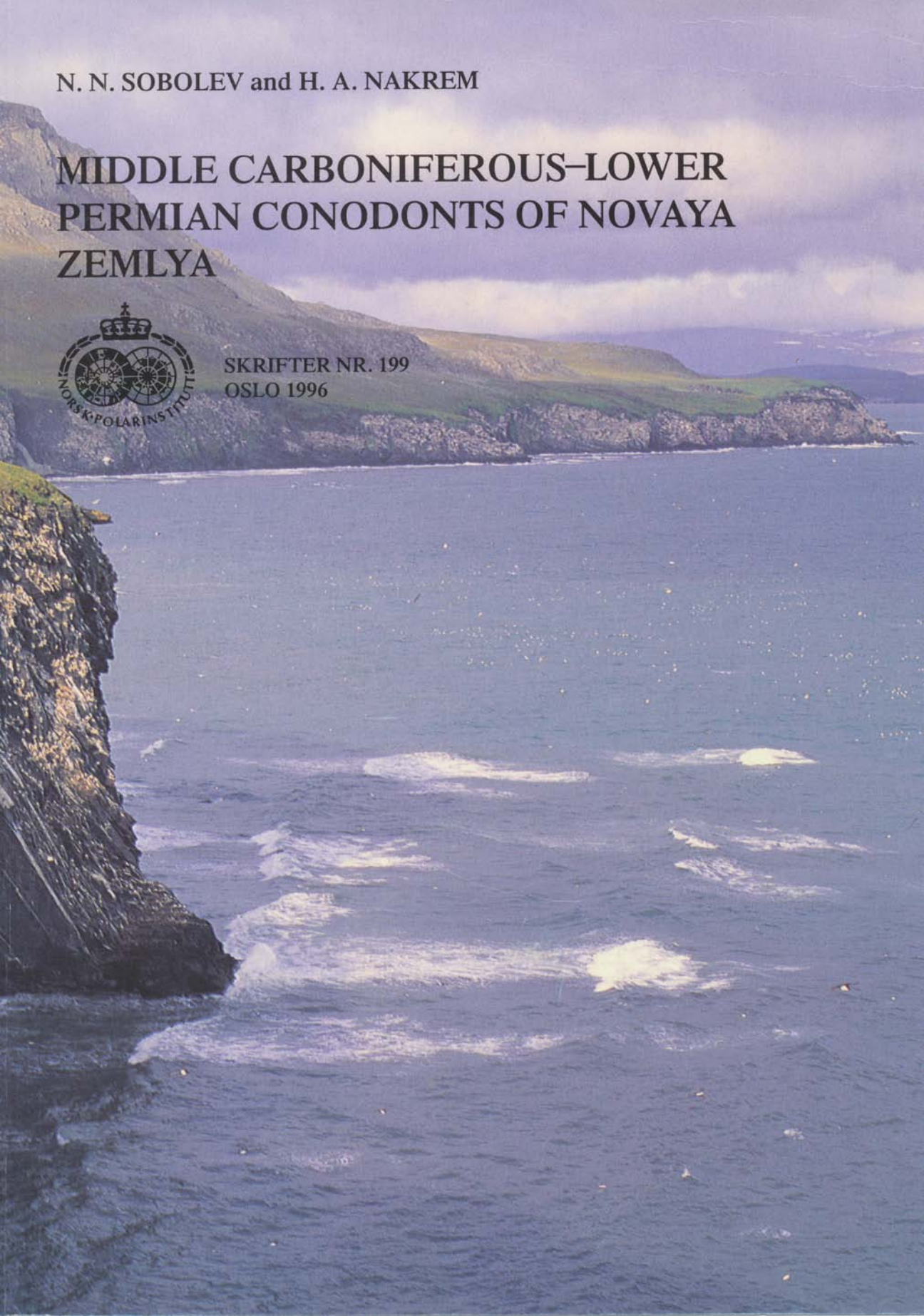
N. N. SOBOLEV and H. A. NAKREM

# MIDDLE CARBONIFEROUS–LOWER PERMIAN CONODONTS OF NOVAYA ZEMLYA



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*Cover:* Palaeozoic rocks along the cliffs in Bezymyannaya Bay. Photo: Hallvard Strøm.

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A total of eleven Middle–Upper Carboniferous and twelve Lower Permian conodont assemblage zones and subzones from 21 sampled sections in Novaya Zemlya and from three wells in the Pechora Sea Shelf are defined in this study. On Novaya Zemlya conodont samples were collected systematically from four regions that represent a wide transition from (near-shore) shallow to deep depositional environments/ settings. Approximately 160 samples contained conodonts. 104 conodont taxa are recognised. Analysis of the distribution of these conodont taxa has resulted in the recognition of 23 local conodont zones and subzones, most of which are assemblage zones.

Chronostratigraphic correlation indicates that these zones range from Early Bashkirian (*Declinognathodus noduliferus* Assemblage Zone) to Late Artinskian (*Neostreptognathodus pequopensis* Assemblage Zone). In the Carboniferous part of the succession, conodont zones are defined from both shallow and basinal facies. Early Permian conodont assemblages obtained from basinal facies are essentially different from coeval assemblages from shallow water deposits. Comparison of conodont assemblages of Novaya Zemlya with zonal assemblages from type sections of the Russian Platform and the Urals has provided precise dating of local stratigraphic units. In addition, correlation of the Middle Carboniferous–Lower Permian sections of Novaya Zemlya with those of the Sverdrup Basin (Arctic Canada) and Svalbard is possible based on the defined conodont zones. Conodont Colour Alteration Index (CAI) isopach maps have been prepared for the Middle Carboniferous and Upper Carboniferous–Lower Permian from Novaya Zemlya and the Pechora Sea Shelf. An analysis of these maps allows identification of potentially oil-producing deposits in the Middle Carboniferous–Lower Permian of the Pechora Shelf; potentially gas-producing deposits of this age may occur in the southern and northern areas of Novaya Zemlya. Additionally, because of the regular distribution in the CAI values, oil- and gas-producing rocks may be present to the west and north of Novaya Zemlya.

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## 1 Introduction

This paper describes the conodont faunas obtained from the Middle Carboniferous through Lower Permian succession in Novaya Zemlya, Arctic Russia, and utilises their biostratigraphic significance. The sedimentary succession on Novaya Zemlya has been difficult to correlate to other regions due to an almost complete absence of biostratigraphically significant fossils. The conodont zonation established here provides a biostratigraphic framework for the internal correlation of the investigated successions, as well as correlations with other Arctic regions (Canada and Svalbard) and with reference sections in the Urals.

This report is the first major work on Carboniferous-Permian conodonts from Novaya Zemlya, apart from a small faunule published in Nakrem et al. (1991) based on material collected by O. Holtedahl in 1921 (Holtedahl 1924, 1930; Nakrem 1989).

The investigated material was collected by the senior author during twelve field seasons in Novaya Zemlya. Preparation of samples took place in St. Petersburg (VNIIOkeangeologia); SEM photos were prepared by both authors in St. Petersburg, Oslo (Paleontological Museum) and in Trondheim (IKU).

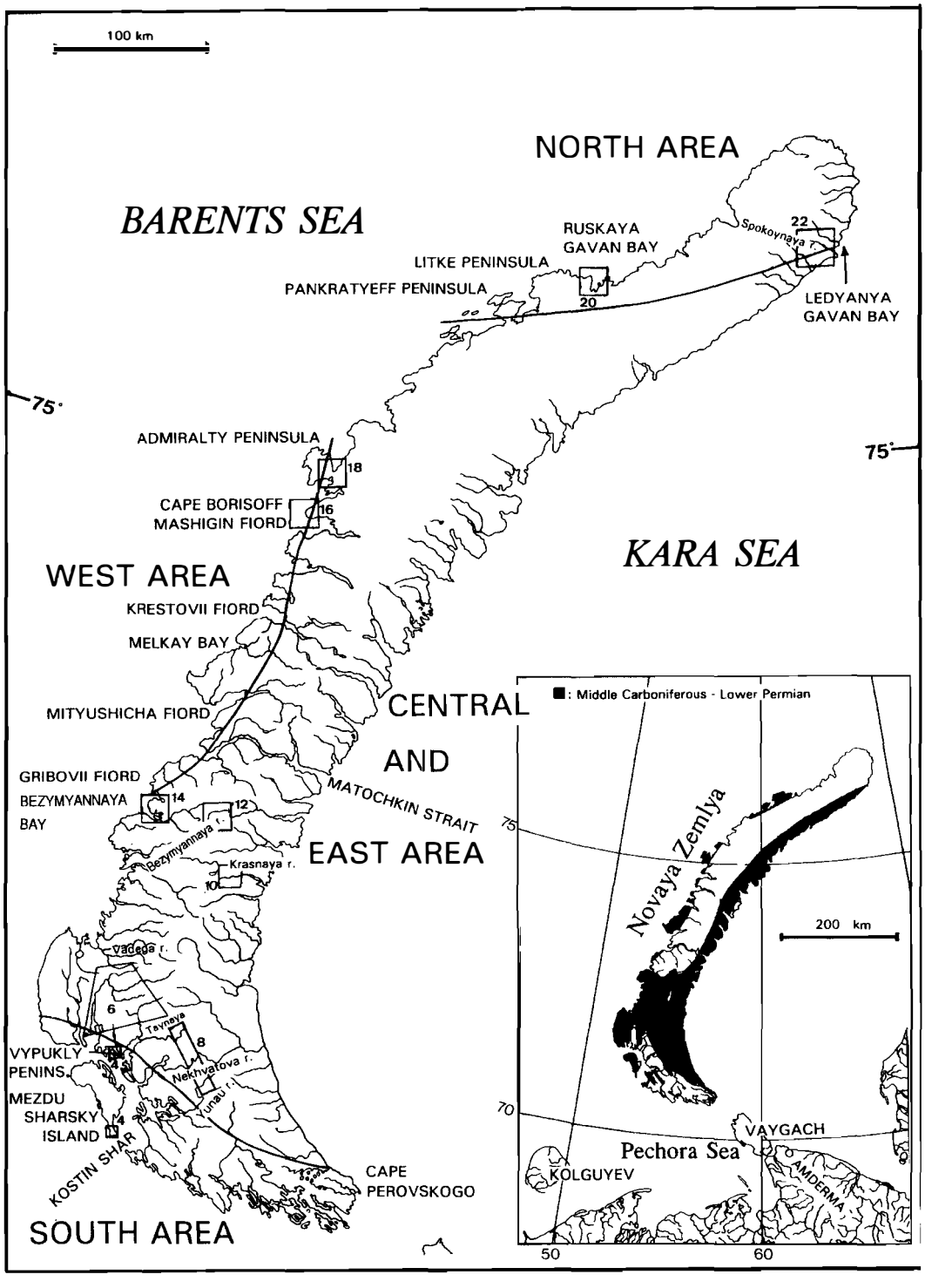


*Fig. 1.* Map of Novaya Zemlya. Framed areas (sampling localities and sections) are enlarged in Figs. 4–23.

# 2 Methods

## 2.1 Sampling procedures

Samples were collected from twenty-one sections, characterising different sedimentary environments of the depositional basin. The deep water part of the depositional basin is dominated by chert and cherty shales with rare carbonate layers. Samples for conodonts were taken from practically all the encountered carbonate beds. In addition search for conodonts on the bedding surfaces of siliceous schists was accomplished following the method proposed by Puchkov (1979). In Novaya Zemlya, this procedure provided good results during studies of the uppermost Devonian Vadegskaya Formation and the Lower Carboniferous Rogachevskaya Formation with recoveries of both separate conodont elements and more complete conodont apparatuses. A visual search for conodonts in the Middle Carboniferous–Lower Permian deposits did not yield the expected results as only rare conodont elements, not identifiable to species, were found.

The Middle Carboniferous–Lower Permian shallow-water succession is of comparatively great thickness (>1 km), and samples were collected at 10–20 m intervals. Mainly limestones were sampled, as well as rocks of a mixed terrigenous-carbonate composition including marls, calcareous siltstones, calcareous sandstones, and conglomerates. Samples (usually 3 to 4 kg) were taken from the base and top of individual beds.

The sampling was accompanied by a bed to bed petrographic description of the sections, as well as a search for foraminifers (M. F. Solovieva, G. E. Sossipatrova, V. I. Davydov, E. V. Bondareva), brachiopods (G. E. Chernyak, V. I. Ustritsky, V. P. Matveev), ammonoids (M. F. Bogoslovskaya, L. F. Kuzina), bryozoans (I. P. Morozova) and tetracorals (O. L. Kossovaya).

## 2.2 Laboratory techniques

The samples collected from carbonate rocks were treated according to standard conodont preparation procedures (Stone 1987). Digestion of limestones was carried out using 10–15% acetic acid. Dolomitic limestones and dolomitic samples required treatment with 20% formic acid. When the solution was changed, the buffer procedure of Jeppsson et al. (1985) was followed to avoid the corrosion of conodont elements. To disintegrate terrigenous carbonate rocks (marls, siltstones, sandstones, conglomerates) the thermo-chemical method of Lethiers et al. (1988) was followed. The samples were initially (1–2 days) subject to heating to 100°C and then dissolved in concentrated acetic acid. The insoluble residue was quickly and carefully wet sieved. This method is very efficient; it enables a full disintegration of 3 kg samples in two weeks. Insoluble residues were screened on a series of sieves, and the fraction smaller than 0.7 mm. was separated in the heavy liquid tetrabromoethane with added methanol to a specific gravity of 2.85 g/cm$^3$. The resulting heavy fraction was dried and examined under a binocular microscope. SEM (Scanning Electron Microscopy) was used for closer examination and photography of selected specimens.

# 3 Study area

Fig. 1 shows the locations of the sections under study. The age of the investigated part of the succession is Middle Carboniferous–Early Permian (Figs. 2 and 3). Detailed maps of particular sections and conodont locations follow in Figs. 4–23. The following sections yielded the richest conodont faunas:

1. Mezhdusharsky Island. Loc. no. 551, 70°56′N, 53°02′E, Figs. 4 and 5
2. Vypukly Peninsula. Loc. no. 8204, 71°26′N, 53°03′E, Figs. 4 and 5
3. Sokolova Peninsula. Loc. no. 549, 71°32′N, 52°28′E, Figs. 6 and 7
4. Vadega River. Loc. no. 11, 71°56′N, 52°45′E, Figs. 6 and 7
5. Rogacheva River. Loc. no. 6616, 71°45′N, 53°03′E, Figs. 6 and 7
6. Severnaya Taynaya River. Loc. no. 513, 71°42′N, 53°37′E, Figs. 6 and 7
7. Yunau River. Loc. no. 124, 753, 71°18′N, 54°48′E, Figs. 8 and 9
8. Yunau River. Loc. no. 101, 71°19′N, 54°45′E, Figs. 8 and 9

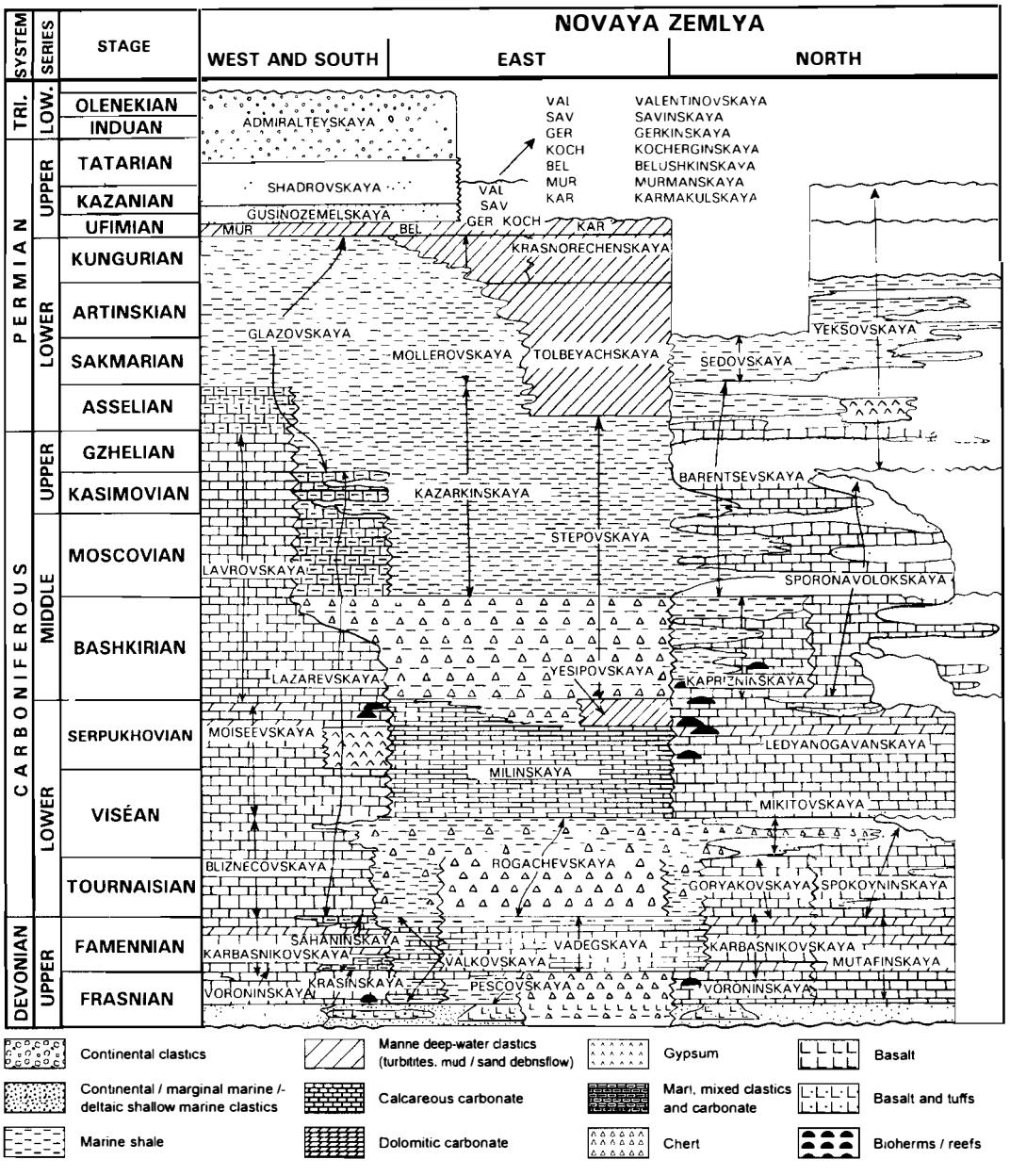


*Fig. 2.* Middle–Upper Palaeozoic sequences of Novaya Zemlya.

9. Nekhvatova River. Loc. no. 752, 71°25′N, 54°31′E, Figs. 8 and 9
10. Taynaya River. Loc. no. 131, 71°34′N, 54°10′E, Figs. 8 and 9
11. Krasnaya River, Loc. no. 600, 601, 500, 5582, 72°25'-72°27′N, 54°45'–55°02′E, Figs. 10 and 11
12. Bezymyannaya River, Loc. no. 513, 602, 72°54′N, 54°32′E, Figs. 12 and 13
13. Bezymyannaya Fiord, Loc. no. 612, 72°52′N, 53°14′E, Figs. 14 and 15
14. Bezymyannaya Fiord, Loc. no. 8421, 72°56′N, 53°16′E, Figs. 14 and 15
15. Cape Borisoff, Loc. no. 486, 74°47′N, 55°50′E, Figs. 16 and 17
16. Admiralty Peninsula, Loc. no. 9031, 75°01′N, 56°26′E, Figs. 18 and 19
17. Litke Peninsula, Loc. no. 804–807, 887, 8818, 8845, 76°10'–76°16′N, 61°00'–62°25′E, Figs. 20 and 21
18. Spokoynaya River, Loc. no. 8422, 76°17′N, 67°32′E, Figs. 22 and 23

In addition to these on-shore localities conodonts from off-shore wells are reported. The wells were drilled in the southern part of the Pechora Sea (the Severo-–Gulyeavskaya–1 and Prirazlomnaya–1 wells), and on Kolguev Island (the Bugrinskaya well).

# 4 Stratigraphy

On Novaya Zemlya various lithofacies complexes can be identified in the Middle Carboniferous–Lower Permian succession. Four distinct depositional environments have been recognised (Figs. 2 and 3).

In northern Novaya Zemlya (Northern Area), marine coastal and shallow shelf deposits are widespread. They are dominated by mixed terrigenous-carbonate sediments in the Middle Carboniferous and by terrigenous sediments in the ?Upper Carboniferous and Lower Permian. Asselian (Lower Permian) anhydrites occur in the eastern part of the area near the Spokoynaya River. Numerous breaks in sedimentation are reported from the northeastern part of the Eks and Glacial Harbour regions, the most important being a Pre-Bashkirian erosional event which affects all deposits below the Lower Devonian.

In western Novaya Zemlya a carbonate platform existed during Middle–Late Carboniferous times. Sedimentation was dominated by the formation of bioclastic packstones containing numerous siliceous nodules. The Bashkirian is characterised by intercalated oolitic limestones, while small algal bioherms formed during the Moscovian and Late Carboniferous. During the Early Permian, carbonate sedimentation was first replaced by marls and subsequently by basinal shales.

In southern Novaya Zemlya a succession of lithofacies complexes formed during the Late Palaeozoic is similar to that in the western area; however, the transition from limestones to marls and shales took place earlier, i.e. during the late Middle–early Late Carboniferous. No significant gaps in sedimentation have been recorded in southern and western Novaya Zemlya.

In central and eastern regions of Novaya Zemlya, basinal facies were deposited during the Middle Carboniferous–Early Permian. Cherts and black shales containing phosphate nodules and intercalations of manganese carbonate ores (crusts) dominate.

Stratigraphic units are usually widespread with homogenous lithological composition and constant thickness in central and western Novaya Zemlya.

## 4.1 Northern Novaya Zemlya

Middle Carboniferous and Lower Permian deposits are subdivided into the Sporonavolokskaya and Yeksovskaya formations (Korago & Kovaleva 1990; Matveev et al. 1989) in the Eks, Glacial Harbour and Spokoynaya River regions in the eastern part of northern Novaya Zemlya. These formations are correlated to the Barentsevskaya and Sedovskaya formations in the Russkaya Harbour, Litke and Pankratyeff Peninsula regions of northern Novaya Zemlya (Petrenko 1945; Geologia SSSR, 1970) (Figs. 2 and 3).

### 4.1.1 *Sporonavolokskaya Formation*

The Sporonavolokskaya Formation (approximately 50 m thickness) rests with an erosive contact on Lower Devonian–Lower Carboniferous strata (Matveev et al. 1989). It is mainly

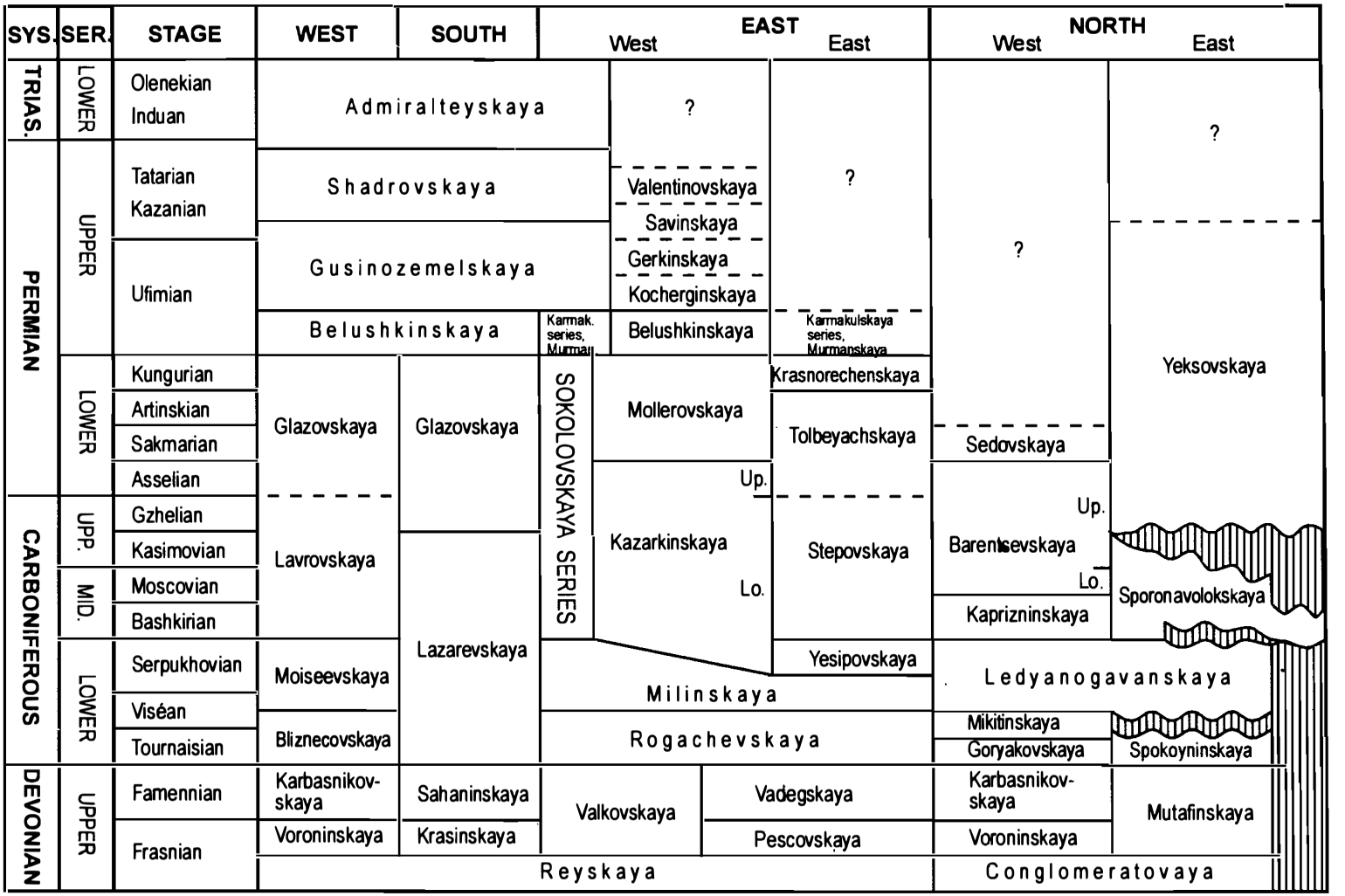


*Fig. 3.* Upper Devonian–Lower Triassic lithostratigraphic scheme, Novaya Zemlya.

composed of sandstones and sandy limestones with lenticular intercalations of oolitic bioclastic grainstones with crinoids, brachiopods and bryozoans. Fine-grained conglomerates are developed at the base of the formation. The formation contains large tetracoral accumulations as well as numerous bryozoans, brachiopods and foraminifers of Middle Carboniferous (Bashkirian and Moscovian) age (Matveev et al. 1989). Conodonts were found in three samples collected from the upper part of the formation from the Spokoynaya River section (Figs. 22 and 23, Table 1), indicating a Kasimovian to Late Moscovian age for this unit.

### 4.1.2 *Yeksovskaya Formation*

The Yeksovskaya Formation overlies, with erosional contact, the Sporonavalokskaya Formation near Eks Gulf and Glacial Harbour (Matveev et al. 1989). Further south, near the Spokoynaya River, a continuous transition between these two formations is believed to exist. In the stratotype section, calcareous conglomerates with *Pseudofusulinella usvae* (Dutkevich) are observed at the base of the formation. Above this basal conglomerate, the formation is characterised by black shales, red and brown calcareous sandstones, and siltstones with lenticular intercalations of gravelstones, and conglomerates. Some anhydrite beds up to 8 m thick occur in the lower part of the formation near the Spokoynaya River. Shelly accumulations with abundant brachiopods, pelecypods and bryozoans, as well as rare foraminifers were also found in the formation. The age of this formation is ?Late Carboniferous–Permian (Korago & Kovaleva 1990). Conodonts were obtained from an anhydrite bed in the Spokoynaya River section (Figs. 22 and 23, Table 1). Based on conodonts, the anhydrite bed is of Early–Middle Asselian age. The thickness of the Upper Carboniferous–Lower Permian part of the Yeksovskaya Formation is 450 to 500 m.

### 4.1.3 *Barentsevskaya Formation*

The Barentsevskaya Formation (approximately 500 m thickness) is divided into two lithologically different units. The Lower Barentsevskaya Formation (110 m) consists of shales and siltstones intercalated with sandy limestones. Conodonts have been extracted from seven horizons within this unit at the Litke Peninsula locality (Figs. 20 and 21, Table 2). The conodonts suggest a Middle Carboniferous age (Bashkirian to Moscovian) for the Lower Barentsevskaya Formation.

The Upper Barentsevskaya Formation (390 m) consists of sandstones, sandy limestones and siltstones intercalated with shales. The fauna is dominated by brachiopods, bryozoans, tetracorals, as well as arenaceous foraminifers. Conodonts

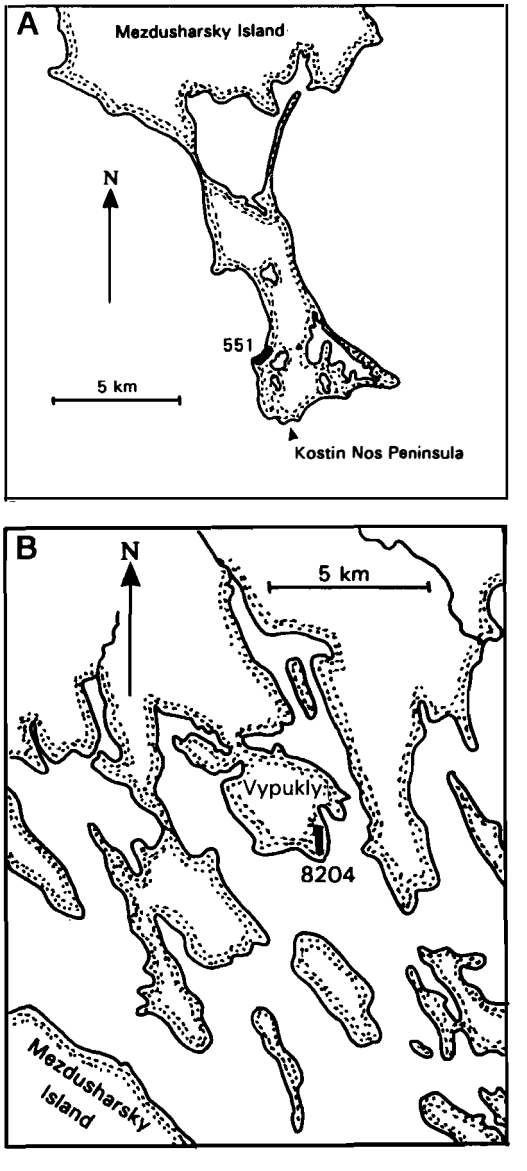


*Fig. 4.* Lazarevskaya Formation, Kostin-Shar Strait. A. Section 551, Mezhdusharsky Island. B. Section 8204, Vypukly Peninsula.

were obtained from sandy limestone intercalations from the middle and upper parts of the Barentsevskaya Formation in a section along the west coast of Russkaya Harbor (Figs. 20 and 21, Table 2). Based on conodonts, the age of the middle and upper parts of the Upper Barentsevskaya Formation is Early Permian (Asselian).

### 4.1.4 *Sedovskaya Formation*

The Sedovskaya Formation is dominated by dark gray shales with rare intercalations of sandy limestones with remains of tetracorals and brachiopods. Conodonts (Table 15) were extracted from limestones in the lower part of the formation in a section along the west coast of Russkaya Harbour (76°15′N, 62°24′E, Table 2, sample no. 887) and in the central part of Litke Peninsula (76°16′N, 61°48′E, Fig. 21, Table 2, sample no. 8818).

Based on conodonts and tetracorals the Sedovovskaya Formation is Early Permian (Sakmarian) in age. The thickness exceeds 490 m.

## 4.2 Eastern and Central Novaya Zemlya

The Lower–Middle Carboniferous–Lower Permian succession is included in the Sokolovskaya Series in eastern and central Novaya Zemlya. In the western part of the area this series is divided into the Mollerovskaya and the upper part of the Kazarkinskaya formations. In the eastern part it is divided into the Krasnorechenskaya, Tolbeyachskaya, Stepovskaya and Yesipovskaya formations (Fig. 3).

The Sokolovskaya Series is widely distributed throughout Novaya Zemlya. Outcrops are recorded in the tributaries of the Yunau, Nekhvatova, Severnaya Taynaya, Yuzhnaya Taynaya, Rogacheva and Vadega rivers in the southern part of the archipelago. Further north the Sokolovskaya Series is widespread in the Bezymyannaya Fiord regions in the northern part of the southern island, and from Sulmenev to Borzov Bay on the northern island. Previously the age of the Sokolovskaya Series was interpreted as Early Permian (Ustritsky 1977; 1981). Conodont faunas from the lower part of this unit show, however, that the series extends down into the Carboniferous. The base is diachronous, ranging in age from Late Serpukhovian to Early Bashkirian.

### 4.2.1 *Kazarkinskaya Formation*

Two different depositional developments have been recognised in the Kazarkinskaya Formation. The first type is reported from the Yunau, Nekhvatova, Yuzhnaya Taynaya rivers and Bezymyannaya Fiord, as well as from the northern island of Novaya Zemlya. In all these regions the Kazarkinskaya Formation is divided into two subunits. The lower unit is characterised by radiolarian black shales and cherts with intercalated crinoidal grainstones and carbonate breccias.

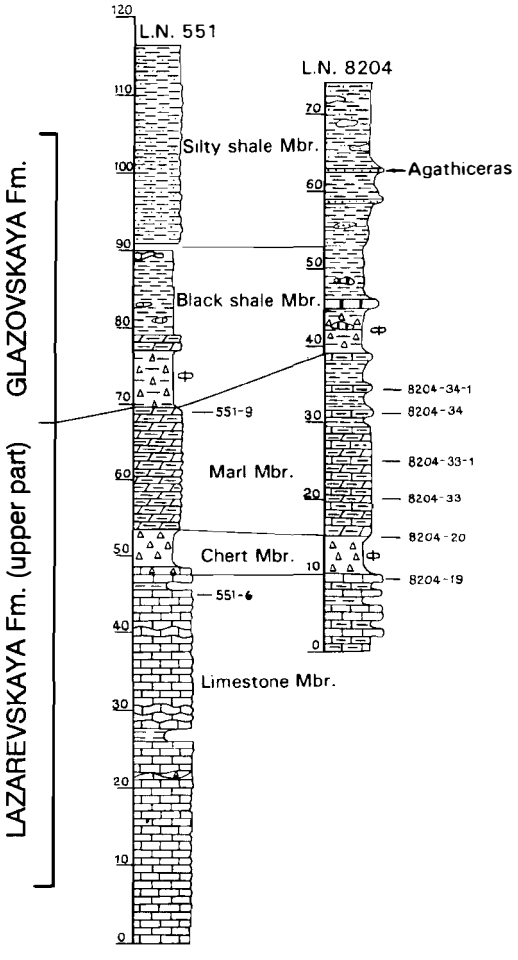


*Fig. 5.* Lithological sections of the Lazarevskaya Formation, Kostin-Shar Strait. See Fig. 4 for locations.

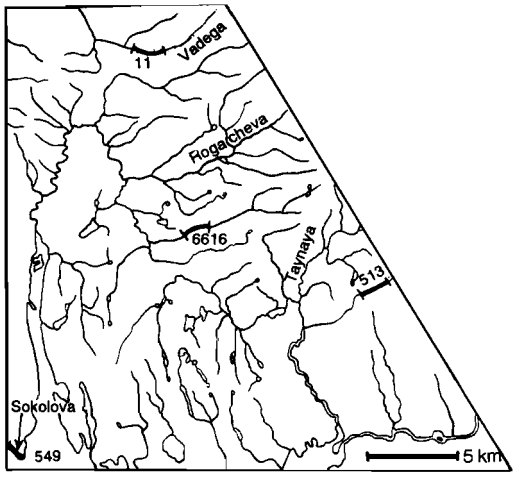


*Fig. 6.* Kazarkinskaya Formation localities. Sokolova Peninsula (section 549), Vadega River (section 11), Severnaya Taynaya River (section 513), and Rogacheva River (section 6616).

The upper unit consists of black shales intercalated with carbonate manganese ores. Faunal remains are represented mainly by radiolarians and conodonts, as well as rare ammonoids. Crinoidal grainstone intercalations, interpreted as turbidites, commonly contain foraminifers. The thickness of the lower part is usually 30–50 m, the upper part 60–90 m. Seven samples from the Yunau River section (Figs. 8 and 9, Table 3) 12 samples from the Bezymyannaya Fiord section (Figs. 14 and 15, Tables 4, 5) and seven samples from the Admiralty Peninsula sections (Figs. 18 and 19, Table 6) produced conodonts.

The second type of depositional development was established in the Lower Kazarkinskaya Formation in the tributaries of the Vadega, Rogacheva and Severnaya Tainaya rivers and in the downstream areas of the Bezymyannaya River on the south island of Novaya Zemlya. The Lower

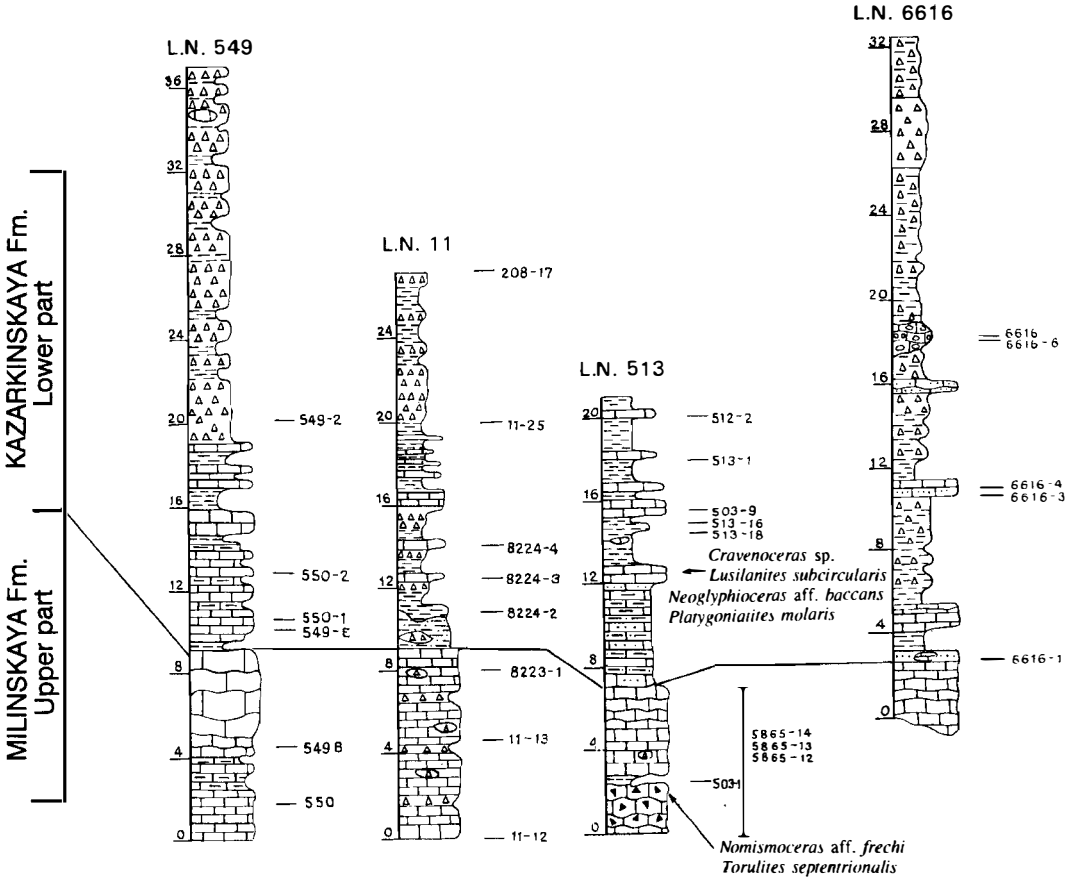


*Fig. 7.* Lithological sections of the Kazarkinskaya Formation. See Fig. 6 for locations.

Kazarkinskaya Formation shows a tripartite division in these localities.

The lowermost part shows fine rhythmical alternations of black shales, cherts and limestones. Conodonts were extracted from samples from the Sokolov Peninsula, the Vadega River, and the tributaries of the Rogacheva and Severnaya Tainaya rivers (Figs. 6 and 7, Tables 7–10). The conodonts indicate a Serpukhovian–Early Bashkirian age for this part.

The middle part is represented by black cherts and siliceous shales containing phosphate nodules. Ammonoids (*Syngastrioceras* sp.) are present in phosphate nodules in the section along the Bezymyannaya River (72°48′N, 53°54′E). Conodonts were extracted from samples collected at Sokolov Peninsula (Loc. no. 549), at the Vadega River (Loc. no. 11) and at the tributary of the Severnaya Tainaya River (Loc. no. 6616) (Figs. 6 and 7, Tables 7–10). The conodonts date the middle part as Early Bashkirian.

The upper unit is represented mainly by black shales with the Late Carboniferous ammonoid *Parashumardites* sp. in the uppermost part. Conodonts were not obtained from this upper unit.

Based on the conodont information, the Lower Kazarkinskaya Formation is of Early (Serpukhovian)–Late Carboniferous age in the investigated areas.

Conodonts were obtained from the Upper Kazarkinskaya Formation along the Yunau, Nekhvatova and Yuzhnaya Tainaya rivers on the southern island, and on Admiralty Peninsula further north. In the southern part of the archipelago the Kazarkinskaya Formation is divided into three members. The lowermost member contains black siliceous shales with rare lenticular intercalations of manganese carbonate ores. The middle member is composed of rhythmically alternating shales and ores while the upper one, like the lower, is predominantly composed of shales (Figs. 8 and 9, Table 3). Conodonts were found in four samples from the lowermost member along the Yunau River (Loc. no. 752), in three samples from the middle member at the Nekhvatova (Loc. no. 752) and Yuzhnaya Tainaya (Loc. no. 131) rivers and in three samples from the upper member at the Yunau River (Loc. no. 101). On Admiralty Peninsula conodonts were extracted from four samples from the Upper Kazarkinskaya Formation (Figs. 18 and 19, Table 6). Based on conodonts the age of the Upper Kazarkinskaya Formation is Asselian, with a possible subdivision into Early, Middle and Late Asselian. The thickness of the Upper Kazarkinskaya Formation is 60–90 m.

### 4.2.2 *Mollerovskaya Formation*

The Mollerovskaya Formation is represented by 60–90 m of dark-gray shales, and silty shales with intercalations of sandstones in the upper part. Conodonts were not obtained from this formation.

### 4.2.3 *Stepovskaya Formation*

The Stepovskaya Formation outcrops along the eastern coast of Novaya Zemlya from the Krasnaya River in the south to Bear Bay in the north. The formation is represented mainly by shales, and can be divided into three sub-units. The lowermost member contains cherts, the middle, shales, and the upper consists of black shales with manganese ores. The best conodont recovery was obtained from sections along the Krasnaya River (Loc. no. 601, 500) and the upper part of the

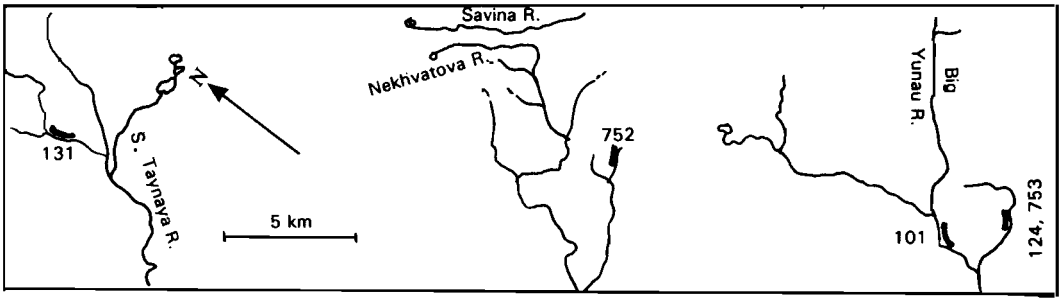


*Fig. 8.* Kazarkinskaya Formation localities. Bolshaya Yunau River (section 124, 753, and 101), Nekhvatova River (section 752), and Taynaya River (section 131).

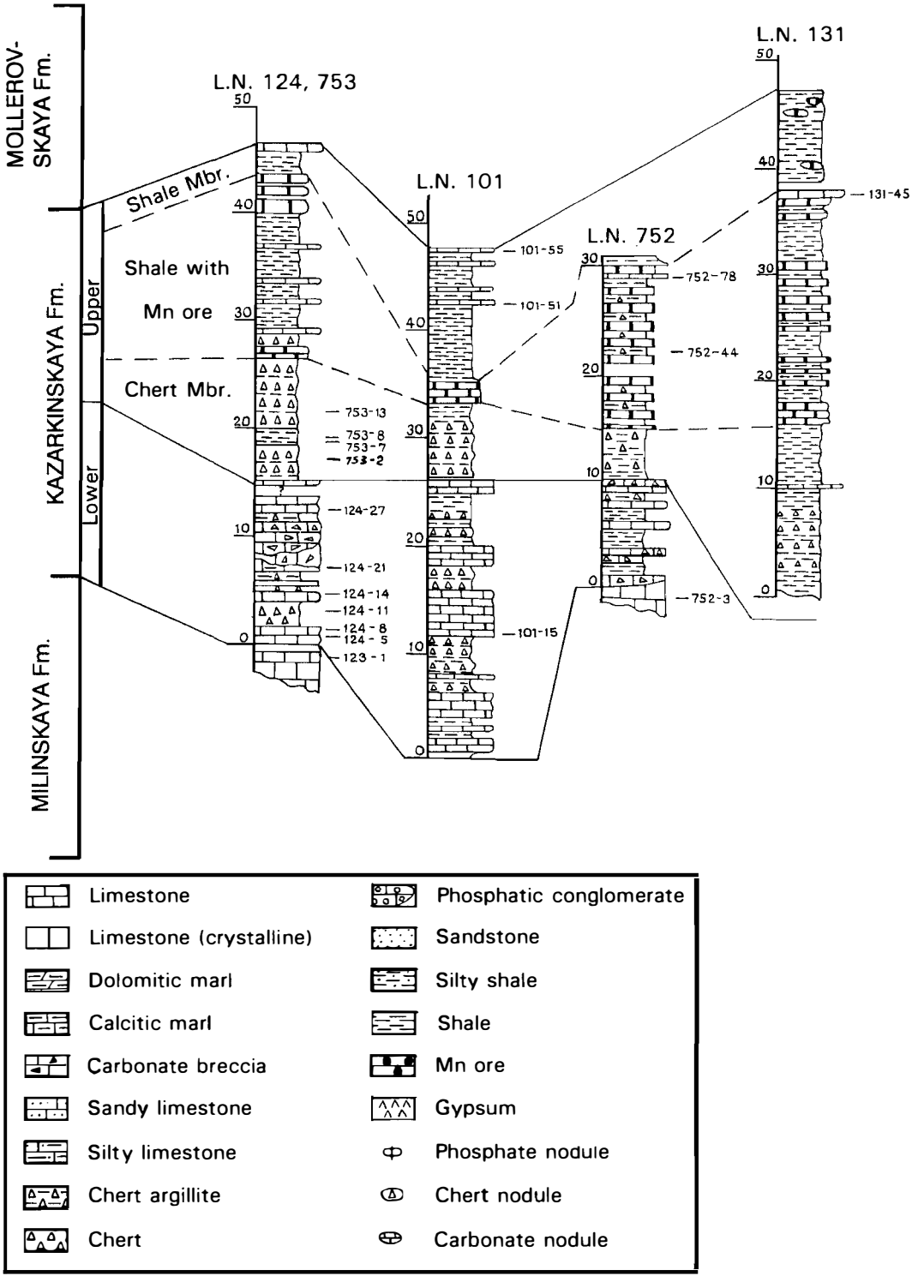


*Fig. 9.* Lithological sections of the Kazarkinskaya Formation. See Fig. 8 for locations.

Bezymyannaya River (Loc. no. 602), see Figs. 10–13.

The cherty member is composed of black radiolarian cherty shales, cherts with phosphate nodules and rare intercalations of bioclastic grainstones. Conodonts (Table 2) were found in ten samples selected from carbonate layers in the lower cherty unit. In addition to the tabulated records, conodonts were also extracted from the cherty member in separate outcrops near Bear Bay (Loc. no. 8335), Tyrtov Bay (Loc. no. 4232), and the Yesipov River (Loc. no. 521). The age of the cherty member based on the conodont faunas is Bashkirian. The thickness of the member is 40–55 m.

The shaly (middle) member is represented by shales with regular intercalations of manganese-bearing siliceous carbonate rocks and rare intercalations of grainstones with graded bedding. Conodonts (Table 11) were found in fourteen samples. The age of the shaly member based on conodonts is Moscovian–Gzhelian. The thickness of the member is 45–50 m.

The upper member of the Stepovskaya Formation is composed of shales with rare lenticular intercalations of manganese carbonate ores. Conodonts were not found in the upper member. The thickness of the member ranges between 15 m near Krasnaya River and 100 m in the upper part of the Bezymyannaya River.

The lower and middle members of the Stepovskaya Formation are reliably correlated with the Lower Kazarkinskaya Fm; the upper member is tentatively correlated with the lower (ore-free) part of the Upper Kazarkinskaya Formation. The composite thickness of the Stepovskaya Formation is 185–200 m.

### 4.2.4 *Tolbeyachskaya Formation*

The Tolbeyachskaya Formation is composed of a succession of stacked turbidite deposits. In the lower part of the formation, the base of each turbidite is composed of graded bedded sandy limestones. The upper part of the formation has a sandy-silty-argillaceous lithology and carbonate intercalations are absent. Conodonts were obtained from the type section of the formation along the Krasnaya River (Figs. 10 and 11, Table 12, Loc. no. 601) as well as from a series of isolated outcrops from the type area (Loc. no. 5582-6, 4409-2). Twelve samples produced conodonts (Table 12). Based on conodonts the Tolbeyachskaya Formation is of Early Permian (Asselian to Artinskian) age. The thickness is 240 m.

## 4.3 Western Novaya Zemlya

Within western Novaya Zemlya, the Lavrovskaya and Glazovskaya formations are considered to be of Middle Carboniferous–Early Permian age.

