Biotic recovery of conodonts following the end-Ordovician mass extinction

Radcliffe, Gail

Biotic Recovery of Conodonts following the End-Ordovician Mass Extinction

Gail Radcliffe

Department of Geological Sciences
University of Durham

Volume 2

A thesis submitted in partial fulfilment of the degree of Doctor of Philosophy

University of Durham

1998

Volume 2

Table of Contents

Title Page i

Table of Contents ii

Appendix A: Systematic Palaeontology

A.1 Introduction **A1**

A.1.1 Descriptive terminology A1
A.1.2 Element notation A1
A.1.2a Ramiform and pectiniform genera A1
A.1.2b Coniform and rastrate genera A2
A.1.3 Synonymy lists A3

A.2 Ramiform and pectiniform taxa **A4**

Order Ozarkodinida Dzik, 1976 A4
Order Prioniodinida Sweet, 1988 A34
Order Prioniodontida Dzik, 1976 A46

A.3 Coniform and rastrate taxa **A80**

Order Belodellida Sweet, 1988 A80
Order Panderodontida Sweet, 1988 A85
Order Panderodontida Sweet, 1988 A94
Order Unknown A103

A.4 Plates **A107**

Appendix B: Abundance tables and percentages

B.1 Anticosti Island **B1**

Point Laframboise (AI 1) and Lac Wickenden Road sections (AI 17a) B1
Abundance Charts B1
Percentages B2
Cap a l'Aigle section (AI 2). B3
Abundance Charts B3
Percentages B4
Becscie, Merrimack and Gun River Formations at various localities. B5

Abundance Charts B5
Percentages B6
Gun River and Jupiter Formations at various localities. B7
Abundance Charts B7
Percentages B8
Upper Jupiter and Chicotte Formations at Brisants Jumpers (A15) and other localities. B9
Abundance Charts B9
Percentages B10

B.2 Lake Timiskaming **B11**

Abundance Charts B11
Percentages B12

B.1 Prongs Creek **B13**

Transitional Limestone Unit. B13
Abundance Charts B13
Percentages B14
Road River Group. B15
Abundance Charts B15
Percentages B16

Appendix C: Localities and conodont samples

C.1 Introduction **C1**

C.2 Sampling areas **C2**

C.2.1 Anticosti Island (Québec) C2
C.2.1a Samples collected during field work C3
C.2.1b Samples collected during the Third International Brachiopod Congress Field Trip, Anticosti Island (Led by P. Copper & J. Jisuo) C7

C.2.2 Lake Timiskaming (Ontario) C10

C.2.3 Prongs Creek (northern Yukon Territories) C14

Appendix D: Sample preparation and collections studied

D.1 Sample Preparation **D1**

D.1.1 Sample Preparation at the University of Durham D1

D.1.2 Sample Preparation at the Geological Survey of Canada D1

D.2 Collections viewed **D2**

D.3 Samples On Loan **D3**

Appendix A

Systematic Palaeontology

A.1 Introduction **A1**

A.1.1 Descriptive terminology A1
A.1.2 Element notation A1
A.1.2a Ramiform and pectiniform genera A1
A.1.2b Coniform and rastrate genera A2
A.1.3 Synonymy lists A3

A.2 Ramiform and pectiniform taxa **A4**

Order Ozarkodinida Dzik, 1976 A4
Order Prioniodinida Sweet, 1988 A34
Order Prioniodontida Dzik, 1976 A46

A.3 Coniform and rastrate taxa **A80**

Order Belodellida Sweet, 1988 A80
Order Panderodontida Sweet, 1988 A85
Order Panderodontida Sweet, 1988 A94
Order Unknown A103

A.4 Plates **A107**

Appendix A

Systematic Palaeontology

A.1 Introduction

Conodonts can be divided in to two informal groups, those with apparatuses largely composed of ramiform / pectiniform elements and those with coniform / rastrate elements. The systematic descriptions that follow have been divided into these two main groupings to enable the comparison of similar apparatuses.

Within the two main groupings, the conodont genera will be discussed within a suprageneric framework. The conodont suprageneric classification is currently unstable and is continually being revised. Major revisions have been undertaken by Sweet (1988), Dzik (1991) and most recently by Aldridge & Smith (1993).

A.1.1 Descriptive terminology

A standard scheme for the description of element morphology has been developed by Sweet (1981b, 1988) and has been utilised herein.

A.1.2 Element notation

A.1.2a Ramiform and Pectiniform genera

The notational scheme suggested by Sweet & Schönlaub (1975; modified by Cooper, 1975), relates element morphology to probable location within the apparatus. This scheme is widely used in Silurian conodont taxonomy and has been assumed herein. The addition of subscripts (e.g. Pa_1 and Pa_2) to this notational scheme occur when multiple pairs of elements are present within an apparatus (suggested by Armstrong, 1990). The standard Sweet & Schönlaub (1975) scheme was extended by Aldridge *et al.* (1995) following the description of prioniodontid bedding plane assemblages. In wake of that study, the descriptions of prioniodontids herein will include Pc and Pd elements.

The element notation Sd has been previously used to describe asymmetrical quadriramate elements. However, in apparatus reconstructions from bedding plane assemblages an Sd position does not exist. In the *Promissium* reconstruction a four processed element occupies an Sb_2 position (Purnell & Donoghue, 1998). Therefore, herein the term Sd will not be used.

A.1.2b Coniform and Rastrate genera

Coniform genera have apparatuses consisting of conical elements lacking denticulated margins (exceptions include serrate elements of *Panderodus*). Rastrate genera are distinguished as consisting of conical elements, which have denticles on the concave posterior margin of the cone.

Barnes *et al.* (1979) described three morphotypes (p, q, r) within coniform apparatuses, based upon the degree of element curvature. This scheme was modified by Armstrong (1990), who subdivided the p and q categories based on variation in cusp cross section. These schemes were based on element morphology and were not compared to the locational scheme used for ramiform genera.

Sansom *et al.* (1995) proposed a locational and shape category scheme based upon the analysis of bedding planes and clusters of *Panderodus*. This scheme is preferred to the premature application of ramiform nomenclature to coniform taxa (see discussion in Sansom *et al.*, 1995).

A notational scheme now exists for coniform and rastrate elements, which relates element morphology to probable location within the bauplan (see remarks in coniform and rastrate section).

A.1.3 Synonymy lists

The synonymy lists are abbreviated, containing only the original species designation, subsequent important taxonomic reviews and the most recent comprehensive synonymy list. The lists are annotated as advised by Matthews (1973, after Richter, 1948).

A.2 Ramiform and Pectiniform taxa

Phylum CHORDATA Bateson, 1886

Class CONODONTA Eichenberg, 1930

sensu Clark, 1981

Order Ozarkodinida Dzik, 1976

Remarks. Sweet (1988) regarded the ozarkodinid apparatus as comprising six or seven morphotypes, with carminate and angulate pectiniform (or platformed equivalents) elements in the P positions. The three dimensional apparatus plan of ozarkodinids has been studied by Schmidt (1934), Rhodes (1952), Nicoll (1985, 1987, 1995), Dzik (1991), Aldridge *et al.* (1987) and Purnell & Donoghue (1998). The most recent apparatus reconstruction consists of 15 elements, including paired Pa, Pb and M elements, a single symmetrical Sa element and four pairs of asymmetrical S elements (Sb_1, Sb_2, Sc_1, Sc_2), which differ in the degree of asymmetry. Multiple Sb and Sc elements have not been differentiated within any of the Ozarkodininda genera studied herein.

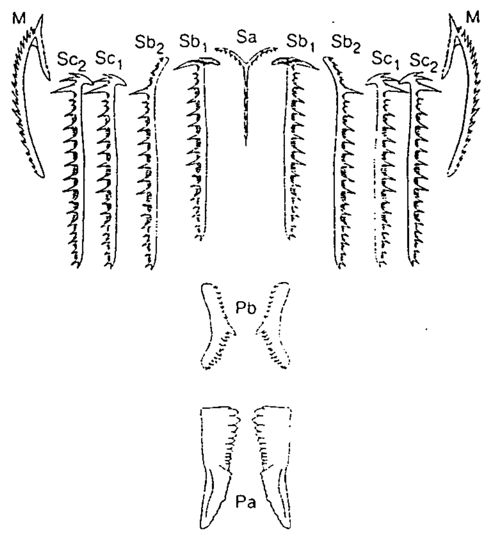


Figure A.1 The ozarkodinid apparatus redrawn from Aldridge *et al.* (1995).

Family Kockelellidae Klapper, 1981

Remarks. Sweet (1988) regarded *Kockelella* Walliser as the type genus of the Kockelellidae. The *Kockelella* apparatus is characterised by carminiscaphate to stelliscaphate Pa and angulate Pb elements. Within this family, Sweet (1988) also included the genus *Ancoradella* Walliser, which is thought to have descended from *K. variablis* Walliser.

Aulacognathus Mostler included within the Pterospathodontidae Cooper by Sweet (1988), but subsequently placed in the Kockelellidae by Aldridge & Smith (1993). The Pa elements of *Aulacognathus* more closely resemble the corresponding elements of younger species of *Kockelella*, which have well-developed lateral processes. However, the M and S elements differ between the two genera, in *Kockelella* they commonly bear discrete denticles separated by wide, u-shaped gaps, whereas in *Aulacognathus* S elements commonly bear fused denticles, apart from *A.* aff. *A. bullatus* (see below).

Genus *Aulacognathus* Mostler, 1967

Type species. *Aulacognathus kuehni* Mostler, 1967.

Diagnosis. Refer to Armstrong (1990, p. 62)

Remarks. The *Aulacognathus* apparatus includes six morphotypes (Pa, Pb, M, Sa, Sb, Sc). This genus is characterised by a stelliscaphate Pa element, with a free anterior process, an inwardly bent posterior process and irregularly ornamented inner and outer-lateral processes (Armstrong, 1990). Species of *Aulacognathus* are traditionally differentiated by variation in the morphology and ornamentation of the Pa element.

Bischoff (1986) identified five previously unknown species of *Aulacognathus* in the Lower Silurian of New South Wales. He diagnosed these new species based on variations in the ornamentation and morphology of the Pa element. Simpson (1995) suggested that *A. antiqus* Bischoff represents a juvenile or aberrant form of another species.

Aulacognathus bullatus (Nicoll & Rexroad, 1969)
Pl. 1, figs 1-7; Pl. 2, figs 1,2

1964 *Spathognathodus sp. ex. aff. Spathognathodus celloni* Walliser p. 74, pl. 14, figs 17-18.

* 1969 *Neospathognathodus bullatus* Nicoll & Rexroad, p. 44, pl. 1, figs 5-7.

1990 *Aulacognathus bullatus* (Nicoll & Rexroad); Armstrong, p. 63, pl. 6, figs 1-2, 4-7.

Holotype. *Neospathognathodus bullatus* Nicoll & Rexroad, 1969, pl. 1, fig. 5 Specimen from the Lee Creek Member of the Brassfield Limestone, Indiana, U. S. A.

Diagnosis. Refer to Armstrong (1990, p. 64)

Description. Refer to the description of *A. bullatus* in Armstrong (1990, p. 62-65)

Remarks. This is a species of *Aulacognathus* with a Pa element that has lateral processes, which are free distally, directed anteriorly and are densely ornamented with nodes. Nicoll & Rexroad (1969) observed that a posterior-outer-lateral process was sometimes developed. If the above characteristics are broadly taken as the diagnostic features of *A. bullatus*, then *A. angulatus* Bischoff, *A. antiqus* Bischoff, *A. bifurcatus* Bischoff and *A. liscombensis* Bischoff may represent ecophenotypic variations of *A. bullatus*.

The Pa element was first described by Nicoll & Rexroad (1969) and the Pb element was associated with the Pa element by Uyeno & Barnes (1983). Armstrong (1990) reconstructed a full apparatus.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario; Jupiter (Pavillion Member) and Chicotte Formations, Anticosti Island, Québec; Road River Group, Prongs Creek, northern Yukon.

Aulacognathus aff. *A. bullatus.*

Pl. 1, figs 8-14

Description. Pa element. Stelliscaphate, with a free anterior process, an inwardly bent posterior process and anteriorly directed inner and outer-lateral processes. The outer lateral process is better developed than the inner and may bifurcate. Ornamentation on the lateral processes varies between rounded nodes and ridges. The carina bears at least six denticles on the posterior process and 11 on the anterior process. The prominent cusp is tall and broad. The proximal anterior denticles are also broad. Posterior denticles decrease in height distally, whereas the anterior denticles are irregular in height, but in general they decrease in height distally. The blade is thickened below the denticle row. The lower surface is shallowly excavated.

Pb element. Anguliscaphate, the posterior and anterior processes bear at least six and four denticles, respectively. The short inner-lateral process commonly bears only two denticles. The cusp is triangular with a wide base. The triangular denticles may be fused at the base or separated by v-shaped gaps. Some rare, possibly aberrant, specimens have wide u-shaped gaps between the denticles and an adenticulate lateral process. The blade is thickened below the denticle row. The entire lower surface is excavated.

M element. Modified tertiopedate, the inner-lateral process bears at least seven denticles, the outer is shorter and bears two denticles and is more steeply inclined. The cusp is wide, tall and antero-posterially compressed with a posterior swelling at its base. The denticles on both processes are triangular and separated by narrow u-shaped gaps. The blade is thickened below the denticle row. The basal cavity is widest beneath the cusp and continues as tapering grooves along the lateral processes.

Sb element. Tertiopedate, with an inner-lateral process bearing four denticles and a shorter outer-lateral process bearing at least three denticles. There is a posterior swelling of the cusp. The denticles are upright, triangular and fused at the base. The blade is thickened below the denticle row.

Sc element. Bipennate, with a posterior and anterior process bearing at least five and three denticles, respectively. The posterior process is almost straight and the anterior process is downwardly directed. The denticles are triangular and separated by narrow u-shaped gaps. The blade is thickened below the denticle row.

Remarks. This is the oldest species of *Aulacognathus* ever recovered. *A.* aff. *A. bullatus* is likely to be the ancestor to the later species of *Aulacognathus*, which first appear within or just below the *celloni* CBZ. The Pa elements of *A.* aff. *A. bullatus* are similar to those of *A. bullatus* (Nicoll & Rexroad). The latter younger species differs in having fused denticles, rather than the discrete denticles seen in *A.* aff. *A. bullatus*

Occurrence. Transitional limestone, Prongs Creek, northern Yukon.

Aulacognathus kuehni Mostler, 1967

Pl. 2, figs 4,5

* 1967 *Aulacognathus kuehni* Mostler, p. 301, pl. 1, figs 12-15, 21, 24, 25.

1972 *Aulacognathus kuehni* Mostler; Aldridge, p. 167-168, pl. 2, fig. 6.

1977 *Aulacognathus kuehni* Mostler; Klapper, p. 61-62, pl. 1, figs 4, 7.

1986 *Aulacognathus kuehni* Mostler, Bischoff, p. 173, pl. 5, figs 10-16.

Holotype. *Aulacognathus kuehni* Mostler, 1967, p. 301, pl. 1. Specimen from the Kitzbuhl, Austria.

Diagnosis. Refer to Bischoff (1986, p. 173)

Description. Pa element. Refer to the description of *A. kuehni* in Aldridge (1972, p. 167).

Sc element. Bipennate with a straight posterior process and a downwardly directed anterior process. Both processes bear at least four badly broken denticles. The processes have a broad base.

Remarks. The Pa element of *A. kuehni* has an anteriorly directed outer-lateral lobe, and a trilobed inner platform. The Pa element depicted by Over & Chatterton (1987a, pl. 3, fig. 20) is atypical as it lacks three lobes on the inner platform.

The Pa element was described by Mostler (1967). Klapper (1977) suggested that *A. ceratoides* Nicoll & Rexroad represented the Pb of this apparatus and Bischoff (1986) emended the diagnosis to include this element. The Sc element herein, is the first to be described in association with *A. kuenhi.* The denticles are thicker and the anterior process is less downwardly and inwardly directed than the Sc elements of *A. bullatus.*

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Aulacognathus sp. A

Pl. 2, figs 6-8

Remarks. The Pa element has a sub-circular, basal cavity flare, and lacks the lateral processes characteristic of *Aulacognathus.* This species has been classified within *Aulacognathus,* as the Sb and Sc elements associated with the Pa element are similar to those of species of *Aulacognathus.* The Sb and Sc elements bear slender denticles and have very broad bases. The cusp on the Sc element is much taller and the base thicker than the corresponding elements of *A. bullatus* herein. This species may represent an aberrant form of another species, such as *A. bullatus.*

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario.

Genus *Kockelella* Walliser, 1964

Type species. *Kockelella variabilis* Walliser, 1957.

Diagnosis. Refer to Barrick & Klapper (1976, p. 72).

Remarks. The Pa element is characteristically carminiscaphate with an 'even-crested' anterior process and a shorter posterior process with smaller denticles, which decline in height distally (Sweet, 1988). The Pa element bears fused denticles, whereas the Pb, M and S elements bear discrete denticles, separated by wide, u-shaped gaps (Armstrong, 1990).

Species of *Kockelella* are differentiated by the morphology of the Pa element. In the early Llandovery, the posterior process is inwardly deflected (Armstrong, 1990), whereas in the upper Llandovery this process is reduced and the element has a large, circular basal cavity (Sweet, 1988).

Kockelella manitoulinensis (Pollock, Rexroad & Nicoll, 1970)

Pl. 3, figs 1,2

* 1970 *Spathognathus manitoulinensis* Pollock *et al.*, p. 761, pl. 111, figs 17-19.

v 1981 *Spathognathus manitoulinensis* Pollock *et al.*; McCracken & Barnes,p. 90, pl. 7, fig. 19.

1990 *Kockelella manitoulinensis* Pollock *et al.*; Armstrong, p. 77, pl. 9, fig. 4-14.

Holotype. *Spathognathus manitoulinensis* Pollock, Rexroad & Nicoll, 1970, pl. 111, figs 19a, 19c. Sample 5-1, from the Manitoulin dolomite, Michigan, U. S. A.

Diagnosis. Refer to Armstrong (1990).

Description. Pa element. This element has been previously described by Armstrong (1990, p. 77). The posterior process is inwardly deflected at an angle of approximately 130° from the anterior process. The anterior process bears six to seven denticles; the most distal anterior denticle is smaller and lacks white matter. The posterior process bears up to six denticles. The denticles on both processes are sub-equal in height and width, and are fused almost to their tips. The processes are thickened beneath the denticle row. White matter distribution varies between specimens; in some samples, the denticles are completely filled with white matter and others are only partially filled.

Pb element. Refer to the description by Armstrong (1990, p. 77).

Remarks. A species of *Kockelella* in which the Pa element has an inwardly deflected posterior process (Armstrong, 1990) and no lateral processes. The Pa elements were first described by Pollock *et al.* (1970). The multielement reconstruction was produced by Armstrong (1990).

McCracken & Barnes (1981) regarded the denticulation, cusp shape, and basal flare of the Pa elements of *K. manitoulinensis* and *O. oldhamensis* (Rexroad) as very similar. They recovered transitional forms between the two species, implying that *K. manitoulinensis* is a descendant of *O. oldhamensis*. However, the morphological similarity may be coincidental (Armstrong, 1990, p. 78). The Pa elements of *O. oldhamensis* from Prongs creek (northern Yukon) have thin, relatively long, posteriorly inclined, anterior denticles and an anterior upper margin, which is not even-crested. The above characteristics are all atypical of species of *Kockelella*.

Armstrong (1990) suggested that the process orientation, basal cavity morphology and white matter distribution of the Pa elements of *K. manitoulinensis* and *Ctenognathus pseudofissilis* Lindström were similar. However, the Pb elements of the two species differ in the fusion of the denticles (Armstrong, 1990). Aldridge & Smith (1993) tentatively placed *C. pseudofissilis* Lindström as the first known representative of the Kockellidae. The upper surface of the *C. pseudofissilis* elements figured by Lindström (1959) are even-crested and it, therefore, seems likely that *K. manitoulinensis* is a descendant of *C. pseudofissilis*.

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario; Ellis Bay (Laframboise Member) and Becscie Formations, Anticosti Island.

