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Stratigraphy and ammonoids from the Middle Triassic Botneheia Formation (*Daonella* Shales) of Spitsbergen

WOLFGANG WEITSCHAT & ULRICH LEHMANN*)

With plates 1–6, 2 tables and 9 text-figures

Contents

Abstract

Sections of the Middle Triassic *Daonella* Shales (Botneheia Formation) of the Isfjorden region of Spitsbergen are measured and their fossil contents of ammonoids are described and stratigraphically analyzed. A revised biostratigraphical interpretation of this sequence is given. The *Daonella* Shales yield fossiliferous nodule layers with different ammonoid faunas which permit a threefold subdivision into the following ammonoid zonation:

Lower Ladinian	zone of *Indigirites tozeri* zone of *Tsvetkovites varius*
Upper Anisian	zone of *Frechites laqueatus*

A correlation of this zonal sequence with the Middle Triassic beds of Taymyr Peninsula, NE USSR, and NE British Columbia is discussed.

Seven genera with eight species are described in detail. *Tsvetkovites varius* n. sp. and *Indigirites tozeri* n. sp. are new to science. A special attention is given to the extremely high infraspecific variation of the ammonoid faunas investigated.

*) Address of authors: Dr. W. WEITSCHAT and Prof. Dr. U. LEHMANN, Geologisch-Paläontologisches Institut und Museum der Universität Hamburg, Bundesstr. 55, D-2000 Hamburg 13, Germany (F.R.)

Zusammenfassung

Profile der Mitteltriassischen Daonellen-Schiefer der Eisfjord-Region Spitzbergens wurden vermessen und die in ihnen enthaltenen Ammoniten beschrieben und stratigraphisch ausgewertet. Daraus ergab sich eine revidierte biostratigraphische Interpretation dieser Gesteinsfolge. Die Daonellen-Schiefer enthalten fossilführende Knollenlagen mit unterschiedlichen Ammoniten-Faunen, welche die folgende Dreigliederung ermöglichen:

Unteres Ladinium	Zone des *Indigirites tozeri* Zone des *Tsvetkovites varius*
Oberes Anisium	Zone des *Frechites laqueatus*

Die Korrelierung dieser Zonenabfolge mit den vergleichbaren Trias-Profilen der Taymyr-Halbinsel, der nordöstlichen UdSSR sowie mit dem nordöstlichen British-Columbien wird diskutiert.

Im paläontologischen Teil werden sieben Genera mit 8 Spezies detailliert beschrieben. Folgende Arten werden neu aufgestellt: *Tsvetkovites varius* n. sp. und *Indigirites tozeri* n. sp. Besondere Aufmerksamkeit wird den großen infraspezifischen Variations-Breiten innerhalb der untersuchten Ammonoideen-Faunen gewidmet.

I. Introduction

In the years 1968, 1972, 1975 and 1981, scientists of the Geologisch-Paläontologisches Institut und Museum performed expeditions to Spitsbergen which, among others, aimed at investigating the biostratigraphical subdivision of the Lower and Middle Triassic. The present paper is a result of the 1981-expedition which was mainly engaged in the Anisian and Ladinian of the Isfjorden region of West Spitsbergen. For that purpose, the Triassic profiles of the Botneheia (Nordenskjöld Land) as well as of Tschermakfjellet and Sauriedalen (Dickson Land) were taken in detail and sampled. The present paper is concerned solely with the ammonoid fauna of the *Daonella* Shales; treatment of the extensive conodont faunas of this stratigraphical section is in preparation.

In addition to the collections made in 1981, those of the earlier expeditions were taken into consideration and gave valuable informations. Our biostratigraphical work in the Triassic of Spitsbergen is intended to be continued.

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II. Stratigraphy

a) Previous work

The sequence of strata investigated in this paper consists of dark-grey, in places intensely bituminous shales 25–50 m in thickness which are quite characteristic of Spitsbergen. They weather papery and contain layers of fos-

siliferous, black bituminous limestone nodules. Since these strata abound in specimens of the bivalve genus *Daonella*, they were named "*Daonella*-Kalk" (MOJSISOVICS), "*Daonella*-Niveau" (FREBOLD), or "*Daonella* Shales". The name "Escarpment Shales" (GREGORY) also characterizes this sequence which forms cliffs between the softer clays and marls above and below.

The *Daonella* Shales have already been the object of scientific interest in the middle of the last century on account of their, in places, very well preserved ammonoid faunas. The first ammonoid faunas described from Spitsbergen (LINDSTRÖM 1865, OEBERG 1877) mainly originated from this stratigraphical level.

The material of these two authors, which was collected by a number of Swedish expeditions, was again investigated and largely revised a little later by MOJSISOVICS (1886). This work is considered the first large-scale description of the arctic Triassic ammonoid faunas. It described a large number of new species and genera and compared them with the Triassic fauna of Siberia. Unfortunately the newly described taxa are founded mainly on only a few specimens, which proved to be unsatisfactory to later workers. MOJSISOVICSs stratigraphical remarks also lack details. He distinguished three units in the Triassic of Spitsbergen: The "Posidonomyen-Kalk", the "*Daonella* Kalk" and the "Schichten mit *Halobia zitteli*". With the ammonoid fauna of the Triassic of Spitsbergen described by SPATH (1921, 1934) the situation is similar, they were collected by several English Spitsbergen expeditions, and their stratigraphical statements are likewise inexact and of little value.

New conceptions about facies and stratigraphy of the Spitsbergen Triassic were first produced by the papers of FREBOLD (1929, 1930, 1931, 1951) which were founded on independent investigations in the field. In the Middle Triassic he distinguished a "*Gymnotoceras* horizon", an "*Eutomoceras* horizon", and the "*Daonella*-Niveau", all of which he considered as Anisian.

A new lithostratigraphical scheme for the Triassic of Spitsbergen was set up by BUCHAN, CHALLINOR, HARLAND, and PARKER (1965). Their results are based on detailed measurements and samplings executed by several Spitsbergen expeditions of the University of Cambridge. This scheme is now generally accepted and forms the basis of all later works. In it, the *Daonella* Shales are included in the new Botneheia Formation (Sassendalen Group) where it occurs in the upper part. Altogether the Botneheia Formation (type section at Vikinghøgda) measures about 150 m in thickness and can be traced all over Spitsbergen. Its top is indicated by a characteristic calcareous sandstone which marks the *Daonella* Shales against the overlying strata. The biostratigraphical classification of the newly erected formations shows little progress in comparison with FREBOLDs works. Within the Botneheia Formation only two horizons were distinguished, a "*Gymnotoceras* – *Eutomoceras* horizon" below and a "*Parapopanoceras* – *Ptychites* horizon" on top. However, the authors hint to the possibility of further subdivision in the upper part (*Daonella* Shales) in accordance with the section at Vikinghøgda.

The first well founded biostratigraphical results were brought out by TOZER & PARKER (1968) who closely inspected the Cambridge collections and the profile at Wallenbergfjellet and compared them with the Triassic ammonoid zones of the Canadian Arctic Islands (Sverdrup Basin). Within the sequence of the *Daonella* Shales they distinguished two fossiliferous horizons, a basal one with *Gymnotoceras laqueatum* and *Parapopanoceras verneuili* and an upper one with *Ptychites* sp., *Nathorstites* sp., and *Protrachyceras* sp. In addition to the ammonoids, the authors also described for the first time different species

of the bivalve genus *Daonella* which are characteristic of the two horizons: *Daonella lindströmi* in the basal horizon, *D. degeeri* in the topmost horizon. They considered the basal horizon to be uppermost Anisian (comparable with the *Gymnotoceras chischa* – zone of British Columbia); the exact position of the upper fauna remained open.

Age		Group	Formation	Facies & Rocks
JURASSIC	Rhaeto-Liassic	Kapp Toscana	Wilhelmøya (15–240 m)	marg. marine sandstones
UPPER TRIASSIC	Norian		De Geer Dalen (30–400 m)	marine to fluviodeltaic sandstones & shales
	Carnian			
MIDDLE TRIASSIC	Ladinian		Tschermakfjellet (12–150 m)	
	Anisian	Sassendalen	Botneheia (20–260 m)	Open marine shales, siltstones and sandstones
LOWER TRIASSIC	Spathian		Sticky Keep (25–310 m)	
	Smithian			
	Dienerian		Vardebukta (15–255 m)	
	Griesbachian			

Tab. I: Triassic stratigraphy of central and eastern Svalbard (after WORSLEY & MORK, 1977). The investigated part is shadowd.

In the later years a number of additional papers appeared on the Triassic of Spitsbergen (FLOOD, NAGY, WINSNES, 1971; KORCHINSKAJA, 1972; HARLAND et al., 1974, BIRKENMAJER, 1977; WORSLEY & MORK, 1978; EDWARDS et al. 1979 etc.). None of these papers discussed in detail the sequence under consideration here. Most of them treat the whole Triassic in the different regions of the Svalbard Archipelago. New results of particular note concern the hitherto scarcely known Triassic of East Spitsbergen (WORSLEY, 1973).

As shown by the papers cited above, the state of knowledge about the Triassic of Spitsbergen at the moment is thus: whereas satisfactory results for Spitsbergen as a whole exist from a lithostratigraphical and lithofacies point of view, precise investigations and comparisons of smaller sections with macro- und micropaleontological and in part also sedimentological questions are lacking; without this, satisfactory correlation is hardly possible with the well documented Triassic provinces from North Canada, Taymyr, and NE Siberia. To date, only two papers of this kind exist for the Spitsbergen Triassic. One describes the uppermost Triassic (BJAERKE & DYPVIK, 1978) and the other describes a section within the Lower Triassic (Smithian) (WEITSCHAT & LEHMANN, 1978).

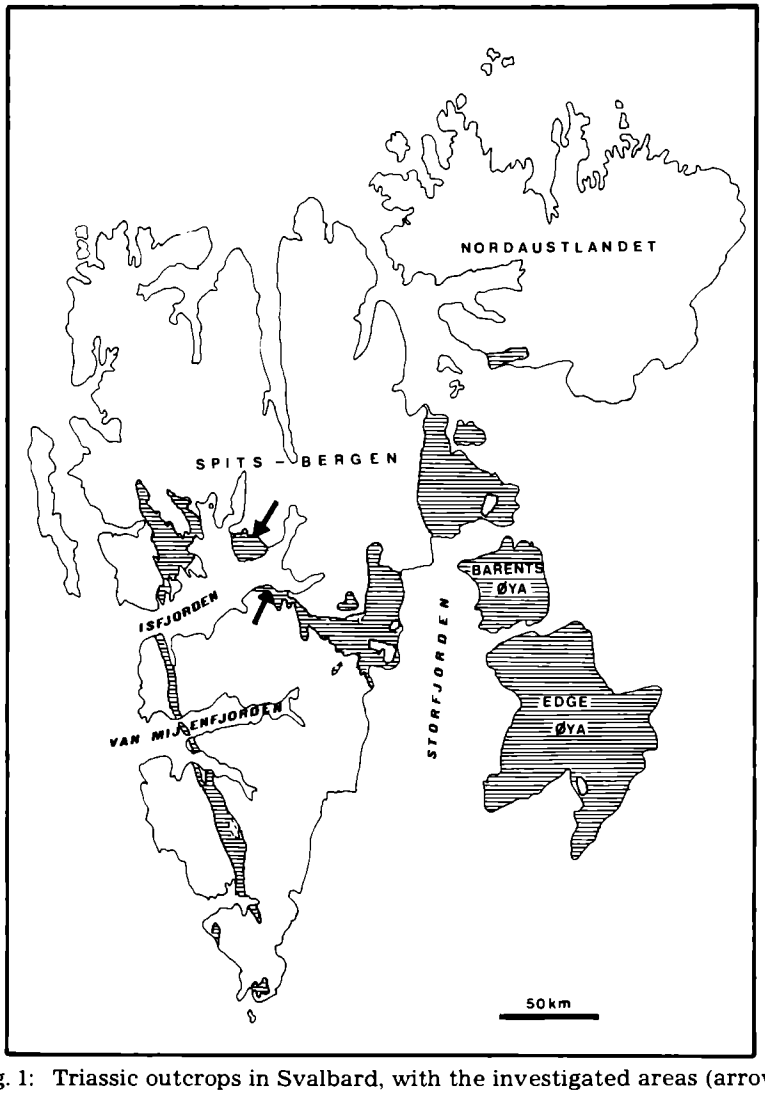
b) Description of the sections

The sections measured in summer, 1981 by SAMTLEBEN & WEITSCHAT occur within the broad outcrop area of Triassic strata which forms the eastern frame of the Spitsbergen trough. The sections are of the sequences described by FREBOLD (1931) in Dickson Land (Tschermakfjellet, Draschedalen, Sauriedalen) and at Sassenfjorden, Nordenskjöld Land, situated about 35 km south-east.

We began drawing the sections in Nordenskjöld Land, where the Middle and Upper Triassic is well exposed for a distance of more than 3 km from De Geer Dalen to Flowerdalen (Botneheia). Work was then resumed in Dickson Land with two profiles at the south and west side of Tschermakfjellet, at Draschedalen and at an eastern transverse valley of Sauriedalen (see text-fig. 2).

The *Daonella* Shales as a whole form a rather uniform persistent sequence within the Middle Triassic of Spitsbergen which is easily marked off lithologically upwards and downwards and which morphologically forms a distinct steep slope. It is underlain by soft marly shales which contain several banks of calcareous marl made up of coprolites. The top boundary towards the Kapp Toscana Formation marks a hard calcareous siltstone horizon, the only horizon in the Triassic which can be traced throughout Svalbard.

The *Daonella* Shale itself is dark-grey weathering blue-black, in places it is intensely bituminous; it weathers into paperlike lamellae. Its thickness in



Text-Fig. 1: Triassic outcrops in Svalbard, with the investigated areas (arrows).

the examined sections increases from 25 m in the northwest to about 50 m in the southeast. Usually the shales do not contain fossils identifiable to species. The vast majority of these is restricted to the nodule layers embedded in the shale. The nodules consist of black, splintery, bituminous limestone weathering light-grey ("Daonellen-Kalk" of MOJSISOVICS). Three more or less persistent nodule layers occur. Beside the nodule layers septarian limestone concretions are common, especially in the upper part; in most cases they are not persistent and unfossiliferous.

