

This genus, which is very characteristic of the upper portion of the Frænkelryggen group, undoubtedly forms the original stock from which the later and more differentiated genus *Dictyaspis* has evolved.

Two species are determined: *Dinaspis robusta* n. sp. (Geno- and Holotype. P. M. O. D 454, Pl. IV, 2 & 3) and *Dinaspis parvula* n. sp.

Dictyaspis nov. gen.

(Fig. 9 and 10. Pl. V; Pl. VI, 2 & 3.)

Relatively small to middle sized forms. The rostral part broad, roundish and short. The dentin ribs on the rostral part longitudinal and only along the front margin transverse. The lateral lobes of the postbranchial part not so hook-shaped as in *Dinaspis*. Posteriorly the dorsal shield drawn out into a concise tip. The impression along the posterior margin very concisely developed. The dentin ribs fine. The pineal macula indistinct. The ventral shield long, with remarkable roundish cuts on the sides (for the branchial plates). Posteriorly strongly vaulted and drawn out very long. The lateral lines composed of a more or less compact network, which can be very complicated and seems to be especially close on the dorsal shield.

These forms are only known from Ben Nevis through all the horizons.

Three species are determined: *Dictyaspis hoeli* n. sp. (Geno- and Holotype P. M. O. D 474, Fig. 10; Pl. V, 1 & 2; Pl. VI, 2 & 3.) *Dictyaspis prisca* n. sp. and *Dictyaspis complicata* n. sp. (Fig. 9.)

Family 4. *Anglaspidae* nov. fam.

(Fig. 11. Pl. VI, 1; Pl. VII, 1 & 2.)

This family comprises small forms with relatively flattened dorsal and more vaulted ventral shields. The dorsal shield's branchial part (Pl. VII, 2) has a quite strongly vaulted margin, which narrows sharply into the branchial sinus. The postbranchial portion has no downwardly curved lateral lobes, but runs on the side into a flat narrow brim, which

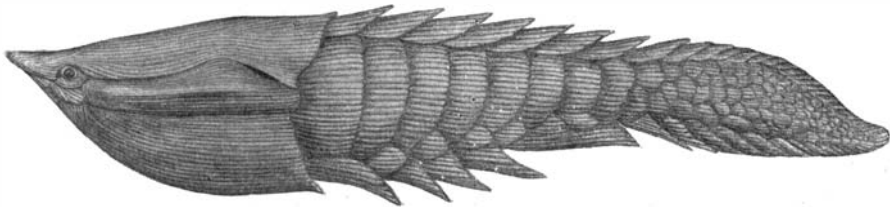


Fig. 11. *Anglaspis heintzi* n. gn. & sp. Reconstruction of the fish in a lateral view. Ca. $\times 2$.

sometimes ends in a short, small point. The dentin ridges on the surface are relatively broad (ca. $\frac{1}{3}$ mm) and vaulted. They compose a characteristic pattern, especially on the flat rostral portion, where they are arranged fanshaped. The ridges between the rostral fan and the orbital notches form a clear "sling".

On the marginal brim the rib pattern is also quite different. The ribs run under an angle to the lateral dorsal line of the lateral line system.

From the inside are seen distinct impressions of the brain, sensory organs and branchials. (Pl. VI, 1.) The maxillar brim is well developed. It composes a relatively short, transversal flat brim. In its internal corners are impressions for the nostril. The nasal sacs themselves are placed close together near the median line.

The ventral shield (Pl. VII, 1) is strongly curved, roundish. The dentin ridges are arranged mainly longitudinally. Only on the front part do we find a fanshaped pattern, and on the marginal part the ridges run parallel to the margin. The impressions for the branchial are clearly seen also on the inside of the ventral shield.

The branchial plate is large with a more or less distinct sharp side edge. (Fig. 11.)

The suborbital plate is small, bent. The side plates of the mouth area short, as also the mandibular plates.

The median dorsal and median ventral scales very large, sharply pointed. The upper side scales very large, the lower ones fairly small. (Fig. 5.) The tail covered with small scales. (Fig. 11)

The lateral line system on the dorsal shield is developed correspondingly with the arrangement in the *Poraspis*. On the other hand, it is greatly reduced on the ventral shield, and is found only as short clefts on the surface (Pl. VII, 1).

The structure of the skeleton is especially characteristic of *Anglaspis*. The upper reticular layer is totally absent, and the large concellae are arranged in longitudinal rows — corresponding with the broad dentin ridges. The concellae open directly into the unusually broad pulpa cavity. The dentin layer may be quite thick.

This new family comprises one genus, *Anglaspis*.

Anglaspis JAEKEL emend. KIÆR.

(Fig. 11. Pl. VI, 1; Pl. VII, 1 & 2.)

As there is only one genus in the family a new genus diagnosis is not necessary.

This genus includes many very characteristic and easily recognized forms, which are closely related to the English form *Cyathaspis mac-culloughi* A. S. WOODWARD, a form which was very imperfectly known. O. JAEKEL has in 1926 shortly redescribed this form, however, without giving a clearer diagnosis, and called it as a new genus *Anglaspis*. The present writer proposes to keep this name.

Seven species of *Anglaspis* are known:

Anglaspis mac-culloughi A. S. WOODWARD (Genotype).

Anglaspis heintzi n. sp. (Fig. 11.)

Anglaspis insignis n. sp. (Pl. VII, 1 & 2.)

Anglaspis insignis var. *brevis* n. var. (Pl. VI, 1.)

Anglaspis platostriata n. sp.

Anglaspis elongata n. sp.

Family 5. *Ctenaspidae* KIÆR.

This family, which in many respects is different from the other *Poraspidi*, has already been described in a preliminary report¹. It composes one genus *Ctenaspis* with three species *Ctenaspis dentatus* KIÆR, *Ctenaspis conselatus* KIÆR and *Ctenaspis kiæri* ZYCH². The last species is unfortunately described in Polish only.

¹ J. KIÆR: *Ctenaspis*, a new genus of Cyathaspidian fishes. Skr. Svalb. og Ish. No. 33. Oslo 1930.

² W. ZYCH: Fauna ryb devonu i downtonu Podola. Pteraspidomorphi: Heterostraci. Czesc I. A.; Lwow 1931.

Tribe II. *Cyathaspidei*.

The surface of the dorsal shield in this tribe is always more or less distinctly divided into 4 parts: The rostral part, the central disc, and two lateral parts (Fig. 3). The lateral line system is in majority of forms imperfectly developed or not known at all.