Kockelella ranuliformis (Walliser, 1964)

Pl. 3, figs 3-5

* 1964 *Spathognathodus ranuliformis* Walliser, p. 82, taf. 6, fig. 9, taf. 22, fig.5-7.

1976 *Kockelella ranuliformis* (Walliser); Barrick & Klapper, p. 76, pl. 2, figs 1-11.

1995 *Kockelella ranuliformis* (Walliser); Simpson & Talent, p. 135-137, pl. 6, figs 1-7.

Holotype. *Spathognathodus ranuliformis* Walliser, 1964, taf. 22, fig. 5. Specimen Wa 744/10 from Bed 11 C, Cellon, Carnic Alps, Austria.

Diagnosis. Refer to Barrick & Klapper (1976, p. 76).

Description. Pa element. This carminiscaphate element has been previously described by Barrick & Klapper (1976, p. 76). Herein, the anterior portion of the blade bears nine or 10 denticles, whereas the shorter posterior portion bears three denticles. The most distal posterior denticle may be slightly inwardly offset from the carina. In lateral view, the basal margin is arched below the cusp, and straight beneath the anterior blade. White matter distribution varies between specimens, the denticles and cusp being completely or partially filled.

Pb element. Refer to the description in Barrick & Klapper (1976, p. 76).

Remarks. A species of *Kockelella* with a Pa element that has a round basal cavity, and lacks lateral processes (Barrick & Klapper, 1976). A full apparatus reconstruction of *K. ranuliformis* was developed by Barrick & Klapper (1976).

Occurrence. Jupiter (Pavillion Member) and Chicotte Formations, Anticosti Island, Québec.

Kockelella sp. A (Over & Chatterton, 1987a)

Pl. 4, figs 1-7

1987a *Spathognathus* sp. A s.f. Over & Chatterton, p. 27, pl. 6, figs 26-27.

Remarks. This species of *Kockelella* has an inwardly deflected posterior process and an outer-lateral process, which meet at an angle greater than 90°. The Pa element has been fully described by Over & Chatterton (1987a, p. 27). A partial apparatus has been recovered, including Pa, Pb, M, Sb and Sc elements. The Pb, M and S elements have fused denticles, which differs from the discrete denticles seen in the elements of *K.* sp. B

Pa elements were recovered from the *amorphognathoides* CBZ of Avalanche Lake (Mackenzie Mountains, Northwest Territories) by Over & Chatterton (1987a). They suggested that *K.* sp. A was a descendant of *K. manitoulinensis*.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario.

Kockelella sp B.

Pl. 3, figs 6-11

Description. Pa element. Pastiniscaphate, with a straight anterior process, an inwardly directed posterior process and an outer-lateral process. The anterior blade bears eight to 12 denticles, which are sub-equal in height. In upper view, the outer-lateral process and the posterior process meet at an angle of 90°. The posterior process is lower than the anterior process and bears up to six denticles, which decrease in height distally. The outer-lateral process is taller than the posterior process, but shorter than the anterior process. It bears at least six sub-equal denticles. In some specimens the anterior process is directed downwards. The cusp is a similar height and width to the anterior-proximal denticles. The denticles on all processes are fused and upright. The basal cavity is widest beneath the cusp. In rare specimens, there is a small sub-rounded basal flare. The basal cavity extends as grooves along the processes.

Pb element. Angulate, in which the anterior and posterior processes meet at an angle of approximately 120°. The posterior process bears up to six denticles, that are smaller and thinner than the anterior denticles, which number at least four. The denticles on both processes are fused. The basal cavity is circular beneath the cusp and extends as tapering grooves along both processes, but does not reach to the tips of the processes. White matter entirely fills the cusp and denticles.

M element. Modified tertiopedate, with two lateral processes that meet at an angle of 120°. The long, lateral process is straight and bears five discrete denticles. The shorter, lateral process is downwardly directed and bears only two denticles. The denticles on both processes are divided by u-shaped gaps. There is a posterior swelling at the base of the cusp. White matter entirely fills the cusp and denticles.

Sa element. Alate, in which the two lateral processes meet at an angle of 115°. Both processes bear at least five denticles. The denticles are fused at the base. The basal cavity is circular beneath the cusp and extends as tapering grooves part way along both processes. White matter entirely fills the cusp and denticles.

Sb element. Tertiopedate, with at least six denticles on each lateral process. The denticles are fused at the base. The posterior edge of the basal cavity is upturned. The basal cavity is circular beneath the cusp and extends as tapering grooves along both processes, not reaching the tips of the processes. White matter entirely fills the cusp and denticles.

Sc element. Bipennate, with a straight posterior process and a downwardly directed anterior process. The processes bear at least three denticles. On the posterior process they are widely spaced whereas on the anterior process they are partially fused.

Remarks. The generic assignment may be questioned as the Pa elements do not have an even-crested lateral process. This species differs from *K.* sp. A (Over & Chatterton) in that the angle between the two lateral processes is less.

The denticulation is less regular on *K.* sp. B, whereas on the Pa of *K.* sp. A it is even crested. In addition, the M and S elements found associated with *K.* sp. A have fused denticles, whereas the M and S elements of *K.* sp. B bear discrete denticles.

Occurrence. Earlton Formation, Lake Timiskaming, Ontario.

Family Spathognathodontidae Hass, 1959

Remarks. Sweet (1988) considered spathognathodontids to have an apparatus containing six or seven morphotypes, with carminate and angulate elements in the P positions, dolabrate or bipennate M elements, and alate, digyrate and bipennate elements in the Sa, Sb and Sc positions.

Genus *Ozarkodina* Branson & Mehl, 1933

Type Species. *Ozarkodina typica* Branson & Mehl, 1933.

Diagnosis. Refer to Barrick & Klapper (1976, p. 78).

Remarks. Species of *Ozarkodina* are characterised by carminate and angulate P elements. They vary in the morphology of the P and M elements, but have similar S elements. The species recovered herein can be divided in to 'types' by Pa and M element morphology:

Type I: Short Pa elements with an arched upper margin. Dolabrate M element, with a straight posterior process: *O. pirata*, *O. polinclinata.*

Type II: A long Pa element with an almost straight upper margin. Tertiopedate M element, with a downwardly directed inner-lateral process: *O. oldhamensis*, *O. hassi*, *O. masurensis*, *O. gulletensis, O. excavata sensu* Jeppsson.

Type III: A long Pa element with an almost straight upper margin. A modified tertiopedate M element, with an almost straight inner-lateral process and a short, denticulate outer-lateral process: *O. aldridgei.*

Type IV: A Pa element with wide, sub-equal denticles. Modified tertiopedate M element, with an almost straight inner-lateral process and a short, denticulate outer-lateral process: *O. protoexcavata.*

Type II and Type III have similar Pa elements, but different M elements, whereas Type III and IV have similar M elements, but different Pa elements. The evolutionary relationships between the 'types' depends upon whether it is the M element morphology, Pa element morphology or denticulation pattern which is the common feature of a lineage.

Orchard (1980) suggested that the Ordovician species *C. pseudofissilis* was ancestral to the Silurian ozarkodinids. However, *C. pseudofissilis* is more likely to represent the ancestor of *Kockelella.*

O. cf. *O. hadra* of Armstrong (1990) occurs in the *celloni* CBZ in Greenland. *O.* cf. *O. hadra* lacks the even-crested upper margin of *Kockelella*, but has more features in common with *Kockelella* than *Ozarkodina.* The Pa of this species is similar to an element of *Kockelella* sp. A. from Lake Timiskaming (Ontario). The Sa and Sb elements are particularly similar to those of *K.* sp. A. and the M element of *O.* cf. *O. hadra* is atypical of *Ozarkodina.*

Ozarkodina aldridgei Uyeno & Barnes, 1983

Pl. 5, figs 1-4

1972 *Spathognathodus* n. sp. B, Aldridge, p. 216, pl. 4, fig. 5.

*v 1983 *Ozarkodina aldridgei* Uyeno & Barnes, p. 20, pl. 3, figs 16-24; pl. 8, fig. 20.

1985 *Ozarkodina aldridgei* Uyeno & Barnes; Aldridge, p. 80, pl. 3.1, figs 24(a), 24 (b).

1995 *Ozarkodina aldridgei* Uyeno & Barnes; Simpson & Talent, p. 139-140, pl.7, fig. 1.

Holotype. *Ozarkodina aldridgei* Uyeno & Barnes, 1983, pl. 3, fig. 17. Specimen GSC 64918 from the Jupiter Formation, Anticosti Island, Québec, Canada.

Diagnosis. Refer to Aldridge (1985, p. 80).

Description. Pa element. This element has been previously described as *Spathognathodus* sp. nov. B by Aldridge (1972, p. 216).

Pb element. Angulate, with a posterior process bearing four denticles and a slightly shorter, higher anterior process, which bears three to four denticles. The cusp is twice the height and width of the denticles and there is a u-shaped gap separating it from the first posterior denticle. The cusp and denticles are laterally compressed. The denticles are separated by u-shaped gaps on the posterior process and v-shaped gaps on the anterior process. The basal cavity is widest beneath the cusp due to an extension of the inner-lateral lip. The cavity continues as a narrow groove to the tips of the processes. White matter entirely fills the cusp and denticles.

M element. Refer to the description of *Neoprioniodus multiformis* Walliser in Aldridge (1972, p. 195).

Sb element. Tertiopedate, with a long, slender cusp, which may be ornamented with longitudinal striations. The denticles are very small proximally, but increase in height and width distally. They are upright and partially fused. The base of the element is very broad. There is a small basal cavity beneath the cusp extending as tapering grooves along the processes.

Sc element. Bipennate, with an inwardly bowed and downwardly directed, anterior process and a straight posterior process. The only example recovered bears at least four denticles on the anterior process and at least five on the anterior process. The cusp and denticles are laterally compressed and completely filled with white matter. The thin basal cavity extends beneath the processes and is only slightly wider beneath the cusp.

Remarks. The Pa element of *O. aldridgei* has a straight blade bearing sub-equal denticles, fused above the basal cavity. The basal-cavity lips extend to produce a wide, sub-circular basal-cavity flare. Uyeno & Barnes (1983) erected *O. aldridgei*, but did not write a diagnosis or describe the elements in detail. The multielement reconstruction figured by Uyeno & Barnes (1983) is followed herein.

Occurrence. Jupiter Formation (Ferrum Member), Anticosti Island, Québec.

Ozarkodina excavata (Branson & Mehl, 1933) *sensu* Jeppsson.
Pl. 5, figs 5-9

1933 *Ozarkodina simplex* Branson & Mehl, p. 52, pl. 3, figs 46, 47.
1933 *Prioniodus excavatus* Branson & Mehl, p. 45, pl. 3, figs 7, 8.
1971 *Neoprioniodus excavatus* Branson & Mehl; Rexroad & Craig, p. 692, pl. 80, figs 6-9.
1974 *Hindeodella excavata* Jeppsson, pl. 4, figs 1-17.
1976 *Ozarkodina excavata excavata* (Branson & Mehl); Barrick & Klapper, p. 78-79, pl. 4, figs 13-23, 26.
1985 *Ozarkodina excavata excavata* (Branson & Mehl); Savage, p. 722, fig. 14, A-L.

Neotype. *Neoprioniodus excavata* Branson & Mehl; Rexroad & Craig, 1971, pl. 80, fig. 7. Specimen from sample 2, Bainbridge Formation, Lithium, Missouri, U. S. A.

Diagnosis. Refer to Jeppsson (1974, p. 29).

Description. Refer to Jeppsson (1974, p. 29-).

Remarks. Jeppsson (1974) reconstructed the multielement apparatus of this species. The elements found herein are similar to those depicted by Barrick & Klapper (1976) and Savage (1985).

Occurrence. Chicotte Formation, Anticosti Island, Québec.

Ozarkodina gulletensis (Aldridge, 1972)
Pl. 6, figs 1-5

	1965	*Spathognathodus* cf. *celloni* Walliser; Brooks & Druce, p. 377, pl. 12, figs 2, 3.
*	1972	*Spathognathodus gulletensis* Aldridge, p. 212-213, pl. 4, figs 9-12.
	1975	*Ozarkodina gulletensis* (Aldridge), Aldridge, pl. 2, figs 7, 8.
	1980	*Ozarkodina gulletensis* (Aldridge); Helfrich, p. 568, pl. 2, figs 21-24, 26-29.
v	1983	*Ozarkodina gulletensis* (Aldridge); Uyeno & Barnes, p. 21, pl. 4, figs 11-14, 16, 17, 19.

Holotype. *Spathognathodus gulletensis* Aldridge, 1972, pl. 4 fig. 9. Specimen X.577, from the Wych Formation, Gullet Quarry, Welsh Borderlands, Britain.

Diagnosis. The Pa element has been diagnosed by Aldridge (1972, p. 212).

Description. Pa element. This carminate element has been previously described as *Spathognathodus gulletensis* by Aldridge (1972, p. 212-213). The specimens herein bear five to eight denticles on the anterior process and four to eight posterior denticles; they decline in height and are inclined distally. In rare specimens the inner lip of the basal cavity is extended to produce a short inner-lateral process bearing one denticle. White matter distribution is variable. It may fill each denticle from the root to the tip, or only to mid-height. Submerged blocks of white matter are often seen especially adjacent to the cusp. The base of the white matter defines an upwardly inclined line, which is furthest from the basal margin at the distal tip of the anterior process.

Pb element. This angulate element has been described as *O. alisonae* by Aldridge (1972, p. 198-199). In the specimens herein, the processes meet at an angle of approximately 120-130°. In rare specimens, there is a central costa on the outer face of the cusp.

M element. Identification of the shape category of this element is problematic as only two poorly preserved specimens have been recovered. Both fragments have one lateral process and a slight posterior swelling at the base of the cusp. The lateral process is steeply inclined downwards and bears at least four erect, compressed denticles, which are fused to midheight. The cusp is tall, broad, and anterio-posteriorly compressed. White matter completely fills the denticles and cusp.

Sa element. Alate, with two lateral processes and a small posterior expansion of the basal margin. The lateral processes are directed downwards and are separated by an angle of approximately 90°. The lateral processes bear at least four denticles. The denticles are erect, compressed and fused to midheight. The cusp is at least four times taller than the denticles; it is compressed antero-posteriorly, with central costae running down its lateral edges. Beneath the cusp, the basal cavity is oval in shape and the anterior edge is downwardly extended. The cavity extends beneath the processes as a very narrow groove. White matter entirely fills the denticles and cusp.

Sb element. Modified tertiopedate, with two lateral processes and a posterior expansion of the basal cavity. The lateral processes are directed downward and meet at 90°. The cusp is compressed with costae running centrally down the lateral faces. The denticles are the same as those on the Sa and M elements. The basal cavity is more rounded than that of the Sa element. White matter entirely filling cusp and denticles.

Sc element. Bipennate, with an inwardly and downwardly deflected anterior process bearing at least five denticles; in all specimens the posterior process is broken. The denticles are the same as those on the other S elements. The cusp is very tall and a costa extends down both lateral faces. The basal cavity is very narrow and extends along the processes, as a groove. White matter completely fills the denticles and cusp.

Remarks. The posterior-distal end of the Pa element is lower than the anterior-distal end. The denticles are broad and the basal-cavity flare is sub-circular. The multielement reconstruction followed herein is that originally proposed by Helfrich (1980).

Uyeno & Barnes (1983) figured this species from Anticosti Island. The Sa and Sb elements figured by Uyeno & Barnes (1983) are not typical of *Ozarkodina gulletensis* and more closely resemble the Sa and Sb elements of *Aulacognathus bullatus* (see pl. 4, fig. 16 and 19). Uyeno & Barnes (1983) suggested that the Pb, Sa, Sb and Sc of *O. gulletensis* were shared with *O. polinclinata*. However, within this study Pb, Sa, Sb and Sc elements of *O. polinclinata* and *O. gulletensis* are morphologically distinct.

The elements of *O. gulletensis* recovered from Lake Timiskaming are much larger and more robust than those recovered from Anticosti Island.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario; Jupiter (Pavillion Member) and Chicotte Formations, Anticosti Island, Québec.

Ozarkodina hassi (Pollock, Rexroad & Nicoll, 1970)
Pl. 6, figs 6,7

*	1970	*Spathognathodus hassi*, p. 760-761, pl. 111, figs 8-12.
	1975	*Ozarkodina hassi* (Pollock *et al.*); Aldridge, pl. 2, fig. 22.
	1975	*Ozarkodina hassi* (Pollock *et al.*); Cooper, p. 1005, pl. 3, figs 7-12.
	1990	*Ozarkodina hassi* (Pollock *et al.*); Armstrong, p. 92, pl. 13, figs 10-16.

Holotype. *Spathognathus hassi* Pollock, Rexroad & Nicoll, 1970, pl. 111, fig. 9. Sample 7-2 from the lower Llandovery of Manitoulin Island, Ontario, Canada.

Diagnosis. Refer to Armstrong (1990).

Description. Refer to McCracken & Barnes (1981, p. 83)

Remarks. The apparatus of *O. hassi* is morphologically similar to that of *O. oldhamensis*. The Pa element of *O. hassi* has larger, more discrete denticles, more unequal anterior denticles, a more prominent cusp and a less extensive basal-cavity flare, than that of *O. oldhamensis*. The Pb element of *O. hassi* has shorter processes, a wider cusp, and a less bowed aboral margin than the Pb element of *O. oldhamensis* (McCracken & Barnes, 1981). The S and M elements of *O. hassi* and *O. oldhamensis* appear to be indistinguishable based on known collections.

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario; Ellis Bay (Laframboise Member) and Becscie Formations, Anticosti Island, Québec; Transitional limestone, Prongs Creek, northern Yukon.

Ozarkodina masurensis Bischoff, 1986.

Pl. 7, figs 1-4

* 1986 *Ozarkodina masurensis* Bischoff, p. 141-144, pl. 22, figs 22- 40; pl. 23, figs 1-20.

Holotype. *Ozarkodina masurensis* Bischoff, 1986, pl. 22, fig. 31. Specimen MU42273 from the Bagdad Formation (Bridge Creek Limestone Member), New South Wales, Australia.

Diagnosis. Refer to Bischoff (1986, p. 141).

Description. Refer to the description in Bischoff (1986, p. 141-145).

Remarks. The distinctive Pa element of *O. masurensis* has an angled, lower margin and a very small, proximal-posterior denticle, resulting in a v-shaped gap when the upper margin is viewed laterally (Bischoff, 1986).

This species has only been previously recorded by Bischoff (1986) from the late *cyphus* to early *triangulatus* GBZs in New South Wales, Australia. However, *S. inclinatus* (Rhodes) figured by Aldridge (1972, pl. 4, fig. 16) from the Welsh Borderlands, is similar to this species in that the proximal denticles are smaller than the cusp.

Occurrence. Transitional Limestone Unit and Road River Group, Prongs creek, northern Yukon.

Ozarkodina cf. *O. masurensis* Bischoff, 1986.
Pl. 8, figs 10, 11

cf. 1986 *Ozarkodina masurensis* Bischoff, p. 141-144, pl. 22, figs 22-40; pl. 23, figs 1-20.

Description. Pb element. Refer to the description in Bischoff (1986, p. 142).

Remarks. The Pb element recovered herein matches the description of the corresponding element within *O. masurensis* by Bischoff (1986). However, in the absence of other elements it cannot be definitely identified. The elements recovered herein are also younger than the elements of *O. masurensis* recorded by Bischoff (1986). Uyeno & Barnes (1983, pl. 1, fig. 17) figured an element similar to this from the Jupiter Formation (Anticosti Island), which they classified as a Pb element of *O. pirata*.

The Pb element of *O. broenlundi* figured by Armstrong (1990, pl. 12, fig. 7) has the same general shape as the elements recovered herein, but differs in the thickness of the denticles.

Occurrence. Jupiter Formation (Ferrum Member), Anticosti Island, Québec.