Only at the Tschermakfjellet section the upper part of the *Daonella* Shales yields numerous small phosphatic nodules.

In the field, we only measured the position of the individual persistent nodule layers within the *Daonella* Shales. Our main purpose was to collect, bed by bed, as many ammonoids as possible for the intended paleontological investigation, sufficient also for statistical analyses.

The following is a description of character, fossil content and lateral variation of the three nodule layers:

Lowermost nodule layer

The lowermost nodule layer occurs 10–15 m above the base of the *Daonella* Shales and can easily be traced in the southeastern sections from De Geer Dalen to Flowerdalen. In Dickson Land it proved fossiliferous only in the section to the south side of Tschermakfjellet. In Draschedalen, where this part of the section ist not easily accessible, the presence of this horizon is testified by fallen nodules containing the characteristic fauna.

The nodules are oval, rather large (60×30×40 cm) and consist of very splintery, dark-grey bituminous limestone. In terms of abundance of enclosed fossils this layer is much inferior to the higher ones.

Represented ammonoids are: *Aristoptychites trochleaeformis, Frechites laqueatus, Parapopanoceras malmgreni, Ussurites spetsbergensis,* and ? *Lenotropites* sp. The three species mentioned first make up the main part of the fauna in about equal numbers, the latter two forms are represented by only a few specimens each.

The bivalve *Daonella lindströmi* is abundant and two valved specimens are not uncommon.

Remains of marine reptiles (e. g. Ichthyosaurs) occur sporadically. The acetic acid residue contains, besides a rich conodont fauna along with cephalopod arm hooks, scales of elasmobranchs, sponge spicules, foraminifera, and fish teeth.

Middle nodule layer

In all profiles a nodule layer could be ascertained about 16–20 m below the top of the *Daonella* Shales. It is not certain, however, if the nodules of the Sassenfjorden exposures are exactly synchronous with those of the northeastern sections, as they differ considerably in character and fossil content. The nodules in the exposures at Nordenskjöld Land are relatively small (30×20×20 cm) and unfossiliferous whereas f. e. in Sauriedalen they reach unusual sizes (90×60×60 cm) with fairly abundant fossils. There they consist of black, bituminous limestone and can hardly be split in a fresh state. Only weathered nodules make collecting possible. The layer was also found in the section at Tschermakfjellet where the nodules are not as large as in Sauriedalen. In Draschedalen nodules in fallen debris indicate the presence of this horizon, recognisable because of its characteristic fauna.

Ammonoids in this layer are: *Aristoptychites euglyphus, Tsvetkovites varius* n. sp., and *Ussurites spetsbergensis;* the first of it composes the main part of the fauna. The acetic acid residue again contains a rich conodont fauna, arm hooks of cephalopods, sponge spicules and foraminifera. Remains of marine reptiles occur here also.

Uppermost nodule layer

The uppermost nodule layer is situated only a few meters below the top of the *Daonella* Shales and was found in all exposures, although in part differing in development. The nodules of this layer differ distinctly from those of the lower layers in shape and development. In many cases they are no real concretions but flat lense-shaped limestone banks, 60–80 cm long and 20–30 cm thick, which are characterized by their contents of abundant bivalves of the genus *Daonella.*

In the exposures between de Geerdalen to Flowerdalen, the nodules contain well preserved ammonoids. East of Flowerdalen, this layer becomes indistinct, consisting of a hardened bank which differs scarcely from the surrounding shale and in which the ammonoid-fauna has been flattened.

The horizon is similarly developed in the outcrops at Sauriedalen and at the south side of Tschermakfjellet; here also ammonoids are scarce and mostly compressed; only the characteristic Daonellas occur in large numbers. The exposures farther northwest (north of Draschedalen) again show large flat limestone lenses with a rich and well preserved ammonoid fauna.

Ammonoids occurring in this layer are: *Aristoptychites kolymensis, Ussurites spetsbergensis, Indigirites tozeri* n. sp., and *Proarcestes* sp. In number, *Aristoptychites* prevails by far. Only one specimen of *Proarcestes* was found.

Besides the ammonoids some rare specimens of Nautiloidea (*Sybillaenautilus* sp., Orthoceratids) occur also. *Daonella degeeri* is the abundandt and characteristic bivalve of this horizon. Other bivalves such as the genera *Nucula, Adontophora,* and *Gervilleia* are rare. Bones of marine reptiles occur also. The acetic acid residue is in comparison with the lower horizons: poor in conodonts, scales of Elasmobranchs, and fish teeth.

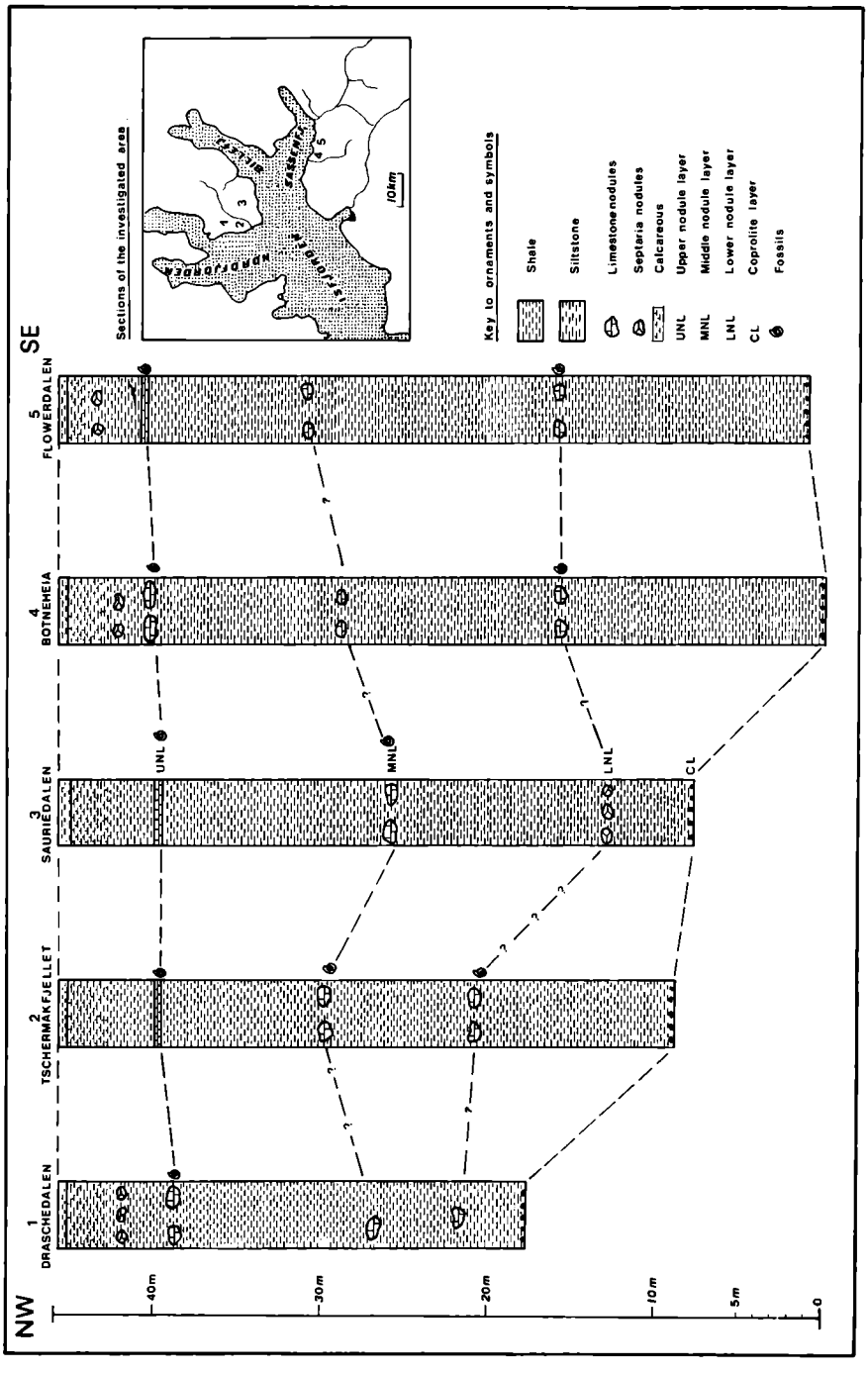
The calcareous sandstone which defines the top of the *Daonella* Shales with respect to the overlying Tschermakfjellet Formation contains many bones and teeth of Saurians (the "Upper Saurier Niveau" of FREBOLD) and only a few specimens of compressed ammonoids which may be referable to the genus *Protrachyceras.*

c) Age and correlation

According to our investigations the level of the *Daonella* Shales in the Isfjorden region of Spitsbergen is characterized by a sequence of three species of the genus *Aristoptychites.* It makes possible a local threefold subdivision of this sequence:

Upper *Daonella* Shales	*(Aristoptychites kolymensis)*
Middle *Daonella* Shales	*(Aristoptychites euglyphus)*
Lower *Daonella* Shales	*(Aristoptychites trochleaeformis)*

The individual species of *Aristoptychites* do not render it feasible yet to define exact ages or to correlate across larger distances, as they are not well enough known from elsewhere. For correlation purposes, the relatively scarce ammonoids, which associated the ptychitid fauna offers better possibilities. For the lower nodule layer this is *Frechites laqueatus* which, according to TO-



Text-Fig. 2: Sections through the *Daonella* Shales (Botneheia Formation) of the Isfjorden region, showing the position of the different nodule layers.

ZER & PARKER (1968), is very similar to *F. chischa; F. chischa* characterizes the uppermost Upper Anisian strata of British Columbia. In the Arctic Triassic of USSR it corresponds to *Frechites laptevi* as described by VAVILOV (1978) from the Triassic sequence of Taymyr peninsula and to *Frechites bisulcatus* mentioned by BYTSCHKOV et al. (1976) from the NE Siberian area.

Parapopanoceras malmgreni also occurs in the lower nodule layer, but as yet it is known only from Spitsbergen. According to TOZER (1968) this genus also occurs in British Columbia but the specimens lack body chambers and are not specifically determinable.

Correlations are also possible with the Arctic Triassic of the Sverdrup Basin (Queen Elizabeth Islands), from which TOZER (1961) described Anisian faunas with *Ptychites* sp., *Gymnotoceras* sp., and *Frechites* sp. at the base of the Blaa Mountain- and Schei Point Formation.

Besides the ammonoids, the species of the bivalve genus *Daonella* are attributed a certain value as guide fossils in the Middle and Upper Triassic. According to TOZER (1968), *Daonella lindströmi,* which is frequent in the lower nodule layer, is similar to *Daonella dubia* GABB, this species being restricted to the uppermost Upper Anisian strata.

The fauna of the lower nodule layer ist therefore classified as uppermost Upper Anisian, following TOZER & PARKER (1968). We suggest a *laqueatus*-zone for this sequence of the Upper Anisian of Spitsbergen.

The middle nodule layer, characterized by abundant occurrence of *Aristoptychites euglyphus,* also contains *Tsvetkovites varius* n. sp. and *Ussurites spetsbergensis.* The genus *Tsvetkovites,* which is here described for the first time from Spitsbergen, was previously only known from Triassic exposures at Cape Tsvetkov of eastern Taymyr Peninsula (VAVILOV & KORCHINSKAJA, 1973). *Tsvetkovites dolioliformis* occurs there in a calcareous sandstone about 8 m above a layer containing ammonoids such as *Arctogymnites, Frechites,* and *Longobardites* which indicate an Upper Anisian age. The Russian authors define the lowermost Ladinian by the occurrence of the genus *Tsvetkovites. Tsvetkovites dolioliformis* is accompanied by *Indigirites krugi, Aristoptychites magarensis, Monophyllites* sp., and *Daonella* cf. *subarctica.* Excluding *Indigirites krugi,* the fauna is almost identical with that of our middle nodule layer in the *Daonella* Shales. *Aristoptychites magarensis* was later treated as a younger synonym of *Aristoptychites kolymensis* by BYTCHKOV et al. (1976), but its description and suture correspond well to *Aristoptychites euglyphus.* The weakly incised suture line, in which only the third and forth lateral saddles show signs of an incision is characteristic of *A. euglyphus.*

The fauna of the middle nodule layer of the *Daonella* Shales thus seems to correspond to that of Cape Tsvetkov in East Taymyr.

This is the first evidence of the lowermost Ladinian in Spitsbergen. This zone was not been recognized from the Arctic Triassic of NE Siberia or from the exposures of the Queen Elizabeth Islands (Arctic Canada). We suggest that this zone in Spitsbergen be formally named the *Tsvetkovites varius* zone. It may be correlated with the zone of *Eoprotrachyceras subasperum* in British Columbia (TOZER, 1967).

The upper nodule layer of the *Daonella* Shales is mainly characterized by the abundant occurrence of *Daonella degeeri* and *Aristoptychites kolymensis.* They are accompanied by rare *Indigirites tozeri* n. sp., *Ussurites spetsbergensis,* and *Proarcestes* sp.

TOZER & PARKER (1968) correlated this horizon with the "*Daonella frami* beds" of the Schei Point and the Blaa Mountains formations of the Queen Eliz-

	NE British Columbia (TOZER, 1967)	Taymyr Peninsula (VAVILOV, 1978)	NE USSR (BYTCHKOV et al. 1976)	Spitsbergen (this paper)
LOWER LADINIAN	*Progonoceratites poseidon*	Not identified	*Arctoptychites omolojensis* "*Longobardites*" *oleshkoi*	*Indigirites tozeri*
	Eoprotrachyceras subasperum	*Tsvetkovites dolioliformis*	Not identified	*Tsvetkovites varius*
UPPER ANISIAN	*Frechites chischa*	*Frechites laptevi*	*Frechites bisulcatus*	*Frechites laqueatus*
	Frechites deleeni	*Frechites deleeni*	*Amphipopanoceras dzeginense*	Not identified

Tab. II: Upper Anisian and Lower Ladinian Zonation and Correlations (after TOZER, 1980).

abeth Islands and considered *Daonella frami* as probably conspecific with *Daonella degeeri*. From the same beds TOZER (1961) described *Longobardites* sp. indet., *Protrachyceras* sp. indet., and *Ptychites nanuk*. The latter species is very similar to *Aristoptychites kolymensis*, differing mainly by its more slender whorl section. The suture line with the characteristic incisions in all saddles is almost identical in both species, as is the type of ribbing.

