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FAUNAS AND CORRELATION OF THE LATE PALEOZOIC ROCKS OF NORTHEAST GREENLAND

PART III

BRACHIOPODA

BY

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WITH 2 PLATES

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Brachiopods in the collections from the Lower Marine group are nearly all isolated specimens, one or only a few from each lot, and nothing significant can now be added to the descriptions by GRÖNWALL (1917) and FREBOLD (1950).

On the other hand larger collections were made by Nielsen from Profiles G and H in the Upper Marine group of Amdrup Land and many of these species have now been located in the upper part of the section in Spitzbergen (FORBES, HARLAND, and HUGHES, 1958). A number of the species in Greenland are represented by few or poorly preserved specimens, but the following are adequately represented to be securely identified with the fauna in Spitzbergen and are so distinctive as to indicate close correlation of our Profiles G and H with the "Brachiopod Cherts" of Spitzbergen.

TAXONOMIC DESCRIPTION

Yakovlevia FREDERICKS, 1925.

Yakovlevia FREDERICKS, 1925, Records of the Geological Committee of the Russian Far East., No. 40, p. 7.

Generotype, *Chonetes (Yakovlevia) kalizinensis* FREDERICKS, 1925.

Diagnosis. Shell nearly semicircular in outline, gently to moderately arched, concavo-convex, and quite thin. The pedicle valve bearing a sulcus that arises a short distance in front of the beak, becomes deep across the umbo, and then widens and becomes shallower toward the front, forming a broad, shallow sinus in the anterior profile. Surface covered by very fine low radial costellae. Posterior margin bearing a single row of minute spines as in *Chonetes*. Pedicle valve having a well-defined, but slender cardinal area. Interior of pedicle valve having large flabellate muscle scars.

Discussion. When FREDERICKS proposed this name he considered *Yakovlevia* a subgenus of *Chonetes* which it resembles in having a ventral cardinal area and fine radial sculpture and in having but a single row of small spines along the ventral cardinal margin. The generotype came from

Permian beds on Cape Kalouzin near Vladivostok. STEPANOV (1937) tentatively referred *Productus impressus* TOULA to *Yakovlevia*, but decided that it belonged to the *Productidae* instead of the *Chonetidae* because the shell is more strongly arched than is normal for the *Chonetidae*.

Yakovlevia (?) *impressus* (TOULA).

Pl. 1, figs. 1—3.

Productus impressus TOULA, 1875, Neues Jahrbuch für Mineralogie, p. 12.
Productus (Yakovlevia?) impressus STEPANOV, 1937, Trans. Arctic Institut, U.S.S.R., vol. 76, p. 112.

Description. Shells of subsemicircular outline and moderately concavo-convex profile attaining a width at the hingline of 7.0 to 8.0 cm, a length of 4.5 to 5.5 cm, and a depth near the middle of about 2.0 cm. The greatest width is at the hingline which in some specimens is extended so that the ears are subacute but in others the cardinal extremities are rectangular.

A ventral sulcus begins about 5 mm in front of the beak, becomes rather deep but narrow across the umbo, but is shallower toward the front margin. The prominent umbonal humps slope gradually down into broad and nearly flat ears. The entire surface is covered by fine radial costellae of which 8 or 9 occupy a space of 1.0 cm near the front of the shell. A single row of small spines occurs along the posterior margin of the pedicle valve, spaced about 3 or 4 mm apart.

Brachial valve and interior not seen.

Discussion. Our shells are rather incomplete and were depressed during lithification and the depth of curvature cited above is taken from the holotype figured by TOULA. The Greenland shells are quite obviously conspecific with those from Spitzbergen but there is some uncertainty whether they belong to the genus *Yakovlevia*. The types of *Y. kalizinensis* were internal molds showing well the large flabellate muscle scars of the pedicle valve, but we have no evidence of the interior of *Y.* (?) *impressus*.

FREDERICKS considered *Yakovlevia* a member of the *Chonetidae* because it possesses a distinct cardinal area and its only spines are along the posterior margin of the pedicle valve. STEPANOV, on the contrary, considered it to be a subgenus of *Productus* because of its profile. He thus had to assume that the cardinal area was secondarily derived. We are inclined to favor reference to the *Chonetidae* but feel that in any event the shell is so specialized as to deserve full generic rank. If it belongs with the *Productidae* it is most closely related to *Linoproductus*.

Occurrence. This species was described from the north shore of Bellsund near Axel Island in Spitzbergen. STEPANOV's specimens were

from the *Spirifer* limestone at Temple Bay. FORBES, HARLAND, and HUGHES (1958) identified it in both the lower and middle parts of the Brachiopod Cherts of Spitzbergen. In Greenland it was found in Profile G (collection G-300).

Muirwoodia wyprechti (TOULA).

Pl. 1, figs. 4, 5.