Ozarkodina oldhamensis (Rexroad, 1967)
Pl. 6, figs 8-13

* 1967 *Spathognathodus oldhamensis* Rexroad, p. 49-50, pl. 3, figs 1-2.
1975 *Ozarkodina oldhamensis* (Rexroad); Aldridge, pl. 3, figs 16-17.
1975 *Ozarkodina oldhamensis* (Rexroad); Cooper, p. 1005-1006, pl. 3, figs 13-14.
v 1981 *Ozarkodina oldhamensis* (Rexroad); McCracken & Barnes, p. 111, pl. 7, figs 3, 5, 14-18.

Holotype. *Spathognathodus oldhamensis* Rexroad, pl. 3, fig. 2. Specimen 10068 from the Brassfield Formation, Cincinnati Arch, U. S. A.

Diagnosis. The Pa element has been diagnosed by Rexroad (1967, p. 49).

Description. Refer to McCracken & Barnes (1981, p. 84).

Remarks. The elements of *O. oldhamensis* are morphologically very similar to those of *O. hassi*. The differences between the Pa and Pb elements of *O. oldhamensis* and *O. hassi* are discussed under the remarks for *O. hassi*. The M and S elements of *O. oldhamensis* can not be distinguished from those of *O. hassi*.

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario; Ellis Bay (Laframboise Member), Becscie, Merrimack, and Jupiter (Base of Goéland Member) Formations, Anticosti Island, Québec; Transitional limestone, Prongs Creek, northern Yukon.

Ozarkodina pirata Uyeno & Barnes, 1983

Pl. 7, figs 5-11

1981	*Ozarkodina* n. sp. C Uyeno & Barnes, pl. 1, fig. 2.
*p 1983	*Ozarkodina pirata* Uyeno & Barnes, p. 21, pl. 1, figs 16, 21-25; pl. 2, figs 12-13, 19-28, *non* pl. 1, fig 17, ?pl. 2, fig. 19.
? 1990	*Ozarkodina pirata* Uyeno & Barnes; Armstrong, p. 94, pl. 13, figs 20-23; pl. 14, figs 1-8.
? 1990	*Ozarkodina* n. sp. C, Armstrong, p. 96-98, pl. 14, figs 17-20.

Holotype. *Ozarkodina pirata* Uyeno & Barnes, 1983, pl. 2, fig. 12. Specimen G.S.C. 64831 from the Jupiter Formation, Anticosti Island, Québec, Canada.

Diagnosis. Refer to Uyeno & Barnes (1983, p.21).

Description. Pa element. A carminate element described previously by Uyeno & Barnes (1983, p. 21). On the specimens herein, the anterior process bears at least six denticles and the shorter posterior process bears three or four denticles. The anterior denticles are taller than those on the posterior process. The inner lip of the basal cavity is upturned. White matter fills the cusp and denticles. In lateral view, the trace of the lower edge of the white matter forms a downwardly-convex line.

Pb element. Refer to the description by Uyeno & Barnes (1983, p. 21). Angulate, with an anterior process bearing at least four denticles and the shorter posterior process bears one or two denticles. The denticles on each process decrease in height distally and are fused at the base. White matter fills the cusp and denticles.

M element. Refer to the description by Uyeno & Barnes (1983, p. 21). A dolabrate element with a rounded antero-basal corner. There is a slight inner swelling of the basal cavity below the cusp and the inner lip of the basal cavity is upturned. White matter fills the cusp and denticles in individual blocks.

Sb element. Tertiopedate, the inner-lateral process bears four denticles and the longer outer-lateral processes bears at least five denticles. The outer-lateral process is more downwardly directed than the inner-lateral process. The denticles are fused only at the base. They are small adjacent to the cusp, but increase in width and height distally. The basal cavity is small and sub-circular beneath the cusp and extends along the processes as grooves. The posterior lip of the basal cavity is upturned, so that the basal cavity can be seen in posterior view.

Sc element. Bipennate, with a straight posterior process and an inwardly bowed and downwardly directed anterior process. The denticles are laterally compressed, fused at the base and inwardly bowed. The cusp is broad at the base and tapers with height. It is at least twice the height of the denticles. The basal cavity is narrow, but slightly wider below the cusp, and extends as a narrow groove. White matter fills the cusp and denticles.

Remarks. Uyeno & Barnes (1983) diagnosed this as a species of *Ozarkodina* with a Pa element that has a straight lower margin, a convex upper margin, a restricted basal cavity and bears uneven denticles. They illustrated three dissimilar Pb elements, two M, two Sa, and two Sc elements within the apparatus of *O. pirata*. Some of these elements (pl. 2, fig. 20, 23, 26) are more likely to represent the elements of *Pseudolonchodina fluegeli.*

Armstrong (1990) emended the diagnosis of *O. pirata.* The original diagnosis is preferred as the P elements differ from those described by Armstrong (1990) in that the anterior denticles are larger than those on the posterior. The elements illustrated by Armstrong (1990) are more closely similar to *O. polinclinata.*

Occurrence. Becscie, Merrimack, Gun River (Sandtop Member) and Jupiter (Goéland and East Point Members) Formations, Anticosti Island, Québec.

Ozarkodina polinclinata (Nicoll & Rexroad, 1969)

Pl. 8, figs 1-5

* 1969 *Spathognathodus polinclinatus* Nicoll & Rexroad, p. 60, pl. 2, figs 19, 20.

1972 *Spathognathodus polinclinatus* Nicoll & Rexroad; Aldridge, p. 214-215, pl. 4, fig. 13.

1977 *Ozarkodina polinclinata* (Nicoll & Rexroad); Cooper, p. 1058-1062, pl. 1, figs 11, 13-15, 17, 28.

v 1983 *Ozarkodina polinclinata* (Nicoll & Rexroad); Uyeno & Barnes, p. 22, pl. 5, figs 11-16, 19.

? 1995 *Ozarkodina polinclinata* (Nicoll & Rexroad); Simpson & Talent, p. 154-156, pl. 10, figs 8-9.

Holotype. *Spathognathodus polinclinatus*, Nicoll & Rexroad, 1969, pl. 2, fig. 19. Specimen 11427 from the Brassfield Formation, Jefferson County, Indiana, U. S. A.

Diagnosis. The Pa element has been diagnosed by Nicoll & Rexroad (1969 p. 60).

Description. Pa element. This has been previously described as *Spathognathodus polinclinatus* Nicoll & Rexroad by Aldridge (1972, p. 214-215). Carminate, with an anterior process bearing at least seven denticles and a shorter posterior process bearing only four denticles. The denticles on both processes increase in height proximally. The denticles on the posterior process are inclined posteriorly, whereas those on the anterior process are upright, but may become inclined anteriorly at the distal end of the process. The denticles can be squat, but more commonly are tall and completely fused. White matter fills the cusp and denticles.

Pb element. This element has been described by Aldridge (1972, p. 200-201) as *Ozarkodina hanoverensis* Nicoll & Rexroad. A carminate element with posteriorly inclined denticles, apart from the anterior-most denticle, which is upright. There are three denticles on the anterior and at least five on the posterior process. The denticles are fused almost to their tips. The anterior denticles are taller and wider than those on the posterior process. White matter fills the cusp and denticles.

M element. Dolabrate, bearing approximately five denticles on the posterior process. The denticles are inclined towards the posterior and are fused only at the bases. The cusp is wide and the antero-basal angle is rounded. White matter fills the cusp. The basal cavity is widest beneath the cusp and tapers to the tip of the posterior process.

Sa element. This has been previously described by as *Trichonodella papilio* by Nicoll & Rexroad (1969, p. 65).

Sb element. This modified tertiopedate element has been previously described as *Trichonodella asymmetrica* Nicoll & Rexroad by Aldridge (1972, p. 217). The inner-lateral process bears at least six denticles, whereas the shorter and less steeply inclined outer-lateral process bears at least four denticles. The lower angle between the two processes is 90°. The denticles are discrete and separated by v-shaped gaps. The denticles on the inner-lateral process initially increase in height distally, but on the distal half of the process decrease in height distally. The cusp is slender and tall and the denticles are compressed and triangular in outline. There is a posterior inflation of the basal cavity beneath the cusp. White matter completely fills the cusp and denticles.

Sc element. A bipennate element that has been previously described by Cooper (1977, p. 1061). The very long posterior process, bearing at least 10 partially fused denticles, curves inwardly distally. The short anterior process bears only one discrete denticle. On the posterior process the proximal denticles are upright, but more distal denticles are inclined posteriorly. The denticles on the posterior process initially increase in height distally, but on the distal third of the process, decrease in height distally. There is thickening of the base below the line of denticles, which is more pronounced in the specimens from Anticosti Island. The basal cavity is a very narrow groove extending along the processes.

Remarks. The Pa element of *O. polinclinata* characteristically has a straight blade bearing slender, sub-equal denticles, and a small, narrow basal cavity. The other elements are all delicate. The S elements bear very long, slender denticles. The elements recovered from Anticosti Island are more robust than those recovered from Lake Timiskaming.

The M element is dolabrate and is morphologically similar to that of *P. fluegeli*, but can be differentiated from that species by the more rounded nature of its antero-basal corner.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario; Jupiter (Pavillion and Chicotte Formations, Anticosti Island, Québec.

Ozarkodina protoexcavata Cooper, 1975

Pl. 8, figs 6-9

? 1970 *Ozarkodina* sp. n A Pollock *et al.*, p. 757, pl. 113, figs 5-8.?

1970 *Ozarkodina* sp. n. B Pollock *et al.*, p. 757, pl. 113, figs 9-11.

? 1970 *Ligonodina*? *variablis* Nicoll & Rexroad; Pollock *et al.*, p. 755, pl. 114, fig.12.

1975 *Ozarkodina protoexcavata* Cooper, p. 1006, pl. 3, figs 1-6.

? 1994 *Ozarkodina excavata puskuensis* subsp. n., Männik, p. 187-190, pl. 1, figs 1-10; pl. 2, figs 1-13.

Holotype. 1975 *Ozarkodina protoexcavata* Cooper, p. 1006, pl. 3, figs 1-6.

Diagnosis. Refer to Cooper (1975, p. 1006).

Description. The P and S elements have been described by Cooper (1975, p.1006). The M element fits the description of the M element of *O. excavata puskuensis* by Männik (1994, p. 188)

Remarks. Cooper (1975) erected this species and described the multielement apparatus. The M element figured by Cooper (1975, pl. 3, fig. 5) appears to be a broken Pb element.

Männik (1994) diagnosed and described *O. excavata puskuensis,* which has a very similar apparatus to *O. protoexcavata*. Männik (1994) regarded the main differences to be that *O. protoexcavata* elements are more compressed and have wider, more fused denticles than *O. e. puskuensis*. The elements herein have wider cusps and denticles than those figured by Männik (1994) and so have been placed within *O. protoexcavata*. It is possible that these taxa are ecophenotypes.

Occurrence. Becscie and Merrimack Formations, Anticosti Island, Québec.

Ozarkodina sp. A

Pl. 8, fig. 12

Remarks. The Pa element only has been recovered. It is carminate, with a posterior process bearing three broad denticles, which are posteriorly inclined. The anterior process bears eight thinner denticles, which are anteriorly inclined. The basal cavity is very distinctive. It forms a wide, deep groove running along the anterior process and the most proximal part of the posterior process.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario.

Ozarkodina cf. *O.* sp. C, Armstrong 1990.

Pl. 7, figs 12,13

cf. 1990 *Ozarkodina* n. sp. C, Armstrong, p. 96-98, pl. 14, figs 17-20.

Remarks. The Pa element of this species is identical to that of *O.* sp. C Armstrong, but the other elements are different. Armstrong (1990) remarked that the apparatuses of *O.* sp. C and *O. excavata* are closely similar differing in the basal cavity and posterior process morphology of the Pa element. He suggested that *O.* sp. C could be a stratigraphic or geographic variant of *O. excavata*.

The Pa element recovered herein, is similar to that of *O. excavata puskuensis*, but differs in that the cusp is less prominent and the anterior process is longer than that of *O. excavata puskuensis*. The Pb elements of the two species are disimilar.

In Greenland, *O.* sp. C has been recovered from the basal Aeronian, Silurian carbonate Formation 1 (Wulff Land) and the mid Aeronian, lower Odins Fjord Formation of Central Peary Land (Armstrong, 1990).

Occurrence. Earlton Formation, Lake Timiskaming, Ontario.

Order Prioniodinida Sweet, 1988

Remarks. Sweet (1988) regarded the prioniodinid apparatus as containing six or seven morphotypes, with a extensiform or breviform digyrate element in one or both of the P positions. The morphotypes are typically stout with discrete, peg-like denticles. The elements within an apparatus tend to be of a similar size, and are inter-gradational morphologically, which has led to confusion over the homology of elements between species (Sweet, 1988).

The determination of the prioniodinid apparatus architecture has been hampered by the lack of abundant bedding plane assemblages and clusters of prioniodinids (Purnell & Donoghue, 1998). Purnell (1993) recognised homologies between ozarkodinids and prioniodinids, and consequently the ozarkodinid plan is applied to prioniodinids (Purnell & Donoghue, 1998).

Family Prioniodinidae Bassler, 1925

Remarks. Sweet (1988, fig. 5.28) illustrated this family as consisting of Ordovician to Devonian genera, which evolved from the 'root stock', *Oulodus*. Aldridge & Smith (1993) included *Pseudolonchodina* within this family. *Pseudolonchodina* differs from *Oulodus* only in the compressed nature of its elements and the shape of the Pa element. The ancestry of *Pseudolonchodina* is currently unknown and needs to be elucidated before it can be confidently assigned within this Family. Multiple Sb and Sc elements have not been differentiated within any of the Prioniodinidae genera studied herein, apart from *Pseudlonchodina*.

Genus *Oulodus* Branson & Mehl, 1933

Type species. *Cordylodus serratus* Stauffer, 1930.

Diagnosis. Refer to Sweet & Schönlaub (1975, p. 45).

Remarks. Sweet & Schönlaub (1975) considered *Oulodus* as comprising species with six morphotypes, which bore 'stout, discrete, peg-like' denticles, separated by u-shaped gaps. Species of *Oulodus* are distinguished by the general morphology of the elements, but the Sc elements may show less inter-species variation.

McCracken & Barnes (1981) tentatively included *Oulodus*? *nathani* and *O.*? *kentuckyensis* within *Oulodus*, on the basis of the general shape of the elements, but considered the Pa elements to be sufficiently different to warrant distinction. These elements are more similar to those of *Ozarkodina* or *Kockelella*.

Within this study, two sets of species currently classified within *Oulodus* have been identified:

Type I. *O. ulrichi*, *O. rohneri*, and *O. panuarensis*

Type II. *O. robustus, O.* ? *nathani*, *O.* ? *kentuckyensis*, and *O. petilus*

Type I species have dolabrate M elements and Sa elements with lateral processes meeting at an angle of less than 90°. Type II species have modified tertiopedate M elements and Sa elements with lateral processes separated by an angle greater than 90°. If the categories represent true evolutionary groups, it is conceivable that the Silurian species *O. panuarensis* evolved from an Upper Ordovician species of *Oulodus* such as *O. rohneri* or *O. ulrichi*, whereas, the Silurian species within Type II may have evolved from *O. robustus*.

Oulodus ? kentuckyensis (Branson & Branson, 1947)
Pl. 9, figs 10-15

* 1947 *Ligonodina kentuckyensis* Branson & Branson, p. 555, pl. 82, figs 28, 35.

p 1975 *Oulodus* sp. A Cooper, p. 997, pl. 2, figs 12, 16, 18, 19, 21.

p 1975 *Oulodus* sp. B Cooper, p. 997-998, pl. 2, figs 15, 17, 20, 22.

v 1981 *Oulodus ? kentuckyensis* (Branson & Branson); McCracken & Barnes, p. 80, pl. 6, figs 1-20.

Holotype. *Ligonodina kentuckyensis* Branson & Branson, 1947, pl. 82, figs 28, 35. Specimen C674-5 from the Brassfield Formation, Kentucky, U. S. A.

Diagnosis. Refer to McCracken & Barnes (1981, p. 80).

Description. Refer to the description of modified oulodiform (= Pa), lonchodiniform (= Pb), euprioniodiniform (= M), trichonodelliform element (= Sa), zygognathiform (= Sb) and ligonodiniform (= Sc) in McCracken & Barnes (1981, p. 80-81).

Remarks. The elements of *O.? kentuckyensis* bear slightly compressed denticles, separated by u-shaped gaps. The Sc element was initially recovered by Branson & Branson (1947). Later, Cooper (1975) figured elements within the multielement reconstruction of *Oulodus* sp. A. and *Oulodus* sp. B, which were assigned by McCracken & Barnes (1981) in their full reconstruction of *O.? kentuckyensis*.

O. angullongensis Bischoff ranges through the *combinatus* to *pseudopedavis* CBZs of New South Wales. The Pa, Sa and Sc elements of *O. angullongensis* Bischoff (1986, p. 69-72) are comparable to those of *O.? kentuckyensis*, but the Pb, M and Sb elements of the two species differ (Bischoff, 1986).

Occurrence. Becscie, Merrimack and Gun River (Sandtop Member) Formations, Anticosti Island, Québec; Transitional Limestone Unit, Prongs Creek, northern Yukon.

Oulodus? *nathani* McCracken & Barnes, 1981

Pl. 9, figs 8,9

*v 1981 *Oulodus*? *nathani* McCracken & Barnes, p. 81, pl. 6, figs 21-32.

Holotype. *Oulodus*? *nathani* McCracken & Barnes, 1981, pl. 6, fig 32. Specimen G.S.C. 60165 from the Becscie Formation, Anticosti Island, Québec, Canada.

Diagnosis. Refer to McCracken & Barnes (1981, p. 81).

Description. Refer to the description of blade (= Pa), lonchodiniform (= Pb), euprioniodiniform (= M), trichonodelliform element (= Sa), zygognathiform (= Sb) and ligonodiniform (= Sc) in McCracken & Barnes (1981, p. 82).

Remarks. The elements of *O.*? *nathani* bear compressed denticles, which are separated by v-shaped gaps. V-shaped gaps between denticles are atypical of the genus *Oulodus*.

Occurrence. Ellis Bay (Laframboise Member) and Becscie Formations, Anticosti Island, Québec; Transitional Limestone Unit, Prongs Creek, northern Yukon.

Oulodus cf. *O. panuarensis* Bischoff, 1986

Pl.10, figs 1-6

v 1983 *Oulodus* sp. A Uyeno & Barnes, p. 19, pl. 1, figs 14, 15, 18-20.

Description. Pa element. Digyrate, with an inner-lateral process bearing at least four distally inclined denticles, and an outer-lateral process with at least three upright denticles. The denticles are separated by wide u-shaped gaps. The cusp is inclined to the posterior. There is a wide basal-cavity flare beneath the cusp, which is shallow and sub-rounded in outline. The basal cavity extends as tapering grooves beneath the lateral processes.

Pb element. This has previously been described as the Pa element of *O. panuarensis* by Bischoff (1986, p.76). Digyrate, with an anteriorly twisted inner-lateral process, and a long, straight outer-lateral process. The outer-lateral process bears six denticles and the inner-lateral process bears two. The denticles on both processes are compressed and are separated by wide, u-shaped gaps. Beneath the cusp and proximal part of the inner-lateral process, the basal cavity is wide and shallow. The cavity extends as tapering groove to the tips of the processes.

M element. Refer to the description in Bischoff (1986, p.76).

Sa element. Alate, with two lateral processes, which diverge at angle of approximately 70 to 80°. The cusp is very long and strongly curved to the posterior. The lateral processes bear at least four denticles, which are interspersed with wide, u-shaped gaps. The denticles are triangular, inwardly directed, and increase in height distally. The basal cavity is very deep below the cusp and extends as tapering grooves along the processes.

Sb element. Tertiopedate, with two lateral processes and a posterior projection of the base of the cusp. The angle between the lateral processes is approximately 60°. The lateral processes bear at least three denticles, which are separated by wide, u-shaped gaps. The basal cavity is deep beneath the cusp and extends as narrow grooves along the lateral processes.

Sc element. Refer to the description in Bischoff (1986, p.76-77).

Remarks. The Pb (= Pa of Bischoff), M and Sc elements of this species are indistinguishable from the corresponding elements in *O. panuarensis*, *sensu* Bischoff (1986, p. 76-77). However, the Pa, Sa, and Sb elements of this species contrast with the corresponding elements figured by Bischoff (1986).