Thus the upper nodule layer seems actually to be synchronous with the "*Daonella frami* beds". However, the exact age of these beds in Arctic Canada cannot be determined precisely.

More difficult is the correlation with the Ladinian strata of NE Siberia where this level is characterized by "*Longobardites*" *oleshkoi* (BYTCHKOV et al., 1976). According to TOZER (1980), this species resembles early forms of Nathorstitidae from the *poseidon* zone of British Columbia.

On the whole, individual species of the Nathorstitidae seem to be especially good guides for correlation of the arctic Ladinian with that of British Columbia. The Nathorstitidae appear to be most numerous in the arctic faunas and are not infrequent in sequences of British Columbia. The individual species of the Nathorstitidae in this area have not been described in detail yet, but according to TOZER (1980, p. 477), the sequences are characterized by six different species, of which the lowermost belongs to the genus *Indigirites*, the others to the genus *Nathorstites*. Representatives of this family first appeared in the zone of *Progonoceratites poseidon* in British Columbia. This corresponds to the first appearance of the Nathorstitidae in Spitsbergen. *Indigirites tozeri* n. sp. from the upper nodule layer may be conspecific with the undescribed species of this genus in British Columbia and may also correspond to "Longobardites" oleshkoi from NE Siberia. We thus propose the term of *Indigirites tozeri* zone for this sequence of Lower Ladinian of Spitsbergen.

III. Systematic Paleontology

Taxonomic approach: The majority of the ammonoid faunas described in this paper come from calcareous nodules, the layers of which can be assumed to be more or less synchronous. In most cases we have 50–100 specimens of every species from each layer, in some cases more than 1000. In comparison to other faunas, our nodule fauna is remarkable for its paucity in genera and species; in most cases there are not more than two, mostly monospecific genera in one layer; usually one species prevails and the other species

make up not more than 1–2 % of the total number of the specimens. The size distribution of the ammonoids is also remarkable; forms occur from only a few millimeters in diameter (ammonitellas are not rare) up to probably adult ones (150 mm in diameter). We must stress probably adult, for the familiar criteria for adult shells such as approximation of the suture line, modified peristomes or differently sculptured body chamber are displayed only in a few exceptional. cases.

For instance, of the *Aristoptychites* faunas which consist of several hundred specimens, only half a dozen attain diameters of more than 100 mm. We cannot recognise different size groups or other indications of sexual dimorphism as in many Jurassic ammonites, in spite of the large number of specimens. This may indicate that 1) the large specimens lived in other biotopes and only occasionally floated between the shells of the smaller ones or 2) growth continued lifelong, but only very few specimens lived long enough to become adult.

Any question of dimorphism whether sexual or other must remain open.

CALLOMON (1963) named similar Jurassic faunal associations "abnormal faunas" and interpreted these exceptions "as swarms of young ammonites". For the faunas from the nodule layers investigated here the term "abnormal faunas" seems to be hardly appropriate. On the contrary, fossil communities of this kind, which evidently originate from mass extinction of whole swarms of ammonites, give a more *normal* picture of ancient faunas than the traditional ones known.

They approximately represent a population in the biological sense and thus offer a possibility for an approach to biospecies. That the faunas are rich in individuals, but poor in genera and species may also indicate the presence of a true population.

This kind of nodule fauna is not as rare as frequently assumed. They have been described from several formations within the last years and seem to be quite normal especially in black shale facies.

In addition, the large number of individuals allows the statistical treatment of variation within the individual species. The results of investigations of this kind with our Spitsbergen faunas were so surprising that they are briefly mentioned here. Features which normally are considered specifically diagnostic such as size proportions of the shell or type of ribbing vary within one species to an extent which was formerly not known and not believed possible. This is especially true for comparable stages of juvenile and subadult forms; in adult shells the width of variation is clearly smaller.

Shell proportions: The variation in shell proportions is wide in all species under consideration. It is most conspicuous in the different species of the genera *Aristoptychites* and *Indigirites,* especially in the ratio diameter/width. Extreme values like 3:1 and 1:1 are connected by transitions, resulting in a normal Gauß curve statistically. The variation in shell proportions is so wide that earlier authors with only a few specimens at their disposal erected up to six species where we find only one.

Shell sculpture: The same applies to the sculpture of the different species of the investigated faunas. This is especially obvious in *Frechites laqueatus,* where the variation concerning the type of ribbing, the tuberculation and the development of a keel is truly extreme. In juvenile forms (up to 30 mm in diameter) there are hardly two specimens which are quite equal in these respects. Here also variations of this degree led former authors to an (under-

standable) accumulation of species which, according to our investigations, are well documented variations, with all transitions, of one species only.

Suture line: In their more general aspect, the suture lines of the different investigated species are fairly constant. It becomes, however, highly variable when it comes to the details of the incisions. Even the suture lines of both sides of an ammonite may differ considerably in detail. This has been illustrated for *Aristoptychites kolymensis* by KÖHLER-LOPEZ & LEHMANN (1984, in press) and is well visible in other species of this genus and in *Ussurites spetsbergensis*.

The problem of variation within a single species and the typological naming of such specimens as it was done in the classical monographs on Triassic ammonoids by DIENER, WAAGEN, MOJSISOVICS, and SPATH i. v. a. was discussed by TOZER (1961, 42–44). His remarks in defence of the typological method of older authors of naming species, which were, that it was the only possible method as long as only a few specimens of different localities were known, are fair and considerate. Still, recognition and consideration of biospecies must remain the ultimate goal in a biological discipline which paleontology is.

The measurements (all in mm) are given in the conventional manner; (D) = diameter; (H) = whorl height; (W) = whorl width and (U) = umbilical width in that order, with the proportions of H, W, and U expressed as a decimal fraction of D.

The arrangements of families and genera follow that of TOZER (1980).

The type material is housed in the collections of the Geologisch-Paläontologisches Institut und Museum der Universität Hamburg (SGPIHM), inventary numbers 2801–2829.

Family **Ptychitidae** MOJSISOVICS, 1882

Genus *Aristoptychites* DIENER, 1916

Type species: *Ammonites gerardi* BLANFORD, 1863

Diagnosis: Involute, fairly thick shell with rounded venter, narrow umbilicus and low radial ribs. Suture line ammonitic, moderately incised. External saddles with prominent incisions.

Remarks: The type species of the genus *Aristoptychites (Ammonites gerardi)* comes from Ladinian strata in the Himalaya units and is characterized by its relatively strongly bent suture line, the saddles of which show characteristic, deep incisions. POPOW (1961), when investigating the *Ptychites* of the NE USSR, also recognized these incisions and extended the generic diagnosis of *Aristoptychites* by this important feature. TOZER (1961) also described forms with this type of saddle incisions from the Triassic *'Daonella frami* beds' of the Canadian arctic islands. He placed this new species into the genus *Ptychites (P. nanuk)*, and later on into the genus *Istreites* SIMIONESCU, 1913.

All the Spitsbergen species of *Ptychites* known so far also possess these saddle incisions, although in the stratigraphically lower species it is not developed in all saddles. Evidently all species described from the Arctic Triassic till now possess this feature and it seems reasonable to us to unite them in the genus *Aristoptychites*. All arctic species of the genus differ from the type species by lack of the strong curvature of the suture line.

Occurrence and age: *Aristoptychites* is widely spread from the NE USSR to the Taymyr peninsula, Spitsbergen and the Canadian Arctic Islands. Whereas in NE USSR the genus is described as mainly Upper Ladinian in age,

representatives of the genus in Taymyr, Spitsbergen and the Canadian Arctic Islands are met with from the uppermost Anisian to the Lower Ladinian strata.

Discussion: According to our investigations, the Spitsbergen *Ptychites* are found in three calcareous nodule layers within the *Daonella* Shales. Whereas we have about 60 specimens from the lowermost layer, the material from the two higher layers consists of several hundred specimens, mostly excellently preserved and in all growth stages.

Statistical analyses of the shell dimensions and investigations of both ontogeny and suture line have shown that the 9 species of *Ptychites* described from the *Daonella* Shales of Spitsbergen till now actually represent only three species with a considerable amount of variation:

Aristoptychites trochleaeformis in the lowermost layer
Aristoptychites euglyphus in the middle layer
Aristoptychites kolymensis in the uppermost layer.

The three species are all characterized by their allometric growth. Up to the 6th–7th whorl, corresponding to a shell diameter of about 25–35 mm, the specimens are nearly globular, thereafter the whorl-height increases abruptly relative to whorl-width, the shell thus becoming more slender in cross section up to the adult stage.

The early ontogenetic stages of the three species can hardly be distinguished as far as shell morphology and the type of ribbing are concerned. It is only after the break in the growth curve that differences become evident. *A. trochleaeformis* is characterized by an oval shell with evenly rounded flanks, whereas the two other species are more triangular in cross section. In the type of ribbing, *A. trochleaeformis* and *A. kolymensis* approach each other by possessing 15–20 straight, very faint ribs per whorl which are still well visible in the middle of the flanks, but fade out ventrally. *A. euglyphus* differs clearly from the two other species in number and shape of the ribs. The shells have 25–30 ribs per whorl which are well developed in the middle of the flanks and hardly less on the venter which they cross with a slight forward bend.

The three species are easily distiguished by the suture line, especially its degree of incision in general and the development of the saddle incision which is characteristic of the genus. Both criteria show a development from *A. trochleaeformis* through *A. euglyphus* to *A. kolymensis* (Text-Fig. 3).

The degree of incision is relatively small in the suture line of *A. trochleaeformis*, and the saddle incision is restricted to two saddles only, namely the 5th and 4th lateral saddle. In addition, it begins at a relatively late ontogenetic stage (at a shell diameter of about 50 mm).

In its degree of incision, the suture line of *A. euglyphus* is intermediate between the two other species. The saddle incision is visible in the 5th, the 4th, and the 3rd lateral saddle, but it also starts ontogenetically late.

The suture line of *A. kolymensis* is intensely incised and the saddle incision is found in all lateral saddles. It starts ontogenetically early at the 5th lateral saddle and soon affects all the other saddles.

Aristoptychites trochleaeformis (LINDSTRÖM, 1865)
(pl. I, figs. 1 a, b)

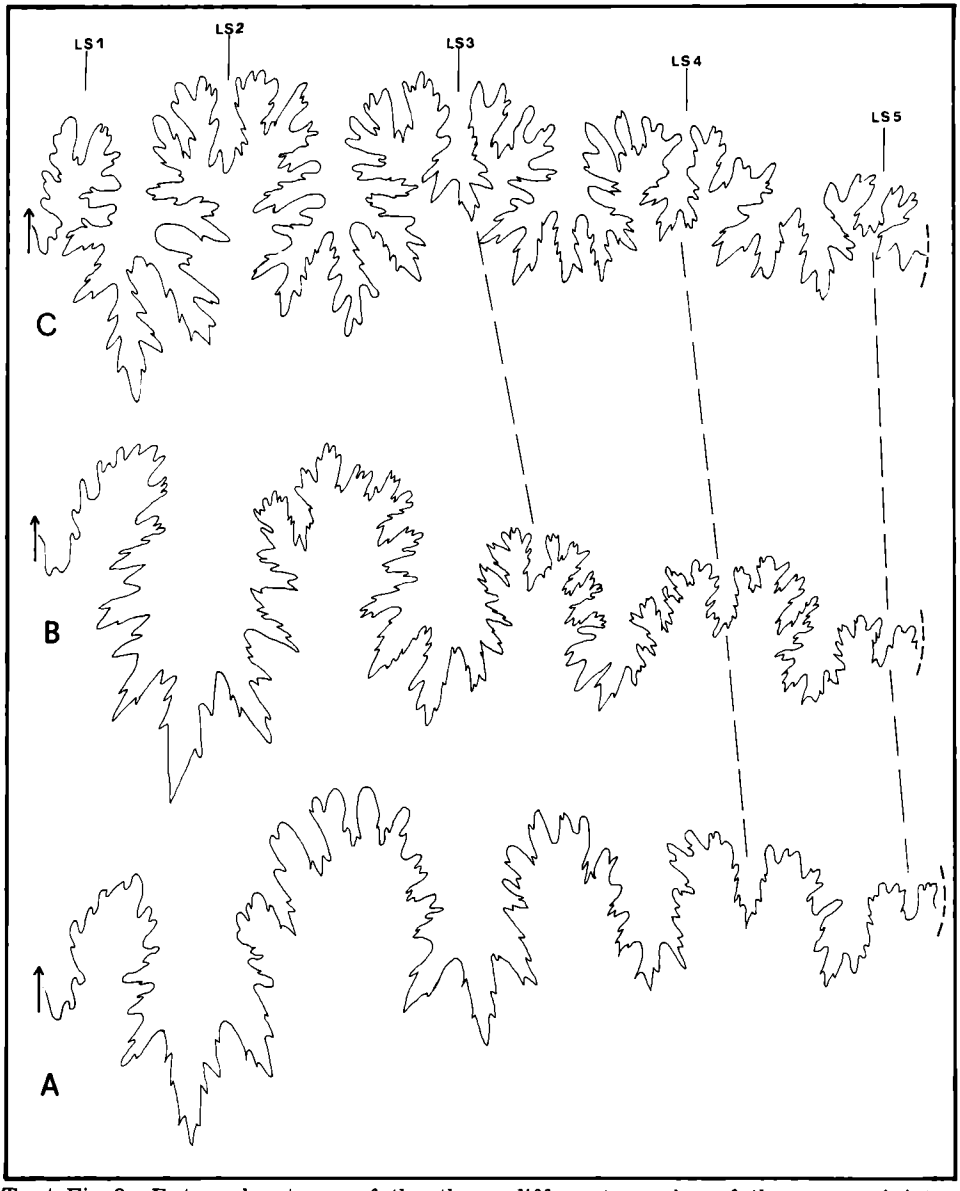
1865 *Nautilus trochleaeformis* LINDSTRÖM, p. 3, pl. 1, fig. 2
pars 1877 *Ammonites trochleaeformis* OEBERG, p. 4, pl. 1, fig. 1, non figs. 4–5
1886 *Ptychites trochleaeformis* MOJSISOVICS, pl. 12, figs. 1–2, pl. 13, figs. 1

Diagnosis: Fairly large *Aristoptychites* with pronounced umbilical shoulder, well rounded flanks and evenly rounded venter. With very low ir-

regularly straight ribs (15–20) which die out near the venter. Suture line moderately denticulate, with five principle saddles. Only the 5th and 4th lateral saddle with typical incision.