The first previously described genus belonging to this tribe was *Pteraspis* (*Cyathaspis*) *banksi* HUXLEY & SALTER (1856). It was re-described by LANKESTER as *Cyathaspis* in 1864 and 1868.

This tribe can be divided into four families: *Cyathaspidae*, *Tolytaspidae*, *Diplaspidae* and *Traquairaspidae*. These four families show, however, a very high degree of specialization and are in many respects sharply divided from one another.

The *Cyathaspidei* occur first in the lower part of marine Ludlow (South Sweden and North America) and continue in the Downtonian (South England).

Family 1. *Cyathaspidae* nov. fam.

Cyathaspidei with a complete division of the dorsal shield into four parts. These parts are separated with clear sculpture limits on the surface. These limits, however, could not be seen in the inner layers of the skeleton, thus, in reality, the dorsal shield is a unit. In the posterior part, the dorsal shield is cut crosswise. The vaulted dentin ridges run transversally on the rostral part, but on the other parts of the shield they have a more or less longitudinal course.

The ventral shield is vaulted, long, crosswise cut in the posterior part. In the majority of forms it composes dentin ridges along the side margins and in front a marginal zone with especially fine and regularly arranged ridges. On the central part the dentin ridges run longitudinally or more or less elliptically.

The lateral line system is imperfectly known. The pores are very few and difficult to see.

The microscopical structure of the skeleton corresponds with that in *Poraspidei*.

The representatives of this family are known as early as in the lower Ludlow and continue in South England in the Downtonian.

The family can be divided into three genera: *Cyathaspis* LANK., *Archegonaspis* nov. gen. and *Eoarchegonaspis* nov. gen.

Cyathaspis LANKESTER.

(Pl. VIII, 1 & 2.)

Comparatively small forms, with a short and broad dorsal shield (Pl. VIII, 2) of nearly ovoid form. The sculpture limits between the four

parts of the shield very sharp, seen on the sculpture kernel as clear impression lines. The rostral part very short and broad. The lateral parts developed as flat brims, broad in the front and median part, narrowing backwards and running to the posterior corner of the dorsal shield. To the posterior portion of the dorsal shield is attached a real dorsal spine (as in *Pteraspis*). This spine is generated by the fact that a median dorsal body scale has grown into the dorsal shield. The pattern of the dentin ridges is very characteristic. On the rostral part they run transversally. On the central disc are developed two kinds of ridges — relatively scanty gross ridges and numerous fine ones. Both kinds are arranged elliptically. The pineal area is surrounded by numerous circular ribs. On the lateral part the ridges are uniform, and longitudinal.

The ventral shield (Pl. VIII, 1) is narrower than the dorsal with an elliptical system of scanty gross and numerous fine ribs in the central part and a marginal zone of fine ribs, which run parallel to the lateral and anterior margin of the shield.

The impressions of the different inner organs on the inside of the shields are indistinct. On the dorsal shield, however, can generally be seen weak impressions of the pineal organ, the semicircular canals, and some of the branchials. The inside of the rostral parts are always perfectly even, without any traces of the nasal sacks. The ventral shield shows no impressions.

This genus was founded by LANKESTER in 1864, but exclusively based upon the dorsal shield, the ventral being defined as *Scaphaspis truncatus* HUX. & SALT. Later KUNTH and WOODWARD have acknowledged that it belonged to the same form.

Cyathaspis is the type genus for the family *Cyathaspidae* and is the youngest, most differentiated, and advanced genus within this family.

From all the forms described before as *Cyathaspis*, only one *Cyathaspis banksi* LANK. really belongs to this genus. The other forms partly belong to *Poraspidei* (*C. sturi*, *C. ludensis*, *C. maccolloughi* and *C. barroisi*) partly — to other genera of *Cyathaspidae* (*C. schmidti*, *C. cf. schmidti*, *C. integer*, *C. wardelli*, *C. van ingeni*).

Archegonaspis JAEKEL.

(Pl. IX, 1 & 2.)

Comparatively small forms (40—47 mm). The dorsal shield (Pl. IX, 2) of elliptic form, with the greatest breadth in the middle or somewhat backwards. The sculpture limits between the four parts relatively sharp. Rostral part broad and short, with an evenly curved margin. The not particularly sharply marked lateral parts small, running quite far backward, but never as far as to the posterior side corner of

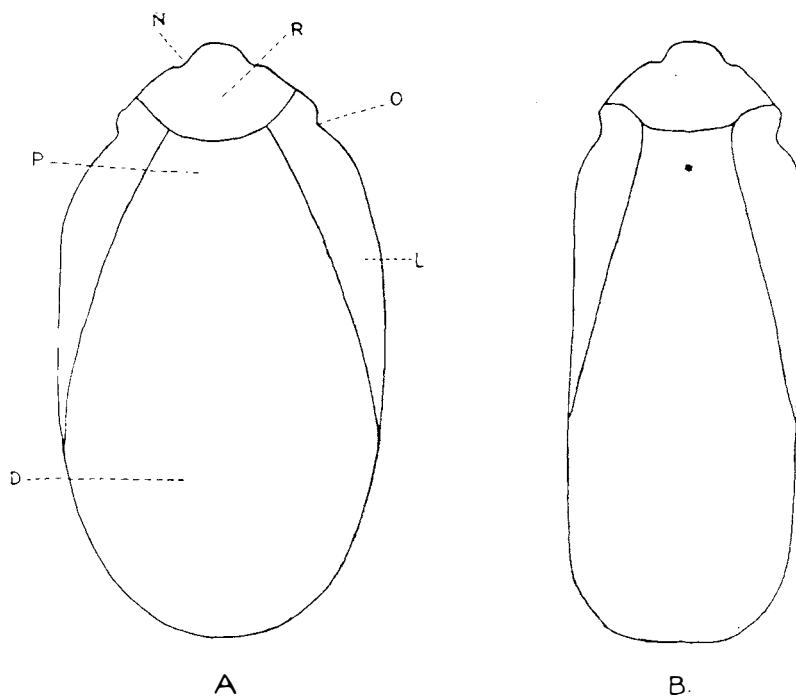


Fig. 12. *Eoarchegonaspis wardelli* BRYANT. Forma lata (A) and angusta (B). Ca. $\times 2$.

the shield. The hind limit sharply truncated. No spine developed. The dentin ridge pattern is quite different in the various species. In the rostral part the dentin ridges always transverse, on the hind part of the shield — longitudinal — more or less converging in the anterior portion of the central disc. On the triangular pineal area the dentin ridges are arranged in a more or less concise pattern, which vary widely in different species. In the majority of the forms the dentin ridges are uniform.