An M element comparable to that of *O.* cf. *O. panuensis* has been described from the lower Silurian of the American midcontinent, as *Neoprioniodus planus* Walliser (Rexroad, 1967, pl. 3, fig. 11), *Neoprioniodus* cf. *N. excavatus* (Branson & Mehl) (Pollock *et al.*, 1970, pl. 114, fig. 20), and *Oulodus* sp. B Cooper (1975, pl. 2, fig. 22). The Sa elements have been figured in Rexroad (1967, *Trichonodella* cf. *T. inconstans* Walliser, pl. 3, fig. 19) from the American midcontinent, and the M and Sb elements have been recorded from Greenland by Armstrong (1990, *Oulodus* spp. indet. group 8, pl. 12, figs 1-3).

Occurrence. Becscie, Merrimack, and Jupiter (Goéland and East Point Members) Formations, Anticosti island, Québec; Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Oulodus petilus (Nicoll & Rexroad, 1969)
Pl. 10, figs 7-12

*	1969	*Ligonodina petila* Nicoll & Rexroad, p. 38, pl. 5, figs 20-22.
p?	1975	*Oulodus jeannae* Sweet & Schönlaub, p. 49-51, pl. 1, figs 13-24.
pv	1983	*Oulodus ?fluegeli* subsp. A. Uyeno & Barnes, p. 19, pl. 7, figs 11-22.
n	1991b	*Aspelundia petila* (Nicoll & Rexroad); McCracken, p. 75. pl. 1, figs 1-4, 7-9,11-12, 15-16, 18, 25, 28-30; pl. 2, figs 1-2, 5-6, 9, 12, 16, 26-28, 30-31.

Holotype. *Ligonodina petila* Nicoll & Rexroad, 1969, pl. 5, fig. 22. Specimen 11357 from the Brassfield Limestone, Indiana, U. S. A.

Diagnosis. Refer to Barrick & Klapper (1976, p. 69).

Description. The Pa, Sa and Sb elements have been previously described by Sweet & Schönlaub (1975, p. 50). The Pb (= *Diadelognathus* n. sp. A and *Diadelognathus excertus* therein), M (= *Diadelognathus* n. sp. B therein) and Sc (=*Ligonodina petila* therein) elements have been described by Nicoll & Rexroad (1969).

Remarks. The diagnostic features of *O. petilus* are the widely spaced denticles on all elements, and the wide, posteriorly flared basal cavities of the Pb, M and Sb elements (Savage, 1985). Elements of this species were first recovered by Nicoll & Rexroad (1969) and partial apparatus reconstructions were discussed by Sweet & Schönlaub (1975), Barrick & Klapper (1976) and Uyeno & Barnes (1983).

Bischoff (1986) described a lineage of *Oulodus* with a similar apparatus to *O. petilus*, involving the evolution from *O. australis* (*pseudopedavis* to *celloni* CBZs) to *O. rectangulus* (*celloni* to *ranuliformis* CBZs), and subsequently *O. sinuosus* (*ranuliformis* CBZ). Savage (1985) reconstructed *Oulodus petilus pacificus* from the *amorphognathoides* and *ranuliformis* CBZs of Alaska, which he differentiated from *O. petilus jeannae,* as the M had a larger basal cavity and the S elements more-widely extended processes. Bischoff (1986, pl. 19, figs 8-12) figured Sa elements similar to those figured by Savage (1985, fig. 11, K-L), which he classified as *O. rectangulus* or *O. sinuosus*. It is possible that a similar evolutionary lineage to that observed by Bischoff (1986) can also be traced in the evolution of *O. petilus*.

Occurrence. Eventurel Creek, Earlton and Thornloe Formations, Lake Timiskaming, Ontario; Jupiter (Ferrum and Pavillion Members) and Chicotte Formations, Anticosti Island, Québec.

Oulodus robustus (Branson, Mehl & Branson, 1951)

Pl. 9, figs 1-3

*	1951	*Eoligonodina robusta* Branson, Mehl & Branson, p. 15, pl. 4, figs 33, 35-37.
	1968	*Plectodina robusta* (Branson, Mehl & Branson); Kohut & Sweet, p. 1471, pl. 185, figs 12, 14, 15, 17, 24.
	1975	*Oulodus robustus* (Branson, Mehl & Branson); Sweet & Schönlaub, p. 48-49, pl. 2, figs 7-12.
v	1981	*Oulodus robustus* (Branson, Mehl & Branson); McCracken & Barnes, p. 79, pl. 4, figs 1-6.
	1988	*Oulodus robustus* (Branson, Mehl & Branson); Barnes, pl. 2, figs 1-3, 6-8.

Holotype. *Eoligonodina robusta* Branson, Mehl & Branson, 1951, pl. 4, fig. 33. Specimen C756-2 from the Richmondian of Kentucky and Indiana, U. S. A.

Diagnosis. Refer to Sweet & Schönlaub (1975, p. 49).

Description. The elements have been described as *Plectodina robusta* by Kohut & Sweet (1968). The Pa has been described as the prioniodiform element of this apparatus by McCracken & Barnes (1981, p.79).

Remarks. *O. robustus* is characterised by comparatively large elements, which bear stout, discrete denticles, which are sub-circular in outline (Sweet & Schönlaub, 1975). Kohut & Sweet (1968) attempted a multielement reconstruction of *O. robustus*, which was later discussed by Sweet & Schönlaub (1975). McCracken & Barnes (1981) added the Pa (= prioniodiform therein) element to the apparatus.

Occurrence. Ellis Bay Formation (Lousy Cove and Laframboise Members), Anticosti Island, Québec.

Genus *Pseudolonchodina* Zhou *et al.*, 1981

Type Species. *Pseudolonchodina irregularis* Zhou, Zhai & Xian, 1981.

Diagnosis. Refer to the generic diagnosis of *Aspelundia* by Armstrong (1990, p. 49)

Remarks. The elements of *Pseudolonchodina* are highly compressed. The apparatus comprises Pa, Pb, M, Sa, Sb and Sc elements. Multiple M and S elements have been identified within the apparatus. Zhou *et al.* (1981) erected *Pseudolonchodina* from specimens recovered from Chinese sections. Elements of species of *Pseudolonchodina* were later recovered by Savage (1985) and Armstrong (1990), but were assigned to a new genus, *Aspelundia*. *Pseudolonchodina* was not recognised as a senior synonym, due to the poor quality of the original illustrations, until a restudy of the Chinese material (Aldridge *pers. comm.*).

Armstrong (1990) was the first to recognise and differentiate two species: *P. fluegeli* (Walliser) and *P. expansa.* Armstrong (1990) regarded the main differences between the two species to be the morphology of the Pb and Sb elements and the extent of the basal cavity. McCracken (1991b) noted that corresponding elements in the two species differ in their denticulation, and that the morphology of the Sc elements differed. The *c* (Sa), *f* (Pa), and *g* (Pb) elements differ in the angle of process divergence between species. The apparatus reconstruction of the *Pseudolonchodina* apparatus differed between the studies of McCracken (1991b) and Armstrong (1990), in that McCracken (1991b) did not differentiate two Sb elements, and the morphology of the Pb elements differed.

Pseudolonchodina capensis (Savage, 1985)

Pl. 11, figs 1-11

*	1964	?*Roundya trichondelloides* Walliser, p. 72, pl. 6, fig. 2; pl. 31, figs 22-25.
?	1981	*Pseudolonchodina irregularis*; Zhou *et al.*, p. 136-137, pl. 1, figs 45-47.
	1985	*Aspelundia capensis* Savage, p. 725-726, fig. 19, A-T.
?	1985	*Oulodus fluegeli* (Walliser); Savage, p. 718-719, fig. 10, A-S.
	1985	*Pandorinellina plana* (Walliser); Savage, p. 724-725, fig. 18, A-Y.
	1986	*Oulodus planus borenorensis* Bischoff, p. 84-86, pl. 20, figs 8-16.
	1987a	*Oulodus* ? n. sp. 2 Over & Chatterton, pl. 5, figs 18-26.
?	1990	*Aspelundia* n. sp. 1 (Over & Chatterton), Armstrong, p. 55, pl. 3, fig. 10.
	1991b	*Aspelundia capensis* Savage?; McCracken, pl. 1, figs 18-20.
?	1993	*Oulodus* ? sp. nov. 2 Over & Chatterton; Xia, pl. II, figs 2-4, 6-12; pl. III, fig. 1.
	1995	*Pseudolonchodina borenorensis* (Bischoff); Simpson & Talent, p. 110-111, pl. 1, fig. 2.

Holotype.? *Roundya trichondelloides* Walliser, 1964, pl. 31, fig. 22. Specimen from the Llandovery of Cellon in the Carnic Alps.

Emended diagnosis. Refer to Bischoff (1986, p. 84).

Description. The elements have been previously described in the literature by Bischoff (1986) and Savage (1985).

Remarks. *P. capensis* has a diagnostic Sa element bearing three denticulate processes. Savage (1985) included elements of *P. capensis* within the apparatuses of *Aspelundia capensis* Savage, *Pandorinellina plana* (Walliser) and *O. fluegeli* (Walliser). *Oulodus planus borenorensis* Bischoff and *Oulodus* sp. 2 Over & Chatterton are multielement reconstructions of *P. capensis*. Simpson & Talent (1995) were the first to incorporate this species into the Genus *Pseudolonchodina* Zhou *et al.*

P. capensis evolved from *P. fluegeli* (Walliser) within the *celloni* CBZ. In the Prongs Creek section, rare Pb and Sa elements characteristic of *P. capensis* are found prior to the *celloni* CBZ. However, it is not until the *celloni* CBZ that *P. capensis* becomes the dominant species of *Pseudolonchodina*.

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Pseudolonchodina expansa (Armstrong, 1990)
Pl. 12, figs 1-8

* 1990 *Aspelundia expansa* Armstrong, p. 50, pl. 3, figs 13-20.
1991b *Aspelundia petila* (Nicoll & Rexroad); McCracken, p. 75. pl. 1, figs 1-4, 7-9, 11-12, 15-16, 18, 25, 28-30, & pl. 2, figs 1-2, 5-6, 9, 12, 16, 26-28, 30-31.
1995 *Pseudolonchodina expansa* (Armstrong); Simpson & Talent, p. 111-112, pl. 1, fig. 3.

Holotype. *Aspelundia expansa* Armstrong, 1990, pl. 3, fig. 13. Specimen MGUH 17.687 from Cape Schuchert Formation, Kap Schuchert, Washington Land, Greenland.

Diagnosis. Refer to Armstrong (1990, p. 50).

Description. The Pa (*f*), Pb (*g*), M_1 (*e*-1), M_2 (*e*-2), Sa (*c*), Sc_1 (*a*-1) and Sc_2 (*a*-2) elements were fully described by McCracken (1991b, p. 76-77; *A. petila*). The Sb_1 and Sb_2 elements have been described by Armstrong (1990, p. 52).

Remarks. Armstrong (1990) characterised this species of *Pseudolonchodina* as having compressed, robust denticles and a modified angulate Pa element.

McCracken (1991b) incorrectly synonymised *Oulodus petilus* (Nicoll & Rexroad) with *Pseudolonchodina expansa* (Armstrong). The two species differ in the degree of compression and the general morphology of all of the elements. McCracken (1991b) included two dissimilar M elements (*e*-1 and *e*-2) within the apparatus of *P. expansa.* The less common M element (*e*-2) possesses a short, denticulate posterior process, and may have occupied a Sb_2 position. The samples processed herein failed to yield these elements.

Occurrence. Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Pseudolonchodina fluegeli (Walliser, 1964)

Pl. 12, figs 9-14

*	1964	*Lonchodina fluegeli* Walliser, p. 44, pl. 6, fig. 4; pl. 32, fig. 24.
v	1983	*Oulodus*? cf. *O.* ?*fluegeli* (Walliser); Uyeno & Barnes, p. 19, pl. 1, figs 1-6.
	1981	*Pseudolonchodina irregularis* Zhou *et al.*, 136-137, pl. 1, figs 45-47.
p	1990	*Aspelundia fluegeli* (Walliser); Armstrong, p. 53-55, pl. 3, figs 1-9, 11, 12.
	1991b	*Aspelundia fluegeli* (Walliser); McCracken, p. 73-75, pl. 1, figs 5, 6, 10, 13, 14, 17, 19-24, 26, 27, 31, 32; pl. 2, figs 3, 4, 7, 8, 10, 11, 13-15, 17-25, 29, 32.
	1995	*Pseudolonchodina fluegeli* (Walliser); Simpson & Talent, p. 112-113, pl. 1, fig. 4.

Holotype. *Lonchodina fluegeli* Walliser, 1964, pl. 6, fig.4, pl. 32, fig. 24. Specimen from the Llandovery of Cellon, Carnic Alps, Austria.

Diagnosis. Refer to Armstrong (1990, p. 53).

Description. The Pa, Pb, M_1 (=M of Armstrong), M_2 (= Sd of Armstrong), Sa, Sb_1, (=Sb_2 of Armstrong) and Sc_1 elements have been described by Armstrong (1990, p. 53-54). The Sc_2 element differs from the Sc_1 element only in the downward deflection of the anterior process.

Remarks. Armstrong (1990) characterised this species of *Pseudolonchodina* as having a narrowly expanded basal cavity, compressed denticles and variably twisted and flexed processes.

Armstrong (1990) did not differentiate between elements of *P. capensis* and those of *P. fluegeli* (Walliser). A Sb_1 element included within the apparatus of *P. fluegeli* by Armstrong (1990), bearing a short, denticulate posterior process, may be alternatively assigned to *P. capensis.*

McCracken (1991b) identified three types of M element (e-1, e-2, and e-3) within the apparatus of *P. fluegeli.* The e-2 element was characterised by an expanded anterior cusp-edge, which bore two denticles. Similar elements were not identified during this study.

Occurrence. Jupiter Formation (Goéland Member), Anticosti Island, Québec; Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Order Prioniodontida Dzik, 1976

Remarks. Sweet (1988) regarded the apparatus of prioniodontid conodonts as containing six or seven morphotypes, with one or two pastinate P elements (or a platform equivalent). Reconstructing the full apparatus at this time proved confusing as there appeared to be more morphotypes than would fit an ozarkodinid apparatus; particularly elements attributable to P locations. This remained a problem until a prioniodontid animal *Promissium pulchrum* Kovács-Endrödy was discovered in the Ordovician Soom Shale (South Africa). Aldridge *et al.* (1995) reconstructed the apparatus comprising paired Pa, Pb, Pc, Pd, M, Sb_1, Sb_2, Sc, Sd and a single Sa element (Fig. A.2). Comparison with the ozarkodinid apparatus reconstruction led Purnell & Donoghue (1998) to suggest that the Sd and Sb_2 elements of *Promissium* are homologous with the Sb_2 and Sc_1 elements of the ozarkodinid apparatus, respectively.

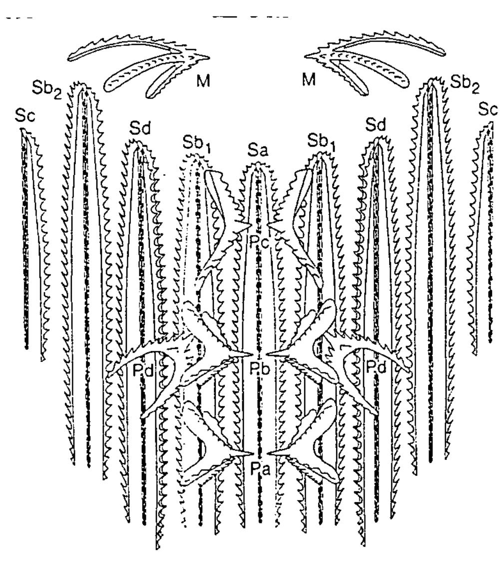


Figure A.2. Plan of the *Promissium pulchrum* apparatus from Aldridge *et al.* (1995).

The Prioniodontida studied herein can be divided into two types (Type I and Type II) by their Pa element morphology, number of P elements and morphology of M elements.

Type I: The Type I apparatus consistently lacks a Pc element. The Pa element of Type I prioniodontids has an inner-lateral process situated to the posterior of the outer-lateral process. M elements are typically dolabrate. The Type I prioniodontids do not have the same number of morphotypes as the *Promissium* template. Examples of Type I include the Family

Distomodontidae, Family Icriodellidae and some members of the Family Balognathidae (e.g. Genus *Gamachignathus* McCracken *et al.*)

Type II: Type II prioniodontids have four P elements. The Pa element of the type two prioniodontids has an inner -lateral process situated to the anterior of the outer-lateral process. In *Pranognathus* Männik & Aldridge, the single process is situated anterior of the bifurcate lateral process. Examples of Type II include *Pterospathodus* Walliser, *Astropentagnathus* Mostler, *Pranognathus* Männik & Aldridge and *Apsidognathus* Walliser.

The general morphology and number of elements within the S array may vary between species within the same genus (e.g. *Astropentagnathus*) and so cannot be used in classification at the family level. *Apsidognathus* has at least four platform elements within its apparatus, and so is preliminary classified within Type II. Genera within the Family Cyrtoniodontidae do not fit into the above categories, as they only have two P elements within their apparatuses.

Element:	**Morphology:**
Pa	Pyramidal, pastiniscaphate with three primary processes and one secondary lateral process.
Pb	Similar to Pa, but processes may be slightly twisted and the secondary lateral process shorter.
Pc	Angulate with twisted processes.
Pd	Bipennate, symmetrically or subsymmetrically arched.
M	Curved, tertiopedate.
Sa	Alate.
Sb_1	Tertiopedate.
Sb_2	More asymmetrical than Sb_1.
Sd (Sc_1)	Asymmetrical, quadriramate
Sc (Sc_2)	Bipennate

Figure A.3. Elements within the *Promissium* apparatus, as described by Aldridge *et al.* (1995).

Family Balognathidae Hass, 1959

Remarks. Sweet (1988) included *Baltoniodus* and its descendant genera, which comprise *Amorphognathus*, *Complexodus*, *Gamachignathus*, *Noixodontus*, *Rhodesognathus* and *Sagittodontina*, in the Balognathidae. Sweet (1988) observed that *Gamachignathus* was closer morphologically to *Prioniodus* than *Baltoniodus*, but was closer stratigraphically to *Baltoniodus*, and so included *Gamachignathus* within the Balognathidae. Aldridge & Smith (1993) added *Pygodus* Lamont & Lindström, *Polonodus* Dzik and *Promissium* Kovács-Endrödy to this family.

The most recent multielement reconstruction of *Amorphognathus* by Armstrong *et al.* (1996) includes a Pc, and tentatively a Pd element. Thus, *Amorphognathus* can be classified within the Type II group of prioniodontids. *Gamachignathus* lacks a Pc element and has characteristics of the Type I prioniodontids.

Genus *Amorphognathus* Branson & Mehl, 1933

Type Species. *Amorphognathus ordovicica* Branson & Mehl, 1933.

Diagnosis. Refer to Bergström (1971, p. 131-134).

Remarks. *Amorphognathus* has a Type II apparatus comprising Pa, Pb, Pc, M, Sa, Sb_1, Sb_2 (= Sd of previous reconstructions) and Sc elements. Armstrong *et al.* (1996) tentatively included a small, pyramidal element in the Pd position, which has not yet been confirmed by other workers.

The Pa elements of *Amorphognathus* species have posterior, anterior, two outer-lateral processes and commonly two inner-lateral processes. The posterior process bears only one row of denticles, whereas the anterior process may be thicker, with two rows of denticles. The Pb elements are pyramidal with an anterior, a posterior and an outer-lateral process. The M element is tertiopedate and the apparatus has a full suite of S elements, including a quadriramate Sb_2 element. Species of *Amorphognathus* can be differentiated on differences in the rare M element (Orchard, 1980) and potentially the robustness and morphology of the Pb element (Savage & Bassett, 1985).

Amorphognathus cf. *A. ordovicicus* Branson & Mehl, 1933
Pl.13, fig.11.