Productus wyprechti TOULA, 1873, Sitzungs-Bericht des Kaiser. Akad. Wissenschaft, Wien, p. 13, Pl. 5, fig. 2; — 1874, ibid., p. 6, fig. 4;
— 1875, Neues Jahrbuch für Mineralogie, p. 10, Pl. 6, figs. 2a—c.
Productus duplex WIMAN, 1914, Nova Acta Regiae Societatis Scientarum Upsalaensis, Ser. 4, vol. 3, N.S., p. 65, Pl. 14, figs. 3—7.
Productus (Thomasia) wyprechi STEPANOV, 1937, Trans. Arctic Institut, U.S.S.R., p. 128, Pl. 2, figs. 8, 9.

Description. This large species of *Muirwoodia* attains a width of 5.0 to 6.0 cm, a length of about 3.0 cm and a depth of about 2.0 cm. The maximum width is at the hinge line and the cardinal extremities are subrectangular. A rather narrow sulcus in the pedical valve is matched by a narrow fold in the brachial valve. The surface is covered with very fine radial costellae of which 10 or 11 occupy a space of 1.0 cm on the anterior part of the shell. A single row of small cardinal spines was borne along the posterior margin of the pedicle valve.

Discussion. The shape of this shell agrees fully with that of *Muirwoodia* but the single pair of large erect spines in the anterior slope of the pedicle valve, so characteristic of *Muirwoodia*, was not represented in TOULA's figures and is not clearly shown on our specimen, which suffered considerable abrasion before burial, but one of the spine bases is indicated in figure 8 of Plate 2 of STEPANOV.

This species is much larger than *M. greenlandica* DUNBAR which occurs in the Foldvik Creek beds in Central East Greenland and is also much larger than *M. mammatus* KEYSERLING of the Lower Permian in the U.S.S.R.

WIMAN's types of *Productus duplex* came from the "Productus cherts" near Dickson Bay and from Eders Island in Bellsund, Spitzbergen. It seems strange that he overlooked TOULA's description of the same species as *Productus wyprechti.*

Occurrence. TOULA's types were from Axel Island and Hornsund in Spitzbergen. STEPANOV found the species in the "Productus beds" at Cape Starostin and on the western shore of Green Harbor in Spitzbergen. In Greenland it occurs in Profile G in Amdrup Land (collection G-300).

Sowerbina granulifera (TOULA).

Pl. 1, figs. 6, 7.

Productus horridus var. *granulifera* TOULA, 1875, Neues Jahrbuch für Mineralogie, p. 233, Pl. 6, figs. 3a—c.

Productus borealis var. *granulifera* STEPANOV, 1937, Trans. Arctic Institute, U.S.S.R., vol. 76, p. 117, Pl. 5, figs. 1—4.

Discussion. TOULA's type of *Productus horridus* var. *granulifera* was from Axel Island in Bellsund, Spitzbergen. It was a small shell, probably juvenile, but its shape and surface ornamentation are distinctive. STEPANOV (1937) described a much larger shell from the "Spirifer limestone" at Temple Bay which he identified with TOULA's variety but referred to *Productus borealis* HAUGHTON. The original description of *Productus borealis* was so inadequate and the illustrations so poor that we feel that that species cannot be identified even generically from the literature. Its surface ornamentation is entirely unknown and the types obviously included two distinct species. We therefore think that it is best to let TOULA's "variety" stand as a distinct species. A specimen before us from Greenland agrees closely in so far as can be judged with the specimen described by STEPANOV.

The pedicle valve of this form is rather strongly and regularly arched so that its profile is almost semicircular. The brachial valve, on the contrary, is only slightly concave. The deep narrow sulcus on the pedicle valve separates the high umbonal humps; its counterpart on the brachial valve is a narrow and subacute fold. Four radial rows of fairly slender but erect spines occur on the pedicle valve, one row following the summit of each visceral hump and extending to the anterior margin, the spines being 8 to 10 mm apart. The other two rows of spines lie a short distance outside those first described and seem to stop about the midlength of the shell. On the brachial valve a row of stout spines occurs along the posterior margin. None of the specimens available show the stout spines on the dorsal side of the ears of the brachial valve. The surface is covered by fine crinkly pustules (these are neither spine bases nor punctae).

This species rather closely resembles *Sowerbina timanicus* STUCKENBURG with which it may prove to be identical.

Occurrence. The specimens identified from Spitzbergen, as recounted above, probably all came from the "Brachiopod Cherts". In Greenland the species was found in Profile H (Collection H-122 and H-119).

Waagenoconcha irginaeformis STEPANOV.

Productus (Waagenoconcha) irginaeformis STEPANOV, 1937, Trans. Arctic Institute, U.S.S.R., vol. 76, p. 124, Pl. 6, figs. 4, 5.