### 4.3.1 *Lavrovskaya Formation*

The Lavrovskaya Formation outcrops along the western coast of Novaya Zemlya from Melky Bay in the south to Glazov Bay in the north. It is mainly composed of limestones. At the base there are oolitic and sandy limestones with Bashkirian foraminifers. In the middle part of the formation bioclastic packstones with numerous nodules and lenticular chert intercalations are present. Abundant typical Moscovian foraminifers and brachiopods (*Choristites* sp.) are found in this part of the section. The upper part of the formation is composed of bioclastic packstones and grainstones with abundant bryozoans, brachiopods and crinoids and siliceous nodules. Small algal bioherms are observed in the upper and middle parts of the formation. A layer of yellow marl is present in the top of the formation. The upper part of the Lavrovskaya Formation has previously been con-

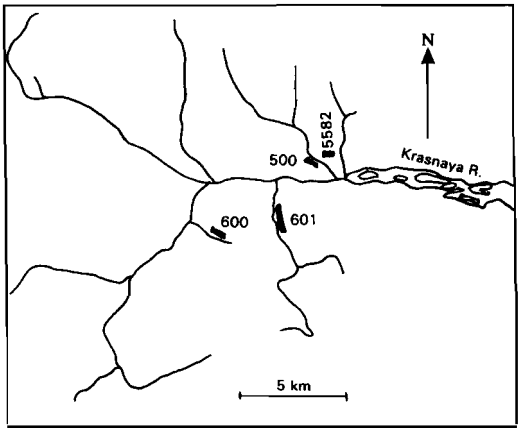


*Fig. 10.* Stepovskaya and Tolbeyachskaya formations, Krasnaya River.

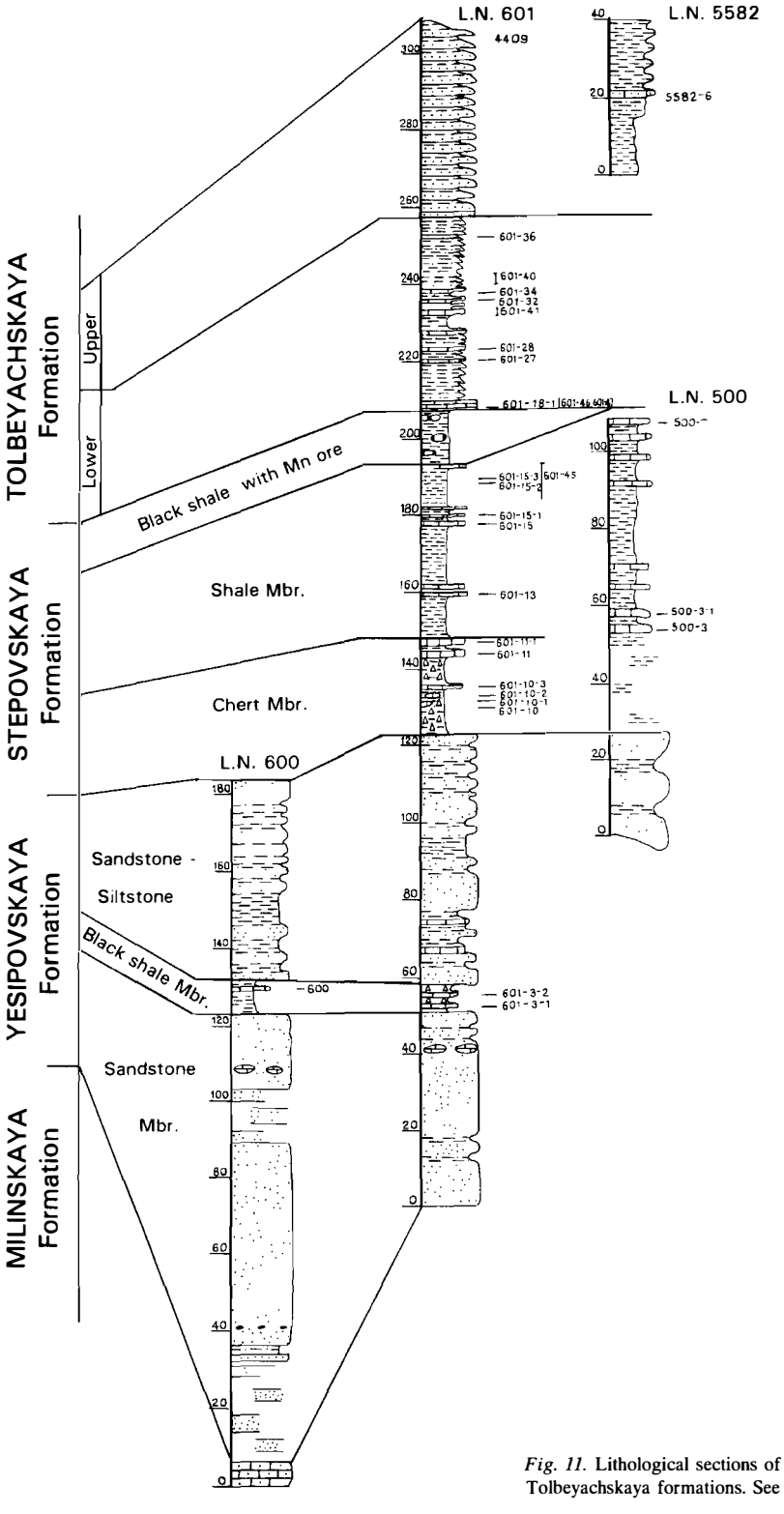


*Fig. 11.* Lithological sections of the Stepovskaya and Tolbeyachskaya formations. See Fig. 10 for locations.

sidered to be of Kasimovian age (horizons with *Protriticites pseudomontiparus* Putrja) (Geologia SSSR, 1970). The age of this unit is now revised because conodonts of Moscovian–Asselian age were found in the middle and upper part of the formation in the type section on Cape Borisoff in Mashigin Bay (Loc. no. 486, Figs. 16 and 17, Table 11).

Conodonts of Moscovian age are recorded from the middle part of the formation. For the first time the presence of Gzhelian and Asselian strata are documented by the presence of the *Streptognathodus elongatus* and *Streptognathodus wabaunsensis* zones in the upper part of the Lavrovskaya Formation. The thickness is 350–500 m.

### 4.3.2 *Glazovskaya Formation*

The Glazovskaya Formation is a thick unit of argillites (400 m) with rare intercalations of siltstones with manganese. Conodonts are not recorded from this unit, the only fossils found are radiolarians.

## 4.4 Southern Novaya Zemlya and Pechora Sea Shelf

In the southern part of Novaya Zemlya the upper part of the Lazarevskaya Formation and the Glazovskaya Formation are considered to be of Middle Carboniferous–Early Permian age.

### 4.4.1 *Lazarevskaya Formation (upper part)*

Good sections of the upper part of the Lazarevskaya Formation are present along the coast of the Kostin Shar Strait in the southern part of Mezdusharsky Island (Loc. no. 551) and on Vypukly Peninsula (Figs. 4 and 5, Table 13). The upper part of the Lazarevskaya Formation is divided into three sub-units (A–C):

A. The Limestone Member; a unit composed of crinoidal grainstones with thin intercalations of shaly limestones and argillites in the upper part. Conodonts (Table 13) were recorded in the top of the member in two sections (Loc. no. 551 and Loc. no. 8204).
B. The Chert Member; consisting of fine rhythmically alternating black cherts and cherty shales with abundant phosphate nodules. Conodonts (Table 13) were found in the upper part of the member in one section (Loc. no. 8204).
C. The Marl Member; a unit consisting of yellow calcareous to dolomitic marls and argillites containing abundant radiolarians and rare small foraminifers, trilobites, nautiloids and brachiopods. Conodonts (Table 13) were found in two sections (Loc. no. 551 and Loc. no. 8204).

The conodont faunas indicate that Units A and B are Bashkirian in age, whereas Unit C is of Late Moscovian–Kasimovian age. Productive conodont samples are tabulated in Table 13. The thickness of the Middle to Upper Carboniferous part of the Lazarevskaya Formation is 40–50 m.

### 4.4.2 *Glazovskaya Formation*

The Glazovskaya Formation in the southern and western parts of Novaya Zemlya is mainly composed of shales and silty shales. In the south the shales contain lenticular intercalations of calcareous siltstones with brachiopods (*Martinia* sp., *Spiriferella* sp. and *Anidanthus* sp.), ammonoids (*Agathiceras* sp. and *Glaphyrites* sp.) and small foraminifers. The age of the Glazovskaya Formation is Late Carboniferous–Early Permian, and the thickness is 180 m+. Conodonts were not recovered from this unit.

### 4.4.3 *Pechora Sea Wells*

Conodonts were obtained from samples from the Pechora Sea shelf from the Severo-Gulyaevskaya-

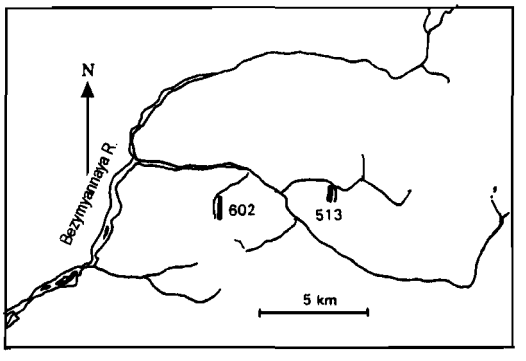


*Fig. 12.* Stepovskaya Formation, Bezymyannaya River (sections 513 and 602).

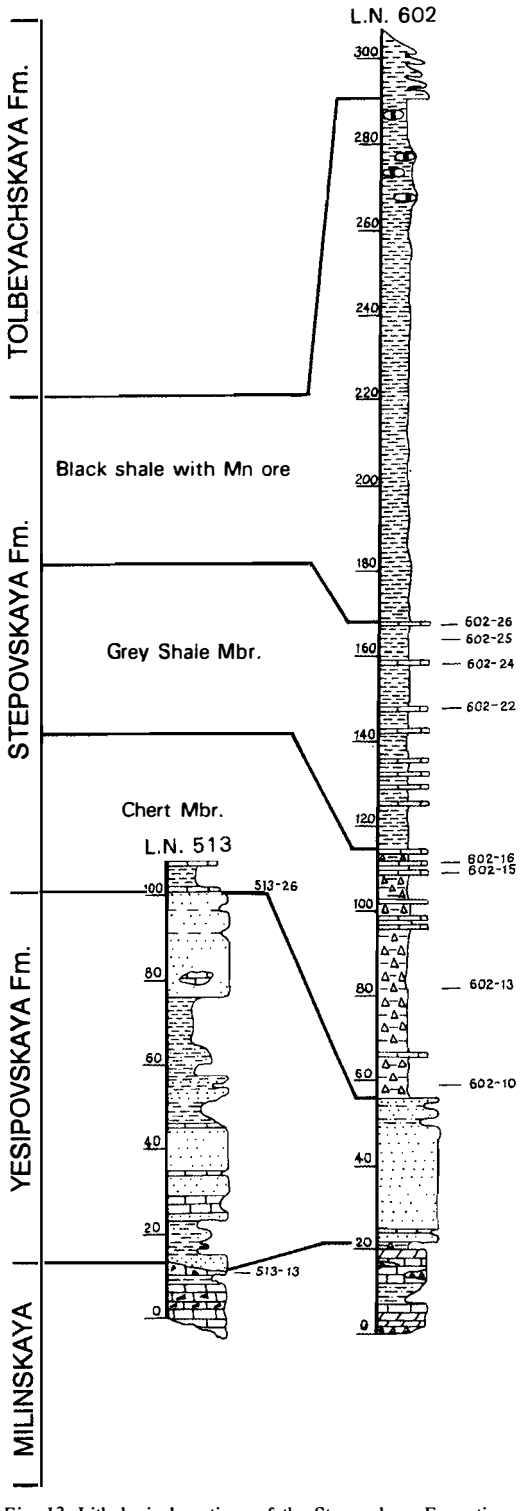


*Fig. 13.* Lithological sections of the Stepovskaya Formation. See Fig. 12 for locations.

1 (SG1), the Prirazlomnaya-1 (PR1) and the Bugrinskaya (BUG) wells (Table 15). Based on the conodont faunas identified from the well samples, strata of Moscovian, Gzhelian and ?Asselian age have been drilled through.

# 5 Biostratigraphy

## 5.1 Middle–Upper Carboniferous conodont biostratigraphy of the Russian platform

### 5.1.1 *Middle Carboniferous*

In the Russian Platform, the Bashkirian conodont faunas have been studied in most detail in the Donets Basin (Nemirovskaya 1975, 1983; Kozitskaya et al. 1978). The succession of conodont assemblages in the Donets Basin served as a basis for the conodont zonations of the Russian Platform, ratified by the Stratigraphic Committee of the USSR (Resolution 1988). Bashkirian conodonts have also been studied from the western slopes of the Urals (Nemirovskaya 1975) (Fig. 24). Although the conodont based subdivision in the Russian Platform and the Urals slightly differ from each other, the general pattern of conodont faunal evolution in these regions is similar. Basal Bashkirian horizons (Voznesenian and the lower part of the Syuranian) are characterised by an impoverished conodont assemblage, which comprises the first representatives of *Declinognathodus*, i.e. *D. lateralis* (Higgins & Bouckaert) and *D. noduliferus* (Ellison & Graves). In the middle part of the Lower Bashkirian, the fauna is mainly composed of *Declinognathodus* and *Idiognathoides* with the first occurrences of *Idiognathodus* and *Neognathodus*. The upper part of the Lower Bashkirian (upper part of the Prikamian and Askinbashian) and Upper Bashkirian is characterised by species of *Streptognathodus*: *Streptognathodus expansus* Igo & Koike, *S. parvus* Dunn and *S. suberectus* Dunn.

The most complete conodont successions of Moscovian age are known from the Russian Platform in the Moscow Basin (Barskov & Alekseev 1975; Shurygina in Barskov et al. 1975; Barskov & Goreva 1981; Barskov et al. 1981; Goreva 1984) and in the Donets Basin (Kosenko 1975;

Kozitskaya et al. 1978); Fig. 25. The establishment of *Neognathodus* conodont zones (Barskov & Goreva 1981) was of great significance for correlation of stratigraphic units between the Russian Platform and North American units. Subdivisions based on *Neognathodus* were previously defined in the Atokan and Desmoinesian deposits of the Appalachian Basin (Merrill & King 1971; Merrill 1972). Unlike the faunas reported from the Moscow Basin, Moscovian conodont faunas in the Donets Basin are dominated by *Streptognathodus* and *Idiognathodus*, whereas *Neognathodus* are comparatively rare. This anomaly in the distribution of conodont faunas was taken into account when establishing a subdivision in the Russian Platform (Barskov et al. 1984). The latter subdivision is based on successive *Streptognathodus* and *Neognathodus* zones. An exception is the Vereian Horizon (basal Moscovian) with a conodont assemblage of close Upper Bashkirian affinity. In the unified scheme for the Russian Platform ratified by the Stratigraphic Committee of the USSR, the Vereian Horizon of the Moscovian Stage and the Upper Bashkirian substage correspond to the well established *Idiognathoides tuberculatus–Declinognathodus marginodosus* conodont Zone (Resolution 1988).

### 5.1.2 *Upper Carboniferous*

The stratigraphic scheme for the Upper Carboniferous of the Russian Platform with conodont zonations established by Barskov et al. (1984) is followed in the present study. This zonation is the result of conodont studies in the Upper Carboniferous stratotype sections of the Moscow Basin (Barskov & Alekseev 1975; Barskov et al. 1981; Alekseev et al. 1984; Akhmetshina et al. 1984), as well as the Donets Depression (Kosenko 1975; Kozitskaya et al. 1978), and the Dnieper-Donets Depression (Kozitskaya 1983); Fig. 26. The boundary between the Moscovian (Middle Carboniferous) and the Kasimovian (Upper Carboniferous) is drawn at the base of the *Streptognathodus oppletus–S. excelsus* Zone. A more detailed subdivision of the Kasimovian was distinguished on the basis of a phylogenetic succession of species of *Idiognathodus* (Barskov et al. 1981).

The Kasimovian–Gzhelian boundary is drawn at the appearance of the morphologically very characteristic species *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva (= *S. elegantulus*, Barskov et al. 1984). Two Gzhelian zones have been distinguished; the *Streptognathodus alekseevi* and *S. elongatus* zones. The *S. alekseevi* Zone is further subdivided into two subzones: the *Streptognathodus simulator* and *S. ruzhencevi* subzones. In addition to the index species, the *S. simulator* Subzone (lower part of the Dobryatinian) is characterised by a group of species with an eccentric position of the axial furrow, e.g. *Streptognathodus simulator* Ellison, *S. eccentricus* Ellison and *S. luganicus* Kozitskaya. The conodont assemblage of the *S. ruzhencevi* Subzone (upper part of the Dobryatinian and Pavlovo-Posadian) in the stratotype sections of the Moscow area is commonly impoverished; it often comprises only *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva, *S. elegantulus* Stauffer & Plummer, and *S. ruzhencevi* (Kozur) (Barskov 1984). The uppermost conodont zone of the Gzhelian corresponds to the Noginian Horizon (the *Daixina sokensis* fusulinid Zone). *Streptognathodus elongatus* Gunnell, whose divergent evolution causes an outburst of speciation in the Asselian (Chernikh & Reshetkova 1987), occurs at the base of the zone. The Noginian Horizon is characterised by an assemblage with co-existing *Streptognathodus elongatus* Gunnell, *S. conjunctus* Barskov, Isakova & Schastlivtseva, *S. simplex* Gunnell, *S. alekseevi* Barskov, Isakova & Schastlivtseva, and *S. elegantulus* Stauffer & Plummer. The Gzhelian–Asselian boundary on the Russian Platform is drawn at the base of the Sokoliegorskian Horizon (base of the *Schwagerina*

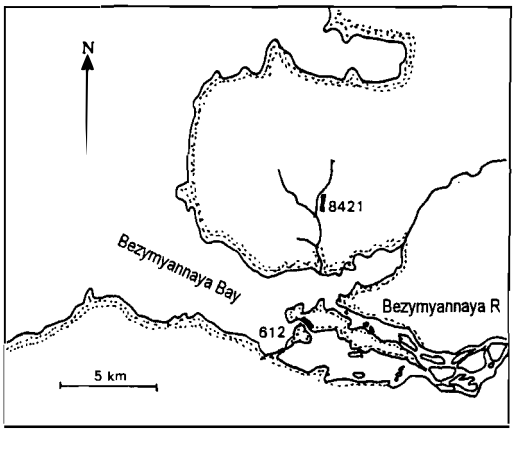


*Fig. 14.* Kazarkinskaya Formation, Bezymyannaya Fiord (sections 612 and 8421).

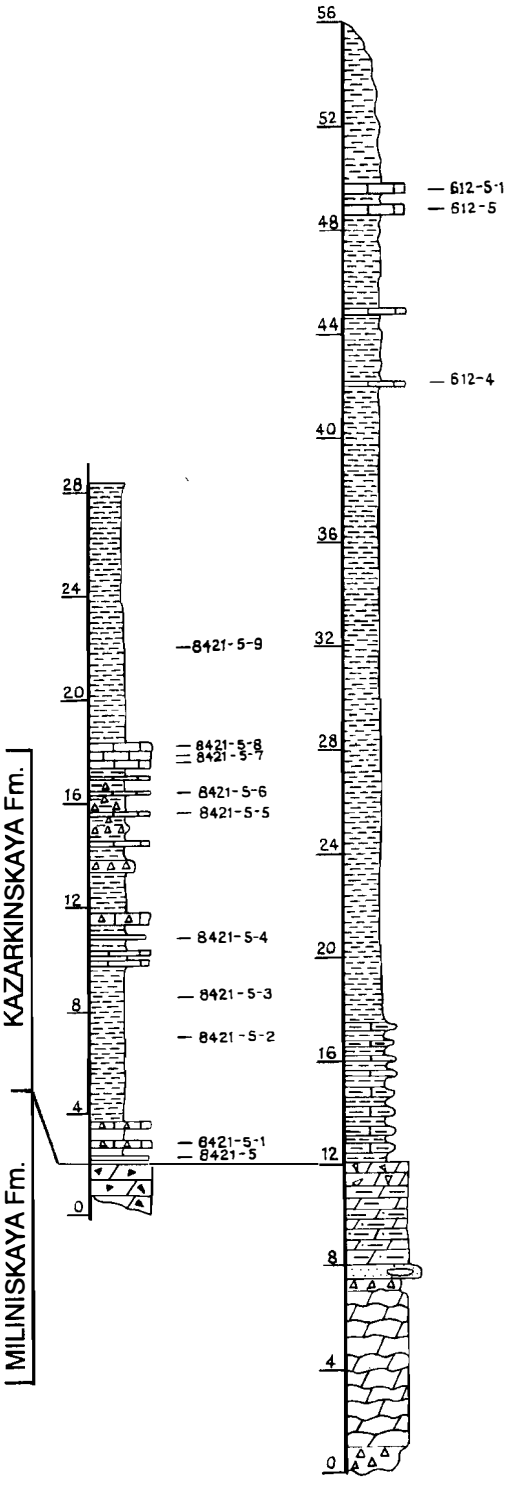


*Fig. 15.* Lithological sections of the Kazarkinskaya Formation. See Fig. 14 for locations.

fusulinid zone) which is marked by the appearance of *Streptognathodus wabaunsensis* Gunnell (Barskov et al. 1981; Barskov et al. 1984).

## 5.2 Middle–Upper Carboniferous conodont assemblages of Novaya Zemlya

The conodont assemblage found in the Middle–Upper Carboniferous deposits of Novaya Zemlya occur both in shallow-marine and basinal facies. The recognised zones are defined and should be considered as *assemblage* zones, as most of them are characterised by the presence (or co-occurrence) of several species, as well as the exclusion of species from adjacent zones (cf. Schoch 1989).

### 5.2.1 *Bashkirian conodont assemblages*

Three conodont assemblages are distinguished in the Bashkirian deposits:

1. *Declinognathodus noduliferus* Assemblage Zone
2. *Declinognathodus–Idiognathoides* Assemblage Zone
3. *Streptognathodus expansus–S. suberectus* Assemblage Zone

The Early Carboniferous (Serpukhovian) *Gnathodus bilineatus bilineatus–Gnathodus bilineatus bollandensis* zones are not discussed here; they are, however, mentioned in the text and in the tables.

#### 5.2.1.1 *Declinognathodus noduliferus* Assemblage Zone

Definition:
Base = first occurrence of *Declinognathodus noduliferus* (Ellison & Graves).
Top = First occurrence of *Idiognathodus* and *Idiognathoides.*

This assemblage is recorded from the lower part of the Kazarkinskaya Formation (Figs. 18 and 19, Table 6), and from the base of the Chert Member of the Stepovskaya Formation (Figs. 12 and 13, Table 15).

The assemblage is composed of *Declinognathodus lateralis* (Higgins & Bouckaert), *D. nodu-*

*liferous inaequalis* (Higgins), *D. noduliferus noduliferus* (Ellison & Graves), *D.* cf. *praenoduliferous* Nigmadzhanov & Nemirovskaya, *Gnathodus bilineatus bilineatus* (Roundy), *G. bilineatus bollandensis* (Higgins & Bouckaert) and *Lochriea commutata* (Branson & Mehl).

A peculiar character of this assemblage is the co-presence of supposed Early Carboniferous (*G. bilineatus bilineatus* (Roundy) and *L. commutata* (Branson & Mehl)) and Middle Carboniferous (*D. noduliferus* (Ellison & Graves)) forms. The latter is considered to mark the Lower–Middle Carboniferous boundary (Lane & Manger 1985; Riley et al. 1985). In Western Europe a similar conodont assemblage is known from the *Homoceras* Zone (Namurian A) (Higgins & Bouckaert 1968; Higgins 1975). In North America a similar fauna is recorded in the Lower Morrowan (Lane 1967; Lane & Straka 1974). In the Donets Basin and within the Dnieper-Donets Depression, similar assemblages are recorded from the Voznesenian Horizon (Lower Bashkirian) (Kozitskaya et al. 1978; Nemirovskaya 1983), and in the Urals in the lower part the Bogdanovian Horizon (Kulagina & Pazukhin 1988). The *D. noduliferus* assemblage zone apparently corresponds to the lower part of Zone C2 in the Sverdrup Basin (Bender 1980; Beauchamp et al. 1989).

### 5.2.1.2 *Declinognathodus–Idiognathoides* Assemblage Zone

Definition:
Base = Disappearance of *Gnathodus* and *Lochriea*, and appearance of *Idiognathoides* and *Idiognathodus*
Top = First occurrence of *Streptognathodus*

This assemblage is recorded from the top of the Limestone Member of the Lazarevskaya Formation (Figs. 4 and 5, Table 13), from the lower part of the Kazarkinskaya Formation (Figs. 6–9, 14–15, Tables 3–5, and 7–10), and from the Chert Member of the Stepovskaya Formation (Figs. 10–13, Tables 12, 15). The assemblage is dominated by *Declinognathodus* and *Idiognathoides*; it is also depicted by the first appearance of rare *Idiognathodus* and the disappearance of *Gnathodus* and *Lochriea.*

This assemblage include *Declinognathodus lateralis* (Higgins & Bouckaert), *D. noduliferus noduliferus* (Ellison & Graves), *D. noduliferus japonicus* (Igo & Koike), *Idiognathoides corrugatus* (Harris & Hollingsworth), *I.* sp. A, *I. lanei* Nemirovskaya, *I. pacificus* Savage & Barkeley, *I. sinuatus* Harris & Hollingsworth, *I. sulcatus* Higgins & Bouckaert, *Idiognathodus* sp. B. and *I. delicatus* Gunnell.

The *Declinognathodus–Idiognathoides* Assemblage Zone is correlated with the *Idiognathoides sinuatus–Neognathodus symmetricus* and the *Idiognathodus sinuosus* zones (Krasnopolyanian, Severokeltmenian, and the lower part of the Prikamian horizons) of the Lower Bashkirian of the Russian Platform, as well as the Morrowan (Lower Pennsylvanian) of North America. In the Urals, similar conodont assemblages are present in the upper part of the Suranian and Akavasian horizons. In Western Europe, similar assemblages are known from the Namurian B and C in England and Belgium (Higgins & Bouckaert 1968; Higgins 1975). The *Declinognathodus–Idiognathoides* Assemblage Zone corresponds to the upper part of Zone C2 and Zone C3 in the Sverdrup Basin (Bender 1980; Beauchamp et al. 1989).

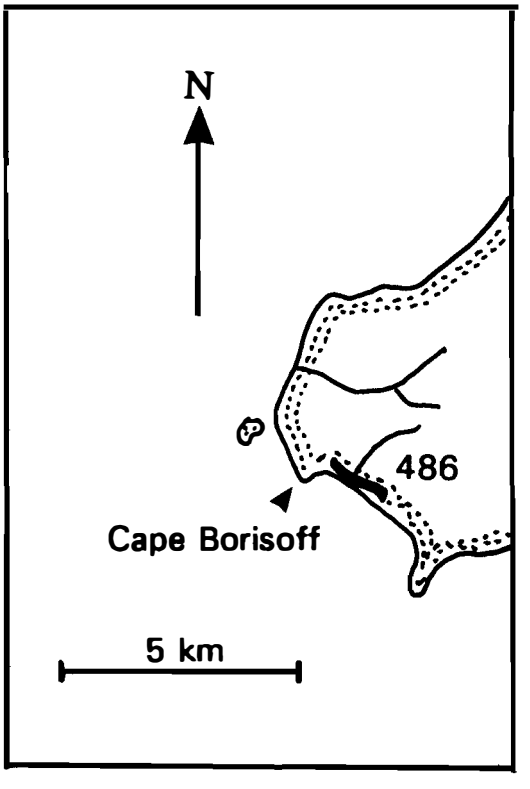


*Fig. 16.* Lavrovskaya Formation, Cape Borisoff (section 486).

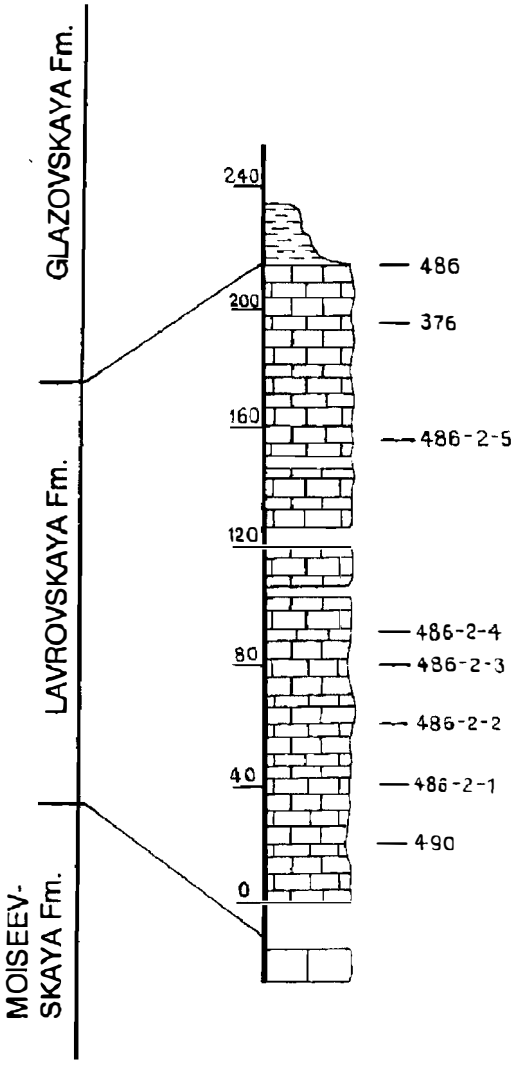


*Fig. 17.* Lithological sections of the Lavrovskaya Formation, Cape Borisoff.

#### 5.2.1.3 *Streptognathodus expansus–S. suberectus* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus*
Top = First occurrence of *Neogondolella*

This assemblage is recorded at the top of the Limestone Member of the Lazarevskaya Formation (Figs. 4 and 5, Table 13), in the Lower Kazarkinskaya Formation (Figs. 6–9, Tables 7–10), and in the middle part of the Stepovskaya Formation (Figs. 12 and 13, Table 15). The assemblage is characterised by the appearance of the *Streptognathodus* group: *Streptognathodus expansus* Igo & Koike, *S. parvus* Dunn and *S. suberectus* Dunn. In addition, species ranging from the underlying Middle Carboniferous deposits (*Declinognathodus noduliferus noduliferus* (Ellison & Graves), *D. noduliferus japonicus* (Igo & Koike), *Idiognathoides corrugatus* (Harris & Hollingsworth), *I. lanei* Nemirovskaya, *I. sinuatus* Harris & Hollingsworth, *I. sulcatus* Higgins & Bouckaert, *I. pacificus* Savage & Barkeley as well as rare *Idiognathodus delicatus* Gunnell, *I.* sp. A. and *Neognathodus* sp.) are present.

On the Russian Platform, *Streptognathodus expansus* Stauffer & Plummer and *S. suberectus* Dunn in association with abundant *Declinognathodus* and *Idiognathoides* are characteristic of the upper part of the Prikamian Horizon (Bashkirian) (the *S. expansus–S. suberectus* Zone) passing up into the Upper Bashkirian (Resolution 1988). In the Donets Basin, a similar conodont assemblage is recorded in the Bashkirian Zuevian and Makeevian horizons (Zones C2bb, C2bc, C2bd) (Kozitskaya et al. 1978; Resolution 1988). In the Urals, similar assemblages are present in the upper part of the Lower Bashkirian (Askynbashian Horizon), and in the Upper Bashkirian (Tashastinian and Asatausian Horizons). In North America, *S. expansus* Igo & Koike and *S. suberectus* Dunn are known from the upper part of the Morrowan (Dunn 1970; Lane & Straka 1974; Grayson 1984; 1990).

### 5.2.2 *Moscovian conodont assemblages*

Moscovian conodonts are recorded both in Novaya Zemlya, and in boreholes on the Pechora Sea shelf. In Novaya Zemlya, they are present in the Lower Kazarkinskaya Formation (Figs. 8–9, 14–15 and 18–19, Tables 3–6), in the middle part of the Stepovskaya Formation (Figs. 10–13, Tables 12, 15), in the upper part of the Sporonavolokskaya Formation (Figs. 22 and 23, Table 1), in the Lower Barentsevskaya Formation (Figs. 20 and 21, Table 2) and in the Lavrovskaya Formation (Figs. 16 and 17, Table 11). The Moscovian is characterised by the appearance of *Gondolella*, associated with *Neognathodus* sp. and abundant *Streptognathodus* and *Idiognathodus*. *Declinognathodus* and *Idiognathoides*, typical in the Bashkirian, are found in great numbers only in

the lower part of this faunal interval. The Moscovian comprises the *Gondolella–Neognathodus–Streptognathodus* fauna which can be subdivided into four sub-units in the proposed biostratigraphic scheme:

1. *Idiognathoides tuberculatus–Neogondolella donbassica* Assemblage Zone
2. *Neognathodus medadultimus* Assemblage Zone
3. *Neognathodus medexultimus–Streptognathodus concinnus* Assemblage Zone
4. *Neognathodus roundyi* Assemblage Zone

#### 5.2.2.1 *Idiognathoides tuberculatus–Neogondolella donbassica* Assemblage Zone

Definition:
Base = First occurrence of *Neogondolella donbassica* (Kosenko)
Top not defined.

This assemblage is present only in the Lower Kazarkinskaya Formation in the Bezymyannaya Fiord area (Loc. no. 8241) (Figs. 14 and 15, Tables 4, 5). The assemblage comprises: *Declinognathodus lateralis* (Higgins & Bouckaert), *Neogondolella donbassica* (Kosenko), *Hindeodus minutus* (Ellison), *Idiognathodus delicatus* Gunnell, *Idiognathoides corrugatus* (Harris & Hollingsworth), *I. sinuatus* Harris & Hollingsworth, *I. sulcatus* Higgins & Bouckaert, *I. tuberculatus* Nemirovskaya, *Streptognathodus expansus* Igo & Koike and *S. parvus* Dunn.

In species composition the assemblage is similar to the *I. tuberculatus–D. marginodosus* Assemblage Zone of the Russian Platform (Resolution 1988), corresponding to the Upper Bashkirian and lower part (Vereian) of the Moscovian. The presence of *Neogondolella donbassica* (Kosenko) allows correlation with the upper part of the *I. tuberculatus–D. marginodosus* Zone which corresponds to the Vereian Horizon of the Moscovian.

#### 5.2.2.2 *Neognathodus medadultimus* Assemblage Zone

Definition:
Base = First occurrence of *Neognathodus medadultimus* Merrill
Top = First occurrence of *Neognathodus medexultimus* Merrill and *Streptognathodus concinnus* Kosenko

This assemblage is distinguished in northern and western Novaya Zemlya, as well as in the Prirazlomnaya Borehole (interval 2442 m) in the Pechora Sea shelf. In northern Novaya Zemlya, it is recorded in the middle part of the Lower Barentsevskaya Formation in the Litke Peninsula (Loc. no. 8875) (Figs. 20 and 21, Table 2), in the west in the lower part of the Lavrovskaya Formation in Cape Borisoff on the northern coast of the Mashigin Bay (Loc. no. 486) (Figs. 16 and 17, Table 11).

The assemblage comprises: *Adetognathus lautus* (Gunnell), *Idiognathodus* cf. *I. podolskensis* Goreva, *Neognathodus bothrops* Merrill, *N. medadultimus* Merrill, and *Streptognathodus* cf. *S. parvus* Dunn.

This assemblage correlates with the *S. medadultimus–S. dissectus* Assemblage Zone of the Russian Platform, which is part of the upper part of the Kashirian Horizon (Moscovian) (Barskov & Goreva 1981; Barskov et al. 1984; Resolution 1988). This assemblage corresponds in North America to the *N. medadultimus* Zone (Merrill 1972) in the lower part of the Desmoinesian, and *N. medadultimus* Merrill defines Zone C5b in the Sverdrup Basin (Beauchamp et al. 1989).

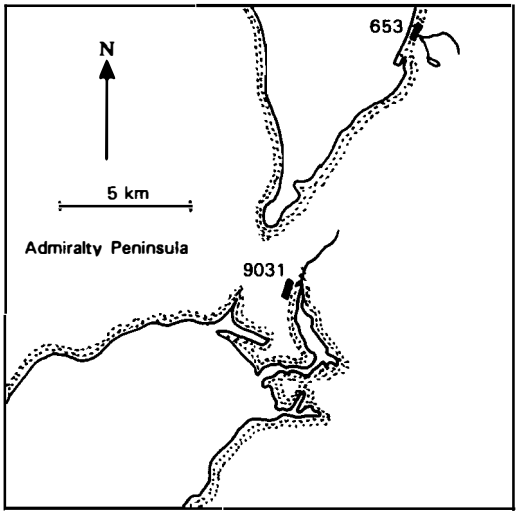


*Fig. 18.* Kazarkinskaya Formation, Admiralty Peninsula (sections 653 and 9031).

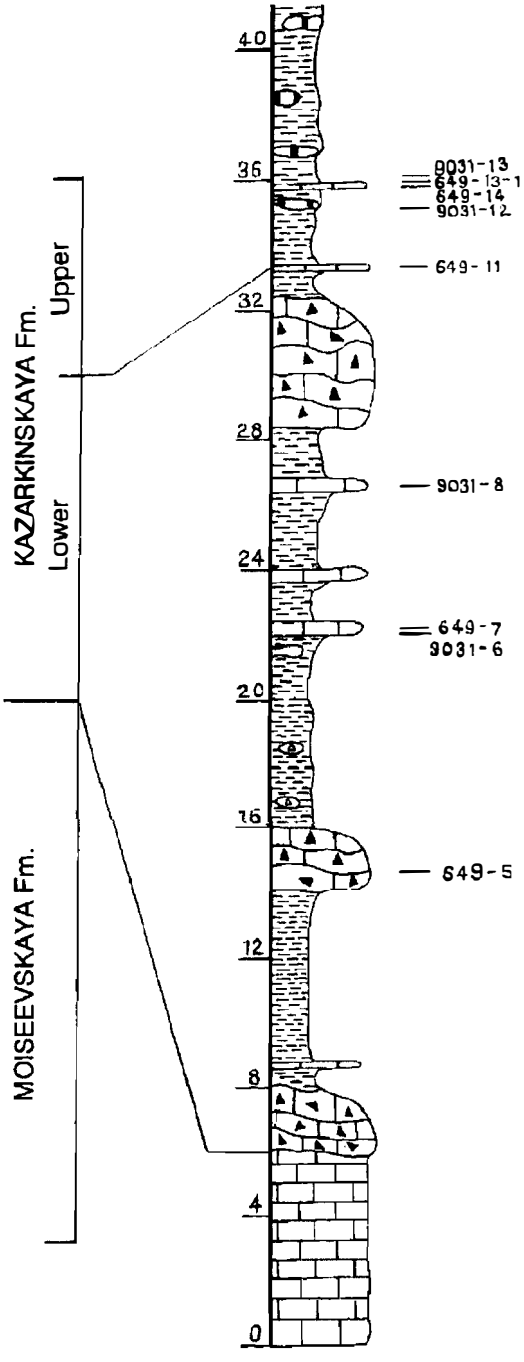


*Fig. 19*. Lithological sections of the Kazarkinskaya Formation. See Fig. 18 for locations.

5.2.2.3 *Neognathodus medexultimus–Streptognathodus concinnus* Assemblage Zone

Definition:
Base = First occurrence of *Neognathodus medexultimus* Merrill and *Streptognathodus concinnus* Kosenko
Top = First occurrence of *Neognathodus roundyi* (Gunnell)

This assemblage is recorded in the North and South Islands of Novaya Zemlya and in the Severogulyaevskaya Borehole (SG1 interval 2827 m) on the Pechora Sea shelf. In northern Novaya Zemlya, it is present in the middle part of the Lower Barentsevskaya Formation in the Litke Peninsula (Loc. no. 8845; 892) (Figs. 20 and 21, Table 2) and in the south, from the Lower Kazarkinskaya Formation in the section along the Bolshaya Yunau River (Loc. no. 124) (Figs. 8 and 9, Table 3).

This assemblage comprises: *Declinognathodus noduliferus noduliferus* (Ellison & Graves), *Neogondolella donbassica* (Kosenko), *G. magna* Stauffer & Plummer, *Hindeodus* cf. *H. minutus* (Ellison), *Idiognathodus delicatus* Gunnell, *I. obliquus* Kosenko & Kozitskaya, *I. podolskensis* Goreva, *Neognathodus medexultimus* Merrill, *Streptognathodus concinnus* Kosenko, *S. dissectus* Kosenko and *S.* cf. *S. expansus* Igo & Koike.

The species *I. obliquus* Kosenko & Kozitskaya, *I. podolskensis* Goreva, *N. medexultimus* Merrill, and *S. concinnus* Kosenko being part of the assemblage, are also characteristic species of the *N. medexultimus–S. concinnus* Assemblage Zone of the Podolian Horizon (Moscovian) on the Russian Platform (Barskov & Goreva 1981; Goreva 1984; Barskov et al. 1984; Resolution 1988). Also of interest is the presence of *Idiognathoides corrugatus* (Harris & Hollingsworth), *I. sinuatus* Harris & Hollingsworth, *I. sulcatus* Higgins & Bouckaert and *I. tuberculatus* Nemirvskaya in the section on the Bolshaya Yunau River. Species of *Idiognathoides* are otherwise not found above the Vereian Horizon in the Russian Platform. It is thus possible that the specimens of *Idiognathoides* and *Declinognathodus noduliferus noduliferus* (Ellison & Graves) in this assemblage are redeposited, a phenomenon often observed in basinal facies of Novaya Zemlya. The *N. medexultimus–S. concinnus* Assemblage Zone corresponds to the Desmoinesian *Neognathodus medexultimus* Zone in North America (Merrill 1972).

5.2.2.4 *Neognathodus roundyi* Assemblage Zone

Definition:
Base = First occurrence of *Neognathodus roundyi* (Gunnell)
Top = First occurrence of *Streptognathodus excelsus* Stauffer & Plummer and *S. oppletus* Ellison

This assemblage is recorded in deposits of the Lower Kazarkinskaya Formation on the Bolshaya Yunau River (Loc. no. 124) (Figs. 6 and 7, Table 3), in the middle part of the Stepovskaya Formation on the Krasnaya River (Loc. no. 500) (Figs. 10 and 11, Table 12), and at the top of the Sporonavolokskaya Formation in the Ledyanya Gavan Bay area (Loc. no. 1701) (Figs. 22 and 23, Table 1). The assemblage is characterised by the following species: *"Gondolella"* cf. *"G." laevis* Kosenko & Kozitskaya, *Neognathodus dilatus* (Stauffer & Plummer), *N. roundyi* (Gunnell), New Genus A sp. D, *Streptognathodus* cf. *S. cancellosus* (Gunnell), *S.*cf. *S. excelsus* Stauffer & Plummer and *S. gracilis* Stauffer & Plummer. *G.* cf. *G. magna* Stauffer & Plummer, *Idiognathodus delicatus* Gunnell, *I. obliquus* Kosenko & Kozitskaya, *I.* cf. *I. podolskensis* Goreva, *Neognathodus kashiriensis* Goreva, *N. medadultimus* Merrill, *N. medexultimus* Merrill and *Streptognathodus concinnus* Kosenko ranges up into this assemblage from the underlying unit. In the Bolshaya Yunau River section, possible reworked specimens of *Idiognathoides sulcatus* Higgins & Bouckaert and *I. tuberculatus* Nemirovskaya occur together with *N. roundyi* (Gunnell).

The assemblage is correlative with *S. cancellosus–N. roundyi* assemblages of the Myachkovian Horizon of the Russian Platform (Barskov & Goreva 1981; Barskov et al. 1984; Resolution 1988). This assemblage is also similar to the North American *Neognathodus roundyi* and *Idiognathodus delicatus–Streptognathodus cancellosus* zones of Desmoinesian age (Merrill 1972).

## 5.2.3 *Upper Carboniferous conodont assemblages*

In the Upper Carboniferous deposits of Novaya Zemlya and the Pechora Sea shelf, three conodont assemblages are distinguished:

1. *Streptognathodus oppletus–S. excelsus* Assemblage Zone
2. *S. alekseevi* Assemblage Zone
3. *S. elongatus* Assemblage Zone

5.2.3.1 *Streptognathodus oppletus–S. excelsus* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus oppletus* Ellison and *S. excelsus* Stauffer & Plummer
Top = First occurrence of *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva and species of *Streptognathodus* with eccentric placement of axial furrow.

*Streptognathodus oppletus* Ellison and *S. excelsus* Stauffer & Plummer are diagnostic species in this zone.

This assemblage is widespread in Novaya Zemlya and is recorded in the Bugrinskaya Borehole on Kolguev Island. In Novaya Zemlya, it is reported from the Marl Member in the upper part of the Lazarevskaya Formation on Mezhdusharsky Island (Loc. no. 551) (Figs. 4 and 5, Table 13), in the middle part of the Stepovskaya Formation on the Krasnaya River (Loc. no. 601) and in the upper part of the Bezymyannaya River (Loc. no. 602) (Figs. 12 and 13, Tables 12, 15), in the Lower Kazarkinskaya Formation in the Admiralty Peninsula (Loc. no. 9031) (Figs. 18 and 19, Table 6), and in the top of the Sporonavolokskaya Formation on the Spokoynaya River (Loc. no. 603) (Figs. 22 and 23, Table 1). At the same stratigraphic level, the first appearance

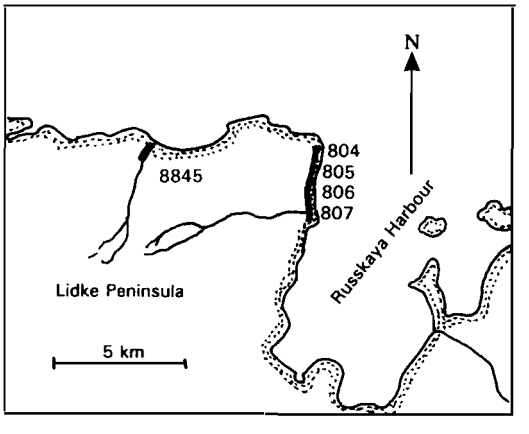


*Fig. 20.* Barentsevskaya and Sedovskaya formations, Litke Peninsula.

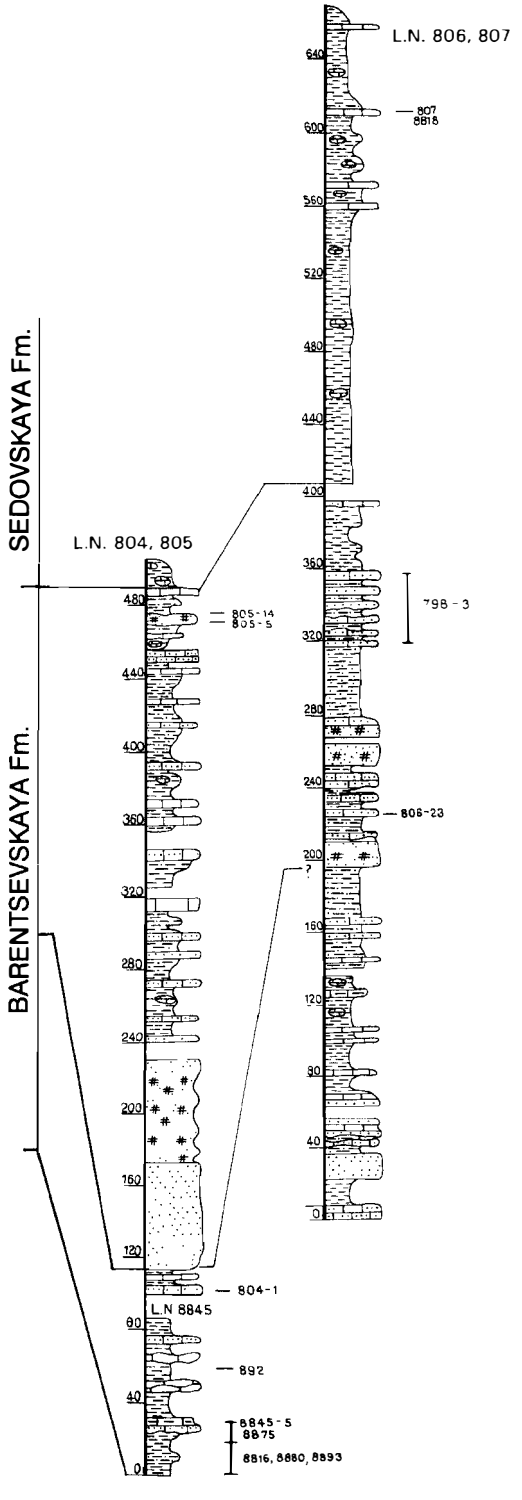


*Fig. 21.* Lithological sections of the Barentsevskaya and Sedovskaya formations, Litke Peninsula.

of *Idiognathodus bachmuticus* Kozitskaya, *I. toretzianus* Kozitskaya, *Streptognathodus elegantulus* Stauffer & Plummer and *S.* sp. B is recorded. *Neogondolella donbassica* (Kosenko), *Idiognathodus delicatus* Gunnell, *Hindeodus minutus* (Ellison), *Streptognathodus gracilis* Stauffer & Plummer and *S. cancellosus* (Gunnell) range from the underlying deposits into this assemblage.

Similar conodont assemblages are known from the Kasimovian in the Moscow Basin (Barskov & Alekseev 1975; Barskov et al. 1981; Goreva 1984; Alekseev et al. 1984), Donets Basin and Dnieper–Donets Depression (Kozitskaya et al. 1978; Kozitskaya 1983), and from the Missourian of North America (Ellison 1941; Lane et al. 1971).

### 5.2.3.2 *Streptognathodus alekseevi* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva
Top = First occurrence of *Streptognathodus elongatus* Gunnell

This assemblage is recorded in the upper part of the Stepovskaya Formation in the Krasnaya River section (Loc. no. 601) (Figs. 10 and 11, Table 12) and in the Severogulyaevskaya (interval 2769 m) and the Prirazlomnaya (interval 2242 m) boreholes on the Pechora Sea shelf (Table 14). The assemblage in the upper part of the Stepovskaya Formation and in the Severogulyaevskaya borehole can be correlated with the *Streptognathodus simulator* Subzone of the *Streptognathodus alekseevi* Zone of Gzhelian age on the Russian Platform (Barskov et al. 1981). The lower boundary is drawn at the first occurrence of *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva in association with *Streptognathodus* with an eccentric position of the axial furrow, i.e. *Streptognathodus eccentricus* Ellison, *S. luganincus* Kozitskaya, and *S. simulator* Ellison. Additional species include *Streptognathodus firmus* Kozitskaya, *S. gracilis* Stauffer & Plummer, *S. elegantulus* Stauffer & Plummer, *S. excelsus* Stauffer & Plummer, *Idiognathodus tersus* Ellison, *I. toretzianus* Kozitskaya, and *I. trigonolobatus* Barskov & Alekseev. On the Russian Platform, the *Streptognathodus simulator* Subzone identifies the lower part of the Dobryatinian (Resolution 1988).