Description. Only one broken fragment of a Pa element has been recovered in samples herein. Two processes are preserved, which are tentatively regarded as lateral processes. Each process is wide and bears two widely spaced nodes. The whole of the lower surface is excavated.

Remarks. The specific classification of this element has been hampered by its poor state and the absence of other more diagnostic elements, such as Pb and M elements. It has been compared to *A. ordovicicus* Branson & Mehl, as this is the only common species of *Amorphognathus* in the uppermost Ordovician.

Occurrence. Ellis Bay Formation (Laframboise Member), Anticosti Island, Québec.

Genus *Gamachignathus* McCracken, Nowlan & Barnes, 1980

Type species. *Gamachignathus ensifer* McCracken *et al.*, 1980.

Diagnosis. Refer to the original diagnosis in McCracken *et al.* (1980. p. 105).

Remarks. *Gamachignathus* has a Type I apparatus, comprising Pa, Pb, Pd (*e*-2 of McCracken & Barnes, 1981), M, Sa, Sb, Sc_1 and Sc_2 elements. The Pa element of the type species has a denticulate outer-lateral process, which is perpendicular to the blade, and an incipient inner-lateral process. Species of

Gamachignathus can be differentiated by the degree of lateral compression of the cusp and denticles.

Gamachignathus? *macroexcavata* (Zhou *et al.*) from the upper Llandovery (*celloni* CBZ) of China is the youngest species that has been classified within the genus *Gamachignathus* (Wang & Aldridge, 1996). The M and Pd elements of *G.*? *macroexcavata* are similar to the corresponding elements in *G. ensifer*. However, the element denticulation, Pa element morphology and Sc element morphology are atypical of *Gamachignathus*.

The prioinodontid genus, *Birksfeldia,* erected by Orchard (1980), has been regarded as closely similar to *Gamachignathus*. In fact, Savage & Bassett (1985) regarded *Gamachignathus* as a junior subjective synonym of *Birksfeldia* Orchard. However, McCracken (1987) argued that although the two genera are closely related they should remain separate genera, due to differences in their morphology and geographic distribution. He noted that the Pa elements of *Gamachignathus* and *Birksfeldia* differed in the length and denticulation of the lateral process, and the denticulation of the antero-lateral process. The debate is likely to continue until the criteria used for erecting conodont genera have been agreed upon. Armstrong *et al.* (1996) have recently reviewed this taxonomic problem.

Gamachignathus ensifer McCracken, Nowlan & Barnes, 1980

Pl. 13, figs 1-6

*	1980	*Gamachignathus ensifer* McCracken *et al.*, pl. 10.1, figs 1-17.
v	1981	*Gamachignathus ensifer* McCracken *et al.*; Nowlan & Barnes, p. 13, pl. 3, figs 13, 14, 17-21.
v	1981	*Gamachignathus ensifer* McCracken *et al.*; McCracken & Barnes, p. 77, pl. 5, figs 1-27.
	1987	*Gamachignathus ensifer* McCracken *et al.*; McCracken, p. 1460, pl. 1, fig. 25.

Holotype. *Gamachignathus ensifer* McCracken *et al.*, 1980, pl. 10.1, figs 9, 13. Specimen GSC 60063 from the Ellis Bay Formation, Anticosti Island, Québec, Canada.

Diagnosis. Refer to McCracken *et al.* (1980, p. 106)

Description. Elements of *G. ensifer* have been described fully in McCracken, Nowlan & Barnes (1980, p. 106-108).

Remarks. *G. ensifer* is distinguished from other species in the genus by the lateral compression of the cusp and denticles.

Occurrence. Ellis Bay Formation (Lousy Cove and Laframboise Members), Anticosti Island, Québec.

Gamachignathus hastatus McCracken, Nowlan & Barnes, 1980
Pl. 13, figs 7-10

* 1980 *Gamachignathus hastatus* McCracken *et al.*, pl. 10.2, figs 1-16.
v 1981 *Gamachignathus hastatus* McCracken *et al.*; McCracken & Barnes, p. 77, pl. 5, figs 28-45.

Holotype. *Gamachignathus hastatus* McCracken *et al.*, 1980, pl. 10.2, fig. 12. Specimen GSC 60084 from the Ellis Bay Formation, Anticosti Island, Québec, Canada.

Diagnosis. Refer to McCracken *et al.* (1980, p. 110)

Description. Elements of *G. hastatus* have been described fully in McCracken, Nowlan & Barnes (1980, p. 110).

Remarks. *G. hastatus* can be distinguished from *G. ensifer* in having elements in which the cusp and denticles are long and slender with a sub-circular cross section.

Occurrence. Ellis Bay Formation (Lousy Cove and Laframboise Members), Anticosti Island, Québec.

Family Cyrtoniodontidae Hass, 1959

Remarks. Sweet (1988) placed *Phragmodus* Branson & Mehl and *Bryantodina* Stauffer within the Cyrtoniodontida. However, *Bryantodina* has carminate and angulate P elements, which are atypical of the Prioniodontida and more characteristic of the Ozarkodinida. The P elements of *Phragmodus* are pastinate, which is characteristic of the Prioniodontida, but lack a well-developed anterior process. Prior to a review of the suprageneric classification, *Phragmodus* is retained within the Family Cyrtoniodontidae, Order Prioniodontidae (Aldridge & Smith, 1993).

Genus *Phragmodus* Branson & Mehl, 1933

Type species. *Phragmodus primus* Branson & Mehl, 1933.

Diagnosis. Refer to Sweet (1981a, p. 245-246).

Remarks. The *Phragmodus* apparatus comprises two P elements, an M element and an S array (Leslie & Bergström, 1995). The Pa and Pb elements have a posterior process and an inner-antero-lateral process. The anterior margin of the cusp projects out of the plane of the blade and is adenticulate. They are not typical pastinate elements, as they lack well-developed anterior processes. The M element is dolabrate or coniform geniculate, and the S elements are alate, tertiopedate, and bipennate (Sweet, 1988).

Phragmodus undatus Branson & Mehl, 1933

Pl. 13, fig. 12.

	1933	*Phragmodus primus* Branson & Mehl, p. 98-99, pl. 6, fig. 26.
*	1933	*Phragmodus undatus* Branson & Mehl, p. 115, pl. 8, figs 22-26.
	1966	*Phragmodus undatus* Branson & Mehl; Bergström & Sweet.
	1981a	*Phragmodus undatus* Branson & Mehl; Sweet, p. 267-270, pl. 1, figs 8-14.
	1995	*Phragmodus undatus* Branson & Mehl; Leslie & Bergström, p. 970-973, figs 4.1-4.13.

Syntypes. *Phragmodus undatus* Branson & Mehl, 1933, pl. 8, figs 22-26. Cotypes C105-4 and C103-3 from the Plattin Formation, Missouri, U. S. A.

Diagnosis. Refer to Sweet (1981a, p. 267).

Description. Sc element. Compressed, bipennate, with a denticulate posterior process and an anterior process reduced to a downward extension of the cusp. The posterior process bears at least five denticles. The proximal denticles are short and erect; distally, the denticles become taller and broader, and are inclined posteriorly. The basal margin of the posterior process is arched. The basal cavity is a narrow groove.

Remarks. Leslie & Bergström (1995) synonymised *P. primus* with *P. undatus*. Major reviews of this species include Bergström & Sweet (1966) and Sweet (1981a).

Occurrence. Ellis Bay Formation (Lousy Cove Member), Anticosti Island, Québec.

Family Distomodontidae Klapper, 1981

Remarks. Sweet (1988) defined the Distomodontidae as containing five or six morphotypes; stelliscaphate and pastinate P elements (or their reduced derivatives), and ramiform elements with short, weakly denticulate or adenticulate processes. He included *Coryssognathus* Link & Druce, *Distomodus* Branson & Branson and *Rotundacodina* Carls & Gandl.

Genus *Coryssognathus* Link & Druce 1972

Type species. *Cordylodus* ? *dubius* Rhodes, 1953.

Diagnosis. Refer to Miller & Aldridge (1993, p. 242).

Remarks. The apparatus of *Coryssognathus* consists of 16 elements, Pa, Pb, Pc, M, Sa / Sb, Sb and two pairs of Sc elements (Miller & Aldridge, 1993). Coniform elements found associated with *Coryssognathus* are thought to represent discrete denticles, which were added on to the elements during ontogeny (Miller & Aldridge, 1993).

Coryssognathus cf. *C. dubius* (Rhodes, 1953)
Pl. 15, figs 4,5

1990 *Dentacodina* aff. *D. dubia* (Rhodes); Armstrong, p. 72-73, pl. 20, figs 17-22.

Description. Pb? element. The elements recovered herein differ from those described by Armstrong (1990, p. 72) only in bearing one small denticle on the anterior edge of the platform.

Remarks. The elements were recovered from a sample, which also contained elements of *D. kentuckyensis*. This element may in fact represent the Pc element of *D. kentuckyensis* (Aldridge *pers. comm.*).

Occurrence. Transitional Limestone Unit, Prongs Creek, northern Yukon.

Genus *Distomodus* Branson & Branson, 1947

Type species. *Distomodus kentuckyensis* Branson & Branson, 1947.

Diagnosis. Refer to Bischoff (1986, p. 94).

Remarks. Species of *Distomodus* have a Type I prioniodontid apparatus plan, characterised by Pa elements with multiple, wide processes, each ornamented with ridges and nodes. Species of *Distomodus* differ in the morphology of the Pa element. The ancestral *D. kentuckyensis* has a Pa element with 4 processes, whereas that of *D. staurognathoides* has 5 processes.

Distomodus kentuckyensis Branson & Branson, 1947

Pl. 14, figs 1-6

* 1947 *Distomodus kentuckyensis* Branson & Branson, p. 553, pl. 81, figs 21-23, 27, 29-33, 36-41.

1967 *Icriodina irregularis* Branson & Branson; Rexroad, p. 33-34, pl. 2, figs 18-21.

1975 *Distomodus kentuckyensis* Branson & Branson; Cooper, p. 998-999, pl. 2, figs 6, 8, 10, 11, 13, 14.

Holotype. *Distomodus kentuckyensis* Branson & Branson, 1947, pl. 81, figs 40, 41. Specimen C675-1, from the Brassfield Limestone, Kentucky, U. S. A.

Diagnosis. The Pa element has been diagnosed by Rexroad (1967, p. 33).

Description. The Pa, Sa and Sc elements were described by Rexroad (1967) and named *I. irregularis, T. brassfieldensis* and *Ligonodina*? *extrorsa,* respectively. Branson & Branson (1947, p. 552-553) originally described the Pb and M elements as *Drepanodus simplexus* and *Distomodus kentuckyensis,* respectively.

Remarks. *D. kentuckyensis* is characterised by a cruciform Pa element with four broad processes bearing irregular and coalescing nodes. The Pa element was originally discovered by Branson & Branson (1947). Aldridge & Mohammed (1982) figured adult and juvenile Pa elements.

Cooper (1975) reconstructed the multielement apparatus of *D. kentuckyensis* consisting of Pa, Pb, M, Sa, Sb and Sc elements. The M, and S elements of *D. kentuckyensis* and *D. staurognathoides* have often been classified and described together (e.g. Aldridge, 1972).

Bischoff (1986) erected a number of species with Pa elements bearing four processes. He differentiated them from *D. kentuckyensis* by the angles between the processes. Within this study, only rare Pa elements of *Distomodus* have been recovered and these all conform to the diagnosis of *D. kentuckyensis*.

Occurrence. Transitional Limestone Unit, Prongs Creek, northern Yukon.

Distomodus staurognathoides (Walliser, 1964)

Pl. 14, figs 7-13

* 1964 *Hadrognathus staurognathoides* Walliser, p. 35, pl. 5, fig. 2; pl. 13, figs 6-15.

1976 *Distomodus staurognathoides* (Walliser); Barrick & Klapper, p. 71-72, pl. 1, figs 20-28.

1977 *Hadrognathus staurognathoides* Walliser; Cooper, p. 1066-1967, pl.1, figs 1, 5-7, 12, 16.

1986 *Distomodus staurognathoides* (Walliser); Bischoff, p. 106, pl. 10, figs 13-36; pl. 11, figs 1-33; pl. 12, figs 1-28.

1987b *Distomodus staurognathoides* (Walliser); Over & Chatterton, p. 581, fig. 1, 1-6.

1990 *Distomodus staurognathoides* (Walliser); Armstrong, p. 73-76, pl. 8, figs 6-10; pl. 9, figs 2-3.

Holotype. *Hadrognathus staurognathoides* Walliser, 1964, pl. 5, fig. 2; pl. 13, fig. 7. From sample 11c within the *P. celloni* CBZ, Carnic Alps, Austria.

Diagnosis. Refer to Bischoff (1986, p. 108).

Description. The Pa element has been described previously as *Hadrognathus staurognathoides* in Nicoll & Rexroad (1969, p. 36) and variations within the Pa element have been noted by Bischoff (1986, p. 110-118). The Pb element has been previously described as *Trichonodella* ? *expansa* in Nicoll & Rexroad (1969, p. 64). The M, Sa, Sb and Sc elements appear morphologically identical to those of *D. kentuckyensis*.

Remarks. *D. staurognathoides* is characterised by a Pa element with five processes. The Pa element was recovered by Walliser (1964) and a multielement reconstruction was first proposed by Barrick & Klapper (1976). Over & Chatterton (1987b) included elements previously assigned to *Johnognathus huddlei* Mashkova considering them to represent the broken posterior process of an S element.

Bischoff (1986) identified four stages within the evolution of *D. staurognathoides*, which differed in the morphology and ornamentation of the Pa elements. The M and S elements are indistinguishable, but the Pb elements vary in the development of a platform ledge. Bischoff (1986) regarded the alpha (*sedgwickii* to mid *crispus* GBZ), beta (upper *crispus* to *murchisoni* GBZ), gamma (*griestonensis* to *murchisoni* GBZ) and delta (upper *murchisoni* to *riccartonensis* GBZ) variations as stages within an evolving lineage.

Occurrence. Jupiter (Ferrum and Pavillion Members) and Chicotte Formations, Anticosti Island, Québec; Road River Group, Prongs Creek, northern Yukon.

Distomodus? sp. A

Pl. 15, figs 1-3

Remarks. The Pa element has a posterior blade and an anterior platform. The platform bears two rows of offset denticles, whereas the blade bears a single row of at least six denticles. The angle of deflection of the blade in relation to the platform is variable. There is an adenticulate, outer-lateral process and an inner, posterior basal-cavity flare. It has an irregular white matter distribution. This element can be distinguished from that found in species of *Icriodella* in the irregular nature of the denticles and white matter distribution. The Pb and M elements associated with the Pa element appear to be identical to those of *D. kentuckyensis*.

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario.

Family Icriodellidae Sweet, 1988

Remarks. Sweet (1988) defined this family as containing genera with a quinquimembrate apparatus, with a pastinate, pastiniscaphate, or stelliscaphate Pa element. The Pa element characteristically has one or more processes, which have two rows of denticles or nodes. He included *Icriodella*, *Pedavis* Klapper & Murphy, *Sannemannia* Al-Rawi and *Stepotaxis* Uyeno & Klapper. The latter three genera have subsequently transferred to the Icriodontidae (Aldridge & Smith, 1993).

Genus *Icriodella* Rhodes, 1953

Type species. *Icriodella superba* Rhodes, 1953.

Diagnosis. Refer to Cooper (1975, p. 1003).

Remarks. Species of *Icriodella* have a Type I prioniodontid apparatus, containing Pa, Pb, Pd, M, Sa, Sb and Sc elements. Species of *Icriodella* can be differentiated by the angle of deflection of the blade and denticulation of the Pa element.

Icriodella deflecta Aldridge, 1972
Pl. 16, figs 1-7

*	1972	*Icriodella deflecta* Aldridge, p. 183-184, pl. 1, figs 4-7.
	1975	*Icriodella deflecta* Aldridge; Aldridge, pl. 1, fig. 16.
	1975	*Icriodella deflecta* Aldridge; Cooper, p. 1003-1004, pl. 2, fig. 7.
	1981	*Icriodella deflecta* Aldridge; McCracken & Barnes, p. 111, pl. 7, figs 40-42.

Holotype. *Icriodella deflecta* Aldridge, 1972, pl. 1, fig. 6. Specimen X.561 from the Venusbank Formation, Welsh Borderland, Britain.

Diagnosis. The Pa element has been diagnosed by Aldridge (1972, p. 183)

Description. Cooper (1975, p. 1003-1004) described all the elements of *I. deflecta*. The M elements recovered herein are very variable, but all have lenticular basal cavities. The S elements characteristically bear compressed cusps and denticles.

Remarks. This is a species of *Icriodella* with a Pa element in which the blade is deflected by approximately 45° from the axial plane of the platform. The M and S elements of *I. deflecta* have been previously regarded as identical to the corresponding element of *I. discreta.* The M elements can been distinguished by the roundness of the basal cavity. The basal cavity of elements of *I. deflecta* is more lenticular than those of *I. discreta.* The S elements have been distinguished by the degree of compression of the cusp and denticles, the S elements of *I. deflecta* being more compressed than those of *I. discreta.* The Sb elements of *I. discreta* may have more twisted processes than the corresponding elements of *I. deflecta.*

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario; Becscie, Merrimack and Gun River Formations, Anticosti Island, Québec.

Icriodella discreta Pollock, Rexroad & Nicoll, 1970

Pl. 16, figs 8-14

* 1970 *Icriodella discreta* Pollock *et al.*, p. 754-755, pl. 111, figs 27-30.
1972 *Icriodella discreta* Pollock *et al.*; Aldridge, p. 184, pl. 1, figs 1-3.
1975 *Icriodella discreta* Pollock *et al.*; Aldridge, pl. 1, fig. 15.
1975 *Icriodella discreta* Pollock *et al.*; Cooper, p. 1004, pl. 2, figs 1-4.
1981 *Icriodella discreta* Pollock *et al.*; McCracken & Barnes, p. 111, pl. 7, figs 30-39.

Holotype. *Icriodella discreta* Pollock, Rexroad & Nicoll, 1970, pl. 111, figs 27a-b. Sample No. 16-6 (12536), from the Reynales Limestone, Niagara Falls, Ontario, Canada.

Emended diagnosis. A species of *Icriodella* with a Pa element in which the blade is deflected only a few degrees from the axial plane of the platform.

Description. The elements of *I. discreta* have been previously described by Cooper (1975, p. 1004). The M elements recovered herein are very variable, but all have sub-circular basal cavities. The S elements have rounded cusps and denticles.

Remarks. The differences between the M and S elements of *I. deflecta* and *I. discreta* are discussed under the remarks for *I. deflecta*.

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario; Becscie, Merrimack and Gun River Formations, Anticosti Island, Québec.

Icriodella cf. *I. inconstans* Aldridge, 1972

Pl. 15, fig. 11

Description. Pa element. The element recovered herein is similar to that of *Icriodella inconstans* (Aldridge, 1972), but differs in lacking a well developed, outer-basal-cavity flare and bearing more rounded denticles.

Remarks. Uyeno & Barnes (1983) recovered Pa elements of *I. inconstans* from the Jupiter Formation (Anticosti Island), which also lacked a pronounced outer-lateral flange and bore rounded denticles in some specimens. Uyeno & Barnes (1983) used the first appearance of this species to identify the base of the *inconstans* CBZ ranging from the upper Jupiter to lower Chicotte Formations (Anticosti Island).

Occurrence. Jupiter Formation (Pavillion Member), Anticosti Island, Québec.

Icriodella sp. A

Pl. 15, fig. 10

Remarks. This species is known only from its Pa element, which appears to be intermediate between *I. discreta* and *I. deflecta.* There is little deflection of the platform from the blade, which is indicative of *I. discreta*. However, the blade and platform are long and the denticulation on the blade is typical of *I. deflecta.*

A similar element was figured by Aldridge & Mohammed (1982, pl. I, fig. 18) from the Oslo Graben.

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario.