The ventral shield, (Pl. IX, 1) elliptic, the lateral margin anteriorly curved, incised for the branchial plates. The dentin pattern in the central part longitudinal. Often a marginal brim is developed on the side and anterior part of the shield, with differently arranged dentin ridges.

The branchial plate imperfectly known, as also the body scales, which seem in one form (*A. integer*) to be arranged similarly to those in *Anglaspis*. On the other hand, in others (*A. lindströmi*) it is more differentiated in a *Pteraspis* direction.

The genus was founded by JAEKEL in 1927 and based on the specimen previously described by KUNTH (1872) as *Cyathaspis integer*. Unfortunately JAEKEL has not given any clear diagnosis.

The only specimen found in the rock is *Archegonaspis lindströmi*. It is known from the Silurian in South Sweden (Skaane). The other

three specimens are found in the erratic blocks in North Germany. Four forms are known:

Archegonaspis integer KUNTH (Pl. IX, 2). Geno and Holotype.

(*Cyathaspis integer* A. KUNTH 1872).

Archegonaspis integer var. *schmidti* GEINITZ (*Cyathaspis schmidti* GEINITZ 1884).

Archegonaspis lindstrømi n. sp. (Pl. IX, 1) (*Cyathaspis?* *schmidti* LINDSTRØM 1895).

Archegonaspis ludensis SALTER (*Pteraspis ludensis* SALTER 1859).

Eoarchegonaspis nov. gen.

(Fig. 12.)

This new genus is established for the two forms known from America and described under the names of *Cyathaspis wardelli* BRYANT and *Cyathaspis van ingeni* BRYANT.

The present writer regards these two forms, as representatives of the *angusta* (Fig. 12 B) and *lata* (Fig. 12 A) forms, and therefore proposes to retain only the name *Eoarchegonaspis wardelli* BRYANT. After the descriptions of BRYANT it must be regarded as being closely related to the *Cyathaspis* and *Archegonaspis*, but it shows some features which makes it necessary to establish a new genus for it. All the material of this form is known from the beds of Red shale in the part of the Yerguard Quarzit, Orange Country N. Y. These beds probably belong to the Medina formation.

Family 2. *Tolypaspidae* nov. fam.

(Pl. X.)

Rather small *Cyathaspidei* with broad convex dentin ridges, transversally arranged in the anterior rostral part and divided into scale-like portions on the median and posterior parts of the dorsal shield. These scale-like portions are ornamented with a broad median ridge, and finer lateral ones more or less curved. The lateral parts form, especially at the back, faintly depressed borders with finer, regularly arranged longitudinal ridges. The lateral lobes of the postbranchial part evenly bent down and with slightly curved anterior margins. The margin of the mouth between the broad preorbital processes strongly curved. The lateral line system developed into the same lines as in *Poraspidei*, and with grouped pores opening on the strong median ribs in the scale-like portions. The structure of the dermal skeleton is like that of *Anglaspis*, the cancellae open with exceedingly large apertures upwards into the wide pulpa canals. The cancellae are not, however, as in *Anglaspis*,

arranged in regular rows below the dentin ridges. Only recorded from the upper marine Ludlow on Oesel, Esthonia, and possibly from Ludlow Bone-Bed, England.

Tolypaspis FR. SCHMIDT

(Pl. X.)

This genus being the only one known, its generic characters agree with those of the family.

The genotype is *Tolypaspis undulata* PAND. The first fragment of this form was described by CH. PANDER in 1856 as being a scale, and named *Tolypelepis*. SCHMIDT first got possession of an almost complete dorsal shield. In 1891 he described this specimen, which according to his description had an outline quite like a *Scaphaspis*. He proposed a new name — *Tolypaspis* — and he adds that the establishment of a new genus is necessary.

The only specimen known is *Tolypaspis undulata* PANDER.

Family 3. *Diplaspidae* nov. fam.

This new family is established on the remarkable specimen found in a bed of Black shale in Westfield, New Brunswick, Canada. According to MATTHEW it belongs to the Clinton formation.

It differs from all other previously known forms, and must therefore be regarded as a representative of a new family. As the author could not study the original specimen he refers to MATTHEW's original description. The new family has only one genus — *Diplaspis* — with one specimen, *Diplaspis acadica* MATTHEW (1888).

Family 4. *Traquairaspidae* nov. fam.

(Pl. XI.)

This new family is established on a remarkable form from the Downtonian in Scotland, it was as early as 1913 preliminarily described by TRAQUAIR as *Cyathaspis cambelli*. This family has only one genus — *Traquairaspis*.

Traquairaspis nov. gen.

(Pl. XI.)

Middle size *Cyathaspidi* with a complete clefting of the dorsal shield into the different parts (rostral, lateral, and the central disc). The anterior part of the lateral plates probably divided as a separate, small supra-orbital plate.

The central disc roundish in the posterior part without any median keel or spine. Pineal area indistinctly limited. Traces of the pineal

organ cannot be seen. The body scales small, probably in more rows than in *Poraspis*.

The sculpture of the plates with fine, distinct *Psammosteus*-like ridges, which usually are sharply divided into short portions. On the central disc of the dorsal shield the ribs are more irregularly arranged than on the ventral shield (Pl. XI, 1). The latter has a well-marked median keel, and the ribs form an elliptical septum with very fine ribs between the gross ones.

On the lateral and branchial plates a clear median keel with a strong ridge is developed. On both sides of the latter, fine ridges, regularly longitudinally arranged, are placed (Pl. XI, 2 & 3).

This genus is represented only by one specimen, *Traquairaspis cambelli* TRAQ. The specimen was found by Professor CABBELL in the Downtonian series in Stonehaven area, Scotland.



PLATES

Plate I.

Poraspis polaris n. gn. & sp. forma angusta.

Dorsal shield from above (1) and lateral aspect (2). (Holotype P. M. O. D 665.) Ca. $\times 4 \frac{1}{2}$.

Fränkelryggen, Red Bay, N. Spitsbergen. Th. Vogt's Exp. 1925.



Plate II.

Poraspis brevis n. gn. & sp. forma lata.

Dorsal shield. (Holotype P. M. O. D 304.) Ca. \times 5.
Frænkelryggen, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1928.