The conodont assemblage in the Prirazlomnaya borehole is correlative with the upper subzone

(*Streptognathodus ruzhencevi*) of the *S. alekseevi* Zone. This assemblage comprises: *Gondolella* cf. *G. magna* Stauffer & Plummer, *Idiognathodus delicatus* Gunnell, *I.* cf. *I. lobulatus* Kozitskaya, *I. trigonolobatus* Barskov & Alekseev, *Streptognathodus excelsus* Stauffer & Plummer and *S. ruzhencevi* (Kozur). On the Russian Platform, the *Streptognathodus ruzhencevi* Subzone is positioned in the upper part of the Dobryatinian and Pavlovo-Posadian Horizons of Gzhelian age (Resolution 1988). Equivalents of the *S. alekseevi* Assemblage Zone are known from Svalbard, where *S. alekseevi* Barskov, Isakova & Schastlivtseva is found in the Kapitol Member of the Nordenskiöldbreen Formation (Nakrem et al. 1992). This assemblage corresponds to Zones C6a and C6b in the Sverdrup Basin (Beauchamp et al. 1989).

#### 5.2.3.3 *Streptognathodus elongatus* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus elongatus* Gunnell
Top = First occurrence of *Streptognathodus wabaunsensis* Gunnell

This assemblage is recorded in the upper part of the Lavrovskaya Formation in the Melkay Bay area (Loc. no. 376) (Figs. 16 and 17, Table 11), at the top of the Lower Kazarkinskaya Formation on the Bolshaya Yunau River (Loc. no. 124) (Figs. 8 and 9, Table 3), in the Stepovskaya Formation on the Krasnaya River (Loc. no. 601) and in the Upper Bezymyannaya River (Loc. no. 602) (Figs. 12 and 13, Tables 12, 15). This assemblage is typified by *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva, *S. elegantulus* Stauffer & Plummer, *S. elongatus* Gunnell, *S. gracilis* Stauffer & Plummer and *S. simplex* Gunnell.

A similar assemblage of conodonts is present on the Russian Platform (Barskov et al. 1984). The *S. elongatus* Zone represents the uppermost zone in the Gzhelian, corresponding to the Noginian Horizon (Resolution 1988). It is traced within the Moscow Syneclise (Barskov & Alekseev 1975; Barskov et al. 1981); in the Dnieper–Donets Depression (Kozitskaya 1983), in the Caspian Depression (Akhmetshina et al. 1984; Akhmetshina 1990), and in the South Urals (Isakova & Nazarov 1986; Chernikh 1989). In North America, an equivalent of the *S. elongatus* Zone is recorded in the Upper Virgillian (upper half the Shawnee Group and Wabaunsee Group) (Ritter 1991). In the Sverdrup Basin *S. elongatus* Ellison is present in the Sakmarian P5 Zone (Beauchamp et al. 1989; Henderson 1988), and in the Asselian in Svalbard (Nakrem 1991a; Nakrem et al. 1992), whereas in Novaya Zemlya *S. elongatus* Gunnell has a wide Late Gzhelian through Asselian range.

The *S. elongatus* Zone has traditionally been correlated with the *Daixina sokensis* fusulinid Zone (Barskov 1984). Recent studies have however revealed that the *S. elongatus* Zone also corresponds to the *Daixina robusta–Daixina bosbytauensis* Zone (Chernikh 1989; Chernikh & Chuvashov 1991).

## 5.3 Lower Permian conodont zonation in the Urals

The first conodont based subdivision of the Lower Permian deposits in the Urals was developed by Movshovich et al. (1979). The succession of the *Streptognathodus elongatus–S. wabaunsensis–S. barskovi* zones was confirmed by a detailed study in South Ural sections. Subsequently, the relationship of conodont zones with fusulinid zones was improved by Barskov (1984), Akhmetshina et al. (1984) and Isakova in Isakova & Nazarov (1986). The Asselian part of the succession was studied in detail by Chernikh & Reshetkova (1987; 1988), and a zonation based on phylogeny of *Streptognathodus* and *Neogondolella* was published. Five stages in *Streptognathodus* evolution define five zones (Fig. 27).

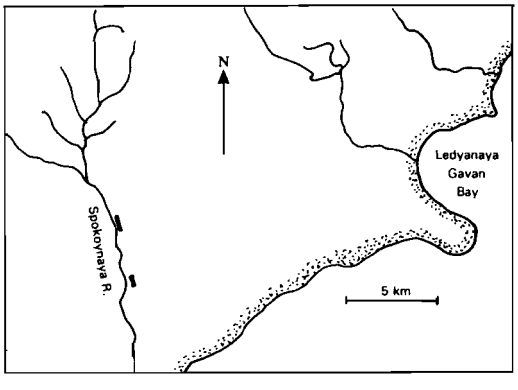


*Fig. 22.* Sporonavolokskaya and Yeksovskaya formations, Spokoynaya River.

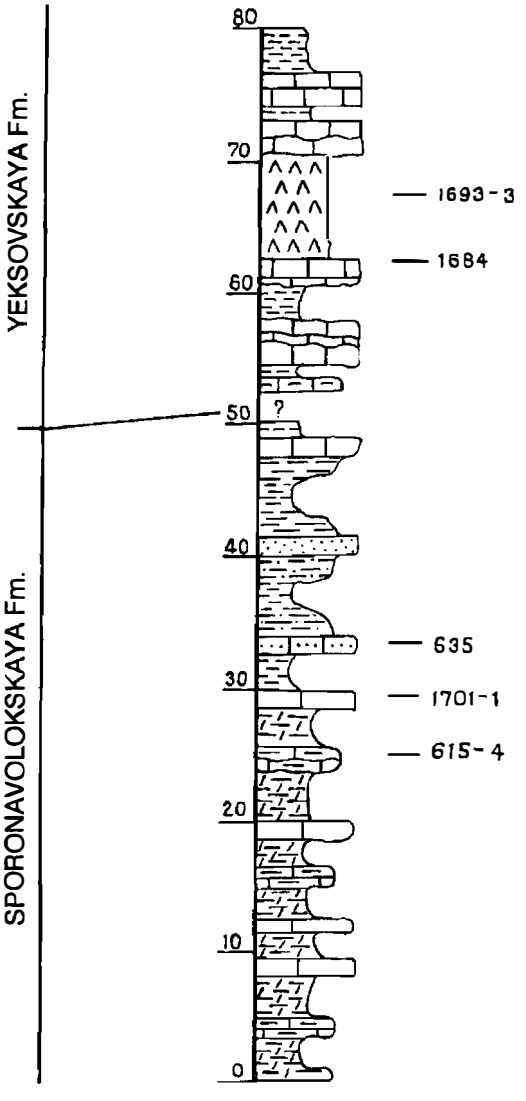


*Fig. 23.* Lithological sections of the Sporonavolokskaya and Yeksovskaya formations, Spokoynaya River.

*Neogondolella* is absent in the Lower Asselian, and but re-appears in the Middle Asselian in the Urals. Four *Neogondolella* zones are distinguished through the Middle–Upper Asselian (Chernikh & Chuvashov 1991), see Fig. 28.

At present, the relationship between the Lower Asselian conodont zones and the fusulinid zones remains unresolved. The data obtained during the study of the Aidaralash section in the South Urals (Davydov et al. 1990), contradict the scheme proposed by Chernikh & Chuvashov (1991).

The subdivision of the Sakmarian–Kungurian is based on an evolutionary succession of *Neogondolella*, *Sweetognathus*, and *Neostreptognathodus* (Chernikh 1989). *Neogondolella* in the Sakmarian of the Urals is mainly represented by endemic species, unknown from other regions. In *Sweetognathus* the following species lineage is recorded: *Sweetognathus merrilli* Kozur (Tastubian)–*S. primus* Chernikh (Late Sterlitamakian)–*S. inornatus* Ritter (Burtsevian)–*S. whitei* (Rhodes) (Burtsevian–Sarginian). The first occurrence of *Neostreptognathodus* (*N. obliquidentatus* Chernikh) (Chernikh 1989) is recorded at the base of the Burtsevian Horizon. In the overlying Artinskian–Kungurian deposits, *Neostreptognathodus* is represented by a standard succession of *N. clarki* Kozur (Irginian)–*N. pequopensis* Behnken (Irginian–Kungurian)–*N. pnevi* Kozur & Movshovich (Saraninian–Kungurian).

Individual conodont and fusulinid zones of the Urals are depicted in Fig. 29.

## 5.4 Lower Permian conodont assemblages in Novaya Zemlya

Unlike the Carboniferous conodont assemblages, Permian faunas of basinal facies are distinctively different from those occurring in shallower settings. This facies dependency prevents a single regional scheme for Novaya Zemlya. In basinal deposits, conodont faunas are dominated by *Neogondolella* which occurs together with some *Streptognathodus* and representatives of *Gondolelloides*. Shallow-water deposits are dominated by *Adetognathus* and morphologically similar species of New Genus A whereas *Idiognathodus*, *Neogondolella*, and *Streptognathodus* occur in low numbers.

Ranges of individual conodont taxa in composite sections through the Middle Carboniferous–Early Permian of Novaya Zemlya are shown in Fig. 30.

### 5.4.1 *Conodont assemblages in the Lower Permian basinal deposits in Novaya Zemlya*

The conodont subdivision of the Lower Permian

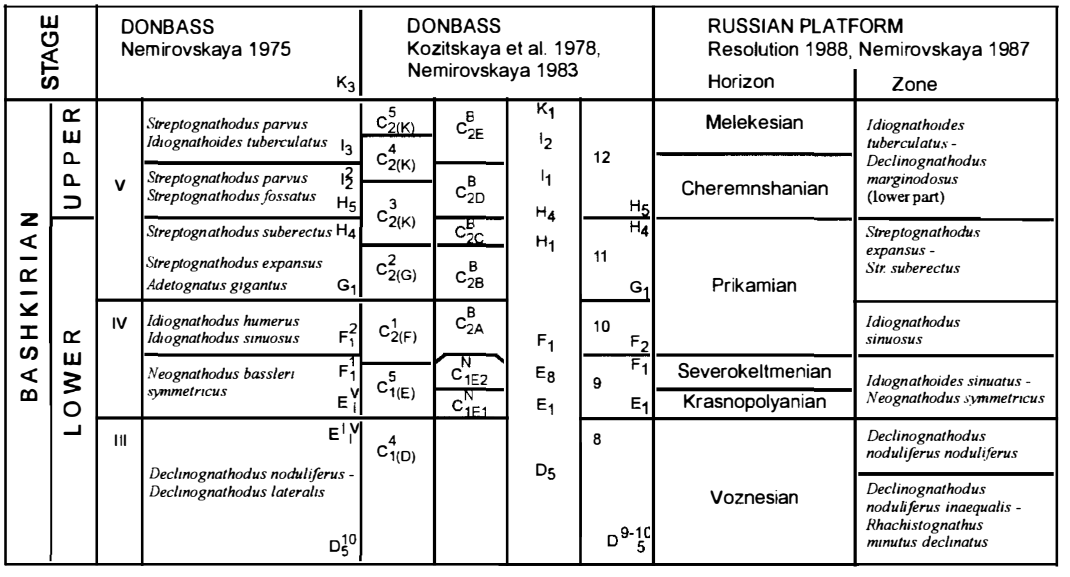


*Fig. 24.* Bashkirian conodont zonations of former USSR.

basinal deposits in Novaya Zemlya is based on the subdivision presented for the Urals (Chernikh & Chuvashov 1991). In the Asselian of Novaya Zemlya, as well as in the Urals, several *Streptognathodus* zones (*Streptognathodus wabaunsensis*, *S. cristellaris* and *S. constrictus–S. barskovi*) are distinguished. At the same time, contrary to the view of Chernikh (1989) and Chernikh & Reshetkova (1987), we presume that the evolution of *Neogondolella* in the Asselian proceeded in

| MOSCOW BASIN | | | | | |
|---|---|---|---|---|---|
| Barskov & Alekseev 1976 | | Barskov & Goreva 1981 | Barskov et al. 1981 | Goreva 1984 | |
| Myachovian | *Streptognathodus cancellosus - Idiognathodus delicatus* | *Neognathodus dilatus Neognathodus roundyi* | *Streptognathodus cancellosus Neognathodus roundyi* | *N. roundyi- S. cancellosus* | *N. roundyi* |
| | | | | | *N. inaequalis* |
| Podolian | *Neognathodus bothrops -* | *Neognathodus medexultimus* | *Neognathodus medexultimus* | *Neognathodus medexultimus - Idiognathodus podolskiensis* | |
| Kashirian | *Idiognathodus delicatus* | *Neognathodus medadultimus* | *Neognathodus medadultimus* | *Neognathodus medadultimus - Idiognathodus obliquus* | |
| | *Idiognathodus delicatus - Neognathodus bassleri* | *Neognathodus bothrops* | *Neognathodus bothrops* | *Neognathodus bothrops - Idiognathdous obliquus* | |
| Vereian | *Declinognathodus noduliferus - Neognathodus bassleri* | *Neognathodus bassleri* | Beds with *Idiognathoides fossatus* | Beds with *Declinognathodus noduliferus - Idiognathoides fossatus* | |

*Fig. 25.* Moscovian conodont zonations of former USSR.

two directions. In the first group, species are distinguished with a simple structure of the main cusp and the posterior end of the platform (*N. belladontae* Chernikh, *N. dentiseparata* Reshetkova & Chernikh, *N. simulata* Chernikh). In the second group morphologically complicated forms (*N. adentata* Chernikh & Reshetkova, *N. discedus* sp. nov.) evolved quickly during the Asselian. Two subzones embraced by the *S. constrictus–S. barskovi* Assemblage Zone are defined: *N. discedus* and *N. discedus* (late form) Assemblage Subzones. The upper part of the Upper Asselian is characterised by the appearance of *Neogondolella* with closely fused denticles forming a distinct carina-blade (*N.* cf. *N. pseudostriata* Chernikh).

In the Asselian deposits of Novaya Zemlya, it was possible to trace the evolution of "*Gondolella*"–*Gondolelloides*. This lineage proceeded toward an elaboration of the carina structure from the forms that have a carina with simple conical, not fused, denticles ("*Gondolella*" cf. "*G.*" *denuda* (Ellison) in the *S. wabaunsensis* Zone) through forms with a conspicuous dissection of cusps ("*Gondolella*" sp. A in the *S. cristellaris* Zone) towards very characteristic forms with icriode-like carina (*Gondolelloides canadensis* Henderson & Orchard and *Gondolelloides* cf. *G. nahanniensis* Henderson & Orchard in the *S. constrictus–S. barskovi* Zone).

In the Sakmarian–Artinskian deposits of Novaya Zemlya two conodont assemblages (*Sweetognathus* sp.–*Neogondolella bisselli*, and *Neostreptognathodus pequopensis* Assemblage Zones) are distinguished.

### 5.4.1.1 *Streptognathodus wabaunsensis* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus wabaunsensis* Gunnell and *S. flangulatoformis* sp. nov.
Top = First occurrence of *Streptognathodus cristellaris* Chernikh & Reshetkova and *Neogondolella discedus* sp. nov.

This assemblage is recorded in the base of the Upper Kazarkinskaya Formation in the Bolshaya Yunau River section (Loc. no. 753) and in the Admiralty Peninsula (Loc. no. 9031) (Figs. 8, 9, 18, 19, Tables 3, 6) and in the top of the Lavrovskaya Formation in Cape Borisoff. Diagnostic species in this assemblage are *S. flangulatus* Gunnell, *S. flangulatoformis* sp. nov., *S. wabaunsensis* Gunnell, *S.* cf. *wabaunsensis* Gunnell and "*Gondolella*" cf. "*G.*" *denuda* (Ellison), whereas *Idiognathodus delicatus* Gunnell, *I. lobulatus* Kozitskaya, *I. tersus* Ellison, *I. toretzianus* Kozitskaya, *Streptognathodus elegantulus* Stauffer &

| DONBASS | | | | RUSSIAN PLATFORM | | | | |
|---|---|---|---|---|---|---|---|---|
| Kozitskaya et al. 1978 | | | | Barskov et al. 1984 | | | Resolution 1988 | |
| $C^{1}_{3(N)}$ | $C^{M}_{2E}$ | $N_3$ | 17 | Myachovian | *Streptognathodus cancellosus* | *Neognathodus roundyi* | Myachovian | *Streptognathodus cancellosus - Neognathodus roundyi* |
| $C^{7}_{2(M)}$ | $C^{M}_{2D}$ | $M_{10}$ | 16 | Podolian | *Streptognathodus concinnus - Idiognathodus podolskiensis* | *Neognathodus medexultimus* | Podolian | *Streptognathodus concinnus - Neognathodus medexultimus* |
| | $C^{M}_{2C}$ | $M_6$ $M_5$ | 15 | Kashirian | *Streptognathodus dissectus* | *Neognathodus medadultimus* | (upper) Kashirian | *Streptognathodus dissectus - Neognathodus medadultimus* |
| | | $M_1$ | | Zninian | *Streptognathodus transitivus* | *Neognathodus bothrops* | (lower) | *Streptognathodus transitivus - Neognathodus bothrops* |
| $C^{6}_{2(L)}$ | $C^{M}_{2B}$ | $L_1$ | 14 | | | | | |
| $C^{5}_{2(K)}$ | $C^{M}_{2A}$ | $K_3$ | 13 | Vereian | *Idiognathoides fossatus* | | Vereian | *Idiognathoides tuberculatus - Declinognathodus marginodosus* (upper part) |

(*Fig. 25* continued)

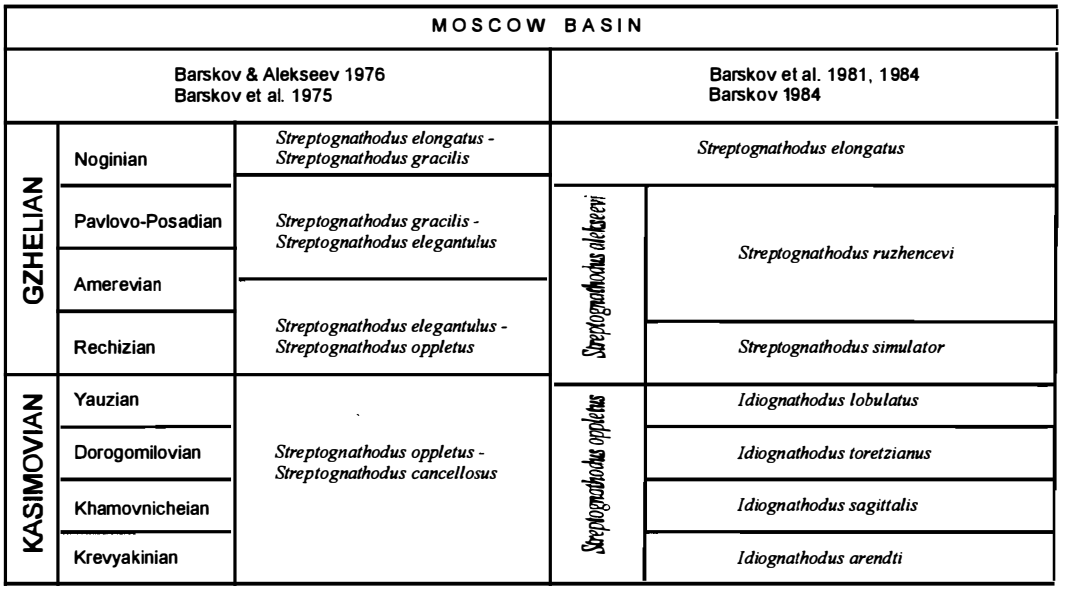


*Fig. 26.* Upper Carboniferous conodont zonations of former USSR.

Plummer, *S. elongatus* Gunnell, *S. gracilis* Stauffer & Plummer and *S. simplex* Gunnell also occur in the underlying unit. The presence of *S. flangulatus* Gunnell and *S. wabaunsensis* Gunnell makes it possible to correlate this assemblage with the *Streptognathodus wabaunsensis* Zone of the Sokoliegorskian Horizon in the Moscow Syneclise (Barskov et al. 1981), the Caspian Depression (Akhmetshina et al. 1984; Akhmetshina 1990), the South Urals (Barskov et al. 1981; Movshovich et al. 1979; Isakova & Nazarov 1986; Chernikh & Reshetkova 1987; Davydov et al. 1990; Chernikh & Chuvashov 1991) and the Donets Depression (Stepanov 1983). In Kansas, *S. wabaunsensis* Gunnell and *S. flangulatus* Gunnell are present in the Falls City Limestone (Admire Group) and the Red Eagle Limestone (Council Grove Group) (Ritter 1991). The *S. wabaunsensis* Assemblage Zone of Novaya Zemlya apparently corresponds to Zone P2 (*S. nodulinearis*) in the Sverdup Basin (Beauchamp et al. 1989; Henderson 1988).

The relationship of the *S. wabaunsensis* Zone to the established fusulinid zonation is vague. Chernikh & Chuvashov (1991) correlate the *S. wabaunsensis* Zone with the lower part of the *Schwagerina vulgaris–Schwagerina fusiformis* Zone, whereas other workers believe that it also embraces the *Daixina robusta–D. bosbytauensis* Zone (Davydov et al. 1990; Akhmetshina 1990).

#### 5.4.1.2 *Streptognathodus cristellaris* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus cristellaris* Chernikh & Reshetkova
Top = First occurrence of *Streptognathodus barskovi* (Kozur) and *S. constrictus* Chernikh & Reshetkova

This assemblage is recorded at the base of the Tolbeyachskaya Formation in the Krasnaya River section (Loc. no. 601) (Figs. 10 and 11, Table 12). The assemblage is composed of *Neogondolella* cf. *N. discedus* sp. nov., "*Gondolella*" sp. A Henderson & Orchard, *Gondolelloides canadensis* Henderson & Orchard, *Streptognathodus cristellaris* Chernikh & Reshetkova, *S. elongatus* Gunnell, *S.* cf. *S. invaginatus* Reshetkova & Chernikh, *S.* cf. *S. latus* Chernikh & Reshetkova and *S. simplex* Gunnell.

The assemblage is similar to the fauna in the *S. cristellaris* Zone of Asselian age in the Urals

| RUSSIAN PLATFORM | | | | DONBASS | |
|---|---|---|---|---|---|
| Resolution 1988 | | | | Stchegolev & Kozitskaya 1984 | |
| GZHELIAN | Noginian | *Streptognathodus elongatus* | | *Streptognathodus elongatus* | $P_5$ |
| | Pavlovo-Posadian | *Streptognathodus ruzhencevi* | *Streptognathodus alekseevi* | *Streptognathodus elegantulus* | $P_3$ |
| | Dobryatinian | *Streptognathodus simulator* | | *Idiognathodus lobulatus - Streptognathodus elegantulus* | P2 |
| KASIMOVIAN | Dorogomilovian | *Idiognathodus lobulatus* | *Streptognathodus oppletus - Streptognathodus excelsus* | *Streptognathodus oppletus - Streptognathodus elegantulus* | $O_5$ |
| | | *Idiognathodus toretzianus* | | | $O_4$ |
| | Khamovnicheian | *Idiognathodus sagittalis* | | *Streptognathodus oppletus - Idiognathodus sagittalis* | |
| | Krevyakinian | *Idiognathodus arendti* | | | $N_5$ |

(*Fig. 26* continued)

| Stage No. | Characteristic features | Typical species | Zone |
|---|---|---|---|
| V | Simplification of the platform structure, disappearance of deep troughs in its anterior part | *S. postfusus* | *postfusus* |
| IV | Generation of deep troughs in the anterior part of the platform | *S. constrictus*<br>*S. fusus*<br>*S. longissimus* | *constrictus* |
| III | Restoration of ridging of parapets in their anterior part | *S. cristellaris* | *cristellaris* |
| II | Appearance of additional lobe on one or both parapet(s) | *S. wabaunsensis*<br>*S. flangulatus*<br>*S. invaginatus*<br>*S. nodulinearis*<br>*S. acuminatus* | *wabaunsensis* |
| I | Divergent evolution of *S. elongatus* through changes in the platform width | *S. elongatus*<br>*S. simplex*<br>*S. aff. barskovi* | *elongatus* |

*Fig. 27.* Morphological features in *Streptognathodus* in the Asselian of the Urals (based on Chernikh & Reshetkova, 1987, 1988).

(Chernikh & Reshetkova 1988), correlative to the Lower Asselian *Schwagerina vulgaris–Schwagerina fusiformis* fusulinid Zone. The presence of *S.* cf. *S. latus* Chernikh & Reshetkova at this level in the Novaya Zemlya section is noteworthy, as *S. latus* Chernikh & Reshetkova is a typical member in the *S. constrictus* Zone of Middle Asselian age in the Urals. The first occurrence of *Neogondolella* with an upwards bent posterior end of the platform, morphologically similar to *N. discedus* sp. nov. is also present in the *S. constrictus* Zone in the Urals. The data presented above do not conclusively correlate the *S. cristellaris* Assemblage Zone of Novaya Zemlya with the *S. constrictus* Zone in the Urals, rather it may also embrace both the *S. cristellaris* and the lower *S. constrictus–N. belladontae* Subzone (Chernikh & Chuvashov 1991).

| Stage No. | Characteristic features | Typical species | Zone |
|---|---|---|---|
| IV | Generation of carina blade | *N. pseudostriata*<br>*N. foliosa*<br>*N. aff. uralensis* | *pseudostriata* |
| III | Differentiation in platform width | *N. striata* | *striata* |
| II | Generation of cusp at the expense of an upwards recurvate posterior end of platform | *N. simulata* | *simulata* |
| I | Lack of cusp or its generation at the expense of an upwards recurvate posterior end of platform | *N. adentata*<br>*N. belladontae* | *belladontae* |

*Fig. 28.* Morphological features in *Neogondolella* in the Asselian of the Urals (from Chernikh & Chuvashov, 1991).

| | | HORIZON | FUSULINID ZONES | MOVSHOVICH ET AL. 1979 | BARSKOV ET AL. 1981 |
|---|---|---|---|---|---|
| L. PERMIAN | KUNGURIAN | Irenian | | *Neostreptognathodus pnevi - Stepanovites festivus* 13 | |
| | | Filippovian | | *Neostreptognathodus pnevi* | |
| | ARTINSKIAN | Saraninian | | 12 | |
| | | Sarginian | *Parafusulina solidissima* | *Sweetognathus bogoslovskaya*<br>*Neostreptognathodus pequopensis*<br>*Neostreptognathodus pequopensis*<br>*Neostreptognathodus ruzhencevi*<br>*Neostreptognathodus tsuvashovi*<br>9 *Gondolella bisselli*<br>*Sweetognathus whitei* | |
| | | Irginian | *Pseudofusulina juresanensis - Parafusulina lutugini* | *Gondolella bisselli*<br>*Gnathodus artinskiensis*<br>*Gnathodus simplex* | |
| | | Burtsevian | *Pseudofusulina concavutas - Pseudofusulina pedissequa* | 8 | |
| | SAKMARIAN | Sterlitamakian | *Pseudofusulina urdalensis* | 7 *G. bisselli, Cavusgnathus lautus, Gnathodus simplex* | |
| | | Tastubian | *Pseudofusulina verneuilli* | *Gondolella bisselli*<br>*Gnathodus simplex*<br>*Idiognathodus delicatus* | |
| | | | *Pseudofusulina moelleri* | 6 | |
| | ASSELIAN | Shikanian | *Schwagerina sphaerica - Schwagerina firma* | 5 *Gnathodus barskovi* | |
| | | Kholodnolozhian | *Schwagerina moelleri - Schwagerina fecunda* | 4 *Gnathodus elongatus - Gnathodus wabaunsensis* | *Streptognathodus simplex - S. barskovi, S. wabaunsensis* |
| | | | *Schwagerina vulgaris - Schwagerina fusiformis* | *Gnathodus simplex - Gnathodus elongatus* | *Streptognathodus simplex - Streptognathodus wabaunsensis* |
| | | | *Daixina robusta - Daixina bosbytauensis* | 3 | |
| U.CARB | | | *Daixina sokensis* | *Gnathodus elegantulus, G. ruzhencevi, G. simplex, G. elongatus* | *S. elongatus, S. conjunctus, S. aff. excelsus, S. alekseevi* |

*Fig. 29.* Lower Permian conodont zonation of the Urals.

5.4.1.3 *Streptognathodus barskovi–Streptognathodus constrictus* Assemblage Zone

Definition:
Base = First occurrence of *Streptognathodus barskovi* (Kozur) and *S. constrictus* Chernikh & Reshetkova
Top not defined.

This assemblage is recorded in the deposits of the Upper Kazarkinskaya Formation in the Bolshaya Yunau River (Loc. no. 101), the Nekhvatova River (Loc. no. 752) and the Yuzhnaya Tainaya River sections (Loc. no. 131) (Figs. 6 and 7, Table 3), and in the Tolbeyachskaya Formation on the Krasnaya River (Loc. no. 601) (Figs. 10 and 11, Table 12). The assemblage is characterised by *S. barskovi* (Kozur) and *S. constrictus* Chernikh & Reshetkova. On the basis of changes in the conodont association accompanying these species (primarily *Neogondolella*) a three-fold subdivision of the assemblage is outlined.

<table>
<tr><th>AKHMETSHINA ET AL. 1981</th><th>ISAKOVA 1986</th><th colspan="2">CHERNIKH & RESHETKOVA 1987, 1988</th><th>CHERNIKH & CHUVASHOV 1991</th></tr>
<tr><td rowspan="8"></td><td rowspan="8"></td><td colspan="2" rowspan="8"></td><td>Neostreptognathodus pnevi</td></tr>
<tr><td>Neostreptognathodus pequopensis</td></tr>
<tr><td>Sweetognathus whitei</td></tr>
<tr><td>Neogondolella bisselli - Neogondolella visibilis</td></tr>
<tr><td>Neogondolella lata - Sweetognathus merrilli</td></tr>
<tr><td>Neogondolella uralensis</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td></td></tr>
<tr><td rowspan="2">Streptognathodus barskovi</td><td rowspan="2">Streptognathodus barskovi</td><td colspan="2">Streptognathodus postfusus</td><td>Neogondolella pseudostriata</td></tr>
<tr><td colspan="2">Streptognathodus constrictus</td><td>Neogondolella striata</td></tr>
<tr><td rowspan="2">Streptognathodus wabaunsensis</td><td rowspan="2">Streptognathodus wabaunsensis</td><td colspan="2">Streptognathodus cristellaris</td><td>N. simulata - S. fusus</td></tr>
<tr><td colspan="2">Streptognathodus wabaunsensis</td><td>S. constrictus - N. belladontae</td></tr>
<tr><td rowspan="2">S. elongatus</td><td rowspan="2">S. elegantulus - S. elongatus</td><td rowspan="2">S. elongatus</td><td>S. simplex</td><td>Streptognathodus cristellaris</td></tr>
<tr><td>S. elongatus</td><td>Streptognathodus wabaunsensis</td></tr>
<tr><td colspan="3"></td><td>S. elongatus</td></tr>
</table>

(*Fig. 29* continued)

#### 5.4.1.4 *Neogondolella discedus Assemblage Subzone*

Definition:
Base = First occurrence of *Neogondolella discedus* sp. nov. together with *Streptognathodus barskovi* (Kozur) and *Streptognathodus constrictus* Chernikh & Reshetkova
Top = First occurrence of *Neogondolella discedus* sp. nov. (late form)

This assemblage is recorded in the lower part of the Tolbeyachskaya Formation (Figs. 10 and 11, Table 12). *Streptognathodus* in the assemblage is represented by the following species: *Streptognathodus barskovi* (Kozur), *S. constrictus* Reshetkova & Chernikh, *S. elongatus* Gunnell, *S. invaginatus* Chernikh & Reshetkova, *S.* cf. *S. longissimus* Chernikh & Reshetkova, *S.* cf. *S. nodulinearis* Reshetkova & Chernikh and *S. simplex* Gunnell. *Neogondolella* is dominated by *Neogondolella adentata* Chernikh & Reshetkova, *N. belladontae* Chernikh, *N. discedus* sp. nov. and *N.* sp. B, with fewer *N.* cf. *N. dentiseparata* Reshetkova & Chernikh, *N.* cf. *N. simulata* Chernikh and *N.* cf. *N. striata* Chernikh & Reshetkova. The assemblage also comprises "*Gondolella*" sp. A Henderson & Orchard and "*G*" cf. sp. B Henderson & Orchard, *Gondolelloides canadensis* Henderson & Orchard and *G.* cf. *G. nahanniensis* Henderson & Orchard. In the Urals, a similar conodont assemblage is known from the Middle Asselian *Schwagerina moelleri–Pseudofusulina fecunda* fusulinid Zone (Chernikh 1989). *N. belladontae* Chernikh and *N. adentata* Chernikh & Reshetkova are characteristic of the *Streptognathodus constrictus–Neogondolella belladontae* Zone in the Urals. Several of the mentioned species of the Novaya Zemlya assemblage are typical representatives in the *S. fusus–N. simulata* Subzone (upper subzone of the *S. constrictus* Zone) of the Middle Asselian in the Urals (Chernikh & Chuvashov 1991). Considering the data presented above, the Novaya Zemlya *S. constrictus–N. discedus* Assemblage Zone is correlated with the Uralian *S. constrictus–N. belladontae* Subzone without excluding the possibility that it might correspond to the higher *Streptognathodus fusus–Neogondolella simulata* Subzone.

#### 5.4.1.5 *Neogondolella discedus (late form)* Assemblage Subzone

Definition:
Base = First occurrence of *Neogondolella discedus* sp. nov. (late form) together with *Streptognathodus barskovi* (Kozur) and *Streptognathodus constrictus* Chernikh & Reshetkova
Top = First occurrence of *Neogondolella foliosa* Chernikh & Reshetkova and *N.* cf. *N. pseudostriata* Chernikh

This assemblage is recorded in the Upper Kazarkinskaya Formation in the Nekhvatova River section (Loc. no. 752) and in the Yuzhnaya Tainaya River section (Loc. no. 121) (Figs. 6 and 7, Table 3), as well as in the lower part of the Tolbeyachskaya Formation (Loc. no. 601) (Figs. 10 and 11, Table 12). The assemblage is characterised by *Streptognathodus fusus* Chernikh & Reshetkova and *Neogondolella discedus* sp. nov. (late form) in association with abundant *N. dentiseparata* Reshetkova & Chernikh, *N. simulata* Chernikh and *N. striata* Chernikh & Reshetkova.

Associated species include *Neogondolella belladontae* Chernikh, "*Gondolella*" sp. A. Henderson & Orchard, *Gondolelloides canadensis* Henderson & Orchard, *Gondolelloides* cf. *G. nahanniensis* Henderson & Orchard, *Streptognathodus* cf. *S. acuminatus* Gunnell, *S. barskovi* Kozur, *S. constrictus* Reshetkova & Chernikh, *S. elongatus* Gunnell, *S. invaginatus* Chernikh & Reshetkova, *S.* cf. *S. longissimus* Chernikh & Reshetkova, *S. simplex* Gunnell, and *Adetognathus lautus* (Gunnell).

The *Streptognathodus barskovi, S. constrictus–Neogondolella discedus* (late form) Assemblage Zone correlates well with the assemblages in the *Neogondolella simulata–Streptognathodus fusus* and *Neogondolella striata* Zones in the Urals, defining the uppermost Kholodnologian Horizon and the base of the Shikhanian Horizon (Chernikh & Chuvashov 1991).

| Novaya Zemlya and Pechora Shelf Conodont Assemblages | Sverdrup Basin (Beauchamp et al. 1989) | |
|---|---|---|
| | Zones | Assemblages of correlative conodont species |
| *Neostreptognathodus pequopensis* | Zone P8, upper part of Unnamed Fm., and Van Hauen Fm. | *Neostreptognathodus pequopensis* |
| *Sweetognathus* sp. - *Neogondolella bisselli* and *Adetognathus paralautus* | Zone P6, upper part of Belcher Channel Fm., Unnamed and Van Hauen Fm. | *Sweetognathus* ex gr. *inornatus* - *Neogondolella bisselli* and *Adetognathus paralautus* |
| *Streptognathodus barskovi* - *Streptognathodus constrictus* | Zone P3, uppermost Canyon Fiord Fm., lowermost Belcher Channel Fm., Nansen Fm. | *Streptognathodus barskovi* - *Streptognathodus constrictus* |
| *Streptognathodus wabaunsensis* and *Streptognathodus noduliferus* | Zone P2, Canyon Fiord and Nansen Fm. | *Streptognathodus noduliferus* |
| *Streptognathodus alekseevi* (lower part) | Zone C6a, middle part of Canyon Fiord and Nansen Fm. | *Streptognathodus simulator* |
| Upper part of *Gondolella* - *Neognathodus* - *Streptognathodus* fauna (*Neognathodus medadultimus*, *N. medexultimus* and *N. roundyi*) | Zone C5, base of Hare Fiord Fm., Nansen and Canyon Fiord Fm. | *Neognathodus medadultimus*, *N. medexultimus* and *N. roundyi* |
| *Declinognathodus* - *Idiognathoides* | Zone C3 and upper part of one C2, Otto Fiord and Nansen Fm. | *Declinognathodus* - *Idiognathoides* - *Idiognathodus* assemblage |
| *Declinognathodus noduliferus* | Zone C2 (lower part), base of Otto Fiord Fm., lower part of Nansen Fiord Fm | *Declinognathodus noduliferus*, *D. lateralis* |

*Fig. 31.* Conodont–based correlation between Novaya Zemlya and Sverdrup Basin.

| Novaya Zemlya and Pechora Shelf Conodont Assemblages | Svalbard (Nakrem 1991a and b) | |
|---|---|---|
| | Spitsbergen | Bjørnøya |
| *Neostreptognathodus pequopensis* | *Neostreptognathodus pequopensis* - *Sweetognathus*, ?upper part of Gipshuken Fm. and Vøringen Mbr. (Kapp Starostin Fm.) | *Neostreptognathodus pequopensis* - *pnevi-clarki*, *Sweetognathus whitei-inornatus*, top Hambergfjellet Fm. |
| *Sweetognathus* (ex gr. *inornatus*) - *Neogondolella bisselli* | *Sweetognathus inornatus*, uppermost Tyrrellfjellet Mbr. | |
| *Streptognathodus barskovi* - *Streptognathodus constrictus* and *S. elongatus* - *Adetognathus lautus* | *Streptognathodus elongatus*, *S.* cf. *barskovi*, *Adetognathus lautus*, lower part of Tyrrellfjellet Mbr. | *Streptognathodus* cf. *constrictus*, *Streptognathodus elongatus* Kapp Dunér Fm. |
| *Streptognathodus alekseevi* | *Streptognathodus alekseevi*, *S. excelsus*, Cadellfjellet and Kapitol Mbrs. | |

*Fig. 32.* Conodont based correlation between Novaya Zemlya and Svalbard.

#### 5.4.1.6 *Neogondolella* cf. *foliosa* Assemblage Subzone

Definition:
Base = First occurrence of *Neogondolella* cf. *foliosa* Chernikh & Reshetkova and *N.* cf. *N. pseudostriata* Chernikh together with *Streptognathodus barskovi* (Kozur) and *Streptognathodus constrictus* Chernikh & Reshetkova
Top not defined.

This assemblage is recorded in the top of the Upper Kazarkinskaya Formation in the Bolshaya Yunau River section (Loc. no. 101) (Figs. 6 and 7, Table 3), and is determined as an analogue to the *Neogondolella foliosa* fauna of the Urals (Chernikh 1989). The assemblage is characterised by the appearance of *Neogondolella* with a well developed carina-blade, i.e., *N.* cf. *N. foliosa* Chernikh & Reshetkova, *N.* cf. *N. pseudostriata* Chernikh. In addition, the assemblage also comprises *Neogondolella simulata* Chernikh, *Gondolelloides canadensis* Henderson & Orchard and *Streptognathodus constrictus* Reshetkova & Chernikh. In the Urals, neogondolellids with a blade-formed carina are characteristic of the Shikhanian Horizon (the *Neogondolella pseudostriata* Zone) (Chernikh & Reshetkova 1987; 1988).

Generally, the Novaya Zemlya *S. barskovi–S. constrictus* Assemblage Zone, with reference to the above data, is of Middle–Late Asselian age. This assemblage corresponds to Zone P3 (Henderson 1988; Beauchamp et al. 1989) in the Sverdrup Basin. Similar faunal elements are recorded from the Nordenskiöldbreen Formation (Tyrrellfjellet Member) in Spitsbergen and from the Kapp Dunér Formation of Bjørnøya, both units are of Asselian age (Nakrem 1991a, 1991b; Nakrem et al. 1992).

#### 5.4.1.7 *Sweetognathus* sp.–*Neogondolella bisselli* Assemblage Zone

Definition:
Base = First occurrence of *Sweetognathus* sp. and *Neogondolella bisselli* (Clark & Behnken)
Top = First occurrence of *Neostreptognathodus pequopensis* Behnken

This assemblage is recorded in the middle part of the Tolbeyachskaya Formation (=Lower Member) in the Krasnaya River section (Loc. no. 601) (Figs. 10 and 11, Table 12).

The assemblage is dominated by *Neogondolella*, e.g. *N. bisselli* (Clark & Behnken), *N.* cf. *N. lata* Chernikh and *N.* sp. in addition to single representatives of *Sweetognathus* sp.

In the Urals, the *Sweetognathus–Neogondolella* association is typical of the upper part of the

| Colour of conodonts in reflected light | C.A.I. | Zones of petroleum generation and destruction | Temperature (°C) |
|---|---|---|---|
| Very pale yellow | 1.0 | | <50-80 |
| Pale yellow | 1.5 | Oil "birth" line | 50-90 |
| Brown to dark brown | 2.0 | | 60-140 |
| Dark brown to grayish brown | 2.5 | "Oil window" | |
| Very dark grayish brown | 3.0 | | 110-200 |
| Very dark grayish brown to very dark brown | 3.5 | Wet gas floor | |
| Very dark brown | 4.0 | | 190-300 |
| Very dark brown to black | 4.5 | Dry gas preservation limit | |
| Black | 5.0 | | 300-400 |
| Grey | 6.0 | | 360-550 |
| White | 7.0 | | 490-720 |
| Colourless, translucent | 8.0 | | >600 |

*Fig. 33.* Conodont Colour Alteration Indices, based on Harris (1979) and Harris & Rejebian (1986).

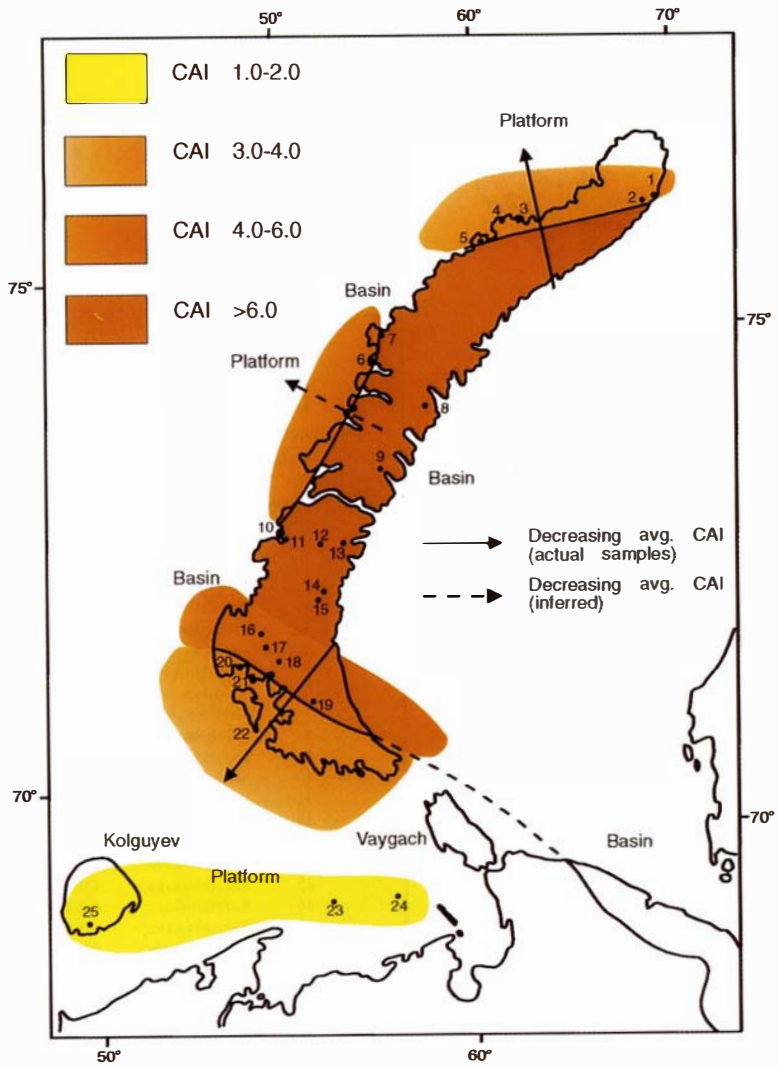


*Fig. 35.* Conodont CAI map, Middle Carboniferous. Sample points, formations and CAI-values:

| Sample point | Formation | CAI-value |
|---|---|---|
| 1 | Sporonavolokskaya | 3.5–4.0 |
| 2 | Sporonavolokskaya | 3.5–4.0 |
| 3 | Barentsevskaya | 3.5–4.0 |
| 4 | Barentsevskaya | 4.0–4.5 |
| 5 | Barentsevskaya | 5.0 |
| 6 | Lavrovskaya | 5.0 |
| 7 | Kazarkinskaya | 6.0 |
| 8 | Stepovskaya | 6.0 |
| 9 | Stepovskaya | 6.0 |
| 10 | Kazarkinskaya | 6.0 |
| 11 | Kazarkinskaya | 5.5–6.0 |
| 12 | Stepovskaya | 6.0 |
| 13 | Stepovskaya | 6.0 |
| 14 | Stepovskaya | 6.0 |
| 15 | Stepovskaya | 6.0 |
| 16 | Kazarkinskaya | 5.0 |
| 17 | Kazarkinskaya | 5.0 |
| 18 | Kazarkinskaya | 5.0 |
| 19 | Kazarkinskaya | 4.0–4.5 |
| 20 | Kazarkinskaya | 4.0–4.5 |
| 21 | Lazarevskaya | 3.5 |
| 22 | Lazarevskaya | 3.0 |
| 23 | SG1 Drillhole | 1.5–2.0 |
| 24 | PR1 Drillhole | 1.5–2.0 |
| 25 | BUG Drillhole | 1.5–2.0 |

Sakmarian (Sterlitamakian) and the base of the Artinskian (Burtsevian) (Chernikh 1989). In the Sverdrup Basin *N. bisselli* appears in Zone P6a, and is common together with *Sweetognathus* in Zones P6b and P7 (Beauchamp et al. 1989). In Spitsbergen *S. inornatus* Ritter is present in the uppermost part of the Tyrrellfjellet Member, whereas elements similar to *S. whitei* (Rhodes) are present in the Vøringen Member (basal Kapp Starostin Formation) (Szaniawski & Małkowski 1979; Nakrem 1991a; Nakrem et al. 1992).

#### 5.4.1.8 *Neostreptognathodus pequopensis* Assemblage Zone

Definition:
Base = First occurrence of *Neostreptognathodus pequopensis*

This assemblage is recorded in the upper part of the Tolbeyachskaya Formation in the Krasnaya River area (Loc. no. 4409, 5582, 5081) (Figs. 10 and 11, Table 12), as well as in the unnamed shale in the area of the Spokoynaya River (Loc. no.

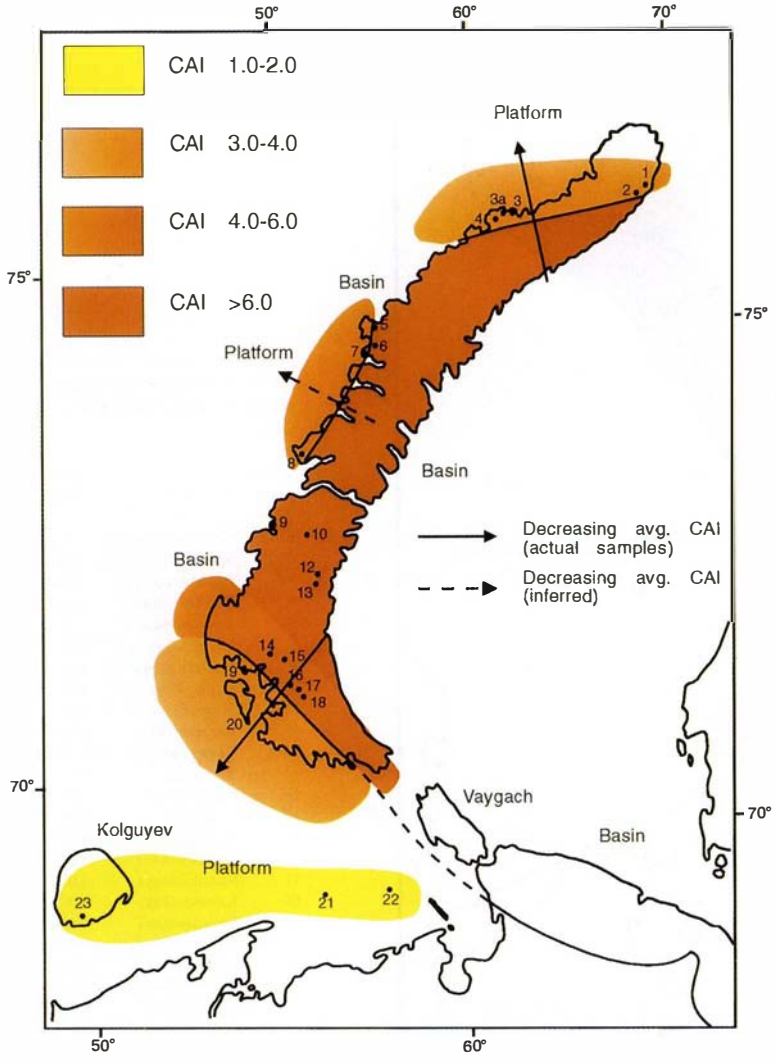


*Fig. 36.* Conodont CAI map, Upper Carboniferous–Lower Permian. Sample points, formations and CAI-values:

| Sample point | Formation | CAI-value |
|---|---|---|
| 1 | Yeksovskaya | 3.5–4.0 |
| 2 | Yeksovskaya | 3.5–4.0 |
| 3 | Barentsevskaya | 3.5–4.0 |
| 3a | Sedovskaya | 3.5–4.0 |
| 4 | Sedovskaya | 3.5–4.0 |
| 5 | Kazarkinskaya | 6.0 |
| 6 | Kazarkinskaya | 6.0 |
| 7 | Lavrovskaya | 4.5–6.0 |
| 8 | Lavrovskaya | 4.5–6.0 |
| 9 | Kazarkinskaya | 6.0 |
| 10 | Stepovskaya | 6.0 |
| 11 | Stepovskaya | 6.0 |
| 12 | Tolbeyakhskaya | 6.0 |
| 13 | Kazarkinskaya | 6.0 |
| 14 | Kazarkinskaya | 4.0–4.5 |
| 15 | Kazarkinskaya | 4.0–4.5 |
| 16 | Kazarkinskaya | 4.0–4.5 |
| 17 | Kazarkinskaya | 4.0–4.5 |
| 18 | Kazarkinskaya | 4.0–4.5 |
| 19 | Lazarevskaya | 3.5 |
| 20 | Lazarevskaya | 3.5 |
| 21 | SG1 Drillhole | 1.0–1.5 |
| 22 | PR1 Drillhole | 1.0–1.5 |
| 23 | BUG Drillhole | 1.0–1.5 |

1618). The assemblage is composed of *Neogondolella bisselli* (Clark & Behnken), *Neogondolella* sp. C, *Neostreptognathodus pequopensis* Behnken and *Neostreptognathodus* sp. The presence of *N. pequopensis* Behnken in the Novaya Zemlya assemblage and the absence of more advanced species of *Neostreptognathodus* permit correlation of this assemblage with the *N. pequopensis* Zone in the Urals, corresponding to the Irginian and Sarginian Horizons of the Artinskian (Chernikh 1989). The index species of the assemblage, *N. pequopensis* Behnken, is widespread in the Lower Permian deposits of the Arctic. It is recorded in the upper part of the Hambergfjellet Formation in Bjørnøya, in the base of the Kapp Starostin Formation (the Vøringen Member), and possibly in the upper part of the Gipshuken Formation in Spitsbergen (Szaniawski & Małkowski 1979; Nakrem 1991b; Nakrem et al. 1992). In the Sverdrup Basin *N. pequopensis* Behnken is recorded in the Unnamed Formation (Zone P8, Beauchamp et al. 1989).