Family Pterospathodontidae Cooper, 1977

Remarks. Sweet (1988) assigned this family to the Order Ozarkodinida, but Aldridge & Smith (1993) later transferred it to the Prioniodontida. Sweet (1988) originally included *Apsidognathus*, *Astropentagnathus*, *Aulacognathus*, *Carniodus*, *Johnognathus* and *Pterospathodus* within this family. However, Aldridge & Smith (1993) transferred *Carniodus* to Fam. nov. 6, *Johnognathus* to the Distomodontidae, *Aulacognathus* to the Kockelellidae and added the genus *Pranognathus*. The Aldridge & Smith (1993) reinterpretation is followed herein apart from the removal of *Carniodus,* which has been retained within this family.

Genera within Pterospathodontidae have a Type II prioniodontid apparatus, containing Pa, Pb, Pc, Pd, M, Sb, and Sc elements. The genera differ in the development of lateral processes on the Pa element.

Genus *Apsidognathus* Walliser, 1964

Type species. *Apsidognathus tuberculatus* Walliser, 1964.

Diagnosis. Refer to Armstrong (1990, p. 41).

Remarks. Seven elements have been identified within the *Apsidognathus* apparatus, which have proven difficult to homologise with other apparatus plans. This has led to the suggestion of a number of possible homologies (Fig. A.4.), the most recent, that of Armstrong (1990) will be followed herein.

Uyeno & Barnes (1983)	**Bischoff (1986)**	**Over & Chatterton (1987a)**	**Armstrong (1990)**	**Shape category, after Armstrong (1990)**
Pa_1	Pa	Pa_1	Platform (Pa_1)	
Sa	Arched scaphate	S	Lyriform (Sa or Sb)	Longitudinally arched, scaphate.
-	Pb	Pb_2	Ambalodiform (Pb)	Arched anguliscaphate or pyramidal pastiniscaphate.
Pb	Stelliscaphate	Pb_1	Astrognathiform (Sa or Sd)	Cruciform, stelliplanate.
Pseudooneotodus n. sp. of Cooper	Coniform	-	Coniform (M)	Tertiopedate.
Pa_2	-	Pa_2	Lenticular (Pa_2)	Scaphate.
-	-	-	Compressed (Sc)	Compressed, scaphate.

Figure A.4. Comparison of the terminology used to describe *Apsidognathus* elements.

The platform element is homologous to the Pa element of other prioniodontids. It has posterior, anterior, two inner-lateral processes and two outer-lateral processes, connected by an ornamented platform. This element differs from the Pa of *Astropentagnathus* in having two inner-lateral processes and a well-developed, inter-process platform, which is thick and ornamented. The general morphologies of the other elements are listed in Figure A.4.

Apsidognathus tuberculatus Walliser, 1964

Pl.17, figs 1-7

* 1964 *Apsidognathus tuberculatus*, p. 29, pl. 5, fig. 1; pl. 12, figs 16-22; pl. 13, figs 1-5.

1975 *Apsidognathus tuberculatus* Walliser; Aldridge, pl. 1, figs 1, 2.

1980 *Apsidognathus tuberculatus* Walliser; Helfrich, pl. 1, figs. 25, 29.

1983 *Apsidognathus tuberculatus* Walliser; Uyeno & Barnes, p. 14-15, pl. 6, figs 6-14.

1986 *Apsidognathus tuberculatus* Walliser; Bischoff, p. 150-156, pl. 1, figs 1-16, 17-28; pl. 2, figs 1-4.

1990 *Apsidognathus tuberculatus* Walliser; Armstrong, p. 41-47, pl. 1, figs 1-11, 12-16; pl. 2, figs 1-4.

Holotype. *Apsidognathus tuberculatus* Walliser, 1964, pl. 5, fig. 1; pl. 12, fig. 18. Specimen from Cellon, Carnic Alps, Austria.

Diagnosis. Refer to Armstrong (1990, p. 42).

Description. Platform and Lyriform elements identical to those found herein have been described by Uyeno & Barnes (1983, p. 14) as Pa and Sa elements respectively. The Coniform elements have previously been described as elements of *Pseudooneotodus* n. sp. of Cooper by Uyeno & Barnes (1983, p. 23-24). The Lenticular elements recovered herein conform to the description of the corresponding elements in *A.* n. sp. of Armstrong (1990, p. 48).

Remarks. The platform element was first recorded by Walliser (1964), the lyriform element by Aldridge (1975), the astrognathiform element by Helfrich (1980), the lenticular element by Uyeno & Barnes (1983), the ambalodiform and coniform elements by Bischoff (1986) and the compressed element by Armstrong (1990). *A. tuberculatus* was firstly diagnosed by Uyeno & Barnes (1983) and subsequently re-diagnosed by Bischoff (1986, p. 150) and Armstrong (1990, p.42), who both identified subspecies. Subspecies of *A. tuberculatus* have been differentiated by the general morphology and ornamentation of the platform and lyriform elements.

Occurrence. Jupiter (Pavillion Member) and Chicotte Formations, Anticosti Island, Québec.

Genus *Astropentagnathus* Mostler, 1967

Type species. *Astropentagnathus irregularis* Mostler, 1967.

Diagnosis. Refer to Armstrong (1990, p. 58).

Remarks. Species of *Astropentagnathus* differ in the presence or absence of an inter-process platform, which has well developed growth lines. The P and M elements of the *Astropentagnathus* species are similar in morphology, whereas the S elements are significantly different.

Astropentagnathus araneum McCracken, 1991c
Pl. 18 figs 12-16

1987a *Astropentagnathus irregularis* Mostler; Over & Chatterton, pl. 2, figs 2-9.

* 1991c *Astropentagnathus araneum* McCracken, p. 109-112, pl. 2, figs 1-10, text figs 5, 6.

Holotype. *Astropentagnathus araneum* McCracken (1991c), pl. 2, fig. 8. Specimen GSC 101208 from the Road River Group, Blackstone River, northern Yukon Territories, Canada.

Diagnosis. Refer to McCracken (1991c p. 109).

Description. Pa element. Refer to the description of the *g* element of *A. araneum* by McCracken (1991c, p. 112, pl. 2, figs 8-10). Specimens from Prongs Creek differ from those described by McCracken (1991c) in that the inner and outer-lateral processes are not directly adjacent; the inner is offset to the anterior of the outer process. The processes are also shorter, the anterior has nine whereas the posterior bears, on average, seven denticles.

Pc element. Refer to the description of the *f* element of *A. araneum* by McCracken (1991c, p. 110-112, pl. 2, figs 2, 6). The long, perpendicular inner-lateral process described by McCracken (1991c), is considered herein to be the outer-lateral process, with the inner-lateral process being poorly developed.

Sb_1 element. Refer to description of ? *b/c* element by McCracken (1991c, p. 109-110).

Sb_2 element. This element is similar to the description and figures of the *a*? element of *A. araneum* in McCracken (1991c, p. 109, pl. 2, fig. 5), but differs in that it has four processes (anterior, posterior, outer and inner-lateral processes) rather than the three described by McCracken (1991c).

Sc element. Bipennate, with anterior and posterior processes meeting at an angle of 45°. The anterior process is inwardly bowed, downwardly directed and bears at least eight denticles. The straight posterior process bears at least five denticles. On both processes the denticles are fused and elongate. The inter-process platform has well developed growth lines.

Remarks. This species is characterised by an inter-process platform on several of the elements. It also differs from other known species of *Astropentagnathus* in having a quadriramate Sb_2 element. McCracken (1991c) identified and reconstructed an apparatus for this species, which is followed herein. However, elements similar to the *e* elements described by McCracken (1991c) have not been recovered during this study.

A. araneum has only previously been recorded by McCracken (1991c) from the northern Yukon. However, it is likely to have been previously identified as *A. irregularis*.

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Astropentagnathus irregularis Mostler, 1967

Pl. 18, figs 1-11

* 1967 *Astropentagnathus irregularis* Mostler, p. 298, pl. 1, figs 1-11.

1986 *Astropentagnathus irregularis* Mostler; Bischoff, p. 158-162, pl. 2, figs 27-29; pl. 3, figs 1-14.

1990 *Astropentagnathus irregularis irregularis* Mostler; Armstrong, p. 59, pl. 5, figs 1-10.

1991c *Astropentagnathus irregularis* Mostler; McCracken, pl. 2, figs 11-19.

Holotype. *Astropentagnathus irregularis* Mostler, 1967, pl. 1, fig. 3.

Emended diagnosis. A species of *Astropentagnathus* with elements that lack an inter-process platform, which has widely spaced growth ridges and microreticulation.

Description. Pa element. This element has been fully described as the Pa_1 element of *A. irregularis irregularis* by Armstrong (1990, p. 59).

Pb element. Pyramidal, pastiniscaphate, with a posterior, anterior and outer-lateral process. The anterior and outer-lateral processes are more steeply directed downwards than the posterior process. An inter-process platform is present between all processes, which lacks the growth lines characteristically seen on elements of *A. araneum*. Denticulation on the processes is variable between specimens. The processes may be adenticulate, or denticulate with ill defined, upright denticles. The entire lower surface is excavated.

Pc element. The adult form of this element has been described as the Pa_2 element, and the juvenile form as the Pb element of *A. irregularis irregularis* by Armstrong (1990, p. 59).

M element. This element has been formerly described as the Sb element of *A. irregularis irregularis* by Armstrong (1990, p. 60). The specimens herein differ from those described by Armstrong (1990) in that the basal cavity is not restricted to beneath the cusp. The anterior tip of the basal cavity is not expanded and the posterior tip is expanded creating a short adenticulate process in adult forms. The basal cavity extends as tapering grooves to the tips of the processes.

Sb_1 element. Tertiopedate, with downwardly directed outer and inner-lateral processes. The angle between the processes is less than 90°. The lateral processes may be twisted. They bear at least eight denticles. The denticles are long, slender and completely fused. The basal cavity is sub-rounded and wide beneath the cusp. The cavity does not appear to continue along the lateral processes.

Sb_2? element. Tertiopedate element, which is similar to the Sb elements, but differs in having a more developed posterior process. The process is short and adenticulate.

Sc element. Bipennate, with downwardly directed posterior and anterior processes. The anterior process is more steeply downwardly directed. The anterior process bears at least five denticles and the posterior process bears at least three. Juvenile and adult forms can be distinguished.

Remarks. *A. irregularis* lacks the inter-process platform and quadriramate Sb_2 element seen in *A. araneum*. The Pa element of *A. irregularis* was first recovered by Mostler (1967). Klapper & Murphy (1975) regarded '*Rhyncognathus*' n. sp. Schönlaub (1971) as the M (= Pb) element, and Armstrong (1990) included the ramiform elements figured by Schönlaub (1971) within this apparatus. Elements with the same morphology as the Sc element of *A. irregularis irregularis* in Armstrong (1990, p. 60) have not been recovered in this study.

Occurrence. Jupiter Formation (Pavillion Member), Anticosti Island, Québec; Road River Group, Prongs Creek, northern Yukon.

Genus *Pranognathus* Männik & Aldridge, 1989

Type Species. *Amorphognathus tenuis* Aldridge, 1972.

Diagnosis. Refer to Männik & Aldridge (1989, p. 904).

Remarks. The *Pranognathus* apparatus comprises Pa, Pb, Pc, Pd, M, Sb_1, Sb_2, and Sc elements. The inner-lateral process of the Pa and Pc elements is more developed than the outer-lateral process.

Pollock *et al.* (1970) identified a Pa element which they termed *Aphelognathus siluricus* Pollock *et al.* Later, Cooper (1977) added Pb (= Pc), M (= Pb?) and S (= Sb_1) elements and placed this species in the new genus *Llandoverygnathus*. Uyeno & Barnes (1983) reassigned this species to *Pterospathodus*, and partially reconstructed the apparatus as consisting of Pa, Pb (= Pc), and M elements.

Aldridge (1972, pl. 2 fig. 3) figured the Pa element of *Amorphognathus tenuis*, an element with five processes (anterior, posterior, outer-lateral and two inner-lateral processes). Uyeno & Barnes (1983, p. 24-25) described a similar Pa element, which differed in having a reduced outer-lateral process. They erected a new species, *Pterospathodus posteritenuis* Uyeno & Barnes, which had an apparatus including Pa, Pb (?), M (= Pb?), Sa, Sb-Sa (?), Sb, Sc-Sb (?), Sc elements.

Männik & Aldridge (1989) regarded *P. tenuis* and *P. posteritenuis* as having comparable apparatus plans but differing in the development of lateral processes on the Pa element. They regarded the multielement apparatus of

Pranognathus tenuis as consisting of Pa, Pb (= Pc), Pc (= Pb), M, Sa, Sb, Sc_1 (= Pd) and Sc_2. Homology with the *Promissium* plan suggests that the element regarded as occupying the Pb position is more likely to have been in the Pc position and vice versa. The Sc_1 element (sensu Männik & Aldridge, 1989) is tentatively homologised with the Pd element.

Bischoff (1986 p. 190-194, pl. 28, figs 13-33) recovered a species of *Pterospathodus*, *Pterospathodus cadiaensis,* from the *staurognathoides* CBZ. The Pa element is blade-like with variable denticulation, lacks lateral processes and has a broad basal cavity. It is possible that this species is a geographic variation of *Pranognathus*, as it occurs at the same time interval and has similar S elements.

Pranognathus cf. *P. tenuis* (Aldridge, 1972)

Pl. 19, figs 1-6

* 1972 *Amorphognathus tenuis* Aldridge, p. 164, pl. 2, figs 3, 4.

1989 *Pranognathus tenuis* Aldridge; Männik & Aldridge, p. 904-905, text-fig. A-Z.

Description. Pc element. Refer to description of *Ambalodus anapetus* Pollock, Rexroad & Nicoll in Aldridge (1972)

Pd element. Bipennate, in which the posterior process is deflected downwards much less than the anterior process. The anterior and posterior processes bear at least three and two denticles respectively. The basal cavity is narrow.

M element. The inner-lateral process is longer and less downwardly directed than the outer-lateral process. The outer-lateral process is a denticulate, downward extension of the lateral edge of the cusp. The inner-lateral and outer-lateral processes bear at least four and three upright, fused, denticles, respectively. There may be a posterior process, but this is broken in all specimens.

Sb_1 element. Tertiopedate, with inner and outer-lateral processes, which are steeply directed downwards and curve inwards distally. The posterior process is also steeply directed downwards, and in some more asymmetrical specimens curves towards the outer-lateral process. All processes are denticulate and bear at least five upright, fused denticles.

Sb_2 element. Tertiopedate elements, which are similar to the Sb_1 elements, but have an adenticulate inner-lateral process. A costa extends down the cusp to the tip of the inner-lateral process.

Sc element. Bipennate, with a posterior process, which is straight or slightly downwardly directed, and an anterior process which is steeply downwardly directed and inwardly inclined. The denticles are upright and partially fused. There are at least four on the anterior process and three on the posterior process. The basal cavity is narrow.

Remarks. *P. tenuis* is a species of *Pranognathus* which has a Pa element with well-developed, lateral processes. The elements recovered herein are very similar to those illustrated as *P. tenuis* in Männik & Aldridge (1989). However, the lack of a well preserved Pa element means that the elements herein can not be definitely assigned to *P. tenuis*.

Occurrence. Transitional Limestone Unit, Prongs Creek, northern Yukon.

Genus *Pterospathodus* Walliser, 1964

Type Species. *Pterospathodus amorphognathoides* Walliser, 1964.

Diagnosis. Refer to Barrick & Klapper (1976, p. 81).

Remarks. The *Pterospathodus* apparatus contains Pa, Pb, Pc, Pd, M, Sb_1, Sb_2, and Sc elements, but lacks a truly symmetrical, Sa element. The inner-lateral process of the Pa element is poorly developed and adenticulate. The outer-lateral process may bifurcate and if so the anterior secondary process is shorter than the posterior secondary process. The Pc element has poorly developed, adenticulate outer and inner-lateral processes. The species of *Pterospathodus* differ in the degree of development of a platform ledge.

Männik & Aldridge (1989) reviewed the taxonomy of *Pterospathodus* and documented gradual changes in morphology through the *celloni* and *amorphognathoides* CBZs. Within the *celloni* CBZ, dextral Pa elements developed pennate lateral processes. Männik & Aldridge (1989) considered pennate and non-pennate taxa to be conspecific and synonymised *P. celloni* (Walliser) with *P. pennatus* (Walliser) and *P. angulatus* (Walliser).

Jeppsson (1979) suggested the synonymy of *Carniodus* Walliser and *Pterospathodus*, but subsequent workers have maintained the separate genera. For example, Männik & Aldridge (1989) regarded *Carinodus* and *Pterospathodus* as separate genera due to the low abundance of *C. carnulus* Walliser in the *celloni* CBZ. However, in samples from Prongs Creek, elements of *C. carnulus* occur in abundance with *P. celloni. C. carnulus* has only been reported from the *celloni* and *amorphognathoides* CBZs (e.g. Armstrong, 1990; Bischoff, 1986; Over & Chatterton, 1987a) and commonly only occurs in samples that yield elements of *Pterospathodus* (e.g. Over & Chatterton, 1987a). Therefore, herein the apparatuses of *Carniodus* and *Pterospathodus* have been synonymised. This is in agreement with the independent work of Männik (1998).

The Männik & Aldridge (1989) reconstruction of *Pterospathodus* lacked a Sc element. Herein, an element that is traditionally assigned to *Carniodus carnulus* is regarded as the Sc element of *Pterospathodus*. Within the Prongs

Creek samples, elements similar to the Pd element of *Pranognathus* were found in samples containing *Pterospathodus*. This element was originally described as *Carniodus carnus* in Walliser (1964, pl. 28, fig. 5) and was later included as the Sb element of *Carniodus carnulus* by Barrick & Klapper (1976). Herein, it is regarded as a Pd element of *Pterospathodus*.

Pterospathodus celloni (Walliser, 1964)

Pl. 19, figs 7-13

1962 *Spathognathodus* n. sp. b Walliser, p. 282, fig. 1, no. 9.

1962 *Ozarkodina* n. sp. a Walliser, p. 282, fig. 1, no. 7.

* 1964 *Spathognathodus celloni* Walliser, p. 73-74, pl. 4, fig. 13; pl. 14, figs 3-16; text figs 1b, 7b-f.

1964 *Cariniodus carnulus* Walliser, p. 32, pl. 6, figs 10; pl. 10, figs 20, 21: pl. 27, figs 27-38; pl. 1; text figs 4a-f.

1971 *Spathognathodus celloni* Walliser; Schönlaub, p. 44, pl. 2, fig 1-5.

1975 *Pterospathodus celloni* (Walliser); Klapper & Murphy, p. 27, pl. 2, figs 2-3.

1976 *Carniodus carnulus* Walliser; Barrick & Klapper, p. 68, pl. 1, figs 1, 2, 6-8, 12-14.

1976 *Pterospathodus celloni* (Walliser); Barrick & Klapper, p. 82, pl. 1, figs 2-3.

1985 *Pterospathodus celloni* (Walliser); Aldridge, p. 80, pl. 3.1, figs 25, 26.

1986 *Pterospathodus celloni* (Walliser); Bischoff, p. 194-197, pl. 28, figs 34-39; pl. 29, figs 1-8.

1989 *Pterospathodus celloni* (Walliser); Männik & Aldridge, text fig. 1 A-F.

1990 *Pterospathodus celloni* (Walliser); Armstrong, p. 118, pl. 19, figs 6-14.

1995 *Pterospathodus celloni* (Walliser); Simpson & Talent, p. 173-175, pl. 12, figs 7-8.

Holotype. *Spathognathodus celloni* Walliser 1964, pl. 14, fig. 5. Specimen Wa740/11 from the Cellon Mountains, Carnic Alps, Austria.

Emended diagnosis. A species of *Pterospathodus* in which the Pa element lacks a platform ledge surrounding the processes.

Description. Pa element. Elements that lack a well developed outer process have been fully described as *Neospathognathodus celloni* Walliser in Aldridge (1972, p. 197) and those with well developed outer-lateral processes as *Neospathognathodus pennatus* Walliser in Aldridge (1972, p. 197).

