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BULLETIN 375

**UPPER LOWER AND LOWER MIDDLE DEVONIAN
CHONETACEAN BRACHIOPODS FROM
BATHURST, DEVON AND ELLESMERE ISLANDS,
CANADIAN ARCTIC ARCHIPELAGO**

P.R. Racheboeuf

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PREFACE

Chonetacean brachiopods are described in detail from Lower to Middle Devonian strata of the Blue Fiord and Bird Fiord formations on Bathurst, Devon, and Ellesmere islands. This is the first comprehensive study of Devonian chonetaceans from the Canadian Arctic Archipelago. It provides taxonomic descriptions of one new genus and ten new species. The biostratigraphic significance of the fauna is considered and a comparison made with established conodont zonation, leading to a tentative correlation.

Such detailed taxonomic and biostratigraphic studies are invaluable for providing a better understanding of the stratigraphic complexity of the economically important Paleozoic rocks of the Arctic Islands, and help to refine the methods used in assessing the hydrocarbon potential of these rocks.

R.A. Price
Acting Assistant Deputy Minister
Geological Survey of Canada

PRÉFACE

Les brachiopodes chonétacéens sont décrits en détail à partir des strates du Dévonien inférieur au Dévonien moyen appartenant aux formations de Blue Fiord et de Bird Fiord des îles Bathurst, Devon et Ellesmere. C'est la première étude globale des brachiopodes chonétacéens de l'archipel Arctique canadien. Ce travail de recherches apporte des descriptions taxonomiques pour un nouveau genre et pour dix nouvelles espèces. L'interprétation biostratigraphique de la faune est prise en considération et on a établi une comparaison en regard d'une zonation de conodontes bien reconnue donnant prise à une tentative de corrélation.

Ces études taxonomiques et biostratigraphiques détaillées revêtent une grande valeur pour une meilleure compréhension de la complexité stratigraphique des roches paléozoïques économiquement importantes de l'archipel Arctique et sont d'une aide précieuse dans le raffinement des méthodes utilisées pour l'estimation du potentiel d'hydrocarbures de ces roches.

R.A. Price
Le sous-ministre adjoint intérimaire de la
Commission géologique du Canada

CONTENTS

1	Abstract/résumé
2	Introduction
2	Acknowledgments
2	Materials studied
2	Previous chonetid investigations
3	Biostratigraphy
5	Paleogeographic affinities
5	Systematic paleontology
6	Family Strophochonetidae
6	<i>Philippotia (Philippotia) briceae</i> sp. nov.
6	<i>Philippotia? (Chlupacina)</i> sp.
7	<i>Johnsonetes ellesmerensis</i> gen. et sp. nov.
8	<i>Johnsonetes arcticus</i> gen. et sp. nov.
9	Family Anopliidae
9	<i>Caplinoplia rectispina</i> (Khalfin)?
10	Family Chonetidae
10	Subfamily Devonochonetinae
10	<i>Devonochonetes? maclareni</i> sp. nov.
11	<i>Sinochonetes wangi</i> sp. nov.
12	<i>Sinochonetes</i> sp. nov. aff. <i>S. wangi</i> sp. nov.
13	Subfamily Dagnachonetinae
13	<i>Dagnachonetes (Dagnachonetes) quietus</i> sp. nov.
14	<i>Dagnachonetes? grinnellensis</i> sp. nov.
14	<i>Dagnachonetes? pordenensis</i> sp. nov.
15	Subfamily Parachonetinae
15	<i>Parachonetes macrostriatus</i> (Walcott)
16	Family Chonostrophiidae
16	<i>Chonostrophiella cynthiae</i> sp. nov.
17	References

Illustrations

Figures

3	1. Index map of Canadian Arctic Archipelago, showing fossil localities.
5	2. Vertical distribution of chonetacean species from the Blue Fiord and Bird Fiord formations.
9	3. Scatter diagram for <i>Johnsonetes arcticus</i> gen. et sp. nov.
10	4. Scatter diagram for <i>Caplinoplia rectispina</i> ?
11	5. Scatter diagram for <i>Devonochonetes? maclareni</i> sp. nov.
12	6. Scatter diagram for <i>Sinochonetes wangi</i> sp. nov.
13	7. Scatter diagram for <i>Dagnachonetes (Dagnachonetes) quietus</i> sp. nov.
15	8. Scatter diagram for <i>Dagnachonetes? pordenensis</i> sp. nov.
16	9. Scatter diagram for <i>Chonostrophiella cynthiae</i> sp. nov.

Plates

20	1-5. Illustrations of fossils.
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UPPER LOWER AND LOWER MIDDLE DEVONIAN CHONETACEAN BRACHIOPODS
FROM BATHURST, DEVON AND ELLESMERE ISLANDS,
CANADIAN ARCTIC ARCHIPELAGO

Abstract

Brachiopods of the Superfamily Chonetacea from the Canadian Arctic Archipelago, which are described and illustrated here, were collected mainly by Brice in 1971 and 1972. All the material is from Emsian strata of the Blue Fiord and Bird Fiord formations on Bathurst, Devon and Ellesmere islands. All the well documented citations in the literature on arctic Devonian chonetids are revised and discussed in order to get as complete a view as possible of the superfamily in the area studied. The present work is the first comprehensive contribution to the knowledge of Devonian chonetacean brachiopods from the Canadian Arctic Archipelago. Thirteen species are described and their biostratigraphic value is established and compared with the conodont zonation.

The taxa identified are: *Philippotia (Philippotia) briceae* sp. nov., *Philippotia?* (*Chlupacina*) sp., *Johnsonetes ellesmerensis* gen. et sp. nov., *J. arcticus* gen. et sp. nov., *Caplinoplia rectispina* (Khalfin?), *Devonochonetes? maclareni* sp. nov., *Sinochonetes wangi* sp. nov., *Sinochonetes* sp. nov. aff. *S. wangi* sp. nov., *Dagnachonetes quietus* sp. nov., *Dagnachonetes? grinnellensis* sp. nov., *Dagnachonetes? pordenensis* sp. nov., *Parachonetes macrostriatus* and *Chonostrophiiella cynthiae* sp. nov.

Paleogeographic affinities of the arctic Devonian chonetid faunas with those of the Old World Realm are very strong. The same species, or very closely related ones, occur in western Siberia (Altaï), in Bohemia, China, Australia, and, in North America, in Nevada and the Yukon. The arctic occurrence of the genus *Chonostrophiiella* has led to a re-evaluation of the paleogeographic significance of the genus and indicates an affinity with the Eastern Americas Realm.

Résumé

Les Brachiopodes de la Superfamille Chonetacea de l'Archipel Arctique canadien qui sont décrits et figurés dans ce travail, ont été récoltés, pour l'essentiel, par Brice en 1971 et 1972. Le matériel provient de couches d'âge zlichovien-dalejien des Formations de Blue Fiord et de Bird Fiord, des îles Bathurst, Devon et Ellesmere. Toutes les références bien documentées se rapportant aux Chonetacés arctiques dévoniens sont révisées et discutées pour obtenir une vue aussi complète que possible de la superfamille dans la région considérée. Ce travail est le premier consacré aux Brachiopodes Chonetacés de cette partie du monde. 13 espèces sont décrites; la distribution verticale des espèces est établie mais demeure provisoire; la valeur biostratigraphique des Chonetacés est mise en évidence et comparée aux zones de Conodontes.

Philippotia (Philippotia) briceae sp. nov., *Philippotia?* (*Chlupacina*) sp., *Johnsonetes ellesmerensis* gen. et sp. nov., *J. arcticus* gen. et sp. nov., *Caplinoplia rectispina* (Khalfin?) *Devonochonetes? maclareni* sp. nov., *Sinochonetes wangi* sp. nov., *Sinochonetes* sp. nov. aff. *S. wangi* sp. nov., *Dagnachonetes quietus* sp. nov., *Dagnachonetes? grinnellensis* sp. nov., *D.? pordenensis* sp. nov., *Parachonetes macrostriatus*, et *Chonostrophiiella cynthiae* sp. nov. sont décrits et figurés.

Les affinités de ces faunes avec celles de la Province du Vieux Monde sont très nettes, des espèces communes ou très proches sont connues dans l'ouest de la Sibérie (Altaï), en Bohême, en Chine, Australie et, en Amérique du Nord, dans les États du Nevada et du Yukon notamment. La présence du genre *Chonostrophiiella* conduit à reconsidérer la signification paléogéographique du genre et témoigne de relations avec le Domaine Nord-est américain.

INTRODUCTION

Most of the material studied was collected during two expeditions to the Canadian Arctic Archipelago by Brice (summer, 1971), and Brice and Meats (summer, 1972). The present work, restricted to the brachiopods of the superfamily Chonetacea, is a continuation of the study by Brice (1982) of pentamerid, rhynchonellid and spiriferid brachiopods from the Blue Fiord and Bird Fiord formations.

Thirteen species are described from the Blue Fiord and Bird Fiord formations, mainly from Devon and Ellesmere islands. In this study, the superfamily Chonetacea shows a greater diversity than previously known. Comparisons and discussions have been added to the systematic description of each species, and the biostratigraphic range of each taxon has been tentatively established according to the available data.

Acknowledgments

The writer is greatly indebted to D. Brice (Lille, France) for suggesting this study as a result of her work on GSC project 710031, to B.S. Norford for authorizing this contribution, and E.W. Bamber for permitting the preparation of specimens from GSC collections. The author is also indebted to C. Babin, D. Brice, P. Copper, J.G. Johnson, A.C. Lenz and A.W. Norris for critically reading the manuscript and offering helpful suggestions.

Material studied

More than 800 specimens from 52 localities were studied. Most of them were collected by Brice, in 1971, and Brice and Meats in 1972. Some material was collected by Kerr, Klapper, McLaren, Norris and Pedder during Operation Franklin, and later. The geographic locations of GSC localities are summarized in Figure 1; areas that yielded chonetids and that are referred to in the text are also given.

Although abundant, the material was not easy to study. It was difficult to examine the internal structures because many specimens were incomplete, poorly silicified, or had both valves connected. In addition, the biostratigraphic results obtained cannot be considered as definitive because a species common in one locality may be rare elsewhere. For these reasons the present work will have to be supplemented by further investigations.

For each species, dimensions (in mm) are given for some specimens; when the material is abundant a diagram is included to show the most important biometric characters for each taxon.

Previous chonetid investigations

In the literature dealing with Devonian faunas from the Canadian Arctic Archipelago, many papers have referred to chonetacean brachiopods. Most of these brachiopods have been only tentatively assigned to genera, and at the specific level all references but one have been left in open

nomenclature. Only the most significant references, which are illustrated or well documented, are listed below.

In the first monograph about Devonian brachiopods from Ellesmere Island, Meyer (1913) described and illustrated *Chonetes lineatus* Conrad from the locality at Brönden, stage Dg of Schei (1903), which is now known to belong to the Bird Fiord Formation. Unfortunately, the original specimens are missing from the author's collection (D. Bruton, pers. comm.).

Thorsteinsson and Tozer (1962) listed *Chonetes* sp. from an isolated outcrop of the Blue Bird Formation (GSC loc. 40796), southwest of Armstrong Point on Victoria Island. Until now, this has been the only reference to a chonetacean from this arctic island.

The first reliable information about arctic Devonian chonetids is by McLaren (in Fortier et al., 1963). Five species are listed: *Chonetes* cf. *C. billingsi* Clarke from the Stuart Bay Formation (basal pebble beds) on Bathurst Island; *Chonetes* sp. A, *Chonetes* sp. B and *Chonetes* sp. from the Blue Fiord Formation on Bathurst, Devon and Ellesmere islands; and *Chonetes* sp. from the Okse Bay Formation of South Cameron Island. No chonetids are recorded from the Bird Fiord Formation.

During the 1970's, several descriptions and illustrations were published. Lenz (1973) illustrated as *Strophochonetes* sp. two pedicle valves from a near-reef Lochkovian brachiopod fauna belonging to the *Quadrithyrus* Zone in the central-eastern part of Bathurst Island, but its position within the Stuart Bay Formation could not be given precisely.

From the Disappointment Bay Formation on Lowther Island, Johnson (1975) identified *Parachonetes*? sp. from the middle member of the formation (GSC loc. C-2682), and *Chonetes* sp. A, C. sp. B and C. sp. C from a higher level in the same member (GSC loc. C-3217).

Uyeno and Mason (1975, p. 714) listed *Parachonetes* aff. *P. macrostriatus* from the base of the Stuart Bay Formation (260 m above the base) in the northeastern part of Bathurst Island (Emsian).

In 1980, Jones and G.P. Smith illustrated *Parachonetes*? sp. from the upper part of the Eids Formation in southwest Ellesmere Island and, in the same year, R.E. Smith was the first to describe a new arctic chonetid, *Asymmetrochonetes spinalonga*, from the Lochkovian of Prince of Wales Island.

Parachonetes sp. cf. *P. macrostriatus* was described by Pedder (1982a) from the Blue Fiord Formation, 16 km west of the head of Sör Fiord (GSC loc. C-12498) on Ellesmere Island.

Perry and Lenz (1978, p. 142) compiled a list of Emsian brachiopod genera from the Canadian Arctic; four genera of chonetids were listed: "*Chonetes*", *Parachonetes*, "*Protochonetes*" and "*Strophochonetes*". The authors reported that "Genera listed in quotation marks are probable new genera but closely related to the genus in question" (p. 143).

It was difficult to establish the conspecificity of these figured specimens with the species described here. However, in some instances, it is clear that some of the specimens listed as *Parachonetes* cf. (or aff.) *macrostriatus* undoubtedly are *P. macrostriatus*. In some instances, pedicle valves figured as *Strophochonetes* sp. by Lenz (1973) possibly belong to *Asymmetrochonetes spinalonga* Smith, 1980.

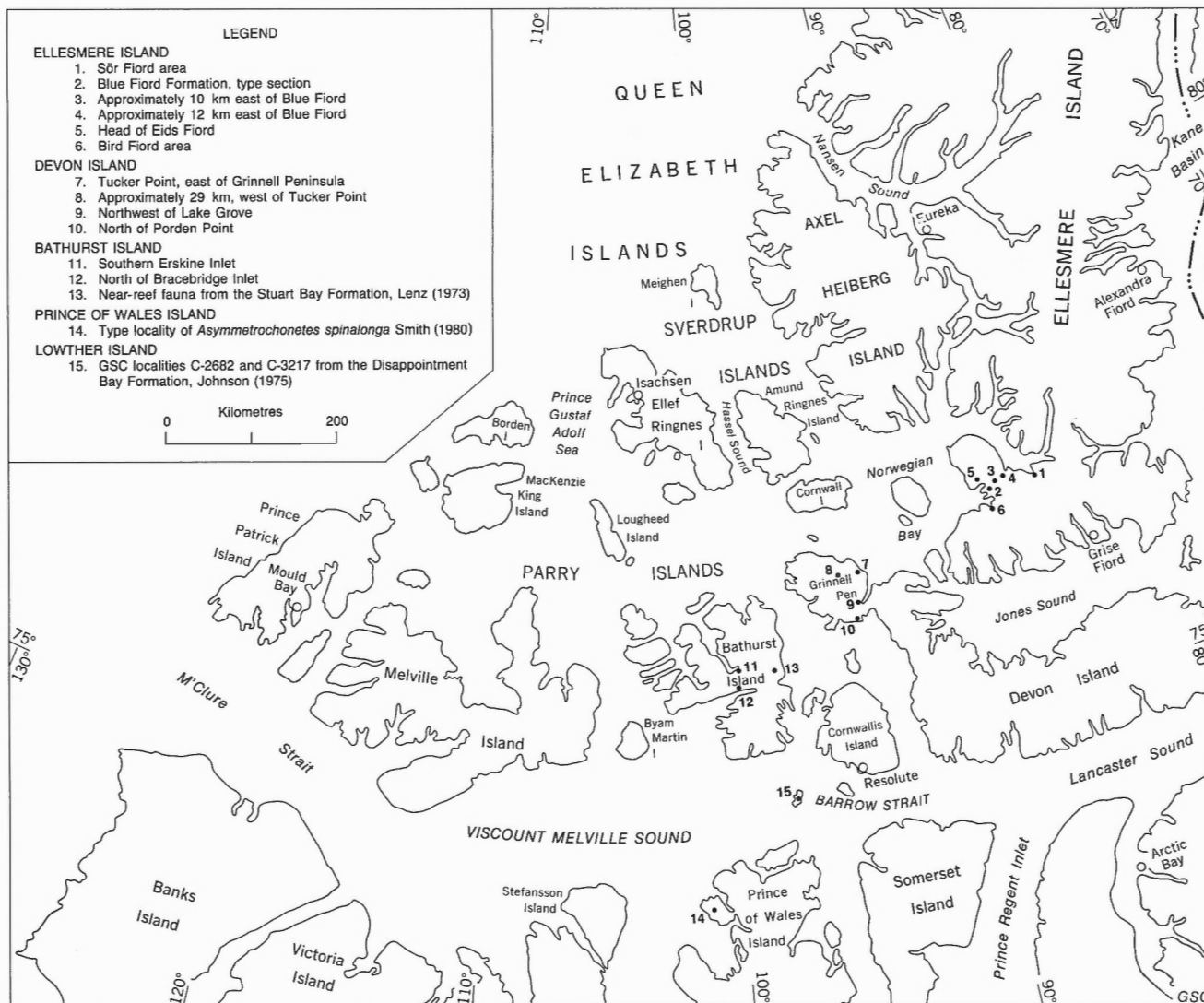


Figure 1. Index map of the Canadian Arctic Archipelago showing localities and areas yielding chonetids mentioned in the text.