Discussion. STEPANOV illustrated two type specimens of this species, one from the "Spirifer limestone" at Temple Bay and one from

the "Productus beds" at Starostin Cape, both in Spitzbergen and both almost certainly from the Brachiopod Cherts (see Fig. 4). We have 5 specimens that appear to be conspecific. Like STEPANOV's specimens, ours are hardly suitably preserved to permit satisfactory description or illustration, the cardinal extremities being incomplete in all and the surface poorly preserved.

The shell is rather strongly arched so that the profile of the pedicle valve is almost a semicircle and the umbo is rather full and overarches the hinge line. The brachial valve, on the contrary, is very slightly concave over the visceral disc but curves gently upward to lie parallel to the edge of the pedicle valve at the front and sides. The pedicle valve has a shallow sulcus which is matched by a shallow and subacute fold on the dorsal valve. There is some evidence that the cardinal extremities were rounded and the greatest width was somewhat in front of the hinge line.

The shell was obviously very thin, as is normal for this genus, and its surface was covered with thickly spaced, minute, oblique spines. Cardinal spines are lacking.

Occurrence. In Greenland this species occurs in both Profile G and H in Amdrup Land (Collections G-337 and H-119).

Dictyoclostus neoinflatus LIKHAREW.

Pl. 1, figs. 8, 9.

Productus inflatus GRÖNWALL [non MCCHESNEY], 1917, Meddel. om Grønland, vol. 43, p. 578, Pl. 29, figs. 17—19.

Productus neoinflatus LIKHAREW, 1939, The Atlas of the Leading Forms of the Fossil Faunas of the U.S.S.R., vol. 5, p. 90, Pl. 21, figs. 2, 3.

Description. The shape and size of this species are well shown by figures 8 and 9 of Plate 1. The ears are not completely preserved in any of the specimens seen but were obviously somewhat extended. The umbo of the pedicle valve is rather low but the shell is distinctly geniculate near the mid-length. The costae are rather subdued and slender, from 10 to 12 occupying a space of 10 mm on the anterior slope. Numerous but very slender, erect spines are distributed at random over the surface of the pedicle valve.

Discussion. In his description of this species LIKHAREW indicated that it occurs in the Lower Permian of Spitzbergen but his types were from the Donetz Basin and the Ufa Plateau. We feel some uncertainty of the identification of our shells with LIKHAREV's species but are confident that they are conspecific with the form identified by GRÖNWALL as *P. inflatus* MCCHESNEY. While the species shows notable resemblance to *P. inflatus* the latter is a mid-Pennsylvanian species from the interior of North America in a faunal province completely distinct from that of

Greenland and Spitzbergen and the resemblance is undoubtedly due to convergence. *P. inflatus* has distinctly larger spines on the body of the shell.

Occurrence. GRÖNWALL described this form from Kap Jungersen (Profile F_2) in Amdrup Land. Our specimens come from Profile H (Collections H-110, H-115, H-119, and H-134). LIKHAREV described it from beds that are either Late Carboniferous or Early Permian in the Donetz Basin and the Ufa Plateau, and indicated that it is present in the Lower Permian of Spitzbergen.

Spiriferella draschei (TOULA).

Pl. 2, figs. 9—14.

Spirifer Draschei TOULA, 1875, Neues Jahrbuch für Mineralogie, p. 239, Pl. 7, fig. 4.

Discussion. No complete shells of this species are known from Spitzbergen and it was based apparently on a single fine pedicle valve which has a very distinctive shape and ornamentation and a very large and highly arched symphytium covering the delthyrium. The cardinal area of the pedicle valve is very high and strongly arched under the umbo which extends far back of the hinge line.

We have two specimens from collection G-300 in Amdrup Land that are about as complete as TOULA's type. The big sulcus on the pedicle valve bears rather slender costae, about 10 in number, and the sides of the valve bear 6 large ribs, of which the pair bounding the sulcus are largest and the rest decrease in size outward. Of these the three nearest the sulcus show a tendency to split into bundles of 2 or 3 ribs each. The surface is covered by a very fine grid of intersecting radial and transverse lirae that at their intersection rise into minute papillae.

TOULA's figure 4a shows the ventral sulcus to be very broad and nearly flat. In both of our specimens the sulcus is somewhat narrower and a little more depressed along the middle and it appears probable that TOULA's figure does not quite accurately represent the shape of the sulcus.

WIMAN (1914, p. 38, pl. 3) redescribed this species and figured numerous specimens from both Spitzbergen and Bear Island, and emphasized the great variability in the number and coarseness of the costae in the sulcus.

STEPANOV (1937, Pl. 8) figured a specimen of this species from Profile G in Amdrup Land under the name *Spiriferella saranae* var. *arctica* HAUGHTON. We think HAUGHTON's illustration of his *Spirifer arcticus* is quite inadequate to permit identification. The type of *S. arcticus* came from an unidentified horizon on Melville Island.