Pb element. This element has been previously described as *Neoprioniodus costatus paucidentatus* Walliser in Aldridge (1972, p. 193-194). The convex inner-lateral face described by Aldridge (1972) is in fact the outer face, and *vice versa.*

Pc element. Refer to the description of *Ozarkodina adiutricis* Walliser in Aldridge (1972, p. 198). There is an incipient outer-lateral process beneath the cusp, and an inner expansion of the basal cavity to the posterior of the outer-lateral process.

Pd element. This element fits the description of *Carniodus carnus* Walliser in Aldridge (1972, p. 169-170), but the elements recovered herein commonly only bear four denticles on the posterior process.

M element. Described fully by Aldridge (1972, p.173-174) as *Neoprioniodus triangularis tenuirameus* (Walliser).

Sb_1 and Sb_2 element. Refer to the description of ?Sa and ?Sb element of *P. celloni* (Walliser) in Armstrong (1990, p. 118).

Sc element. Refer to the description of *Neoprionidus subcarnus* Walliser in Aldridge (1972, p. 195-196).

Remarks. The Schönlaub (1971) identified the Pb (= Pc) element and Barrick & Klapper (1976) described the M, and S (= Pb) elements. Jeppsson (1979) and Mabillard & Aldridge (1983) suggested that *Exochognathus brevialatus* (Walliser) may have occupied a Sa / Sb position. The S element of Barrick & Klapper (1976), was reinterpreted as a Pb / M intermediate by Aldridge (1985) and later as a Pc (=Pb) by Männik & Aldridge (1989). Herein, Pd, and Sc elements are added and the Pb and Pc elements of Männik & Aldridge (1989) are reversed.

Occurrence. Chicotte Formation, Anticosti Island, Québec; Road River Group, Prongs Creek, northern Yukon.

Pterospathodus rhodesi Savage, 1985
Pl. 19, figs 14, 15

- * 1985 *Pterospathodus amorphognathoides rhodesi* Savage, p. 714, fig. 3 A-T.
- 1987a *Pterospathodus pennatus rhodesi* (Savage); Over & Chatterton, p. 21-22, pl. 4, figs 5, 6.
- 1990 *Pterospathodus pennatus rhodesi* (Savage); Armstrong, p. 120-122, pl. 20, figs 6-16
- 1991c *Pterospathodus rhodesi* Savage; McCracken, p. 109, pl. 5, figs 6-15.

Holotype. *Pterospathodus amorphognathoides rhodesi* Savage, 1985, fig. 3 A, B. Specimen number USNM 371651 from the Heceta Limestone, south-eastern Alaska.

Diagnosis. Refer to Savage (1985, p. 714).

Description. Pa element. Stelliscaphate, with a long carina, which curves inwardly in the anterior-most third. The outer-lateral process is posteriorly directed and bears seven denticles, which are fused to their tips. The inner-lateral process is an adenticulate inward expansion of the platform and basal cavity; this is situated posterior of the carina – outer-lateral process intersection. A wide platform surrounds the processes and is upturned at the edges. The basal cavity extends as tapering grooves, which do not reach the tips of the processes.

Pb element. Pastiniscaphate, with a posterior process which is longer and higher than the anterior process. The outer-lateral process is adenticulate, developed as a minor extension of a costa running down the cusp. The anterior process bears four denticles, whereas the posterior process bears five, larger denticles. The proximal posterior denticle is wider than the other denticles. The denticles on both processes decline in height distally and are fused to their tips. There is a narrow ridge below the line of denticles on the outer face of the anterior and posterior processes. The cusp is robust and sub-rounded in cross section. The basal cavity is obscured.

Remarks. A species of *Pterospathodus* in which the Pa element has a wide platform ledge surrounding the processes. It differs from *Pterospathodus amorphognathoides* Walliser in the thicker platform ledge and the lack of a bifurcating outer-lateral process. Savage (1985) reconstructed the apparatus of this species to include Pb (= Pc), M and S (=Pb) elements. Armstrong (1990) and McCracken (1991c) described the Sa and Sb elements.

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Pterospathodus ? sp. A

Pl. 17, figs 8-15

Description. Pa element. Pastinate, with five to seven denticles on the posterior process and six to nine on the anterior process. There is a central, adenticulate, inner-lateral projection of the basal cavity. The denticles on the posterior process are wider, taller and inclined more steeply to the posterior than those on the anterior process; the denticles on the anterior process increase in width distally. The denticles on both processes are almost fused to their tips and generally decrease in height distally. The basal cavity is expanded on the outer side beneath the cusp or just posterior to the cusp, whereas on the inner side maximum expansion occurs further to the anterior. The basal cavity extends as tapering grooves to the tips of the processes. White matter fills the denticles and cusp.

Pb element. Pyramidal pastiniscaphate, with an anterior process bearing six denticles and posterior process bearing three denticles. On the outer-lateral face of the cusp, there is a central costa, which extends into a short outer-lateral process, bearing one small denticle. The cusp is tall, wide, and steeply inclined to the posterior. The cusp and denticles are laterally compressed. On the anterior process, the denticles increase in height distally, are fused at the base and separated by v-shaped gaps. The denticles on the posterior process are very small. The processes are joined from their tips by a downward extension of the basal cavity, creating a deep oval cavity beneath the cusp. White matter is restricted to the cusp.

M element. Dolabrate, with a very large, laterally compressed cusp, which is inclined posteriorly and curved inwardly. The anterio-basal corner of the cusp extends downwards in to an anticusp. The posterior basal extension of the cusp bears one small denticle. The basal cavity is deep and has a sub triangular outline beneath the cusp.

Sb element. Tertiopedate, with posterior, inner and outer-lateral costa that extend in to denticulate processes. The processes in all specimens have been broken. There is a deep sub-circular basal cavity beneath the cusp.

Sc element. Dolabrate, with a keel along the anterior edge of the cusp that extends in to an anticusp. The straight, posterior process bears only one small triangular, compressed denticle. The basal cavity is deep, forming an oval outline beneath the cusp and extends to the tip of the anticusp. The posterior process is broken in all specimens, so the extent of the basal cavity can not be determined.

Remarks. This species has been tentatively placed within *Pterospathodus*. However, the apparent lack of a Pc element and the tall cusp of the Pb element, are characteristics of *Gamachignathus*. *Pterospathodus* sp. A differs from species of *Gamachignathus* in that on the Pa element the outer-lateral process is situated to the posterior of the inner-lateral process. *Pterospathodus* sp. A. differs from *Gamachignathus*? *macroexcavata* in the Pa element denticulation and curvature of the basal margin.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario.

A.3 Coniform and Rastrate taxa

Phylum CHORDATA Bateson, 1886

Class CONODONTA Eichenberg, 1930
Sensu Clark, 1981

Order Belodellida Sweet, 1988

Remarks. Sweet (1988) defined this order as including conodont apparatuses with four to five morphotypes, characteristically coniform elements with thin walls, smooth faces, deep basal cavities and typically well developed keels or costae. He included the Belodellidae Khodalevich & Tschernich, Ansellidae Fåhræus & Hunter and Dapsilodontidae Sweet. The Dapsilodontidae has subsequently been transferred to the Protopanderodontida by Aldridge & Smith (1993).

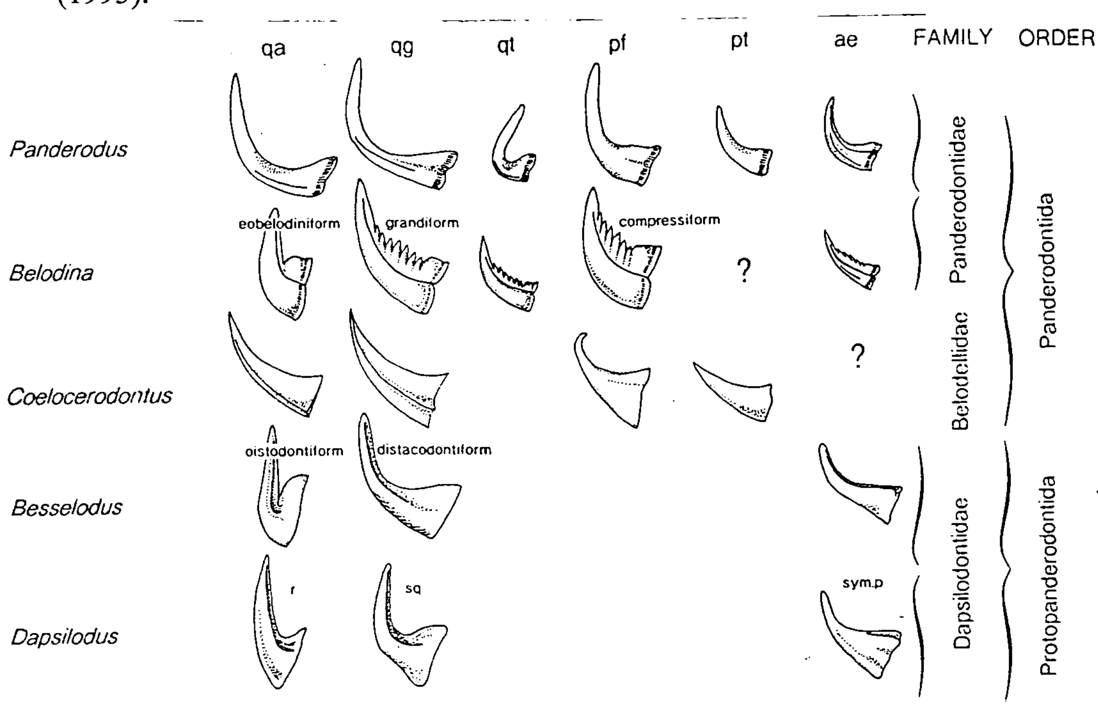


Figure A.5. Homology of the *Panderodus* plan with other coniforms (from Sansom *et al.* 1995).

Dzik (1991) combined the Bellodellida and Panderodontida Sweet, a step reversed by Aldridge & Smith (1993). Sansom *et al.* (1995) suggested homology between some elements in the apparatuses of *Coelocerodontus* Ethington and *Belodella* Ethington, and *Panderodus*. However, they suggested that a full architectural study of the bellodellid apparatus would be a prerequisite to placing the Belodellidae within the Panderodontida.

Family Belodellidae Khodalevich & Tschernich, 1973

Remarks. Sweet (1988) included *Belodella*, *Coelocerodontus*, *Dvorakia* Klapper & Barrick, *Stolodus* Lindström and *Walliserodus* Serpagli within this family. *Goverdina* Fåhræus & Hunter was added by Aldridge & Smith (1993).

Armstrong (1990)	McCracken (1991b)	This study
Sp	c dyscritiform	Aequaliform
r	a curvatiform	Tortiform
Ap	e unicostatiform	Arcuatiform
Aq	d deboltiform	Graciliform
Sq	b multicostatiform	Falciform ?

Figure A.6 Comparison of the notational schemes applied to *Walliserodus* elements.

Genus *Walliserodus* Serpagli, 1967

Type species. *Acodus curvatus* Branson & Branson, 1947, designated by Cooper (1975, p. 995).

Diagnosis. Refer to Cooper (1975, p. 995).

Remarks. The *Walliserodus* apparatus contains five morphotypes. The apparatus consists of broad, coniform elements which lack furrows, and are commonly ornamented with costae. Species of *Walliserodus* are differentiated by the general morphology of the ae element and the nature of lateral costae.

Walliserodus blackstonensis McCracken, 1991b
Pl. 20, figs 1-7

1990 *Walliserodus bicostatus* (Branson & Mehl); Armstrong, p. 122, pl. 21, figs 1-5.

* 1991b *Walliserodus blackstonensis* McCracken, p. 80, pl. 3, figs 1-42.

Holotype. *Walliserodus blackstonensis* McCracken, 1991b, pl. 3, fig. 14. Specimen GSC 101111 from the Road River Group, Blackstone River, northern Yukon Territory, Canada.

Diagnosis. Refer to McCracken (1991b, p. 80).

Description. Refer to McCracken (1991b, p. 80-81).

Remarks. McCracken (1991b) synonymised *W. bicostatus sensu* Armstrong (1990) with *W. blackstonensis*. Armstrong (1990) considered the distinguishing feature of *W. blackstonensis* (*W. bicostatus* therein) to be the double lower-lateral costae exhibited by the aequaliform (sym. p) and graciliform (aq) elements. However, McCracken (1991b) alternatively diagnosed this species as including elements with wide bases, narrow recurved cusps, keeled margins and costate ornamentation, apart from on the tortiform (= *a* therein) element.

This species has only previously been described from Greenland (Armstrong, 1990) and the northern Yukon (McCracken, 1991b).

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Walliserodus curvatus (Branson & Branson, 1947)
Pl. 20, figs 1-13

*	1947	*Acodus curvatus* Branson & Branson, p. 554, pl. 81, fig. 20.
	1975	*Walliserodus curvatus* (Branson & Branson); Cooper, p. 995, pl. 1, figs 10, 11, 16-21.
	1981	*Walliserodus curvatus* (Branson & Branson); McCracken & Barnes, p. 90-91, pl. 1, figs 26-30.
Pv	1983	*Walliserodus sancticlairi* Cooper; Uyeno & Barnes, p. 26, pl. 7, figs 1-3, 5, 6.
	1990	*Walliserodus curvatus* (Branson & Branson); Armstrong, p. 124-126, pl. 21, figs 6-15.
	1991b	*Walliserodus curvatus* (Branson & Branson): McCracken, p. 81, pl. 4, fig. 12.
	1995	*Walliserodus curvatus* (Branson & Branson); Simpson & Talent, p.127- 128, pl. 4, figs 21-25.

Holotype. *Acodus curvatus* Branson & Branson, 1947, pl. 81, fig. 20. Specimen C672-4 from the Brassfield Formation, Kentucky, U. S. A.

Diagnosis. Refer to Armstrong (1990, p. 125).

Description. The elements have been fully described by Armstrong (1990, p. 125-126).

Remarks. *W. curvatus* has recurved graciliform (aq), falciform? (sq) and tortiform (r) elements, with keeled lower margins, and a graciliform (aq) element with one to three costae on the inner face (Armstrong, 1990).

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario; Becscie, Jupiter and Chicotte Formations, Anticosti Island, Québec; Transitional Limestone Unit, Prongs Creek, northern Yukon.

Walliserodus sancticlairi Cooper, 1976

Pl. 20, figs 14-23

*1976 *Walliserodus sancticlairi* Cooper, p. 214- 215, pl. 1, figs 8-11, 16-21.

p 1977 *Walliserodus sancticlairi* Cooper; Barrick, p. 59, pl. 1, figs 11, 13-20.

pv 1983 *Walliserodus sancticlairi* Cooper; Uyeno & Barnes, p. 26, pl. 7, figs 1-3, 5, 6.

1990 *Walliserodus* cf. *W. sancticlairi* Cooper; Armstrong, p. 126-127, pl. 21, figs 16-24.

1991b *Walliserodus sancticlairi* Cooper; McCracken, p. 81-82, pl. 4, figs 3-10, 15.

1995 *Walliserodus sancticlairi* Cooper; Simpson & Talent, p. 128-129, pl. 4, figs 26-27.

Holotype. *Walliserodus sancticlairi* Cooper, 1976, pl. 1, figs 8, 12. Sample OSU 31164, from the St. Clair Limestone, Southern Illinois, U. S. A.

Diagnosis. Refer to diagnosis in Cooper (1976, p. 214)

Description. The elements have been previously described by Armstrong (1990, p. 126-127).

Remarks. *W. sancticlairi* differs from *W. curvatus* in the lack of costae on the inner face of the *a* (tortiform) element (McCracken, 1991b). The other elements of *W. sancticlairi* differ from the corresponding elements in *W. curvatus* in the presence and arrangement of costa (See McCracken, 1991b, p. 82).

Occurrence. Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Order Panderodontida Sweet, 1988

Remarks. Sweet (1988) regarded the longitudinal furrow as the diagnostic characteristic of this order. Sansom *et al.* (1995) regarded the furrow as diagnostic at the family level and proposed that the Panderodontida should include apparatuses comprising an anterior domain of qa, qg and qt elements, a posterior domain of pf and pt elements, and a symmetrical ae element.

Family Panderodontidae Lindström, 1970

Remarks. Sansom *et al.* (1995) suggested that the qt element may be unique to members of the Panderodontidae, as it has not yet been recorded in other apparatuses.

They tentatively included *Pseudobelodina* Sweet, *Parabelodina* Sweet, *Culumbodina* Moskalenko and *Plegagnathus* Ethington & Furnish within this family, on the grounds that their elements exhibit a furrow. *Pseudobelodella* Armstrong also bears a characteristic furrow and is included within this family.

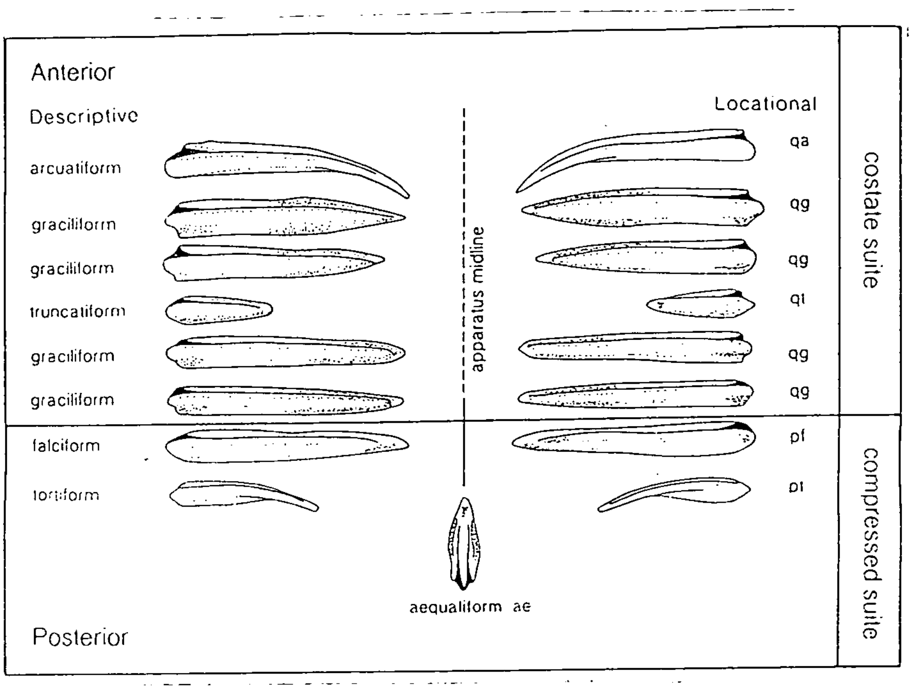
Genus *Panderodus* Ethington, 1959

Type species. *Paltodus unicostatus* Branson & Mehl, 1933.

Diagnosis. Refer to Sweet (1979, p. 62).

Remarks. The elements of *Panderodus* are simple coniforms with a distinctive furrow on one face or both faces in aequaliform elements. The falciform element shows most interspecific variation.

The *Panderodus* plan was proposed by Sansom *et al.* (1995), using rare clusters and bedding-plane assemblages. The apparatus comprised six morphotypes: a pair of arcuatiform (qa) elements, four pairs of graciliform (qg) elements, a pair of truncatiform (qt) elements, a pair of falciform (pf) elements, a pair of tortiform (pt) elements and a single aequaliform (ae) element (Figure A.7). This reconstruction is followed herein.



FigureA.7 *Panderodus* plan from Sansom *et al.* (1995, text figure 6)

Barrick (1977)	**Armstrong (1990)**	**Sansom *et al.* (1995) Descriptive:**	**Sansom *et al.* (1995) Locational:**
Sc	tp	Tortiform	Pt
M	sq	Falciform	Pf
	-	Aequaliform	Ae
	r	Truncatiform	Qt
Sb + Sa	sym. p	Graciliform	Qg
	aq	Arcuatiform	Qa

Figure A.8. Comparison of notational schemes applied to *Panderodus* elements.

Panderodus acostatus (Branson & Branson)
Pl. 23, figs 1-8
Pl. 24, figs 7-15

* 1947 *Paltodus acostatus* Branson & Branson, p. 554, pl. 82, figs 1-5, 23-24.

1953 *Paltodus equicostatus* Rhodes, p. 297, pl. 21, figs 106-109.