Holotype: *Nautilus trochleaeformis* LINDSTRÖM, 1865. Coll. Naturhist. Riksmus. Paleozool. Avd. Stockholm, no. Mo. 340

Material: 45 specimens from the lower nodule layer of the *Daonella* Shales at Vindodden (Nordenskjöld Land), 15 specimens from the lower nodule layer at Tschermakfjellet (Dickson Land).



Text-Fig. 3: External sutures of the three different species of the genus *Aristoptychites*, showing the evolution of the incisions of the lateral saddles (LS 1–LS 5) and the depth of the respective incisions from: *A. trochleaeformis* (A), through *A. euglyphus* (B), to *A. kolymensis* (C).

Types and dimensions:

Specimen	D	H	W	U
Holotype Mo 340	110	63 (0.57)	51 (0.46)	15.5 (0.14)
Specimen no. 2801	155	75 (0.48)	64 (0.41)	26 (0.17)
Specimen no. 2802	48.5	27.0 (1.0)	30.0 (0.63)	11 (0.23)

Remarks: The holotype is 110 mm in diameter, has a body-chamber nearly one whorl in length and shows the characteristic costation of this species.

Our material consists of about 60 specimens in various stages of growth. The largest one is 190 mm in diameter, has a body chamber one whorl in length and seems to show an enlarged umbilicus. Most of the specimens are recrystallized so that only a few do show the suture line, which is moderately denticulated. Only the 4th and 5th lateral saddles show the characteristic incision.

Comparisons: *A. trochleaeformis* can easily be distinguished from *A. euglyphus* by the curvature and number of the ribs. In the costation it resembles *A. kolymensis* and *A. nanuk* from which *A. trochleaeformis* is distinguished by its whorl section, by the size and by its less denticulated suture line with only two bifid lateral saddles.

Age and occurrence: *A. trochleaeformis* is widely spread in the uppermost Anisian (zone of *Frechites laqueatus*) of the Svalbard Archipelago.

Aristoptychites euglyphus (MOJSISOVICS, 1886)
(pl. I, figs. 2–3; pl. II, figs. 1–3)

pars 1877 *Ammonites trochleaeformis* OEBERG, p. 4, pl. 1, Figs. 2–3, non fig. 1
1886 *Ptychites euglyphus* MOJSISOVICS, p. 94, pl. XIV, figs. 1–3
1886 *Ptychites lundgreni* MOJSISOVICS, p. 90–91, pl. XIII, fig. 4, pl. XIV, fig. 4
1886 *Ptychites nordenskjöldi* MOJSISOVICS, p. 92–93, Pl. XIII, fig. 3
1886 *Ptychites latifrons* MOJSISOVICS, p. 95, pl. XIII, Figs. 5–6

Diagnosis: Fairly large *Aristoptychites* with triangular whorl section and almost sharply edged venter. With broad distinct ribs (25–30) which are straight at the flanks and curved forewards at the venter. External suture line moderately incised, with four principal saddles. Only the 3rd, 4th, and 5th lateral saddle with incisions.

Lectotype: *Ammonites trochleaeformis* OEBERG, pl. 1, figs. 2–3. Coll. Naturhist. Riksmus. Paleozool. Avd. Stockholm, no. Mo. 314, a, b.

Material: More than 500 specimens from the middle nodule layer of the *Daonella* Shales east side of Sauriedalen. About 20 specimens from *Daonella* Shales, Kongressfjellet.

Types and dimensions:

Specimen	D	L	W	U
Lectotype Mo 314	76	39.5 (0,51)	40 (0.52)	14 (0.18)
specimen Coll. SAMTLEBEN	69	35 (0.51)	30 (0.43)	14 (0.20)
specimen no. 2803	74	40 (0.54)	46 (0.62)	14 (0.19)
specimen no. 2804	58	33 (0.56)	48 (0.82)	12.5 (0.20)
specimen no. 2805	32,5	19.5 (0.60)	35 (1.1)	9.5 (0.29)

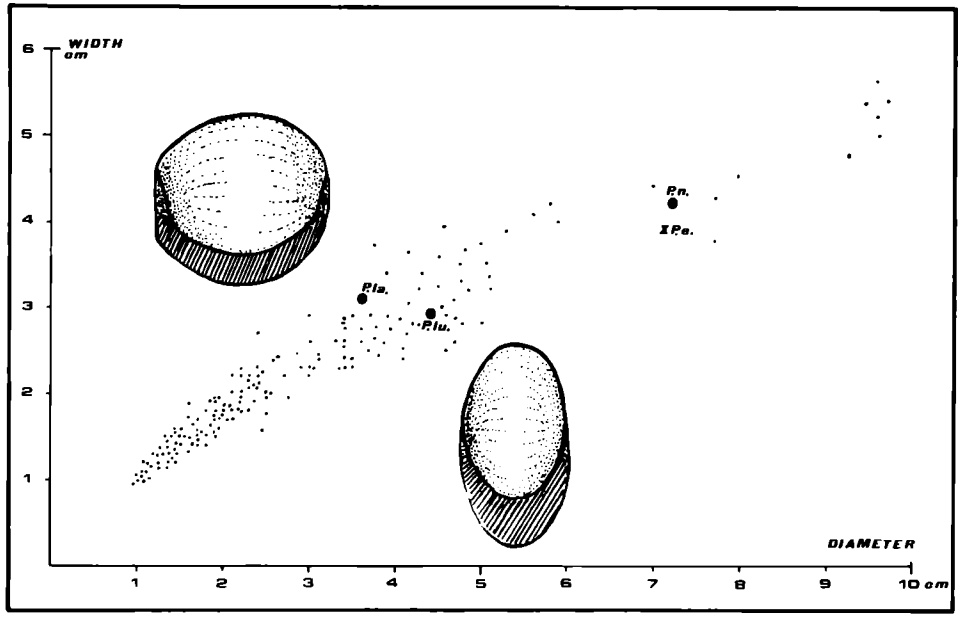
Remarks: MOJSISOVICS (1886) described the following four species from the 'Black *Daonella* limestone' at Saurie Hook: *P. lundgreni, P. nordenskjöldi, P. euglyphus* and *P. latifrons*. As diagnostic features distinguishing the species

he named the size, the relation whorl height/whorl width, and the sculpture. Of each of his species he had between 2 and 9 specimens.

Our collection which consists of several hundred specimens in various growth stages stems from the middle nodule layer at the eastern side of Sauriedalen. That section seems to be identical with the place where MOJSISOVICS' specimens were collected.

Investigation of our fauna proved that it consists of only one species which varies very much in relative whorl width, especially so in juvenile and subadult specimens. We suggest the name *Aristoptychites euglyphus* for the species because the holotype of it represents a good average in its measurements and is large enough with its diameter of 76 mm to show the characteristic morphological features of the species. The holotypes of *P. latifrons* and *P. lundgreni*, on the contrary, are juvenile forms measuring only 38 and 45 mm in diameter. The holotype of *P. nordenskjöldi* measures 94 mm in diameter and shows the fimbriate sculpture supposed by MOJSISOVICS to be typical of this species. We do not consider this sculptural element as a specific feature, for this peculiar wrinkling of the shell not only occurs sporadically with all *Ptychites* species from Spitsbergen but may also not infrequently be observed in specimens of other genera, e. g. *Indigirites*.

The largest specimen at our disposal measures 180 mm in diameter, its body chamber comprising only 1/3 whorl. Since the body chamber of the *Ptychites* usually comprises at least one complete whorl, the size of adult specimens of *A. euglyphus* may be assumed to be at least 220 mm in diameter. This species is especially characterized by its type of ribbing: 25–30 straight



Text-Fig. 4: Width/Diameter diagramm of *Aristoptychites euglyphus*, showing the extraordinary extent of the shell variation. Position of the holotypes of MOJSISOVICS' species
● P. la.= *Ptychites latifrons*
● P. lu.= *Ptychites lundgreni*
● P. n. = *Ptychites nordenskjöldi*
× P. e. = *Ptychites euglyphus*

ribs, most distinct at the middle of the flanks, crossing the venter curved forward and slightly weakening, dissolved into fine striae.

Due to the intense recrystallisation within the chambers, the suture line is preserved only in a small number of specimens. In general it is slightly more incised than that of *A. trochleaeformis* and the incision of the lateral saddles which is characteristic of the genus, is visible in the 5th, 4th, and 3rd lateral saddle.

Comparisons: *A. euglyphus* differs from all other Spitsbergen species of this genus by its large number of ribs and by their distinctness. In size it is similar to *A. trochleaeformis*. As to the character of the suture line, it is intermediate betwen *A. trochleaeformis* and *A. kolymensis*.

Age and occurrence: *A. euglyphus* is restricted to the middle nodule layer of the *Daonella* Shales of Spitsbergen. This layer is fossiliferous only in the sections of Dickson Land (Kongressfjellet, Sauriedalen, Tschermakfjellet). Judging from the joint occurrence with the genus *Tsvetkovites* its age is the lowermost Lower Ladinian.

Aristoptychites kolymensis (KIPARISOVA, 1937)
(pl. III, figs. 1–4)

1937 *Ptychites kolymensis* KIPARISOVA, p. 166, pl. IV, fig. 3
?1961 *Aristoptychites magarensis* POPOW, p. 105, pl. 24, fig. 1
1961 *Aristoptychites kolymensis* POPOW, p. 105, pl. 25, fig. 5
1965 *Ptychites nanuk* TOZER, BUCHAN et al., p. 81
1968 *Ptychites* sp. TOZER & PARKER, p. 27, fig. a c)
1979 *Aristoptychites kolymensis* VAVILOV & ALEKSEYEV, p. 312, fig. 1
1984 *Aristoptychites kolymensis* KÖHLER-LOPEZ & LEHMANN, in press.

Diagnosis: Fairly small *Aristoptychites* with characteristic triangular whorl section. Ornamentation composed of low straight ribs which die out near the venter. Suture line highly denticulated with prominent incisions in all external saddles.

Holotype: *Ptychites kolymensis* KIPARISOVA, 1937. Reg. No. TsNIGR-muzey 88/5302.

Material: More than 1000 specimens from the upper nodule layer of the *Daonella* Shales out of the exposures from the Botneheia to Flowerdalen (Nordenskjöld Land). About 200 specimens from the upper nodule layer of the *Daonella* Shales at Draschedalen (Dickson Land).

Types and dimension:

Specimen	D	H	W	U
Specimen no. 2806	63	32 (0.51)	30 (0.48)	14 (0.22)
Specimen no. 2807	52	27 (0.52)	28 (0.53)	11 (0.21)
Specimen no. 2808	51	26 (0.51)	22 (0.43)	10 (0.19)
Specimen no. 2828	52	26 (0.50)	33 (0.64)	11 (0.21)

Remarks: Surprisingly this form was not recognized as an independent species until only a few years ago, although it is quite frequent in the upper nodule layer of the *Daonella* Shales of the Isfjorden region. BUCHAN et al. (1965) determined it as *Ptychites nanuk* which TOZER (1961) had described from the '*Daonella frami* beds' of the Canadian Arctic Islands, and which are almost synchronous with the *Daonella* Shales.

By the Russian authors KLUBOV, PCHELINA (1965) this species was named *Ptychites* cf. *trochleaeformis* in descriptions of the Triassic sequences of the Barents Öya and *Aristoptychites* cf. *kolymensis* in profile descriptions of the van Keulenfjorden.

KÖHLER-LOPEZ & LEHMANN (1984, in press) investigated several hundred very well preserved specimens from the upper nodule layer of the *Daonella* Shales at the Botneheia and described this species in detail. They especially discussed the development of the suture line and the early ontogeny and stress the wide variation in the morphology of juvenile representatives of this species, a feature which we also observed in the stratigraphically lower species of this genus. The authors identified this species as *Aristoptychites kolymensis*, a characteristic and frequent form in the ? Upper Ladinian of the northeast Siberian Triassic.

Our material consists, in addition to the collections of LEHMANN (1968, 1972), of a fauna from the sections in Draschedalen (Dickson Land) collected by WEITSCHAT & SAMTLEBEN (1981). Contrary to the specimens from the Botneheia, the latter material in many cases retained the body chambers. Therefore additional information to that of KÖHLER-LOPEZ & LEHMANN can be given concerning the size.

The largest specimen at our disposal measures 70 mm in diameter, its body chamber is 1⅓ whorl long. Since neither fragments of larger specimens nor signs of size assortment were found, *Aristoptychites kolymensis* can be considered a relatively small species as compared to its predecessors.

Comparisons: *A. kolymensis* differs from the two other species from the *Daonella* Shales of Spitsbergen by its smaller size and by the more intensely slit suture line. It is very similar to the more slender *Aristoptychites nanuk*.

Age and occurrence: *A. kolymensis* occurs in the Lower Ladinian of the entire Svalbard Archipelago. The type locality (Kolyma basin) was at first considered Anisian (KIPARISOVA), later Upper Ladinian (VAVILOV & ALEKSEYEV).

Family **Parapopanoceratidae** TOZER, 1971

Genus *Parapopanoceras* HAUG, 1894

Diagnosis (Treatise): Like *Megaphyllites*, but more discoidal; body chamber modified.

Type species: *Popanoceras verneuili* MOJSISOVICS, 1886

Age and occurrence: Anisian of Arctic Triassic and British Columbia.