Spiriferella (?) *parryanus* (TOULA).

Pl. 1, figs. 11—15.

Spirifer Parryanus TOULA, 1875, Neues Jahrbuch für Mineralogie, Pl. 7, figs. 8a—d.

Discussion. TOULA based this species on a single incomplete pedicle valve and one brachial valve from a locality between the two arms of Northfjord in Spitzbergen. It is a small species with a narrow and rather deep ventral sulcus and with each lateral slope bearing 5 broad simple ribs separated by narrower grooves. The surface is covered by a grid of intersecting radial and concentric lirae of which those in the sulcus appear as radial rows of coarse papillae. The cardinal area is of moderate height and the ventral beak rather low.

We have a single pedicle valve from Collection G-300 in Amdrup Land that agrees very closely with TOULA's type but adds nothing to our knowledge of the specific characters.

Neospirifer grönwalli, n. sp.

Pl. 2, figs. 6—8.

Description. The size, shape and ornamentation of this species are well shown by figures 6–8 on Plate 2. The hinge line is shorter than the greatest width of the shell. The prominent sulcus on the pedicle valve is angular and depressed along the midline; the fold on the brachial valve is narrow and acutely angular. The cardinal area on the pedicle valve is rather low and nearly flat except where it curves up under the beak. The surface is covered by rather slender, rounded costae. The earliest costae tend to split into fascicles of 3 within about 5 mm of the beak, the middle one of each triad being larger than the others. Occasional splitting occurs farther forward and the fasciculation becomes subdued. About 8 costae occupy a width of 1.0 cm on the anterior part of the shell. Extremely fine concentric growth lines cross the costae and intervening furrows.

Discussion. Several large species of *Spirifer* occur in the Arctic faunas and the identification of several of them is in a very unsatisfactory state. WIMAN (1917) identified them with such far away species as *Spirifer cameratus* MORTON (Desmoinesian of the interior of the U.S.A.), *Spirifer ravana* DIENER (Permian of the Himalayas), *Spirifer marconi* WAAGEN (Permian of the Salt Range in Pakistan), and *Spirifer fasciger* KEYSERLING (Early Permian of the Ural Region). TSCHERNYSCHEW (1902) identified one as *Spirifer condor* D'ORBIGNY (Early Permian of South America), and STEPANOV (1937) identified one as *Spirifer moosakhailensis* DAVIDSON (Permian of India). Later workers have generally followed these early leads, but with modern refinements there is no longer any

justification for identifications with species from such diverse faunal provinces at a distance of 3,000 to 10,000 miles away. The resemblances are superficial and in most cases not close when specimens are available for comparison. Furthermore the specimens from Spitzbergen and Greenland have generally been rolled and considerably broken before burial so that it is difficult to evaluate individual variation.

Unfortunately the collections from northeast Greenland include only a single beautifully preserved specimen suitable for description (Pl. 2, figs. 6–8). This is probably the form identified by TOULA (1875), Pl. 7, fig. 3) as *Spirifer cameratus* MORTON, and by FREBOLD (1950, Pl. 4) as *Spirifer* cf. *moosakhailensis* DAVIDSON, *Spirifer marcoui* WAAGEN, and *Spirifer ravana* DIENER. It is very similar if not identical to the form HARKER (1960) described from Grinnell Peninsula as *Spirifer striatoparadoxus* TOULA. As that species was originally described from the Spirifer limestone in Spitzbergen it is to be expected in the Greenland fauna, but the single specimen figured by TOULA in 1875 and refigured by DUNBAR (1955, Pl. 28, fig. 1) appears to differ in shape from HARKER's form, and from ours, being convex rather than emaciate and having a broader and gently concave ventral sulcus. If HARKER was correct in his identification then the species described by DUNBAR (1955) from Central East Greenland was misidentified, for it is quite different from the form described by HARKER and from that herein described as *N. grönwalli.*

Occurrence. *N. grönwalli* occurs in the Brachiopod Cherts of Spitzbergen. Our fine specimen is from Profile G in Amdrup Land (Collection G-300), and fragments apparently of this species were collected from Profile H (Collection H-119).

Athyris amdrupi n.sp.

Pl. 2, figs. 1—5.

Athyris Royssiana WIMAN, 1914, Nova Acta Regiae Societatis Scientiarum Upsalaensis, Ser. 4, vol. 3, No. 8, p. 30, Pl. 1, figs. 21—55; Pl. 2, figs. 1—13 [not *Athyris Royssiana* TSCHERNYSCHEW, 1902].

Athyris Royssiana FREBOLD, 1950, Meddel. om Grønland, vol. 126, No. 3, p. 69, Pl. 6, figs. 6, 7.