### 5.4.2 *Conodont assemblages in the Lower Permian coastal marine and shallow water deposits in northern Novaya Zemlya*

Conodont assemblages from the Lower Permian shallow-water deposits in northern Novaya Zemlya differ markedly from the Uralian assemblages, and, at the same time, they are very similar to the assemblages in the Sverdrup Basin and Svalbard.

In shallow-water deposits of northern Novaya Zemlya four conodont Assemblage Zones are defined:

1. *Streptognathodus nodulinearis* Assemblage Zone
2. *S. elongatus–Adetognathus lautus* Assemblage Zone
3. New Genus A sp. B Assemblage Zone
4. *Adetognathus paralautus* Assemblage Zone

#### 5.4.2.1 *Streptognathodus nodulinearis* Assemblage Zone

Definition:
The range of *Streptognathodus nodulinearis* Reshetkova & Chernikh

*Streptognathodus nodulinearis* Reshetkova & Chernikh is recorded from the anhydrite unit of the Yeksovskaya Formation on the Spokoynaya River (Loc. no. 1684); (Figs. 22 and 23, Table 1). In basinal deposits of Novaya Zemlya, this species is present in the *Streptognathodus wabaunsensis* and *S. barskovi–S. constrictus* conodont assemblage zones. In the Urals, *Streptognathodus nodulinearis* Reshetkova & Chernikh is associated with *S. wabaunsensis* Gunnell and is present in the *Streptognathodus constrictus* Zone (Chernikh 1989). In shallow-water deposits of the Nansen and Canyon Fiord Formations in the Sverdrup Basin, *S. nodulinearis* Reshetkova & Chernikh is present in the P2 Zone (Asselian) (Beauchamp et al. 1989).

#### 5.4.2.2 *Streptognathodus elongatus–Adetognathus lautus* Assemblage Zone

Definition:
The concurrent range of *Streptognathodus elongatus* Gunnell, *Adetognathus lautus* (Gunnell) and *Neogondolella* cf. *N. dentiseparata* Reshetkova & Chernikh.

This assemblage is recorded from the anhydrite unit of the Yeksovskaya Formation on the Spokoynaya River (Loc. no. 1696); (Figs. 22 and 23, Table 1). The assemblage is dominated by two species, i.e. *Adetognathus lautus* (Gunnell) and *Streptognathodus elongatus* Gunnell. Rare *S.* cf. *S. elegantulus* Stauffer & Plummer and *Neogondolella* cf. *N. dentiseparata* Reshetkova & Chernikh are also present. The first three species in this assemblage have a broad stratigraphic range from Late Carboniferous through the Early Permian (Sakmarian). Of significance for dating the assemblage is the presence of *N.* cf. *N. dentiseparata* Reshetkova & Chernikh which is presently known only from the Middle Asselian. In Svalbard *Adetognathus lautus* (Gunnell) and *Streptognathodus elongatus* Gunnell are recorded in the Tyrrellfjellet Member (Nakrem 1991a; Nakrem et al. 1992).

#### 5.4.2.3 New Genus A sp. B Assemblage Zone

Definition:
Base = First occurrence of New Genus A sp. B
Top = First occurrence of *Adetognathus paralautus* Orchard

This assemblage is recorded in the deposits of the Upper Barentsevskaya Formation in the Litke Peninsula (Loc. no. 805, 806, 798; Figs. 20 and 21, Table 2). The assemblage is dominated by representatives of New Genus A. In addition, there are rare *Adetognathus lautus* (Gunnell), *A.* sp. B Henderson, *Idiognathodus* sp. and *Streptognathodus* cf. *S. wabaunsensis* Gunnell. Representatives of New Genus A are known only from Canada and Novaya Zemlya. In the Sverdrup Basin, they are recorded in the Canyon Fiord and Nansen formations, in beds of Middle Carboniferous to Late Asselian age. *Adetognathus* sp. B, and *S.* cf. *S. wabaunsensis* Gunnell, being part of the Novaya Zemlya New Genus A sp. B Assemblage Zone, are known from Asselian deposits (Zones P2–P3) in the Sverdrup Basin (Henderson 1988). The Asselian age of the Novaya Zemlya assemblage is also supported by the occurrence of the Asselian tetracorals *Tschussovskenia kiaeri* (Holtedahl) and *Profescherina spitzbergensis* Dobrolyubova in these beds.

5.4.2.4 *Adetognathus paralautus* Assemblage Zone

Definition:
The range of *Adetognathus paralautus* Orchard

This assemblage is recorded in the deposits of the Sedovskaya Formation at the Litke Peninsula (Loc. no. 887, 8818) (Figs. 20 and 21, Table 2). The assemblage is composed of *Adetognathus paralautus* Orchard, *Diplognathodus* sp., and *Neogondolella bisselli* (Clark & Behnken). In the Urals, *A. paralautus* Orchard is a characteristic element in the Tastubian Horizon of the Sakmarian (Chernikh 1989) where it apparently has its oldest occurrence. In British Columbia (Canada), *A. paralautus* Orchard is a characteristic element of Fauna 1 (*Adetognathus* fauna), which correlates with the upper part of the Sterlitamakian, Burtsevian, and Irginian Horizons of the Urals (Orchard & Forster 1988). At approximately the same stratigraphic level, *A. paralautus* Orchard is recorded in the uppermost Nansen and Unnamed formations (Zones P6a, P6b) of the Sverdrup Basin (Henderson 1988; Beauchamp et al. 1989). The Novaya Zemlya *A. paralautus* Assemblage Zone is similar in its composition to Fauna 1 of British Columbia and the P6a conodont zone of the Sverdrup Basin, which dates it as Late Sakmarian-Artinskian.

# 6 Correlation of the Upper Paleozoic deposits in the Western Arctic

The series of biostratigraphically defined units established on the basis of conodont studies allow a direct correlation of the Middle Carboniferous–Lower Permian deposits in Novaya Zemlya and the Pechora shelf with coeval deposits of Svalbard (Spitsbergen and Bjørnøya) and the Sverdrup Basin (Canadian Arctic Archipelago). For correlation with Svalbard the conodont faunas described in Szaniawski & Małkowski (1979), Nakrem (1991a and b) and Nakrem et al. (1992) were used. The conodont zones as described in Henderson (1988) and Beauchamp et al. (1989) and references therein were followed for the Sverdrup Basin.

A comparative analysis of conodont assemblages from the western sector of the Russian Arctic and the Canadian Arctic Archipelago enables eight reliable correlation levels to be distinguished (Fig. 31) whereas four such levels are established at Svalbard (Fig. 32). A conodont based correlation scheme for the Arctic is depicted in Fig. 34.

# 7 Conodont Colour Alteration Index (CAI)

In the Colour Alteration Index (CAI) study, the technique and colour scale outlined by Epstein et al. (1977) and improved by Rejebian et al. (1987) were applied (Fig. 33).

The change in colour is related to a progressive and irreversible alteration of trace amounts of organic matter within the phosphatic conodont elements. Factors affecting change in CAI include temperature, time and pressure. CAI analyses reveal aspects of the geothermal history of basins, map heat flow and indicate burial depth and the amount of overburden. Conodont CAI has an advantage over TAI (Thermal Alteration Index in plant material) in marine carbonates where plant material is scarce, and in rocks affected by high temperature metamorphism (>100°C). It indicates the thermal maturation of rocks and hydrocarbon genesis. In accordance with the recommendations of Nowlan & Barnes (1987), the value of CAI was defined in the lightest parts of the platform (Pa) elements, excluding thin-walled elements and juvenile forms.

The analysis of conodont CAI value distribution isopach maps based on the Middle Carboniferous and Upper Carboniferous to Lower Permian conodont evaluations (Figs. 35 and 36 respectively) has led to the following conclusions:

1. The CAI values obtained from Middle Carboniferous conodonts are not significantly different from the values obtained from Upper Carboniferous–Lower Permian conodonts from similar depositional settings. This result may suggest similarities in the amount of overburden or distance from thermal source.
2. Conodont CAI values mapped from stratigraphic equivalents (Middle Carboniferous or Upper Carboniferous–Lower Permian) shows an increase in CAI from near-shore to more

basinal facies. In the basinal facies areas, the CAI values are maximal (CAI = 5.0–6.0), whereas the figures decrease significantly when moving into more near-shore facies (carbonate- and carbonate-marl shallow water deposits). Observations in southern and northern Novaya Zemlya show that the CAI values = 3.5–4.0 even in shallow water deposits immediately grading into basinal facies. The lowest CAI values were found in the Carboniferous to Permian deposits on Timan-Pechora shelf and Kolguev Island (CAI = 1.0–2.0). Western Novaya Zemlya might be regarded as an exception to the rule with CAI values as high as 4.5–5.0 being recorded. The reason for this anomality is the high pressure/temperature metamorphic nature of these rocks.

For an assessment of the hydrocarbon potential of the Upper Paleozoic rocks we used correlation charts of CAI and zones of petroleum generation and destruction as suggested by Dow (1977) and modified by Utting et al. (1989) (Fig. 33). In accordance with this chart, hydrocarbons generated in pre-Middle Carboniferous time may be present in the Upper Paleozoic rocks and gas-producing (wet gas and dry gas) in the North and South areas of Novaya Zemlya (CAI = 3.0–4.5). Investigated Upper Paleozoic deposits of the Pechora Sea shelf (CAI = 1.0–2.0) suggest placement of these strata within the oil–window. Moreover, considering that conodont CAI values regularly increase towards basinal facies, one can forecast existence of oil-producing Upper Paleozoic deposits in the Barents shelf north and west off Novaya Zemlya. Generation and/or migration of hydrocarbons after formation of the Upper Paleozoic rocks dealt with in the present study cannot be predicted from the recorded conodont C.A.I data.

# 8 Systematic description of Pa conodont elements

Illustrated specimens are housed in the CNIGR Museum, St. Petersburg, with collection number CNIGR 12745.

New taxa are described by the senior author. Synonyms are only included for Russian references except where otherwise important for taxonomic or biostratigraphic discussion.

Genus ADETOGNATHUS Lane, 1967

Type species.—*Cavusgnathus lautus* Gunnell, 1933

*Adetognathus lautus* (Gunnell, 1933)
Plate 15/I, K

1933 *Cavusgnathus lautus*—Gunnell, p. 286, pl. 31, figs. 67, 68, pl. 33, figs. 9
1978 *Adetognathus gigantus* (Gunnell); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 15, pl. 15, figs. 3, 4
1979 *Cavusgnathus lautus* Gunnell; Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, figs. 3, 4
1984 *Adetognathus gigantus* (Gunnell); Goreva, pl. 1, figs. 1–5.
1984 *Adetognathus lautus* (Gunnell); Goreva, pl. 1, figs. 8–13

Remarks.—*A. lautus* (Gunnell) consists of sinistral *A. lautus* sensu formo and dextral *A. gigantus* sensu formo as an asymmetrical pair. The free blade of the sinistral form species is relatively long with greatest height of denticles in middle or anterior part. Dextral form differs from sinistral form by the presence of a short fixed blade terminating in a large denticle considerably exceeding the remaining denticles in size.

Stratigraphic range.—Lower Carboniferous–Lower Permian of North America; Zones C1–P2 of the Sverdrup Basin; Gzhelian–Asselian (Cadellfjellet and Tyrrellfjellet Mbrs.) of Spitsbergen; Middle–Upper Carboniferous the Russian Platform; Sakmarian of the Urals.

Occurrence on Novaya Zemlya and Pechora Sea.—Sinistral *A. lautus* sensu formo: Middle Carboniferous (Moscovian)–Middle Asselian, *Streptognathodus barskovi–S. constrictus* Assemblage Zone. Kazarkinskaya Fm. (Table 3), Lower Barentsevskaya Fm. (Table 2), Wells PR1 and

SG1 (Table 14). Dextral *A. gigantus* sensu formo: Moscovian. Lower Barentsevskaya Fm. (Table 11), Well PR1 (Table 14).

Material.—18 elements.

*Adetognathus paralautus* Orchard, 1984
Plate 15/C, D

1984 *Adetognathus paralautus*—Orchard, p. 210, pl. 23. 1, figs. 15, 16, 20–25

Remarks.—*Adetognathus paralautus* Orchard differs from *A. lautus* (Gunnell) by a generally sinuous platform outline, and also in the essentially identical parapets ornamented by well developed transverse ridges.

Stratigraphic range.—The *Adetognathus* fauna Harper Ranch beds (late Wolfcampian) British Columbia; zones P6a–P6b (latest Sakmarian to Aktastinian) of Sverdrup Basin; Sakmarian (Tastubian) of Urals; Maping Formation (Lower Permian) of China.

Occurrence on Novaya Zemlya.—Late Sakmarian–Artinskian, *Adetognathodus paralautus* Assemblage Zone. Sedovskaya Fm. (Table 11).

Material.—3 elements.

*Adetognathus* sp. *B* Henderson, 1988
Plate 15/H

1986 *Adetognathus paralautus*—Orchard; Henderson & McGugan, p. 228, pl. 6, figs. 12, 13
1988 *Adetognathus* sp. B–Henderson, p. 177–178, pl. 2, figs. 8–11, pl. 4, figs. 13–18

Remarks.—Henderson & McGugan (1986) and Henderson (1988) distinguished this species as transitional between *A. lautus* (Gunnell) and *A. paralautus* Orchard. By general outline of the platform *A*. sp. B Henderson resembles *A. lautus* (Gunnell), but differs from the latter by more sinuous platform outline with better–developed parapets and transverse ridges.

Stratigraphic range.—Zones P3–P5 (Middle Asselian–Sterlitamakian) of Sverdrup Basin; Telford Fm. (?Sakmarian) in British Columbia.

Occurrence on Novaya Zemlya.—Asselian, New Genus A sp. B Assemblage Zone. Upper Barentsevskaya Fm. (Table 11).

Material.—2 elements.

Genus *DECLINOGNATHODUS* Dunn, 1966

Type species.—*Cavusgnathus nodulifera* Ellison & Graves, 1941.

Remarks.—*Declinognathodus* differs from *Idiognathoides* by the central position of the free blade in the latter.

*Declinognathodus lateralis* (Higgins & Bouckaert, 1968)
Plate 1/M

1968 *Streptognathodus lateralis*—Higgins & Bouckaert, p. 45, pl. 5, figs. 1–4, 7
1978 *Declinognathodus lateralis* (Higgins & Bouckaert); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 29, pl. 15, figs. 5, 6, 8
1983 *Declinognathodus lateralis* (Higgins & Bouckaert); Nemirovskaya, figs. 24, 25, 30, 32
1988 *Declinognathodus lateralis* (Higgins & Bouckaert); Kulagina & Pazukhin, figs. 9, 10

Remarks.—The presence of a median carina extending nearly to the posterior tip distinguishes this species from *D. noduliferus* (Ellison & Graves).

Stratigraphic range.—Namurian of western Europe; Lower Pennsylvanian of North America; zone C2 of Sverdrup Basin; Lower Bashkirian of Donbass and Urals.

Occurrence on Novaya Zemlya.—Lower Bashkirian, *Declinognathodus noduliferus* and *Declinognathodus–Idiognathoides* assemblage zones, and Lower Moscovian, *Idiognathoides tuberculatus–Neogondolella donbassica* Assemblage Zone. Lower Kazarkinskaya Fm. (Tables 3–5, 7–10), Stepovskaya Fm, Chert Mbr. (Table 15).

Material.—27 elements.

*Declinognathodus noduliferus* (Ellison & Graves, 1941)
Plate 1/E

1941 *Cavusgnathus nodulifera*—Ellison & Graves, p. 4, pl. 3, fig. 4.
1975 *Declinognathodus noduliferus* (Ellison & Graves); Barskov & Alekseev, fig. 2/1–2
1978 *Declinognathodus noduliferus* (Ellison & Graves); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 30, pl. 15, figs. 7, 9–14
1981 *Declinognathodus noduliferus* (Ellison & Graves); Barskov, Alekseev & Goreva, pl. 1, fig. 1
1983 *Declinognathodus noduliferus* (Ellison & Graves); Nemirovskaya, fig. 28
1984 *Declinognathodus noduliferus* (Ellison & Graves); Goreva, pl. 1, figs. 14–23
1988 *Declinognathodus noduliferus* (Ellison & Graves); Kulagina & Pazukhin, figs. 1–5

Remarks.—In *D. noduliferus* (Ellison & Graves), unlike *D. lateralis* (Higgins & Bouckaert), the carina terminates posteriorly against the outer margin or curves laterally to merge with the outer margin.

Stratigraphic range.—Namurian B, C of western Europe; Lower Pennsylvanian of North America; zone C2 of Sverdrup Basin; Bashkirian–Early Moscovian of Russian Platform and Urals.

Occurrence on Novaya Zemlya and Pechora Sea.—Bashkirian, *Declinognathodus noduliferus*, *Declinognathodus–Idiognathoides* and *Streptognathodus expansus–S. suberectus* assemblage zones, and Moscovian, *Neognathodus medexultimus* Assemblage Zone. Lower Kazarkinskaya Fm. (Tables 3–10), Stepovskaya Fm, Chert Mbr. (Tables 12, 15), Lower Barentsevskaya Fm. (Table 2), and Well SG1 (Table 14).

Material.—93 elements.

*Declinognathodus noduliferus inaequalis* (Higgins, 1975)
Plate 1/F

1975 *Declinognathodus noduliferus inaequalis*—Higgins, p. 53, pl. 12, figs. 1–7, 12, pl. 14, figs. 11–13, pl. 15, figs. 10, 14

Remarks.—Subspecies of *D. noduliferus* (Ellison & Graves) in which the carina is deflected to the outer side near the posterior end of the platform.

Stratigraphic range.—Namurian ($H^1$–$R^1$) in Great Britain; lowermost Bashkirian of the Russian Platform and the Urals.

Occurrence on Novaya Zemlya.—Lower Bashkirian, *Declinognathodus noduliferus* Assemblage Zone. Stepovskaya Fm. (Tables 12, 15).

Material.—5 elements.

*Declinognathodus noduliferus japonicus* (Igo & Koike, 1964)
Plate 1/C

1964 *Streptognathodus japonicus*—Igo & Koike, p. 188, pl. 28, figs. 5–10 only
1988 *Declinognathodus noduliferus japonicus* (Igo & Koike); Kulagina & Pazukhin, figs. 6–8

Remarks.—*D. noduliferus japonicus* (Igo & Koike) differs from *D. noduliferus* (Ellison &

Graves) in possessing a carina which merges with the parapet immediately at the anterior margin of the platform. At the outer, anterior end of the platform *D. noduliferus japonicus* (Igo & Koike) has one or two nodes.

Stratigraphic range.—Namurian ($H^2$)–Westphalian of western Europe; Bashkirian of the Urals; lower part of the Weiningian of China.

Occurrence on Novaya Zemlya.—Bashkirian, *Declinognathodus–Idiognathoides* and *Streptognathodus expansus–S. suberectus* Assemblage Zones. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3, 7–10), Stepovskaya Fm, Chert Mbr. (Table 12).

Material.—86 elements.

Genus *GNATHODUS* Pander, 1856

Type species.—*Gnathodus mosquensis* Pander, 1856.

*Gnathodus bilineatus bilineatus* (Roundy, 1926)
Plate 1/K

1926 *Polygnathus bilineatus*—Roundy, p. 13, pl. 3, fig. 10
1978 *Gnathodus bilineatus bilineatus* (Roundy); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 33, pl. 14, figs. 1, 7, 8
1983 *Gnathodus bilineatus bilineatus* (Roundy); Nemirovskaya, fig. 22
1984 *Dryphenotus bilineatus bilineatus* (Roundy)–Alekseev, Barskov & Migdisova, fig. 1, 10.

Stratigraphic range.—Middle Visean-Namurian A of western Europe; Upper Mississippian (Valmeyeran–Chesterian) North America; Upper Visean-Serpukhovian of Moscovian Basin; Upper Visean-base Bashkirian (*Declinognathodus noduliferus* Zone) Donbass and Urals.

Occurrence on Novaya Zemlya.—Upper Visean–base Bashkirian, *Gnathodus bilineatus bilineatus–G. bilineatus bollandensis* and *Declinognathodus noduliferus* Assemblage Zones. Milinskaya Fm. (Tables 3, 7–10, 15), Base Kazarkinskaya Fm. (Tables 4–10), Yesipovskaya Fm. (Table 12), Stepovskaya Fm, Chert Mbr. (Table 15).

Material.—70 elements.

*Gnathodus bilineatus bollandensis* Higgins & Bouckaert, 1968
Plate 1/ J

1968 *Gnathodus bilineatus bollandensis*—Higgins & Bouckaert, p. 29, pl. 2, figs. 10–13, pl. 3, figs. 4–8, 10
1978 *Gnathodus bilineatus bollandensis* Higgins & Bouckaert; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 34, pl. 14, figs. 2–4
1984 *Dryphenotus bilineatus bollandensis* (Higgins & Bouckaert); Alekseev, Barskov & Migdisova, pl. 1, fig. 16–19

Remarks.—*G. bilineatus bollandensis* Higgins & Bouckaert differs from *G. bilineatus bilineatus* (Roundy) by its smaller size and smooth to weakly ornamented expanded part of platform.

Stratigraphic range.—Namurian A of western Europe; Upper Mississippian (Chesterian) North America; Serpukhovian of Donbass and Moscow Basins.

Occurrence on Novaya Zemlya.—Serpukhovian-base Bashkirian, *Gnathodus bilineatus bilineatus–G. bilineatus bollandensis* and *Declinognathodus noduliferus* Assemblage Zones. Lower Kazarkinskaya Fm. (Tables 7–10), Yesipovskaya Fm. (Table 12), Stepovskaya Fm, Chert Mbr. (Table 15).

Material.—22 elements.

Genus *GONDOLELLA* Stauffer & Plummer, 1932

Type species.—*Gondolella elegantula* Stauffer & Plummer, 1932

*Gondolella magna* Stauffer & Plummer, 1932
Plate 11/G

1932 *Gondolella magna*—Stauffer & Plummer, p. 25, 43, pl. 3, figs. 6, 7, 10, 11
1978 *Gondolella magna* Stauffer & Plummer; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 45, pl. 32, figs. 1–3

Remarks.—*G. magna* Stauffer & Plummer differs from *G. elegantula* Stauffer & Plummer in the more rounded outline of the rear edge of the platform, its more rippled surface, and the carina consists of nodes or node-like denticles.

Stratigraphic range.—Pennsylvanian (Desmoinesian-Missourian) in North America; Upper Carboniferous of the Russian Platform.

Occurrence on Novaya Zemlya and Pechora Sea.—Upper Moscovian and Lower Gzhelian, *Streptognathodus dissectus–S. concinnus* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3), Well PR1 (Table 14).

Material.—4 elements.

*"Gondolella"* cf. *"G."* denuda (Ellison, 1941)
Plate 9/H

1941 cf. *Gondolella denuda*—Ellison, p. 121, pl. 20, fig. 54, pl. 21, figs. 1, 2, 36
1972 cf. *Gondolella denuda*—Ellison, von Bitter, p. 68, pl. 6, figs. 1a–f

Description.—The Pa element has a narrow, long, and very reduced platform. The carina consists of high conical denticles slightly inclined backwards. The cusp is large and pyramidal in shape, and terminally positioned.

Remarks.—Elements having elongate, largely reduced platforms were assigned to *G. denuda* Ellison by Ellison (1941) and von Bitter (1972). However, elements assigned to *G. denuda* Ellison by Ellison have a carina with needle-like denticles whereas those described by von Bitter have conical denticles. The current specimen has a carina similar to forms described by von Bitter from the Shawnee Group (Upper Pennsylvanian) of Kansas.

Occurrence on Novaya Zemlya.—Lower Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3).

Material.—1 element.

*"Gondolella"* cf. *"G."* *laevis* Kosenko & Kozitskaya, 1975
Plate 10/O

1975 cf. *Gondolella laevis*—Kosenko & Kozitskaya in Kosenko p. 129, figs. 6–10

Description.—The specimen is relatively narrow, with a smooth-plated platform with a big terminal cusp and a carina consisting of high partly-merged denticles. Outline of the platform and the structure of the carina are similar to those of *G. laevis*.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus roundyi* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3).

Material.—1 element.

*"Gondolella"* sp. *A.* Henderson & Orchard, 1991
Plate 10/D–F

1985 ?*Gondolella* sp. A–Orchard & Struik, p. 549, pl. 2, fig. 31
1991 *"Gondolella"* sp. A–Henderson & Orchard, p. 260, pl. 2, figs. 10–13
1991 cf. *"Gondolella"* sp. A–Henderson & Orchard, p. 260, pl. 3, figs. 7, 8

1991 ?"*Gondolella*" sp. B–Henderson & Orchard, p. 260, pl. 3, fig. 6

Description.—The platform is long and narrow. A short posterior process is present in the same plane as the platform, or inclined towards the platform. The carina consists of 13 to 15 large conical, laterally compressed denticles. In the middle and anterior parts of the carina, the tops of the denticles are slightly transversely compressed. The subterminal cusp is bigger than other denticles. Posterior to the cusp there is a short, denticulate process.

Stratigraphic range.—?Allex Allen Formation, British Columbia; Buttle Lake Group (Lower Permian), Vancouver Island, Canadian Cordillera.

Occurrence on Novaya Zemlya.—Asselian. *Streptognathodus cristellaris* Assemblage Zone, and *Neogondolella discedus–N. discedus* (late form) Assemblage Subzones. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—3 elements.

*"Gondolella"* cf. *"G."* sp. A. Henderson & Orchard, 1991
Plate 10/G, I

Remarks.—Elements with only one denticle behind the cusp, and with posteriorly partially fused carina denticles are assigned to "*Gondolella*" cf. *"G."* sp. A.

Occurrence on Novaya Zemlya.—Asselian. *Neogondolella discedus–N. discedus* (late form) Assemblage Subzones. Tolbeyachskaya Fm. (Table 12).

Material.—10 elements.

*"Gondolella"* cf. *"G."* sp. B. Henderson & Orchard, 1991
Plate 14/F, G

1991 cf. *"Gondolella"* sp. B. Henderson & Orchard, p. 260, pl. 2, figs. 6, 7, 15, 16

Remarks.—Two fragmented Pa elements with a relatively low carina with fused denticles are assigned to this species. The way the denticles are fused distinguishes this species from "*G.*" sp. A.

Stratigraphic range.—"*Gondolella*" sp. B. Henderson & Orchard has been described from the Belcourt Formation (Middle to Late Asselian), Northeast British Columbia and Mount Christie Formation East-Central Yukon Territory (Canada).

Occurrence on Novaya Zemlya.—Middle Asselian, *Streptognathodus barskovi–S. constrictus–Neogondolella discedus* Assemblage Zone, Tolbeyachskaya Fm. (Table 12).

Material.—2 elements.

Genus *GONDOLELLOIDES* Henderson & Orchard, 1991

Type species.—*Gondolelloides canadensis* Henderson & Orchard, 1991

Remarks.—As stated by Henderson & Orchard (1991: p. 257) the distinctive carina is the main distinguishing character of *Gondolelloides*. This character is well developed in the Novaya Zemlya fauna, specimens of which were used in the original generic description. Henderson & Orchard (1991) assigned to *Gondolelloides* (New Genus A of Henderson & McGugan, 1986) Pa elements with a narrow and long platform with typical gondolellid upper and lower surfaces. However, the icriode-like carina suggested a different assignment.

*Gondolelloides canadensis* Henderson & Orchard, 1991
Plate 10/A, J–N

1986 Gen. et sp. nov. A–Henderson & McGugan, fig. 7 (2–3)
1991 *Gondolelloides canadensis*—Henderson & Orchard, p. 258–259, pl. 1, figs. 1–15, pl. 2, figs. 8, 9, 14, pl. 3, figs. 1–3, 5

Description.—In addition to typical specimens of *Gondolelloides canadensis* Henderson & Orchard (Plate 10/J, K, N), specimens with a wider platform and carinal denticles or with a more narrow platform and denticles with a distinct reduction in the middle part are present.

Stratigraphic range.—Middle-Upper Asselian–Sakmarian in western and northern Canada.

Occurrence on Novaya Zemlya.—Asselian-Sakmarian, *Neogondolella discedus* Assemblage Subzone to *N.* cf. *N. foliosa* Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—30 elements.

*Gondolelloides* cf. *G. nahanniensis* Henderson & Orchard, 1991
Plate 10/B, C, H

1991 cf. *Gondolelloides nahanniensis*—Henderson & Orchard, p. 260, pl. 2, figs. 1–5, pl. 3, fig. 9

Remarks.—Only fragments of Pa elements are in the present collection. These specimens are assigned to *G.* cf. *G. nahannensis* Henderson & Orchard because they possess the typical carina for this species. The carina consists of rather narrow and very high fused denticles. A figured specimen in Henderson & Orchard (1991: pl. 3, fig. 9) is from Novaya Zemlya.

Stratigraphic range.—Asselian, western and northern Canada.

Occurrence on Novaya Zemlya.—Middle Asselian, *N. discedus* (late form) Assemblage Subzone.

Material.—8 elements.

Genus *HINDEODUS* Rexroad & Furnish, 1964

Type species.—*Trichonodella imperfectus* (Rexroad, 1957)

*Hindeodus minutus* (Ellison, 1941)
Plate 15/J

1941 *Spathodus minutus*—Ellison, p. 120, pl. 20, figs. 50–52

Stratigraphic range.—Upper Mississippian (Chesterian)–Lower Permian North America; zones C1–P9 of Sverdrup Basin; Lower Permian of Svalbard.

Occurrence on Novaya Zemlya and Pechora Sea.—Middle Carboniferous (Bashkirian-Moscovian)–Upper Carboniferous (Gzhelian). Lower Kazarkinskaya Fm. (Tables 4–5), Stepovskaya Fm. (Table 12), Sporonavolokskaya Fm. (Table 1), Well SG1 (Table 14).

Material.—3 (+3 "cf.") elements.

Genus *IDIOGNATHODUS* Gunnell, 1931

Type species.—*Idiognathodus claviformis* Gunnell, 1931.

*Idiognathodus bachmuticus* Kozitskaya, 1978
Plate 5/J

1978 *Idiognathodus bachmuticus*—Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 47, pl. 23, figs. 9–11

Remarks.—*I. bachmuticus* Kozitskaya differs from *I. lobulatus* Kozitskaya by the presence of two accessory lobes, and from *I. toretzianus* Kozitskaya by the asymmetrical upper surface of the platform.

Stratigraphic range.—Kasimovian of Donets Basin.

Occurrence on Novaya Zemlya.—Kasimovian and Gzhelian, *Streptognathodus excelsus* and *S. alekseevi* assemblage zones. Stepovskaya Fm. (Tables 12, 15).

Material.—3 elements.

*Idiognathodus delicatus* Gunnell, 1931
Plate 4/F, I

1931 *Idiognathodus delicatus*—Gunnell, p. 250, pl. 29, figs. 23–25
1975 *Idiognathodus delicatus* Gunnell; Barskov & Alekseev, pl. 2, figs. 7–9
1978 *Idiognathodus delicatus* Gunnell; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, pl. 21, figs. 2, 3, 5–10
1979 *Idiognathodus delicatus* Gunnell; Barskov & Alekseev, p. 112, pl. 8, figs. 30–34, pl. 9, figs. 1–4
1979 *Idiognathodus delicatus* Gunnell; Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, fig. 1
1983 *Idiognathodus delicatus* Gunnell; Barskov & Kononova, pl. 3, fig. 13
1983 *Idiognathodus delicatus* Gunnell; Kozitskaya, pl. 1, fig. 4
1984 *Idiognathodus delicatus* Gunnell; Goreva, pl. 2, figs. 15–17, 20
1987 *Idiognathodus delicatus* Gunnell; Chernikh & Reshetkova, pl. 1, figs. 1, 2

Remarks.—Forms showing a symmetrical platform with a smooth upper surface ornamented by parallel transverse ridges and with two large accessory lobes to the anterior portion of the platform are here assigned to *I. delicatus* Gunnell. *I. ellisoni* Clark & Behnken differs from *I. delicatus* Gunnell in possessing a flat upper platform surface and with a narrow furrow separating the transverse ridges.

Stratigraphic range.—The species has a wide geographic distribution in Middle–Upper Carboniferous to Lower Permian rocks. In the Sverdrup Basin it is present in zones C4–C6b (Lower Moscovian-Gzhelian); in Svalbard in the Nordenskiöldbreen Fm. (Cadellfjellet and Tyrrellfjellet Mbrs.).

Occurrence on Novaya Zemlya and Pechora Sea.—Upper Bashkirian (*Streptognathodus expansus*–*S. suberectus* Assemblage Zone)–Lower Asselian (*Streptognathodus wabaunsensis* Assemblage Zone). Lazarevskaya Fm. (Table 13), Kazarkinskaya Fm. (Tables 3–10), Stepovskaya Fm. (Table 15), Lower Barentsevskaya Fm. (Table 2), Lavrovskaya Fm. (Table 11), Well SG1, PR1 (Table 14).

Material.—78 elements.

*Idiognathodus lobulatus* Kozitskaya, 1978
Plate 9/L, M

1978 *Idiognathodus lobulatus*—Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 50, pl. 24, figs. 6–10
1981 *Idiognathodus lobulatus* Kozitskaya; Barskov, Alekseev & Goreva, pl. 2, fig. 2
1981 *Idiognathodus lobulatus* Kozitskaya; Barskov, Isakova & Schastlivtseva, pl. 1, fig. 3
1983 *Idiognathodus lobulatus* Kozitskaya; Kozitskaya, pl. 1, figs. 5, 6
1984 *Idiognathodus lobulatus* Kozitskaya; Alekseev, Barskov & Migdisova, pl. 1, figs. 15, 19

Remarks.—*I. lobulatus* Kozitskaya differs from other species by the presence of only one accessory lobe consisting of 1–4 nodes on the inner side of the platform where the carina terminates.

Stratigraphic range.—Kasimovian–Gzhelian of Donbass, Moscow Basin, and the Urals.

Occurrence on Novaya Zemlya and Pechora Sea.—Gzhelian-Lower Permian, *Streptognathodus wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Stepovskaya Fm. (Table 15), Well PR1 (Table 14).

Material.—5 elements.

*Idiognathodus obliquus* Kosenko & Kozitskaya, 1978
Plate 4/C, H

1978 *Idiognathodus obliquus*—Kosenko & Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 51, pl. 22, figs. 6–9
1984 *Idiognathodus obliquus* Kosenko & Kozitskaya; Goreva, pl. 2, figs. 7–11

Description.—The platform is lanceolate with a pointed posterior end. The upper surface is ornamented by abundant transverse ridges inclined at an angle less than 50°–60° towards the longitudinal axis of the platform. Two accessory lobes are well separated from the central part of the platform and consist of nodes, making longitudinal rows. *I. obliquus* Kosenko & Kozitskaya differs from *I. sinuosis* Ellison & Graves by the better developed transverse ridges and by the presence of a big outer lobe with regular nodes.

Stratigraphic range.—Upper Moscovian of Donbass and Moscow Basin.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Gondolella–Neognathodus–Streptognathodus* assemblage (upper part). Lower Kazarkinskaya Fm. (Table 3).

Material.—48 elements.

*Idiognathodus podolskensis* Goreva, 1984
Plate 4/G, K

1984 *Idiognathodus podolskensis*—Goreva, p. 108, pl. 2, figs. 23–27

Description.—Platform is curved being widest in the anterior third. Carina is short, two accessory lobes are well differentiated. The anterior platform contains ramp-like adenticulate ridges (rostra). The posterior part of the platform is concave, ornamented by slanted transverse ridges. Pa elements of *I. podolskensis* Goreva differ from those of other species by the prominent depression in the central part of the platform.

Stratigraphic range.—Moscovian (Podolian) of the Moscow Basin

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus medadultimus* to *N. roundyi* assemblage zones. Lower Kazarkinskaya Fm. (Table 3), lower Barentsevskaya Fm. (Table 2).

Material.—8 elements.

*Idiognathodus robustus* Kosenko & Kozitskaya, 1978
Plate 4/B

1978 *Idiognathodus robustus*—Kosenko & Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 53, pl. 22, figs. 1–3

Description.—The upper surface of the anterior half of the platform is concave, ornamented along the center by separate nodes. Anterior parts of parapets have big nodes or cross ridges. The posterior half of the platform is ornamented by few (2–6) transverse ridges. Pa elements of *I. robustus* Kosenko & Kozitskaya differ from those of *I. delicatus* Gunnell in the poorly delineated accessory lobes and their ornamentation.

Stratigraphic range.—Upper Moscovian of Donets Basin.

Occurrence on Novaya Zemlya and Pechora Sea.—Upper Moscovian. Top of Lower Barentsevskaya Fm. (Table 2), Lavrovskaya Fm. (Table 11), Well SG1 (Table 14).

Material.—5 elements.

*Idiognathodus sinuosus* Ellison & Graves, 1941
Plate 2/K

1941 *Idiognathodus sinuosus*—Ellison & Graves, p. 6, pl. 3, fig. 22
1978 *Idiognathodus sinuosis* Ellison & Graves; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, pl. 21, fig. 4

Remarks.—This species is similar to *I. delicatus* Gunnell, but can be distinguished from the latter by its long, narrow and inwardly curved and posteriorly pointed platform with a lobe developed on the inner side of the platform.

Stratigraphic range.—Lower-Middle Pennsylvanian of North America; Upper Bashkirian-Lower Moscovian of Russian Platform.

Occurrence on Novaya Zemlya and Pechora Sea.—Upper Moscovian. Lower Kazarkinskaya Fm. (Table 3), Well SG1 (Table 14).

Material.—21 elements.

*Idiognathodus tersus* Ellison, 1941
Plate 5/K

1941 *Idiognathodus tersus*—Ellison, p. 134, pl. 23, fig. 5, 6
1983 *Idiognathodus tersus* Ellison; Kozitskaya, pl. 1, fig. 7
1987 ?*Idiognathodus tersus* Ellison; Chernikh & Reshetkova, pl. 3, figs. 2–4

Remarks.—Pa elements lacking accessory lobes are assigned to *I. tersus* Ellison.

Stratigraphic range.—Upper Pennsylvanian (Missourian–Virgilian) in North America; Gzhelian of Russian Platform and Urals.

Occurrence on Novaya Zemlya.—Gzhelian, *Streptognathodus alekseevi* and *S. elongatus* Assemblage Zone, and Asselian, *S. wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Stepovskaya Fm. (Tables 12, 15), Lavrovskaya Fm. (Table 11).

Material.—31 elements.

*Idiognathodus toretzianus* Kozitskaya, 1978
Plate 6/L; Plate 9/K (cf.)

1978 *Idiognathodus toretzianus*—Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 57, pl. 24, figs. 1–3
1981 *Idiognathodus toretzianus* Kozitskaya; Barskov, Isakova & Schastlivtseva, pl. 1, figs. 1, 2
1983 *Idiognathodus toretzianus* Kozitskaya; Barskov & Kononova, pl. 3, fig. 17
1983 *Idiognathodus toretzianus* Kozitskaya; Kozitskaya, pl. 1, figs. 8–10, 13
1984 *Idiognathodus toretzianus* Kozitskaya; Alekseev, Barskov & Migdisova, pl. 1, figs. 16, 17, 23
1987 *Idiognathodus toretzianus* Kozitskaya; Chernikh & Reshetkova, pl. 1, figs. 7–9

Description.—Platform is oval to lanceolate. Carina reaches from 1/3 to 1/2 of the length of the platform. Small accessory lobes are present on the outer and inner side of the platform in the anterior part. The surface of the platform in some specimens is ornamented by twisted transverse ridges, which may break in the middle or posterior part of the platform. Characteristic features of *I. toretzianus* Kozitskaya are varying platform outlines, the length of the carina, the shape of the transverse ridges, and the commonly developed two small accessory lobes in the anterior part of the platform. The variation in morphological

characters was outlined by Kozitskaya (1978). Specimens with longer carina ending in a median position between the accessory lobes are denoted as *I. cf. I. toretzianus* Kozitskaya, which also are differentiated from typical specimens in having larger than normal accessory lobes.

Stratigraphic range.—Upper Carboniferous (Kasimovian–Gzhelian) of Russian Platform and Urals.

Occurrence on Novaya Zemlya.—Upper Carboniferous (Kasimovian-Gzhelian)—Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Stepovskaya Fm. (Tables 12, 15), Upper Kazarkinskaya Fm. (Table 3).

Material.—27 elements.

*Idiognathodus trigonolobatus* Barskov & Alekseev, 1976
Plate 5/M

1976 *Idiognathodus trigonolobatus*—Barskov & Alekseev, p. 121, figs. 1d, 1g
1984 *Idiognathodus trigonolobatus* Barskov & Alekseev; Goreva, pl. 2, fig. 29

Description.—The platform has a subrhombical form. The anterior part of the platform is ornamented by nodes, which may join to produce ridges. The posterior half of the platform is ornamented by rare transverse ridges. Accessory lobes are poorly separated from the main part of the platform; the big inner lobe shows triangular contours.

Remarks.—Pa elements of *I. trigonolobatus* Braskov & Alekseev differ from *I. delicatus* Gunnell by the triangular shape of the inner lobe.

Stratigraphic range.—Typical *I. trigonolobatus* Barskov & Alekseev are described from the Upper Moscovian (Myachkovian)–Kasimovian of the Moscow Basin. Forms similar to *I. trigonolobatus* Barskov & Alekseev are found in Gzhelian deposits of Urals (Chernikh & Reshetkova, 1987).

Occurrence on Novaya Zemlya and Pechora Sea.—Gzhelian, *Streptognathodus alekseevi* Assemblage Zone. Stepovskaya Fm. (Table 12), Well PR1 (Table 14).

Material.—11 elements.

*Idiognathodus* sp. A
Plate 2/A

Description.—This platform element has a very short carina, grading into a narrow and shallow axial furrow comprising about 2/3 of the total length of the platform. The anterior part of the platform is ornamented by transverse ridges, consisting of fused nodes. The posterior part of the platform is ornamented by rare coarse transverse ridges. The exterior edges of the platform are uplifted, especially in the anterior part, where they are ornamented by large nodes.

Remarks.—*I.* sp. A differs from *I. robustus* Kosenko & Kozitskaya by its very short carina and the ornamentation of the anterior part of the platform.

Occurrence on Novaya Zemlya.—Upper Bashkirian, *Streptognathodus expansus–S. suberectus* Assemblage Zone. Lower Kazarkinskaya Fm. (Tables 7–10).

Material.—2 elements.

*Idiognathodus* sp. B
Plate 2/H

Description.—This platform element has an oval shape without a carina. The upper surface is slightly concave, the posterior part is ornamented with thin twisted transverse ridges. In the anterior

part of the platform there is a cavity showing no ornament. At the outer side the cavity is delimited by a faint oriented ridge, and at the inner side by an uplifted edge to the platform ornamented by short transverse ridges.

Remarks.—The outline of the platform of *I.* sp. B is similar to those of *I. klapperi* Lane & Straka, however it differs by the ornament of the upper surface of the platform.

Occurrence on Novaya Zemlya.—Lower Bashkirian, *Declinognathodus–Idiognathoides* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3).

Material.—1 element.

*Idiognathodus* sp. C.
Plate 3/F

Remarks.—Juvenile form of *Idiognathodus* with two small accessory lobes and slightly concave upper surface of the platform. Displays some similarities with *I. ellisoni* (Clark & Behnken), and differs from *I. delicatus* Gunnell in having concave upper surface and smaller accessory lobes.

Occurrence on Novaya Zemlya.—Moscovian. Upper Barentsevskaya Fm. (Table 2).

Material.—1 small element.

Genus *IDIOGNATHOIDES* Harris & Hollingsworth, 1933

Type species.—*Idiognathoides sinuata* Harris & Hollingsworth, 1933.

*Idiognathoides corrugatus* (Harris & Hollingsworth, 1933)
Plate 2/B, C

1933 *Idiognathoides corrugata*—Harris & Hollingsworth, p. 202, pl. 1, figs. 7, 8a, b
1978 *Idiognathoides corrugatus* (Harris & Hollingsworth); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 60, pl. 14, figs. 1–8
1981 *Idiognathoides corrugatus* (Harris & Hollingsworth); Barskov, Isakova & Schastlivtseva, pl. 1, fig. 4
1983 *Idiognathoides corrugatus* (Harris & Hollingsworth); Nemirovskaya, fig. 39
1984 *Idiognathoides corrugatus* (Harris & Hollingsworth); Goreva, pl. 1, figs. 28, 35

Remarks.—The Pa element of *I. corrugatus* (Harris & Hollingsworth) differs from *I. sinuatus* (Harris & Hollingsworth) by its very short median trough with a blade attached to the right side, and from *I. convexus* (Ellison & Graves) by its broader platform and straight transverse ridges.

Stratigraphic range.—Lower Pennsylvanian (Morrowan–Atokan) North America; zone C3 of the Sverdrup Basin; Namurian B, C of western Europe; Bashkirian-base Moscovian of Russian Platform.

Occurrence on Novaya Zemlya.—Bashkirian, *Declinognathodus–Idiognathoides* and *Streptognathodus expansus–S. suberectus* assemblage zones, and Moscovian. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3–5, 7–10), Stepovskaya Fm. (Table 12).

Material.—24 elements.

*Idiognathoides lanei* Nemirovskaya, 1978
Plate 1/D

1978 *Idiognathoides lanei*—Nemirovskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 63, pl. 16, figs. 8–10

Description.—Platform element with transverse ridges at the posterior half of the platform and a blade attached to the left side. Narrow parapets are separated by a short trough. *I. lanei* Nemirovskaya differs from *I. sinuatus* Harris & Hollingsworth by a shorter median trough and continuous transverse ridges on the posterior part of the platform.

Stratigraphic range.—Bashkirian of the Donbass Basin.

Occurrence on Novaya Zemlya.—Bashkirian, *Declinognathodus–Idiognathoides* and *Streptognathodus expansus–S. suberectus* Assemblage Zone. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3, 8–10), Stepovskaya Fm. (Table 12).

Material.—12 elements.

*Idiognathoides pacificus* Savage & Barkeley, 1985
Plate 2/F

1985 *Idiognathoides pacificus*—Savage & Barkeley, p. 1467, figs. 9/9–26

Description.—The long narrow platform is ornamented by distinct straight transverse ridges. A short median trough is obliquely connected to the inner side of the platform, separating the anterior part of the inner parapet from the lower part of the platform. The basal cavity is wide and flaring and generally asymmetric.

Remarks.—The examined specimens are different from the original holotype illustrations, but are similar to other specimens illustrated by Savage & Barkeley (1985, e.g. figs. 9/11 and 9/15). The examined material also shows similarities with *I. corrugatus* (Harris & Hollingsworth), but differs in that the anterior part of the inner parapet is distinctly separated from the platform by a groove.

Stratigraphic range.—Early–Middle Pennsylvanian (upper Morrowan–lower Atokan), North America (Alaska); Weininginian Stage (Upper Carboniferous) of China.

Occurrence on Novaya Zemlya.—Lower Bashkirian, *Declinognathodus–Idiognathoides* Assemblage Zone. Lazarevskaya Fm. (Table 13).

Material.—27 elements.

*Idiognathoides sinuatus* Harris & Hollingsworth, 1933
Plate 1/H, I

1933 *Idiognathoides sinuata*—Harris & Hollingsworth, p. 201, pl. 1, fig. 14
1978 *Idiognathoides sinuatus* Harris & Hollingsworth; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 64, pl. 18, figs. 1–3
1981 *Idiognathoides sinuatus* Harris & Hollingsworth; Barskov, Isakova & Schastlivtseva, pl. 1, fig. 2
1983 *Idiognathoides sinuatus* Harris & Hollingsworth; Nemirovskaya, figs. 34, 35
1984 *Idiognathoides sinuatus* Harris & Hollingsworth; Goreva, pl. 1, figs. 25, 26 (only)
1988 *Idiognathoides sinuatus* Harris & Hollingsworth; Kulagina & Pazukhin, fig. 13

Remarks.—*I. sinuatus* Harris & Hollingsworth differs from *I. sulcatus* Higgins & Bouckaert in that the Pa elements have parapets ornamented by ridges, the latter have parapets with nodes. It is further distinguished from *I. corrugatus* (Harris & Hollingsworth) by a long median trough.

Stratigraphic range.—Pennsylvanian (Morrowan-Atokan) of North America; zone C3 of the Sverdrup Basin; Namurian B, C, Westphalian A of western Europe; Bashkirian-Moscovian of Donbass and the Urals; Moscovian of the Moscow Basin.