Parapopanoceras malmgreni (LINDSTRÖM, 1865)
(pl. IV, figs. 1–4)

1865 *Ceratites malmgreni* LINDSTRÖM, p. 4, pl. II, figs. 1–2
1877 *Ceratites malmgreni* OEBERG, p. 10, pl. II, figs. 1–6
1886 *Popanoceras malmgreni* MOJSISOVICS, p. 68, Pl. XV, fig. 1
1886 *Popanoceras verneuili* MOJSISOVICS, p. 69, pl. XV, figs. 5–9
1886 *Popanoceras* div. f. indet., MOJSISOVICS, p. 69, pl. XV, figs. 2–4
1968 *Parapopanoceras verneuili* TOZER, p. 536, pl. 26, figs. i–l

Diagnosis: *Parapopanoceras* of medium size with narrow umbilicus and fine slightly curved striae. Phragmocone thick with well rounded venter. With typical change in whorl section of the initial part of the body chamber. Peristome with constrictions. Suture line with five, moderately incised lobes and phylloid saddles.

Holotype: *Ceratites malmgreni* LINDSTRÖM, 1865. Coll. Naturhist. Riksmus. Paleozool. Avd. Stockholm, no. Mo 369.

Types and dimensions

Specimen	D	L	W	Z
Holotype Mo. 369a	31	18.5 (0.6)	11.5 (0.35)	–
specimen no. 2809	56	31 (0.55)	15 (0.27)	8 (0.14)
specimen no. 2810	51	27.5 (0.53)	13 (0.26)	7.5 (0.15)
specimen no. 2811	31	17 (0.54)	14 (0.45)	3 (0.1)
specimen no. 2812	33	21 (0.68)	12 (0.39)	2 (0.06)

Material: About 65 specimens from the lower nodule layer, *Daonella* Shales, Vindodden (Nordenskjöld Land) and 15 specimens from the lower nodule layer, *Daonella* Shales, Tschermakfjellet (Dickson Land).

Remarks: Our material consists of about 80 specimens in various stages of growth; in most of them the body chamber is compressed flat. Only in about 15 specimens the body chamber is preserved and shows the characteristic features of this species.

Whereas the phragmacone of this species is discoidal in cross section, with a well rounded venter, the shape begins to change in the first third of the body chamber; the cross section lengthens and the venter sharpens. In the last third of the body chamber the height decreases again and the venter flattens. This causes a characteristic excentricity of the umbilicus with a change of the coiling spiral and the width of the umbilicus. A well developed peristome characterizes the end of the body chamber in *P. malmgreni*. It is especially well visible in casts.

Text-Fig. 5: *Parapopanoceras malmgreni* (LINDSTRÖM, 1865) External suture at a whorl height of about 23 mm. (Spec. no. 2812)

The largest specimen at our disposal measures 68 mm in diameter and shows the change in shape of the body chamber as mentioned above. Most of our specimens are juvenile shells and they vary considerably in their whorl proportions.

In LINDSTRÖMs holotype of this species the body chamber is compressed flat. The two other species from the *Daonella* Shales of Spitsbergen attributed to the genus *Parapopanoceras* by MOJSISOVICS do not belong to this genus in our opinion.

Investigation of the type material (OEBERG, LINDSTRÖM, MOJSISOVIC) together with our collection shows clearly that there exist only one species of the genus *Parapopanoceras* with a considerable amount of variation. We

therefore consider *Parapopanoceras verneuili* as a subjective synonym of *P. malmgreni*.

Age and occurrence: So far, *Parapopanoceras malmgreni* is only known from Spitsbergen. It occurs in the Zone of *Frechites laqueatus* of the Upper Anisian.

Family **Ceratitidae** MOJSISOVICS, 1879

Subfamily Beyrichitinae, SPATH, 1934

Genus *Frechites* SMITH, 1932

Diagnosis (Treatise): Like *Gymnotoceras* but with tuberculation on ventral shoulders and at point of bifurcation; keel faint or absent.

Type species: *Ceratites humboldtensis* HYATT & SMITH, 1905.

Age and occurrence: Upper Anisian – Lower Ladinian of the Arctic and Eastern Pacific Triassic provinces.

Frechites laqueatus (LINDSTRÖM, 1865)
(pl. IV, figs. 5–6)

1865 *Ceratites laqueatus* LINDSTRÖM, p. 5, pl. II, figs. 3–4
1877 *Ceratites laqueatus*, OEBERG, p. 8, pl. II, figs. 7–9
1886 *Ceratites geminatus* MOJSISOVICS, p. 49, pl. XI, figs. 7, 13, 14
1886 *Ceratites laqueatus*, MOJSISOVICS, p. 51, pl. IX, figs. 1–2
1886 *Ceratites arcticus* MOJSISOVICS, p. 55, pl. IX, fig. 9
1886 *Ceratites nathorsti* MOJSISOVICS, p. 53, pl. IX, fig. 3
1968 *Gymnotoceras laqueatum*, TOZER & PARKER, p. 537, pl. 26, figs. e–h

Diagnosis: *Frechites* with quadrangular whorl section and falcoid ribs which may have bullae at the bifurcation and tuberculate endings. Ventral keel faint, degenerate on body chamber. Suture line with wrinkled saddles.

Holotype: *Ceratites laqueatus* LINDSTRÖM, 1865. Coll. Naturhist. Riksmus. Paleozool. Avd. Stockholm, no. Mo. 264

Types and dimensions:

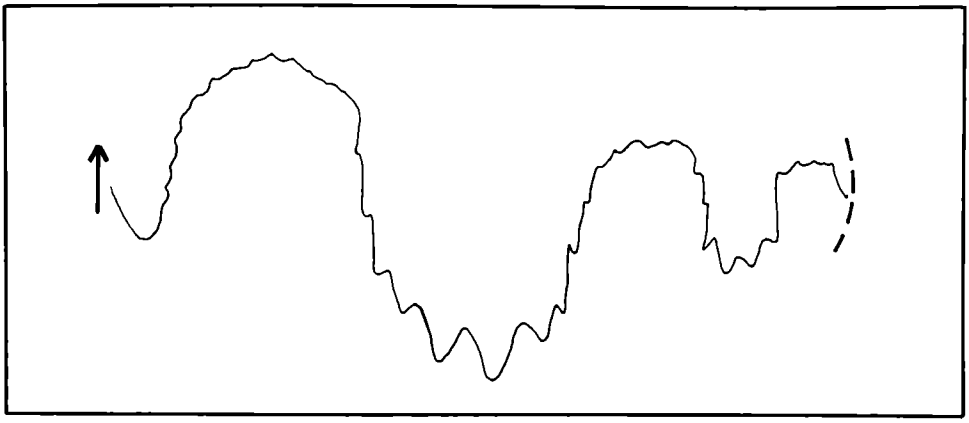
Specimen	D	L	W	U
holytype Mo. 263	47	25 (0.53)	16 (0.34)	12 (0.26)
specimen no. 2813	30	14 (0.46)	13 (0.45)	9 (0.3)
specimen no. 2814	24	10.5 (0.41)	9.5 (0.38)	8.5 (0.33)

Material: 35 specimens from the lower nodule layer, *Daonella* Shales at the Botneheia (Nordenskjöld Land) and 17 specimens from the lower nodule bed, *Daonella* Shales, Tschermakfjellet (Dickson Land).

Remarks: Our sample consists of about 50 specimens all of which originate from one nodule layer and which represent various growth stages.

Our largest specimen is 55 mm in diameter. Its body chamber is preserved, but the phragmocone is partly compressed flat. The fauna as a whole varies remarkably as concerns development of the keel and the sculpture. Especially in juvenile shells hardly any specimen equals the other, as to the number of ribs, the tuberculation and the development of the keel. The whorl proportions, the suture line and the shape of the ribs are relatively constant.

MOJSISOVICS (1886) in his fauna of the '*Daonella* Kalk' of the Isfjorden region distinguished four species of this genus, each consisting of 1–3 specimens;



Text-Fig. 6: *Frechites laqueatus* (LINDSTRÖM, 1865) External suture at a whorl height of 12 mm. (Spec. no. 2813)

the species were described as differing mainly in the features mentioned above as highly variable.

Investigation of the type material together with our collection shows clearly that only one species exists, which varies much in its juvenile stages. LINDSTRÖMs holotype measures 50 mm in diameter and already shows the typical features of the species.

Comparisons: *Frechites laqueatus* closely resembles *F. chischa* from the Toad-Formation (Upper Anisian) of British Columbia. It differs only in the development of the keel, which in most of the Spitsbergen specimens is weak and may disappear on the body chamber.

Age and occurrence: *Frechites laqueatus* is restricted to the lower nodule layer of the *Daonella* Shales of Spitsbergen. It is common in the outcrops of the Isfjorden and Nordfjorden area but is also described from more eastern exposures at Wallenbergfjellet (TOZER & PARKER, 1968). KLUBOV (1965) describes some species of the genus *Frechites* from the Upper Anisian strata of Barents- and Edge-Öya. *F. laqueatus* is a useful guide ammonite for the Upper Anisian. According to TOZER (1980) the *laqueatus zone may be correlated with the zones of Frechites laptevi* (Taymyr), *Frechites bisulcatus* (NE-USSR), *Frechites chischa* (British Columbia) and *Frechites occidentalis* (Nevada).

Family **Nathorstitidae** SPATH, 1951

Genus *Tsvetkovites* VAVILOV & KORCHINSKAJA, 1973

Type species: *Tsvetkovites dolioliformis* VAVILOV & KORCHINSKAJA, 1973

Diagnosis: Relatively small, tumid, dolioform on inner whorls. Cross section of whorls ranging from trapezoidal to triangular. Umbilicus relatively narrow, sharply delineated, with adumbilical tubercles, from which indistinct small ribs extend. Suture line ceratitic, with weakly capitate saddles.

Range and occurrence: Lowermost Ladinian of Eastern Taymyr and Spitsbergen.

Tsvetkovites varius n. sp.
(pl. V, figs. 1–4)

Holotype: Specimen figured pl. V, figs. 1a, b, SGPIHM No. 2815

Diagnosis: Fairly small *Tsvetkovites* showing the characteristical ontogenetic change of whorl dimensions. With low ribs which bend strongly backwards in the middle of the flank. Suture line ceratitic with three external lobes with crenulated bases. Saddles phylloid.

Stratum typicum: Middle nodule layer of *Daonella* Shales (Botneheia Formation).

Locus typicus: East side of Sauriedalen, Dickson Land (Spitsbergen).

Derivatio nominis: From Latin varius, concerning the characteristic ontogenetic change in whorl dimension.

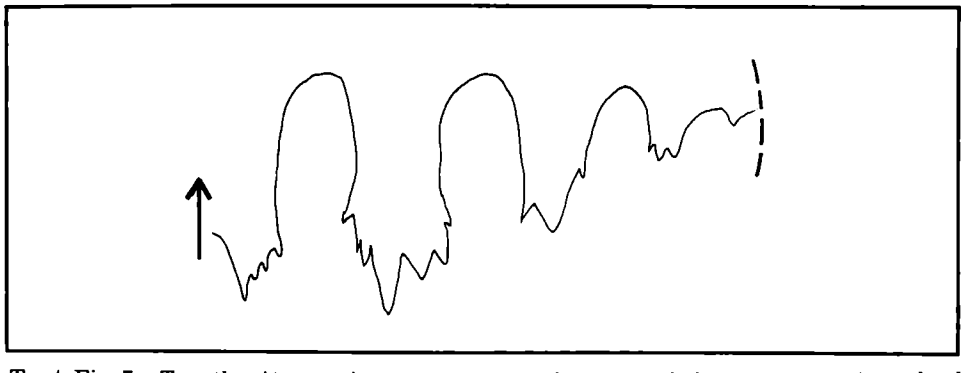
Types and dimensions:

Specimen	D	L	W	U
Holotype No. 2815	21	10.5 (0.47)	8.5 (0.40)	5 (0.23)
Paratype no. 2816	17	8 (0.47)	8 (0.47)	5 (0.29)
Paratype no. 2817	16	8 (0.5)	9 (0.56)	6.5 (0.41)
Paratype no. 2818	12.5	6 (0.48)	8 (0.68)	4.5 (0.36)

Material: More than 300 specimens from the middle nodule layer, *Daonella* Shales, east side of Sauriedalen (Dickson Land).

Description: Our collection includes about 300 specimens in various growth stages; most of them have crushed body chambers. No specimen is more than 20 mm in diameter. As there is no indication of a classification, we conclude that *T. varius*, similar to the type-species of the genus, is a very small form. The holotype is 20 mm in diameter, its body chamber measures about 3/4 of a whorl. The suture line is visible.

The material shows the remarkable ontogenetic change in the whorl dimensions which has been described by VAVILOV & KORCHINSKAJA from the type species *T. dolioliformis*. Up to a diameter of about 15 mm the shell is dolioform, with trapezoidal whorl section and broadly rounded tricarinate, bisulcate venter. The umbilicus at that diameter is relatively wide and bears distinct, small ribs at the umbilical border which die out in the middle of the flank. The last whorl becomes triangular in section, with a distinctly keeled



Text-Fig. 7: *Tsvetkovites varius* n. sp. External suture of the paratype at a whorl height of 7 mm. (Spec. no. 2817)

venter; its umbilicus becomes narrower. The sculpture at this stage is composed of flat strongly falcoid ribs.

Beside these ontogenetic changes there exists a high rate of variation concerning the width, the ornamentation and the character of the umbilicus. The external suture line has three lateral lobes with weakly crenulated bases, and small phylloid saddles.

Comparisons: *Tsvetkovites varius* n. sp. is similar to *T. dolioliformis* from the Lower Ladinian of Cape Tsvetkov (Taymyr Peninsula, USSR). It differs from it by a more complicated suture line and by its different ornamentation.

Age and occurrence: *T. varius* is known until now only from the Lower Ladinian of Spitsbergen. The genus seems to be a useful guide form for the lowermost Lower Ladinian of the East Arctic Triassic.

Genus *Indigirites* POPOW, 1946

Type species: *Indigirites krugi* POPOW, 1946

Diagnosis: Nathorstitidae with narrow to imperforate umbilicus and acute venter. Highly variable in thickness. Whorl sides may have low radial plications that die out towards the periphery. Growth lines slightly falcoid. Suture lines ceratitic, with phylloid saddles and sharply crenulated lobes.