Description. Shells of extraordinary breadth for this genus, attaining a width of about 4.0 cm, a length of about 1.8 cm and a thickness of about 1.2 cm. The hinge line is shorter than the greatest width of the shell whose outline is transversely elliptical. A low, rounded sulcus on the pedical valve attains a width of 7 or 8 mm at the front of the shell and is matched by a corresponding low fold on the brachial valve.

The surface is smooth except for fine growth lines which become more prominent near the front margin.

In the interior the brachial valve bears a low, transversely elongate, subquadrate cardinal process, bounded laterally by deep dental sockets. The pedicle valve bears short, transversely elongated hinge teeth and a large subcordate diductor muscle impression that embraces a small elongate oval adductor muscle scar located back of the middle of the valve.

Discussion. This species was copiously illustrated by WIMAN from specimens collected from the "Spirifer limestone" on Mt. Wijks in Dickson Bay and from the shore of Green Harbor and of Bellsund, all in Spitzbergen. WIMAN apparently identified this species as *A. Royssiana* KEYSERLING on the authority of TSCHERNYSCHEW, but it is difficult to understand how such an identification could have been made from the description and illustrations of that species by either KEYSERLING or TSCHERNYSCHEW. KEYSERLING's original figure showed an internal mold with traces of the growth lines superposed. It shows a shell of transversely elliptical outline in which the length is .7 the width. TSCHERNYSCHEW's figures (1902, Pl. 43, figs. 11, 12) show a small shell of similar proportions. In the form here under discussion the width is more than twice the length.

Occurrence. This species is obviously common in the Brachiopod cherts of Spitzbergen. In Greenland it is also common in Profile H in Amdrup Land (Collection H-115, H-122, H-134, H-141, and H-110). It occurs also in Profile G (Collection G-300).

There are fragmentary specimens of several other species of brachiopods in the collections from northeast Greenland but none of them suitable for description; the forms discussed above appear to be the ones of most significance for correlation with Spitzbergen.

SUMMARY

The brachiopod faunas of Profiles G and H in Amdrup Land are still imperfectly known. Their study has been based on small collections made under difficult conditions and within a few days of field work. Numerous species are represented in these collections by specimens too fragmentary to permit safe identification.

FREBOLD (1950) recognized 13 species. Four of these are clearly identical with the species we have described above, but were identified under other names, as follows.

FREBOLD		DUNBAR
Productus (Horridonia) timanicus	=	*Sowerbina granulifera* (TOULA)
Productus (Waagenoconcha) irginae var *irginaeformis*	=	*Waagenoconcha irginaeformis* (STEPANOV)
Spiriferella saranae var. *arcticus*	=	*Spiriferella draschei* (TOULA)
Athyris royssiana	=	*Athyris amdrupi* n. sp.

Six of the remaining species seem to this writer to be misidentified or to be based on specimens too fragmentary to permit safe identification. *Productus cora* D'ORBIGNY, for example, was described from Bolivia in a different province and in different faunal association. The single small shell figured by FREBOLD was incomplete and appears to have been worn before burial. It might be identified with any one of the numerous species of the genus *Linoproductus*. Likewise, *Productus arcticus* WHITFIELD was based on a fragmentary specimen from an undetermined horizon at Cape Sheridan in extreme northeast Ellesmere Land. This specimen was illustrated by WHITFIELD under the name *Productus semireticulatus* var. *arcticus*. Under the circumstances it would be hazardous to try to distinguish WHITFIELD's variety from many of the described species of the prolific genus *Dictyoclostus*. FREBOLD illustrated a single imperfect ventral valve under the name *Productus cancriniformis* but the present writer feels that it shows no more than generic characters. It is a species of the genus *Cancrinella*. The large spirifers are particularly troublesome because they have thin shells and commonly are somewhat deformed and incomplete. FREBOLD identified *Spirifer moosakhailensis* DAVIDSON, *Spirifer marcoui* WAAGEN, and *Spirifer ravana* DIENER. All of these are from India at localities several thousands of miles from Greenland and in a different faunal province and with quite different faunal associations. The Greenland shells do not actually resemble the types of these species closely, and their identification in Greenland seems to this writer highly dubious.

Besides the 9 species and genera described above, the collections before us include fragmentary specimens of several other species too poorly represented to be identified. From what is now known, however, it seems certain that Profiles G and H correlate rather closely with the Brachiopod Cherts of Spitzbergen.

WIMAN (1914) described many species from the Brachiopod Cherts of Spitzbergen and from the Spiriferkalk at the top of the section in Bear Island and concluded that these units were at least partly equivalent. His work is copiously illustrated with excellent figures from which it is evident that he had excellent collections.

STEPANOV (1937) redescribed the fauna of the Brachiopod Cherts of Spitzbergen in which he recognized 50 species plus 2 varieties. Some of

his species are represented by fragmentary specimens, however, and his illustrations leave much to be desired.