BIOSTRATIGRAPHY

Historical and detailed information about localities, sections and rock types are given in Brice (1982, p. 4-15). As the present work concerns the same area and stratigraphic interval, this information is not repeated here.

The ages assigned to the different faunas were mainly established by correlating arctic faunas with those from Nevada. In this way, Brice assigned an Emsian (late?) age to the lower and middle part of the lower Blue Fiord Formation by comparison with the *Eurekaspirifer pinyonensis* Zone and *Elythyra* beds from Nevada. The upper part of the Lower member and the lower Upper member of the Blue Fiord Formation were at that time considered to be Eifelian in age by comparison with the *Leptathyris circula* Zone and the lower *Warrenella kirki* Zone of Nevada. The uppermost Blue Fiord Formation and the Bird Fiord Formation were referred to the Eifelian, while the upper Bird Fiord Formation could locally be late Eifelian or Givetian in age (Brice, 1982, p. 23).

Since Brice completed her work, more up-to-date biostratigraphic data have become available. Progress in paleontological investigations, mainly on brachiopods and conodonts, from the Arctic Archipelago and northwestern Canada has shown that such correlations are not tenable. Discussions have been published in several recent papers, from which some results are outlined below.

Weyant (1975a) established that the beds 550 m above the base of the Blue Fiord Formation in southwest Ellesmere Island are of Emsian age, as they yielded conodonts characteristic of this age.

Pedder and Klapper (1977, p. 231, 233) established a correlation between the Cranswick Formation (Yukon), the lower Blue Fiord Formation as developed at Sör Fiord (southwest Ellesmere Island), the Stuart Bay Formation on Bathurst Island, and the Disappointment Bay Formation on Lowther Island, on the basis of the *inversus* Zone. This takes into account the fact that the fauna studied by Johnson (1975) from GSC locality C-2682 on Lowther Island is older than the *Elythyra* fauna from Nevada (Perry and Lenz, 1978, p. 153).

Johnson (1977), and Johnson, Klapper and Trojan (1980), established correlations between the brachiopod assemblages and conodont zones in central Nevada. The chart by Johnson et al. (1980, Fig. 5) shows clearly that *Eurekaspirifer pinyonensis* begins in the upper *dehiscens* Zone, while the *Elythyna* fauna is equivalent to the lower *serotinus* Zone (i.e. faunal intervals 10 to 14 are of Zlichovian-Dalejan age).

Several significant papers concerning the Blue Fiord Formation have been recently published by Pedder (1982a, b), and Pedder et al. (1983).

In the Sør Fiord area, the lowest 28 m of the Blue Fiord Formation must be referred to the *dehiscens* Zone (= early Zlichovian) (GSC loc. C-12501). In the Sør Fiord section the interval 180.2-181.5 m above the base of the formation (GSC loc. C-12424) yields *Polygnathus* aff. *P. perbonus* (= Zlichovian) (Pedder, 1982a, p. 78, 80). In the Sør Fiord section, Pedder and McLean (1982, p. 58) report that *Polygnathus inversus* ranges from 293 to 916 m above the base, and that *P. serotinus* is known from 916 to 1045 m above the base of the same section. The overlapping of *inversus* and *serotinus* in the sample from the 916 m level is diagnostic of the basal part of the *serotinus* Zone, according to Klapper and Ziegler (1979).

Pedder (1983, p. 233) confirmed the Dalejan age of the upper part of the Blue Fiord Formation, from 148.6 m below the top of the formation (*serotinus* Zone), in the Sør Fiord section.

On southwestern Ellesmere Island, in the Goose Fiord and Blubber Point areas, unit 3 of the Bird Fiord Formation has been assigned a late *serotinus* Zone or *patulus* Zone age (late Dalejan by Pedder and Goodbody [1983, p. 337]).

On southwestern Ellesmere Island, the *dehiscens* Zone apparently ranges from the Upper Eids Formation up to 140 m above the base of the Blue Fiord Formation (Uyeno and Klapper, 1980, p. 83). These strata overlie a coral fauna which is early Zlichovian in age (Pedder and Smith, 1983); the Zlichovian there is possibly 600 m thick.

Northwest of Vendom Fiord, the Blue Fiord Formation must be referred to the *serotinus* Zone (Dalejan) up to 311 m above its base (i.e. 58 m below the top) (Pedder, 1983, p. 233). In the Blubber Point area, the Bird Fiord Formation, up to 385 m above the base, belongs to the *serotinus* Zone or younger, probably Dalejan (Pedder, 1983, p. 89).

As most of the chonetid taxa are new species, the superfamily Chonetacea does not provide much biostratigraphic data (Fig. 2). However, by correlation with other stratigraphically well documented areas, several points may be emphasized that seem to agree well with recent data based on conodonts and brachiopods.

The lowest chonetid fauna recognized in the Sør Fiord area of Ellesmere comprises *Caplinoplia rectispina* (Khalfin?), *Sinochonetes wangi* sp. nov. and *Parachonetes macrostriatus*. The first species is apparently known only from the U.S.S.R. Altaï Region, from the Kondratiev Beds, in which it occurs together with *Leptaenopyxis bouei* (Khalfin, 1948, 1955, 1960). In Bohemia, *L. bouei* is confined to the Koneprusy and Zlichov limestones (Havlíček, 1967), corresponding to the Pragian-Zlichovian.

Until now, the genus *Sinochonetes* was known only by its type species, *Chonetes minutisulcatus*, from the Siegenian of the South China region (Wang, Boucot and Rong, 1981). The species described here, *Sinochonetes wangi* sp. nov., has

much finer radial ornamentation; in terms of chonetid evolution, this character could presumably be early (?) Emsian in age.

Parachonetes macrostriatus is stratigraphically more important, but somewhat difficult to use; even if the arctic specimens are conspecific with the species described by Walcott and re-illustrated by Johnson (1966, 1970), most of the citations in the literature are in faunal lists, often under open nomenclature. Only illustrated references will be used here.

In Nevada, *Parachonetes macrostriatus* appears in the *Acrospirifer kobejana* Zone and is present in the *Eurekaspirifer pinyonensis* Zone (Johnson, 1970, p. 136), referred to the Emsian. In the Yukon Territory, Perry et al. (1974, p. 1094) recorded the species from one locality of the Cranswick Formation (79.2 m below the contact with the Ogilvie); this formation had been assigned to the Emsian. Lenz (1977) described and illustrated *P. macrostriatus* from the Royal Creek area and indicated that the species is apparently confined to Zlichovian strata.

Parachonetes? sp. illustrated by Johnson (1975, Pl. 4, figs. 3, 4) from the Disappointment Bay Formation on Lowther Island (GSC loc. C-2682) is certainly *P. macrostriatus*. According to Uyeno, in Pedder and Klapper (1977, p. 233), GSC locality C-2682 yields *Polygnathus inversus*, together with *Carinata lowtherensis* (cf. Johnson and Boucot, 1972) and *Parachonetes?* sp. This confirms that *P. macrostriatus* is confined to the Zlichovian.

It is not clear whether the specimens named as *Parachonetes?* sp. by Jones and Smith (1980) from the upper part of the Eids Formation on southwest Ellesmere Island belong to *P. macrostriatus*. Such an assignment appears to be likely and, if it is correct, the age assigned by the two authors to localities E, F, and G (middle to late Zlichovian or early Dalejan) should be younger.

In the Sør Fiord area, the lowest 28 m of the Blue Fiord Formation have been assigned to the *dehiscens* Zone (= early Zlichovian) (Pedder, 1982a). The uppermost part of the formation is Dalejan in age (because of the appearance of *P. serotinus* between 905.9 and 914 m above the base). In this area, *P. macrostriatus* is actually known from 34.5 to 183 m above the base of the formation. According to data from conodonts, these strata are Zlichovian in age and the vertical range of the species agrees with that established in the Yukon Territory as well as on Lowther Island.

Outside the Sør Fiord area, and among the material available, *P. macrostriatus* has been found in the Blue Fiord area, at 193 m above the base of the Blue Fiord Formation (GSC loc. C-21867). It has also been found on Devon Island in an area northwest of Grove Lake (southeast Grinnell Peninsula) at about 15 m above the contact with the Prince Albert Formation (GSC loc. C-10262). Although the vertical distribution of the species remains poorly known in these areas, its presence is indicative of a Zlichovian age and a correlation can be tentatively established at the top of the range of *P. macrostriatus*. It is not clear why the two species of the oldest chonetid fauna studied here (*Caplinoplia rectispina* and *Sinochonetes wangi* sp. nov.) are lacking in the Blue Fiord area as well as on Devon Island (northwest of Grove Lake). The most likely reason is that there was insufficient sampling.

The new genus *Johnsonetes* is of limited biostratigraphic value. However, *Johnsonetes latus* (Chatterton) from the Murrumbidgee Group in Australia, ranges from the uppermost *Receptaculites* Limestone up to the middle Warroo

BLUE FIORD FORMATION		BIRD FIORD FM.	GENERA AND SPECIES
Lower Member	Upper Member	Lower Part	
			<i>Caplinoplia rectispina</i>
			<i>Sinochonetes wangi</i> sp. nov.
			<i>Parachonetes macrostriatus</i>
			<i>Johnsonetes ellesmerensis</i> gen. et sp. nov.
			<i>Dagnachonetes ? grinnellensis</i> sp. nov.
			<i>Philippotia (Philippotia) briceae</i> sp. nov.
			<i>Johnsonetes arcticus</i> gen. et sp. nov.
			<i>Philippotia (Chlupacina)</i> sp.
			<i>Devonochonetes ? maclareni</i> sp. nov.
			<i>Sinochonetes</i> sp. nov. aff. <i>S. wangi</i> sp. nov.
			<i>Chonostrophoella cynthiae</i> sp. nov.
			<i>Dagnachonetes ? pordenensis</i> sp. nov.
			<i>Dagnachonetes (Dagnachonetes) quietus</i> sp. nov.

GSC

Figure 2. Schematic vertical distribution of the chonetacean species identified in this paper from the Blue Fiord and Bird Fiord formations.

Limestone. Chatterton (1973) concluded that the fauna of the middle Warroo Limestone is "probably upper Emsian but may be as young as Eifelian".

Chonetes sp. B described and illustrated by Johnson (1975) from the Disappointment Bay Formation on Lowther Island, (GSC loc. C-3217) is probably conspecific with *Johnsonetes ellesmerensis* sp. nov. On Lowther Island, *Chonetes* sp. B occurs higher than GSC locality C-2682, which yields *P. macrostriatus* and conodonts of the *inversus* Zone, which is Zlichovian.

The subgenus *Philippotia* (*Philippotia*), which occurs in the Blue Fiord area [*P. (Philippotia) briceae* sp. nov., GSC localities C-21869 and C-21870] would be indicative of a Zlichovian-Dalejan age by comparison with fauna from Bohemia (Havlíček and Racheboeuf, 1979) and southwestern Europe (Racheboeuf, 1982).

Specimens referred to *Philippotia?* (*Chlupacina*) are questionable since the generic assignment is based on the size and ornamentation of the pedicle valve only. However, such small strophochonetids are known only from the latest Emsian (Dalejan) of China (*Perichonetes* Xu, 1979, Tangxiang Formation) and from the earliest Eifelian of Bohemia and southwestern Europe [*P. (Chlupacina)* (Havlíček and Racheboeuf, 1979) Choteč Limestone].

The last chonetacean brachiopod of stratigraphic importance is *Chonostrophoella cynthiae* sp. nov. from the upper part of the Blue Fiord Formation on Devon Island. In addition to the fact that it represents the first record of *Chonostrophoella* in the Canadian Arctic Archipelago, the genus is restricted to Lower Devonian strata. In the areas north of Porden Point and northwest of Grove Lake (Devon Island), the GSC localities that yield *C. cynthiae* sp. nov. were assigned to the Eifelian by Brice (1982). Such a stratigraphic position is unlikely for the genus, even if *C. cynthiae* is one of the more recent species. Indeed, *C. cynthiae* sp. nov. occurs together with *Dagnachonetes quietus* sp. nov. in the area north of Porden Point. The latter species is known also from the Bird Formation of the Blue Fiord area (southwest Ellesmere Island), which is probably late Dalejan in age according to Pedder (1983) and Pedder and Goodbody (1983).

The genus *Dagnachonetes* Afanasjeva, is known from upper Emsian to upper Givetian strata in southwestern Europe, central Europe and Asia. Although new, the only species assigned with certainty to this genus [*D. (Dagnachonetes) quietus* sp. nov.] from the upper Blue Fiord and Bird Fiord formations, shows an evolutionary stage that would be more in keeping with an early Middle Devonian (Eifelian) age.

In conclusion, the chonetacean brachiopods described here are indicative of an Emsian age (? early Zlichovian to Dalejan) for most of the Blue Fiord Formation in the areas studied. This conclusion agrees well with the results obtained by Pedder and Goodbody (1983) from their work on conodonts. From the localities studied, only GSC localities C-21955 and 27761, which contain the *quietus* species without *Chonostrophoella cynthiae*, could be Eifelian in age.

PALEOGEOGRAPHIC AFFINITIES

As known at present in the Canadian Arctic, the superfamily Chonetacea is represented by four families: the Strophochonetidae, Anopliidae, Chonetidae and Chonostrophoidea. The Family Eodevonariidae is not represented. The most important character of the faunas studied here is the scarcity of anopliids; only two species of costate anopliids are known: the so-called *Chonetes* cf. *C. billingsi* (McLaren in Fortier et al., 1963) from Lochkovian (?) strata, and *Caplinoplia rectispina* (Khalfin, 1948)? from the early Zlichovian, described here. While smooth anopliids from the same time interval are common in Nevada, none of the *Anoplia* species occurs in the Canadian Arctic.

Furthermore, among the family Chonetidae collected from the Canadian Arctic Archipelago, one other important observation is the lack of septate forms (i.e. chonetids with accessory septa in their dorsal interior). This may be related to paleogeographic factors (septate chonetids are not common in the Old World Realm) or to environmental conditions. However, it may reflect different evolutionary trends in different paleogeographic stocks, separating eastern Old World Realm faunas (Uralian and Cordilleran sub-provinces) from western ones (southwestern Europe and northwestern Africa).

The geographic affinities of the Pentamerida, Rhynchonellida and Spiriferida from the Blue Fiord and Bird Fiord formations have been emphasized by Brice (1982). She concluded (p. 17) that by the end of the Early Devonian some connections existed between the Cordilleran subprovince of the Old World Realm and the Canadian Arctic Archipelago, as faunal evidence for these two areas shows. At the generic level, all arctic chonetaceans but one, *Chonostrophoella*, are widespread in the Old World Realm, with the exception of the western part (Germany, France, Spain, and North Africa) (Racheboeuf, 1981). The genus *Chonostrophoella* along with *Costellirostra*, *Fimbrispirifer* and *Cupularostrum* show a close relationship with the Eastern Americas Realm, at least during some short time intervals.

SYSTEMATIC PALEONTOLOGY

All specimens illustrated in this report have been assigned GSC type numbers and are in the national type collection of the Geological Survey of Canada in Ottawa.

For easy reference, locality data accompany the description of each taxon, rather than being placed under a separate locality index.