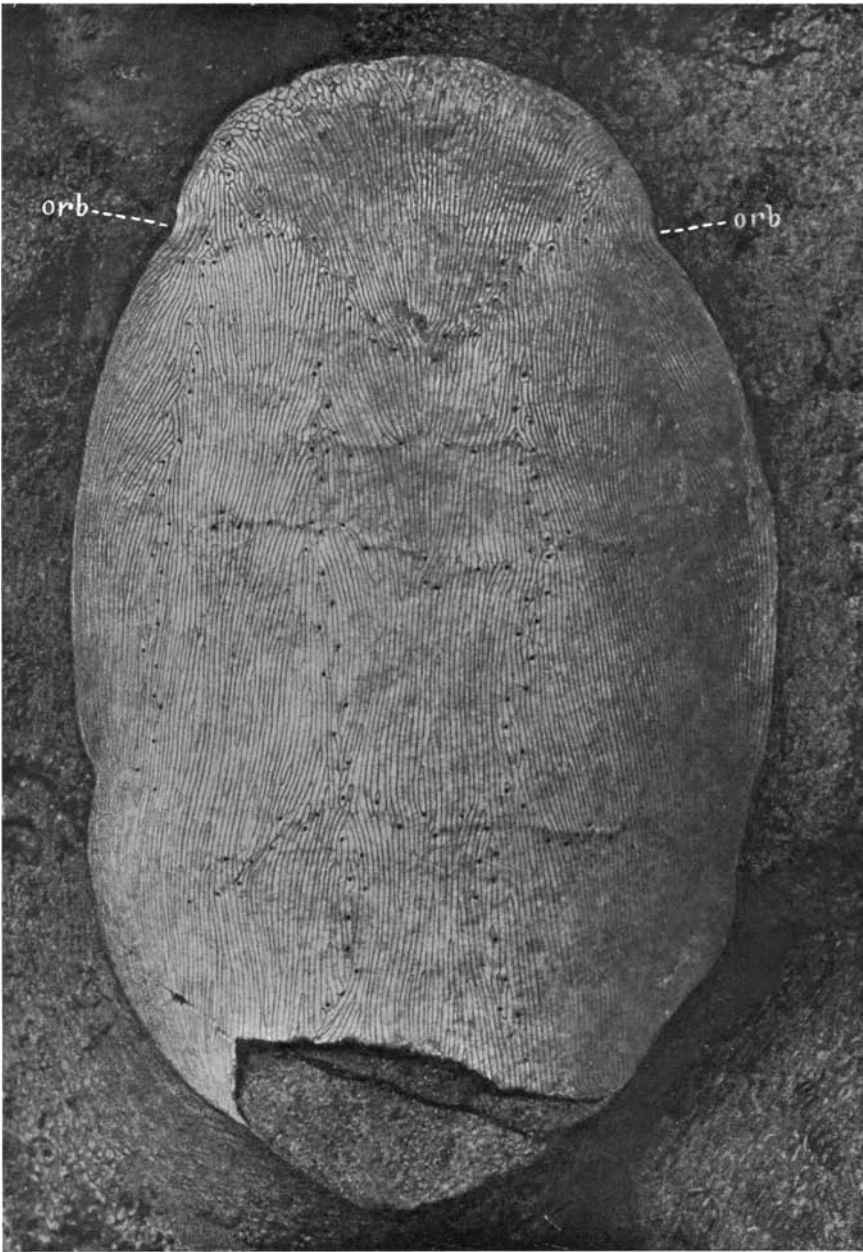


Plate III.

1. and 2. *Poraspis rostrata* n. gn. & sp. forma lata.

Ventral shield. 1. from above, 2. lateral aspect. (P. M. O. D 135.)
Ca. $\times 2^{1/2}$.

Ben Nevis, Red Bay, N. Spitsbergen. Isachsen's exp. 1909—10.

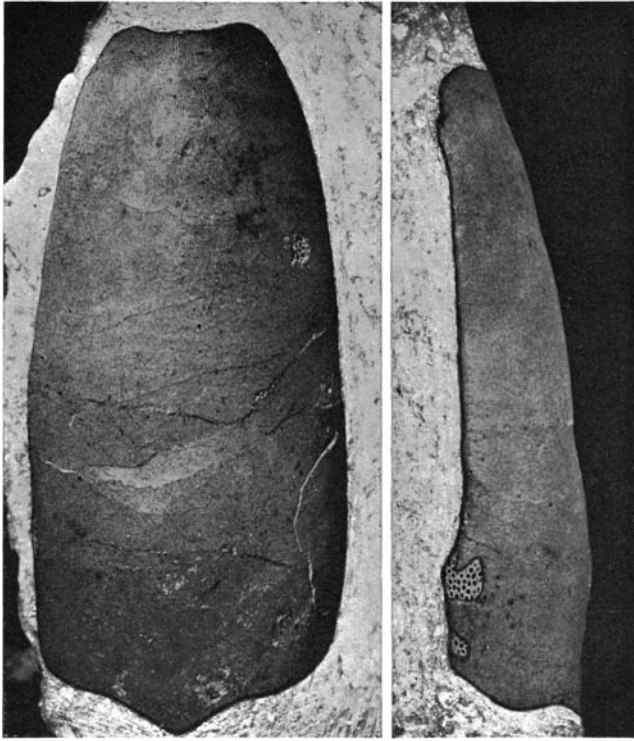
3. *Poraspis cylindrica* n. gn. & sp.

Dorsal shield. The internal impressions well preserved. (Holotype
P. M. O. D 205.) Ca. $\times 2$.

Ben Nevis, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1928.

4. *Poraspis polaris* n. gn. & sp.

A cross section of the dermal shield. 1. basal layer, 2. cancellated
layer, 3. reticular layer, 4. dentin layer. 1 c — cross section of one of the
lateral line system canals. Ca. $\times 50$.