The age of these arctic faunas is perhaps still subject to uncertainty. FREBOLD (1950) and LICKHAREV and EINOR (1939) regarded them as Lower Permain (Sakmarian) and the present writer is inclined to agree. On the contrary, STEPANOV (1957) recently proposed the Svalbardian Stage, based on the Brachiopod Cherts of Spitzbergen to replace the Kungurian Stage in the standard world section of the Permian. This writer has been unable to study STEPANOV's evidence for placing these beds so high but must admit that Stepanov has the advantage of a wide knowledge of the Permian faunas of the U.S.S.R. But if his correlation is correct then the Artinskian Stage is not represented in either Amdrup Land or Spitzbergen, where Sakmarian beds with *Pseudoschwagerina* are succeeded with apparent conformity by beds carrying the Svalbard fauna.

The relation of these northern deposits to those of Central East Greenland presents another problem. In a recent discussion of the section in Grinnell Peninsula, HARKER and THORSTEINSSON (1960) presented a correlation chart showing the section in Central East Greenland to range from the base of the Sakmarian to the top of the Tatarian. That section includes 5 distinct facies, (1) dolomite with gypsum, (2) black *Posidonia* shales, (3) brachiopod limestones, (4) gray *Martinia* limestones, and (5) white blocks redeposited as conglomerate in 5 distinct zones in the Lower Triassic. HARKER and THORSTEINSSON superpose these in sequence with the dolomite and gypsum opposite the Sakmarian and Artinskian and the "White blocks" opposite the Kazanian and Tatarian. To such correlation the present writer must take emphatic and complete exception. WOLF MAYNC (1942) gave a fine summary of the stratigraphy of the Permian of Central East Greenland based on extensive personal field work and on all the published literature, and concluded that the several facies deeply intertongue and are essentially contemporaneous. DUNBAR (1955) followed this with a comprehensive study of the brachiopods collected from all these beds by LAUGE KOCH's field parties over a 13 year period and found that the faunas fully confirm MAYNC's stratigraphic studies. While each facies carries a distinct facies fauna, the species range from one facies into another where they intertongue. Neither the brachiopod limestone facies nor the Martinakalk facies lie above the *Posidonia* shale facies; they all intertongue in a complex fashion. The "White blocks" are not in place; they represent boulders derived from Permian beds that lay just to the west of Kap Stosch and were transported and redeposited during Early Triassic time; but their fauna can be matched in white limestone in the "Dolomite and gypsum" facies down the strike from Kap Stosch along Schucherts Flod Valley, and these beds lie within 100 feet of the base of the Permian section. In short, the column pre-

sented by HARKER and THORSTEINSSON and the correlations indicated have no validity whatever.

DUNBAR (1955) concluded that the beds in Central East Greenland represent but a short span of Permian time and belong high in the Permian. They include several distinctive species otherwise known only in the Zechstein horizon of western Europe and they include the ammonite genus *Cyclolobus* which occurs only about 100 feet above the base of the Permian section on Clavering Ø. That genus is structurally more advanced than *Waagenoceras* which characterizes the Guadalupian Series in America and the Upper Productus limestone of the Salt Range in India. *Cyclolobus* occurs only in the highest part of the Chideru formation at the top of the Salt Range section.

Like the faunas farther north in Amdrup Land and Spitzbergen and Bear Island, the faunas of the Foldvik Creek formation in Central East Greenland belong to an Arctic Province with affinities in the north of the U.S.S.R. and they all have some genera in common, but the present study confirms the judgement that there are almost no species in common between Central East Greenland and the Lower Permian faunas farther north. The difference can hardly be attributed to facies control since the Foldvik Creek formation itself includes such a wide range of facies all of one age.

Of 39 species described by DUNBAR from Central East Greenland only 3 were tentatively identified with species that occur farther north. Of these the very thick shelled *Streptorhynchus* appears to be identical with *S. kempei* which was copiously illustrated by WIMAN from Bear Island. *Spiriferella keilhavii* was described from Bear Island by VON BUCH in 1846 and was tentatively identified by DUNBAR in Central East Greenland, but the shells redescribed by Wiman from Bear Island as *Spiriferella keilhavii* appear to be quite different and DUNBAR's identification of the shells in Central East Greenland is uncertain. The type of *Spirifer striato-paradoxus* TOULA was described from Spitzbergen but TOULA illustrated only a single imperfect pedicle valve which has a distinctly longer hinge line than any of the shells in Central East Greenland. HARKER and THORSTEINSSON identified shells from Grinnell Peninsula as *Spirifer striato-paradoxus* TOULA but their well illustrated species is certainly distinct from DUNBAR's species that was so identified.