Occurrence on Novaya Zemlya.—Bashkirian, *Declinognathodus–Idiognathoides* and *Streptognathodus expansus–S. suberectus* assemblage

zones, and Moscovian. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3–5, 7–10), Stepovskaya Fm. (Tables 12, 15).

Material.—152 elements.

*Idiognathoides sulcatus* Higgins & Bouckaert, 1968
Plate 1/B

1968 *Idiognathoides sulcata*—Higgins & Bouckaert, p. 41, pl. 4, figs. 4–6
1978 *Idiognathoides sulcatus* Higgins & Bouckaert; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 66, pl. 18, figs. 4–6
1983 *Idiognathoides sulcatus* Higgins & Bouckaert; Nemirovskaya, fig. 36

Remarks.—*I. sulcatus* Higgins & Bouckaert differs from Pa elements of *I. sinuatus* Harris & Hollingsworth in having equal parapets ornamented with nodes.

Stratigraphic range.—Namurian B and C, and Westphalian A of western Europe; Lower Pennsylvanian of North America; Bashkirian of the Donbass Basin; Weininginian (Upper Carboniferous) of China.

Occurrence on Novaya Zemlya.—Bashkirian–Moscovian. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3–5), Stepovskaya Fm. (Tables 12, 15), Lavrovskaya Fm. (Table 11).

Material.—92 elements.

*Idiognathoides tuberculatus* Nemirovskaya, 1978
Plate 1/A

1978 *Idiognathoides tuberculatus*—Nemirovskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 67, pl. 17, figs. 3–6
1981 *Idiognathoides tuberculatus* Nemirovskaya; Barskov, Alekseev & Goreva, pl. 1, fig. 3
1984 *Idiognathoides tuberculatus* Nemirovskaya; Goreva, pl. 1, figs. 30, 31

Description.—Pa elements with parapets of different heights ornamented by ridges. On the convex outer side of the platform there are several nodes. *I. tuberculatus* Nemirovskaya resembles *I. sinuatus* Harris & Hollingsworth, but differs in the presence of nodes on the outer side of the platform.

Stratigraphic range.—Upper Bashkirian–Lower Moscovian of Russian Platform and Urals.

Occurrence on Novaya Zemlya.—Moscovian, *Gondolella–Neognathodus–Streptognathodus* assemblage. Lower Kazarkinskaya Fm. (Tables 3–5).

Material.—7 elements.

*Idiognathoides* sp. A.
Plate 1/G

Remarks.—The deep median trough in the examined specimens is a typical character also seen in *I. fossatus* (Branson & Mehl). *I.* sp. A. differs however from *I. fossatus* (Branson & Mehl) in the circular posterior end of the platform and the larger basal cavity.

Occurrence on Novaya Zemlya.—Lower Bashkirian, *Declinognathodus–Idiognathoides* Assemblage Zone. Lazarevskaya Fm. (Table 13), Stepovskaya Fm, Chert Mbr. (Table 12).

Material.—19 elements.

Genus *LOCHRIEA* Scott, 1942

Type species.—*Lochriea montanaensis* Scott, 1942

*Lochriea commutata* (Branson & Mehl, 1941)
Plate 1/L

1941 *Spathognathodus commutatus*—Branson & Mehl, p. 98, pl. 19, figs. 1–4
1978 *Gnathodus commutatus commutatus* (Branson & Mehl); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 35, pl. 12, figs. 1–6
1983 *Paragnathodus commutatus* (Branson & Mehl); Nemirovskaya, fig. 13
1984 *Paragnathodus commutatus* (Branson & Mehl); Alekseev, Barskov & Migdisova, pl. 1, fig. 2

Remarks.—Pa elements of this species are characterised by a wide basal cavity and smooth upper surfaces of the platform. *L. commutata* (Branson & Mehl) differs from *L. symmutata* (Rhodes, Austin & Druce) by its wider and assymetric platform and basal cavity. It is distinguished from *L. nodosa* (Bischoff) and *L. mononodosa* (Rhodes, Austin & Druce) by the smooth outer surface of the platform.

Stratigraphic range.—Upper Mississippian (Chesterian) of North America; zone C1 of the Sverdrup Basin; Middle Visean–Namurian A of western Europe; Middle Visean–Serpukhovian of Donbass; Serpukhovian of Moscow Basin.

Occurrence on Novaya Zemlya.—Visean–lowermost Bashkirian, *Gnathodus bilineatus bilineatus–G. bilineatus bollandensis* and *Declinognathodus noduliferus* assemblage zones. Milinskaya and Lower Kazarkinskaya Fm. (Tables 6–10), Yesipovskaya Fm. (Tables 12, 15).

Material.—27 elements.

Genus *NEOGNATHODUS* Dunn, 1970

Type species.—*Polygnathus bassleri* Harris & Hollingsworth, 1933

*Neognathodus* cf. *N. bassleri* (Harris & Hollingsworth, 1933)
Plate 3/M

1933 cf. *Polygnathus bassleri*—Harris & Hollingsworth, p. 198, pl. 1, figs. 13a–e

Remarks.—Forms with equally developed parapets and a carina not reaching the posterior edge of the platform are here assigned to *Neognathodus* cf. *N. bassleri* (Harris & Hollingsworth). *N.* cf. *N. bassleri* (Harris & Hollingsworth) Pa elements differ from *N. bothrops* Merrill by the shorter carina.

Stratigraphic range.—*N. bassleri* (Harris & Hollingsworth) is known from the Lower Pennsylvanian of North America; Namurian of western Europe; and the Bashkirian–Lower Moscovian (Vereynian) of the Russian Platform.

Occurrence on Novaya Zemlya.—Moscovian, *Gondolella–Neognathodus–Streptognathodus* assemblage. Lavrovskaya Fm. (Table 11).

Material.—2 elements.

*Neognathodus bothrops* Merrill, 1972
Plate 3/J

1972 *Neognathodus bothrops*—Merrill, p. 823, pl. 1, figs. 8–15
1979 *Neognathodus bothrops* Merrill; Barskov, Alekseev & Goreva, pl. 2, fig. 24
1981 *Neognathodus bothrops* Merrill; Barskov & Goreva, pl. 1, fig. 2, pl. 2, fig. 1
1984 *Neognathodus bothrops* Merrill; Goreva, pl. 4, figs. 18–22

Remarks.—*N. bothrops* Merrill together with *N. bassleri* (Harris & Hollingsworth) and *N. colombiensis* (Stibane) form a group of species with equal outer and inner parapets. *N. bothrops* Merrill Pa elements differs from *N. bassleri* (Harris & Hollingsworth) in the longer carina. It differs from *N. colombiensis* (Stibane) in that the anterior parts of the parapets are parallel or

convergent to the carina as compared to the arrow-like platform in *N. colombiensis* (Stibane).

Stratigraphic range.—Pennsylvanian (Morrowan, Atokan, Desmoinesian) of North America; lower part of the Moscovian (Vereynian, Kashirian) of Russian Platform.

Occurrence on Novaya Zemlya.—Moscovian, *Neognathodus medexultimus* Assemblage Zone. Lower Barentsevskaya Fm. (Table 2).

Material.—1 element.

*Neognathodus* cf. *N. dilatus* (Stauffer & Plummer, 1932)
Plate 3/C

1932 cf. *Gnathodus dilatus*—Stauffer & Plummer, p. 40, pl. 4, figs. 10, 11, 13, 14

Remarks.—Pa elements with a reduced outer parapet are here assigned to *N.* cf. *N. dilatus* (Stauffer & Plummer). The inner parapet in the anterior portion consists of short transverse ridges and nodes in the posterior portion. *N.* cf. *N. dilatus* (Stauffer & Plummer) with a well developed inner parapet differs from other species with a reduced outer parapet (e.g. *N. metanodosus* Merrill, *N. polynodosus* Merrill, *N. oligonodosus* Merrill and *N. anodosus* Merrill).

Stratigraphic range.—*Neognathodus dilatus* (Stauffer & Plummer) is known from the Pennsylvanian (upper part of the Desmoinesian) of North America; upper part of the Moscovian (Myachkovian)–base of Kasimovian (Krevyakinian) of the Russian Platform.

Occurrence on Novaya Zemlya.—Upper Moscovian–?Kasimovian, *Streptognathodus excelsus* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3), Sporonavolokskaya Fm. (Table 1).

Material.—3 elements.

*Neognathodus kashiriensis* Goreva, 1984
Plate 3/B

1984 *Neognathodus kashiriensis*—Goreva, p. 109, pl. 4, figs. 1–11
1981 *Neognathodus kashiriensis* Goreva; Barskov & Goreva, pl. 2, figs. 14–16

Remarks.—Diagnostic characters include lanceolate platform with a centrally placed carina. The carina is curved towards the outer edge, and the denticles join the ridges of the outer parapet.

Stratigraphic range.—Moscovian (Kashirian) of Moscow Basin.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus roundyi* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3).

Material.—1 element.

*Neognathodus medadultimus* Merrill, 1972
Plate 3/D, H

1972 *Neognathodus medadultimus*—Merrill, p. 824, pl. 1, figs. 2–7, pl. 2, fig. 19
1975 *Neognathodus medadultimus* Merrill; Barskov & Alekseev, pl. 2, fig. 21
1979 *Neognathodus medadultimus* Merrill; Barskov, Alekseev & Goreva, pl. 2, fig. 26
1981 *Neognathodus medadultimus* Merrill; Barskov & Goreva, pl. 1, figs. 3, 6, 7
1984 *Neognathodus medadultimus* Merrill; Goreva, pl. 4, figs. 26–28

Remarks.—Pa elements where the inner parapet reaches the posterior end of the platform and with the outer parapet connected with the carina at a distance of 1/3 of the length of the platform are here assigned to *N. medadultimus* Merrill. *N. medadultimus* Merrill differs from *N. bothrops* Merrill by its shorter outer parapet; from *N. medexultimus* Merrill by its longer outer parapet.

Stratigraphic range.—Pennsylvanian (Atokan-Desmoinesian) of North America; zone C5b of the Sverdrup Basin; Moscovian (Kashirian, Podolian) of Moscow Basin.

Occurrence on Novaya Zemlya and Pechora Sea.—Upper Moscovian, *Neognathodus medadultimus–N. roundyi* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3), Lower Barentsevskaya Fm. (Table 2), Lavrovskaya Fm. (Table 11), Well PR1 (Table 14).

Material.—7 elements.

*Neognathodus medexultimus* Merrill, 1972
Plate 3/G, K, L

1972 *Neognathodus medexultimus*—Merrill, p. 825, pl. 2, figs. 20–26
1981 *Neognathodus medexultimus* Merrill; Barskov & Goreva, pl. 1, figs. 9, 13 (only)
1984 *Neognathodus medexultimus* Merrill; Goreva, pl. 4, figs. 29–31

Remarks.—*N. medexultimus* Merrill Pa elements resemble those of *N. medadultimus* Merrill, but differ from the latter by a shorter outer parapet. Also, in *N. medexultimus* Merrill the carina merges more anteriorly with the nodes of the outer platform margin.

Stratigraphic range.—Pennsylvanian (Desmoinesian) of North America; Zone C5b of the Sverdrup Basin; Upper Moscovian (Podolian-Myachkovian) of the Moscow Basin.

Occurrence on Novaya Zemlya and Pechora Sea.—Upper Moscovian, *Neognathodus medexultimus* and *N. roundyi* assemblage zones. Sporonavolokskaya Fm. (Table 1), lower Barentsevskaya Fm. (Table 2), Well SG1 (Table 14).

Material.—4 elements.

*Neognathodus roundyi* (Gunnell, 1931)
Plate 3/A, E

1931 *Gnathodus roundyi*—Gunnell, p. 249, pl. 29, figs. 19, 20
1975 *Neognathodus roundyi* (Gunnell); Barskov & Alekseev, pl. 2, fig. 20
1978 *Neognathodus roundyi* (Gunnell); Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 75, pl. 20, figs. 9–12
1984 *Neognathodus roundyi* (Gunnell); Goreva, pl. 4, figs. 32–34

Remarks.—*N. roundyi* (Gunnell) differs from other species by the presence of one or two nodes on the outer parapet of the Pa element.

Stratigraphic range.—Pennsylvanian (Desmoinesian) of North America; Upper Moscovian (Myachkovian) of Russian Platform.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus roundyi* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3), Stepovskaya Fm. (Table 12), Sporonavolokskaya Fm. (Table 1).

Material.—6 elements.

Genus *NEOGONDOLELLA* Bender & Stoppel, 1965

Type species.—*Gondolella mombergensis* (Tatge, 1956)

*Neogondolella adentata* Chernikh & Reshetkova, 1987
Plate 14/E, I

1987 *Neogondolella adentata*—Chernikh & Reshetkova, p. 33, pl. 8, figs. 1, 2
1988 *Neogondolella adentata* Chernikh & Reshetkova; Chernikh & Reshetkova, p. 67, pl. 1, figs. 1–3

Description.—The platform is prolonged and symmetrical. The posterior edge of the platform is straight and bent upwards. A cusp is absent, but the posteriormost part of the platform is abruptly bent upwards giving a superficially "cusp-like" impression. Denticles of the carina are small, distinctly separated. The platform of *N. adentata* Chernikh & Reshetkova is most similar to that of *N. dentiseparata* Reshetkova & Chernikh but differs from the latter form by the absence of a cusp.

Stratigraphic range.—Asselian (*Schwagerina moelleri–Pseudofusulina fecunda* Zone) of the South Urals.

Occurrence on Novaya Zemlya.—Asselian, *Neogondoella discedus* Assemblage Subzone. Tolbeyachskaya Fm. (Table 12).

Material.—4 elements.

*Neogondolella belladontae* Chernikh, 1990
Plate 11/F, J, K

1987 *Neogondolella* sp. nov. 1–Chernikh & Reshetkova, pl. 8, figs. 5, 10
1990 *Neogondolella belladontae* Chernikh in Chuvashov, Dyukina, Mizens & Chernikh, p. 339, pl. 33, figs. 1, 2, 4

Description.—The platform is narrow, prolongated with rounded posterior-lateral margins. The lateral sides of the platform are convex upwards and separated from the carina by small adcarinal grooves, narrow in the posterior part of the platform and gradually broadening in the anterior part. Denticles of the carina are low and distinctly separated. The cusp is large and terminally postitioned. Lateral sides of the cusp are smoothly and connect with the lateral sides of the platform. The lower surface is smooth and is characterised by a rounded basal loop that extends anteriorly as a narrow keel and groove.

Remarks.—In the contours of the platform and the structure of the upper and lower surfaces, Pa elements of *N. belladontae* Chernikh resemble those of *N. dentiseparata* Reshetkova & Chernikh and *N. adentata* Chernikh & Reshetkova, but are distinctly different in possessing a very large cusp.

Stratigraphic range.—Asselian (*Schwagerina moelleri–Pseudofusulina fecunda* Zone) of the South Urals.

Occurrence on Novaya Zemlya.—Asselian, *Neogondolella discedus* Assemblage Subzone and *N. discedus* (late form) Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—13 elements.

*Neogondolella* cf. *N. belladontae* Chernikh, 1990
Plate 9/A, B, D, F

Remarks.—Pa elements of *N.* cf. *N. belladontae* Chernikh differ from typical *N. belladontae* Chernikh in the shape of the cusp and the way it is connected to the platform (adcarinal furrows reach the posterior margin of the platform). The cusp is large as in typical *N. belladontae* Chernikh, whereas individual denticles are closer fused.

Occurrence on Novaya Zemlya.—Asselian, *Neogondolella discedus* Assemblage Subzone. Tolbeyachskaya Fm. (Table 12), Middle Asselian. Upper Kazarkinskaya Fm. (Table 6).

Material.—13 elements.

*Neogondolella bisselli* (Clark & Behnken, 1971)
Plate 13/D, E

1971 *Gondolella bisselli*—Clark & Behnken, p. 429, pl. 1, figs. 12–14
1979 *Gondolella bisselli* Clark & Behnken; Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, fig. 11, pl. 2, fig. 1

1986 *Neogondolella bisselli* (Clark & Behnken); Chernikh, pl. 28, fig. 7, pl. 32, fig. 7
1990 *Gondolella bisselli* Clark & Behnken; Akhmetshina, fig. 1

Remarks.—Arched forms with an elongated teardrop-shaped platform outline, carina with low discrete denticles and with a rounded posterior margin of the platform and a basal loop are here assigned to *N. bisselli* (Clark & Behnken). *N. bisselli* (Clark & Behnken) differs from the similar *N. gujioensis* Igo by a narrower platform and the missing carina-blade; from *N. dentiseparata* Reshetkova & Chernikh by the more massive platform with broader adcarinal furrows and more tightly joined carinal denticles.

Stratigraphic range.—Widely distributed in the *bisselli-whitei* Conondont Zone; Lower Artinskian of the Urals; ?Asselian–Artinskian of the Sverdrup Basin; upper Wolfcampian–Leonardian (Harper Ranch Beds), British Columbia.

Occurrence on Novaya Zemlya.—Uppermost Sakmarian-Artinskian, *Sweetognathus* sp.–*Neogondolella bisselli*, *Neostreptognathodus pequopensis* and *Adetognathus paralautus* assemblage zones. Tolbeyachskaya Fm. (Table 12), Sedovskaya Fm. (Table 2).

Material.—39 elements.

*Neogondolella dentiseparata* Reshetkova & Chernikh, 1986
Plate 12/J, K; Plate 13/ J, K

1986 *Neogondolella dentiseparata*—Reshetkova & Chernikh, p. 109, pl. 1, figs. a–c
1986 *Neogondolella dentiseparata* Reshetkova & Chernikh; Chernikh in Papulov, pl. 27, figs. 25–28

Description.—The platform of this species is elongated, symmetrical and nearly straight. The margins are subparallel in the posterior half but taper moderately to a point in the anterior half. The posterior margin of the platform is rounded. The denticles of the carina are discrete. Adcarinal furrows are narrow, small and smooth.

Remarks.—*N. dentiseparata* Reshetkova & Chernikh differs from *N. bisselli* (Clark & Behnken) by subparallel margins, more separated denticles of the carina and narrower adcarinal furrows.

Stratigraphic range.—Asselian (*Schwagerina moelleri–Pseudofusulina fecunda* and *Schwagerina sphaerica–Pseudofusulina firma* zones) in the South Urals; Maping Formation (Lower Permian) of China.

Occurrence on Novaya Zemlya.—Asselian, *Streptognathodus barskovi–S. constrictus* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12), Yeksovskaya Fm. (Table 1).

Material.—9 elements.

*Neogondolella discedus* Sobolev sp. nov.
Plate 11/D; Plate 12/C, I, L, M
Plate 14/H (cf.)
Plate 12/A, B, H (late form)

1987 *Neogondolella* aff. *adentata*—Chernikh & Reshetkova, pl. 8, fig. 6, 12 (late form)

Types.—Holotype CNIGRI 12745/162; Plate 12/ M.

Type locality.—Krasnaya River.

Type horizon.—Lower part of the Tolbeyachskaya Fm., Asselian.

Devation of name.—Splitting; the way the posterior margin is inverted, forming two ridges.

Diagnosis.—Platform narrow and elongated with upwardly convex lateral margins. Inner and outer

margins of the platform slightly wavy. Ridges present on both outer and inner side of posterior end of platform upper side merging with carina posteriorly. Carinal denticles separated in anterior portion of platform; closely fused in posterior portion. Posteriormost part of platform rim bent upwards giving the impression of a cusp.

Description.—The platform is prolonged and narrow. The inner and posterior margins of the platform are straight or slightly undulating, the outer margin is slightly convex. The posterior part of the platform is asymmetric, it is delimited in the front part by two distinct ridges. The lateral surfaces of the platform are convex, they are separated from the carina by narrow and shallow adcarinal furrows. Carina consists of low denticles, distinctly separated at the anterior part and closely connected in the posterior portion. The posterior margin of the basal loop is straight and extends anteriorly as a narrow keel.

A late form of *N. discedus* sp. nov. is separated from early form in that the number of lateral ridges is significantly reduced. In some places in the inner ridge these ridges retain a ridge-like height. The outer ridge is divided into two nodes. Some specimens in the collection have a faint ridge where the nodes are connected (Plate 12/A, H) whereas others have quite separated nodes (Plate 12/B). The late form may represent a new subspecies.

Remarks.—*N. discedus* sp. nov. differs from *N. adentata* Chernikh & Reshetkova by more pronounced upwardly bent posterior part or rim of the platform in the Pa elements, the presence of ridges near the posterior margin of the platform and fused denticles in the posterior part of the carina.

Stratigraphic range.—The late form has an Asselian (*Schwagerina moelleri–Pseudofusulina fecunda* Zone) range in south Urals.

Occurrence on Novaya Zemlya.—Asselian, *Neogondolella discedus* Assemblage Subzone. Tolbeyachskaya Fm. (Table 12). The late form has an Asselian range, *Neogondolella discedus* (late form) Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—17 elements (late form: 7 elements).

*Neogondolella donbassica* (Kosenko, 1975)
Plate 11/B, H

1975 *Gondolella donbassica*—Kosenko, p. 127, figs. 1–5

Description.—The platform is longitudinally arched with an asymmetrically developed posterior part and a micro-ornamented upper surface. The carina does not extend to the posterior end and the cusp lies in front of the platform termination. A low fixed blade passes anteriorly into a short free blade. A short longitudinal ridge connects the fixed blade with the cusp.

Stratigraphic range.—Moscovian of the Donbass Basin.

Occurrence on Novaya Zemlya.—Moscovian–Kasimovian. Kazarkinskaya Fm. (Tables 3–6).

Material.—8 elements.

*Neogondolella* cf. *N. foliosa* Chernikh & Reshetkova, 1988
Plate 13/C

1987 cf. *Neogondolella* sp. nov. 3 Chernikh & Reshetkova, pl. 8, figs. 9, 11, 13, 14
1988 cf. *Neogondolella foliosa*—Chernikh & Reshetkova, p. 68, pl. 1, figs. 5–8

Diagnosis of *Neogondolella foliosa* Chernikh & Reshetkova (from Chernikh & Reshetkova 1988).—The platform is asymmetrical, with a rounded posterior margin curved downwards. A moderately small cusp is usually surrounded by a narrow brim. The denticles in the anterior part of the platform show a tendency to fuse into a blade, and a free blade is outlined.

Remarks.—*N.* cf. *N. foliosa* Chernikh & Reshetkova differs from *N. foliosa* Chernikh & Reshetkova in the terminal position of the cusp on the platform. In the outline of the posterior part of the platform, *N.* cf. *N. foliosa* Chernikh & Reshetkova resembles *Gondolella* sp. A Henderson & McGugan from the lower part of the Telford Formation (Henderson & McGugan, 1986), but differs from latter forms by the broader and less concave surface of the platform and the more fused nature of the carinal denticles.

Stratigraphic range.—Uppermost Asselian (*Schwagerina sphaerica–Pseudofusulina firma* Zone) of the South Urals.

Occurrence on Novaya Zemlya.—Asselian, *Neogondolella* cf. N. *foliosa* Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3).

Material.—3 elements.

*Neogondolella* cf. *N. pseudostriata* Chernikh, 1990
Plate 13/B, G, H

1990 cf. *Neogondolella pseudostriata*—Chernikh in Chuvashov, Dyukina, Mizens & Chernikh, p. 374, pl. 38, figs. 1–4

Description.—The platform is narrow, elongated with a rounded posterior margin and convex parapets. The denticles in the anterior part of the platform fuse into a low blade. The posteriormost 7–8 denticles of the carina are partially fused. The cusp is small and is located in a pit cavity. Adcarinal furrows are narrow but fairly deep.

Remarks.—*Neogondolella* cf. *N. pseudostriata* Chernikh differs from typical *N. pseudostriata* Chernikh by a narrower platform, and partially fused posteriormost 7–8 denticles (*N. pseudostriata* Chernikh has 3–4 fused denticles).

Stratigraphic range.—In Urals species of *Neogondolella* having a carina-blade are typical in the Upper Asselian (*Schwagerina sphaerica–Pseudofusulina firma* Zone).

Occurrence on Novaya Zemlya.—Asselian, *Neogondolella discedus* (late form) Assemblage Subzone and *N.* cf. *N. foliosa* Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3).

Material.—12 elements.

*Neogondolella simulata* Chernikh, 1990
Plate 12/F, G; Plate 13/A

1990 *Neogondolella simulata*—Chernikh in Chuvashov, Dyukina, Mizens & Chernikh, p. 346, pl. 34, figs. 1–4

Description.—The platform is elongated with a rounded posterior margin. Lateral margins of the platform have a typical gently undulating outline. Adcarinal furrows are narrow and shallow. The carina consists of separated denticles which increase in height anteriorly. The cusp is large, laterally compressed. The axis usually makes an angle with the longitudinal axis of the platform. The basal loop is rounded. The keel and basal groove are narrow.

Remarks.—*N. simulata* Chernikh Pa elements differ from the similar *N. dentiseparata* Chernikh by a laterally compressed cusp and closer spaced carinal denticles lying unconformably along the longitudinal axis of the platform.

Stratigraphic range.—Middle–Upper Asselian (most typical in the *Schwagerina moelleri–Pseudofusulina fecunda* Zone), but also including the *Schwagerina sphaerica–Pseudofusilina firma* Zone) of the South Urals.

Occurrence on Novaya Zemlya.—Middle–Upper Asselian, *Neogondolella discedus* (late form) Assemblage Subzone, and *N.* cf. *N. foliosa* Assemblage Subzone. Upper Kazarkinskaya Fm. (Tables 3, 6), Tolbeyachskaya Fm. (Table 12).

Material.—44 elements.

*Neogondolella striata* Chernikh & Reshetkova, 1986
Plate 13/L; Plate 13/I, M (cf.)

1986 *Neogondolella striata*—Chernikh & Reshetkova in Papulov, p. 129, pl. 32, figs. 1–6
1987 *Neogondolella striata* Chernikh & Reshetkova; Chernikh & Reshetkova, pl. 8, figs. 3, 4

Description.—The platform has a triangular shape with a straight or slightly slanted posterior margin. The carina is formed by partially fused low denticles, nearly equal in height. Cusp is bigger than other denticles and is located in a small pit. The upper surface of the platform has a wavy reticulated or ornamented structure. Pa elements with an elongated triangular broad platform with a straight posterior margin are here assigned to *N. striata* Chernikh & Reshetkova. The basal cavity gradually expands from the anterior edge of the platform towards the posterior reflecting the outline of the platform. Chernikh and Reshetkova pointed out in their description that "gerontic or large forms have the cusp divided into two separate nodes" (Chernikh & Reshetkova in Papulov (1986) p. 130). The same feature is characteristic of *N. discedus* sp. nov. (late form), but the latter is easily distinguished from *N. striata* Chernikh & Reshetkova by its platform's outline and basal cavity. *N. striata* Chernikh & Reshetkova differs from *N. bisselli* (Clark & Behnken) by the triangular outline of the platform and from *N. idahoensis* Youngquist, Hawley & Miller by the absence of a carina-blade.

Stratigraphic range.—Middle(?)–Upper Asselian of the South Urals.

Occurrence on Novaya Zemlya.—Middle–Upper Asselian, *Neogondolella discedus* Assemblage Subzone and *N. discedus* (late form) Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—8 elements.

*Neogondolella* sp. A
Plate 11/I

Description.—The platform is symmetrical, with slightly convex lateral sides and a rounded posterior margin. The upper surface of the platform is concave. Adcarinal furrows are wide but shallow. Denticles of the carina are low and distinctly discrete in the posterior half of the platform and partially fused and increase in height anteriorly. The cusp is moderately small and is terminal, it connects with denticles of the carina by a longitudinal ridge. The small rounded basal cavity extends anteriorly as a narrow keel.

Remarks.—*N.* sp. A possesses typical features of Middle Carboniferous smooth *Gondolella* on one hand, and of Asselian *Neogondolella* on the other. Thus, the structure of the upper platform of *N.* sp. A makes it similar to *Gondolella* ex gr. *donbassica* (Kosenko), while the basal cavity rather suggests close affinities with the Neogondolella ex gr. *N. adentata* Chernikh–*N. discedus* sp. nov. complex.

Occurrence on Novaya Zemlya.—Upper Carboniferous (Gzhelian), *Streptognathodus alekseevi* and *S. elongatus* assemblage zones. Stepovskaya Fm. (Table 12).

Material.—2 elements.

*Neogondolella* sp. B
Plate 11/A, G

Description.—Only fragmented elements of this species were recovered. The posterior-lateral part of the inner side of the platform is curved upwards with an anteriorly positioned conical pit. The posterior part of the platform has a distinctly asymmetrical outline. On the platform, closer to the posterior margin, the platform distinctly tapers. The large cusp is turned to the axis of the platform and inclined forward. Adcarinal furrows are wide and shallow.

Remarks.—The outline of the platform in *N.* sp. is similar to *N. discedus* sp. nov. It differs however from the latter by having a large cone-like cusp.

Occurrence on Novaya Zemlya.—Asselian, *Neogondolella discedus* Assemblage Subzone. Tolbeyachskaya Fm. (Table 12).

Material.—8 elements.

*Neogondolella* sp. C
Plate 12/D, E

Description.—The platform is wide with a rounded, slightly downwardly curved posterior margin. Adcarinal furrows are wide and shallow. Carina consists of separated low denticles. The cusp is large and pyramidal in shape. The basal cavity is very wide in the posterior part and is narrow anteriorly. The posterior margin of the basal loop is straight.

Remarks.—*N.* sp. C differs from the resembling *N. gujioensis* Igo by the absence of a carina-blade and its triangular basal cavity with a straight posterior margin.

Occurrence on Novaya Zemlya.—Artinskian, *Neostreptognathodus pequopensis* Assemblage Zone. Upper part of the Tolbeyachskaya Fm. (Table 12).

Material.—17 elements.

Genus *NEOSTREPTOGNATHODUS* Clark, 1972

Type species.—*Streptognathodus sulcoplicatus* Youngquist, Hawley & Miller, 1951

*Neostreptognathodus pequopensis* Behnken, 1975
Plate 15/E, F; Plate 15/G (cf.)

1975 *Neostreptognathodus pequopensis*—Behnken, p. 310, pl. 1, figs. 21, 22, 25 (only)
1979 *Neostreptognathodus pequopensis* Behnken; Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 2, figs. 7a, 7b
1986 *Neostreptognathodus pequopensis* Behnken; Alekseeva et al. pl. 132, fig. 7, pl. 134, figs. 3–7

Remarks.—This species is characterised by a platform that bears two rows of symmetrical, rounded and discrete nodes clearly separated by a furrow. The platform is widest at the mid-point, being more pointed posteriorly. The free blade is positioned in a central position. *N. pequopensis* Behnken differs from *N. clarki* Kozur by a median groove extending along the whole platform.

Stratigraphic range.—Artinskian (Irginian, Sarginian, Saraninian)–Kungurian of the Urals; Lower Leonardian of North and South America; Zone P8 of the Sverdrup Basin; (?) upper part of the Gipshuken Fm. and the Vøringen Member (Kapp Starostin Fm.) of Spitsbergen; upper part of the Hambergfjellet Fm. of Bjørnøya.

Occurrence on Novaya Zemlya.—Artinskian, *Neostreptognathodus pequopensis* Assemblage Zone. Uppermost part of the Tolbeyachskaya Fm. (Table 12).

Material.—4 elements.

*Neostreptognathodus* sp.
Plate 15/A, B

Description.—The platform is elongate with a teardrop-shaped outline, being widest in the posterior third. The upper surface of the platform is ornamented by two parallel rows of ridge-like nodes, separated by a median furrow. Posteriorly the ridges become oriented radially around the platform margin. The free blade occurs in a

subcentral position. The basal cavity is broadly flared laterally.

Remarks.—*N.* sp. has an outline and ornament of the upper surface very similar to that of *N.* aff. *N. ruzhencevi* Kozur (Orchard & Forster, 1988), but differs from the latter by the lesser asymmetry of the anterior part of the platform.

Occurrence on Novaya Zemlya.—Artinskian, *Neostreptognathodus pequopensis* Assemblage Zone. Uppermost part Tolbeyachskaya Fm. (Table 12).

Material.—1 element.

Genus NEW GENUS A Henderson, 1988

Remarks.—Only scaphate Pa elements are recognised for this genus which represents a homeomorph of *Neostreptognathodus* and *Adetognathus*. New Genus A differs from *Adetognathus* by the free blade being separated by furrows both from the inner and outer parapets. Unlike *Neostreptognathodus*, the furrow separating the free blade from the outer parapet in New Genus A is usually smaller than the inner furrow. Also, New Genus A has a less developed basal cavity, and a general absence of pustulose microornamentation.

New Genus A sp. A Henderson, 1988
Plate 7/E

1988 New Genus A sp. A–Henderson, pp. 137–138, pl. 1, figs. 7, 14, 16–19

Description.—The free blade meets the platform in a subcentral position. The parapets are ornamented by transverse ridges. The upper surface is V-shaped. Outer parapet is higher than the inner parapet. Free blade is long (1/2 of the total element length) and consists of 6 laterally compressed, partially fused denticles. Basal cavity is asymmetrical broadening in the inner part of the platform.

Remarks.—New Genus A sp. A differs from New Genus A sp. B in the approximately equal parapets ornamented by transverse ridges in the former.

Stratigraphic range.—Zone C5a and Zone P1 (Lower Moscovian to lowermost Asselian) of the Sverdrup Basin.

Occurrence on Novaya Zemlya.—Asselian, New Genus A sp. B Assemblage Zone. Upper Barentsevskaya Fm. (Table 2).

Material.—1 element.

New Genus A sp. B Henderson, 1988
Plate 14/B–D

1985 I*diognathodus*—*Streptognathodus plexus*–Orchard & Struik, p. 550, pl. 2, fig. 19
1986 ?*Streptognathodus* sp. A–Henderson & McGugan, p. 232, fig. 6/10
1988 New Genus A sp. B–Henderson, pp. 138–140, pl. 1, figs. 8, 12, 13

Description.—The blade is displaced towards the outer margin of the platform. Parapets are equal in height and separated by a relatively deep V-shaped sulcus, which is traceable up to the anterior edge of the platform separating the inner parapet from a very short fixed blade. The outer parapet is separated from the fixed blade by a shallower furrow. Outer parapet ornamented by transverge ridges. Inner parapet is longer than the outer parapet and ornamented by ridges only in the posterior part. Basal cavity is large and symmetrical.

Remarks.—New Genus A sp. B differs from New Genus A sp. A in the displaced blade, and the shape and ornamentation of the parapets.

Stratigraphic range.—Alex Allan and Telford Formations (British Columbia); zone C6a (Upper Carboniferous) and zone P2 (Lower Permian) of the Sverdrup Basin.

Occurrence on Novaya Zemlya.—Asselian, New Genus A sp. B Assemblage Zone. Upper Barentsevskaya Fm. (Table 2).

Material.—12 elements.

New Genus A sp. C
Plate 7/D, H; Plate 14/A

Description.—The platform is fairly narrow with a pointed termination subcentral or displaced towards the outer margin of the blade. Parapets are approximately equal and ornamented by nodes or by node-like ridges. Basal cavity is asymmetrical, broadening towards the outer margin.

Remarks.—New Genus A sp. C resembles New Genus A sp. B, however it differs from the latter by its equal parapets ornamented by nodes.

Occurrence on Novaya Zemlya.—Asselian, New Genus A sp. B Assemblage Zone. Upper Barentsevskaya Fm. (Table 2).

Material.—4 elements.

New Genus A sp. D
Plate 11/C

Description.—The platform is massive with subparallel lateral margins. The posterior margin is rounded. Parapets are ornamented with rare, short and wide transverse ridges separated in the anterior part of the platform by a wide and shallow median groove, which is smooth towards the posterior margin of the platform. A very short fixed blade is well separated from the inner parapet and nearly fused with the outer parapet. Basal cavity is large and asymmetrical.

Remarks.—New Genus A sp. D Pa elements differ from those of other species by its subparallel parapets separated by a very shallow median groove, by the shape of the transverse ridges, and by a fixed blade poorly separated from the outer parapet.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus roundyi* Assemblage Zone. Uppermost Sporonavolokskaya Fm. (Table 1).

Material.—1 element.

?New Genus A sp.
Plate 9/J

Description.—The margins of the platform are subparallel and taper only in the posteriormost portion to a rounded termination. The upper surface of the platform is smooth and ornamented by seven pairs of transverse ridges separated by a narrow and shallow median furrow. In the posterior part of the platform the ridges are located radially. The blade is long and a has a short fixed part consisting of 9 laterally compressed, partially fused denticles. The fixed blade is subcentral and well separated from the inner parapet but poorly separated from the outer. Basal cavity is asymmetric and flares broadly only in the anterior part of the platform.

Remarks.—?New Genus A sp. is questionably assigned to the new genus because the platform has a smooth upper surface whereas the other species described above have a V-shaped upper surface to the platform.

Occurrence on Novaya Zemlya.—Lower Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3).

Material.—1 element.

Genus *STREPTOGNATHODUS* Stauffer & Plummer, 1932

Type species.—*Streptognathodus excelsus* Stauffer & Plummer, 1932

*Streptognathodus* cf. *S. acuminatus* Gunnell, 1933
Plate 6/E

1933 cf. *Streptognathodus acuminatus*—Gunnell, 1933, p. 285, pl. 33, fig. 33
1987 cf. *Streptognathodus acuminatus* Gunnell; Chernikh & Reshetkova, p. 34, pl. 7, fig. 5
1990 cf. *Streptognathodus acuminatus* Gunnell; Akhmetshina, pl. 1, figs. 5, 8

Description.—This species is characterised by an elongated outline to the platform and with an offset or a break in the structures on the inner parapet. The anterior part of the platform is separated by a break.

Remarks.—Ellison (1941), von Bitter (1972), Perlmutter (1975), and Isakova & Nazarov (1986) included *S. acuminatus* Gunnell in synonomy with *S. wabaunsensis* Gunnell. Chernikh & Reshetkova (1987), as based on Urals sections, have shown that *S. acuminatus* Gunnell differs from typical *S. wabaunsensis* Gunnell by a break of the inner parapet at the level of the blade termination.

Stratigraphic range.—Pennsylvanian (Wabaunsee Groop) of North America; Asselian of the South Urals and Caspian Depression.

Occurrence on Novaya Zemlya.—Lower–Middle Asselian, *Streptognathodus wabaunsensis* and *S. barskovi–S. constrictus* assemblage zones. Upper Kazarkinskaya Fm. (Table 3).

Material.—2 elements.

*Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva, 1981
Plate 5/F, G

1971 *Streptognathodus elegantulus* Stauffer & Plummer; Lane, Merrill, Straka & Webster, pl. 1, fig. 28
1972 ?*Streptognathodus* sp. A von Bitter, pl. 1, figs. 2a–e
1975 *Streptognathodus elegantulus* Stauffer & Plummer; Barskov & Alekseev, pl. 2, fig. 1
1978 *Streptognathodus elegantulus* Stauffer & Plummer; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, pl. 28, figs. 5, 8, 10, 11 (only)
1981 *Streptognathodus alekseevi*—Barskov, Isakova & Schastlivtseva, p. 85, pl. 1, figs. 11–14
1981 *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva; Barskov, Alekseev & Goreva, pl. 2, fig. 12
1983 *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva; Kozitskaya, pl. 1, figs. 14–16
1986 *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva; Isakova & Nazarov, p. 128, pl. 39, figs. 5, 6
1986 *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva; Chernikh, pl. 27, figs. 9–14, 18
1987 *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva; Chernikh & Reshetkova, pl. 1, figs. 19–21, pl. 2, figs. 1, 2
1989 *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva; Barrick & Boardman, pl. 3, figs. 3, 6, 19, 22, 24

Remarks.—The platform in this species is symmetrical without accessory lobes. The median trough is deep and U-shaped, traceable across to the posterior end of the platform. The carina occupies one third to one half of the total platform length. *S. alekseevi* Barskov, Isakova & Schastlivtseva differs from resembling *S. elegantulus* Stauffer & Plummer by a shorter carina.

Stratigraphic range.—Gzhelian of Moscow Basin, Donbass, Urals, Caspian Depression; Pennsylvanian of North America; ?Nordenskiöldbreen Fm. (Cadellfjellet and Kapitol Mbrs.) of Spitsbergen.

Occurrence on Novaya Zemlya.—Gzhelian, *Streptognathodus alekseevi* and *S. elongatus* assemblage zones. Stepovskaya Fm. (Table 12).

Material.—24 elements.

*Streptognathodus barskovi* (Kozur, 1976)
Plate 6/G; Plate 8/K; Plate 6/C (cf.)

1976 *Gnathodus barskovi*—Kozur in Kozur & Mostler, p. 67, pl. 3, fig. 6
1979 *Gnathodus barskovi* Kozur; Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, fig. 7
1981 *Streptognathodus barskovi* (Kozur); Barskov, Isakova & Schastlivtseva, pl. 2, fig. 14
1984 *Streptognathodus barskovi* (Kozur); Akhmetshina, Barskov & Isakova, pl. 8, figs. 16, 17
1986 *Streptognathodus barskovi* (Kozur); Isakova & Nazarov, p. 129, pl. 32, figs. 12, 13
1987 *Streptognathodus barskovi* (Kozur); Chernikh & Reshetkova, p. 35, pl. 7, figs. 1, 10, 11
1990 *Streptognathodus barskovi* (Kozur); Akhmetshina, pl. 1, fig. 17

Remarks.—*S. barskovi* (Kozur) differs from *S. elongatus* Gunnell and *S. alius* Akhmetshina by a wider platform which is narrow at the end of the carina and traceable anteriorly as long anterior branches. Specimens with 1–2 nodes on the inner parapet are assigned to *S.* cf. *S. barskovi* (Kozur).

Stratigraphic range.—Middle–Upper Asselian of the Urals and Caspian Depression; Zone P3 of the Sverdrup Basin; ?Nordenskiöldbreen Fm. (Brucebyen Beds of the Tyrrellfjellet Member) of Spitsbergen.

Occurrence on Novaya Zemlya.—Middle–Upper Asselian, *Neogondolella discedus* and *N. discedus* (late form) Assemblage Subzones. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—7 elements.

*Streptognathodus* cf. *S. cancellosus* (Gunnell, 1933)
Plate 5/E

1933 cf. *Idiognathodus cancellosus*—Gunnell, p. 270, pl. 31, fig. 10

Remarks.—This species is characterised by presence of two accessory lobes and a carina extending to the posterior end of the platform. Carina denticles in the posterior part of the platform are transversely elongated and connect with the transverge ridges of the parapets.

Stratigraphic range.—Uppermost Moskovian (Myachkovian)–Kasimovian of Russian Platform and Urals; Pennsylvanian of North America; ?zone C5b of the Sverdrup Basin.

Occurrence on Novaya Zemlya.—Uppermost Moscovian–Kasimovian, *Neognathodus roundyi* and *Streptognathodus oppletus–Streptognathodus excelsus* assemblage zones. Lazarevskaya Fm. (Table 13), Stepovskaya Fm. (Table 12), Sporonavolokskaya Fm. (Table 1).

Material.—3 elements.

*Streptognathodus concinnus* Kosenko, 1975
Plate 4/E, J

1975 *Streptognathodus concinnus*—Kosenko, p. 130, figs. 11–15
1978 *Streptognathodus concinnus* Kosenko; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, pl. 26, figs. 3–5
1981 *Streptognathodus concinnus* Kosenko; Barskov, Alekseev & Goreva, pl. 1, fig. 7
1984 *Streptognathodus concinnus* Kosenko; Goreva, pl. 3, figs. 15–22

Remarks.—This species is characterised by Pa elements with a nearly symmetrical, narrow platform with two nodose accessory lobes. The median furrow is narrow and deep. The carina is short, less than one third of the total platform length. *S. concinnus* Kosenko differs from resem-

bling *S. excelsus* Stauffer & Plummer by its narrower platform, narrow and shallower median furrow and a shorter carina.

Stratigraphic range.—Upper Moscovian (Podolian) of the Russian Platform.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus medexultimus–Streptognathodus concinnus* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3).

Material.—21 elements.

*Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva, 1981
Plate 9/G

1981 *Streptognathodus conjunctus*—Barskov, Isakova & Schastlivtseva, p. 86, pl. 2, figs. 1–5
1984 *Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva; Akhmetshina, Barskov & Isakova, pl. 8, figs. 7–9
1986 *Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva; Isakova & Nazarov, p. 129, pl. 30, figs. 1–6
1986 *Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva; Chernikh, pl. 29, figs. 12, 13
1987 *Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva; Chernikh & Reshetkova, pl. 5, figs. 15–18
1990 *Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva; Akhmetshina, fig. 16

Remarks.—This species is characterised by an asymmetric platform with a wider outer and a narrower inner side. Accessory lobes are missing, but in the anterior part of the inner parapet one or two nodes may present. The median furrow is shallow. The carina is one third of the total platform length, and at the end of the carina there is a high transverse ridge crossing the median furrow. The latter character is considered a diagnostic feature.

Stratigraphic range.—Upper Gzhelian–Lower Asselian of South Urals and Caspian Depression.

Occurrence on Novaya Zemlya.—Upper Gzhelian, *Streptognathodus elongatus* Assemblage Zone. Stepovskaya Fm. (Table 15).

Material.—1 element.

*Streptognathodus constrictus* Reshetkova & Chernikh, 1986
Plate 8/A, B

1979 *Gnathodus wabaunsensis* (Gunnell); Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 4, fig. 9
1979 ?*Gnathodus elongatus* (Gunnell); Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 4, fig. 10
1986 *Streptognathodus constrictus*—Reshetkova & Chernikh, p. 111, pl. 1, figs. i–r
1986 *Streptognathodus constrictus* Reshetkova & Chernikh; Isakova & Nazarov, p. 133, pl. 32, figs. 1–11
1986 *Streptognathodus constrictus* Reshetkova & Chernikh; Chernikh, pl. 31, figs. 1–9
1987 *Streptognathodus constrictus* Reshetkova & Chernikh; Chernikh & Reshetkova, p. 35, pl. 6, figs. 6, 10–12, 16, 17, pl. 7, fig. 14
1990 *Streptognathodus constrictus* Reshetkova & Chernikh; Akhmetshina, pl. 1, fig. 4

Description.—The platform is elongate and very narrow near the termination of the carina with a symmetrically located median furrow. The carina occupies more than 1/2 of the total platform length. The anterior part of the parapets is separated from the carina by well developed troughs. *S. constrictus* Reshetkova & Chernikh differs from resembling *S. elongatus* Gunnell and *S. simplex* Gunnell by the outline of the anterior part of the platform and by the well developed troughs.

Stratigraphic range.—Middle–Upper Asselian of South Urals and Caspian Depression; Zone P3 of the Sverdrup Basin; ?Kapp Dunér Fm. of Bjørnøya.

Occurrence on Novaya Zemlya.—Middle–Upper Asselian, *Streptognathodus barskovi–S. constrictus* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—12 elements.

*Streptognathodus cristellaris* Chernikh & Reshetkova, 1987
Plate 8/D, G

1986 *?Streptognathodus* ex gr. *wabaunsensis* Gunnell; Isakova & Nazarov, pl. 31, figs. 1–3
1987 *Streptognathodus cristellaris*—Chernikh & Reshetkova, p. 36, pl. 7, figs. 7, 9
1988 *Streptognathodus cristellaris* Chernikh & Reshetkova; Chernikh & Reshetkova, p. 69, pl. 1, figs. 9–11
1990 *Streptognathodus cristellaris* Chernikh & Reshetkova; Akhmetshina, pl. 1, fig. 15

Description.—This species is characterised by an elongated platform with a symmetrical median trough. On the inner parapet there is an accessory lobe consisting of 2 to 3 transverse ridges. *S. cristellaris* Chernikh & Reshetkova differs from the resembling *S. wabaunsensis* Gunnell by the structure of this accessory lobe.

Stratigraphic range.—Asselian (*Streptognathodus cristellaris* zone–lower part of the *S. constrictus* zone), South Urals and Caspian Depression.

Occurrence on Novaya Zemlya.—Asselian, *Streptognathodus cristellaris* Assemblage Zone. Tolbeyachskaya Fm. (Table 12).

Material.—3 elements.

*Streptognathodus dissectus* Kosenko, 1975
Plate 4/L

1975 *Streptognathodus dissectus*—Kosenko, p. 131, pl. 1, figs. 16–20
1978 *Streptognathodus dissectus* Kosenko; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, pl. 26, figs. 1, 2, 6, 7
1981 *Streptognathodus dissectus* Kosenko; Barskov, Alekseev & Goreva, pl. 1, fig. 11
1984 *Streptognathodus dissectus* Kosenko; Goreva, pl. 3, figs. 23–26

Remarks.—The platform of this species is slightly asymmetrical. One (in juvenile forms) or two accessory lobes are developed in the anterior part of the platform. The inner lobe is formed due to the break and outward curving of the anterior part of the inner parapet. The median furrow is deep and wide. The carina is one third of the total platform length. *S. dissectus* Kosenko differs from other species with two accessory lobes in the development of the inner lobe.

Stratigraphic range.—Moscovian (Kashirian) of the Russian Platform

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus medadultimus–N. medexultimus–Streptognathodus concinnus* Assemblage Zone. Lower Kazarkinskaya Fm. (Table 3), Stepovskaya Fm. (Table 12).

Material.—5 elements.

*Streptognathodus eccentricus* Ellison, 1941
Plate 5/B; Plate 8/C, L

1941 *Streptognathodus eccentricus*—Ellison, p. 132, pl. 22, fig. 24
1975 *Streptognathodus simulator* Ellison; Barskov & Alekseev, pl. 2, fig. 19
1978 *Streptognathodus eccentricus* Ellison; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 91, pl. 30, figs. 6, 7
1983 *Streptognathodus eccentricus* Ellison; Kozitskaya, pl. 1, figs. 27, 28
1984 *Streptognathodus eccentricus* Ellison; Alekseev, Barskov & Migdisova, pl. 1, figs. 12, 14, 18
1987 *Streptognathodus eccentricus* Ellison; Chernikh & Reshetkova, pl. 2, figs. 14–16

Remarks.—This species is characterised by an eccentrically located median furrow and by the presence of two accessory lobes. The latter character distinguishes *S. eccentricus* Ellison from other species having an eccentrical location of the median furrow (e.g. *S. luganicus* Kozitskaya and *S. simulator* Ellison).

Stratigraphic range.—Pennsylvanian (Missourian and Virgilian) of North America; Gzhelian (Rechinskian) of Russian Platform and South Urals.

Occurrence on Novaya Zemlya.—Gzhelian, *Streptognathodus alekseevi* Assemblage Zone. Stepovskaya Fm. (Table 12).

Material.—8 elements.