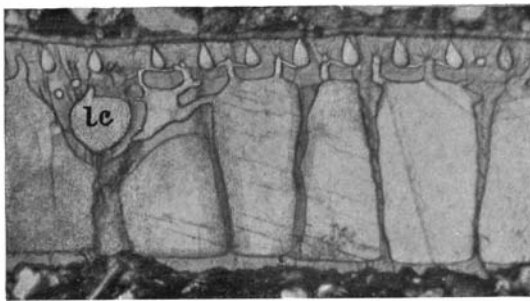


1

2



3



4

3

2

1

4

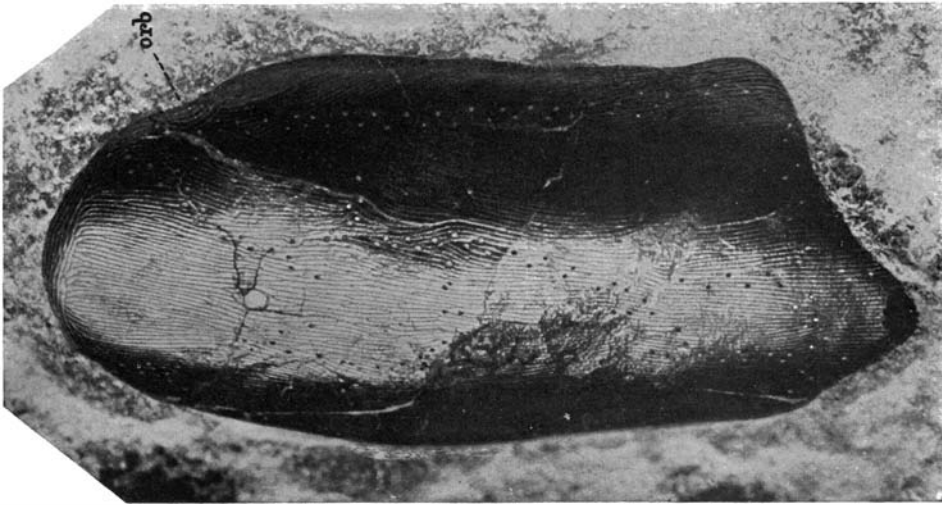
Plate IV.

1. *Homalaspis nitida* n. gn. & sp.

Dorsal shield. (Geno- & Holotype P. M. O. D 156.) Ca. \times 5.
Ben Nevis, Red Bay, N. Spitsbergen. Isachsen's exp. 1909--10.

2. and 3. *Dinaspis robusta* n. gn. & sp.

Dorsal shields from above (2) and lateral view (3). (Geno- & Holotype
P. M. O. D 454.) Ca. \times 4.
Fränkelryggen, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1925.



1



2



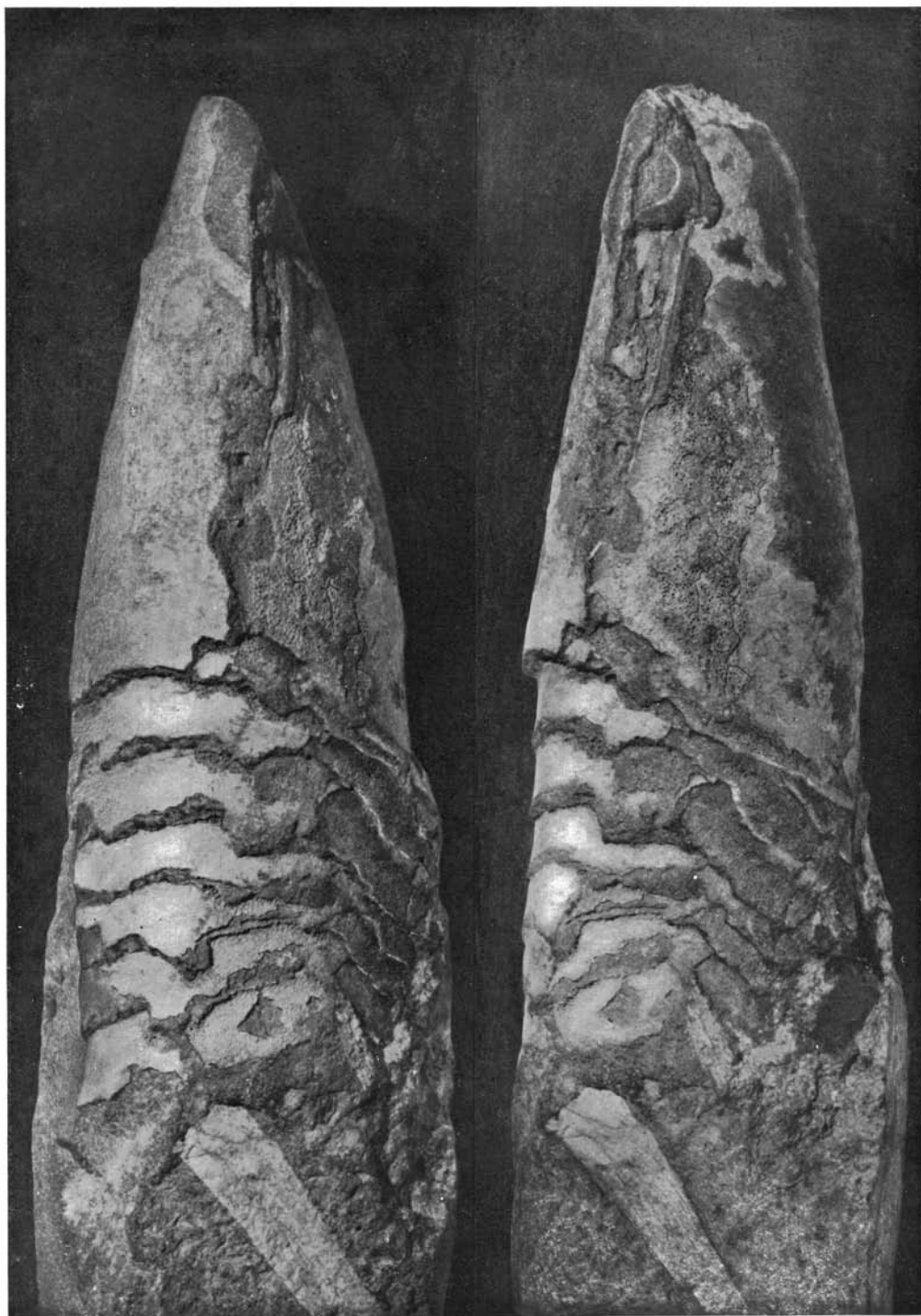
3

Plate V.

Dictyaspis hoeli n. gn. & sp.

A nearly complete specimen, lateral view, from two different aspects.
(Geno- & Holotype P. M. O. D 474.) Ca. $\times 2\frac{1}{2}$.

Ben Nevis, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1928.



1

2

Plate VI.

1. *Anglaspis insignis* var. *brevis* n. gn. & sp.

Dorsal shield. Impressions on the stone matrix. (P. M. O. D 193). Ca. \times 4.
Frænkelryggen, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1928.