In view of the fact that so few of the species in Central East Greenland resemble those from the northern areas, and that so many of the most distinctive species in the northern faunas are not present in Central East Greenland, and visa verse, we much conclude that the Foldvik Creek beds represent a distinct and much younger horizon than the beds in Amdrup Land and Spitzbergen.

Færdig fra trykkeriet den 13. juni 1962.

PLATES

Plate I.

Figs. 1—3. *Yakovlevia impressus* (TOULA).
1, 2. TOULA's illustrations of the holotype from the Brachiopod Cherts on the north shore of Bellsund near Axel Island, Spitzbergen.
3. Incomplete and somewhat crushed ventral valve from Collection G-300 in Profile G in Amdrup Land.

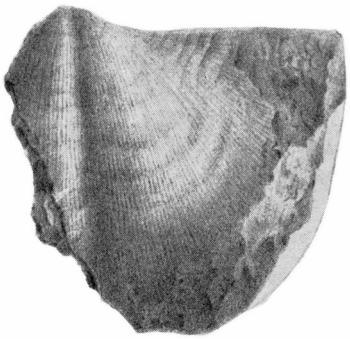
Figs. 4, 5. *Muirwoodia wyprechti* (TOULA).
Brachial and lateral views of the holotype, after TOULA, from the Brachiopod Cherts in Spitzbergen.

Figs. 6, 7. *Sowerbina granulifera* (TOULA).
6. Holotype, after TOULA, believed to be a young individual.
7. Ventral view of incomplete shell from Profile H (Collection H-122) in Amdrup Land.

Figs. 8, 9. *Dictyoclostus neoinflatus* LIKHAREW. Pedicle and lateral view of a shell from Profile H (Collection H-115) in Amdrup Land.

Fig. 10. *Dictyoclostus* cf. *D. neoinflatus* LIKHAREW. Pedicle view of a shell from Profile H (Collection H-119) in Amdrup Land.

Figs. 11—15. *Spiriferella* (?) *parryanus* (TOULA).
11—14. Original illustrations of TOULA from Spitzbergen.
15. Pedicle view of incomplete shell from Profile G (Collection G-300) in Amdrup Land.



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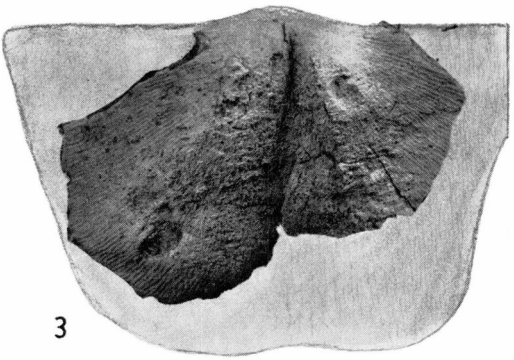

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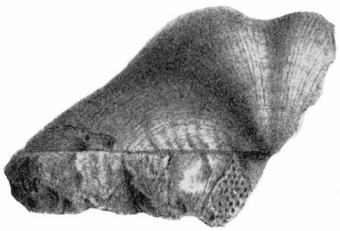

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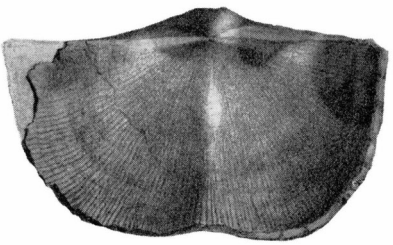

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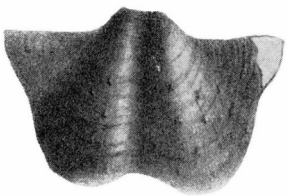

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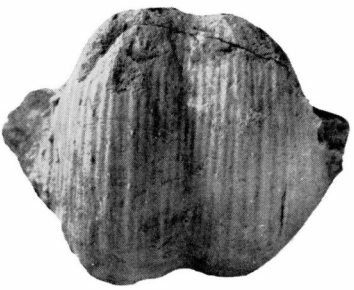

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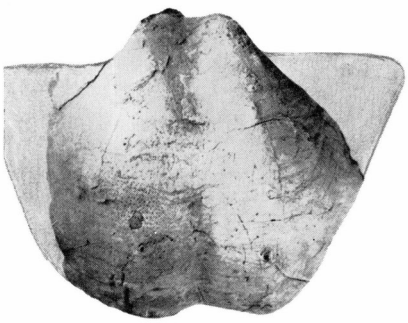

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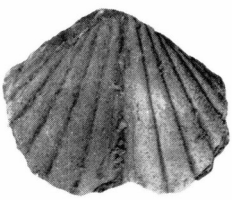

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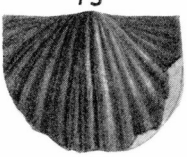

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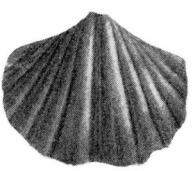