Phylum BRACHIOPODA Dumeril, 1806

Class ARTICULATA Huxley, 1869

Order STROPHOMENIDA Öpik, 1934

Superfamily CHONETACEA Bronn, 1862

Family STROPHOCHONETIDAE Muir-Wood, 1962

Genus *Philippotia* Racheboeuf, 1982

Type species. *Hemichonetes belairensis* Racheboeuf, 1981.

Subgenus *Philippotia* (*Philippotia*) Racheboeuf, 1981

Type species. *Hemichonetes belairensis* Racheboeuf, 1981.

Philippotia (*Philippotia*) *briceae* sp. nov.

Plate 1, figures 4-9

Derivation of name. In honour of Dr. D. Brice, Lille, France.

Material and occurrence. Eight specimens from the Lower member of the Blue Fiord Formation, Ellesmere Island, 12.5 km southeast of the head of Blue Fiord. Collected by Brice and Meats in 1972, GSC localities C-21869 (2 specimens), C-21870 (2 specimens), and C-21893 (4 specimens).

Dimensions (mm).

GSC no.	75791 (holotype)	75788	75789	75790
GSC locality	C-21870	C-21869	C-21893	C-21870
Length of pv (L)	4.9	5.3	3.4	6.1
Width (W)	7.3	8.7	4.8	8.7
Ratio L/W	0.67	0.61	0.70	0.70
Depth of pv (D)	-	0.6	0.4	0.7
Ratio L/D	-	8.8	8.5	8.7
Capillae per mm	4	4	5	3
Total number of capillae	49	53	37	55

Description. Exterior: shell small (maximum length 6 mm), transverse in outline (length/width ratio between 0.63 and 0.64). Pedicle valve weakly convex, brachial valve almost flat. Maximum width located at hinge line. Anterior margin regularly rounded, lateral margins straight, almost perpendicular to hinge line. Interareas not observed. Ornamentation with enlarged median capilla reaching anterior margin of pedicle valve, and rounded radial capillae, except on the posterolateral parts of shell, which are always smooth. Capillae increase by intercalation in posterior half of pedicle valve, then by bifurcation toward margins. Three to four capillae per mm along anterior margin. In shells more than 5 mm long, total number of capillae varies from 49 to 55. Two spines on right side of pedicle valve; no spine on left one.

Pedicle valve interior: hinge teeth not observed. Muscle field indistinct, divided by short and narrow myophragm. Visceral cavity well delimited. Inner surface impressed by external capillae.

Brachial valve interior: the only specimen available shows a pair of anderidia, long, narrow and straight, diverging anteriorly at 55°. Median septum reduced posteriorly to flattened ridge between anterior adductor scars, anteriorly elevated as very narrow brevisseptum. Cardinal process short, wide, its anterior margin being almost vertical above valve floor. Inner cristae (see Garcia-Alcalde and Racheboeuf, 1975) straight, narrow and rounded not extending laterally beyond distal part of sockets. Inner surface impressed by external ornament.

Comparisons. These specimens are assigned to the genus *Philippotia* rather than to *Asymmetrochonetes*. The latter genus is confined to Lochkovian strata and has no younger representatives. *Philippotia* (*Philippotia*) *briceae* sp. nov. differs from the type species, *P.* (*P.*) *belairensis*, by its smaller size and almost planoconvex profile. Internally, the new species has a better defined ventral visceral cavity and very small and scarce pustules. Pedicle exteriors can easily be distinguished from juvenile shells of *Johnsonetes ellesmerensis* sp. nov. as they lack a spine on the left side of the posterior margin and the posterolateral parts of the valve are always smooth, without any radial rib.

Figured specimens. GSC 75792 and 75788 from GSC locality C-21869 (Pl. 1, figs. 7, 8); GSC 75791 and 75790 from GSC locality C-21870 (Pl. 1, figs. 4-6); GSC 75789 from GSC locality C-21893 (Pl. 1, fig. 9).

Locality data. GSC locality C-21869, Ellesmere Island, latitude 77°13'45"N, longitude 86°24'W, Blue Fiord Formation, Lower member, about 197 m above the base of the formation.

GSC C-21870 from the same locality, 198 m above the base of the Blue Fiord Formation.

GSC locality C-21893 from Ellesmere Island, latitude 77°13'48"N, longitude 86°24'22"W, about 12.5 km southeast of the head of Blue Fiord, Blue Fiord Formation, Lower member, 167 m below the top of the formation.

Subgenus *Philippotia* (*Chlupacina*)
(Havlíček and Racheboeuf, 1979)

Type species. *Chlupacina longispina* Havlíček and Racheboeuf, 1979.

Philippotia? (*Chlupacina*) sp.

Plate 1, figures 1-3

Material and occurrence. Thirteen specimens (11 pedicle and 2 brachial exteriors) from the Upper member of the Blue Fiord Formation, Ellesmere Island. Collected by Brice and Meats, 1972, GSC localities C-21918 (12 specimens) and C-21924 (1 specimen).

Description. Exterior: very small (maximum length 2.9 mm), planoconvex and transverse shell (length/width ratio about 0.68). Maximum width located at hinge line. Pedicle valve weakly convex. Interareas not observed. Median capilla enlarged, relatively narrow, irregular, reaching the anterior margin of the pedicle valve. Radial capillae very small, low, rounded, with narrower intervals. Capillae increasing by bifurcation on pedicle valve, by intercalation on brachial valve. Nine to eleven capillae per mm along anterior margin. One (possibly two) spine bases on right side of pedicle valve. Spines not observed.

Interior unknown.

Comparisons. A generic assignment cannot be made with certainty because of the lack of internal features and preserved spines in the material available. The size of the specimens and their external morphology and ornamentation are very similar to those of species belonging to the subgenus *Philippotia* (*Chlupacina*), which appears to characterize species from the lower Eifelian in southwestern Europe and Bohemia. An assignment to this subgenus is likely, but it cannot be proved since interiors have not been observed. In 1979, Xu described the genus *Perichonetes* from the Tangxiang Formation of China; this genus has a long median septum fused posteriorly with the ridge surrounding the delthyrial cavity of the pedicle valve. An assignment to this genus cannot be completely rejected, because of the similar external morphological features.

Figured specimens. GSC 75793 and 75794 from GSC locality C-21918 (Pl. 1, figs. 1-3).

Locality data. GSC locality C-21918, Ellesmere Island, latitude 77°12'50"N, longitude 86°34'W, about 9.5 km southeast of the head of Blue Fiord, Blue Fiord Formation, between 20 and 28 m below the top of the Lower member.

GSC locality C-21924, Ellesmere Island, latitude 77°12'40"N, longitude 86°32'20"W, about 9.5 km southeast of the head of Blue Fiord, Blue Fiord Formation, 65 m above the base of the Upper member.

Genus *Johnsonetes* gen. nov.

Type species. *Chonetes filistriata* Walcott, 1884.

Derivation of name. In honour of Dr. J.G. Johnson, Oregon State University, Corvallis, U.S.A.

Diagnosis. Shell transverse in outline; maximum width at hinge line; cardinal extremities acute, at least in oldest shells. Spines asymmetrically arranged, with two more spines on right side of pedicle valve. Proximal part of spines bent medially, curving progressively outward to become subparallel to mid-line. Pedicle valve with narrow, ill defined, enlarged median capilla on beak. Dorsal interior with median septum, anderia and reasonably well developed inner cristae. Visceral cavity usually well delimited.

Species assigned. *Chonetes filistriata* Walcott, 1884 (type species); *Protochonetes latus* Chatterton, 1973, Pl. 17, figs. 3-24; *Johnsonetes ellesmerensis* sp. nov.; *Johnsonetes arcticus* sp. nov.

Comparisons. The generic name *Johnsonetes* is proposed here to include species that were previously listed as "*Strophochonetes*" in the Canadian Arctic and in Nevada, and which have in common several original characteristics within the Family Strophochonetidae.

In his very accurate revision of *Chonetes filistriata*, Johnson (1970, p. 133) discussed the taxonomic position of the species that he had referred to "*Strophochonetes*". The author established the strophochonetid nature of the species *C. filistriata*, despite the lack of an enlarged median capilla, and correctly rejected the assignment to the genus *Strophochonetes* s.s. However, as can be assumed from Johnson's illustrations (*ibid.* Pl. 31, figs. 5, 8, 12) and as my own observations of the same material have shown, some specimens of *C. filistriata* bear a reduced, ill defined,

enlarged median capilla on the beak. The enlarged median capilla is better, but variably, developed in *Johnsonetes ellesmerensis* sp. nov. (compare Pl. 1, figs. 12, 13, 16). In *J. arcticus* sp. nov. it is almost imperceptible. In *Protochonetes latus* Chatterton, an enlarged median capilla may be present in some specimens (1979, Pl. 17, fig. 13).

The erection of a new genus is warranted, when the following are taken into consideration: the reduction of the median capilla, which is possibly an evolutionary trend, the asymmetrically arranged spines (which can easily be deduced from Chatterton's illustrations for the species *latus*; see his Plate 17), the trend of developing a sulcus on the pedicle valve, and the interior dorsal structures (mainly the development of a median septum or a brevisseptum).

In its shell shape, *Johnsonetes* gen. nov. is somewhat similar to *Leptochonetes* Havlíček and Racheboeuf, 1979 from Bohemia, but externally the latter has oblique and symmetrically arranged spines. *Johnsonetes* gen. nov. differs from *Novellinetes* Havlíček and Racheboeuf, 1979 from the Dalejan strata of Bohemia in its asymmetrical spines, development of a median septum and ventral muscle scars.

Johnsonetes ellesmerensis sp. nov.

Plate 1, figures 10-18

Derivation of name. After Ellesmere Island.

Material and occurrence. More than 100 almost complete specimens from the Lower member of the Blue Fiord Formation, Ellesmere Island, Blue Fiord area. Collected by Brice in 1971, GSC localities C-10335 (7 specimens) and C-10336 (25 specimens); collected by Brice and Meats in 1972, GSC localities C-21858 (5 specimens), C-21859 (3 specimens), C-21860 (10 specimens); C-21861 (1 specimen), C-21862 (5 specimens); C-21863 (17 specimens), C-21872 (2 specimens), C-21873 (1 specimen), C-21881 (11 specimens), C-21903 (4 specimens), and C-21869 (1 specimen).

Dimensions (mm).

GSC no.	75796 (holotype)	75795	75797	75801	75802
GSC locality	C-10336	C-10335	C-10336	C-21863	C-21869
Length of pv (L)	6.0	6.8	6.3	7.3	5.4
Width (W)	8.2	10.4	9.5	11.0	7.9
Ratio L/W	0.73	0.65	0.66	0.66	0.68
Depth of pv (D)	1.4	1.6	1.3	?	?
Ratio L/D	4.28	4.25	4.84	-	-
Capillae per mm	5	4	4	5	4
Total number of capillae	66	72	60	81	56

Description. Exterior: shell small (maximum length 7.8 mm, corresponding width 11.0 mm), transverse in outline (length/width ratio between 0.64 and 0.74), with maximum width located about mid-length in small specimens and at hinge line in largest shells. Cardinal extremities acute. Pedicle valve gently convex, brachial valve weakly concave. Pedicle valve commonly flattened at top, anterior half of valve sometimes developing a weak sulcus. Interareas not observed. Spines asymmetrically arranged; maximum of six spines with two more spines on right side of beak (4' 3' - 1, 2, 3, 4), spines 3' and 4' of left side appearing before their

homologues 3 and 4. Spines primarily curving toward mid-line, then curving outward becoming almost parallel to mid-line. Enlarged median capilla developed on beak only, low and narrow, tapering anteriorly. Radial capillae low, rounded, increasing by bifurcation, rarely intercalating, on pedicle valve and mainly by intercalation on brachial valve. Four capillae per mm along anterior margin. Total number of capillae varies between 31 and 73 on shells from 3.2 to 6.4 mm long.

Pedicle valve interior: strongly impressed by external ornamentation. Muscle field relatively small with oval adductor scars and triangular, anteriorly ill defined, diductor scars. Muscle field divided by short myophragm. Posterior ridges wide, low and straight. Visceral cavity limited in some of largest specimens. Hinge teeth not observed.

Brachial valve interior: median septum supporting cardinal process, which is elevated above valve floor. Length of septum about two thirds that of valve. Anderidia long and narrow, anteriorly divergent at 45-50°, fusing posteriorly with cardinal process. Myophore not observed. Inner cristae short, low and rounded, anteriorly divergent at about 130°. Indistinct adductor scars. Inner surface of valve impressed by external radial ribs in small shells; small, radially arranged papillae on largest specimens.

Comparisons. Externally, *Johnsonetes ellesmerensis* sp. nov. differs from *J. latus* (Chatterton) by its smaller size and more numerous costae (31 to 73 costae on shells between 5.0 and 11.0 mm in width, instead of 40 to 55 on shells of *J. latus* between 10 and 15 mm). Internally, *J. ellesmerensis* lacks the strong dorsal septum developed in the Australian species.

Johnsonetes ellesmerensis sp. nov. appears more closely related to *Chonetes filistriata* Walcott (type species). Externally, the new species has more radial capillae (21 to 27, instead of 20 in 5 mm at a distance of 5 mm anterior to the beak). The interior of the dorsal valve has narrower inner cristae than in *J. ellesmerensis* and the median septum is thinner, never developed as a breviseptum.

Figured specimens. GSC 75796 (holotype) from GSC locality C-10336 (Pl. 1, fig. 10); GSC 75797 to 75800 (paratypes) from the same locality (Pl. 1, figs. 11, 14-16, 18); GSC 75795 (paratype) from GSC locality C-10335 (Pl. 1, fig. 12); GSC 75801 (paratype) from GSC locality C-21863 (Pl. 1, fig. 17); GSC 75802 (paratype) from GSC locality C-21869 (Pl. 1, fig. 13).

Locality data. GSC locality C-10335, Lower member of the Blue Fiord Formation, type section, Blue Fiord on Ellesmere Island, 160 m above the base of the formation.

GSC locality C-10336, same locality, about 165 m above the base of the formation.

GSC localities C-21858, C-21860, C-21862 and C-21863, Ellesmere Island, Blue Fiord Formation, Lower member, latitude 77°13'46"N, longitude 86°24'20"W, at 163 m, between 167 and 169 m, 171 and 173 m, and 173 and 175 m above the base of the formation, respectively.

GSC localities C-21859 and C-21861, Blue Fiord Formation, Lower member, type section, southwest Ellesmere Island, at 165 m, and between 169 and 171 m above the base of the formation, respectively.

GSC localities C-21881 and C-21903, same locality, type section at 179 m and 180 m above the base of the formation.

GSC locality C-21872, southeast of Blue Fiord, latitude 77°13'45"N, longitude 86°24'W, Blue Fiord Formation, Lower member, at 214 m above the base of the formation.

GSC locality C-21873, about 12.5 km southeast of the head of Blue Fiord, latitude 77°13'48"N, longitude 86°24'20"W, Blue Fiord Formation, Lower member, 215 m above the base.

Johnsonetes arcticus sp. nov.

Plate 1, figures 19-23; Plate 2, figures 1-11; Figure 3

1963 *Chonetes* sp. A, McLaren in Fortier et al., p. 629.

Derivation of name. After the Canadian Arctic.

Material and occurrence. Thirty-six specimens from the Upper member of the Blue Fiord Formation. Bathurst Island, collected by Norris in 1955, GSC locality C-26207 (1 specimen). Ellesmere Island, collected by Brice and Meats in 1972, GSC localities C-21914 (2 specimens), C-21918 (12 specimens), C-21929 (2 specimens), C-21930 (9 specimens), C-21931 (1 specimen) and C-21939 (9 specimens).

Dimensions (mm).