*Streptognathodus elegantulus* Stauffer & Plummer, 1932
Plate 6/A, B

1932 *Streptognathodus elegantulus*—Stauffer & Plummer, p. 47, pl. 4, figs. 6, 7, 22, 27
1978 *Streptognathodus elegantulus* Stauffer & Plummer; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 93, pl. 28, figs. 6–8 (only)
1981 *Streptognathodus elegantulus* Stauffer & Plummer; Barskov, Alekseev & Goreva, pl. 2, fig. 9
1983 *Streptognathodus elegantulus* Stauffer & Plummer; Kozitskaya, pl. 1, figs. 20–22
1984 *Streptognathodus elegantulus* Stauffer & Plummer; Alekseev, Barskov & Migdisova, pl. 1, figs. 5, 10, 11 (only)
1986 *Streptognathodus elegantulus* Stauffer & Plummer; Isakova & Nazarov, p. 131, pl. 29, figs. 1–3
1986 *Streptognathodus elegantulus* Stauffer & Plummer; Chernikh, pl. 27, figs. 3–8
1986 *Streptognathodus elegantulus* Stauffer & Plummer; Chernikh & Reshetkova, pl. 1, figs. 16–18, pl. 3, figs. 7–9

Remarks.—*S. elegantulus* Stauffer & Plummer is characterised by an absence of accessory lobes and by having a deep median trough. *S. elegantulus* Stauffer & Plummer differs from *S. alekseevi* Barskov, Isakova & Schastlivtseva, *S. elongatus* Gunnell and *S. oppletus* Ellison by its longer carina; from *S. firmus* Kozitskaya by its straight platform and carina. *S. ruzhencevi* (Kozur) unlike *S. elegantulus* Stauffer & Plummer has a convex platform with a carina extending over the parapets.

Stratigraphic range.—Pennsylvanian (Desmoinesian–Virgilian)–Lower Permian of North America; Zone C6b–P3 (Gzhelian-Asselian) of the Sverdrup Basin; Kasimovian–Gzhelian of Russian Platform; Gzhelian-Asselian of Urals.

Occurrence on Novaya Zemlya and Pechora Sea.—Kasimovian–Middle Asselian. Lazarevskaya Fm. (Table 13), Kazarkinskaya Fm. (Tables 3, 6), Stepovskaya Fm. (Tables 12, 15), Yeksovskaya Fm. (Table 1), Well SG1 (Table 14).

Material.—96 elements.

*Streptognathodus elongatus* Gunnell, 1933
Plate 6/D, K

1933 *Streptognathodus elongatus*—Gunnell, p. 283, pl. 33, fig. 30
1975 *Streptognathodus elongatus* Gunnell; Barskov & Alekseev, pl. 2, fig. 15
1979 *Gnathodus elongatus* (Gunnell); Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, fig. 5
1981 *Streptognathodus elongatus* Gunnell; Barskov, Isakova & Schastlivtseva, pl. 1, figs. 15–18
1983 *Streptognathodus elongatus* Gunnell; Akhmetshina, pl. 1, figs. 1–3
1986 *Streptognathodus elongatus* Gunnell; Chernikh, pl. 30, figs. 6–9
1986 *Streptognathodus elongatus* Gunnell; Isakova & Nazarov, p. 130, pl. 29, figs. 7–11
1987 *Streptognathodus elongatus* Gunnell; Chernikh & Reshetkova, pl. 4, figs. 4, 5 (only)
1990 *Streptognathodus elongatus* Gunnell; Akhmetshina, pl. 1, fig. 2

Remarks.—Pa elements of this species are very variable in outline. Morphologically transitions with narrow-platform *S. simplex* Gunnell and wide-platform *S. barskovi* (Kozur) can be observed. *S. elongatus* Gunnell differs from *S. alekseevi* Barskov, Isakova & Schastlivtseva by the absence of a median trough and from *S. elegantulus* Stauffer & Plummer in the shorter carina.

Stratigraphic range.—Pennsylvanian (Virgilian)–Lower Permian (Wolfcampian) of North America; Zone P5 of the Sverdrup Basin; Gzhelian (Noginian)–Asselian of the Russian Platform and Urals; Asselian of Spitsbergen (Tyrrellfjellet Member of the Nordenskiöldbreen Fm.) and Bjørnøya (Kapp Dunér Fm.).

Occurrence on Novaya Zemlya.—Gzhelian, *Streptognathodus elongatus* Assemblage Zone, and Asselian. Kazarkinskaya Fm. (Tables 3, 6), Stepovskaya Fm. (Tables 12, 15), Tolbeyachskaya Fm. (Table 12), Yeksovskaya Fm. (Table 1), Lavrovskaya Fm. (Table 11).

Material.—42 elements.

*Streptognathodus excelsus* Stauffer & Plummer, 1932
Plate 4/A; Plate 5/D

1932 *Streptognathodus excelsus*—Stauffer & Plummer, p. 48, pl. 4, figs. 2, 5
1933 *Streptognathodus multinodosus* Gunnell, p. 280, pl. 32, fig. 11
1933 *Streptognathodus subdivisis* Gunnell, p. 281, pl. 32, fig. 16
1933 *Streptognathodus chanutensis* Gunnell, p. 282, pl. 32, figs. 66–68
1933 *Streptognathodus clarki* Gunnell, p. 283, pl. 33, fig. 3
1975 *Streptognathodus excelsus* Stauffer & Plummer; Barskov & Alekseev, pl. 2, fig. 18
1978 *Streptognathodus excelsus* Stauffer & Plummer; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 94, pl. 29, figs. 7–9
1981 *Streptognathodus excelsus* Stauffer & Plummer; Barskov, Alekseev & Goreva, pl. 1, fig. 8
1984 *Streptognathodus excelsus* Stauffer & Plummer; Goreva, pl. 3, figs. 27–30
1986 *Streptognathodus excelsus* Stauffer & Plummer; Chernikh, pl. 27, figs. 19–23
1987 *Streptognathodus excelsus* Stauffer & Plummer; Chernikh & Reshetkova, pl. 3, figs. 5, 6

Remarks.—*S. excelsus* Stauffer & Plummer resembles *S. zethus* Chernikh & Reshetkova, however the latter species is different in the asymmetrical position of the median trough and in the general asymmetry of the platform. *S. excelsus* Stauffer & Plummer differs from *S. concinnus* Kosenko by the wider platform, the longer carina and the deeper and wider median trough.

Stratigraphic range.—Pennsylvanian (Desmoinesian–Virgilian) of North America; Kasimovian–Gzhelian of Russian Platform and Urals.

Occurrence on Novaya Zemlya and Pechora Sea.—Kasimovian–Gzhelian, *Streptognathodus excelsus–S. elongatus* assemblage zones. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3, 6), Stepovskaya Fm. (Tables 12, 15), Sporonavolokskaya Fm. (Table 1), Well PR1 (Table 14).

Material.—110 elements.

*Streptognathodus* cf. *S. excelsus* Stauffer & Plummer, 1932
Plate 4/D

Remarks.—Pa elements with 2–3 terminal ridges crossing the median trough are here assigned to *Streptognathodus* cf. *S. excelsus* Stauffer & Plummer.

Occurrence on Novaya Zemlya.—Uppermost Moscovian–lowermost Kasimovian, uppermost part of the *Neognathodus roundyi* Assemblage

Zone. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 3–5).

Material.—10 elements.

*Streptognathodus expansus* Igo & Koike, 1964
Plate 2/E, J

1964 *Streptognathodus expansus*—Igo & Koike, p. 189, pl. 28, fig. 14
1978 *Streptognathodus expansus* Igo & Koike; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 96, pl. 25, figs. 1, 2

Stratigraphic range.—Lower Pennsylvanian (upper part of the Morrowan) of North America; upper and middle Bashkirian of the Russian Platform and the Urals.

Occurrence on Novaya Zemlya.—Bashkirian, *Streptognathodus expansus–S. suberectus* Assemblage Zone,–Moscovian. Lower Kazarkinskaya Fm. (Tables 3–5, 7–10), Stepovskaya Fm. (Tables 12, 15).

Material.—30 elements.

*Streptognathodus firmus* Kozitskaya, 1978
Plate 3/I

1978 *Streptognathodus firmus*—Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 97, pl. 29, figs. 1–6
1983 *Streptognathodus firmus* Kozitskaya; Kozitskaya, pl. 1, fig. 23
1984 *Streptognathodus firmus* Kozitskaya; Alekseev, Barskov & Migdisova, pl. 1, figs. 7, 8 (only)
1984 *Streptognathodus elegantulus* Stauffer & Plummer; Alekseev, Barskov & Migdisova, pl. 1, figs. 4, 6

Description.—The platform is massive, asymmetrical with a pointed posterior end. There are no accessory lobes. Carina terminates at the posterior end of the platform. In the middle part the platform has a typically convex outer outline. *S. firmus* Kozitskaya differs from *S. elegantulus* Stauffer & Plummer by its curved carina and platform.

Stratigraphic range.—Kasimovian–Gzhelian of Russian Platform.

Occurrence on Novaya Zemlya.—Gzhelian, *Streptognathodus alekseevi* Assemblage Zone. Stepovskaya Fm. (Table 12).

Material.—21 elements.

*Streptognathodus flangulatoformis* Sobolev sp. nov.
Plate 7/A, B

Types.—Holotype CNIGR 12745/98; Plate 7/A.

Type locality.—Bolshaya Yunau River.

Type horizon.—Chert Member of the upper part of the Kazarkinskaya Fm., Asselian.

Derivation of name.—The name refers to the morphological resemblance to *S. flangulatus* Gunnell.

Diagnosis.—Platform elongate. Parapets ornamented by transverse ridges. Accessory lobes present on both side of anterior portion of platform. Carina long, ending at porterior margin of platform.

Description.—The platform is elongate and constricted near the termination of the fixed blade. The parapets are ornamented by transverse ridges. The anterior parts of the parapets are separated from the carina by deep troughs. Accessory lobes are present on both sides of the anterior portion of the platform. Outer lobe consists of one to four discrete nodes. A free blade is composed of laterally compressed and partially fused denticles. Carina is long and anteriorly consists of partially fused denticles and posteriorly of isolated nodes. The basal cavity is large and asymmetrically flared.

Remarks.—*S. flangulatoformis* sp. nov. differs from the similar *S. flangulatus* Gunnell by the longer carina.

Occurrence on Novaya Zemlya.—Lower Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Lavrovskaya Fm. (Table 11).

Material.—92 elements.

*Streptognathodus flangulatus* Gunnell, 1933
Plate 7/I, K; Plate 7/L (cf.)

1933 *Streptognathodus flangulatus*—Gunnell, p. 285, pl. 33, fig. 35
1987 *Streptognathodus flangulatus* Gunnell; Chernikh & Reshetkova, pl. 6, fig. 1
1990 *Streptognathodus flangulatus* Gunnell; Akhmetshina, figs. 20, 21

Remarks.—This species has a platform outline resembling *S. wabaunsensis* Gunnell, but differs from the latter in having two accessory lobes. The inner lobe usually consists of 2 to 3 nodes. In *S.* cf. *S. flangulatus* Gunnell, the carina is longer than in typical specimens.

Stratigraphic range.—Upper Pennsylvanian of North America; Lower Asselian of South Urals and Caspian Depression. *S.* cf. *S. flangulatus* has a longer than typical carina.

Occurrence on Novaya Zemlya.—Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Lavrovskaya Fm. (Table 11).

Material.—25 elements.

*Streptognathodus fusus* Chernikh & Reshetkova, 1987
Plate 8/E, J

1987 *Streptognathodus fusus*—Chernikh & Reshetkova, p. 34, pl. 7, fig. 13
1988 *Streptognathodus fusus* Chernikh & Reshetkova; Chernikh & Reshetkova, p. 70, pl. 1, figs. 12–14

Description.—The platform is elongate, tapering posteriorly close to the carina termination. The median furrow is asymmetrical. The carina occupies about half of the total platform length. The inner parapet, in the anterior part of the platform, is larger than the outer and is separated from the free blade by a deep trough. The ribbing of the parapets is more irregular in the anterior part of the inner parapet. *S. fusus* Chernikh & Reshetkova differs from *S. constrictus* Reshetkova & Chernikh by its wider platform and the asymmetrical structure of the parapets.

Stratigraphic range.—Middle Asselian of South Urals.

Occurrence on Novaya Zemlya.—Middle Asselian, *Neogondolella discedus* (late form) Assemblage Subzone. Upper Kazarkinskaya Fm. (Table 3).

Material.—2 elements.

*Streptognathodus gracilis* Stauffer & Plummer, 1932
Plate 5/H, I

1932 *Streptognathodus gracilis*—Stauffer & Plummer, p. 48, pl. 4, figs. 12, 23
1975 *Streptognathodus gracilis* Stauffer & Plummer; Barskov & Alekseev, pl. 2, figs. 16, 17
1978 *Streptognathodus gracilis* Stauffer & Plummer; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 98, pl. 30, figs. 8, 9
1983 *Streptognathodus gracilis* Stauffer & Plummer; Kozitskaya, pl. 1, fig. 24
1986 *Streptognathodus gracilis* Stauffer & Plummer; Chernikh, pl. 27, figs. 16, 17
1987 *Streptognathodus gracilis* Stauffer & Plummer; Chernikh & Reshetkova, pl. 2, figs. 9–11

Remarks.—*S. gracilis* Stauffer & Plummer differs from other species by the presence of an accessory lobe only on the inner side of the platform in its middle portion. In *S. wabaunsensis* Gunnell, the single lobe is positioned more anteriorly.

Stratigraphic range.—Pennsylvanian (Missourian–Virgilian) of North America; Kasimovian–Gzhelian of Russian Platform; Upper Moscovian–Gzhelian of Urals.

Occurrence on Novaya Zemlya.—Upper Moscovian, *Neognathodus roundyi* Assemblage Zone,–Lower Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Lazarevskaya Fm. (Table 13), Kazarkinskaya Fm. (Table 3), Stepovskaya Fm. (Tables 12, 14), Lavrovskaya Fm. (Table 11).

Material.—66 elements.

*Streptognathodus invaginatus* Reshetkova & Chernikh, 1986
Plate 6/L

1986 *Streptognathodus invaginatus*—Reshetkova & Chernikh, p. 111, pl. 1, figs. c–f
1986 *Streptognathodus invaginatus* Reshetkova & Chernikh; Chernikh, pl. 29, figs. 14–17
1987 *Streptognathodus invaginatus* Reshetkova & Chernikh; Chernikh & Reshetkova, p. 37, pl. 4, figs. 14–19, pl. 6, fig. 2

Remarks.—This species is characterised by a platform with a single lobe on the inner side. This lobe is separated from the posterior part of the platform by a distinct sinus. Two terminal transverse ridges cross the median furrow. *S. invaginatus* Reshetkova & Chernikh differs from the similar *S. wabaunsensis* Gunnell by its wider and rounder platform, a symmerical median furrow, and the presence of a sinus. Also, in *S. invaginatus* Reshetkova & Chernikh, the terminal ridges on the platform are not dissected by the median furrow.

Stratigraphic range.—Lower Asselian of Urals and Caspian Depression.

Occurrence on Novaya Zemlya.—Lower–Middle Asselian, *Streptognathodus cristellaris* Assemblage Zone–*S. barskovi–S. constrictus* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—4 elements.

*Streptognathodus* cf. *S. latus* Chernikh & Reshetkova, 1988
Plate 8/H

1988 cf. *Streptognathodus latus*—Chernikh & Reshetkova, p. 71, pl. 2, figs. 1, 3

Diagnosis of *Streptognathodus latus* Chernikh & Reshetkova (from Chernikh & Reshetkova 1988).—The platform is wide and symmetrical. The median trough is narrow and shallow. Parapets are flat and ornamented by dense transverse ridges, partly dichotomous. The latter feature distinguishes *S. latus* Chernikh & Reshetkova from other species.

Stratigraphic range.—Middle Asselian (*Streptognathodus constrictus* Zone) of the Urals.

Occurrence on Novaya Zemlya.—Asselian, *Streptognathodus cristellaris* Assemblange Zone. Tolbeyachskaya Fm. (Table 12).

Material.—1 element.

*Streptognathodus* cf. *S. longissimus* Chernikh & Reshetkova, 1988
Plate 6/H; Plate 8/I

1988 cf. *Streptognathodus longissimus*—Chernikh & Reshetkova, p. 72, pl. 2, figs. 4–7
1990 cf. *Streptognathodus longissimus* Chernikh & Reshetkova; Akhmetshina, pl. 1, fig. 22

Diagnosis of *Streptognathodus longissimus* Chernikh & Reshetkova (from Chernikh & Reshetkova 1988).—The platform is elongate, symmetrical and tapers slightly in the anterior part. The fixed

part of the carina occupies about one third of the total platform length and is separated from the parapets by deep troughs. Posterior part of platform is ornamented by transverge ridges.

Remarks.—*S.* cf. *S. longissimus* Chernikh & Reshetkova differs from *Streptognathodus longissimus* Chernikh & Reshetkova by the presence of transverse ridges all along the parapets of the platform, rather than just in the posterior part.

Stratigraphic range.—Middle–Upper Asselian (*Streptognathodus constrictus–S. postfusus* Zones) of the Urals and the Caspian Depression.

Occurrence on Novaya Zemlya.—Middle–Upper Asselian, *Neogondolella discedus–N. discedus* (late form) Assemblage Subzones. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12).

Material.—3 elements.

*Streptognathodus luganicus* Kozitskaya, 1978
Plate 5/A

1978 *Streptognathodus luganicus*—Kozitskaya in Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 101, pl. 30, figs. 10, 11
1983 *Strepathodus luganicus* Kozitskaya; Kozitskaya, pl. 1, fig. 29
1986 *Streptognathodus luganicus* Kozitskaya; Isakova & Nazarov, p. 89, pl. 22, fig. 1
1987 *Streptognathodus luganicus* Kozitskaya; Chernikh & Reshetkova, pl. 3, fig. 16

Description.—The platform is asymmetrical with the axial furrow displaced towards the inner margin. No accessory lobes are present. *S. luganicus* Kozitskaya differs from *S. simulator* Ellison and *S. eccentricus* Ellison by the absence of accessory lobes from the platform.

Stratigraphic range.—Lower part of Gzhelian, *Streptognathodus alekseevi* Zone of Russian Platform and South Urals.

Occurrence on Novaya Zemlya.—Lower Gzhelian, *Streptognathodus alekseevi* Assemblage Zone. Stepovskaya Fm. (Table 12).

Material.—1 element.

*Streptognathodus nodulinearis* Reshetkova & Chernikh, 1986
Plate 6/F; Plate 8/F

1986 *Streptognathodus nodulinearis*—Reshetkova & Chernikh, p. 112, pl. 1, figs. kh-shch
1986 *Streptognathodus nodulinearis* Reshetkova & Chernikh; Chernikh, pl. 29, figs. 1–5
1987 *Streptognathodus nodulinearis* Reshetkova & Chernikh; Chernikh & Reshetkova, p. 38, pl. 5, figs. 11–13

Description.—The platform is elongate, symmetrical or slightly curved inwards. It has a straight axial furrow. An accessory lobe is present on the inner side of the platform and consists of a short vertical row of 3–4 nodes parallel to the axial furrow. *S. nodulinearis* Reshetkova & Chernikh differs from the similar *S. wabaunsensis* Gunnell by the shape of the accessory lobe.

Stratigraphic range.—Lower Asselian (*Streptognathodus wabaunsensis* Zone) of Urals; Zone P2 of the Sverdrup Basin.

Occurrence on Novaya Zemlya.—Lower–Middle Asselian, *Streptognathodus nodulinearis* Assemblage Zone–*S. barskovi–S. constrictus* Assemblage Zone. Upper Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12), Yeksovskaya Fm. (Table 1).

Material.—6 elements.

*Streptognathodus oppletus* Ellison, 1941
Plate 5/C

1933 *Idiognathodus multinodosus*—Gunnell, p. 279, pl. 33, fig. 5
1941 *Streptognathodus oppletus*—Ellison, p. 132, pl. 22, figs. 13, 14, 16

1975 *Streptognathodus oppletus* Ellison; Barskov & Alekseev, pl. 2, fig. 13
1978 *Streptognathodus oppletus* Ellison; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 102, pl. 27, figs. 6, 7, 10, 15, 16
1979 *Streptognathodus oppletus* Ellison; Barskov & Alekseev, p. 114, pl. 10, fig. 29
1983 *Streptognathodus oppletus* Ellison; Barskov & Kononova, pl. 3, figs. 7, 8, 18, 20
1983 *Streptognathodus oppletus* Ellison; Kozitskaya, pl. 1, figs. 25, 26
1984 *Streptognathodus oppletus* Ellison; Alekseev, Barskov & Migdisova, pl. 1, figs. 1–3
1984 *Streptognathodus oppletus* Ellison; Goreva, pl. 3, figs. 38–44
1986 *Streptognathodus oppletus* Ellison; Chernikh, pl. 26, figs. 1, 2, 15
1987 *Streptognathodus oppletus* Ellison; Chernikh & Reshetkova, pl. 2, figs. 12, 13

Remarks.—The platform of *S. oppletus* Ellison is characterised by possessing a long prominent carina, and poorly developed accessory lobes, and thus differs from the similar *S. parvus* Dunn elements. *S. oppletus* Ellison differs from other species lacking accessory lobes (e.g. *S. elegantulus* Stauffer & Plummer, *S. firmus* Kozitskaya and *S. ruzhencevi* (Kozur)) in the presence of two to three continuous transverse ridges at the posterior margin of the platform.

Stratigraphic range.—Pennsylvanian (Desmoinesian–Missourian) of North America; Zone C6a of the Sverdrup Basin; Kasimovian–Lower Gzhelian of Russian Platform and Urals.

Occurrence on Novaya Zemlya.—Kasimovian–Gzhelian *Streptognathodus oppletus–S.excelsus* Assemblage Zone and lowermost part of the *S. alekseevi* Assemblage Zone. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Table 3), Tolbeyachskaya Fm. (Table 12), and the Well BUG (Table 14).

Material.—9 elements.

*Streptognathodus parvus* Dunn, 1966
Plate 2/D

1966 *Streptognathodus parvus*—Dunn, p. 1302, pl. 158, figs. 9, 10
1978 *Streptognathodus parvus* Dunn; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 104, pl. 25, figs. 4–8
1984 *Streptognathodus parvus* Dunn; Goreva, pl. 3, figs. 7–14

Remarks.—*Streptognathodus parvus* Dunn differs from other species having continuous traverse ridges at the posterior end of the platform (e.g. *S. oppletus* Ellison and *S. transitivus* Kosenko), by the presence of a narrow inner accessory lobe with two or three nodes. *S. parvus* Dunn differs from species with an accessory lobe (e.g. *S. gracilis* Stauffer & Plummer and *S. nodulinearis* Reshetkova & Chernikh) by the longer posteriorly extending carina and its continuous transverge ridges at the posterior end of platform.

Stratigraphic range.—Pennsylvanian (upper Morrowan–Atokan) of North America; upper Bashkirian–lower part of the Moscovian (Vereynian–Kashirian) of Russian Platform and Urals.

Occurrence on Novaya Zemlya.—Bashkirian, *Streptognathodus expansus–S. suberectus* Assemblage Zone, Moscovian, including the *Neognathodus medadultimus* Assemblage Zone. Lazarevskaya Fm. (Table 13), Lower Kazarkinskaya Fm. (Tables 4, 5, 7–10), Stepovskaya Fm. (Tables 12, 15), Lower Barentsevskaya Fm. (Table 2), Lavrovskaya Fm. (Table 11).

Material.—20 elements.

*Streptognathodus ruzhencevi* (Kozur, 1976)
Plate 6/N

1976 *Gnathodus ruzhencevi*—Kozur in Kozur & Mostler, pl. 3, fig. 12

Remarks.—*S. ruzhencevi* (Kozur) differs from similar species (e.g. *S. elegantulus* Stauffer & Plummer and *S. firmus* Kozitskaya) by the convex upper surface of the platform and the carina extends all the length of the platform.

Stratigraphic range.—Gzhelian (upper subzone of the *Streptognathodus alekseevi* Zone) Russian Platform and Urals.

Occurrence in Pechora Sea.—Gzhelian, well PR1 (Table 14).

Material.—5 elements.

*Streptognathodus simplex* Gunnell, 1933
Plate 5/N; Plate 7/J; Plate 6/M (cf.)

1933 *Streptognathodus simplex*—Gunnell, p. 289, pl. 33, fig. 40
1975 *Idiognathodus* n. sp. A Perlmutter, pl. 1, 13
1976 *Gnathodus simplex* (Gunnell); Kozur & Mostler pl. 2, figs. 3, 5
1978 *Gnathodus simplex* (Gunnell); Kozur, pl. 1, figs. 1–3, 5
1979 *Gnathodus simplex* (Gunnell); Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, fig. 10
1980 *Gnathodus simplex* (Gunnell); Bando, Bhatt, Gupta, Hayashi, Kozur, Nakasawa & Wang, pl. 3, fig. 2
1981 *Streptognathodus simplex* Gunnell; Barskov, Isakova & Schastlivsteva, pl. 1, figs. 20–23
1983 *Streptognathodus simplex* Gunnell; Akhmetshina, pl. 8, figs. 10, ?11
1986 *Streptognathodus simplex* Gunnell; Isakova & Nazarov, p. 131, pl. 30, figs. 10, 12–16, 21 (only)
1986 *Streptognathodus simplex* Gunnell; Chernikh, pl. 30, figs. 1–4, pl. 31, figs. 15–17
1987 *Streptognathodus simplex* Gunnell; Chernikh & Reshetkova, p. 38, pl. 7, fig. 2
1990 *Streptognathodus simplex* Gunnell; Akhmetshina, fig. 14

Remarks.—*S. simplex* Gunnell Pa elements are very similar to those of *S. elongatus* Gunnell, and there is a gradual transition between these two species. Typical *S. simplex* Gunnell differs from typical *S. elongatus* Gunnell by the presence of a narrow platform, equal parapets and 2–3 terminal transverse ridges crossing the axial furrow. Forms that have 1–2 nodes on the inner side of the platform are assigned to *S.* cf. *S. simplex* Gunnell.

Stratigraphic range.—Upper part of the Gzhelian–Lower Permian Urals, Caspian Depression and the Russian Platform.

Occurrence on Novaya Zemlya.—Upper Gzhelian, *Streptognathodus elongatus* Assemblage Zone,–Asselian, *S. barskovi–S. constrictus* Assemblage Zone. Kazarkinskaya Fm. (Tables 3, 6), Stepovskaya Fm. (Tables 12, 15), Lavrovskaya Fm. (Table 11).

Material.—23 elements.

*Streptognathodus simulator* Ellison, 1941
Plate 7/C

1941 *Streptognathodus simulator*—Ellison, p. 107, pl. 22, figs. 25, 27–30
1978 *Streptognathodus simulator* Ellison; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 106, pl. 30, figs. 1–5
1981 *Streptognathodus simulator* Ellison; Barskov, Alekseev & Goreva, pl. 2, fig. 10
1983 *Streptognathodus simulator* Ellison; Kozitskaya, pl. 1, figs. 30–33
1986 *Streptognathodus simulator* Ellison; Chernikh, pl. 27, figs. 22, 23
1987 *Streptognathodus simulator* Ellison; Chernikh & Reshetkova, pl. 2, figs. 19–21, pl. 3, figs. 17–20

Remarks.—*S. simulator* Ellison differs from other species with an eccentric axial furrow (e.g. *S. luganicus* Kozitskaya and *S. eccentricus* Ellison) on the platform by the presence of one accessory lobe on the inner side of the platform.

Stratigraphic range.—Pennsylvanian (Missourian–Virgilian) of North America; Lower Gzhelian of Russian Platform and Urals.

Occurrence on Novaya Zemlya and Pechora Sea.—Gzhelian, lower part of the *Streptognathodus alekseevi* Assemblage Zone. Stepovskaya Fm. (Table 12), Well SG1 (Table 14).

Material.—8 elements.

*Streptognathodus suberectus* Dunn, 1966
Plate 2/G, I

1966 *Streptognathodus suberectus*—Dunn, 1966, p. 1303, pl. 157, figs. 4–6
1978 *Streptognathodus suberectus* Dunn; Kozitskaya, Kosenko, Lipnyagov & Nemirovskaya, p. 106, pl. 25, fig. 3

Remarks.—*S. suberectus* Dunn differs from other species with two accessory lobes of the platform (e.g. *S. concinnus* Kosenko, *S. cancellosus* (Gunnell) and *S. excelsus* Stauffer & Plummer) in that *S. suberectus* Dunn has these lobes displaced more posteriorly. The investigated specimens are very similar to those of *S. elongatus* Gunnell, but are distinguished from the latter by their inner parallel lobe with several nodes.

Stratigraphic range.—Pennsylvanian (Morrowan) of North America; zone C6a of the Sverdrup Basin; upper part Lower Bashkirian–Upper Bashkirian of Russian Platform and Urals.

Occurrence on Novaya Zemlya.—Bashkirian, *Streptognathodus expansus–S. suberectus* Assemblage Zone. Lower Kazarkinskaya Fm. (Tables 7–10), Stepovskaya Fm. (Table 15).

Material.—31 elements.

*Streptognathodus wabaunsensis* Gunnell, 1933
Plate 6/J
Plate 7/F, G; Plate 9/C, E (cf.)

1933 *Streptognathodus wabaunsensis*—Gunnell, p. 285, pl. 33, fig. 32
1979 *Gnathodus wabaunsensis* (Gunnell); Movshovich, Kozur, Pavlov, Pnev, Polozova, Chuvashov & Bogoslovskaya, pl. 1, fig. 8
1981 *Streptognathodus wabaunsensis* Gunnell; Barskov, Isakova & Schastlivsteva, pl. 2, figs. 6–13
1983 *Streptognathodus wabaunsensis* Gunnell; Kalmykova in Stepanov, pl. 139, figs. 6–10
1984 *Streptognathodus wabaunsensis* Gunnell; Akhmetshina, Barskov & Isakova, pl. 1, figs. 12–15
1986 *Streptognathodus wabaunsensis* Gunnell; Isakova & Nazarov, p. 132, pl. 31, figs. 4–19
1986 *Streptognathodus wabaunsensis* Gunnell; Chernikh, pl. 28, figs. 1–6, pl. 31, figs. 10, 11
1987 *Streptognathodus wabaunsensis* Gunnell; Chernikh & Reshetkova, p. 39, pl. 5, figs. 1–7, pl. 7, figs. 3, 4
1990 *Streptognathodus wabaunsensis* Gunnell; Akhmetshina, pl. 1, figs. 6, 11

Remarks.—Distinguishing characters of *S. wabaunsensis* Gunnell Pa elements include their very shallow median groove and the accessory lobe developed near the anterior portion of the platform. Chernikh & Reshetkova (1987) noted that forms with morphologically different platforms had been assigned to *S. wabaunsensis* Gunnell. The diagnostic character of this species is the presence of the accessory lobe situated anteriorly on the inner side of the platform. The former element appears in the upper Gzhelian, the latter in basal Asselian strata. Elements that differ from the typical ones by possesing a longer carina are assigned to *S.* cf. *S. wabaunsensis* Gunnell (Plate 7/F, G).

Stratigraphic range.—Uppermost Gzhelian–Asselian of Urals; Asselian of Russian Platform; Virgilian of North America.

Occurrence on Novaya Zemlya.—Uppermost Gzhelian–Middle Asselian, *Streptognathodus wabaunsensis* Assemblage Zone. Upper Kazarkinskaya Fm. (Tables 3, 6), Stepovskaya and Tolbeyachskaya Fm. (Tables 12, 15), Upper Barentsevskaya Fm. (Table 2), Lavrovskaya Fm. (Table 11).

Material.—41 elements.

*?Streptognathodus* sp.
Plate 9/Fig. I

Description.—The platform is symmetrical and rhombic in outline, it is wide in the middle part, with tapering in both the anterior and posterior margins of the platform. The parapets are ornamented by coarse transverse ridges. On the posterior margin of the platform the ridges are radially arranged. The denticulated free blade joins the platform in a central position and continues onto the platform as an adenticulate to slightly denticulate ridge-like carina. The carina occupies about 2/3 of the platform length. The basal cavity is large, symmetrically flared and extends anteriorly as a groove below the free blade.

Remarks.—?*S.* sp. is most similar to *Streptognathodus* without accessory lobes; the shape of the platform and the ornamentation of the parapets are however different in previously described species of *Streptognathodus.*

Occurrence on Novaya Zemlya.—Kasimovian, *Streptognathodus oppletus–S. excelsus* Assemblage Zone. Lazarevskaya Fm. (Table 13).

Material.—1 element.

Genus *SWEETOGNATHUS* Clark, 1972

Type species.—*Spathognathodus whitei* Rhodes, 1963.

*Sweetognathus* sp.

(Not illustrated)

Remarks.—The extracted elements are very small (juvenile) specimens. The platform is flat to slightly arched. The carinal nodes are small, slightly elongate transversely and bear a dense pustulose microornamentation. The small size of the elements does not allow identification to species level. According to Chernikh (pers. comm.) the current forms are similar in morphology to Sterlitamakian *Sweetognathus* of the Urals.

Occurrence on Novaya Zemlya.—Upper Sakmarian–Lower Artinskian *Sweetognathus* sp–*Neogondolella bisselli* Assemblage Zone. Tolbeyachskaya Fm. (Table 12).

Material.—2 elements (lost during SEM photography).

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Appendix. Tables 1–15

*Table 1.* Productive conodont samples of the Sporonavolokskaya and Yeksovskaya formations, Spokoynaya River.

| SYSTEM | CARBONIFEROUS | | | PERMIAN | | |
|---|---|---|---|---|---|---|
| Series | Middle | | Middle-Upper | Lower | | |
| Stage | Moscovian | | Moscovian-Kasimovian | Asselian | | |
| Formation | Sporonavolovskaya | | | Yeksovskaya | | |
| Conodont assemblage | ? | N. roundyi | Str. oppletus-Str. excelsus | Streptognathodus nodulinearis | Str. elongatus-A. lautus | Total |
| Sample no. | 615-5 | 1701-1 | 635 | 1684 | 1693-3 | |
| Adetognathus lautus | - | - | - | - | - | 4 |
| A. sp. (fragments) | 1 | 1 | - | - | - | 2 |
| Hindeodus minutus | - | - | 1 | - | - | 1 |
| Neognathodus cf. N. dilatus | - | - | 1 cf | - | - | 1 |
| N. medexultimus | - | 2 | - | - | - | 2 |
| N. roundyi | | 3 | - | - | - | 3 |
| Neogondolella cf. N. dentiseparata | - | - | - | - | - | 5 |
| New Genus A sp. D | - | 1 | - | - | - | 1 |
| Streptognathodus cancellosus | - | 1 cf | - | - | - | 1 |
| S. elegantulus | - | - | - | - | - | 1 |
| S. elongatus | - | - | - | - | - | 5 |
| S. excelsus | - | - | 1 cf | - | - | 1 |
| S. nodulinearis | - | - | - | - | - | 2 |
| Total | 1 | 8 | 3 | 2 | 15 | |
| C.A.I. | 3.5-4.0 | | | | | |

*Table 2.* Productive conodont samples of the Barentsevskaya and Sedovskaya formations, Litke Peninsula. Conodont assemblages: 1–3: ?, 4: *N. medadultimus*, 5–6: *N. medexultimus*–*S. concinnus*, 7: ?, 8–11: New Genus A sp. B, 12–13: *Adetognathus paralautus.*

| SYSTEM | CARBONIFEROUS | | | | | | | PERMIAN | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | Middle | | | | | | | Lower | | | | | | |
| Stage | Bashkir. | | Moscovian | | | | | Asselian | | | | Sakmarian | | |
| Formation | Barentsevskaya | | | | | | | | | | | | | |
| | Lower | | | | | | | Upper | | | | | | Total |
| Conodont ass. (see caption) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| Sample no. | 8880 | 8816 | 8853 | 8875 | 8845-4 | 892 | 804-1 | 805-5 | 805-14 | 806-26 | 798-3 | 8818 | 887 | |
| Adetognathus lautus | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| A. paralautus | - | - | - | - | - | - | - | - | - | - | - | 3 cf | - | 3 |
| A. sp. B Henderson | - | - | - | - | - | - | - | 2 | - | - | - | - | - | 2 |
| A. sp. (fragments) | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| Declinognathodus noduliferus | 1 cf | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| D. sp. | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Idiognathodus delicatus | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 1 |
| I. podolskensis | - | - | - | 1 cf | - | - | - | - | - | - | - | - | - | 1 |
| I. robustus | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| I. sp. C | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| I. sp. (fragments) | 1 | 1 | 2 | 1 | - | - | - | - | 1 | - | - | - | - | 6 |
| Neognathodus bothrops | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| Neognathodus medadultimus | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| Neognathodus medexultimus | - | - | - | - | 1 | 1 | - | - | - | - | - | - | - | 2 |
| Neogondolella bisselli | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| New Genus A sp. A | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| New Genus A sp. B | - | - | - | - | - | - | - | 5 | - | 3 | 4 | - | - | 12 |
| New Genus A sp. C | - | - | - | - | - | - | - | - | 1 | - | 3 | - | - | 4 |
| Streptognathodus parvus | - | - | - | 3 cf | - | - | - | - | - | - | - | - | - | 3 |
| S. wabaunsensis | - | - | - | - | - | - | - | - | 3 cf | - | - | - | - | 3 |
| Total | 2 | 4 | 3 | 7 | 1 | 1 | 1 | 10 | 5 | 3 | 7 | 3 | 2 | |
| C.A.I. | 3.5-4.0 | | | | | | | | | | | | | |

*Table 3*. Productive conodont samples of the Kazarkinskaya Formation, Bolshaya Yunau River (sections 124, 753, and 101), Nekhvatova River (section 752), and Taynaya River (section 131). Conodonts assemblages: 1: *Gnathodus bilineatus bilineatus*, 2: *Declinognathodus–Idiognathoides*, 3: *Streptognathodus dissectus–S. concinnus*, 4: *Neognathodus roundyi*, 5: *Streptognathodus elongatus*, 6: *Streptognathodus wabaunsensis*, 7: *Neogondolella discedus* sp. nov. late form.

| SYSTEM | CARBONIFEROUS | | | | | | | | | | PERMIAN | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | | | Middle | | | | | | Upper | Lower | | | | | | | | | |
| Stage | Serpuk | | | Ba | Moscov. | | | | | Gzh | Asselian | | | | | | | | | |
| Formation | Milinskaya | | | Lower Kazarkinskaya | | | | | | | Upper Kazarkinskaya | | | | | | | | | |
| Member | | | | | | | | | | | Chert Mb | | | | Shale with Mn ore | | | Shale Mb | | |
| Conod. assembl. | 1 | | | 2 | 3 | | 4 | | 5 | | 6 | | | | 7 | | | | | |
| Sample no. | 123 1 | 752 3 | 131 | 101 15 | 124 5 | 124 8 | 124 11 | 124 14 | 124 21 | 124 27 | 753 2 | 753 7 | 753 8 | 753 13 | 752 44 | 752 78 | 131 45 | 101 51 | 101 55 | Tot |
| Adetognathus lautus | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 2 |
| Declinognathodus lateralis | - | - | - | 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 |
| D. noduliferus noduliferus | - | - | - | 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 |
| D. noduliferus japonicus | - | - | - | 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 22 |
| Gnathodus bilineatus bilineatus | 1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| Gondolella magna | - | - | - | - | - | 1 | - | 1 cf | - | - | - | - | - | - | - | - | - | - | - | 2 |
| "Gondolella" cf. "G." denuda | - | - | - | - | - | - | - | - | - | - | - | 1 cf | - | - | - | - | - | - | - | 1 |
| "G." laevis | - | - | - | - | - | - | 1 cf | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| G. sp. A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | 3 |
| Gondolelloides canadiensis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 cf | 3 | 10 | 3 | - | 18 |
| G. nahanniensis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5 cf | - | - | - | 5 |
| Hindeodus minutus | - | - | - | - | - | - | - | 1 cf | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Idiognathodus delicatus | - | - | - | 1 | - | 6 | 7 | 17 | 1 | - | - | 5 | - | - | - | - | - | - | - | 37 |
| I. sp. B | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| I. lobulatus | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| I. obliquus | - | - | - | - | 2 | 2 | 29 | 15 | - | - | - | - | - | - | - | - | - | - | - | 48 |
| I. podolskensis | - | - | - | - | - | 2 | - | 5 cf | - | - | - | - | - | - | - | - | - | - | - | 7 |
| I. tersus | - | - | - | - | - | - | - | - | - | - | - | 20 | - | - | - | - | - | - | - | 20 |
| I. toretzianus | - | - | - | - | - | - | - | - | - | - | - | 6 | - | - | - | - | - | - | - | 6 |
| I. sp (fragments) | - | - | - | 2 | - | 15 | 11 | - | 1 | - | - | - | - | - | - | - | - | - | - | 29 |
| Idiognathoides corrugatus | - | - | - | 4 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 |
| I. lanei | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| I. sinuatus | - | - | - | 13 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 14 |
| I. sulcatus | - | - | - | - | 1 | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| I. tuberculatus | - | - | - | - | 1 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Neognathodus cf. N. dilatus | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| N. kashirensis | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 1 |
| N. medadultimus | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| N. roundyi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Neogondolella belladontae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | 2 | - | - | 6 |
| N. dentiseparata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5+3cf | - | - | 8 |
| N. discedus sp. nov. late form | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | 3 | - | - | 7 |
| N. donbassica | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| N. cf. N. foliosa | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - | 1 |
| N. simulata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3cf | 4cf | 21 | 3 | - | 31 |
| N. striata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1cf | - | - | 1 |
| N. cf. N. pseudostriata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 7 | 2 | 3 | - | 13 |
| N. sp. (fragments) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 | 62 | 46 | 1 | 2 | 117 |
| ? New Genus A sp | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 |
| Streptognathodus acuminatus | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1cf | - | - | 2 |
| S. alekseevi | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| S. barskovi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 1 | - | - | 3 |
| S. concinnus | - | - | - | - | 4 | 13 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | 21 |
| S. constrictus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5cf | 4 | 1 | 1 | 11 |
| S. dissectus | - | - | - | - | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| S. elegantulus | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | 3 |
| S. elongatus | - | - | - | - | - | - | - | - | 1cf | 1 | - | - | 1 | - | - | 1 | 1 | 1 | - | 6 |
| S. excelsus | - | - | - | - | - | - | - | 3cf | 2cf | - | - | - | - | - | - | - | - | - | - | 5 |
| S. expansus | - | - | - | - | 1 | - | 1cf | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| S. flangulatoformis | - | - | - | - | - | - | - | - | - | - | 2 | 82 | 1 | 1 | - | - | - | - | - | 86 |
| S. flangulatus | - | - | - | - | - | - | - | - | - | - | - | 17 | - | - | - | - | - | - | - | 17 |
| S. fusus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | 2 |
| S. gracilis | - | - | - | - | - | - | - | 2 | - | - | - | 5 | - | - | - | - | - | - | - | 7 |
| S. invaginatus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 |
| S. longissimus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1cf | - | - | 1 |
| S. nodulinearis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 |
| S. oppletus | - | - | - | - | - | - | - | - | - | 1cf | - | - | - | - | - | - | - | - | - | 1 |
| S. simplex | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 2 | 3 | - | - | 7 |
| S. wabaunsensis | - | - | - | - | - | - | - | - | - | - | - | 13cf | 2 | - | - | 1 | - | - | - | 16 |
| Total | 1 | 2 | 1 | 59 | 17 | 43 | 60 | 54 | 5 | 4 | 2 | 155 | 4 | 5 | 13 | 103 | 109 | 15 | 2 | |
| C.A.I. | 6.0 | | | | | | | | | | | | | | | | | | | |

*Table 4.* Productive conodont samples of the Kazarkinskaya Formation, Bezymyannaya Fiord (section 8421).

| SYSTEM | CARBONIFEROUS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | | Middle | | | | | | Upper | |
| Stage | Serpukhovian | | Bashkir | Moscovian | | | | | Kasimov | |
| Formation | Kazarkinskaya | | | | | | | | | |
| Conodont assemblage | Gnathodus bilineatus bilineatus | | Declino.-Idiognath | I. tuberculatus-N. donbassica | | | ? | | S. excelsus | Total |
| Sample no. | 8421-5 | 8421-5-1 | 8421-5-2 | 8421-5-3 | 8421-5-5 | 8421-5-6 | 8421-5-7 | 8421-5-8 | 8421-5-9 | |
| Declinognathodus lateralis | - | - | - | - | 3 | 2 | - | - | - | 5 |
| Gnathodus bilineatus bilineatus | 1 cf | 3 | - | - | - | - | - | - | - | 4 |
| Idiognathodus delicatus | | - | | - | - | 3 | 9 | 1 | - | 13 |
| Idiognathoides sulcatus | - | - | 3 | 21 | - | 23 | - | - | - | 47 |
| Lochriea homopunctata | 1 | - | - | - | - | - | - | - | - | 1 |
| Neogondolella donbassica | - | - | - | 1 | 2 | - | - | - | 1 | 5 |
| Streptognathodus excelsus | - | - | - | - | - | - | - | - | 2 cf | 2 |
| S. expansus | - | - | - | - | 5 | 4 | 1 | - | - | 10 |
| S. parvus | - | - | - | 1 | 2 | 1 | - | - | - | 4 |
| Total | 2 | 3 | 3 | 23 | 12 | 33 | 10 | 1 | 3 | |
| C.A.I. | 6.0 | | | | | | | | | |

*Table 5.* Productive conodont samples of the Kazarkinskaya Formation, Bezymyannaya Fiord (section 612).

| SYSTEM | CARBONIFEROUS | | |
|---|---|---|---|
| Series | Middle | | |
| Stage | Bashkirian | Moscovian | |
| Formation | Kazarkinskaya | | |
| Conodont assemblage | Declinognathodus-Idiognathoides | Gondolella-Neognathodus-Streptognatodus | Total |
| Sample no. | 612-4 | 612-5 | 612-5-1 |
| Declinognathodus lateralis | 2 | - | - | 2 |
| D. noduliferus | 20 | - | - | 20 |
| Neogondolella donbassica | - | 1 cf | - | 1 |
| Hindeodus minutus | 1 cf | - | - | 1 |
| Idiognathoides curvigatus | 1 cf | - | - | 1 |
| I. sinuatus | 6 | 2 | 1 | 9 |
| I. sulcatus | - | 2 | - | 2 |
| Total | 30 | 5 | 1 | |
| C.A.I. | 6 | | | |

*Table 6.* Productive conodont samples of the Kazarkinskaya Formation, Admiralty Peninsula.

| SYSTEM | CARBONIFEROUS | | | | | | | PERMIAN | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | Middle | | | Upper | | | | Lower | | | | |
| Stage | Bashk. | Mosc. | | Kasimovian | | | | Asselian | | | | |
| Formation | Kazarkinskaya | | | | | | | | | | | |
| | Lower | | | | | | | Upper | | | | |
| Conodont assemblage | Declinogn. noduliferus | | Gond.-Neognath.-Streptogn. | Streptogn. excelsius | | | | Streptogn. wabauns-ensis | | Streptogn. barskovi-S. constrictus | | Total |
| Sample no. | 653 | 653A | 649-5 | 649-7 | 9031-6 | 9031-8 | 649-11 | 9031-12 | 9031-14 | 649-13 | 649-13-1 | |
| Declinognathodus noduliferus | - | 3 | - | - | - | - | - | - | - | - | - | 3 |
| Gnathodus bilineatus bilineatus | 1 | 6 | - | - | - | - | - | - | - | - | - | 6 |
| Idiognathodus delicatus | - | - | - | 6 | - | 2 | 5 | - | - | - | - | 13 |
| I. sp. (fragments) | - | - | - | 3 | - | 1 | - | - | - | 1 | - | 5 |
| Lochriea commutata | 1 | - | - | - | - | - | - | - | - | - | - | 1 |
| Neognathodus sp. (fragments) | - | - | 2 | - | - | - | - | - | - | - | - | 2 |
| Neogondolella cf. N. belladontae | - | - | - | - | - | - | - | - | - | 3 | 3 | 6 |
| N. donbassica | - | - | - | - | 1 | - | 1 cf | - | - | - | 1? | 3 |
| N. simulata | - | - | - | - | - | - | - | - | - | 1 | 1 | 2 |
| N. sp. (fragments) | - | - | - | - | - | - | - | 1 | 5 | - | - | 6 |
| Streptognathodus elegantulus | - | - | - | - | - | - | 1 cf | 1 | - | 1 cf | - | 3 |
| S. elongatus | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| S. excelsus | - | - | - | 2+2 cf | - | - | 4 | - | - | - | - | 8 |
| S. simplex | - | - | - | - | - | - | - | - | - | - | 1 cf | 1 |
| S. wabaunsensis | - | - | - | - | - | - | - | 1 cf | 2 cf | 1? | 5 cf | 9 |
| S. sp. (fragments) | - | - | 1 | 4 | 4 | - | - | - | 3 | - | - | 9 |
| Total | 2 | 9 | 3 | 17 | 2 | 3 | 11 | 3 | 10 | 8 | 11 | |
| C.A.I. | 6.0 | | | | | | | | | | | |

*Table 7.* Productive conodont samples of the Kazarkinskaya Formation, Sokolova Peninsula.

| SYSTEM | CARBONIFEROUS | | | | | | |
|---|---|---|---|---|---|---|---|
| Series | Lower | | | | | Middle | Total |
| Stage | Serpukhovian | | | | | Bashkirian | |
| Formation | Milinskaya | | Kazarkinskaya | | | | |
| Conodont assemblage | Gnathodus bil. bilineatus | | Gnathodus bilineatus bollandensis | | | Declinognathodus-Idiognathoides | |
| Sample no. | 530 | 549B | 549E | 550-1 | 550-2 | 549 | |
| Declinognathodus noduliferus noduliferus | - | - | - | - | | 17 | 17 |
| D. noduliferus japonicus | - | | | - | - | 4 | 4 |
| Gnathodus bilineatus bilineatus | 3 | - | - | 13 | 1 | - | 17 |
| G. bilineatus bollandensis | - | - | - | 6 | - | - | 6 |
| Idiognathoides pacificus | - | - | - | - | - | 1 | 1 |
| I. sinuatus | - | - | - | - | - | 1 | 1 |
| Lochriea commutata | - | 1 | 1 | 4 | 3 | - | 9 |
| Total | 3 | 1 | 1 | 24 | 4 | 23 | |
| C.A.I | 4.0 - 4.5 | | | | | | |

*Table 8.* Productive conodont samples of the Kazarkinskaya Formation, Vadega River.