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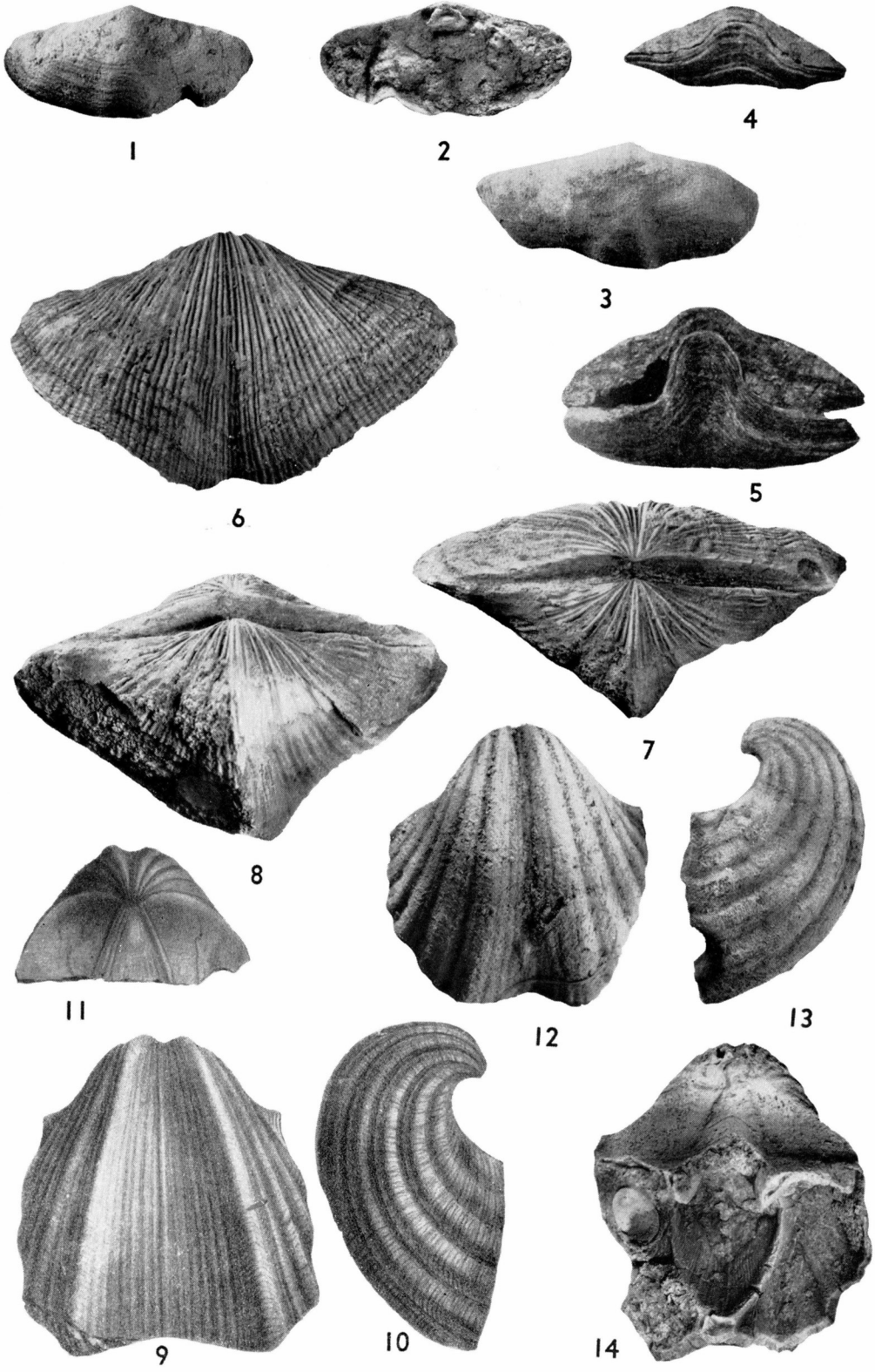
Plate II.

Figs. 1—5. *Athyris amdrupi* n. sp.
1, 2. Exterior and interior views of a brachial valve from Collection H-115.
3. Exterior view of a brachial valve from Collection H-122.
4, 5. Anterior views of a nearly mature shell and a gerontic individual, after WIMAN, from the Spirifer limestone at the base of the Brachiopod Cherts on Mt. Wijk in Dickson Bay, Spitzbergen.

Figs. 6—8. *Neospirifer grönwalli*, n. sp.
Ventral, posterior, and dorsal views of the holotype from Profile G (Collection G-300) in Amdrup Land.

Figs. 9—14. *Spiriferella draschei* (TOULA).
9—11. Three views of the holotype, after TOULA, 1875.
12—14. Three views of a shell from Profile G (Collection G-300) in Amdrup Land.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