GSC no.	75803 (holotype)	75804	75811
GSC locality	C-21928	C-21928	C-21939
Length of pv (L)	12.5	14.0	16.3
Width of pv (W)	18.0	18.5	29.0
Ratio L/W	0.69	0.75	0.56
Depth of pv (D)	4.2	5.3	6.2
Ratio L/D	2.97	2.64	2.62
Total number of costae	66	-	80

Description. Exterior: shell of medium size (maximum length 16.3 mm, corresponding width 29.0 mm), transverse (length/width ratio between 0.56 and 0.75), semicircular to subtrapezoidal in outline with maximum width always located at hinge line. Pedicle valve moderately to highly arched, the L/D ratio decreasing from 3.5 to 2.2 during ontogeny. Pedicle valve flattened at top. Anterior margin slightly convex or almost parallel to hinge line. Cardinal extremities acute. Ventral interarea concave, anacline, about twice as high as dorsal interarea, which is flat and hypercline. Pseudodeltidium wide and weakly prominent, chilidium reduced. Spines asymmetrically arranged, with two more spines on the right side of the pedicle valve (4', 3'-1, 2, 3, 4). Spines primarily curving toward mid-line, then curving outward to become almost perpendicular to hinge line. Radial ornamentation of wide, low and rounded costae with narrower intervals. Costae increasing mainly by bifurcation on pedicle valve, and by intercalation on brachial valve. Along anterior margin, costae number 10 to 15 per 5 mm. In shells ranging from 7 to 16.3 mm in length, total number of costae varies from 58 to 84.

Pedicle valve interior: teeth wide, thick, oval in outline and rounded anteriorly. Posterior muscle-bounding ridges straight, wide and low. Median septum high, short,

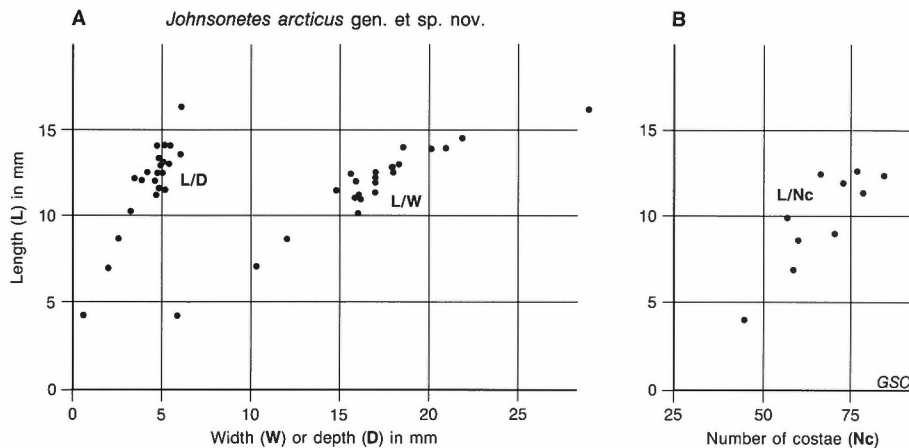


Figure 3. *Johnsonetes arcticus* gen. et sp. nov. from the upper Blue Fiord Formation, Ellesmere Island: A - length versus width (L/W) and length versus depth (L/D); B - length versus number of costae (L/Nc).

extending anteriorly as a thin myophragm dividing small oval adductor scars; diductor scars ill-defined. Visceral cavity deep and well delimited. Inner surface impressed by external radial ribbing; in largest shells, only peripheral margin is costate.

Brachial valve interior: short cardinal process rarely extending beyond hinge line; cardinal process subtriangular and weakly bilobed posteriorly. Myophore directed posteriorly. No alveolus. Narrow and well developed median septum projecting beyond mid-length of valve. Anderidia narrow and high, anteriorly divergent at 45°. Outer cristae long and thin. Inner cristae long and wide, S-shaped, with their middle part parallel to hinge line; proximal part straight posteriorly, covering dental sockets, and anteriorly divergent at 140°. Distal (lateral) part of inner cristae bending anterolaterally and tapering, diverging anteriorly at 140°. Muscle scars ill-defined; anterior adductor scars triangular, elongated and more deeply impressed in valve floor than posterior ones. Inner surface strongly impressed by external ornament, without papillae or pustules.

Comparisons. *Johnsonetes arcticus* sp. nov. differs from *J. ellesmerensis* sp. nov. by its larger size, more arched and deeper pedicle valve, and less numerous costae. However, the external morphology of these two species is very similar and they have the same maximum number of spines. Internally, the most significant differences are in the brachial valve. In *J. arcticus*, the median septum is shorter and higher than in *J. ellesmerensis*, but the most apparent difference is in the development of the inner cristae, which are longer and wider in *J. arcticus*.

The new species differs from *Protochonetes latus* Chatterton, 1973 (here assigned to the new genus *Johnsonetes* from the uppermost *Receptaculites* Limestone and the lower half of the Waroo Limestone [upper Emsian-Eifelian (?) of New South Wales] by its larger size (maximum width 29 mm instead of 15 mm) and finer radial costellae (about 55-60 for shells that are 10 mm wide, instead of 40 as in *P. latus*). Internally, the new species differs in having a greater development of all the interior brachial features (median septum, anderidia, inner cristae) than in *P. latus*. In addition, muscle scars are better impressed in the Australian species.

Figured specimens GSC 75803 (holotype) from GSC locality C-21928 (Pl. 1, figs. 19-21); GSC 75809 (paratype) from GSC

locality C-21872 (Pl. 2, figs. 1, 2); GSC 75807 and 75808 (paratypes) from GSC locality C-10348 (Pl. 2, figs. 8-11); GSC 75804 (paratype) from GSC locality C-21928 (Pl. 2, figs. 6, 7); GSC 75805 (paratype) from GSC locality C-21930 (Pl. 2, figs. 3-5); GSC 75806 (paratype) from GSC locality 26522 (Pl. 1, figs. 22, 23).

Locality data. GSC locality 26207, Bathurst Island, north of Cache "T" Blue Fiord Formation, "from the basal 20 feet" (Fortier et al., 1963, p. 629).

GSC locality C-21914, southwest of Ellesmere Island, Blue Fiord Formation, type section, 56 m below the top of the Lower member.

GSC locality C-21918, Ellesmere Island, about 9.5 km southeast of the head of Blue Fiord, latitude 77°12'50"N, longitude 86°34'W, between 20 and 28 m below the top of the Lower member of the Blue Fiord Formation.

GSC locality C-21929, same area, latitude 77°12'40"N, longitude 86°33'20"W, 80 to 90 m above the base of the Upper member of the Blue Fiord Formation.

GSC localities C-21930 and C-21931, same locality, between 85 and 95 m, and 90 and 100 m, respectively, above the base of the Upper member of the Blue Fiord Formation.

GSC locality C-21939, Ellesmere Island, about 10 km southeast of the head of Blue Fiord, latitude 77°12'34"N, longitude 86°32'20"W, between 120 and 124 m above the base of the Upper member of the Blue Fiord Formation.

Family ANOPLIIDAE Muir-Wood, 1962

Genus *Caplinoplia* Havlíček and Racheboeuf, 1979

Type species. *Caplinoplia pragensis* Havlíček and Racheboeuf, 1979.

Caplinoplia rectispina (Khalfin, 1948)?

Plate 2, figures 12-23; Figure 4

Material and occurrence. Twenty-eight calcareous specimens from the Lower member of the Blue Fiord Formation, Ellesmere Island. Collected by Brice in 1971, GSC locality C-10294 (1 specimen), C-10295 (3 specimens), C-10299 (22 specimens) and C-10302 (4 specimens).

Dimensions (mm).

GSC no.	75812	75813	75814
GSC locality	C-10299	C-10299	C-10299
Length of pv (L)	8.3	7.8	5.8
Width of pv (W)	11.0	8.4	6.4
Ratio L/W	0.75	0.78	0.9
Depth of pv (D)	3.5	3.2	2.0
Ratio L/D	2.37	2.48	2.9
Total number of costae	52	50	34

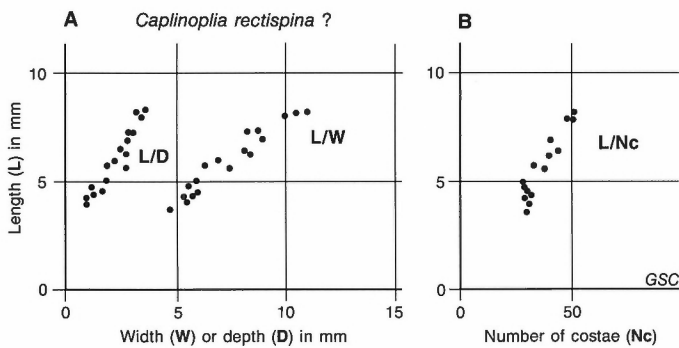


Figure 4. *Caplinoplia rectispina?* from the Lower member of the Blue Fiord Formation, Ellesmere Island: A - length versus width (L/W) and length versus depth (L/D); B - length versus number of costae (L/Nc).

Description. Exterior: shell small (maximum length 8.3 mm), slightly transverse (length/width ratio between 0.75 and 0.9), regularly rounded, or approximately subtriangular in outline. Maximum width at hinge line in smallest specimens, between hinge line and mid-length in adults. Ears small, triangular and slightly convex. Pedicle valve strongly convex longitudinally (length/depth ratio between 2.28 and 2.9 for shells more than 5 mm in length). Transverse profile arched with slightly concave flanks and almost flattened at the top. Ventral interarea apsacline to orthocline, concave, dorsal interarea hypercline. Small triangular pseudodeltidium. Chilidium not observed. Three spines of orthomorph type, perpendicular to hinge line, on each side of beak. Spines alternating, first on right side of beak, then on left side. Radial ornamentation of rounded costellae increasing mainly by bifurcation on pedicle valve and by intercalation on brachial valve. Primary costellae number 21 to 23 on umbo, most of them bifurcating between mid-length and margins, where they number up to 53 on largest specimen.

Pedicle valve interior: hinge teeth not observed. Muscle field weakly impressed on valve floor; diductors triangular, small and with slight radial grooves from pattern of external costellae; adductor scars very small, semi-elliptical in outline. Muscle field divided by thin, relatively long myophragm. Posterior muscle-bounding ridges straight, low and rounded, diverging anteriorly at 90°. Inner surface of valve impressed by external ornamentation.

Brachial valve interior: bilobed, short and stocky cardinal process, bounded anteriorly by a weak alveolus. Inner cristae low, short, slightly divergent anteriorly. Anderidia narrow and high, diverging anteriorly at 40° and fused posteriorly with posterior part of median septum. Median septum wide, as a flattened ridge between anterior adductor scars, extending anteriorly as a thin, blade-like ridge ending before mid-length. Two pairs of ill-defined accessory septa formed by strong pustules almost fused at their base. Inner surface covered with small, radially arranged papillae in brachial area. Margins of valve impressed by external ornament.

Comparisons. The morphology of the spines, as well as the dorsal interior features (alveolus, brevisseptum and cardinal process) warrant the assignment of this material to the genus *Caplinoplia*. Arctic specimens can only be compared to *Chonetes rectispina* Khalfin, 1948 from the Lower Devonian (Kondratiev Beds) of Altaï. Unfortunately, interiors of *C. rectispina* are poorly known. However, specimens described here are very similar in all their external features to Khalfin's species (see Khalfin, 1955, p. 239), but their

conspecificity cannot yet be proved. Costate anopliids appear to be very rare in the Devonian of the Canadian Arctic. The only other occurrence known is that of *Chonetes* cf. *C. billingsi* in the Stuart Bay Formation from Bathurst Island documented by McLaren (see Fortier et al., 1963, p. 607).

Figured specimens. GSC 75812 to 75819 from GSC locality C-10299, Plate 2, figures 12-23.

Locality data. GSC locality C-10294, Ellesmere Island, Sør Fiord area, Lower member of the Blue Fiord Formation, 1.55 m above the base.

GSC locality C-10295, same locality, 2.10 m above the base.

GSC locality C-10299, same locality, 21 m above the base.

GSC locality C-10302, same locality, 30.7 m above the base of the lower Blue Fiord Formation.

Family CHONETIDAE Bronn, 1862

Subfamily DEVONCHONETINAE Muir-Wood, 1962

Genus *Devonochonetes* Muir-Wood, 1962

Type species. *Strophomena carinata* Conrad, 1842.

Devonochonetes? maclareni sp. nov.

Plate 3, figures 7-14; Figure 5

Derivation of name. In honour of Dr. D.J. McLaren.

1963 *Chonetes* sp. B, McLaren in Fortier et al., p. 321 (GSC locality 26517).

Material and occurrence. About 200 specimens from the Upper member of the Blue Fiord Formation, Ellesmere Island. Sør Fiord area, collected by Klapper and Pedder in 1971, GSC localities C-12461 (20 specimens) and C-12464 (50 specimens); Blue Fiord area, collected by Kerr in 1967, GSC locality C-6721 C (30 specimens); collected by McLaren in 1955, GSC locality 26517 (6 specimens); collected by Brice and Meats in 1972, GSC localities C-21928 (5 specimens), C-21930 (28 specimens), C-21931 (25 specimens), C-21936 (5 specimens), C-21937 (14 specimens) and C-21938 (18 specimens); GSC locality 27778 (2 specimens).

Dimensions (mm).

GSC no.	75820a (holotype)	75820b	75821	75824
GSC locality	C-6721 C	C-6721 C	C-6721 C	27778
Length of pv (L)	6.2	6.4	9.3	9.2
Width of pv (W)	9.8	10.1	12.0	15.1
Ratio L/W	0.63	0.63	0.77	0.61
Depth of pv (D)	0.7	0.9	1.2	1.6
Ratio L/D	8.85	7.1	7.75	5.75
Capillae per mm	8	9	-	7

Devonochonetes? maclareni sp. nov.

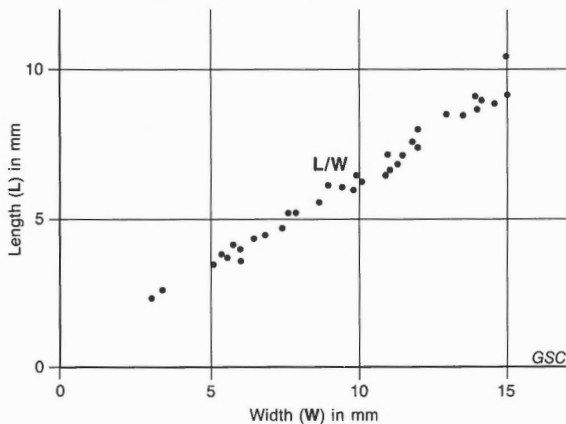


Figure 5. *Devonochonetes? maclareni* sp. nov., length versus width (L/W).

Description. Exterior: shell small (maximum length 9.5 mm), transverse in outline (length/width ratio between 0.61 and 0.77), slightly concavo-convex. Pedicle valve almost flat in juvenile specimens. Maximum width located at mid-length. Ventral interarea flat and apsacline, with a wide, not very prominent pseudodeltidium. Dorsal interarea narrow and hypercline; chilidium not observed. Radial ornamentation of low and narrow capillae, triangular in section. Capillae increasing by intercalation on both valves. In the posterior half of the pedicle valve, capillae separated by wide intervals. Toward mid-length, the first intercalations appear; capillae widen progressively toward the anterior margin so those originating on beak are wider than those originating by intercalation. This peculiar character of the radial ribbing gives a typical parvicostellate aspect to the external ornamentation. Along anterior margin, capillae number seven to nine per mm. Up to nine pairs of spines on each side of beak; spines symmetrically arranged and of oblique orthomorph type.

Pedicle valve interior: median septum relatively short, high and narrow, ending anteriorly in thin, low myophragm reaching anterior margin of visceral cavity. Adductor scars subtriangular, elongated, not anteriorly limited; diductor scars triangular, elongated, radially grooved and rounded at their anterior margins located at mid-length of valve. Near mid-line, diductors separated by two vascula media. Visceral cavity typically heart-shaped, well delimited. Muscle field bounded posteriorly by straight, low and rounded posterior ridges, diverging anteriorly at 100°. Teeth not observed.

Brachial valve interior: stout cardinal process, strongly bilobed internally, supported by long median septum, which is about two thirds of valve length. No alveolus. Inner cristae progressively widening and sloping down laterally, their posterior margins overhanging posterior half of relatively small, laterally elongated dental sockets. Anderidia fused posteriorly with septum, diverging anteriorly at 60° to 80°. Adductor scars impressed well on valve floor. Numerous fine pustules developed in front of anterior adductor scars; in largest shells, these delimit the brachial area anterolaterally.

Comparisons. The new species is only questionably referred to the genus *Devonochonetes*, from which it differs by its external ornament as well as its dorsal interior (cardinal process not elevated, strong median septum and inner cristae). *Devonochonetes? maclareni* sp. nov. is somewhat similar to the species described as *Devonochonetes?* from

southwest Europe (Racheboeuf, 1981), in particular it resembles *D.? kerfornei* in its external ornament, but it lacks the strong accessory septa in the dorsal interior.