| SYSTEM | CARBONIFEROUS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | | | | | | Middle | | |
| Stage | Serpukhovian | | | | | | Bashkirian | | |
| Formation | Milinskaya | | | Kazarkinskaya | | | | | |
| Conodont assemblage | Gnathodus bilineatus bilineatus | | | Gnathodus bilineatus bollandensis | | | Declinognathodus-Idiognathoides | | Total |
| Sample no | 11-12 | 11-13 | 8223-1 | 8224-2 | 8224-3 | 8224-4 | 11-25 | 208-17 | |
| Declinognathodus noduliferus noduliferus | - | - | - | - | - | - | - | 3 | 3 |
| D. noduliferus japonicus | - | - | - | - | - | - | 15 | 18 | 33 |
| Gnathodus bilineatus bilineatus | 1 | 1 | 2 | 2 | | 1 | - | - | 7 |
| G. bilineatus bollandensis | - | - | - | 4 | 1 | - | - | - | 5 |
| Idiognathodus sp. | | - | - | - | - | - | - | 4 | 4 |
| Idiognathoides pacificus | - | - | - | - | - | | 2 | 7 | 9 |
| Lochriea commutata | 2 | - | - | 1 | 1 | 1 | - | - | 5 |
| Streptognathodus expansus | - | - | - | - | - | - | 1 cf | - | 1 |
| Total | 3 | 1 | 2 | 7 | 2 | 2 | 18 | 32 | |
| C.A.I | 5.0 | | | | | | | | |

*Table 9.* Productive conodont samples of the Kazarkinskaya Formation, Severnaya Taynaya River.

| SYSTEM | CARBONIFEROUS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | | | | Middle | | | | | |
| Stage | Serpukhovian | | | | Bashkirian | | | | | |
| Formation | Milinskaya | | | | Kazarkinskaya | | | | | Total |
| Conodont assemblage | Gnathodus bilineatus bilineatus | | | | Declinognathodus noduliferus | | | Declinognathodus-Idiognathoides | | |
| Sample no | 5865-12 | 5865-13 | 5865-14 | 503-1 | 513-18 | 513-16 | 503-9 | 513-1 | 512-2 | |
| Declinognathodus noduliferus noduliferus | - | - | - | - | 1 | 1 | 1 | - | - | 3 |
| Gnathodus bilineatus bilineatus | 1 | 1 | 1 | 3 | 3 | 1 | 8 | - | - | 18 |
| G. bilineatus bollandensis | - | - | - | - | - | - | 2 | - | - | 2 |
| Idiognathoides sp. | - | - | - | - | - | - | - | 2 | 1 | 3 |
| Lochriea commutata | - | - | - | - | - | - | 3 | - | - | 3 |
| Total | 1 | 1 | 1 | 3 | 4 | 2 | 14 | 2 | 1 | |
| C.A.I. | 5.0 | | | | | | | | | |

*Table 10.* Productive conodont samples of the Kazarkinskaya Formation, Rogacheva River.

| SYSTEM | CARBONIFEROUS | | | | | | |
|---|---|---|---|---|---|---|---|
| Series | Lower | | | Middle | | | |
| Stage | Serpukhovian | | | Bashkirian | | | |
| Formation | Kazarkinskaya | | | | | | Total |
| Conodont assemblage | Gnathodus bilineatus bollandensis | | | Declinognathodus-Idiognathoides | | S. expansus S. suberectus | |
| Sample no. | 6616-1 | 6616-3 | 6616-4 | 6616-6 | 6616 | 1061-27 | |
| Declinognathodus lateralis | - | - | - | 3 | - | - | 3 |
| Declinognathodus noduliferus japonicus | - | - | - | 5 | 3 | 3 | 8 |
| Declinognathodus noduliferus nodulliferus | - | - | - | 3 | 3 | 3 | 9 |
| Gnathodus bilineatus bilineatus | 4 | 1 | - | - | - | - | 5 |
| Gnathodus bilineatus bollandensis | 3 | - | - | - | - | - | 3 |
| Idiognathodus delicatus | - | - | - | - | - | 4 | 4 |
| Idiognathodus sp. A | - | - | - | - | - | 2 | 2 |
| Idiognathoides corrugatus | - | - | - | - | - | 8 | 8 |
| I. cf. sp. A | - | - | - | 7 | 4 | - | 11 |
| I. lanei | - | - | - | - | - | - | 5 |
| I. pacificus | - | - | - | 2 cf | - | - | 2 |
| I. sinuatus | - | - | - | 59 | 14 | 5 | 73 |
| Lochriea commutata | 1 | - | 1 | - | - | - | 2 |
| Streptognathodus expansus | - | - | - | - | - | 12 | 12 |
| S. parvus | - | - | - | - | - | 5 | 5 |
| S. suberectus | - | - | - | - | - | 28 | 28 |
| Total | 8 | 1 | 1 | 79 | 21 | 70 | |
| C.A.I. | 5.0 | | | | | | |

*Table 11.* Productive conodont samples of the Lavrovskaya Formation, Cape Borisoff.

| SYSTEM | CARBONIFEROUS | | | | | | | PERMIAN | |
|---|---|---|---|---|---|---|---|---|---|
| Series | Middle | | | | | | Upper | Lower? | |
| Stage | Moscovian | | | | | | Gzhelian | Asselian? | |
| Formation | Lavrovskaya | | | | | | | | Total |
| Conodont assemblage | Gondolella-Neognathodus-Streptognathodus | | | | Neog. medexult. | ? | Streptogn. elongatus | Streptogn. wabaunsensis | |
| Sample no. | 490 | 486-2-1 | 486-2-2 | 486-2-3 | 486-2-4 | 486-2-5 | 376 | 486 | |
| Idiognathodus delicatus | - | - | - | - | - | 1 | - | - | 1 |
| I. robustus | - | 3 | - | - | - | - | - | - | 3 |
| I. tersus | - | - | - | - | - | - | - | 1 | 1 |
| I. sp. (fragments) | - | - | - | 2 | - | - | - | 1 | 3 |
| Idiognathoides sulcatus | 4 | - | - | - | - | - | - | - | 4 |
| Neognathodus bassleri | - | - | - | 2 | - | - | - | - | 2 |
| N. medadultimus | - | - | - | 1 cf | 3 | - | - | - | 4 |
| N. sp. (fragments) | 2 | - | 2 | - | - | - | - | - | 4 |
| Streptognathodus elegantulus | - | - | - | - | - | - | 1 | 2 | 3 |
| S. elongatus | - | - | - | - | - | - | 7 | 2 | 9 |
| S. flangulatus | - | - | - | - | - | - | - | 3 | 3 |
| S. flangulatoformis sp. nov. | - | - | - | - | - | - | - | 6 | 6 |
| S. gracilis | - | - | - | - | - | - | 6 | 3 + 3 cf | 12 |
| S. parvus | - | 1 | - | - | - | - | - | - | 1 |
| S. simplex | - | - | - | - | - | - | 3 | - | 3 |
| S. wabaunsensis | - | - | - | - | - | - | - | 4 + 5 cf | 9 |
| S. sp. (fragments) | - | 1 | - | - | - | - | 10 | 10 | 21 |
| Total | 6 | 5 | 2 | 5 | 3 | 1 | 27 | 39 | |
| C.A.I. | 5.0 - 6.0 | | | | | | | | |

*Table 12*. Productive conodont samples of the Stepovskaya and Tolbeyachskaya formations, Krasnaya River. Conodont assemblages: 1: *Gnathodus bilineatus bilineatus*, 2: *Gnathodus bilineatus bollandensis*, 3: *Declinognathodus-Idiognathoides*, 4: *Streptognathodus expansus–S. suberectus*, 5: *Neognathodus roundyi*, 6: *Streptognathodus excelsus*, 7: *Streptognathodus alekseevi*, 8: *Streptognathodus elongatus*, 9: *Streptognathodus cristellaris*, 10: *Neogondolella discedus* sp. nov., 11: *Neogondolella discedus* sp. nov. late form, 12: *Sweetognathus-Neogondolella*, 13: *Neostreptognathodus pequopensis*.

| SYSTEM | CARBONIFEROUS | | | | | | | | | | | | | | | | | | | PERMIAN | | | | | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | | | Middle | | | | | | | | | Upper | | | | | | | Lower | | | | | | | | | | | | | | | | | |
| Stage | Serpuk. | | | Bashkirian | | | | | | ? | | Mos. | Kas. | Gzhelian | | | | | | Asselian | | | | | ? | Sakmarian - Artinskian | | | | | | | | | | | | |
| Formation | Yesipov. | | | Stepovskaya | | | | | | | | | | | | | | | | Tolbeyachskaya | | | | | | | | | | | | | | | | | | |
| Member | | | | Chert Member | | | | Shale Member | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conodont assm. (see caption) | 1 | 2 | | 3 | | | | 4 | | | ? | 5 | 6 | 7 | | 8 | | | | 9 | 10 | | | | 11 | ? | 12 | | | 13 | | | | | | | |
| Sample no. | 600 | 601 3-1 | 601 3-2 | 601 10 | 601 10-1 | 601 10-2 | 601 10-3 | 601 11 | 601 11-3 | 500 3 | 500 3-1 | 500 7 | 601 13 | 601 15 | 601 15-1 | 601 15-2 | 601 15-3 | 601 45 | 601 46 | 601 47 | 601 18-1 | 601 27 | 601 28 | 601 41 | 601 33 | 601 34 | 601 36 | 601 40 | 5582 6 | 4409 2 | | | | | | | |
| Declinognathodus lateralis | - | - | - | 3 | 1 cf | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 |
| D. noduliferus | - | - | - | 6 | 4 | 1 | 8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 19 |
| D. noduliferus inaequalis | - | - | - | 3 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| D. noduliferus japonicus | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| G. bilineatus bilineatus | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| G. bilineatus bollandensis | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| "Gondolella" sp. A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 5 cf | - | 5 cf | - | - | - | - | - | - | - | - | - | - | - | - | - | 11 |
| "Gondolella" sp. B | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 cf | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Gondolelloides canadensis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 2 | 8 | - | 1 | - | - | - | 2 cf | - | - | - | - | - | - | - | - | - | 16 |
| G. cf. G. nahanniensis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 cf | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Hindeodus minutus | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Idiognathodus bachmuticus | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| I. tersus | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 | - | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 9 |
| I. toretzianus | - | - | - | - | - | - | - | - | - | - | - | - | - | 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 12 |
| I. trigonolobatus | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 |
| I. sp. (fragments) | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 10 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 14 |
| Idiognathoides corrugatus | - | - | - | - | 1 cf | - | - | 2 | 1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 |
| Idiognathoides lanei | - | - | - | - | - | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5 |
| I. sinuatus | - | - | - | 1 | 8 | 1 | 3 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 16 |
| I. sulcatus | - | - | - | - | - | 1 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| I. sp. A | - | - | - | 2 | 5 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 8 |
| Lochriea commutata | 1 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5 |
| Neognathodus roundyi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| Neogondolella adentata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| N. discedus sp. nov. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | 16 |
| N. discedus sp. nov. late form | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 cf | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| N. belladontae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 6 | - | - | - | - | - | - | - | - | - | - | - | - | - | 8 |
| N. cf. N. belladontae | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | 8 |
| N. bisselli | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 11 | 23 | 3cf | - | - | - | - | - | - | 37 |
| N. dentiseparata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 cf | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

*Table 12, continued.*

| SYSTEM | CARBONIFEROUS | | | | | | | | | | | | | | | | | | | PERMIAN | | | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | Middle | | | | | | | | | | | | Upper | | | | | | Lower | | | | | | | | | | | | | | | |
| Stage | Serpuk. | Bashkirian | | | | | | | | ? | Mos. | Kas. | Gzhelian | | | | | | | Asselian | | | | ? | Sakmarian - Artinskian | | | | | | | | | | |
| Formation | Yesipov. | Stepovskaya | | | | | | | | | | | | | | | | | | Tolbeyachskaya | | | | | | | | | | | | | | | |
| Member | | Chert Member | | | | | | Shale Member | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conodont assm. (see caption) | 1 | 2 | | 3 | | | | 4 | | | ? | 5 | 6 | 7 | | | 8 | | | 9 | 10 | | | | 11 | ? | 12 | | | 13 | | | | | |
| Sample no. | 600 | 601 3-1 | 601 3-2 | 601 10 | 601 10-1 | 601 10-2 | 601 10-3 | 601 11 | 601 11-3 | 500 3 | 500 3-1 | 500 7 | 601 13 | 601 15 | 601 15-1 | 601 15-2 | 601 15-3 | 601 45 | 601 46 | 601 47 | 601 18-1 | 601 27 | 601 28 | 601 41 | 601 33 | 601 34 | 601 36 | 601 40 | 5582 6 | 4409 2 | |
| N. striata | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | 3 | - | - | - | - | - | - | 7 |
| N. sp. A | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| N. sp. B. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 6 | - | - | - | - | - | - | - | - | - | 7 |
| N. sp. C. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 17 | - | 17 |
| N. sp. (fragments) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 17 | 2 | 7 | - | 52 | 11 | 2 | 3 | 2 | 13 | 8 | 8 | 125 |
| Neostreptognathodus pequopensi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | 4 |
| N. sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| Streptognathodus alekseevi | - | - | - | - | - | - | - | - | - | - | - | - | - | 11 | 4 | 8 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 24 |
| S. barskovi | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 cf | - | - | 2 | 1 | - | - | - | - | - | - | 4 |
| S. cancellosus | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| S. constrictus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| S. cristellaris | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| S. dissectus | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| S. eccentricus | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 8 |
| S. elegantulus | - | - | - | - | - | - | - | - | - | - | - | - | - | 39 | - | 6 | 7 | 1 cf | - | - | - | - | - | - | - | - | - | - | - | - | 53 |
| S. elongatus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | 2 | 1 | 1+1cf | - | 4 | - | - | - | - | - | - | - | 12 |
| S. excelsus | - | - | - | - | - | - | - | - | - | - | - | 1 cf | 2 | 44 | 17 | - | - | 4 | - | - | - | - | - | - | - | - | - | - | - | - | 68 |
| S. expansus | - | - | - | - | - | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| S. firmus | - | - | - | - | - | - | - | - | - | - | - | - | - | 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 21 |
| S. invaginatus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 cf | - | - | - | 2 | - | - | - | - | - | - | - | 3 |
| S. gracilis | - | - | - | - | - | - | - | - | - | - | - | - | 1 cf | 24 | 12 | - | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 40 |
| S. latus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| S. longissimus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | 2 |
| S. luganicus | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| S. nodulinearis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 |
| S. oppletus | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| S. parvus | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| S. simplex | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 3 | 1 | 2+2cf | - | - | 1 | - | - | - | - | - | - | 10 |
| S. simulator | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 |
| S. suberectus | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| S. wabaunsensis | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 cf | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Sweetognathus sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 |
| Total | 3 | 8 | 2 | 12 | 19 | 6 | 15 | 7 | 4 | 10 | 1 | 3 | 3 | 193 | 41 | 18 | 10 | 10 | 34 | 9 | 36 | 1 | 113 | 23 | 2 | 4 | 4 | 24 | 52 | 12 | |
| C.A.I. | 6.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

*Table 13.* Lazarevskaya Formation, Kostin-Shar Strait. Mezhdusharsky Island (section 551) and Vypukly Peninsula (section 8204).

| SYSTEM | CARBONIFEROUS | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| Series | Middle | | | | | | Upper | | |
| Stage | Bashkirian-Moscovian | | | | | | Kasimovian | | |
| Formation | Lazarevskaya | | | | | | | | |
| Conodont assemblage | Declinoganthodus-Idiognathoides | | ?S.expansus-S.suberectus | ? | | | S.oppletus-S. excelsus | | |
| Sample no. | 8204-19 | 8204-20 | 551-6 | 8204-33 | 8204-33-1 | 8204-34 | 8204-34-1 | 551-9 | |
| D. noduliferus japonicus | - | 3 | 13 | - | - | - | - | - | 16 |
| Idiognathodus delicatus | - | - | - | - | - | - | - | 2 | 2 |
| I. sp. | - | - | 1 | - | - | - | - | - | 1 |
| Idiognathoides corrugatus | - | - | 3 | - | - | - | - | - | 3 |
| I. sp. A | 5 | - | - | - | - | - | - | - | 5 |
| I. lanei | - | 1 | - | - | - | - | - | - | 1 |
| I. sinuatus | 12 | - | 14 | - | - | - | - | - | 26 |
| I sulcatus | 3 | - | - | 11 | 8 | - | - | - | 22 |
| I pacificus | - | - | 13 | - | - | - | - | - | 13 |
| Neognathodus sp | - | - | 1 | - | - | - | - | - | 1 |
| Streptognathodus cancellosus | - | - | - | - | - | 1 cf | - | - | 1 |
| S. elegantulus | - | - | - | - | - | - | - | 17 +1 cf | 18 |
| S. excelsus | - | - | - | 3 cf | 2 cf | - | - | 1 | 6 |
| S. gracilis | - | - | - | - | - | - | - | 1 | 1 |
| S. parvus | - | - | 4 cf | - | - | - | - | - | 4 |
| S. oppletus | - | - | - | - | - | - | 1 cf | 2 + 3 cf | 6 |
| S. sp. B | - | - | - | - | - | - | - | 1 | 1 |
| Total | 18 | 4 | 49 | 14 | 10 | 1 | 1 | 28 | |
| C.A.I. | 3.5 | | | | | | | | |

*Table 14.* Productive conodont samples of the Middle Carboniferous–Lower Permian wells Severo-Gulyaevskaya-1 (SG1), Prirazlomnaya-1 (PR1), and Bugrinskaya (BUG) in the Pechora Sea.

| SYSTEM | CARBONIFEROUS | | | | | | PERMIAN | Total |
|---|---|---|---|---|---|---|---|---|
| Series | Middle | | | Upper | | | Lower? | |
| Stage | Moscovian | | | Kasimov. | Gzhelian | | Asselian? | |
| Well nr. | PR1 | SG1 | SG1 | BUG | SG1 | PR1 | SG1 | |
| Well deep (metres) | 2442+0.05 | 2817+1.8 | 2827+0.05 | 2398.2-2400.8 | 2769+0.3 | 2442+1.5 | 2710+0.6 | |
| Adetognathus lautus | 6 | - | - | - | - | - | 4 | 10 |
| Declinognathodus noduliferus | - | 6 | - | - | - | - | - | 6 |
| Gondolella magna | - | - | - | - | - | 2 ex gr. | - | 2 |
| G. sp. | - | - | - | - | - | 2 | - | 2 |
| Hindeodus minutus | - | 1 cf | - | - | - | - | - | 1 |
| Idiognathodus delicatus | - | 3 | - | - | - | 10 | - | 13 |
| I. lobulatus | - | - | - | - | - | 2 cf | - | 2 |
| I. robustus | - | 1 | - | - | - | - | - | 1 |
| I. sinuosus | - | 1 | - | - | - | - | - | 1 |
| I. trinogonolobatus | - | - | - | - | - | 4 | - | 4 |
| I. sp. (fragments) | - | - | - | 2 | - | 2 | - | 4 |
| Neognathodus medadultimus | 1 | - | - | - | - | - | - | 1 |
| N. medexultimus | - | 1 | - | - | - | - | - | 1 |
| N. sp. | - | - | 1 | - | - | - | - | 1 |
| Streptognathodus cf. S. cancellosus | - | - | - | 1 | - | - | - | 1 |
| S. elegantulus | - | - | - | - | - | - | 1 | 1 |
| S. excelsus | - | - | - | - | - | 4 | - | 4 |
| S. oppletus | - | - | - | 2 | - | - | - | 2 |
| S. ruzhencevi | - | - | - | - | - | 5 | - | 5 |
| S. simulator | - | - | - | - | 1 ex gr. | - | - | 1 |
| S. sp. (fragments) | - | - | - | - | 7 | 23 | 1 | 31 |
| Total | 7 | 13 | 1 | 5 | 8 | 54 | 6 | |
| C.A.I. | 1.0-1.5 | | | | | | | |

*Table 15.* Productive conodont samples of the Stepovskaya Formation, Bezymyannaya River (sections 513 and 602).

| SYSTEM | CARBONIFEROUS | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | Lower | Middle | | | | | Upper | | | | |
| Stage | Serpuk. | Bashkirian | | | | Moscov. | Kasimov. | | Gzhelian | | |
| Formation | Stepovskaya | | | | | | | | | | |
| Member | Chert Member | | | | | Grey Shale Member | | | | | |
| Conodont assemblage | Gnathodus bilineatus bilineatus | Declinogn. noduliferus | | S. expansus- S. suberectus | | Gondol.- Neogn.- Streptog. | S.cppletus- S.excelsus | | Strept. elongatus | | |
| Sample no. | 513-13 | 513-26 | 602-10 | 602-13 | 602-15 | 602-16 | 602-22 | 602-24 | 602-25 | 602-26 | |
| Declinognathodus lateralis | - | - | 5 | - | - | - | - | - | - | - | 5 |
| D. noduliferus inaequalis | - | 2 | - | - | - | - | - | - | - | - | 2 |
| D. nod. noduliferus | - | 2 | 1 ex gr. | 3 | - | - | - | - | - | - | 6 |
| D. nod. praenoduliferus | - | 1 | - | - | - | - | - | - | - | - | 1 |
| Gnathodus bil. bilineatus | 1 | 1 | 2 ex gr. | - | - | - | - | - | - | - | 4 |
| Gnathodus bil. bollandensis | - | 2 | - | - | - | - | - | - | - | - | 2 |
| Idiognathodus bachmuticus | - | - | - | - | - | - | - | 2 | - | - | 2 |
| I. deficatus | - | - | - | - | - | - | - | - | - | 3 | 3 |
| I. lobalatus | - | - | - | - | - | - | - | - | - | 1 cf | 1 |
| I. tersus | - | - | - | - | - | - | - | - | - | 2 | 2 |
| I. toretzianus | - | - | - | - | - | - | - | 4 | - | 5 | 9 |
| I. sp (fragments) | - | - | - | - | - | - | - | 18 | - | 13 | 31 |
| Idiognathoides sinuatus | - | - | - | - | - | 3 | - | - | - | - | 3 |
| I. sulcatus | - | - | - | 5 | - | 3 | - | - | - | - | 8 |
| Lochriea commutata | 2 | - | - | | - | - | - | - | - | - | 2 |
| L. homopunctata | 2 | - | - | - | - | - | - | - | - | - | 2 |
| Neognathodus sp. (frag.) | - | - | - | - | - | 2 | - | - | - | - | 2 |
| Neogondolella sp. indet | - | - | - | - | - | 1 | - | - | 1 | 1 | 3 |
| Streptognathodus conjunctus | - | - | - | - | - | - | - | - | - | 1 | 1 |
| S. elegantulus | - | - | - | - | - | - | - | - | 1 cf | 3 | 4 |
| S. elongatus | - | - | - | - | - | - | - | | - | 9 cf | 9 |
| S. excelsus | - | - | - | - | - | - | 2 cf | | 7 | 17 | 26 |
| S. expansus | - | - | - | 1 | - | - | - | - | - | - | 1 |
| S. gracilis | - | - | | - | - | - | 1 cf | - | 5 | - | 6 |
| S. parvus | - | - | - | 1 | - | 1 cf | - | - | - | - | 2 |
| S. simplex | - | - | - | - | | - | - | - | 2 | - | 2 |
| S. suberectus | - | - | | 1 | 2 cf | - | - | - | - | - | 3 |
| S. wabaunsensis | - | - | - | - | - | - | - | - | - | 2 cf | 2 |
| Total | 5 | 8 | 8 | 11 | 2 | 10 | 3 | 24 | 16 | 57 | |
| C.A.I. | 6 0 | | | | | | | | | | |

Plates 1–15

# Plate 1

A — *Idiognathoides tuberculatus* Nemirovskaya
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-5, X120. CNIGR 12745/1

B — *Idiognathoides sulcatus* Higgins & Bouckaert
Bezymyannaya Fiord, Kazarkinskaya Fm., sample no. 612-5, X105. CNIGR 12745/2

C — *Declinognathodus noduliferus japonicus* (Igo & Koike)
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-15, X88. CNIGR 12745/3

D — *Idiognathoides lanei* Nemirovskaya
Rogacheva River, Kazarkinskaya Fm., sample no. 1061-27, X115. CNIGR 12745/4

E — *Declinognathodus noduliferus* (Ellison & Graves)
Severnaya Taynaya River, Kazarkinskaya Fm., sample no. 503-9, X70. CNIGR 12745/5

F — *Declinognathodus noduliferus inaequalis* (Higgins)
Bezymyannaya River, Stepovskaya Fm., sample no. 513-26, X120. CNIGR 12745/6
Juvenile form

G — *Idiognathoides* sp. A
Vypukly Peninsula, Lazarevskaya Fm., sample no. 8204-19, X84. CNIGR 12745/7

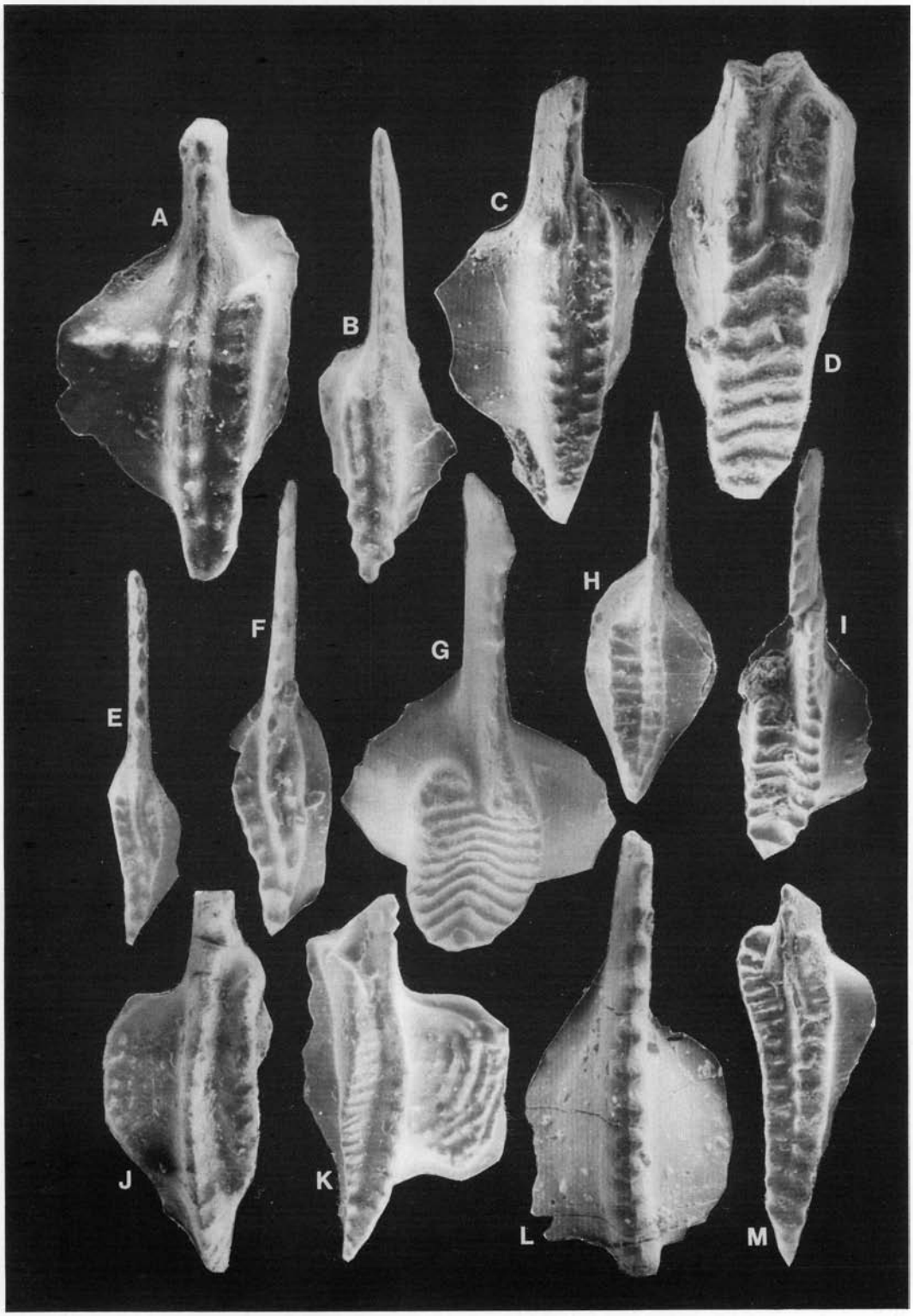
H, I — *Idiognathoides sinuatus* Harris & Hollingsworth
H — Bezymyannaya Fiord, Kazarkinskaya Fm., sample no. 612-4, X70. CNIGR 12745/8
I — Vypukly Peninsula, Lazarevskaya Fm., sample no. 8204-19, X84. CNIGR 12745/9

J — *Gnathodus bilineatus bollandensis* (Higgins & Bouckaert)
Bezymyannaya River, Stepovskaya Fm., sample no. 513-26, X70. CNIGR 12745/10

K — *Gnathodus bilineatus bilineatus* (Roundy)
Severnaya Taynaya River, Kazarkinskaya Fm., sample no. 503-9, X70. CNIGR 12745/11

L — *Lochreia commutata* (Branson & Mehl)
Sokolova Peninsula, Kazarkinskaya Fm., sample no. 550-2, X100. CNIGR 12745/12

M — *Declinognathodus lateralis* (Higgins & Bouckaert)
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-15, X60. CNIGR 12745/13


A
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M

# Plate 2

A — *Idiognathodus* sp. A
Rogacheva River, Kazarkinskaya Fm., sample no. 1061-27, X56. CNIGR 12745/14

B, C — *Idiognathoides corrugatus* (Harris & Hollingsworth)
B — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-15, X70. CNIGR 12745/15
C — Mezhdusharsky Island, Lazarevskaya Fm., sample no. 551-6, X112. CNIGR 12745/16

D — *Streptognathodus parvus* Dunn
Rogacheva River, Kazarkinskaya Fm., sample no. 1061-27, X77. CNIGR 12745/17

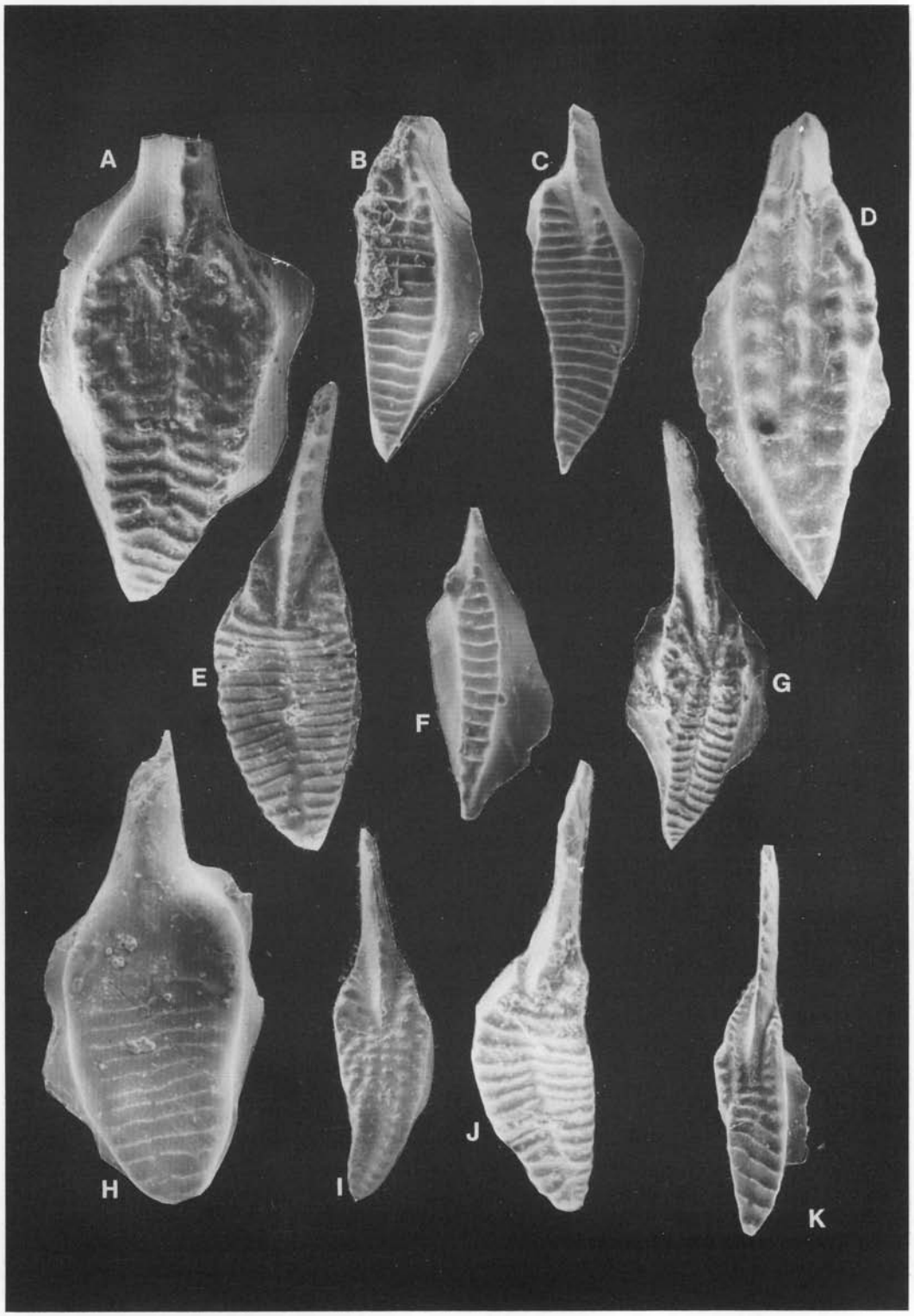
E, J — *Streptognathodus expansus* Igo & Koike
E — Rogacheva River, Kazarkinskaya Fm., sample no. 1061-27, X70. CNIGR 12745/18
J — Krasnaya River, Stepovskaya Fm., sample no. 601-11-2, X120. CNIGR 12745/19

F — *Idiognathoides pacificus* Savage & Barkeley
Mezhdusharsky Island, Lazarevskaya Fm., sample no. 551-6, X77. CNIGR 12745/21

G, I — *Streptognathodus suberectus* Dunn
G — Rogacheva River, Kazarkinskaya Fm., sample no. 1061-27, X50. CNIGR 12745/22
I — Rogacheva River, Kazarkinskaya Fm., sample no. 1061-27, X56. CNIGR 12745/23

H — *Idiognathodus* sp. B
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-15, X63. CNIGR 12745/24

K — *Idiognathodus sinuosus* Ellison & Graves
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-14, X56. CNIGR 12745/43


A
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# Plate 3

A, E *Neognathodus roundyi* (Gunnell)
A Spokoynaya River, Yeksovskaya Fm., sample no. 1701-1, X130. CNIGR 12745/25
E Spokoynaya River, Yeksovskaya Fm., sample no. 1701-1, X80. CNIGR 12745/26

B *Neognathodus kashiriensis* Goreva
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-14, X70. CNIGR 12745/28

C *Neognathodus* cf. *N. dilatus* (Stauffer & Plummer)
Spokoynaya River, Yeksovskaya Fm., sample no. 635, X165. CNIGR 12745/29

D, H *Neognathodus medadultimus* Merrill
Pechora Sea, Prirazlomnaya-1 well, sample no. PR2442-5.0, X84. CNIGR 12745/213
H Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-11, X112. CNIGR 12745/34

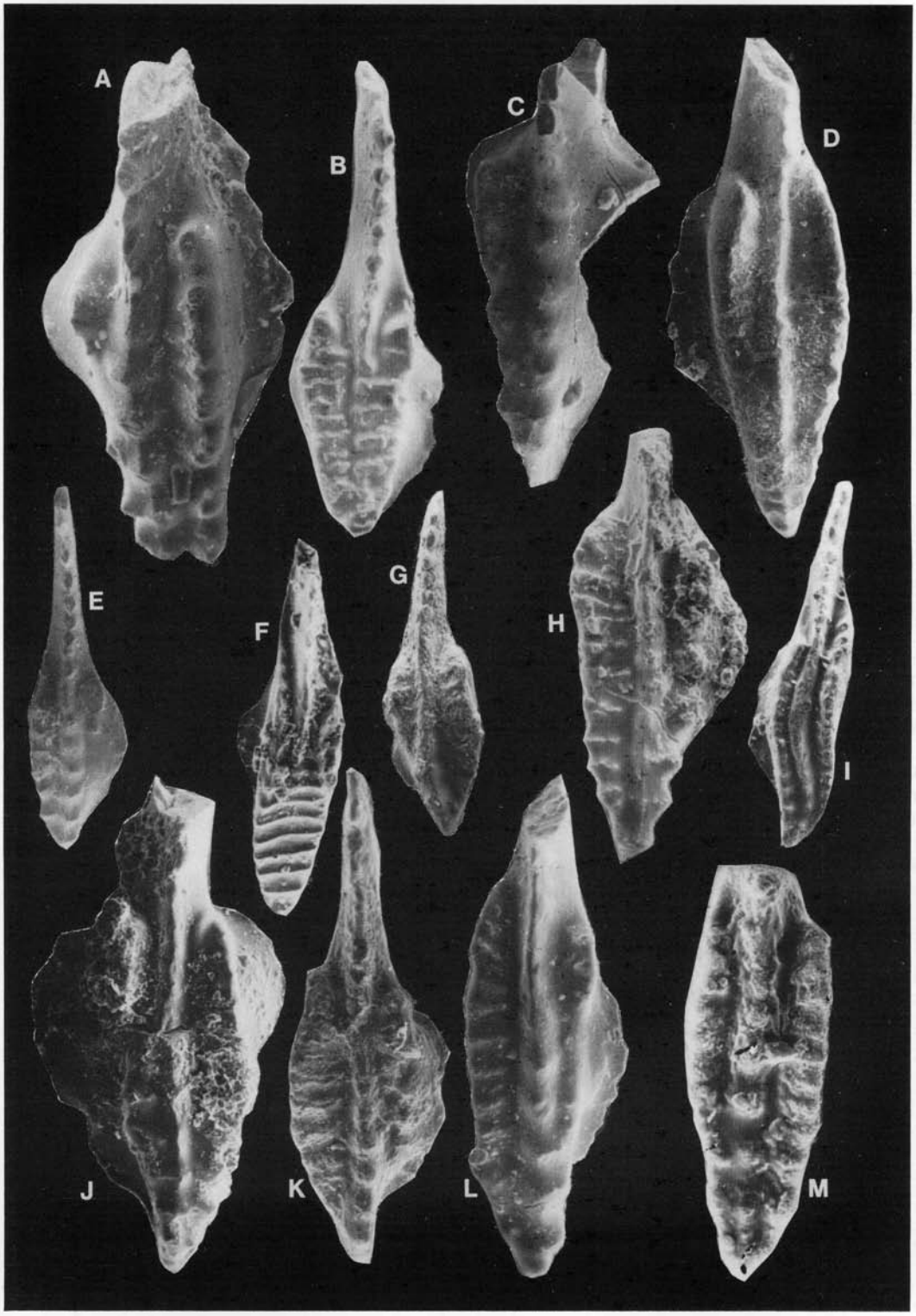
F *Idiognathodus* sp. C
Litke Peninsula, Barentsevskaya Fm., sample no. 805-5, X98. CNIGR 12745/200

G, K, L *Neognathodus medexultimus* Merrill
G Litke Peninsula, Barentsevskaya Fm., sample no. 8845, X50. CNIGR 12745/31
K Pechora Sea, Severo-Gulyaevskaya-1 well, sample no. SG2827-1.8, X70. CNIGR 12745/214
L Spokoynaya River, Yeksovskaya Fm., sample no. 1701, X150. CNIGR 12745/33

I *Streptognathodus firmus* Kozitskaya
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X70. CNIGR 12745/70

J *Neognathodus bothrops* Merrill
Litke Peninsula, Barentsevskaya Fm., sample no. 8875, X67. CNIGR 12745/36

M *Neognathodus* cf. *N. bassleri* (Harris & Hollingsworth)
Cape Borisoff, Lavrovskaya Fm., sample no. 486-2, X95. CNIGR 12745/37


A
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# Plate 4

A — *Streptognathodus excelsus* Stauffer & Plummer
Mezhdusharsky Island, Lazarevskaya Fm., sample no. 551-9, X98. CNIGR 12745/60

B — *Idiognathodus robustus* Kosenko & Kozitskaya
B — Cape Borisoff, Lavrovskaya Fm., sample no. 486-2L, X77. CNIGR 12745/39

C, H — *Idiognathodus obliquus* Kosenko & Kozitskaya
C — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-11, X56. CNIGR 12745/40
H — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-14, X56. CNIGR 12745/41

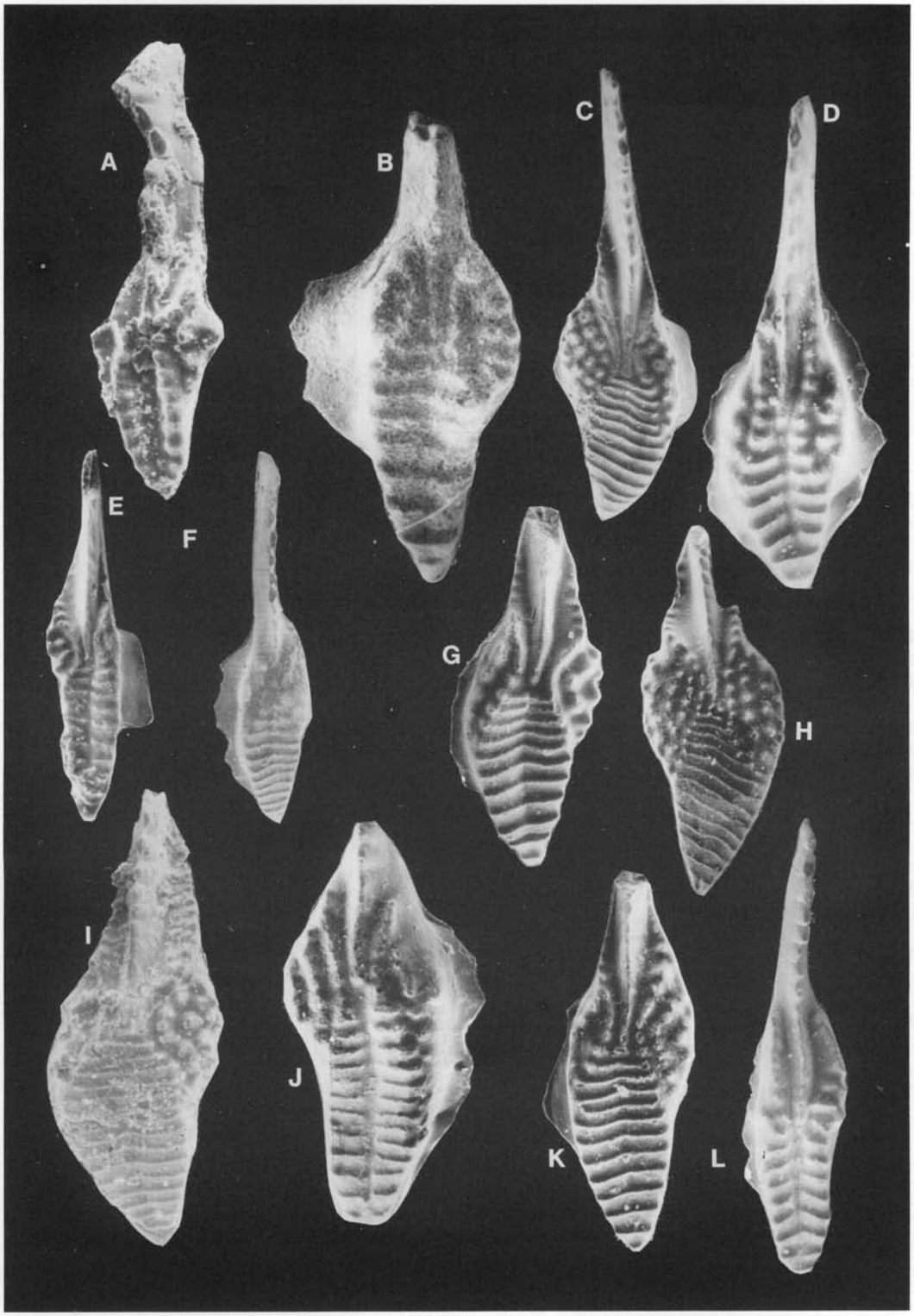
D — *Streptognathodus* cf. *S. excelsus* Stauffer & Plummer
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-14, X77. CNIGR 12745/42

E, J — *Streptognathodus concinnus* Kosenko
E — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-8, X49. CNIGR 12745/59
J — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-5, X91. CNIGR 12745/58

F, I — *Idiognathodus delicatus* Gunnell
F — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-15, X56. CNIGR 12745/44
I — Cape Borisoff, Lavrovskaya Fm., sample no. 5257-1, X77. CNIGR 12745/45

G, K — *Idiognathodus podolskensis* Goreva
G — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-14, X77. CNIGR 12745/47
K — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-14, X77. CNIGR 12745/48

L — *Streptognathodus dissectus* Kosenko
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-5, X88. CNIGR 12745/57


A
B
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# Plate 5

A — *Streptognathodus luganicus* Kozitskaya
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X70. CNIGR 12745/62

B — *Streptognathodus eccentricus* Ellison
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X49. CNIGR 12745/63

C — *Streptognathodus oppletus* Ellison
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X56. CNIGR 12745/64

D — *Streptognathodus excelsus* Stauffer & Plummer
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X42. CNIGR 12745/65

E — *Streptognathodus* cf. *S. cancellosus* (Gunnell)
Spokoynaya River, Yeksovskaya Fm.. sample no. 1701-1, X133. CNIGR 12745/54

F, G — *Streptognathodus alekseevi* Barskov, Isakova & Schastlivtseva
F Krasnaya River, Stepovskaya Fm., sample no. 601-15, X67. CNIGR 12745/68
G Krasnaya River, Stepovskaya Fm., sample no. 601-15, X70. CNIGR 12745/82

H, I — *Streptognathodus gracilis* Stauffer & Plummer
H Krasnaya River, Stepovskaya Fm., sample no. 601-15, 4, upper view, X70. CNIGR 12745/79
I Krasnaya River, Stepovskaya Fm., sample no. 601-15, X70. CNIGR 12745/80

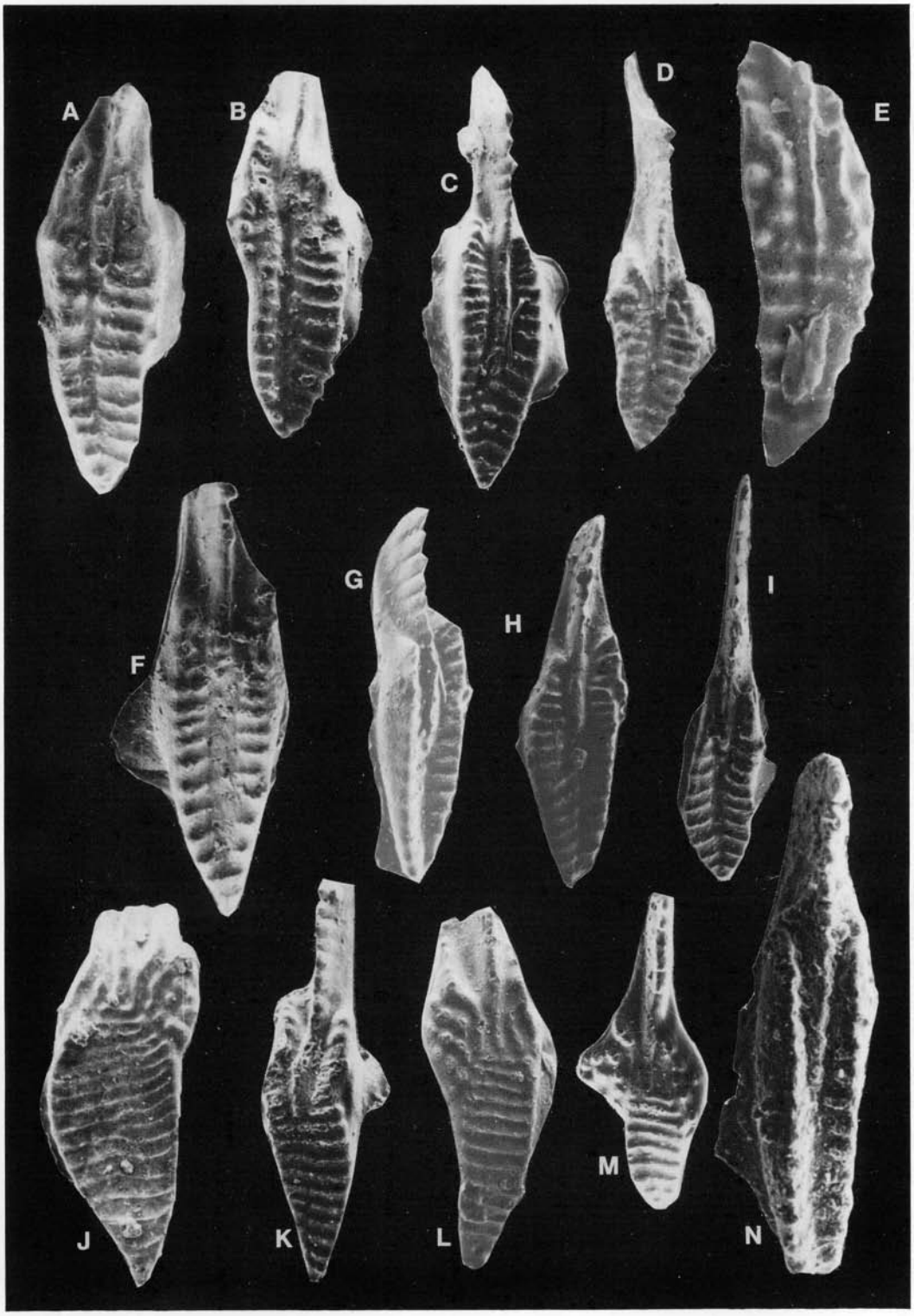
J — *Idiognathodus bachmuticus* Kozitskaya
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X70. CNIGR 12745/71

K — *Idiognathodus tersus* Ellison
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X63. CNIGR 12745/72

L — *Idiognathodus toretzianus* Kozitskaya
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X49. CNIGR 12745/73

M — *Idiognathodus trigonolobatus* Barskov & Alekseev
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X42. CNIGR 12745/74

N — *Streptognathodus simplex* Gunnell
Cape Borisoff, Lavrovskaya Fm., sample no. 376, X77. CNIGR 12745/75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# Plate 6