2. and 3. *Dictyaspis hoeli* n. gn. & sp.

Ventral shield, from above (2) and lateral view (3). (P. M. O. D 495.)
Ca. \times 2.
Ben Nevis, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1928.

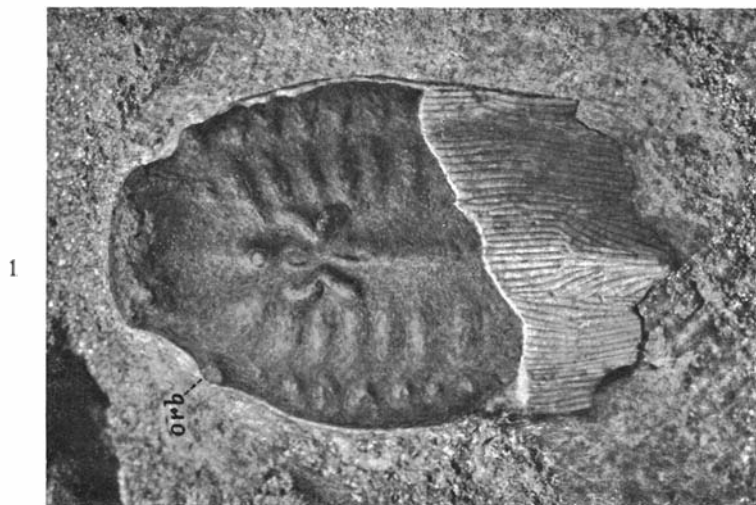
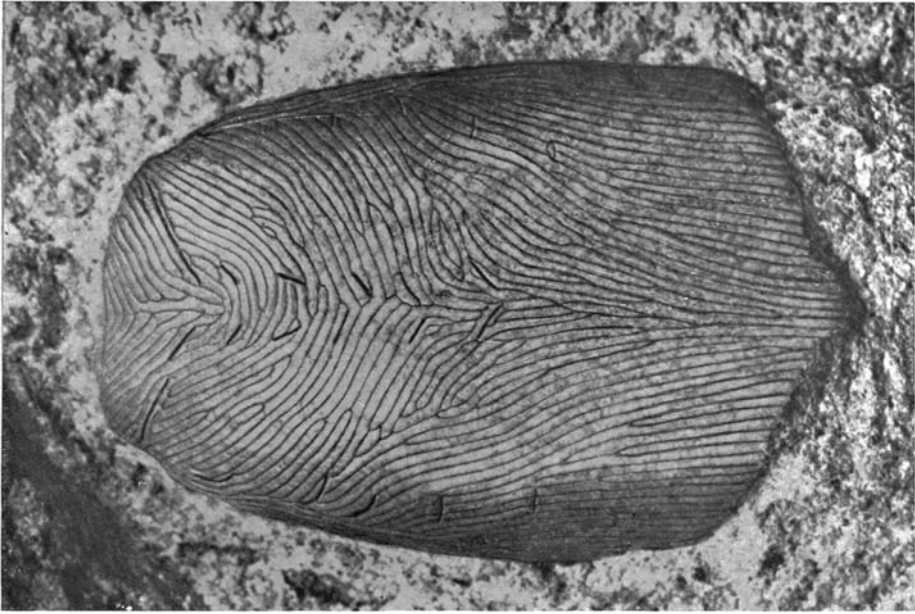


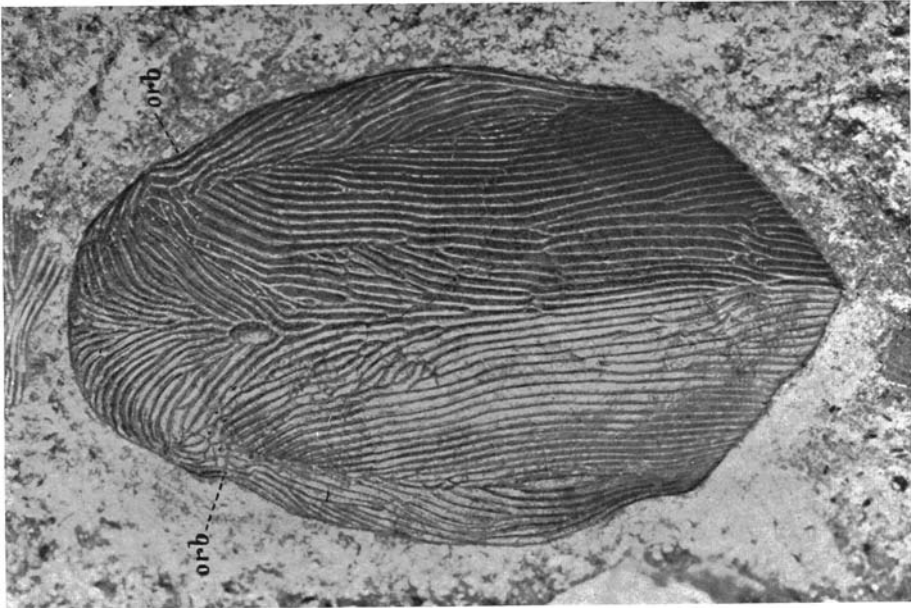
Plate VII.

Anglaspis insignis n. gn. & sp.

1. Ventral shield. (Holotype P. M. O. D 186.) Ca. \times 5.
2. Dorsal shield. (P. M. O. D 186.a.) Ca. \times 5.
Frænkelryggen, Red Bay, N. Spitsbergen. Th. Vogt's exp. 1928.