Figured specimens. GSC 75820a (holotype) from GSC locality C-6721 C (Pl. 3, fig. 9); GSC 75821 to 75823 (paratypes) from the same locality (Pl. 3, figs. 11-14); GSC 75824-75825 (paratypes) from GSC locality 27778 (Pl. 3, figs. 7, 8, 10).

Locality data. GSC locality C-12461, Ellesmere Island, Sör Fiord section, 2641 ft (805 m) above exposed base, 943 ft (287 m) below top.

GSC locality C-12464, Ellesmere Island, Sör Fiord section 2753 to 2754 ft (839 m) above exposed base.

GSC locality C-6721 C, Ellesmere Island, 3 miles (10 km) east of extremity of Blue Fiord, latitude 86°41'N, longitude 77°16'W, on north side of river, at base of cliff. Blue Fiord Formation.

GSC locality 26517, Ellesmere Island, south side of Eids Fiord, middle Blue Fiord Formation, unit 7 (Fortier et al., 1963, p. 321).

GSC locality C-21928, Ellesmere Island, 9 to 10 km southeast of the head of Blue Fiord, latitude 77°12'40"N, longitude 86°32'20"W, 77 m above the base of the Upper member of the Blue Fiord Formation.

GSC locality C-21930, Ellesmere Island, southeast of Blue Fiord, slumped blocks between 85 and 95 m from the base of the Upper member of the Blue Fiord Formation, latitude 77°12'40"N, longitude 86°33'20"W.

GSC locality C-21931, same locality, slumped rocks from 90 to 100 m above the base of the Upper member.

GSC locality C-21936, Ellesmere Island, about 10 km southeast of the head of Blue Fiord, latitude 77°12'38"N, longitude 86°32'W, Blue Fiord Formation, Upper member, about 108 m above the base of the member.

GSC locality C-21937, same locality, between 112 and 116 m above the base of the Upper member of the Blue Fiord Formation.

GSC locality C-21938, same locality, between 116 and 120 m above the base of the Upper member of the Blue Fiord Formation.

GSC locality 27778, southwest Ellesmere Island, head of Eids Fiord, Blue Fiord Formation, from higher than 495 m above the base of the formation (Fortier et al., 1963, p. 321).

Genus *Sinochonetes* Wang, Boucot and Rong, 1981

Type species. *Chonetes minutisulcatus* Hou and Xian, 1975

Sinochonetes wangi sp. nov.

Plate 3, figures 15-21; Figure 6

Derivation of name. In honour of the late Prof. Yu Wang, Nanjing, China.

Material and occurrence. Twenty-seven specimens from the Lower member of the Blue Fiord Formation, Sör Fiord area, Ellesmere Island, collected by Brice in 1971, GSC localities

C-10295 (1 specimen), C-10299 (7 specimens), C-10302 (5 specimen), C-10313 (12 specimens) and C-10322 (2 specimens).

Dimensions (mm).

GSC no.	75826 (holotype)	75827	75828a	75828b
GSC locality	C-10299	C-10299	C-10299	C-10299
Length of pv (L)	7.5	8.6	7.1	6.0
Width (W)	10.2	11.1	10.0	8.1
Ratio L/W	0.735	0.77	0.71	0.74
Capillae per mm	13	10	-	12

Description. Exterior: shell small (maximum length 12 mm), transverse in outline (length/width ratio between 0.62 and 0.77). Shell semicircular to subtrapezoidal with maximum width always located at hinge line. Ears triangular, slightly convex, well delimited. Pedicle valve convex (length/depth ratio between 2.5 and 3) sometimes with a faint sulcus; sulcus originating near beak but sometimes restricted to anterior half of shell only. Among 24 pedicle valves, 7 lack a sulcus. Median fold corresponding to sulcus developed on brachial valve when sulcus is present. Ventral interarea strongly apsacline and flat; dorsal interarea hypercline, almost linear. Pseudodeltidium and chilidium not observed. Radial ornamentation of very narrow, low and rounded capillae with narrower intervals; capillae increasing both by intercalation and bifurcation. Along anterior margin, 10 to 13 capillae per mm. Shell surface covered with very tiny concentric growth lines. Five to six spines symmetrically arranged on each side of beak. No spines preserved.

Pedicle valve interior: hinge teeth wide, stout, anteriorly rounded. Posterior muscle-bounding ridges relatively short, straight and wide. Myophragm broad, high and short, dividing a weakly impressed muscle field. Adductor scars elliptical, or semielliptical, in outline. Diductors radially striate, subtriangular, with their rounded anterior margin located at mid-length of the valve or slightly more anteriorly. Visceral cavity ill-defined. Inner surface covered with very small pustules, except on muscle field.

Brachial valve interior: cardinal process wide and short, internally bilobed and anteriorly bounded by a weak alveolus. Cardinal process ventrally connected with a slightly swollen callus. Median septum high and wide, length more than half the valve length, ending at flexure of valve located one-third of its length from anterior margin. Aderidia stout, diverging anteriorly at 60°, fusing posteriorly with posterior part of septum. Inner cristae long, narrow, almost parallel to hinge line and diverging anteriorly at 170°. Dental sockets fairly shallow. Anterior half of valve longitudinally depressed medially, in relation to external fold, when present. Inner surface covered with elongate, radially arranged pustules, the bases of which almost fuse in anterolateral parts of valve.

Comparisons. The external morphology of the shell, as well as the internal features, allow the assignment of these specimens to the genus *Sinochonetes* Wang, Boucot and Rong, 1981. The new species differs from *Sinochonetes minutisulcatus* (Hou and Xian) (the type species) in the following characteristics: the shell is more finely ribbed and has more numerous hinge spines (five to six pairs instead of three to four); internally, the callus on the cardinal process is less well developed and the median septum is somewhat shorter and less elevated. Elsewhere, the inner cristae are longer, better developed and more divergent anteriorly in *S.*

Sinochonetes wangi sp. nov.

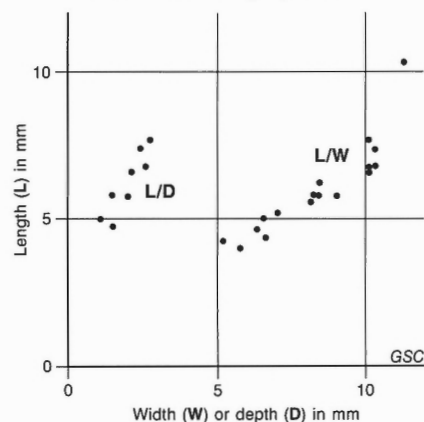


Figure 6. *Sinochonetes wangi* sp. nov. from the lower Blue Fiord Formation, Ellesmere Island; length versus width (L/W) and length versus depth (L/D).

wangi sp. nov. than in the type species. *Sinochonetes minutisulcatus* is known only from the Siegenian of the South China Region of the Old World Realm.

Figured specimens. GSC 75826 (holotype) from GSC locality C-10299 (Pl. 3, figs. 16, 17), GSC 75827 to GSC 75828 (paratypes) from the same locality (Pl. 3, figs. 15, 18, 19); GSC 75829 (paratype) from GSC locality C-10302 (Pl. 3, fig. 21) and GSC 75830 (paratype) from GSC locality C-10313 (Pl. 3, fig. 20).

Locality data. GSC locality C-10295, Ellesmere Island, Sør Fiord area, Blue Fiord Formation, Lower member, 1.5 m above the base.

GSC locality C-10299, same locality, 23 m above the base.

GSC locality C-10302, same locality, 30.7 m above the base.

GSC locality C-10313, same locality, 104 m above the base.

GSC locality C-10322, same locality, 197 m above the base.

Sinochonetes sp. nov. aff. *S. wangi* sp. nov.

Plate 3, figures 22-25

Material and occurrence. Five pedicle valves from the middle Blue Fiord Formation, head of Eids Fiord, southwest Ellesmere Island, collected by McLaren in 1955, GSC locality 27777.

Dimensions (mm).

GSC no.	75831	75832	75833	75834
GSC locality	27777	27777	27777	27777
Length of pv (L)	12.4	11.0	10.2	12.0
Width of pv (W)	18.0	15.7	13.3	17.0
Ratio L/W	0.688	0.70	0.767	0.705
Capillae per mm	8	9	8	-

Comparisons. Despite the lack of brachial valves, the external and internal morphology of the pedicle valves of this form are typical of the genus *Sinochonetes*. These specimens are very close to *S. wangi* sp. nov. in shape, radial ribbing and internal features. However, they differ in having a larger shell, which is about twice the size of that of *S. wangi*. Moreover, the posterior muscle-bounding ridges are better developed and more divergent in *Sinochonetes* sp. nov.; the myophragm is longer and the diductor scars are more triangular, elongated and distinctly remote anteriorly. Although these characteristics are of real value at the specific level, additional material, especially brachial valves, is necessary before this taxon can be described as a new species.

Figured specimens. Four pedicle valves, GSC 75831, 75833 and 75834 from GSC locality 27777 (Pl. 3, figs. 22-25).

Subfamily DAGNACHONETINAE Afanasjeva, 1978

Genus *Dagnachonetes* Afanasjeva, 1978

Type species. *Dagnachonetes caucasius* Afanasjeva, 1978.

Subgenus *Dagnachonetes* (*Dagnachonetes*) Afanasjeva, 1978

Type species. *Dagnachonetes caucasius* Afanasjeva, 1978.

Dagnachonetes (*Dagnachonetes*) *quietus* sp. nov.

Plate 4, figures 7-14; Figure 7

Derivation of name. After the latin *quietus*, calm; alluding to the morphology of the shell.

Material and occurrence. Sixty-four specimens from the upper Blue Fiord and lower Bird Fiord formations. Blue Fiord Formation, Devon Island, collected by Brice in 1971: north of Porden Point, GSC locality C-10271 (20 specimens); east of Grinnell Peninsula, GSC locality C-10281 (23 specimens). Bird Fiord Formation, Devon Island, Tucker Point anticline, collected by McLaren in 1955, GSC locality 27761 (20 specimens). Ellesmere Island, Blue Fiord area, collected by Brice and Meats in 1972, GSC locality C-21955 (1 specimen).

Dimensions (mm).

GSC no.	75835 (holotype)	75836	75837	75838
GSC locality	C-10271	C-10271	C-10271	C-10271
Length of pv (L)	14.0	11.5	14.5	12.5
Width of pv (W)	22.0	20.0	23.0	20.1
Ratio L/W	0.63	0.575	0.63	0.62
Depth of pv (D)	3.0	2.5	2.7	2.4
Ratio L/D	4.66	4.6	5.37	5.20
Capillae per mm	12	-	11	13

Description. Exterior: shell of medium size (maximum length 14.5 mm; corresponding width 23 mm), transverse in outline (length/width ratio between 0.52 and 0.69). Anterior margin slightly convex, sometimes almost parallel to hinge line. Maximum width at hinge line; lateral margins almost perpendicular to hinge line. Pedicle valve weakly convex.

Dagnachonetes (*Dagnachonetes*) *quietus* sp. nov.

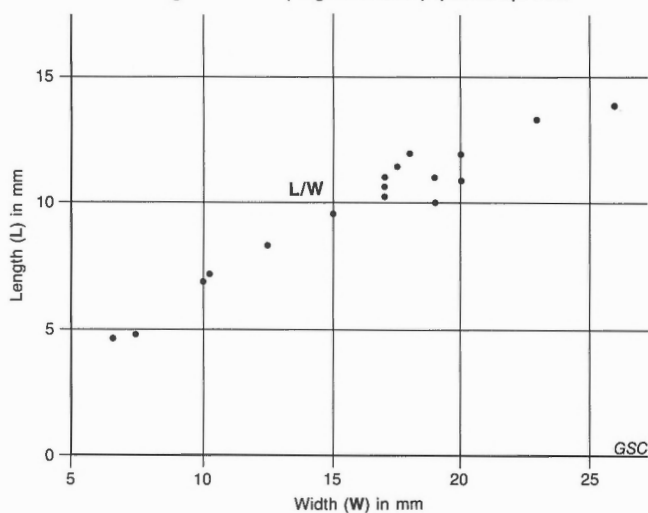


Figure 7. *Dagnachonetes* (*Dagnachonetes*) *quietus* sp. nov. from the upper Blue Fiord Formation, Devon Island; length versus width (L/W).

Brachial valve weakly concave, almost flat. Ventral interarea flat and aplanate with wide delthyrial opening; pseudodeltidium short. Dorsal interarea hypercline; chilidium not observed. Radial ornamentation of very fine, low, narrow and rounded capillae with larger intervals. Capillae commonly irregular, sinuous, increasing both by bifurcation and intercalation and thinning toward the anterior commissure. Growth lines numerous, more or less regularly spaced in posterior half of shell, becoming stronger and irregular in anterior half of largest specimens. Eight to eleven capillae per mm in middle part of shell, and 9 to 14 along anterior margin. Spines are symmetrically arranged, one pedicle valve shows eight spine bases on each side of beak; spines are of oblique orthomorph type.

Pedicle valve interior: median septum high, short and narrow, ending at posterior margin of adductor scars, giving way anteriorly to low, thin myophragm extending as far as mid-length of valve. Adductor scars oval, elongated. Vascula media short, well impressed, parallel to myophragm. Diductor scars triangular, regularly rounded anteriorly, bounded posteriorly by straight posterior ridges diverging at approximately 135°. Teeth massive, bulbous. Inner surface covered with very small papillae almost radially arranged.

Brachial valve interior: wide and short cardinal process, internally bilobed; myophore not observed. Alveolus ill-defined. Inner cristae variably developed, sometimes very long, straight, subparallel to hinge line, sometimes shorter, bending posteriorly, rarely extending beyond sockets. Median septum, supporting cardinal process, as a regular, low, rounded ridge becoming narrower and tapering anteriorly. Length of median septum about two thirds that of valve. Aderidia straight, well developed, diverging anteriorly at 55°, fused posteriorly with cardinalia. Anterior adductor scars relatively large, limited anteriorly in largest shells; posterior scars triangular, deeply impressed in their proximal part, not delimited anterolaterally. Inner surface covered with small papillae almost regularly arranged.

Comparisons. Both external and internal characters allow the assignment of arctic specimens to the genus *Dagnachonetes* Afanasjeva, 1978. The thinning of capillae from beak to anterior margin, as well as the development of strong growth lines, and the location of inner cristae almost at the hinge line, are typical for the subgenus

D. (Dagnachonetes) and exclude their belonging to the subgenus *D. (Luanquella)* Garcia-Alcalde and Racheboeuf, 1978. Specimens from the Canadian Arctic are very close to *Dagnachonetes caucasius* (type species) from the Eifelian (*D. caucasius* and *Alatiformia araxica* Zone) from Nakichevan, U.S.S.R. *Dagnachonetes quietus* sp. nov. differs from the type species in the following points: externally, the radial ribbing is much finer, with 8 to 11 capillae per mm instead of 4; internally, the most significant differences are in the brachial valve: inner cristae are narrower and longer, anderidia are relatively shorter, and brachial ridges are never developed in *D. (D.) quietus* sp. nov. These differences are sufficient to warrant the proposal of a new species.

Figured specimens. GSC 75835 (holotype) from GSC locality C-10271 (Pl. 4, figs. 7-10), GSC 75836 to 75837 (paratypes) from GSC locality C-10271 (Pl. 4, figs. 13, 14) and GSC 75839 (paratype) from GSC locality C-10281 (Pl. 4, figs. 11, 12).

Locality data. GSC locality C-10271, Devon Island, north of Porden Point, southeast of Grinnell Peninsula, latitude 76°18'52"N, longitude 93°47'57"W, upper Blue Fiord Formation.

GSC locality C-10281, Devon Island, Grinnell Peninsula, about 30 km from Tucker Point, latitude 76°45'N, longitude 94°32'W, upper Blue Fiord Formation, between 13 and 15 m below the top.

GSC locality C-21955, Ellesmere Island, about 5 km northeast of the head of Bird Fiord, latitude 77°12'16"N, longitude 86°32'30"W, Bird Fiord Formation, Lower member, between 0 and 2 m above the base.

GSC locality 27761, Devon Island, Grinnell Peninsula, Tucker Point anticline, lower Bird Fiord Formation (Fortier et al., 1963, p. 248).

Dagnachonetes? grinnellensis sp. nov.

Plate 3, figures 1-6

Derivation of name. After Grinnell Peninsula.