A, B *Streptognathodus elegantulus* Stauffer & Plummer
A Mezhdusharsky Island, Lazarevskaya Fm., sample no. 551-9, X56. CNIGR 12745/55
B Litke Peninsula, Barentsevskaya Fm., sample no. SG2710-06, X77. CNIGR 12745/205

C *Streptognathodus* cf. *S. barskovi* (Kozur)
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-47, X63. CNIGR 12745/86

D *Streptognathodus elongatus* Gunnell
Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X77. CNIGR 12745/87

E *Streptognathodus* cf. *S. acuminatus* Gunnell
Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X63. CNIGR 12745/88

F *Streptognathodus nodulinearis* Chernikh & Reshetkova
Spokoynaya River, Yeksovskaya Fm., sample no. 1684, X125. CNIGR 12745/89

G *Streptognathodus barskovi* (Kozur)
Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X112. CNIGR 12745/90

H *Streptognathodus* cf. *S. longissimus* Chernikh & Reshetkova
Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X63. CNIGR 12745/91

I *Streptognathodus simplex* Gunnell
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18-1, X120. CNIGR 12745/92

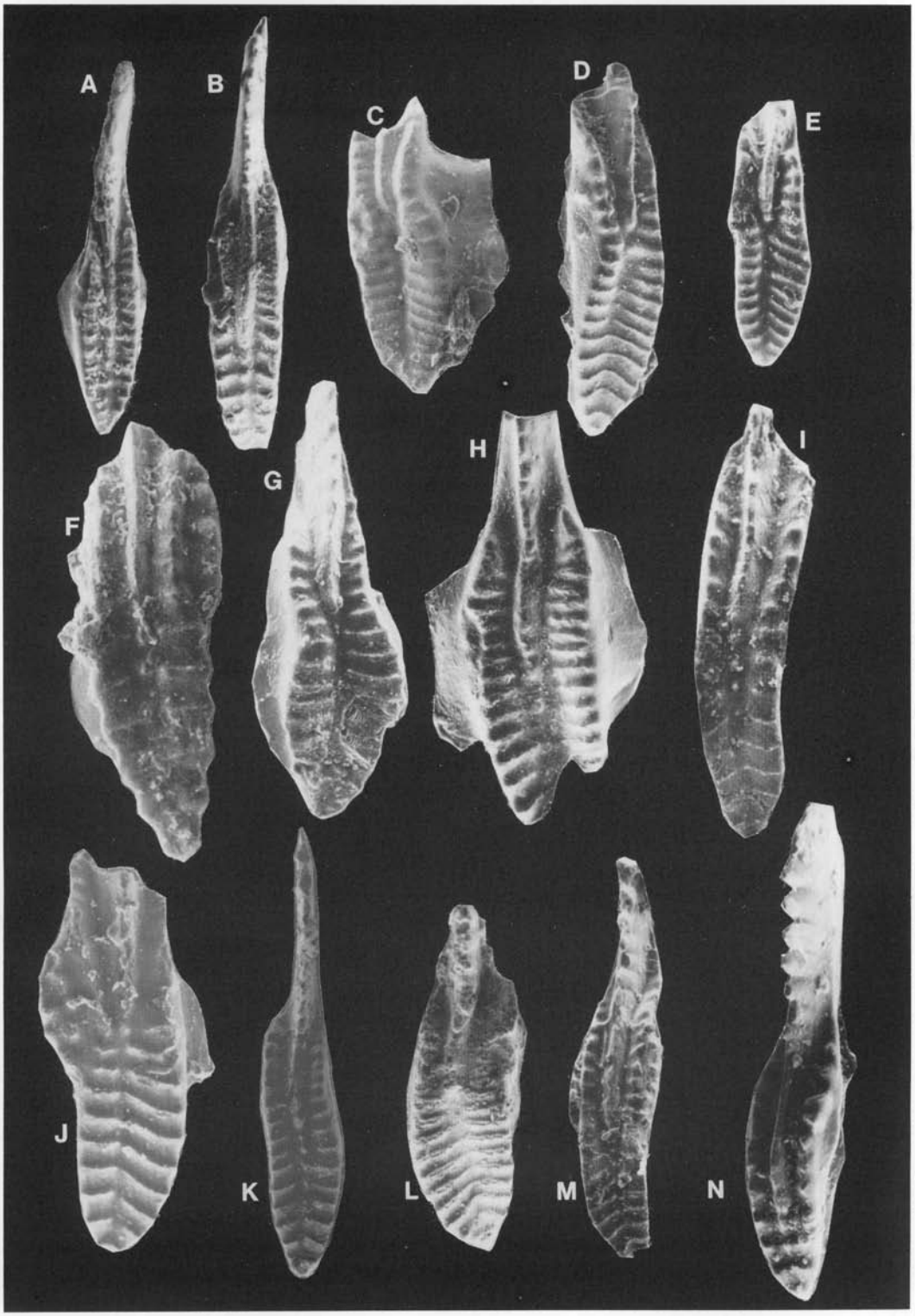
J *Streptognathodus wabaunsensis* Gunnell
Nekhvatova River, Kazarkinskaya Fm., sample no. 752-78, X120. CNIGR 12745/94

K *Streptognathodus elongatus* Gunnell
Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/112

L *Streptognathodus invaginatus* Chernikh & Reshetkova
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X63. CNIGR 12745/96

M *Streptognathodus* cf. *S. simplex* Gunnell
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18-1, X91. CNIGR 12745/97

N *Streptognathodus ruzhencevi* (Kozur)
Pechora Sea, Prirazlomnaya-1 well, sample no. PR2442-1.5, X70. CNIGR 12745/211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# Plate 7

A, B *Streptognathodus flangulatoformis* sp. nov
A Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X77. Holotype, CNIGR 12745/98
B Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/99

C *Streptognathodus simulator* Ellison
Krasnaya River, Stepovskaya Fm., sample no. 601-15-1, X70. CNIGR 12745/76

D, H New Genus A sp. C
D Litke Peninsula, Barentsevskaya Fm., sample no. 798-3, X84. CNIGR 12745/195
H Litke Peninsula, Barentsevskaya Fm., sample no. 805-14, X105. CNIGR 12745/196

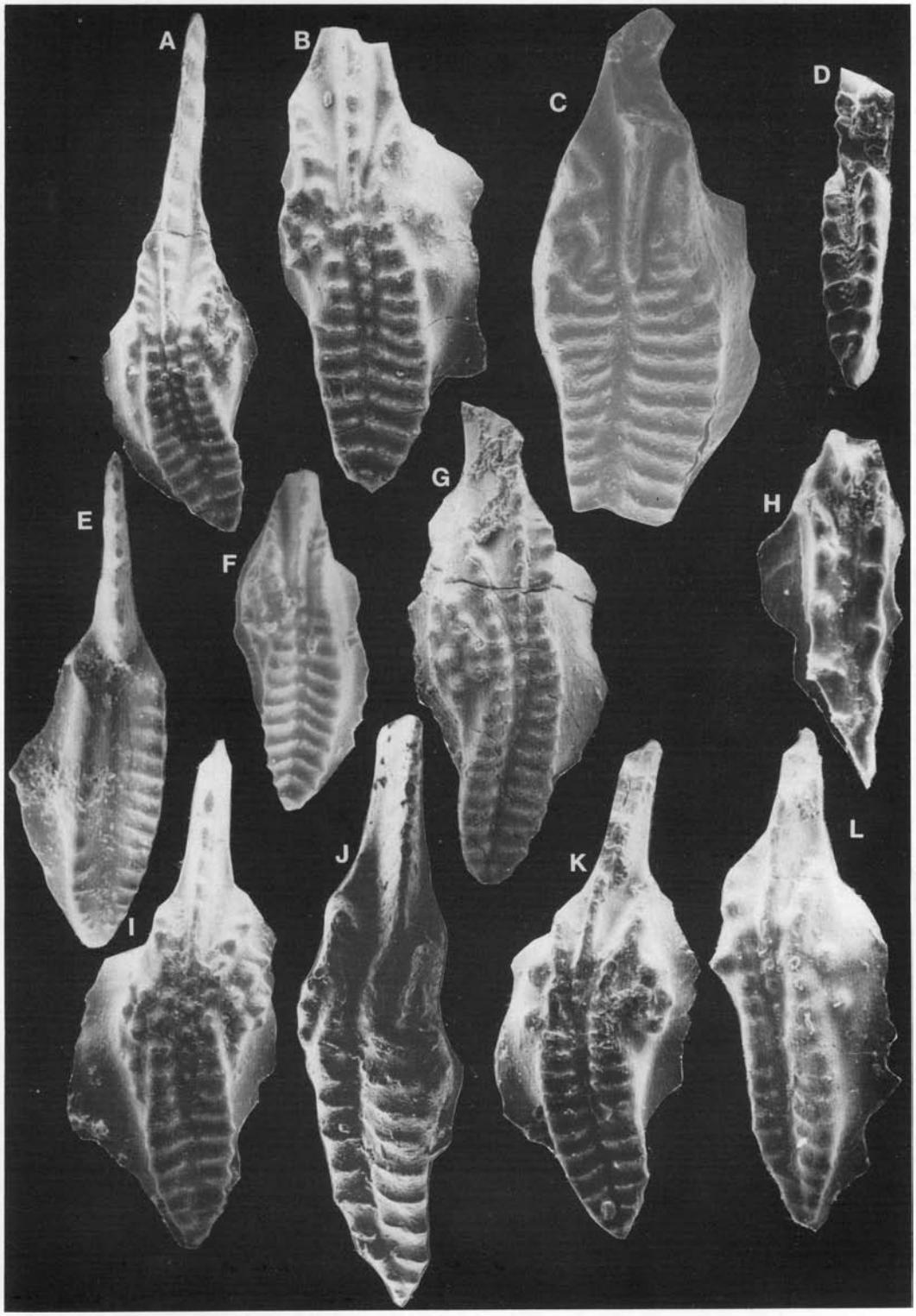
E New Genus A sp. A Henderson
Litke Peninsula, Barentsevskaya Fm., sample no. 805-5, X112. CNIGR 12745/193

F, G *Streptognathodus* cf. *S. wabaunsensis* Gunnell
F Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X70. CNIGR 12745/108
G Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/109

I, K *Streptognathodus flangulatus* Gunnell
I Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/104
K Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/106

J *Streptognathodus simplex* Gunnell
Krasnaya River, Stepovskaya Fm., sample no. 601-15-2, X70. CNIGR 12745/83

L *Streptognathodus* cf. *S. flangulatus* Gunnell
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/107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# Plate 8

A, B *Streptognathodus constrictus* Reshetkova & Chernikh
A Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/110
B Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/111

C, L *Streptognathodus eccentricus* Ellison
C Krasnaya River, Stepovskaya Fm., sample no. 601-15, upper view, X42. CNIGR 12745/78
L Krasnaya River, Stepovskaya Fm., sample no. 601-15, oblique lateral view, X70. CNIGR 12745/78

D, G *Streptognathodus cristellaris* Chernikh & Reshetkova
D Krasnaya River, Tolbeyachskaya Fm., sample no. 601-46, D–X80, G–X77. CNIGR 12745/113
G Krasnaya River, Tolbeyachskaya Fm., sample no. 601-46, D–X80, G–X77. CNIGR 12745/114

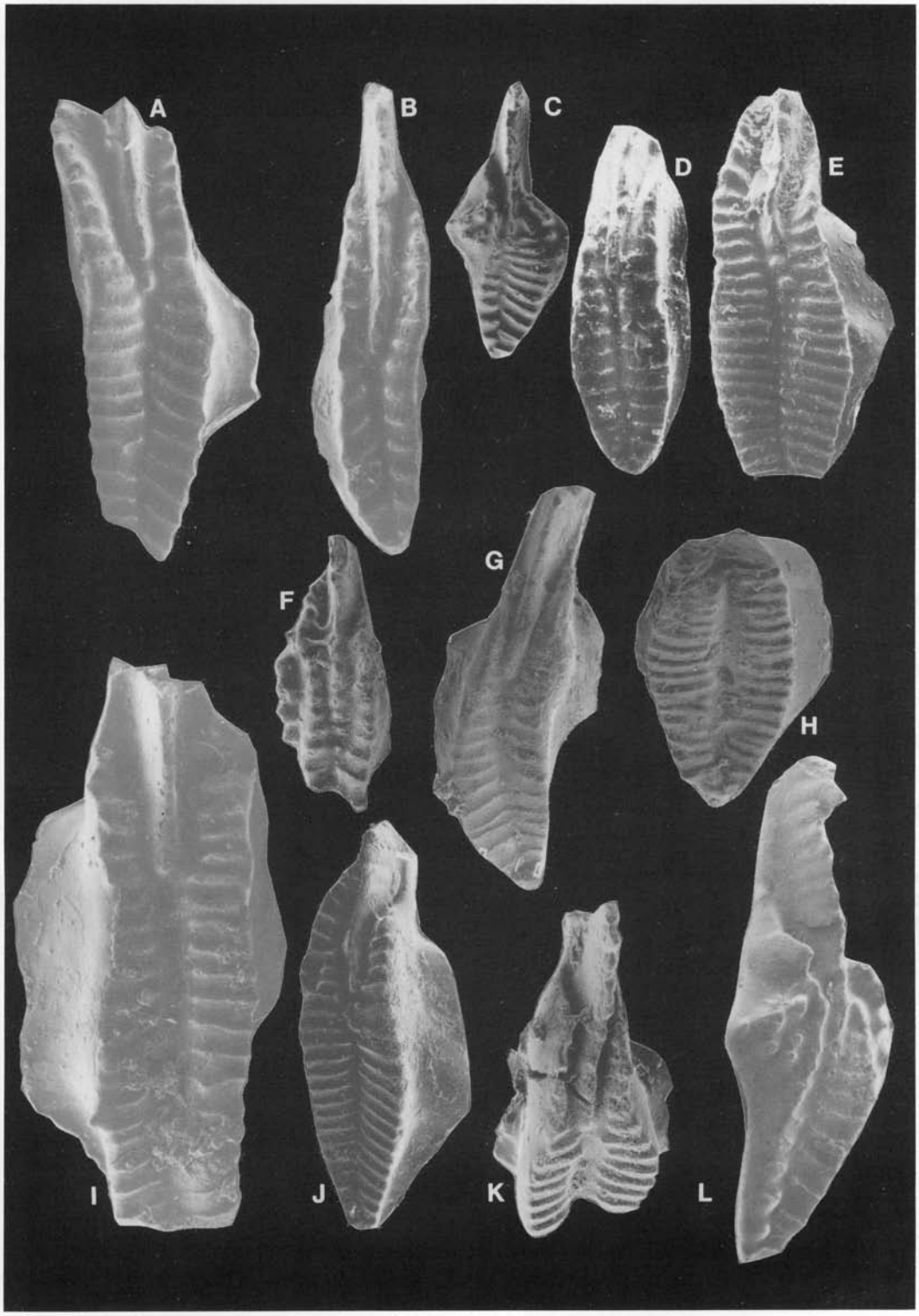
E, J *Streptognathodus fusus* Chernikh & Reshetkova
E Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/115
J Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/116

F *Streptognathodus nodulinearis* Chernikh & Reshetkova
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X77. CNIGR 12745/117

H *Streptognathodus* cf. *S. latus* Chernikh & Reshetkova
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-46, X70. CNIGR 12745/118

I *Streptognathodus* cf. *S. longissimus* Chernikh & Reshetkova
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/119

K *Streptognathodus barskovi* (Kozur)
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/120, 121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# Plate 9

A, B, D, F *Neogondolella* cf. *belladontae* Chernikh

A Admiralty Peninsula, Kazarkinskaya Fm., sample no. 649-13, X180. CNIGR 12745/122

B Admiralty Peninsula, Kazarkinskaya Fm., sample no. 649-13, X133. CNIGR 12745/123

D Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18-1, X70. CNIGR 12745/148

F Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/149

C, E *Streptognathodus* cf. *S. wabaunsensis* Gunnell

C Bezymyannaya River, Stepovskaya Fm., sample no. 602-26, X120. CNIGR 12745/124

E Bezymyannaya River, Stepovskaya Fm., sample no. 602-26, X84. CNIGR 12745/126

G *Streptognathodus conjunctus* Barskov, Isakova & Schastlivtseva
Bezymyannaya River, Stepovskaya Fm., sample no. 602-26, X84. CNIGR 12745/128

H "*Gondolella*" cf. "*G.*" *denuda* (Ellison)
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X49. CNIGR 12745/129

I ? *Streptognathodus* sp.
Mezhdusharsky Island, Lazarevskaya Fm., sample no. 551-9, X91. CNIGR 12745/130

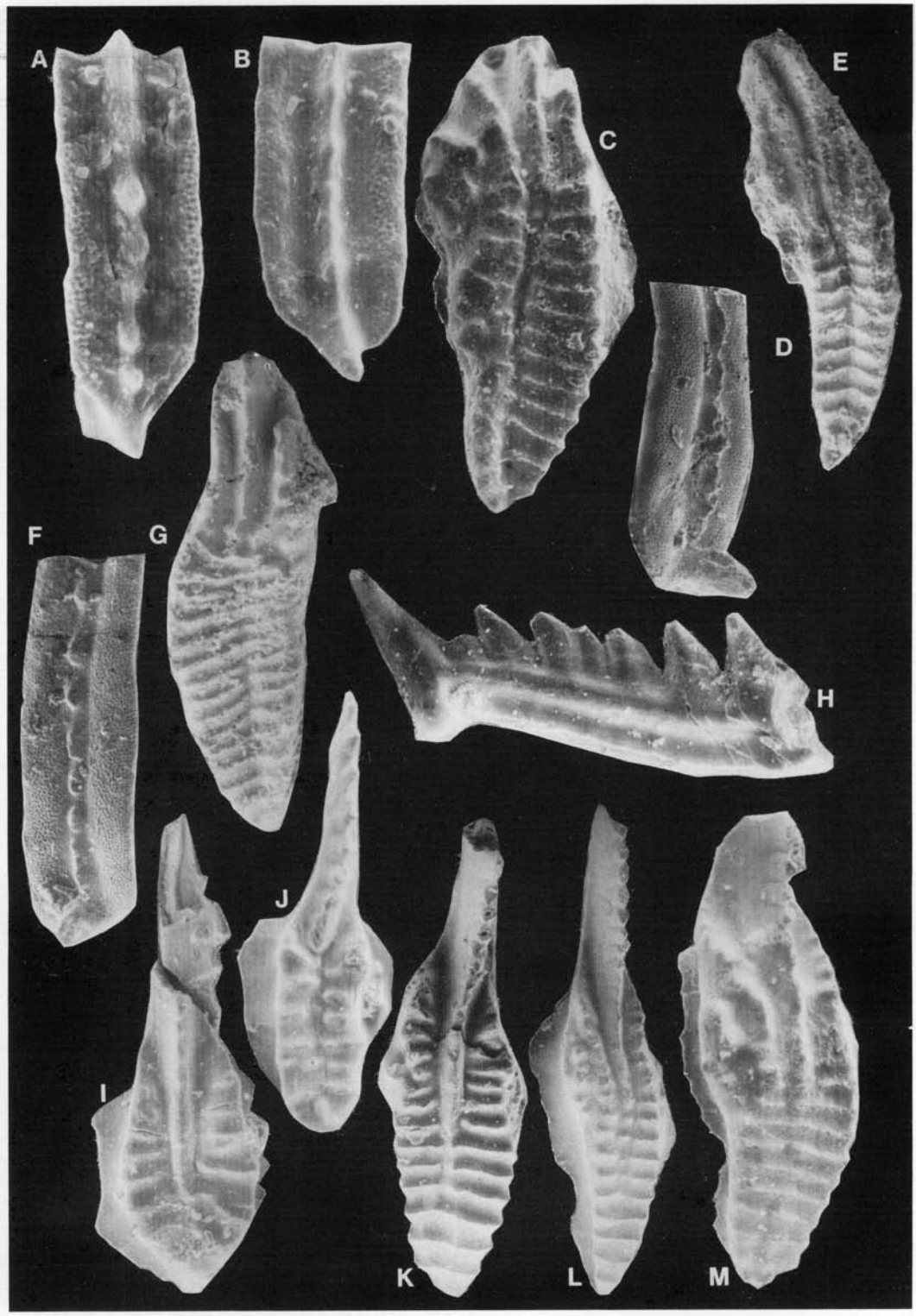
J ?New Genus A sp.
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/131

K *Idiognathodus* cf. *toretzianus* Kozitskaya
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/132

L, M *Idiognathodus lobulatus* Kozitskaya

L Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/133

M Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 753-7, X84. CNIGR 12745/134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# Plate 10

A, J–N *Gondolelloides canadensis* Henderson & Orchard

A Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/135

J Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-51, upper view, X70. CNIGR 12745/142

K Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-51, oblique lateral view, X70. CNIGR 12745/142

L Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, fragment, X160. CNIGR 12745/137

M Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, upper view, X56. CNIGR 12745/137

N Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/142

B, C, H *Gondolelloides* cf. *G. nahanniensis* Henderson & Orchard

B Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/218

C Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/219

H Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/224

D–F "*Gondolella*" sp. A. Henderson & Orchard

D Taynaya River, Kazarkinskaya Fm., sample no. 131-45, lateral view, X28. CNIGR 12745/139

E Taynaya River, Kazarkinskaya Fm., sample no. 131-45, upper view, X28. CNIGR 12745/139

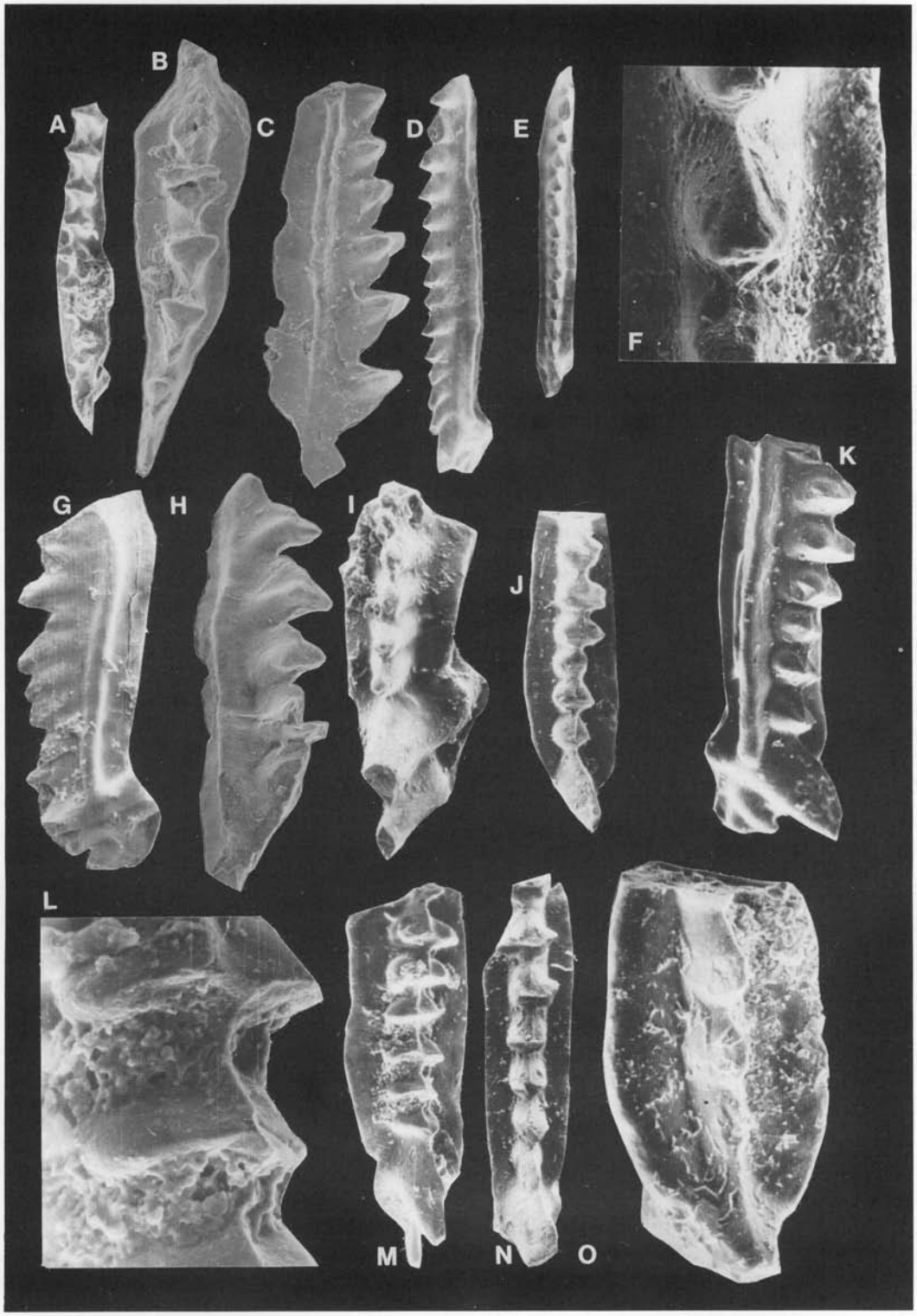
F Taynaya River, Kazarkinskaya Fm., sample no. 131-45, fragment, X155. CNIGR 12745/139

G, I "*Gondolella*" cf. "*G*" sp. A. Henderson & Orchard

G Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X56. CNIGR 12745/140

I Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X84. CNIGR 12745/141

O "*Gondolella*" cf. "*G.*" *laevis* Kosenko & Kozitskaya
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-11, X125. CNIGR 12745/61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# Plate 11

A, E — *Neogondolella* sp. B
A — Krasnaya River, Tolbeyachskaya Fm., sample no. 601-47, X105. CNIGR 12745/145
E — Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18-1, X70. CNIGR 12745/146

B, H — *Neogondolella donbassica* (Kosenko)
B — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-5, X84. CNIGR 12745/51
H — Admiralty Peninsula, Kazarkinskaya Fm., sample no. 9031-6, X56. CNIGR 12745/50.

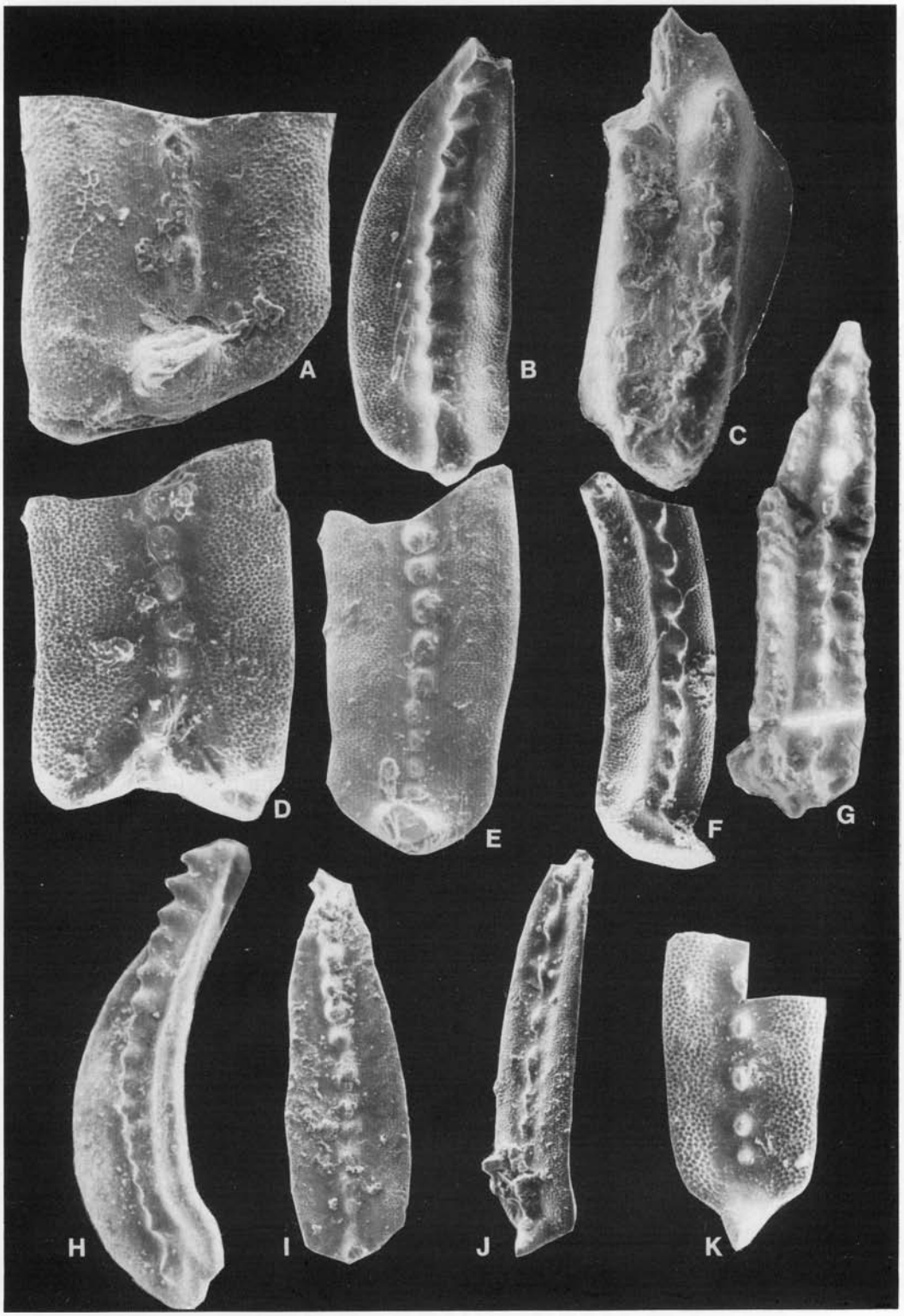
C — New Genus A sp. D
Spokoynaya River, Yeksovskaya Fm., sample no. 1701-1, X120. CNIGR 12745/202

D — *Neogondolella discedus* sp. nov
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-46, X105. CNIGR 12745/150

G — *Gondolella magna* Stauffer & Plummer
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 124-8, X70. CNIGR 12745/52

F, J, K — *Neogondolella belladontae* Chernikh
F — Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X42. CNIGR 12745/153
J — Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X105. CNIGR 12745/155
K — Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/154

I — *Neogondolella* sp. A
Krasnaya River, Stepovskaya Fm., sample no. 601-15, X42. CNIGR 12745/156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# Plate 12

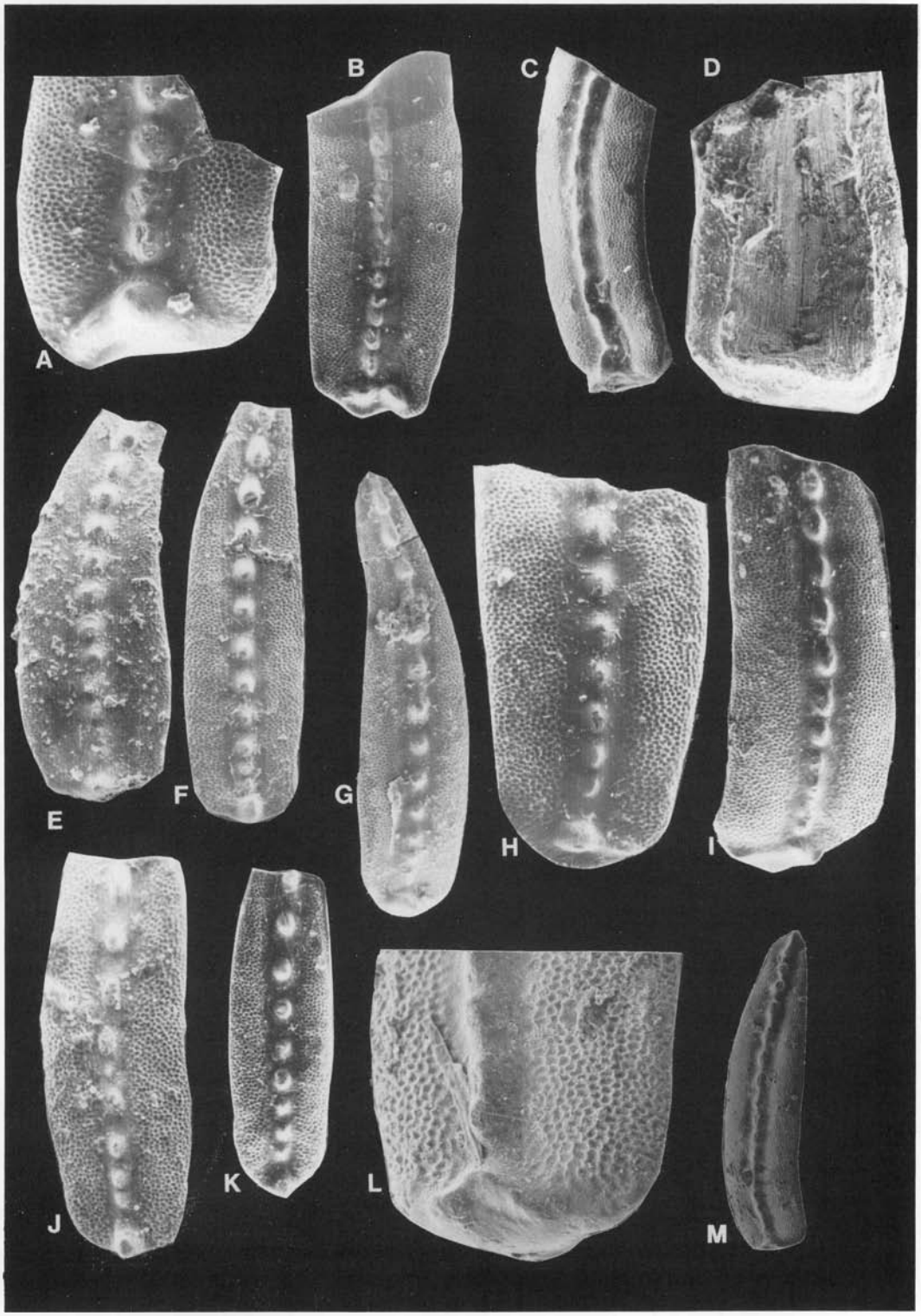
A, B, H *Neogondolella discedus* sp. nov. (late form)
A Nekhvatova River, Kazarkinskaya Fm., sample no. 752-78, X133. CNIGR 12745/157
B Nekhvatova River, Kazarkinskaya Fm., sample no. 752-78, X70. CNIGR 12745/158
H Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X105. CNIGR 12745/159

C, I, L, M *Neogondolella discedus* sp. nov.
C Krasnaya River, Tolbeyachskaya Fm., no. 601-28, X63. CNIGR 12745/160
I Krasnaya River, Tolbeyachskaya Fm., no. 601-28, X77. CNIGR 12745/161
L Krasnaya River, Tolbeyachskaya Fm., no. 601-28, fragment, X160. CNIGR 12745/162
M Krasnaya River, Tolbeyachskaya Fm., no. 601-28, holotype, X42. CNIGR 12745/163

D, E *Neogondolella* sp. C
D Krasnaya River, Tolbeyachskaya Fm., sample no. 5582-6, X84. CNIGR 12745/190
E Krasnaya River, Tolbeyachskaya Fm., sample no. 5582-6, X63. CNIGR 12745/191

F, G *Neogondolella simulata* Chernikh
F Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/164
G Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/166

J, K *Neogondolella dentiseparata* Reshetkova & Chernikh
J Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18-1, X84. CNIGR 12745/167
K Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X63. CNIGR 12745/168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# Plate 13

A — *Neogondolella simulata* Chernikh
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-51, X70. CNIGR 12745/169

B, G, H — *Neogondolella* cf. *pseudostriata* Chernikh
B — Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-51, X70. CNIGR 12745/170
G — Nekhvatova River, Kazarkinskaya Fm., sample no. 752-78, X63. CNIGR 12745/171
H — Nekhvatova River, Kazarkinskaya Fm., sample no. 752-78, X53. CNIGR 12745/172

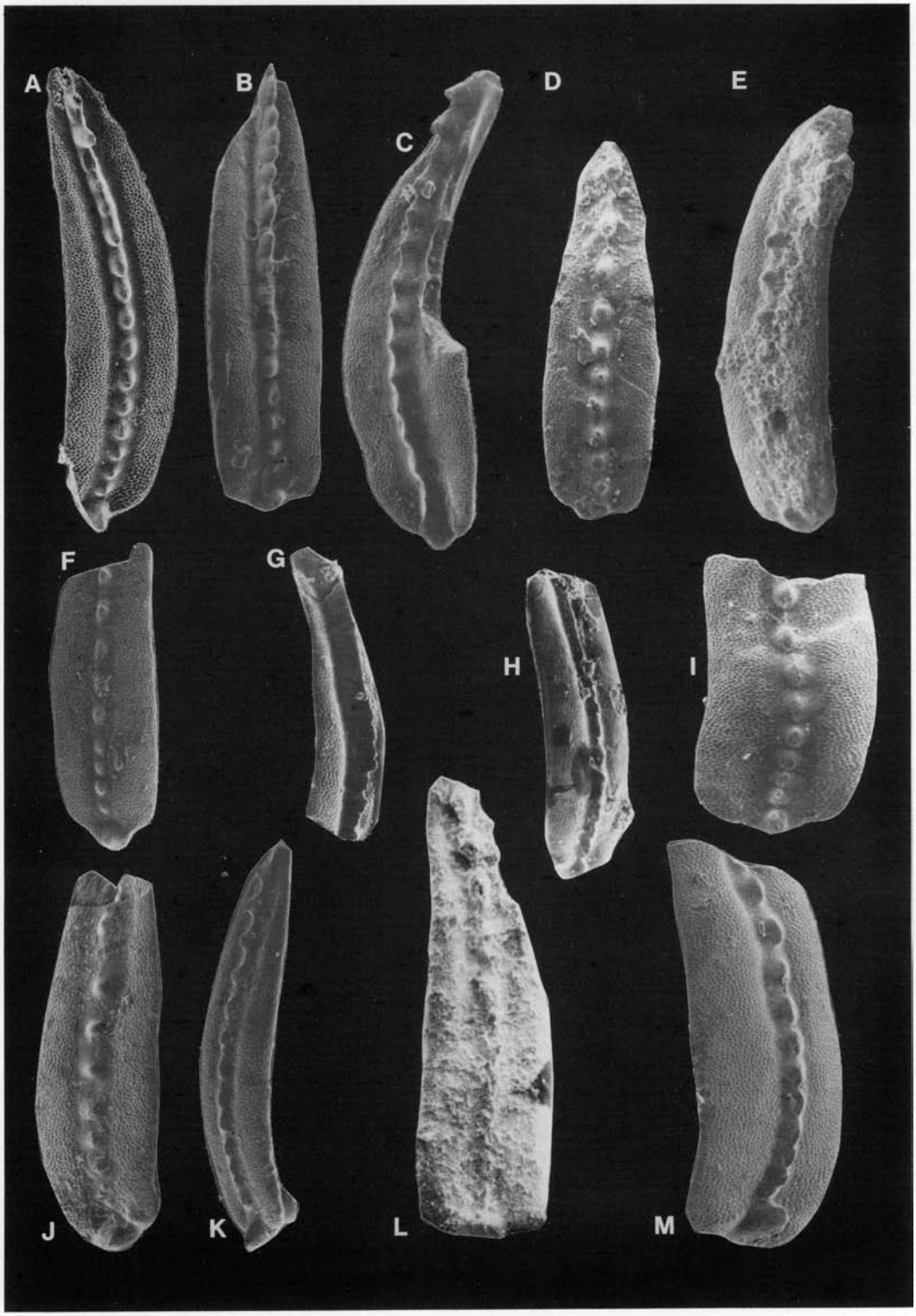
C — *Neogondolella* cf. *N. foliosa* Chernikh & Reshetkova
Bolshaya Yunau River, Kazarkinskaya Fm., sample no. 101-51, X70. CNIGR 12745/173

D, E — *Neogondolella bisselli* (Clark & Behnken)
D — Krasnaya River, Tolbeyachskaya Fm., sample no. 601-40, X63. CNIGR 12745/188
E — Litke Peninsula, Barentsevskaya Fm., sample no. 8875, X70. CNIGR 12745/189

F, J, K — *Neogondolella dentiseparata* Reshetkova & Chernikh
F — Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/176
J — Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/177
K — Taynaya River, Kazarkinskaya Fm., sample no. 131-45, X70. CNIGR 12745/178

L — *Neogondolella striata* Chernikh & Reshetkova
Krasnaya River, Tolbeyachskaya Fm., sample no. 601-41, X49. CNIGR 12745/180

I, M — *Neogondolella* cf. *N. striata* Chernikh & Reshetkova
I — Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X84. CNIGR 12745/181
M — Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X77. CNIGR 12745/182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# Plate 14

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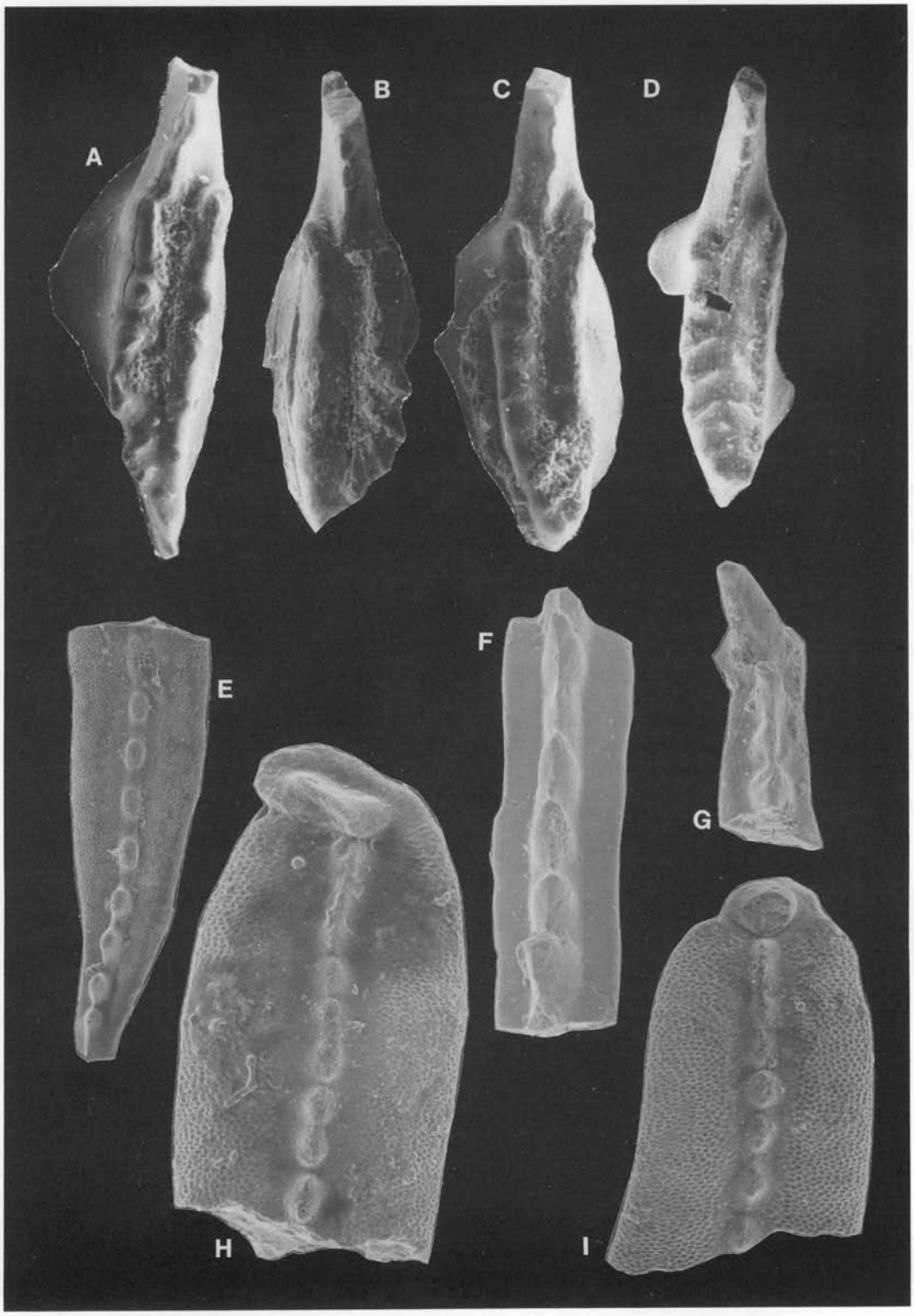
| A | New Genus A sp. C<br>Litke Peninsula, Barentsevskaya Fm., sample no. 798-3, X125. CNIGR 12745/194 |
| B–D | New Genus A sp. B Henderson |
| B | Litke Peninsula, Barentsevskaya Fm., sample no. 798-3, X84. CNIGR 12745/197 |
| C | Litke Peninsula, Barentsevskaya Fm., sample no. 806-23, X84. CNIGR 12745/198 |
| D | Litke Peninsula, Barentsevskaya Fm., sample no. 805-5, X77. CNIGR 12745/199 |
| E, I | *Neogondolella adentata* Chernikh & Reshetkova |
| E | Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X70. CNIGR 12745/225 |
| I | Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X105. CNIGR 12745/223 |
| F, G | "*Gondolella*" cf. "*G.*" sp. B Henderson & Orchard |
| F | Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18-1, X70. CNIGR 12745/221 |
| G | Krasnaya River, Tolbeyachskaya Fm., sample no. 601-18, X70. CNIGR 12745/222 |
| H | *Neogondolella* cf. *N. discedus* sp. nov<br>Krasnaya River, Tolbeyachskaya Fm., sample no. 601-28, X105. CNIGR 12745/223 |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# Plate 15

A, B *Neostreptognathodus* sp.
A Krasnaya River, Tolbeyachskaya Fm., sample no. 5582-6, X175. CNIGR 12745/183
B Krasnaya River, Tolbeyachskaya Fm., sample no. 5582-6, X70. CNIGR 12745/183

C, D *Adetognathus paralautus* Orchard
C Litke Peninsula, Sedovskaya Fm., sample no. 8818, X70. CNIGR 12745/184
D Litke Peninsula, Sedovskaya Fm., sample no. 8818, X70. CNIGR 12745/185

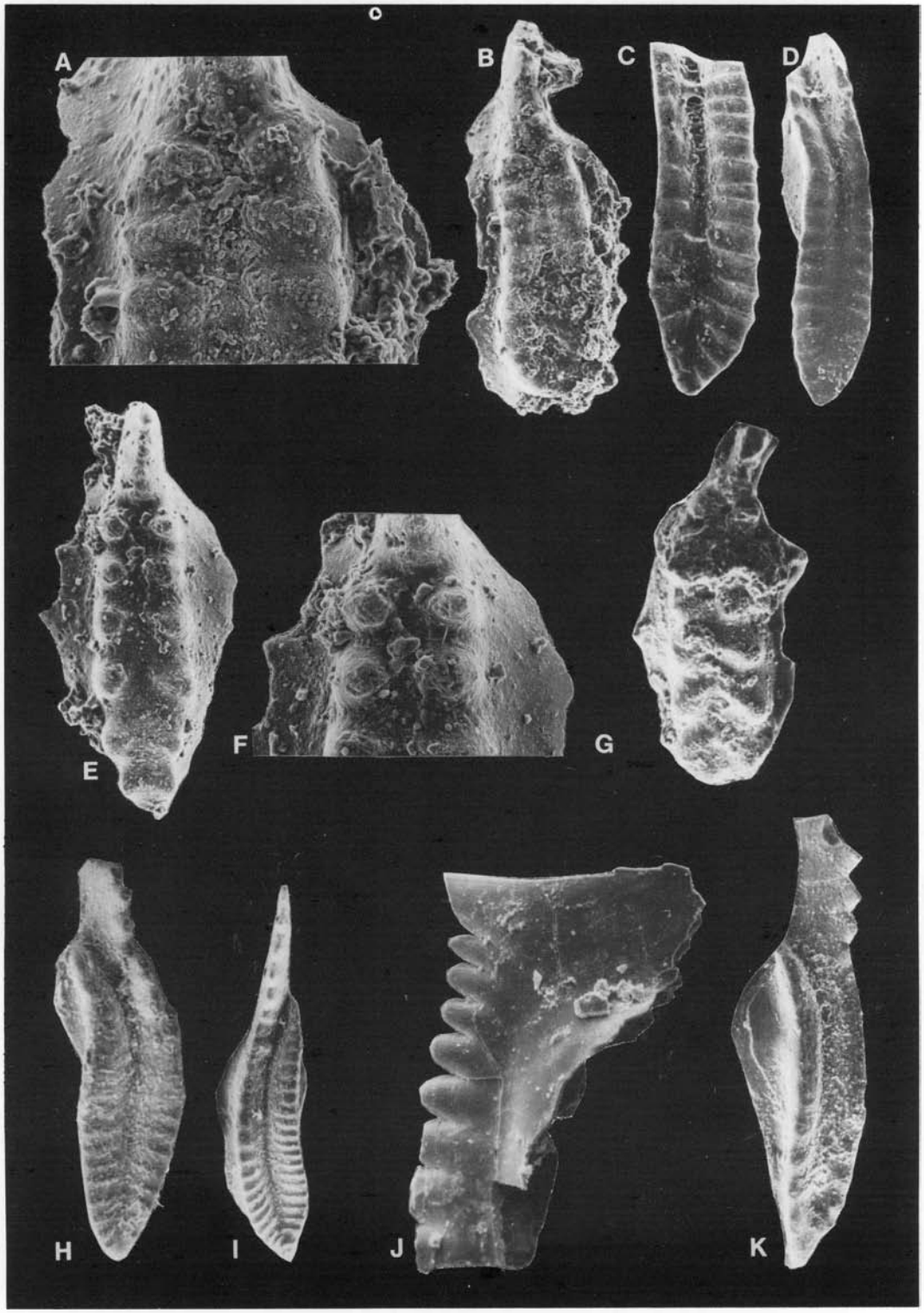
E, F *Neostreptognathodus pequopensis* Behnken
E Krasnaya River, Tolbeyachskaya Fm., sample no. 5582-6, X70. CNIGR 12745/186
F Krasnaya River, Tolbeyachskaya Fm., sample no. 5582-6, X120. CNIGR 12745/186

G *Neostreptognathodus* cf. *N. pequopensis* Behnken
Krasnaya River, Tolbeyachskaya Fm., sample no. 4409-2, X84. CNIGR 12745/187

H *Adetognathus* sp. B Henderson
Litke Peninsula, Barentsevskaya Fm., sample no. 805-5, X120. CNIGR 12745/203

I, K *Adetognathus lautus* (Gunnell)
I Litke Peninsula, Barentsevskaya Fm., sample no. PR2442-5.0, X63. CNIGR 12745/207
K Spokoynaya River, Yeksovskaya Fm., sample no. 1693-3, X105. CNIGR 12745/192

J *Hindeodus minutus* (Ellison)
Spokoynaya River, Yeksovskaya Fm., sample no. 635, X123. CNIGR 12745/53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