1



2

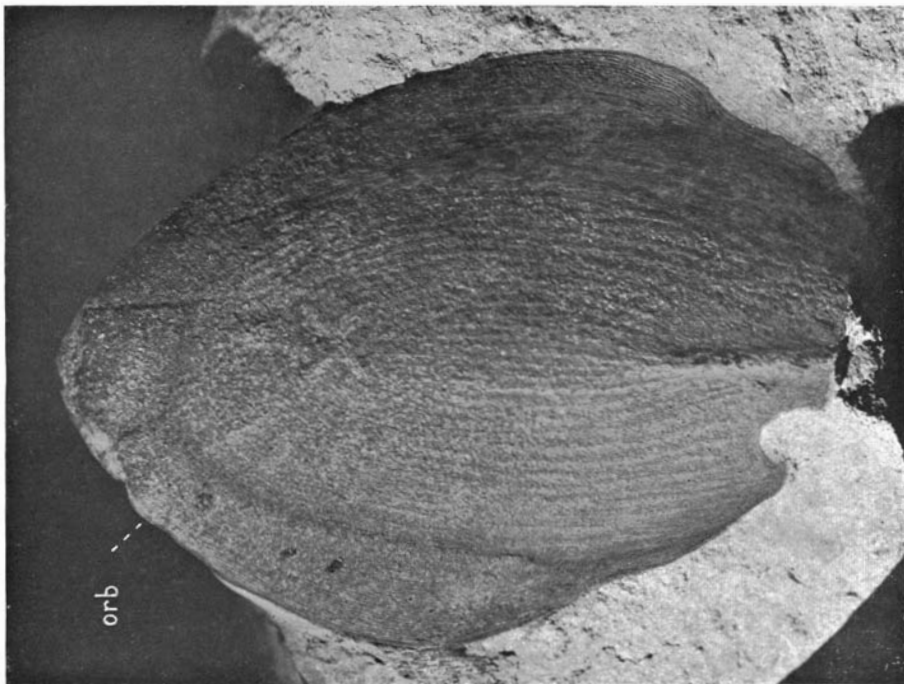
Plate VIII.

Cyathaspis banksi LANK.

1. Ventral shield. (Geol. Surv. Unit. Kingd. 21463.) Ca. \times 5.
2. Dorsal shield. (Mus. Pract. Geol. London.) Ca. \times 5.
Scotland.



1



2

Plate IX.

1. *Archegonaspis lindstrømi* n. sp.

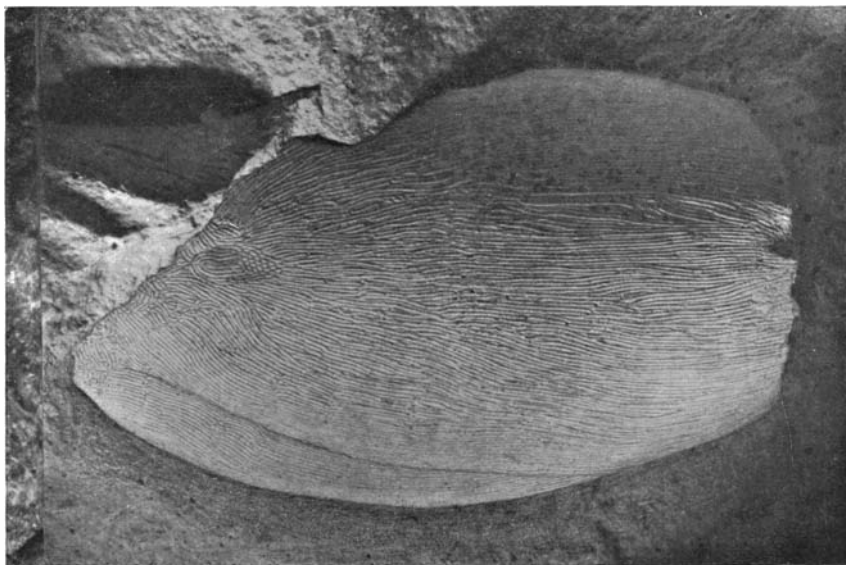
Ventral shield. (Riksmus. Stockh.) Ca. $\times 2\frac{1}{2}$.
Skaane. South Sweden.

2. *Archegonaspis integer* KUNTH.

Dorsal shield. (Geno- & Holotype. Geol.-Paläont. Mus. Berlin.) Ca. $\times 4$.
Erratic block, North Germany.



1



2

Plate X.

Tolypaspis undulata PANDER.

Dorsal shield. (Geno- & Holotype. Geol. Mus. Acad. Sc. Leningrad.
257/592.) Ca. \times 5.
Oesel, Esthonia.



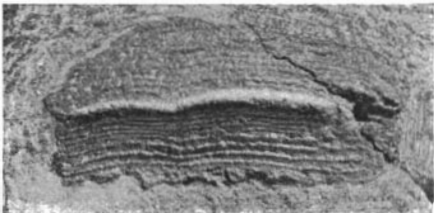
Plate XI.

Traquairaspis cambelli TRAQ.

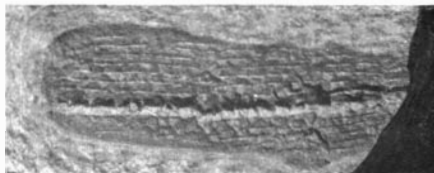
1. Ventral shield. (Edinb. Univ. Geol. Lab. 5.) Ca. \times 3.
 2. and 3. Different side plates and scales. (Edinb. Univ. Geol. Lab. 87, VII b.) Ca. \times 3.
- Stonehaven area. Scotland.



1



2



3

SKRIFTER OM SVALBARD OG ISHAVET

- Nr. 1. HOEL, ADOLF, *The Norwegian Svalbard Expeditions 1906—1926*. 1929. Kr. 10,00.
 " 2. RAVN, J. P. J., *On the Mollusca of the Tertiary of Spitsbergen*. 1922. Kr. 1,60.
 " 3. WERENSKIOLD, W. and IVAR OFTEDAL, *A burning Coal Seam at Mt. Pyramide, Spitsbergen*. 1922. Kr. 1,20.
 " 4. WOLLEBÆK, ALF, *The Spitsbergen Reindeer*. 1926. Kr. 10,00.
 " 5. LYNGE, BERNT, *Lichens from Spitsbergen*. 1924. Kr. 2,50.
 " 6. HOEL, ADOLF, *The Coal Deposits and Coal Mining of Svalbard (Spitsbergen and Bear Island)*. 1925. Kr. 10,00.
 " 7. DAHL, KNUT, *Contributions to the Biology of the Spitsbergen Char*. 1926. Kr. 1,00.
 " 8. HOLTEDAHL, OLAF, *Notes on the Geology of Northwestern Spitsbergen*. 1926. Kr. 5,50.
 " 9. LYNGE, BERNT, *Lichens from Bear Island (Bjørnøya)*. 1926. Kr. 5,80.
 " 10. IVERSEN, THOR, *Hopen (Hope Island), Svalbard*. 1926. Kr. 7,50.
 " 11. QUENSTEDT, WERNER, *Mollusken aus den Redbay- und Greyhooksschichten Spitzbergens*. 1926. Kr. 8,50.

Nos. 1—11: Vol. I.]

From Nr. 12 the papers will not be collected into volumes, but only numbered consecutively.