Material and occurrence. One hundred mainly incomplete or badly preserved specimens from the lower Blue Fiord Formation, Devon Island, collected by Brice in 1971; southeast of Grinnell Peninsula, northwest of Grove Lake, GSC locality C-10262.

Dimensions (mm).

GSC no.	75841	75842	75843	75844
GSC locality	C-10262	C-10262	C-10262	C-10262
Length of pv (L)	9.2	10.0	9.5	8.1
Width of pv (W)	12.4	15.0	15.0	10.5
Ratio L/W	0.74	0.66	0.63	0.77
Depth of pv (D)	2.6	3.5	3.0	2.3
Capillae per mm	9	11	10	11

Description. Exterior: shell small (maximum length 11.2 mm), moderately transverse (length/width ratio between 0.63 and 0.77). Commissure regularly rounded; maximum width located at hinge line in largest shells, slightly anterior to it in juvenile specimens. Pedicle valve regularly arched; brachial valve concave. Ventral interarea narrow, flat, and apsacline with relatively small pseudodeltidium. Dorsal

interarea very narrow and hypercline, with low, wide, slightly prominent chlidium. Radial ornamentation of very fine, low, rounded capillae increasing mainly by bifurcation. Capillae separated by narrower intervals and crossed by very fine concentric growth lines, some of them becoming lamellose anteriorly. Nine to twelve capillae per mm along anterior margin. Five spines on each side of beak; only symmetrically arranged bases are preserved, but in their proximal part, spines appear to be posterolaterally directed.

Pedicle valve interior: hinge teeth not observed; posterior muscle-bounding ridges relatively short, low and rounded. Median septum thickened posteriorly. Poor muscle scar impressions on available specimens. Vascula media well developed, long and wide, parallel to mid-line. Visceral cavity delimited in largest shells only.

Brachial valve interior: cardinal process elevated above posterior part of median septum, bilobed internally; myophore not observed. Median septum a thick, rounded ridge, about two-thirds of valve length. Anderidia long, elevated above valve floor, diverging anteriorly at 60°, not fused posteriorly with septum. Muscle scars not impressed. Inner cristae two long, rounded ridges subparallel to hinge line. Inner surface covered with very small pustules, except on brachial platform.

Comparisons. The new species is tentatively assigned to the genus *Dagnachonetes* because of its external ornament, and posterolaterally directed hinge spines, the shape and location of the inner cristae, anderidia and the median septum. However, the available material is not well enough preserved for a subgeneric assignment. Among the other species of the genus, *D.? grinnellensis* sp. nov. differs by its relatively small, slightly transverse and clearly concavo-convex shell.

Figured specimens. GSC 75840 (holotype) from GSC locality C-10262 (Pl. 3, figs. 3, 4), GSC 75841 to 75846 (paratypes) from the same locality (Pl. 3, figs. 1, 2, 5, 6).

Locality data. GSC locality C-10262, Devon Island, southeast of Grinnell Peninsula, northwest of Grove Lake, latitude 76°25'N, longitude 93°40'W, Blue Fiord Formation, Lower member, 5 m above contact with Prince Albert Formation.

Dagnachonetes? pordenensis sp. nov.

Plate 4, figures 1-6; Figure 8

Derivation of name. After Porden Point.

Material and occurrence. Forty-five specimens from the upper Blue Fiord Formation, Devon Island, collected by Brice in 1971; Grinnell Peninsula, northwest of Grove Lake, GSC locality C-10272 (6 specimens); north of Porden Point, GSC locality C-10293 (39 specimens).

Dimensions (mm).

GSC no.	75847	75848	75849	75850
GSC locality	C-10293	C-10293	C-10293	C-10293
Length of pv (L)	6.4	6.5	6.1	4.7
Width of pv (W)	9.2	9.4	8.7	6.4
Ratio L/W	0.695	0.691	0.70	0.73
Depth of pv (D)	1.6	1.7	1.6	0.9
Ratio L/D	4.0	3.82	3.81	5.22
Capillae per mm	14	-	-	16

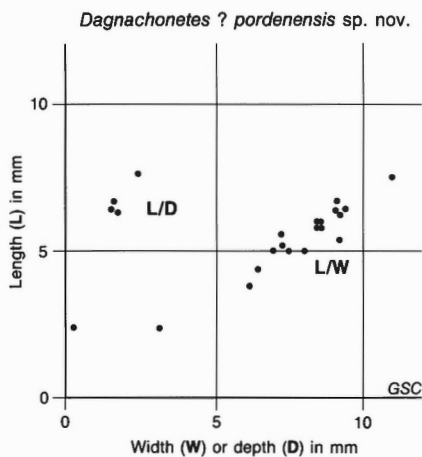


Figure 8. *Dagnachonetes? pordenensis* sp. nov., length versus width (L/W) and length versus depth (L/D).

Description. Exterior: shell small (maximum length 7.6 mm), moderately transverse outline (length/width ratio between 0.67 and 0.75). Commissure regularly rounded; maximum width at hinge line in juvenile specimens, located almost at mid-length in largest shells. Pedicle valve gently arched (length/depth ratio between 3 and 4), brachial valve moderately concave. Ventral interarea relatively high in relation to size of shell, gently concave and slightly apsacline, with a prominent triangular pseudodeltidium. Dorsal interarea very narrow and hypercline. Radial ornamentation of very fine, low, rounded capillae with narrower intervals, increasing both by intercalation and bifurcation. Along anterior margin, capillae number 15 to 18 per mm. Shell surface covered with very fine concentric growth lines in its posterior half; growth lines becoming lamellose anteriorly. Five spines on each side of the beak, symmetrically arranged, only bases are preserved; spines directed posterolaterally in their proximal part.

Pedicle valve interior: hinge teeth short, thick and elongated laterally. Posterior-bounding muscle ridges relatively long, wide and low, progressively curving toward the anterior margin. In small shells, posterior ridges are straight, diverging anteriorly at 120°. Median septum thickened and elevated posteriorly, ending anteriorly in a thin myophragm. Diductor scars relatively wide and short, rounded, with their anterior margin located at mid-length of valve. Adductor scars oval or subcircular, deeply impressed; two strong vascular trunks (vascula media) originate at their anterior margin. Visceral cavity delimited in largest specimens only. Except on muscle scars, inner surface covered with very small and numerous pustules, often fused together and more or less radially arranged.

Brachial valve interior: cardinal process strongly bilobed internally, supported by a stout median septum, which is about two-thirds the valve length. Septum high, thick, rounded at the top, separating deeply impressed anterior adductor scars. Anderidia as two thick, short, elevated ridges diverging anteriorly at 70°, not fusing posteriorly with the septum. Posterior adductor scars relatively small, triangular. Inner cristae curving posteriorly, overhanging sockets in their proximal part, widened and becoming almost parallel to hinge line in their distal part. Myophore not observed. Inner surface covered with strong, irregular, elongate pustules, except on brachial platform of largest specimens.

Comparisons. This small species can be only tentatively assigned to the genus *Dagnachonetes* because of the features of its dorsal interior, which are rather unusual for the genus. All the external characteristics agree well with such a generic assignment, as do the interior ventral characters. In the brachial valve, the inner cristae are relatively short, thick, and bend posteriorly; the anderidia diverge strongly anteriorly and pustules are strongly developed. These features do not prove the assignment of the new species to the genus *Dagnachonetes*, but this assignment is actually considered to be the most appropriate.

In size and shape, *D.? pordenensis* sp. nov. resembles *D.? grinnellensis* sp. nov.; the two species can be definitively distinguished by the finer radial ribbing and the stouter internal dorsal features of the former species.

Figured specimens. GSC 75852 (holotype) (Pl. 4, figs. 2, 3) and GSC 75847 to 75851 (paratypes) from GSC locality C-10293, (Pl. 4, figs. 1, 4-6).

Locality data. GSC locality C-10272, Devon Island, northwest of Grove Lake, southeast of Grinnell Peninsula, latitude 76°25'N, longitude 93°53'W, upper Blue Fiord Formation.

GSC locality C-10293, Devon Island, north of Porden Point, Grinnell Peninsula, latitude 76°18'N, longitude 93°47'W, Blue Fiord Formation, upper part.

Superfamily PARACHONETINAE Johnson, 1970

Genus *Parachonetes* Johnson, 1966

Type species. *Chonetes macrostriata* Walcott, 1884.

Parachonetes macrostriatus (Walcott, 1884)

Plate 4, figures 15-20

Material and occurrence. Fourteen calcareous, almost complete specimens from the Lower member of the Blue Fiord Formation. Devon Island, southeast of Grinnell Peninsula, collected by Brice in 1971; GSC locality C-10262 (4 specimens). Ellesmere Island, Sør Fiord, collected by Brice in 1971, GSC localities C-10303 (4 specimens), C-10304 (3 specimens) and C-10322 (2 specimens); area at the head of Blue Fiord, collected by Brice and Meats in 1972, GSC locality C-21867 (1 specimen).

Comparisons. Despite their poor preservation, these specimens can be referred to the genus *Parachonetes* Johnson, 1966. The shape of the shell, the morphology and distribution of the hinge spines, as well as the development of the dorsal alveolus, indicate such a generic assignment. At the specific level, the arctic specimens are similar in size, convexity and radial costae to *P. macrostriatus* (Walcott). Johnson (1975, p. 854, Pl. 4, figs. 3, 4) described and illustrated *Parachonetes?* sp. from the Disappointment Bay Formation of Lowther Island; this unique specimen (from GSC locality C-2682) appears to be conspecific with that described here.

Jones and Smith (1980, p. 687; Pl. 4, figs. 14-16) described *Parachonetes?* sp. from near the top of the Eids Formation, in a section southwest of Ellesmere Island. Size, convexity and ornamentation of the figured specimens, particularly the irregular, sinuous costae originating along the posterior margin of the shell, strongly suggest that they belong to the species *macrostriatus*.

Outside the Canadian Arctic Archipelago, the species is known from Nevada in the *Acrospirifer kobehana* and *Eurekaspirifer pinyonensis* zones (Johnson, 1970), in the Yukon Territory (Ludvigsen, 1970; Lenz, 1977; Jackson et al., 1978), in the Mackenzie Mountains (Perry et al., 1974) and in central Eastern Alaska (Lane and Ormiston, 1979), in Zlichovian strata.

Figured specimens. GSC 75853 to 75856 from GSC locality C-10262, (Pl. 4, figs. 15-20).

Locality data. GSC locality C-10262, Devon Island, northwest of Grove Lake, southwest of Grinnell Peninsula, latitude 76°25'N, longitude 93°48'W, Lower member of the Blue Fiord Formation, 5 m above the contact with the Prince Albert Formation.

GSC localities C-10303, C-10304, C-10322, 37.3 m, 38 m and 197.3 m, respectively, above the base of the Blue Fiord Formation, Sör Fiord, Ellesmere Island.

GSC locality C-21867, Ellesmere Island, about 12.5 km southeast of the head of Blue Fiord, latitude 77°13'45"N, longitude 86°24'W, Lower member of the Blue Fiord Formation, 193 m above the base of the formation.

Family CHONOSTROPHIIDAE Muir-Wood, 1962

Genus *Chonostrophiella* Boucot and Amsden, 1964

Type species. *Chonetes complanata* Hall, 1857.

Chonostrophiella cynthiae sp. nov.

Plate 5, figures 1-10; Figure 9

Derivation of name. After Cynthia, goddess of the moon.

Material and occurrence. Two hundred and eleven mainly incomplete, calcareous shells, three of which are articulated, from Devon Island, Upper member of the Blue Fiord Formation. Southeast of Grinnell Peninsula, north of Porden Point, collected by Brice in 1971, GSC localities C-10252 (26 specimens), C-10270 (90 specimens), C-10271 (27 specimens) and C-10293 (43 specimens); northwest of Grove Lake, collected by Brice in 1971, GSC localities C-10272 (19 specimens) and C-10274 (6 specimens).

Dimensions (mm).

GSC no.	75857 (holotype)	75858	75860a	75860b
GSC locality	C-10293	C-10293	C-10271	C-10271
Length of pv (L)	22.5	24.0	12.3	15.1
Width of pv (W)	47.0	42.0	20.2	26.5
Ratio L/W	0.48	0.57	0.609	0.57
Depth of pv (D)	3.3	3.7	1.5	2.1
Capillae per mm	10	11	9	9

Description. Exterior: shell large (maximum width 46.5 mm), almost perfectly semicircular in outline (mean length/width ratio 0.58, 43 measurements). Posterior margin of shell rectilinear. Pedicle valve nearly flat in small

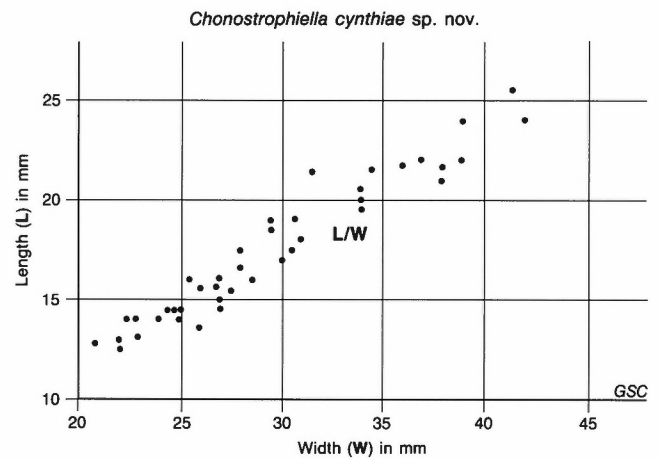


Figure 9. *Chonostrophiella cynthiae* sp. nov. from the upper Blue Fiord Formation, Devon Island; length versus width (L/W).

specimens, becoming progressively, regularly and gently concave during ontogeny. Brachial valve gently convex. Ventral interarea flat and strongly procline, at a low angle with dorsal interarea, which is anacline and one third high. Pseudodeltidium fairly large, triangular and prominent. One specimen shows two thick chilidial plates. Up to nine pairs of spines almost symmetrically arranged on each side of beak. Spines of orthomorph type, at a high angle with posterior margin (angle varies between 80° and 95°). Radial ornamentation of very fine capillae with narrower intervals. Capillae low, rounded, sinuous and irregular in width, increasing both by intercalation and bifurcation. Capillae number 9 to 14 per mm along anterior margin. Shell surface covered with numerous concentric growth lines, only one or two being strongly differentiated.

Pedicle valve interior: hinge teeth broad and short, rounded anteriorly. Visceral cavity large, posteriorly bounded by two rounded pads almost parallel to hinge line. Muscle field very large, longitudinally divided by a long, thin myophragm extending anteriorly up to two thirds of valve length. Adductor scars narrow, triangular and elongated. Diductors very wide, rounded anteriorly and remote medially. Vascula media weakly impressed, short and narrow. Muscle field bounded posteriorly by two low ridges, which diverge anteriorly at approximately 150°. Except for the muscle field, visceral cavity covered with tiny papillae. Posterior part of cavity between posterior ridges and hinge line with strong pustules virtually fused at their bases.

Brachial valve interior: median septum as rounded ridge, narrowing and declining anteriorly, extending up to mid-length of valve. Cardinal process large, bilobed internally; myophore triangular, widened, with two deeply, longitudinally grooved lobes. Anterior margin of cardinal process nearly vertical with respect to valve floor. Inner cristae short and narrow but relatively high and rounded at top, bending posteriorly, their steep anterior margin laterally prolonging anterior edge of cardinal process. Dental sockets partly covered by posterior margin of inner cristae. Anterior adductor scars deeply impressed, triangular in outline and bounded laterally by long, narrow, high anderidia diverging anteriorly at about 50°. Posterior adductor scars distinct, tear-shaped in outline. Brachial platform smooth, well-differentiated in large specimens. Inner surface covered with numerous and very small papillae.

Comparisons. External as well as internal features of these specimens are typical for the genus *Chonostrophiella*, and warrant this generic assignment. Primarily, *Chonostrophiella cynthiae* sp. nov. can be easily distinguished from the other species of the genus by its large size and relatively more widely spaced spines, although adequate comparative material of the species referred by Boucot and Amsden to *Chonostrophiella* was not available (*Chonetes dawsoni* Billings, 1874; *Chonostrophia helderbergia* Hall and Clarke, 1892; *C. jervensis* Schubert; *C. lindenensis* Foerste, 1909). Comparison with *Chonetes complanata* Hall, 1857 (type species), can be established because of the revision by Boucot and Amsden in 1964. Externally, *C. cynthiae* sp. nov. differs from *C. complanata* by the presence of more numerous, more widely spaced hinge spines at higher angles, and the outline of the shell is more semicircular. In *C. cynthiae* sp. nov., the ventral interarea is strongly procline, almost catacline, and the dorsal interarea is anacline, almost catacline, whereas in *C. complanata* they are catacline to steeply aspacline and steeply anacline, respectively. Furthermore, the pseudodeltidium is larger and more prominent in the arctic specimens. Internally, the ventral muscle field is wider, with more anteriorly divergent posterior ridges in *C. cynthiae* sp. nov. In the brachial valve interior, inner cristae are better developed in the new species and the morphology (see description above) is quite characteristic.