Range and occurrence: Lower Ladinian of northeastern Siberia, Taymyr Peninsula, British Columbia and Spitsbergen.

Remarks: POPOW (1946) separated this genus on account of its weakly pronounced ribs and the more acute venter from the genus *Nathorstites*. These features, though, which vary very much in the family Nathorstitidae would not permit that separation. As TOZER (1980, p. 417) noticed, 'the course of the growth lines seems to be the most useful taxonomic character'. Another important diagnostic, generic feature is the suture line which clearly is more complicated in *Indigirites* and which lacks the typical bend of the suture line of the genus *Nathorstites*.

Indigirites tozeri n. sp.
(pl. V, figs. 5–8)

1968 *Nathorstites* sp. TOZER, p. 538, p. 27, fig. (A) (c)

Diagnosis: Involute fairly tumid shell with acute venter, triangular whorl section and narrow umbilicus. Growth lines slightly falcoid. With weak spiral strigation. Suture line with phylloid saddles and seven deeply crenulated external lobes.

Holotype: Figured pl. V, figs. 5a, b (SGPIHM no. 2819). We take one of our specimens collected bed by bed and not TOZERs fragmental specimen as the holotype.

Stratum typicum: Upper part of *Daonella* Shales (Botneheia Formation).

Locus typicus: Botneheia, Nordenskjöld Land (Spitsbergen).

Derivatio nominis: In honour of Dr. E. T. TOZER who figured this species for the first time.

Types and dimensions:

Specimen	D	H	W	U
holotype no. 2819	36	19.5 (0.54)	21 (0.58)	3 (0.08)
paratype no. 2820	33,5	20 (0.60)	15 (0.45)	–
paratype no. 2821	45	28.5 (0.63)	16 (0.33)	–
paratype no. 2822	34	20 (0.58)	13 (0.38)	–

Material: About 90 specimens from the upper nodule layer of the *Daonella* Shales at Botneheia (Nordenskjöld Land) and 4 specimens from the same level at Draschedalen (Dickson Land).

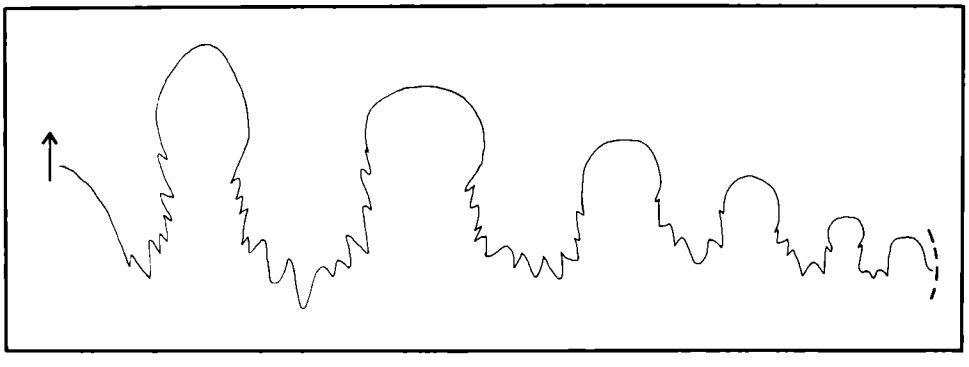
Description: Our collection includes specimens of various growth stages. Most of them are small (20–30 mm in diameter) internal moulds, and nearly all of them show the suture line. The holotype is 36 mm in diameter with partly preserved test and nearly one whorl body chamber. The largest specimen is a phragmocone of 45 mm which shows that adult forms of *Indigirites tozeri* attain a diameter of at least 70 mm.

The paratypes figured on pl. V, figs. 6–8 give a good impression of the extraordinary variation in thickness, ornamentation and the character of the umbilicus of this species. Especially the variation in thickness is remarkable: Specimens exist nearly twice as thick as others at the same diameter. In a smaller sample than ours, without the intermediate forms which we have, the extreme modifications would certainly have been ascribed to different species.

The type of ribbing is also highly variable. Totally smooth specimens exist and others which have low distinct radial folds near the umbilicus dying out in the middle of the whorl. All specimens show low lateral ridges. Referring to the character of the umbilicus there are specimens where it is completely sealed while others are narrow but distinctly umbilicate.

A useful invariable character seems to be the course of the growth lines (see TOZER, 1980, p. 41) and the suture line. The growth lines of *Indigirites tozeri* are fine, slightly falcoid and most conspicuous in the middle of the whorl.

The suture line is composed of 7 external lobes with sharply crenulated bases. The saddles are phylloid and the first lateral saddle is more slender than the following ones. The course of the suture line does not show the characteristic curvation of the Spitsbergen *Nathorstites* of the higher stratigraphic levels.



Text-Fig. 8: *Indigirites tozeri* n. sp. External suture of the holotype at a whorl height of 18 mm. (Spec. no. 2819)

Remarks: The different species of the genus *Nathorstites* described from the Ladinian and ? Carnian strata of Spitsbergen (*N. tenuis* STOLLEY, *N. gibbosus* STOLLEY, *N. lindstroemi* BÖHM, *N. lenticularis* (WHITEAVES), *N. macconelli* (WHITEAVES), and *N. strongulatus* KORCHINSKAYA) are mainly established on the above mentioned varying characters (ribbing, thickness).

Our material from the main '*Nathorstites* level' at Kongressfjellet (Dickson Land) shows that the species of the genus *Nathorstites* are also highly variable in thickness and ribbing. This was already mentioned by FREBOLD (1929, p. 305) and later by TOZER (1961, p. 91; 1980, p. 417). We assume that most of the above mentioned species are extreme modifications of only one or two species.

Age and occurrence: *Indigirites tozeri* is until now only known from the upper nodule layer of the *Daonella* Shales of Spitsbergen, which are dated as Lower Ladinian (zone of *Indigirites tozeri*).

Family **Arcestidae** MOJSISOVICS, 1875

Genus *Proarcestes* MOJSISOVICS, 1893

Remarks: Only one specimen from the upper nodule layer at the Botneheia may be attributed to this genus. Its diameter measures 130 mm, one third of which is occupied by the body chamber. In cross section the whorl is oval; the umbilicus is closed by a callus and body chamber and phragmocone show the constrictions typical of the Arcestidae. The suture line is ammonitic with highly incised lobes and saddles.

Owing to the scarcity of our material we abstain from naming this species.

Dimensions:

Specimen	D	L	W	U
specimen no. 2829	130	79 (0.61)	88 (0.68)	–

Age and occurrence: Representatives of this genus are widespread in the Middle Triassic of the Tethys province. Our specimen from the Lower Ladinian is the first find of the genus in the Arctic Triassic.

Family **Ussuritidae** HYATT, 1900

Genus *Ussurites* HYATT, 1900

Diagnosis (Treatise): Like *Monophyllites* but with simpler suture line. First lateral saddle indented only on ventral side, second lateral saddle on dorsal side.

Type species: *Monophyllites sichoticus* DIENER, 1895.

Range and occurrence: Middle Triassic, worldwide.

Ussurites spetsbergensis (OEBERG, 1877)
(pl. VI, figs. 1–5)

pars 1877 *Ceratites spetsbergensis* OEBERG, p. 14, pl. 4, figs. 1a, b non (1c)
1886 *Monophyllites spetsbergensis* MOJSISOVICS, p. 72, pl. XI, figs. 20–21
1934 *Ussurites (?) spetsbergensis* SPATH, p. 300, pl. X, figs. 1–2

Diagnosis: Fairly large *Ussurites*, compressed and moderately evolute, with well rounded ventrolateral shoulders and arched venter. Ornamentation

composed of fine striae which are nearly straight on the flanks and bend forward across the venter. With characteristical, widely spaced ventrolateral tubercles.

Holotype: *Ceratites spetsbergensis* OEBERG, 1877. Coll. Naturhist. Mus. Paleozool. Avd. Stockholm, no. Mo. 407.

Types and dimensions:

Specimen	D	L	W	U
Holotype Mo. 407	~ 95	39.5 –	26 –	–
specimen no. 2823	67	30 (0.45)	–	22 (0.33)
specimen no. 2824	42.5	18.5 (0.44)	16 (0.38)	13.5 (0.32)
specimen no. 2825	61	27.5 (0.45)	19 (0.31)	19.5 (0.31)
specimen no. 2826	34	15 (0.44)	12 (0.35)	10.5 (0.30)
specimen no. 2827	35	17 (0.49)	12 (0.34)	10.5 (0.30)

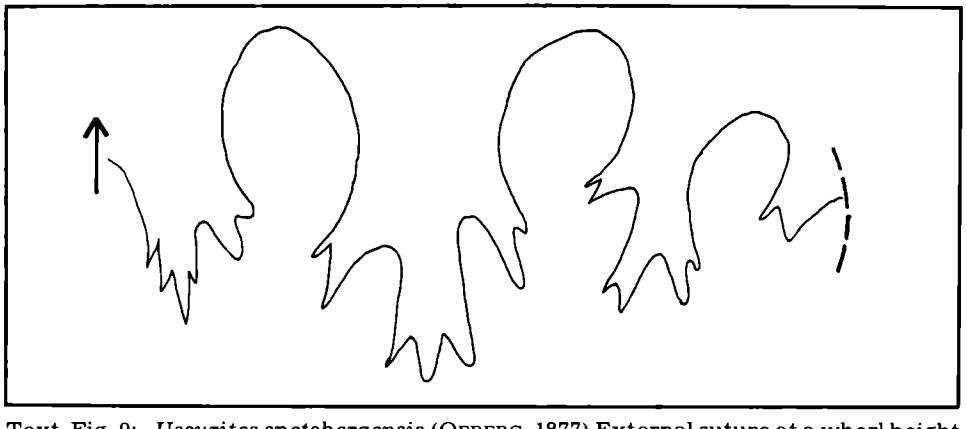
Material: 1 specimen from the lower nodule layer at Flowerdalen (Nordenskjöld Land), 4 specimens from the middle nodule layer, east side of Sauriedalen (Dickson Land), about 250 specimens from the upper nodule layer at the Botneheia and 10 specimens from the upper nodule layer at the north side of Draschedalen.

Remarks: Our sample consists of about 300 specimens in various stages of growth. The body chamber in almost all of them is compressed and measures about 3/4 of a whorl. *U. spetsbergensis* is the only ammonite species which occurs in all of the fossiliferous calcareous nodule layers of the *Daonella* Shales.

The holotype is a badly preserved fragment consisting of two half whorls; they well show the characteristic features of the species, except the suture line. The largest specimen of our collection is a phragmocone, 71 mm in diameter, indicating that adult forms may have reached a diameter of at least about 130 mm.

The large number of our sample shows that this species also is characterized by a wide variation of whorl section, umbilical width, and sculpture – especially in juvenile stages.

The degree of compression was, by former authors, considered to be a specific character within the genus *Ussurites;* we, however, have all transi-



Text-Fig. 9: *Ussurites spetsbergensis* (OEBERG, 1877) External suture at a whorl height of 23 mm. (Spec. no. 2825)

tions from almost circular to highly compressed whorl sections within our material.

The growth lines are rather uniform in shape and intensity. They are very fine, straight on the flanks and cross the venter with a strong forward bend. The ribbing, on the contrary, varies very much. There are all transitions from specimens with distinctly marked straight ribs to completely smooth specimens. A sculptural element characteristic of this species are flat, ventrolateral knots (parabolic nodes) in the number of 3–7 per whorl which may develop into low elevations, several millimeters long, in larger specimens. To our knowledge, knots of this kind have not been described with representatives of the genus *Ussurites*.

The suture line is relatively constant in this species also. The three lateral saddles are phylloid; the first and the second ones are almost equal in size, whereas the third lateral saddle is considerably smaller. The external lobe is relatively wide and short, the lateral lobe is deeply tripartite with few coarse incisions.

Age and occurrence: *Ussurites spetsbergensis* is a relatively rare form in the company of *Aristoptychites* in the *Daonella* Shales of Spitsbergen. In addition, KLUBOV (1965) described this species from Triassic exposures on Barents-Öya and Edge-Öya.

It occurs from the Upper Anisian (*laqueatus*-zone) to the Lower Ladinian (*tozeri*-zone) in Spitsbergen.

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Plates

Plate I
(figures natural size unless otherwise stated)

Fig. 1 a, b: *Aristoptychites trochleaeformis* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation), Vindodden, Nordenskjöld Land, Spitsbergen.
Upper Anisian, Zone of *Frechites laqueatus*. × 0,5 Typ. Cat. no. SGPIHM 2801 (p. 39)

Fig. 2 a, b: *Aristoptychites euglyphus* (MOJSISOVICS, 1886) Isfjorden-Kolonien, *Daonella* Shales (Botneheia Formation), Spitsbergen.
Lower-Ladinian, Zone of *Tsvetkovites varius* n. sp. Lectotype, Riksmuseum Pal. Zool. Avd., Stockholm, no. Mo. 314 a, b. (p. 41)

Fig. 3 a, b: *Aristoptychites euglyphus* (MOJSISOVICS, 1886) Middle nodule layer, *Daonella* Shales (Botneheia Formation), East Side aof Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. Extremely wide variation. (p. 41) Type Cat. no. SGPIHM 2805.