- Nr. 12. STENSIÖ, ERIK A:SON, *The Downtonian and Devonian Vertebrates of Spitsbergen. Part I. Cephalaspidae*. A. Text, and B. Plates. 1927. Kr. 60,00.
 " 13. LIND, J., *The Micromycetes of Svalbard*. 1928. Kr. 6,00.
 " 14. *A paper on the topographical survey of Bear Island*. (In preparation.)
 " 15. HORN, GUNNAR and ANDERS K. ORVIN, *Geology of Bear Island*. 1928. Kr. 15,00.
 " 16. JELSTRUP, HANS S., *Déterminations astronomiques*. 1928. Kr. 2,00.
 " 17. HORN, GUNNAR, *Beiträge zur Kenntnis der Kohle von Svalbard (Spitzbergen und der Bäreninsel)*. 1928. Kr. 5,50.
 " 18. HOEL, ADOLF, *Das Festungsprofil auf Spitzbergen. Jura und Kreide. I. Vermessungsergebnisse*. (In the press.)
 " 19. FREBOLD, HANS, *Das Festungsprofil auf Spitzbergen. Jura und Kreide. II. Die Stratigraphie*. 1928. Kr. 3,00.
 " 20. FREBOLD, HANS, *Oberer Lias und unteres Callovien in Spitzbergen*. 1929. Kr. 2,50.
 " 21. FREBOLD, HANS, *Ammoniten aus dem Valanginien von Spitzbergen*. 1929. Kr. 4,00.
 " 22. HEINTZ, ANATOL, *Die Downtonischen und Devonischen Vertebraten von Spitzbergen. II. Acanthaspida*. 1929. Kr. 15,00.
 " 23. HEINTZ, ANATOL, *Die Downtonischen und Devonischen Vertebraten von Spitzbergen. III. Acanthaspida. — Nachtrag*. 1929. Kr. 3,00.
 " 24. HERITSCH, FRANZ, *Eine Caninia aus dem Karbon des De Geer-Berges im Eisfjordgebiet auf Spitzbergen*. 1929. Kr. 3,50.
 " 25. ÅBS, OTTO, *Untersuchungen über die Ernährung der Bewohner von Barentsburg, Svalbard*. 1929. Kr. 5,00.
 " 26. FREBOLD, HANS, *Untersuchungen über die Fauna, die Stratigraphie und Paläogeographie der Trias Spitzbergens*. 1929. Kr. 6,00.
 " 27. THOR, SIG, *Beiträge zur Kenntnis der invertebraten Fauna von Svalbard*. 1930. Kr. 18,00.
 " 28. FREBOLD, HANS, *Die Altersstellung des Fischhorizontes, des Grippianiveaus und des unteren Saurierhorizontes in Spitzbergen*. 1930. Kr. 4,00.
 " 29. HORN, GUNNAR, *Franz Josef Land. Natural History, Discovery, Exploration and Hunting*. 1930. Kr. 5,00.
 " 30. ORVIN, ANDERS K., *Beiträge zur Kenntnis des Oberdevons Ost-Grönlands*. HEINTZ, ANATOL, *Oberdevonische Fischreste aus Ost-Grönland*. 1930. Kr. 4,00.

SKRIFTER OM SVALBARD OG ISHAVET

- Nr. 31. FREBOLD, HANS, *Verbreitung und Ausbildung des Mesozoikums in Spitzbergen* 1930. Kr. 17,00.
- „ 32. ABS, OTTO, *Über Epidemien von unspezifischen Katarrhen der Luftwege auf Svalbard*. 1930. Kr. 2,00.
- „ 33. KLÆR, JOHAN, *Ctenaspis, a new Genus of Cyathaspidian Fishes*. 1930. Kr. 1,00.
- „ 34. TOLMACHEW, A., *Die Gattung Cerastium in der Flora von Spitzbergen*. 1930. Kr. 1,00.
- „ 35. D. SOKOLOV und W. BODYLEVSKY, *Jura- und Kreidefaunen von Spitzbergen*. 1931. Kr. 15,00.
- „ 36. SMEDAL, GUSTAV, *Acquisition of Sovereignty over Polar Areas*. 1931. Kr. 10,00.
- „ 37. HANS FREBOLD: *Fazielle Verhältnisse des Mesozoikums im Eisfjordgebiet Spitzbergens*. 1931. Kr. 8,75.
- „ 38. LYNGE, B., *Lichens from Franz Josef Land*. 1931. Kr. 3,00.
- „ 39. HANSSEN, OLAF and LID, JOHANNES: *Flowering Plants of Franz Josef Land collected on the Norwegian Scientific Expedition 1930*. 1932. Kr. 3,50.
- „ 40. KLÆR, JOHAN. (In the Press.)
- „ 41. B. LYNGE and P. F. SCHOLANDER: *Lichens from North East Greenland*. 1931. Kr. 9,50.
- „ 42. ANATOL HEINTZ: *Beitrag zur Kenntnis der devonischen Fischfauna Ost-Grönlands*, 1931. Kr. 4,00.
- „ 43—46. BJØRLYKKE, BJØRN, *Some vascular Plants from South East Greenland. Collected on the „Heimen“ Expedition in 1931. Preliminary Report*. LID, JOHANNES, *Vascular Plants from South East Greenland. Collected on the „Signalhorn“ Expedition in 1931*. LYNGE, B., *Lichens from South East Greenland. Collected in 1931 on Norwegian Expeditions*. OMANG, S. O. F., *Beiträge zur Hieraciumflora Ost-Grönlands*. 1932. Kr. 4,00.
- „ 47. LYNGE, B., *A Revision of the Genus Rhizocarpon (Ram.) Th. Fr. in Greenland*. 1932. Kr. 2,00.
- „ 48. VAAGE, JAKOB, *Vascular Plants from Eirik Raude's Land. (East Greenland 71° 30'—75° 40' lat. N)*, 1932 Kr. 7,00.
- „ 50. JELSTRUP, HANS S., *Détermination astronomique de Mygg-Bukta au Groenland Oriental*, 1932. Kr. 3,75.
- „ 51. B. J. BIRKELAND et GEORG SCHOU, *Le climat de l'Eirik-Raudes-Land*. 1932. Kr. 2,00.
- „ 52. KLÆR, JOHAN †, *The Downtonian and Devonian Vertebrates of Spitsbergen. IV. Suborder Cyathaspidia. Preliminary Report*. 1932. Kr. 5,50.