Chonostrophiella khinganensis Hamada, 1971, from the Lower Devonian of the Lesser Khingan District (northeastern China) is smaller; its outline is not typically semicircular and the ventral muscle field is relatively smaller and narrower.

According to Boucot and Amsden (1964, p. 881) *Chonostrophiella* ranges from the early Early Devonian to late Early Devonian (Esopusian age, with *Etymothyris*), and its geographic distribution is restricted to eastern North America and possibly Colombia. The occurrence of this genus in northeastern China, in the Canadian Arctic Archipelago and in Venezuela (Benedetto, 1985) adds considerably to the geographic extension of *Chonostrophiella* during Early Devonian time.

Figured specimens. GSC 75857 (holotype) from GSC locality C-10293 (Pl. 5, figs. 1, 8), GSC 75858, GSC 75859 (paratypes) from GSC locality C-10293 (Pl. 5, figs. 4, 10); GSC 75860 to 75862 (paratypes) from GSC locality C-10271 (Pl. 5, figs. 5, 6, 9); GSC 75863 (paratype) from GSC locality C-10291 (Pl. 5, figs. 2, 3); GSC 75864 (paratype) from GSC locality C-10270 (Pl. 5, fig. 7).

Locality data. GSC locality C-10252, Devon Island, north of Porden Point, upper Blue Fiord Formation.

GSC locality C-10270, Devon Island, north of Porden Point, Grinnell Peninsula, latitude 76°18'47"N, longitude 93°48'15"W, upper Blue Fiord Formation.

GSC locality C-10271, Devon Island, north of Porden Point, southeast of Grinnell Peninsula, latitude 76°18'52"N, longitude 93°47'57"W, upper Blue Fiord Formation.

GSC locality C-10293, Devon Island, north of Porden Point, Grinnell Peninsula, latitude 76°18'N, longitude 93°47'W, upper Blue Fiord Formation.

GSC locality C-10272, Devon Island, northwest of Grove Lake, southeast of Grinnell Peninsula, latitude 76°25'N, longitude 93°53'W, upper Blue Fiord Formation.

GSC locality C-10274, same locality, about 20 m above GSC locality C-10272.

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PLATE 1

Figures 1-3. *Philippotia* ? (*Chlupacina*) sp.

1. Pedicle valve, x 6, GSC 75793, GSC locality C-21918.
2. Pedicle valve, x 6, GSC 75794, GSC locality C-21918.
3. Pedicle valve, x 6, GSC 75793, GSC locality C-21918.

Figures 4-9. *Philippotia* (*Philippotia*) *briceae* sp. nov.

- 4, 5. Pedicle valve, latex cast of exterior (fig. 4) and interior (fig. 5), x 4, holotype, GSC 75791, GSC locality C-21870.
6. Pedicle valve exterior, latex cast, x 4, paratype, GSC 75790, GSC locality C-21870.
7. Interior of a nearly complete brachial valve, latex cast, x 4, paratype, GSC 75792, GSC locality C-21869.
8. Pedicle valve exterior, latex cast, x 4, paratype, GSC 75788, GSC locality C-21869.
9. Pedicle valve exterior, latex cast, x 4, paratype, GSC 75789, GSC locality C-21893.

Figures 10-18. *Johnsonetes ellesmerensis* gen. et sp. nov.

10. Pedicle valve, x 3, holotype, GSC 75796, GSC locality C-10336.
11. Pedicle valve, x 3, paratype, GSC 75797, GSC locality C-10336.
12. Pedicle valve, x 3, paratype, GSC 75795, GSC locality C-10335.
13. Shell with both valves connected and with well preserved hinge spines, latex cast, x 3, paratype, GSC 75802, GSC locality C-21869.
- 14, 15. Interior of a brachial valve, internal mould (fig. 14) and latex cast (fig. 15), x 3, paratype, GSC 75800, GSC locality C-10336.
16. Incomplete brachial valve interior, x 3, paratype, GSC 75799, GSC locality C-10336.
17. Pedicle valve, latex cast, x 3, paratype, GSC 75801, GSC locality C-21863.
18. Interior of brachial valve, latex cast, x 3, paratype, GSC 75798, GSC locality C-10336.

Figures 19-23. *Johnsonetes arcticus* gen. et sp. nov.

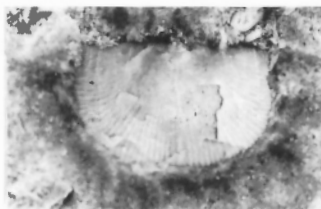
- 19-21. Pedicle valve, x 3, in ventral (fig. 19), lateral (fig. 20) and posteroventral (fig. 21) views, holotype, GSC 75803, GSC locality C-21928.
- 22, 23. Nearly complete shell in dorsal view (fig. 23, x 3), and enlarged view of the posteromedian part of the shell (fig. 22, x 9) GSC 75806, GSC locality 26522.



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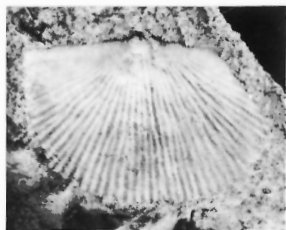
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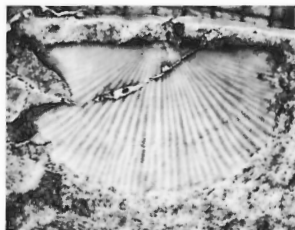
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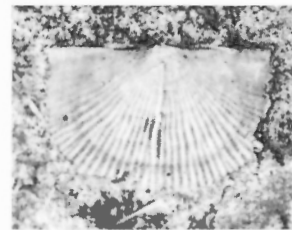
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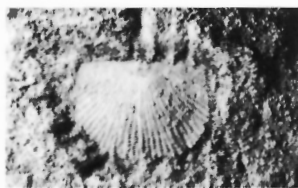
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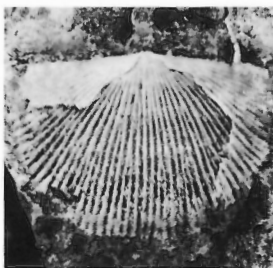
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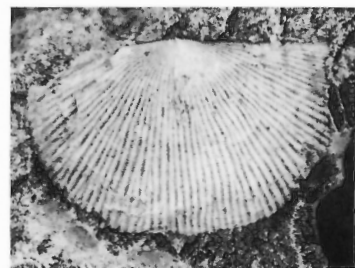
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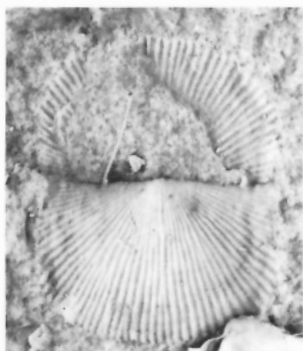
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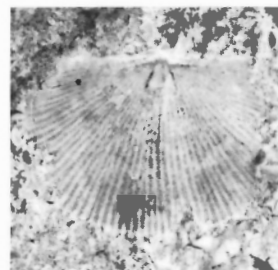
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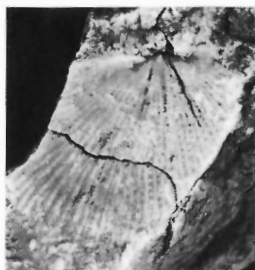
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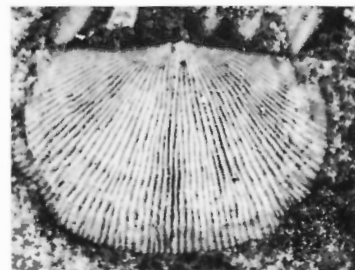
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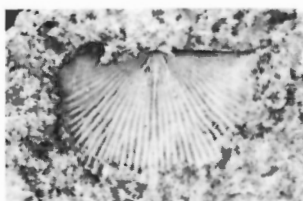
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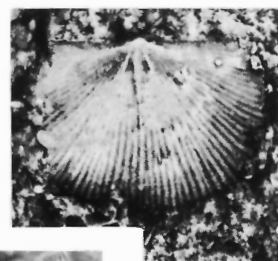
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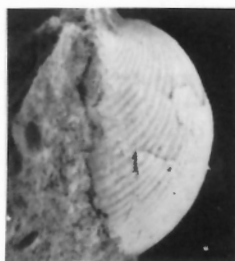
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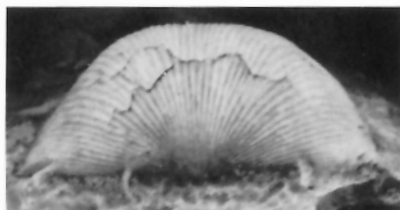
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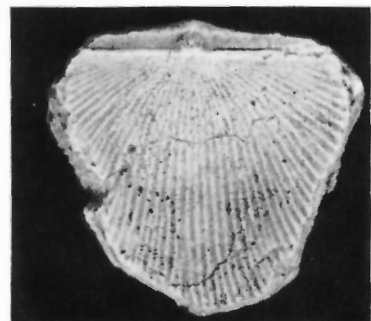
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PLATE 2

Figures 1-11. *Johnsonetes arcticus* gen. et sp. nov.

- 1, 2. Interior of a juvenile pedicle valve, posterior (fig. 1) and ventral (fig. 2) views, x 3, paratype, GSC 75809, GSC locality C-21872.
- 3-5. Pedicle valve interior, posterior (fig. 3), lateral (fig. 4) and ventral (fig. 5) views, x 3, paratype, GSC 75805, GSC locality C-21930.
- 6, 7. Interior of a gerontic pedicle valve, posterior (fig. 6) and ventral (fig. 7) views, x 3, paratype, GSC 75804, GSC locality C-21928.
8. Posterior part of a brachial valve interior, latex cast, x 3, paratype, GSC 75807, GSC locality C-10348.
- 9-11. Brachial valve interior mould (fig. 9), latex cast (fig. 11), x 3, and enlarged view of the posteromedian part of the valve (fig. 10), x 5, paratype, GSC 75808, GSC locality C-10348.

Figures 12-23. *Caplinoplia rectispina* (Khalfin ?)

- 12, 13. Pedicle valve, posterior (fig. 12) and ventral (fig. 13) views, x 3, GSC 75813, GSC locality C-10299.
14. Juvenile pedicle valve, x 3, GSC 75814, GSC locality C-10299.
- 15, 16. Free broken shell, lateral (fig. 15) and dorsal (fig. 16) views, x 3, GSC 75815, GSC locality C-10299.
- 17, 18. Pedicle valve interior, posterior (fig. 17) and ventral (fig. 18) views, x 3, GSC 75817, GSC locality C-10299.
19. Large, gerontic pedicle valve, x 3, GSC 75812, GSC locality C-10299.
20. Brachial valve exterior, x 3, GSC 75816, GSC locality C-10299.
21. Brachial valve interior, x 3, GSC 75818, GSC locality C-10299.
- 22, 23. Incomplete brachial valve interior, latex cast (fig. 22) and original (fig. 23), x 3, GSC 75819, GSC locality C-10299.



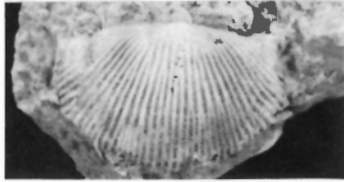
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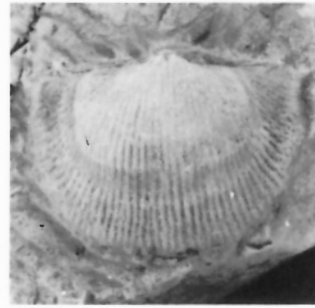
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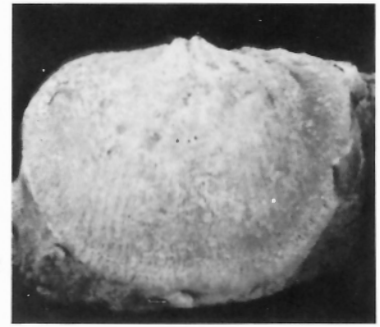
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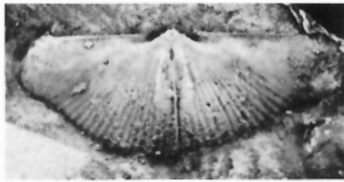
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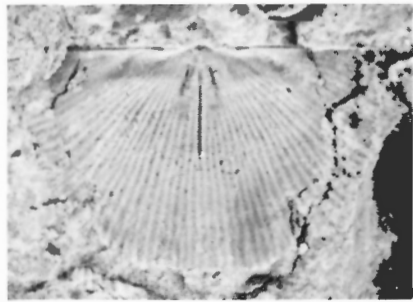
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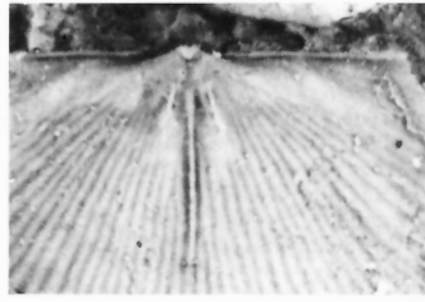
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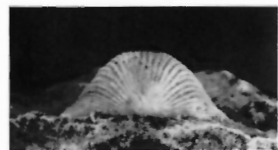
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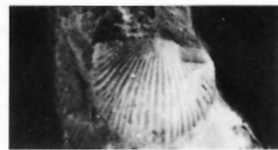
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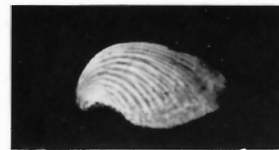
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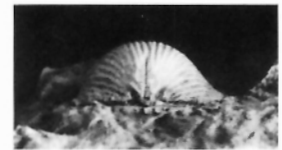
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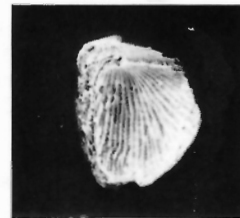
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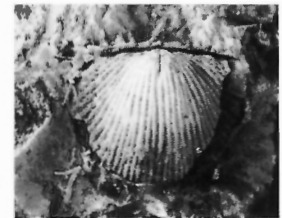
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PLATE 3

Figures 1-6. *Dagnachonetes? grinnellensis* sp. nov.

1. Two pedicle valves, one interior view and one exterior view, x 2.5, paratype, GSC 75843, GSC locality C-10262.
2. Pedicle valve, x 2.5, paratype, GSC 75841, GSC locality C-10262.
- 3, 4. Internal mould of a complete shell, pedicle (fig. 3) and brachial (fig. 4) valve interiors, x 2.5, holotype, GSC 75840, GSC locality C-10262.
5. Dorsal side of a complete shell, latex cast, x 2.5, paratype, GSC 75845, GSC locality C-10262.
6. Incomplete brachial interior, x 2.5, paratype, GSC 75846, GSC locality C-10262.

Figures 7-14. *Devonochonetes? maclareni* sp. nov.

- 7, 8. Pedicle valve, general view (fig. 7, x 2.5), and detailed view of the radial ribbing (fig. 8, x 5), paratype, GSC 75824, GSC locality 27778.
9. Pedicle valve, x 2.5, holotype, GSC 75820a, GSC locality C-6721C.
10. Two pedicle valves, x 2.5, paratype, GSC 75825, GSC locality 27778.
11. Pedicle valve interior, x 2.5, paratype, GSC 75821, GSC locality C-6721C.
12. Brachial valve, x 2.5, paratype, GSC 75823, GSC locality C-6721C.
13. Brachial valve interior, x 2.5, paratype, GSC 75822a, GSC locality C-6721C.
14. Incomplete brachial valve interior, x 2.5, paratype, GSC 75822b, GSC locality C-6721C.

Figures 15-21. *Sinochonetes wangi* sp. nov.