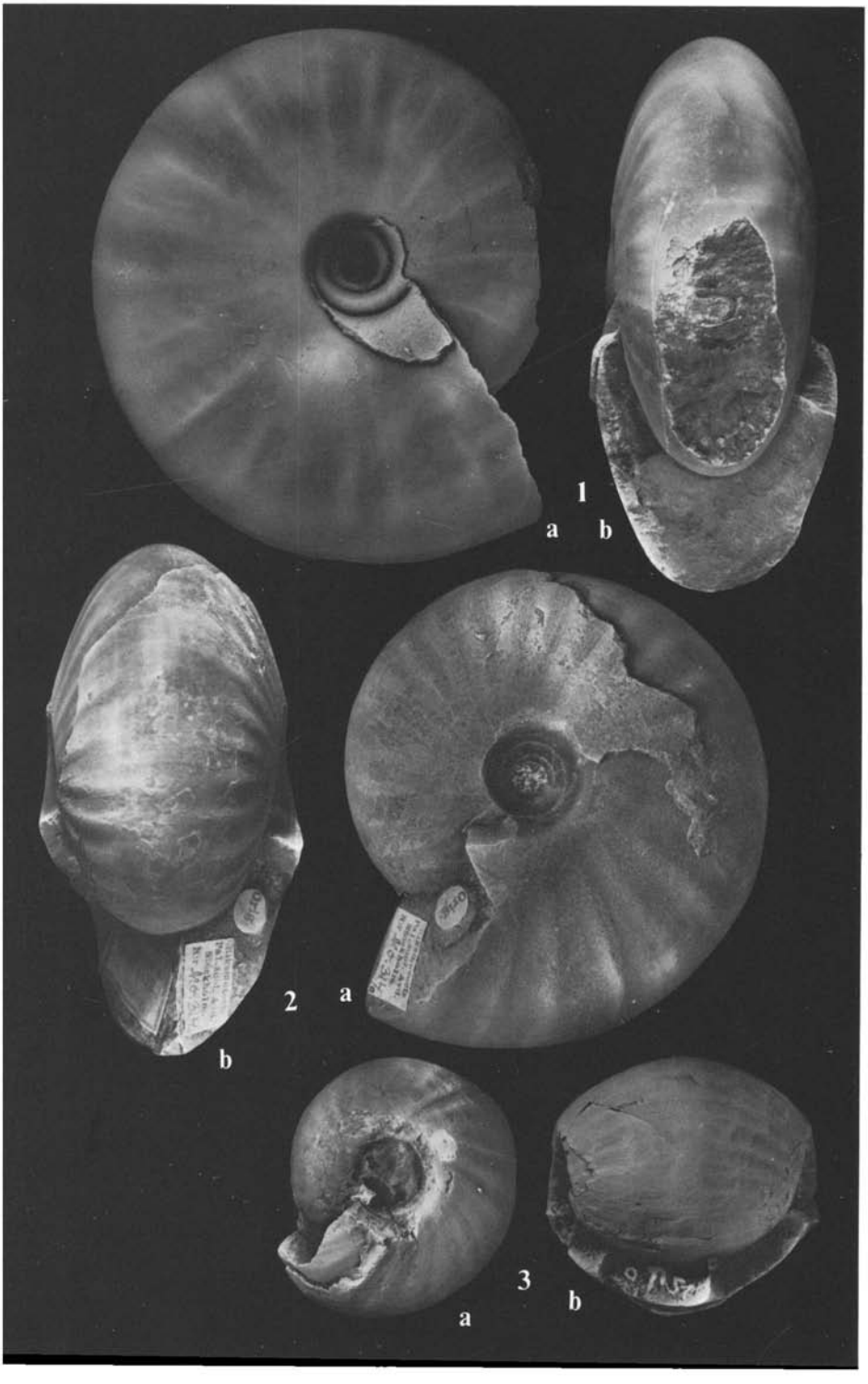
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Plate II
(Figures natural size unless otherwise stated)

Fig. 1 a, b: *Aristoptychites euglyphus* (MOJSISOVICS, 1886) Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. Extremely slender variety. (p. 41) Coll. C. SAMTLEBEN (Kiel)

Fig. 2 a, b: *Aristoptychites euglyphus* (MOJSISOVICS, 1886) Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. (p. 41) Type Cat. no. SGPIHM 2803

Fig. 3 a, b: *Aristoptychites euglyphus* (MOJSISOVICS, 1886) Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. Wide variety. (p. 41) Type Cat. no. SGPIHM 2804

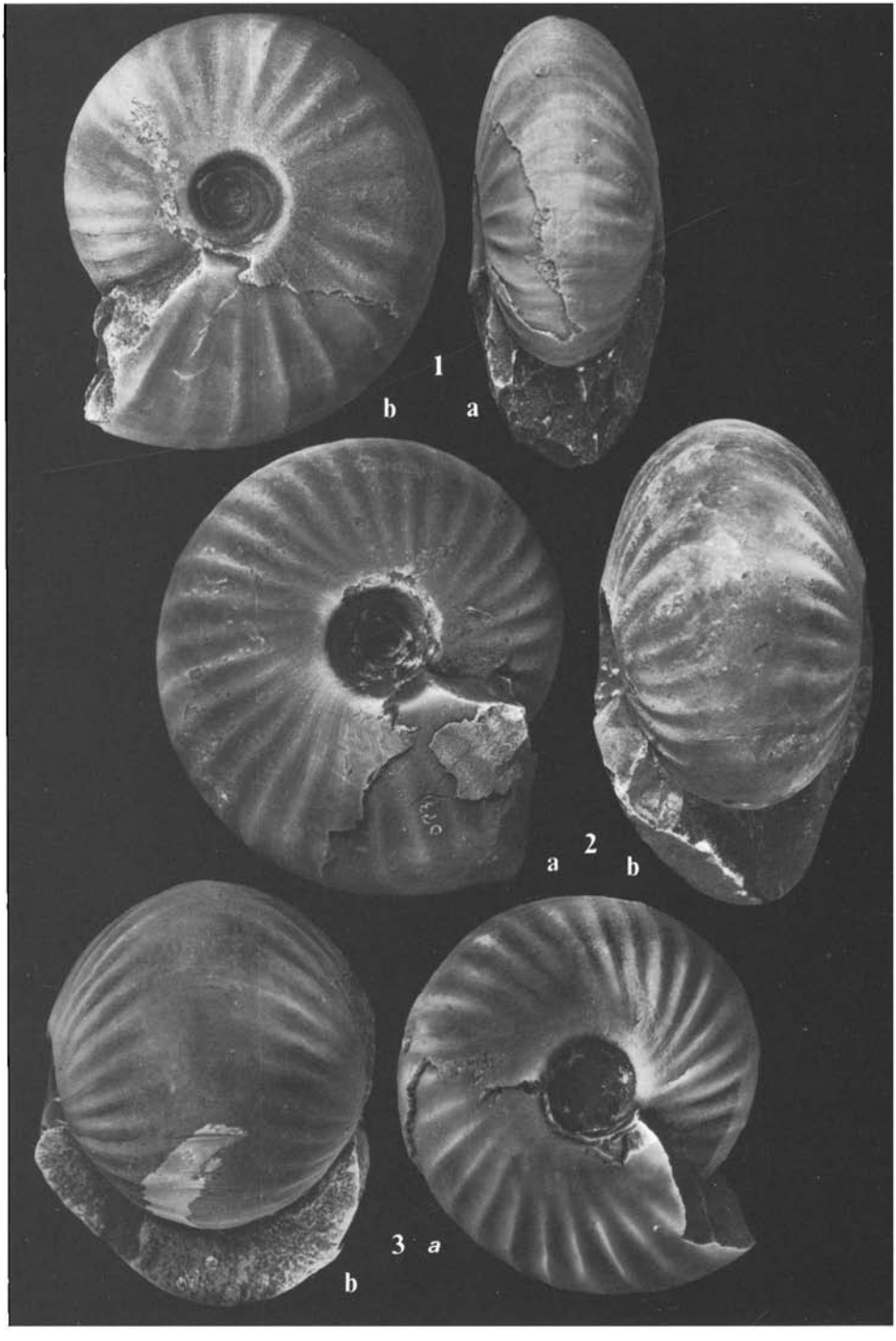
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Plate III
(figures natural size unless otherwise stated)

Fig. 1 a, b: *Aristoptychites kolymensis* (KIPARISOVA, 1937) Upper nodule layer, *Daonella* Shales (Botneheia Formation); north side of Draschedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Slender variety with preserved body chamber. (p. 43) Type Cat. no. SGPIHM 2806

Fig. 2 a, b: *Aristoptychites kolymensis* (KIPARISOVA, 1937) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Intermediate variety. (p. 43) Type Cat. no. SGPIHM 2807

Fig. 3 a, b: *Aristoptychites kolymensis* (KIPARISOVA, 1937) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Slender variety. (p. 43) Type Cat. no. SGPIHM 2808

Fig. 4 a, b: *Aristoptychites kolymensis* (KIPARISOVA, 1937) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Thick variety. (p. 43) Type Cat. no. SGPIHM 2828

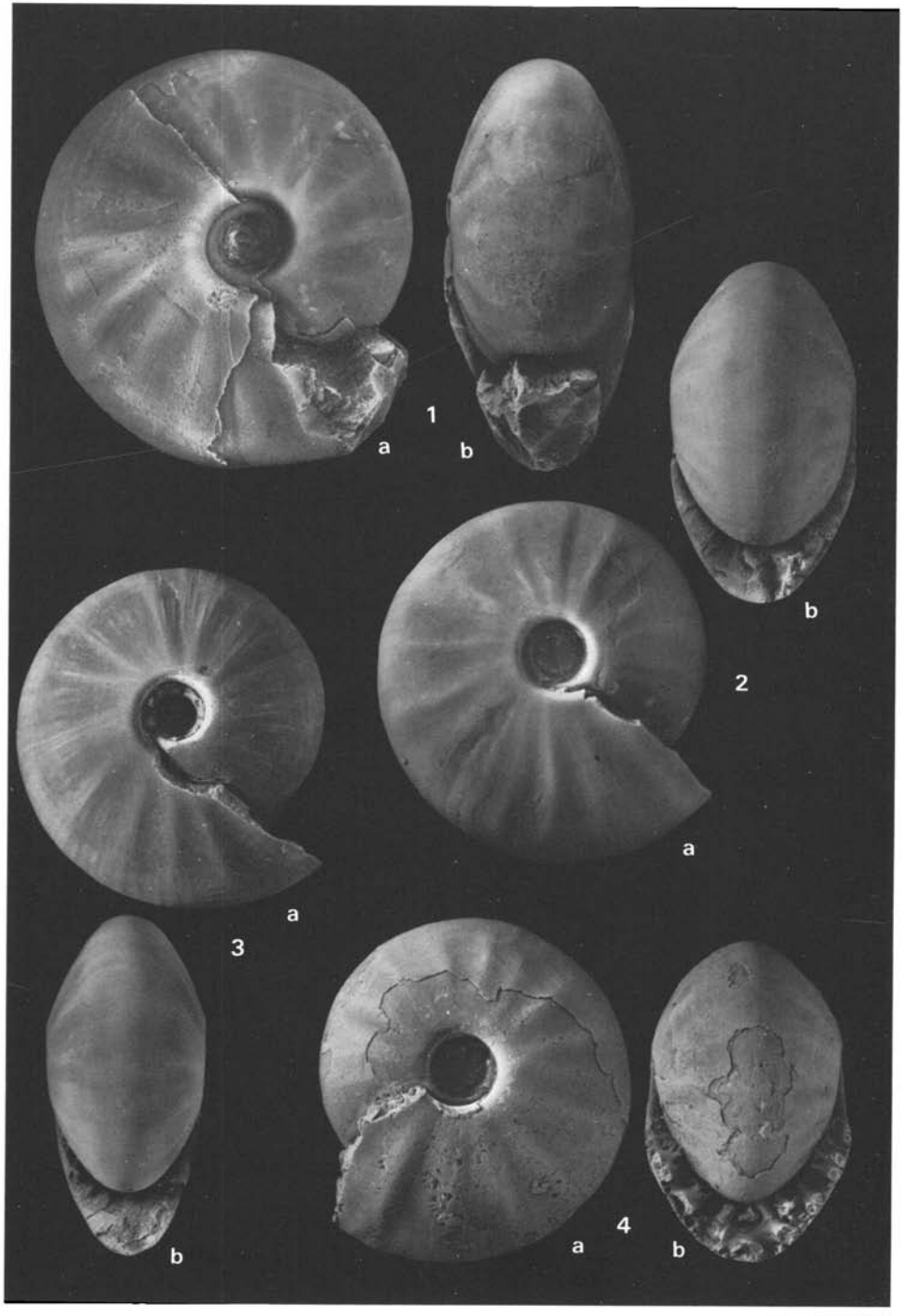
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Plate IV
(figures natural size unless otherwise stated)

Fig. 1 a, b, c: *Parapopanoceras malmgreni* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Upper Anisian, Zone of *Frechites laqueatus*. Specimen with completely preserved body chamber showing the typical change in whorl section in the initial part of the body chamber (p. 44) Type Cat. no. SGPIHM 2809

Fig. 2: *Parapopanoceras malmgreni* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation); Tschermakfjellet (south side), Dickson Land, Spitsbergen.
Upper Anisian, Zone of *Frechites laqueatus*. Specimen with body chamber, showing the constrictions of the peristome. (p. 44) Type Cat. no. SGPIHM 2810

Fig. 3 a, b: *Parapopanoceras malmgreni* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation); Vindodden, Nordenskjöld Land, Spitsbergen.
Upper Anisian, Zone of *Frechites Laqueatus*. Phragmocone with thick well rounded venter. (p. 44) Type Cat. no. SGPIHM 2811

Fig. 4: *Parapopanoceras malmgreni* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation); Vindodden, Nordenskjöld Land, Spitsbergen.
Upper Anisian, Zone of *Frechites laqueatus*. Phragmocone with preserved suture line. (p. 44) Type Cat. no. SGPIHM 2812

Fig. 5 a, b: *Frechites laqueatus* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation); Vindodden, Nordenskjöld Land, Spitsbergen (p. 46)
Upper Anisian, Zone of *Frechites laqueatus*. Type Cat. no. SGPIHM 2813

Fig. 6 a, b: *Frechites laqueatus* (LINDSTRÖM, 1865) Lower nodule layer, *Daonella* Shales (Botneheia Formation); Vindodden, Nordenskjöld Land, Spitsbergen.
Upper Anisian, Zone of *Frechites laqueatus*. Specimen with feeble ribs (p. 46) Type Cat. no. SGPIHM 2814

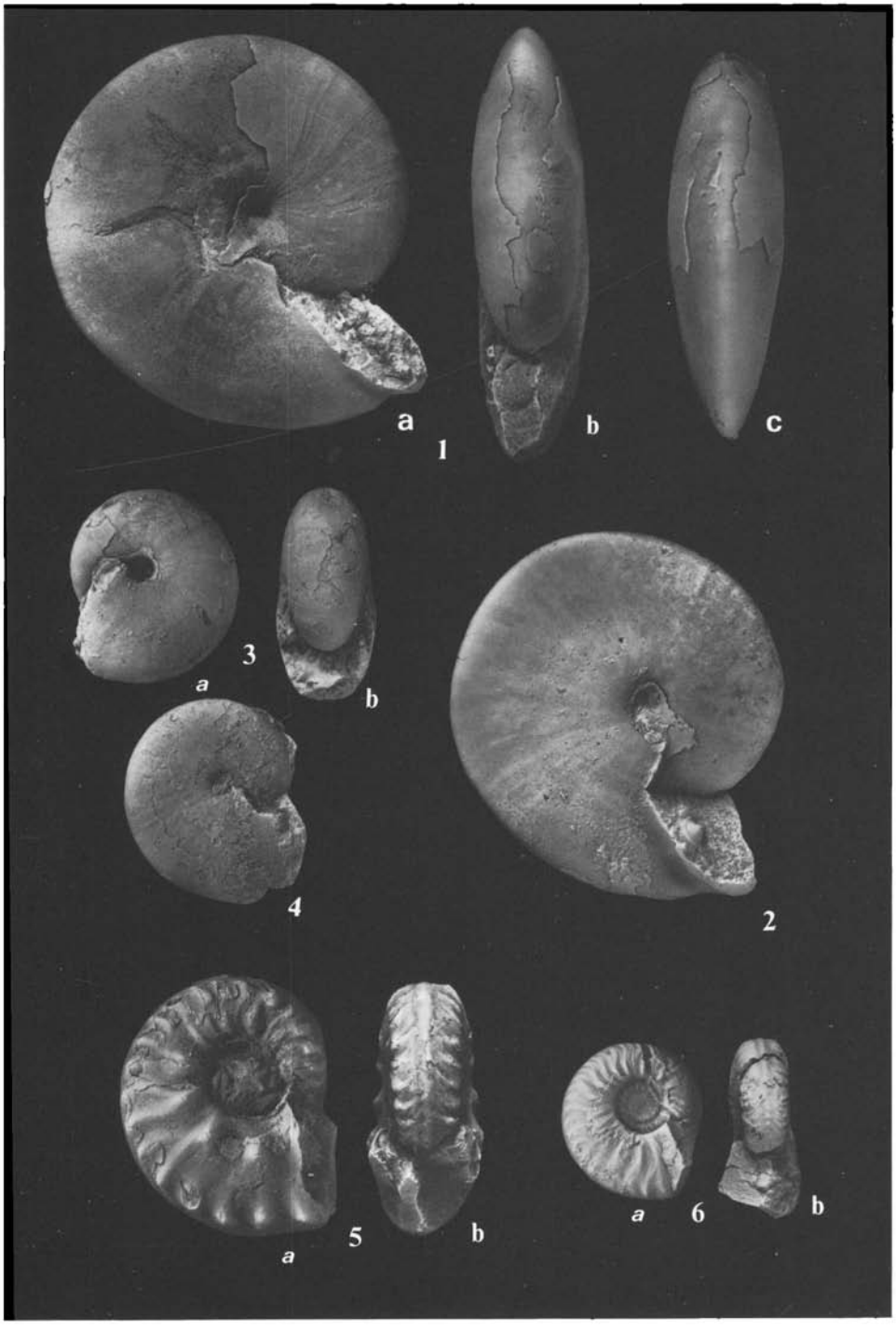
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Plate V
(figures natural size unless otherwise stated)

Fig. 1 a, b: *Tsvetkovites varius* n. sp. Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. Holotype, with preserved triangular body chamber. × 2 (p. 48) Type Cat. no. SGPIHM 2815

Fig. 2 a, b: *Tsvetkovites varius* n. sp. Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen. Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. Paratype, with rounded whorl section. × 2 (p. 48) Type Cat. no. SGPIHM 2816

Fig. 3 a, b: *Tsvetkovites varius* n. sp. Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian. Zone of *Tsvetkovites varius* n. sp. Paratype × 2 (p. 48) Type Cat. no. SGPIHM 2817

Fig. 4 a, b: *Tsvetkovites varius* n. sp. Middle nodule layer, *Daonella* Shales (Botneheia Formation); east side of Sauriedalen, Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Tsvetkovites varius* n. sp. Paratype, juvenile phragmocone, with the broadly rounded tricarinate bisulcate venter. × 2 (p. 48) Type Cat. no. SGPIHM 2818

Fig. 5 a, b: *Indigirites tozeri* n. sp. Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Holotype, relatively thick variety, with $^3/_4$-whorl body chamber and partly preserved test. (p. 49) Type Cat. no. SGPIHM 2819

Fig. 6 a, b: *Indigirites tozeri* n. sp. Upper nodule layer, *Daonella* Shales (Botneheia Formation); Draschedalen (north side), Dickson Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp., Paratype, with well visible growth lines and sealed umbilicus. (p. 49) Type Cat. no. SGPIHM 2820

Fig. 7 a, b: *Indigirites tozeri* n. sp. Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp., Paratype, phragmocone with slender whorl proportions and sharpened venter. (p. 49) Type Cat. no. SGPIHM 2821

Fig. 8 a, b: *Indigirites tozeri* n. sp. Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Paratype, phragmocone with intermediate whorl proportions. (p. 49) Type Cat. no. SGPIHM 2822

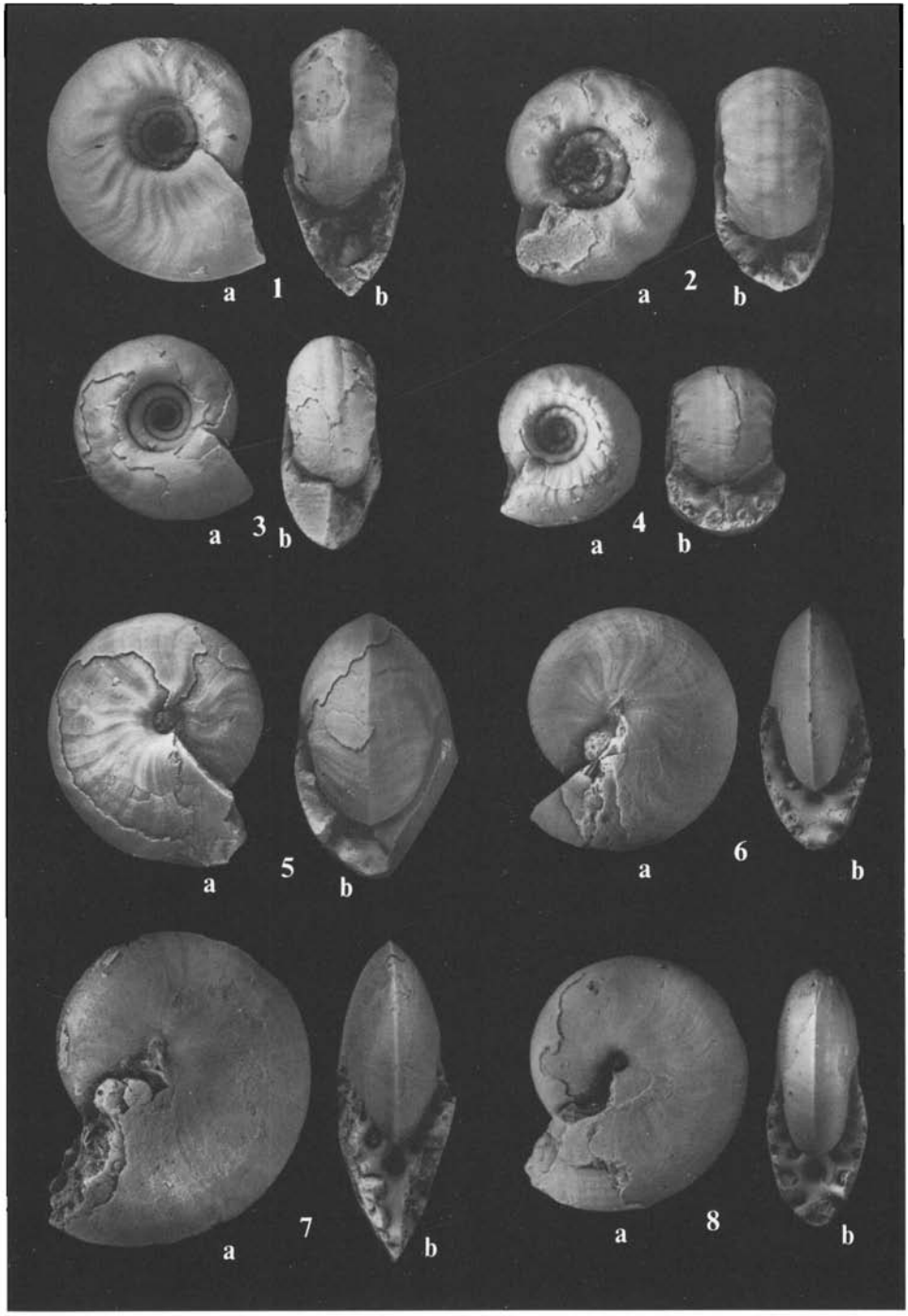
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Plate VI
(figures of natural size unless otherwise stated)

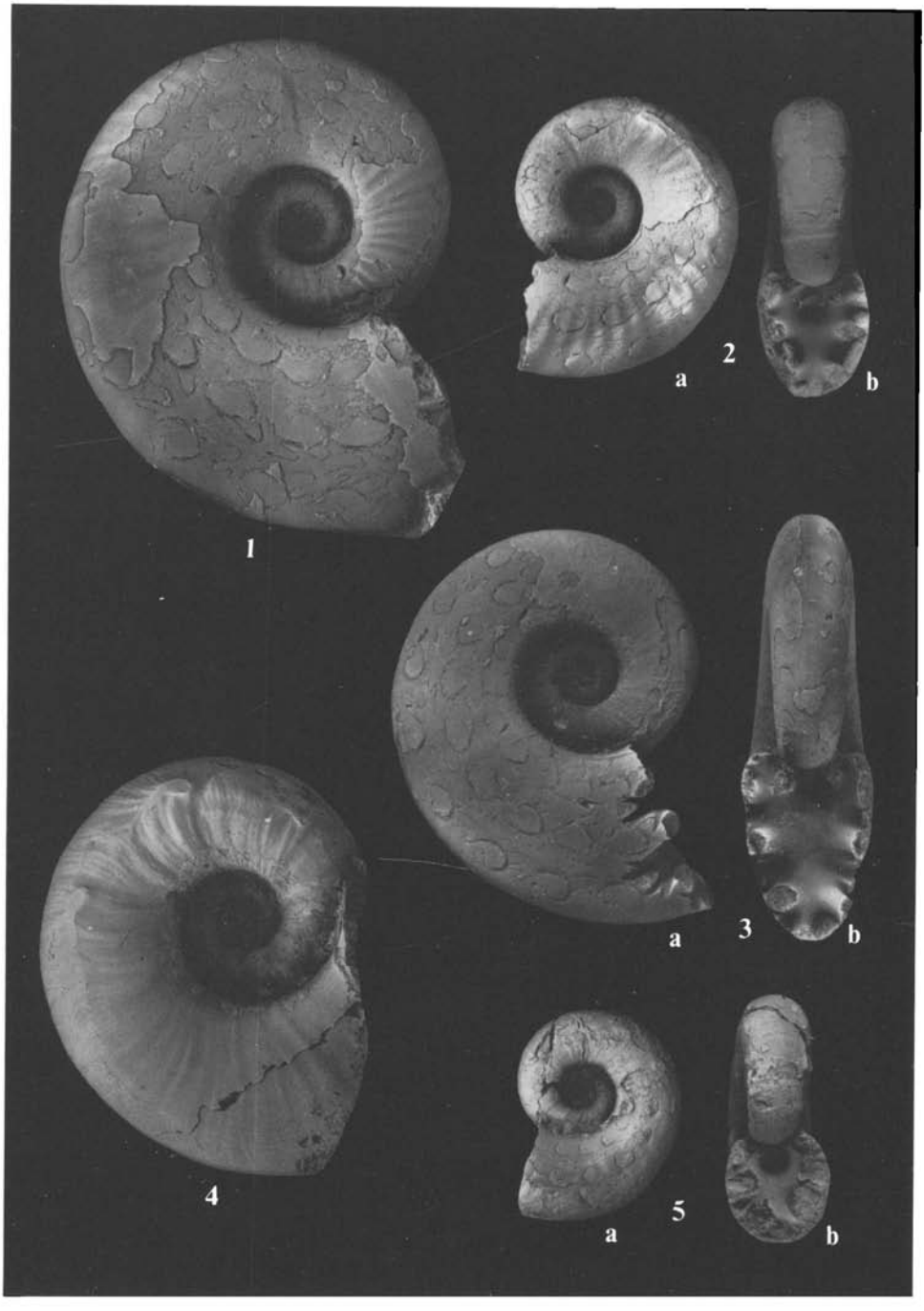
Fig. 1: *Ussurites spetsbergensis* (OEBERG, 1877) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Specimen with partly preserved test. (p. 51) Type Cat. no. SGPIHM 2833

Fig. 2 a, b: *Ussurites spetsbergensis* (OEBERG, 1877) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Phragmocone with slightly compressed whorl proportion (p. 51) Type Cat. no. SGPIHM 2824

Fig. 3 a, b: *Ussurites spetsbergensis* (OEBERG, 1877) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen. Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Phragmocone with strongly compressed whorl proportion. (p. 51) Type Cat. no. SGPIHM 2825

Fig. 4: *Ussurites spetsbergensis* (OEBERG, 1877) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Specimen, showing the characteristic ventrolateral knots (parabolic nodes). × 2 (p. 51) Type Cat. no. SGPIHM 2826

Fig. 5 a, b: *Ussurites spetsbergensis* (OEBERG, 1877) Upper nodule layer, *Daonella* Shales (Botneheia Formation); Botneheia, Nordenskjöld Land, Spitsbergen.
Lower Ladinian, Zone of *Indigirites tozeri* n. sp. Phragmocone with nearly rounded whorl section. (p. 51) Type Cat. no. SGPIHM 2857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