15. Pedicle valve, x 3, paratype, GSC 75828, GSC locality C-10299.
- 16, 17. Pedicle valve, lateral (fig. 16) and ventral (fig. 17) views, x 3, holotype, GSC 75826, GSC locality C-10299.
- 18, 19. Pedicle valve interior, ventral (fig. 18) and posterior (fig. 19) views, x 3, paratype, GSC 75827, GSC locality C-10299.
20. Juvenile pedicle valve, x 3, paratype, GSC 75830, GSC locality C-10313.
21. Incomplete brachial valve interior, latex cast, x 3, paratype, GSC 75829, GSC locality C-10302.

Figures 22-25. *Sinochonetes* sp. nov. aff. *S. wangi* sp. nov.

22. Pedicle valve with two preserved hinge spines, x 3, GSC 75833, GSC locality 27777.
23. Two partly decorticated pedicle valves, x 3, GSC 75831, GSC locality 27777.
- 24, 25. Pedicle interior, posterior (fig. 24) and ventral (fig. 25) views, x 3, GSC 75834, GSC locality 27777.

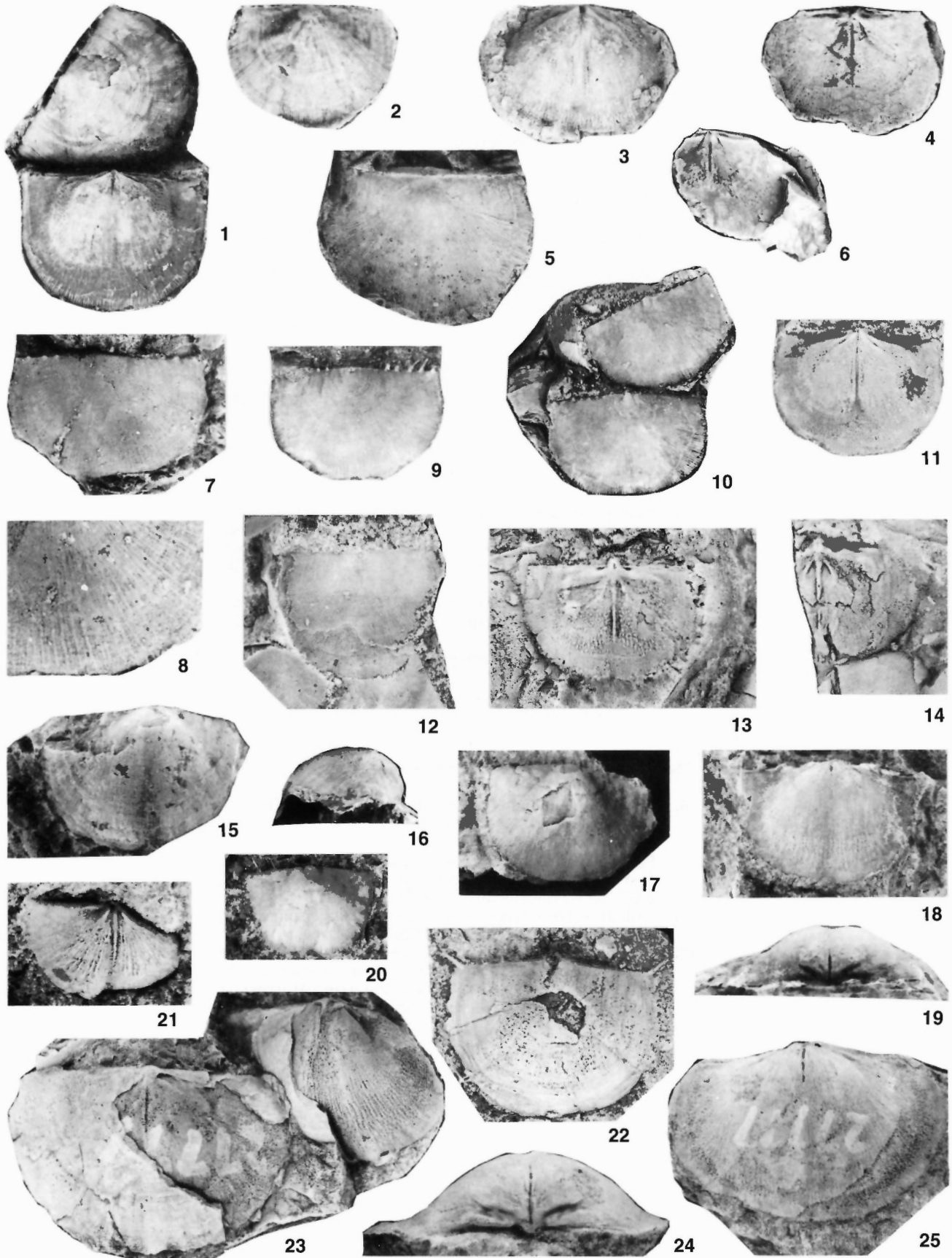


PLATE 4

Figures 1-6. *Dagnachonetes? pordenensis* sp. nov.

1. Pedicle valve, x 4, paratype, GSC 75847, GSC locality C-10293.
- 2, 3. Nearly complete shell with prepared dorsal interior, ventral (fig. 2) and dorsal (fig. 3) views, x 4, holotype, GSC 75852, GSC locality C-10293.
4. Brachial interior, x 4, paratype, GSC 75849, GSC locality C-10293.
5. Brachial interior, x 4, paratype, GSC 75851, GSC locality C-10293.
6. Pedicle interior, x 4, paratype, GSC 75848, GSC locality C-10293.

Figures 7-14. *Dagnachonetes (Dagnachonetes) quietus* sp. nov.

- 7-10. Nearly complete shell with prepared brachial valve interior, ventral (fig. 7), lateral (fig. 8), and dorsal (fig. 9) views and latex cast (fig. 10) of the brachial valve, x 3, holotype, GSC 75835, GSC locality C-10271.
- 11, 12. Brachial valve interior, original (fig. 11) and latex cast (fig. 12), x 3, paratype, GSC 75839, GSC locality C-10281.
13. Pedicle valve, x 3, paratype, GSC 75837, GSC locality C-10271.
14. Pedicle valve interior, x 3, paratype, GSC 75836, GSC locality C-10271.

Figures 15-20. *Parachonetes macrostriatus* (Walcott).

- 15, 16. Incomplete pedicle valve interior, posterior (fig. 15) and ventral (fig. 16) views, x 2, GSC 75853, GSC locality C-10262.
- 17, 18. Pedicle valve interior with partly preserved shell, posterior (fig. 17) and ventral (fig. 18) views, x 2, GSC 75854, GSC locality C-10262.
19. Pedicle valve interior with preserved hinge spines, x 2, GSC 75855, GSC locality C-10262.
20. Brachial valve, damaged specimen showing the cardinal process, alveolus and inner cristae in the posterior part of the valve, and the external irregular costae, x 2, GSC 75856, GSC locality C-10262.

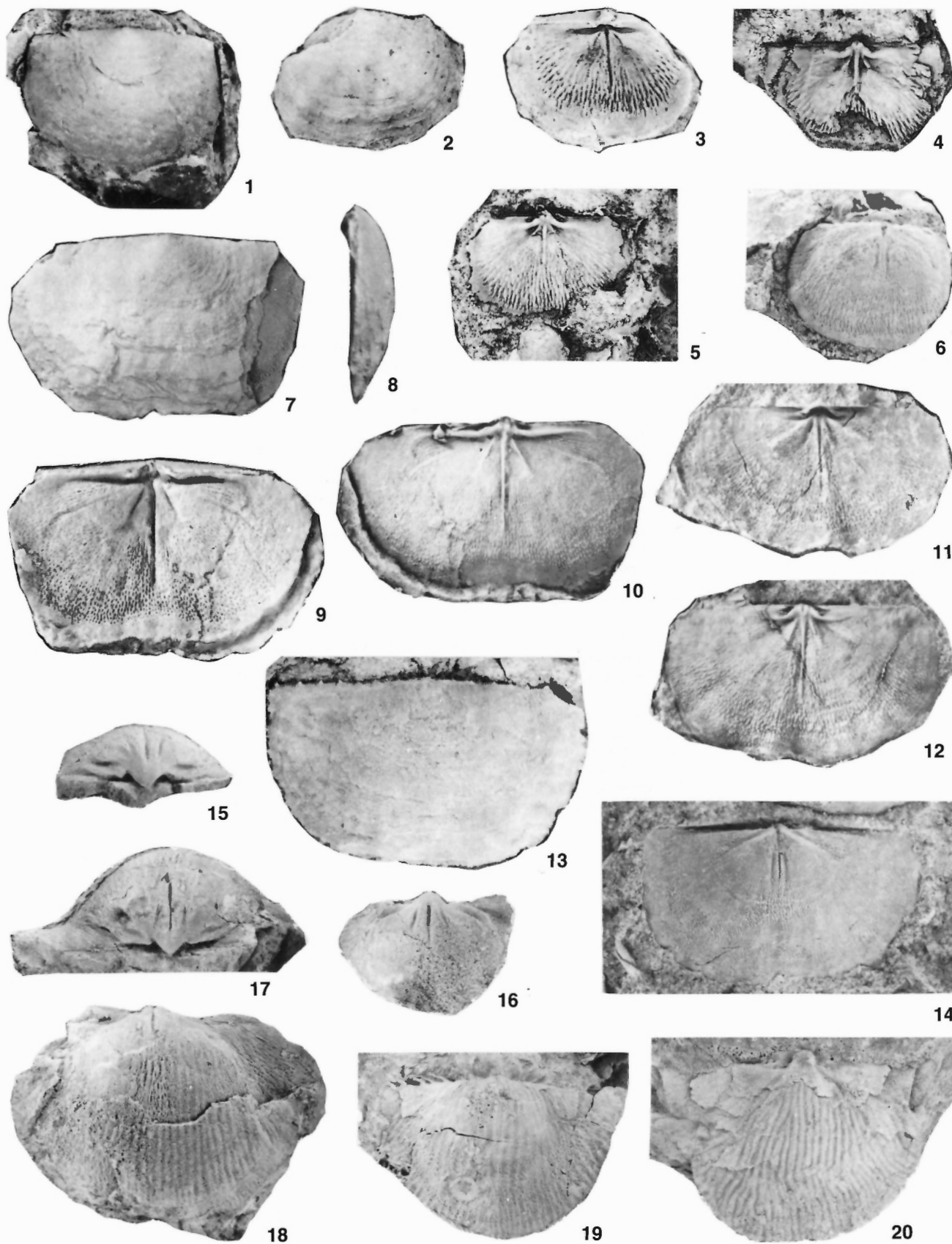
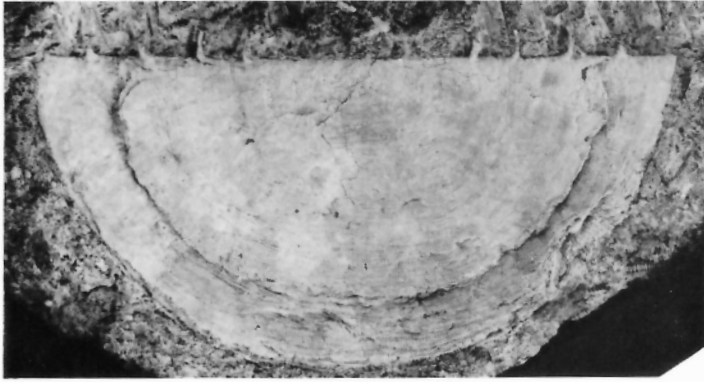


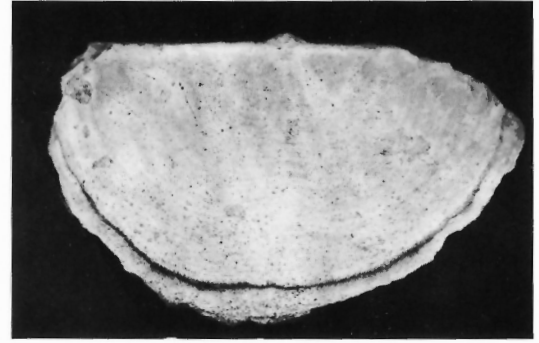
PLATE 5

Figures 1-10. *Chonostrophiella cynthiae* sp. nov.

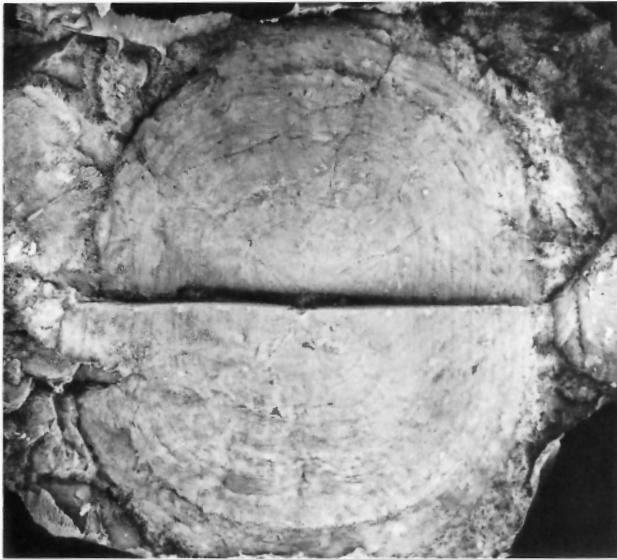
1. Pedicle valve, x 1.8, holotype, GSC 75857, GSC locality C-10293.
- 2, 3. Ventral (fig. 2, x 1.5) and posterior (fig. 3, x 1.7) views of a nearly complete shell, paratype, GSC 75863, GSC locality C-10291.
4. Complete shell with both valves connected, latex cast, x 1.5, paratype, GSC 75858, GSC locality C-10293.
5. Pedicle valve interior, latex cast, x 2, paratype, GSC 75862, GSC locality C-10271.
6. Ventral view of a young individual, x 2, paratype, GSC 75860, GSC locality C-10271.
7. Posterior view of the posteromedian part of a complete shell embedded in matrix, showing the pseudodeltidium, myophore and chilidial plates, x 4, paratype, GSC 75864, GSC locality C-10270.
8. Detailed view of the external ornamentation, x 5.5, holotype, GSC 75857, GSC locality C-10293.
9. Interior of a nearly complete brachial valve, latex cast, x 2, paratype, GSC 75861, GSC locality C-10271.
10. Internal mould of a brachial valve, x 2, paratype, GSC 75859, GSC locality C-10293.



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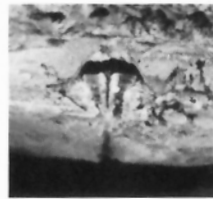
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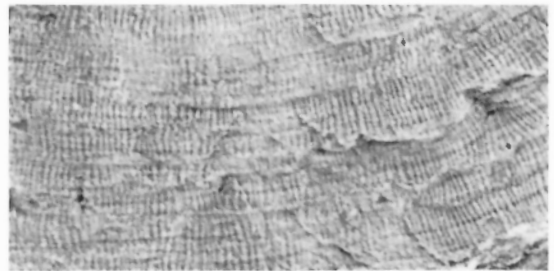
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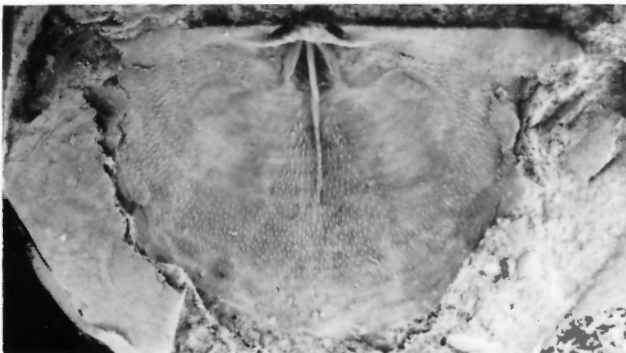
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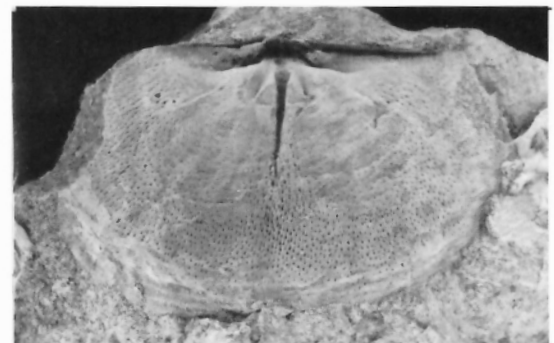
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