1990 *Panderodus* aff. *P. unicostatus* (Branson & Mehl); Armstrong, p. 110, pl. 17, figs 8-13.

v 1995 *Panderodus acostatus* (Branson & Branson); Sansom *et al.*, Text-Fig. 7.

Holotype. *Paltodus acostatus* Branson & Branson, 1947, pl. 82, figs 23-24. Specimen C676-4 from the Brassfield Formation, Kentucky, U. S. A.

Diagnosis. Refer to Rhodes (1953, p. 297).

Description. The elements of this species have been previously described by Armstrong (1990, p. 110). Additional, serrate arcuatiform elements have been previously described by Cooper (1975, p. 993).

Remarks. The elements of *P. acostatus* are morphologically similar to those of *P. unicostatus* (Branson & Mehl). The differences between the two are discussed under remarks for the latter species. Elements of *P. acostatus* have often been identified as elements of *P. equicostatus* (Rhodes) in the literature. However, *P. equicostatus* is a junior subjective synonym of *P. acostatus* (Sansom, 1992)

P. acostatus periodically develops serrations on the arcuatiform element. Serrate elements have traditionally been classified as a separate species, *P. serratus,* in form taxonomy. Serrate elements have also been observed in the *P. unicostatus* apparatus (e.g. Uyeno & Barnes, 1983). A detailed study is needed to discern which species of *Panderodus* develop serrate elements, and the significance of their occurrence.

Occurrence. Eventurel Creek Formation, Lake Timiskaming, Ontario; Ellis Bay (Lousy Cove Member), Becscie, Merrimack, Gun River, Jupiter and Chicotte Formations, Anticosti island, Québec.

Panderodus langkawiensis (Igo & Koike, 1967)
Pl. 23, figs 9-17

*	1967	*Acodus langkawiensis* Igo & Koike, p. 12, pl. 1, figs 19-20.
	1977	*Panderodus spasovi* Drygant; Barrick, p. 56, pl. 3, figs 13-21.
	1990	*Panderodus* aff. *P. spasovi* Drygant; Armstrong, p. 107-108, pl. 17, figs 14-24.
v	1995	*Panderodus langkawiensis* (Igo & Koike); Sansom *et al.*, Text-Fig. 7.
	1995	*Panderodus langkawiensis* (Igo & Koike); Simpson & Talent, p. 116-117, pl. 1, figs 19-20.

Holotype. *Acodus langkawiensis* Igo & Koike, 1967, pl. 1, fig. 19. Specimen from the Setul Limestone, Langkawi Island, Malaysia.

Diagnosis. Refer to the diagnosis of *P. spasovi* Drygant in Barrick (1977, p. 56).

Description. Previously described by Armstrong (1990, p. 107).

Remarks. The elements of *P. langkawiensis* are small, highly compressed, with a strongly recurved cusp. The cusp of graciliform elements may be at an angle of 90° to the base (Barrick, 1977). Elements of *P. panderi* (Stauffer) all also highly compressed, which led Armstrong (1990) to suggest that *P. langkawiensis* was a descendant of *P. panderi*.

Occurrence. Chicotte Formation, Anticosti Island, Québec; Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Panderodus panderi (Stauffer, 1940)
Pl. 24, figs 1-6

*	1940	*Paltodus panderi* Stauffer, p. 427, pl. 23, figs 219-220.
	1953	*Paltodus recurvatus* Rhodes, p. 297, pl. 85, figs 8-9.
	1959	*Panderodus panderi* (Stauffer); Stone & Furnish, p. 226, pl. 31, fig. 4.
	1990	*Panderodus recurvatus* (Rhodes); Armstrong, p. 104-7, pl. 16, figs 1-11.
v	1995	*Panderodus panderi* (Stauffer); Sansom *et al.*, Text-Fig. 7.
	1995	*Panderodus recurvatus* (Rhodes); Simpson & Talent, p. 117-118, pl. 1, figs 21-27.

Holotype. *Paltodus panderi* Stauffer, 1940, pl. 60, fig. 8. Specimen from the shale overlying Cedar Valley Limestone, Austin, Minnesota, U.S.A.

Diagnosis. Refer to the diagnosis of *P. recurvatus* (Rhodes) in Armstrong (1990, p. 106).

Description. The elements have been previously described by Armstrong (1990, p. 106).

Remarks. *P. panderi* is characterised by laterally compressed and highly recurved elements. A curved heel is commonly present on the dorsal margin of the base.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario; Ellis Bay, Gun River, Jupiter and Chicotte Formations, Anticosti Island, Québec; Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Panderodus staufferi (Branson, Mehl & Branson, 1951)

*	1951	*Paltodus staufferi* Branson, Mehl & Branson, p. 7-8, pl.1, figs 23-27.
	1968	*Panderodus staufferi* (Branson, Mehl & Branson); Kohut & Sweet, p. 1470, pl. 186, figs 4-5.
	1990	*Panderodus greenlandensis* Armstrong, p. 102-4, fig. 33, pl. 15, figs 1-8.
v	1994	*Panderodus staufferi* (Branson, Mehl & Branson); Sansom *et al.*, Text-Fig. 7.

Syntypes. *Paltodus staufferi* Branson, Mehl & Branson, pl.1, figs 23-27. Four syntypes from the Whitewater Formation, east of Versailles, Ripley County, Indiana, U.S.A.

Diagnosis. Refer to the diagnosis of *P. greenlandensis* in Armstrong (1990, p. 102).

Description. The elements of this species have been fully described by Armstrong (1990, p. 102-104).

Remarks. The elements are all robust, broad, deeply furrowed with lateral costae. The basal wrinkle zone is well developed.

Occurrence. Thornloe Formation, Lake Timiskaming, Ontario; Jupiter and Chicotte Formations, Anticosti Island, Québec; Transitional Limestone Unit, Prongs Creek, northern Yukon.

Panderodus unicostatus (Branson & Mehl, 1933)

Pl. 25, figs 1-5

*	1933	*Paltodus unicostatus* Branson & Mehl, p. 42, pl. 3, fig. 3.
	1977	*Panderodus unicostatus* (Branson & Mehl); Barrick, p. 56-57, pl. 3, figs 1, 2, 5, 6.
v	1994	*Panderodus unicostatus* (Branson & Mehl); Sansom *et al.*, Text-Fig. 7.
	1995	*Panderodus unicostatus* (Branson & Mehl); Simpson & Talent, p. 118-121, pl. 2, figs 1-32.

Syntypes. *Paltodus unicostatus* Branson & Mehl, 1933, pl. 3, fig. 3. Two elements from the Bainbridge Formation near Lithium, Missouri, U.S.A.

Diagnosis. Refer to the diagnosis of *P. unicostatus* in Barrick (1977, p. 56).

Description. The elements of *P. unicostatus* have been previously described by Cooper (1976, p. 213-214).

Remarks. The elements of *P. unicostatus* are gradually curving and tapering, slender cones (Barrick, 1977). This species is similar to *P. acostatus,* but can be differentiated by the more recurved nature of its falciform element. Serrate arcuatiform elements have been periodically observed within the apparatus of *P. unicostatus* (e.g. Uyeno & Barnes).

Occurrence. Earlton and Thornloe Formations, Lake Timiskaming, Ontario; Transitional Limestone Unit, Prongs Creek, northern Yukon.

Panderodus sp. A

Pl. 25, figs 6-10

Remarks. A partial apparatus has been recovered. It is similar to that of *P. panderi,* but differs in that the falciform element is erect rather than recurved and has a more pronounced heel than the corresponding element of *P. panderi.* The falciform element is morphologically similar to that illustrated as *Panderodus* sp. A by Armstrong (1990, pl. 16, fig. 20).

Occurrence. Evanturel Creek Formation, Lake Timiskaming, Ontario.

Panderodus sp. B

Pl. 25, figs 11, 12

Remarks. Only two elements of this species have been recovered, a qt and an unidentifiable element. The tortiform element has a narrow base, which is slightly longer than the cusp. The erect cusp tapers and is entirely filled with white matter. The element has a prominent costa on the unfurrowed face. The other element is unidentifiable, as it has been crushed and fractured. The elements were recovered from a sample, which also contains *P. unicostatus.*

Occurrence. Earlton Formation, Lake Timiskaming, Ontario.

Genus *Pseudobelodella* Armstrong, 1990

Type species. *Pseudobelodella silurica* Armstrong, 1990.

Diagnosis. Refer to Armstrong (1990, p. 111)

Remarks. The elements of *Pseudobelodella* are rastrate and have a panderodontid furrow. Armstrong (1990) recognised four morphotypes within the apparatus. The element nomenclature of Armstrong (1990) has been retained herein, as only one element of *Pseudobelodella* has been recovered, and so the apparatus can not be compared with that of *Panderodus*.

Armstrong (1990) differentiated *Pseudobelodella* from *Belodella*, as *Pseudobelodella* has an ap element and a morphologically different sym. p element. However, the elements of *Pseudobelodella* are significantly different from *Belodella* in that they possess a panderodontid furrow. This feature has been regarded as diagnostic at the family level (Sansom *et al.*, 1995).

Armstrong (1990) observed that *Pseudobelodella* was restricted to deeper water in the upper *celloni* and *amorphognathoides* CBZs in Greenland. Elements of *Pseudobelodella* have only been recovered from the *celloni* CBZ of the deep water Prongs Creek section (northern Yukon).

Pseudobelodella silurica Armstrong, 1990

Pl. 26, figs 9, 10

	1978	*Belodella* n. sp. A, Miller, p. 341, pl. 1, figs 19-23.
	1987a	*Belodella* n. sp. A, Over & Chatterton, pl. 6, figs 4, 8-11.
*	1990	*Pseudobelodella silurica* Armstrong, p. 111, pl. 18, figs 3-9.
	1995	?*Pseudobelodella silurica* Armstrong; Simpson & Talent p. 176, pl. 12, fig. 12.

Holotype. *Pseudobelodella silurica* Armstrong, 1990, pl. 18, fig. 4. Specimen MGUH 17-947 from the Lafayette Bugt Formation, at Kap Schuchert, Washington Land, Greenland.

Diagnosis. As for genus.

Description. Refer to the description of sym. p. element in Armstrong (1990, p. 111).

Remarks. Refer to generic remarks.

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Order Protopanderodontida Sweet, 1988

Remarks. Sweet (1988) erected this order to include apparatuses with one or multiple morphotypes, which were unfurrowed coniform elements with longitudinal striae. He included the Protopanderodontidae Lindström, Clavohamulidae Lindström, Acanthodontidae Lindström and Drepanoistodontidae Fåhræus & Nowlan. The Dapsilodontidae was originally classified within the Order Belodellida, but has been reclassified within the Order Protopanderodontida by Aldridge & Smith (1993). This new classification conforms with the study of apparatus structure by Sansom *et al.* (1995).

Family Dapsilodontidae Sweet, 1988

Remarks. Sweet (1988) included *Besselodus* Aldridge and *Dapsilodus* Cooper within this family, as their apparatuses comprised compressed, deeply excavated coniform elements, with characteristic oblique ornamentation along the anterior margins.

Genus *Dapsilodus* Cooper, 1976

Type species. *Distacodus obliquicostatus* Branson & Mehl, 1933.

Diagnosis. Refer to Armstrong (1990, p. 70).

Remarks. Serpagli (1970) and later Cooper (1976) identified three morphotypes within *D. obliquicostatus*. Barrick (1977) identified the same three morphotypes, and in addition two variants within the graciliform elements. The two variants differed in the degree of torsion, but gradation between the two end members made separation of the two variants difficult (Barrick, 1977). Thus, later workers did not record this variation within the torsion of the graciliform elements (Armstrong, 1990; McCracken, 1991). Within this study, the graciliform elements vary in the development of a basal heel.

McCracken (1991b) identified a fourth morphotype (*a* element therein) within *D. obliquicostatus*, which has a subdued costa on one face, whilst the other face is acostate or bears a weak costa. This element may have been previously assigned within the graciliform morphotype. Herein, the apparatus of *Dapsilodus* is regarded as consisting of three main morphotype locations, one of which may be divided by the presence / absence of a basal heel. The *a* element of McCracken (1991b) is rare and may be a minor iterative or ecophenotypic variant.

Sansom *et al.* (1995) compared the *Dapsilodus* elements with those of *Panderodus* morphotypes and identified: a single aequaliform (ae), a suite of graciliform (qg) and a pair of arcuatiform (qa) elements within the *Dapsilodus* apparatus (Figure A.5). Cooper (1976) suggested that the ratio of elements within the apparatus was 1 arcuatiform: 2 graciliform + aequaliform, whereas work by Barrick (1977) suggested a ratio of 1 aequaliform: 10 graciliform: 5 arcuatiform. Herein, the ratio is 1 aequaliform: 12-8 graciliform: 3 arcuatiform. However, this ratio is suspect, as it is unlikely that the apparatus would contain an odd number of arcuatiform elements. The complete apparatus structure of *Dapsilodus* cannot be definitely determined until a bedding-plane assemblage or element clusters have been recovered and studied.

The upper Ordovician, *Besselodus* and *Paroistodus* Lindström have apparatuses similar to that of *Dapsilodus*. *Besselodus borealis*, as reconstructed by Nowlan & McCracken (in Nowlan *et al.*, 1988) contains five major morphotypes, one of which can be subdivided. *Paroistodus* has four main morphotypes, two of which can be subdivided. Nowlan *et al.* (1988) have suggested that either of these genera may have been the ancestral to the Silurian *Dapsilodus*. *Besselodus* and *Paroistodus* are abundant in deep-water sections during the upper Ordovician. *Dapsilodus* is most abundant in deeper-water sections in the Silurian and is only rarely recovered from shallow-water environments. Armstrong (1990) suggested loss of elements may have been a feature of the evolution of *Dapsilodus*.

Cooper (1976)	**Armstrong (1990)**	**Nowlan & McCracken (in Nowlan *et al.* 1988) McCracken (1991b)**	**Sansom *et al.* (95)**
Distacodontiform	sym.	*c*	Aequaliform
Distacodontiform	sq	*b*	Graciliform
Acodontiform	r	*e*	Arcuatiform
-	-	*a*	-

Figure A.9. Comparison of the notational schemes applied to *Dapsilodus* elements.

Dapsilodus obliquicostatus (Branson & Mehl, 1933)
Pl. 21, figs 1-5

* 1933 *Distacodus obliquicostatus* Branson & Mehl, p. 41, pl. 3, fig. 2.
1976 *Dapsilodus obliquicostatus* (Branson & Mehl); Cooper, p. 212, pl. 2, figs 10-13, 18-20.
1977 *Dapsilodus obliquicostatus* (Branson & Mehl); Barrick, p. 50, pl. 2, figs 6, 10, 13.
1990 *Dapsilodus obliquicostatus* (Branson & Mehl); Armstrong, p. 70, pl. 7, figs 7-12.
1991b *Dapsilodus obliquicostatus* (Branson & Mehl); McCracken, p. 78-79, pl. 4, figs 11, 13, 14, 16-28, 30-32, 35, 40.

Holotype. *Distacodus obliquicostatus* Branson & Mehl 1933, pl. 3, fig. 2. Specimen from the Bainbridge Formation, Lithium, Missouri, U. S. A.

Diagnosis. Refer to the generic diagnosis in Armstrong (1990, p. 70).

Description. Refer to descriptions in Armstrong (1990, p. 70)

Remarks. The number of morphotypes within this species is discussed under generic remarks. Elements similar to those described as *a* elements by McCracken (1991) do occur in the Prongs Creek samples, but are very rare.

Occurrence. Transitional Limestone Unit and Road River Group, Prongs Creek, northern Yukon.

Dapsilodus? sp. B McCracken (1991b)
Pl. 21, Figs 6-9

1991b *Dapsilodus*? sp. B, McCracken, p.79 , pl. 4, figs 29, 34, 36-38.

Description. Refer to McCracken (1991b, p. 79).

Remarks. The elements of *Dapsilodus* ? sp. B have a distinctive bell shaped base. McCracken (1991b) regarded these elements as similar to elements of the Ordovician genera *Paroistodus* ? and *Scabbardella* Orchard, but differing from *Paroistodus* ? sp. A Nowlan & McCracken in having oblique and longitudinal striae. Oblique striae are a characteristic feature of *Dapsilodus* and so the elements of this species are more likely to belong within the Genus *Dapsilodus*. However, *Dapsilodus* ? sp. B appears to lack an aequaliform element, as seen in other species of *Dapsilodus* (herein and McCracken, 1991b).

The discovery of a single oistodontiform element in association with *Dapsilodus*? sp. B led McCracken (1991b) to suggest that the elements in his study were a result of contamination. However, the discovery of similar elements in the samples herein indicates that contamination by laboratory techniques in unlikely.

McCracken (1991b) recovered elements of this species from the *gregarius* and *turriculatus* GBZs. Herein, *Dapsilodus*? sp. B occurs within the basal *celloni* CBZ.

Occurrence. Road River Group, Prongs Creek, northern Yukon.

Family Drepanoistodontidae Fåhræus & Nowlan, 1978

Remarks. Sweet (1988) included *Drepanoistodus* Lindström, *Paltodus* Pander and *Paroistodus* within this family. Aldridge & Smith (1993) followed Bergström (1981) in including *Nordiodus* Serpagli and *Scandodus* Lindström, and also suggested that *Decoriconus* Cooper belonged within the Drepanoistodontidae.

Genus *Decoriconus* Cooper, 1975

Type species. *Paltodus costulatus* Rexroad, 1967.

Diagnosis. Refer to Barrick (1977, p. 53).

Remarks. The elements of *Decoriconus* are small, twisted with striate ornamentation and a posterior longitudinal groove on both faces (Barrick, 1977). The apparatus of *Decoriconus* includes three morphotypes.

Barrick (1977) calculated the approximate ratio of the different morphotypes within *D. fragilis* (Branson & Mehl). His results suggested a ratio of one arcuatiform element: four aequaliform and graciliform elements. Herein, the ratio is one aequaliform: approximately six graciliform and arcuatiform elements. However, the ratio varies considerably between samples and may not be a reliable indication of the number of elements in an individual apparatus.

Cooper (1976)	Barrick (1977)	Armstrong (1990)	McCracken (1991)	This study
Paltodontiform	Sa	sym. p	c	aequaliform
Acontiodontiform	Sb	sq	b	graciliform
Drepanodontiform	Sc	r	-	arcuatiform

Figure A.10 Comparison of the notational schemes applied to *Decoriconus* elements.

Decoriconus costulatus (Rexroad, 1967)
Pl. 21, figs 10-15.

* 1967 *Paltodus costulatus* Rexroad, p. 40-41, pl. 4, figs 26-29.
1975 *Decoriconus costulatus* (Rexroad); Cooper, p. 992, pl. 1, figs 1, 12, 15, 22.
v 1981 *Decoriconus costulatus* (Rexroad); McCracken & Barnes, p. 75, pl. 2, figs 24-27.

Holotype. *Paltodus costulatus* Rexroad, 1967, pl. 4, fig. 27. Specimen 10041, from the Brassfield Limestone, Cincinnati Arch, U. S. A.

Diagnosis. Refer to Rexroad (1967, p. 40)

Description. The elements have been previously described by Cooper (1975) and McCracken & Barnes (1981).

Remarks. Cooper (1976) suggested that *D. fragilis* differed from *D. costulatus* in three aspects. Firstly, *D. fragilis* had larger, more robust skeletal elements than *D. costulatus*. Secondly, the apparatus of *D. fragilis* included an arcuatiform element, whereas the apparatus of *D. costulatus* lacked this element. Some elements of *D. fragilis* lacked ornamentation, which Cooper (1976) regarded as a key feature of the *D. costulatus* elements. Barrick (1977) clarified Cooper's suggestion by adding that 'all elements of *D. costulatus* are striate whereas the Sa (= aequaliform) element of *D. fragilis* is not'.

The evidence from this study does not concur with the first aspect, the difference in robustness. In the Prongs Creek section, the *Decoriconus* elements found at the base of the Silurian have pronounced striae and can be classified as *D. costulatus*. However, the elements are very robust, whereas the elements of *Decoriconus* found higher in the section are smaller and more compressed. Therefore, the evidence from this section does not suggest that *D. fragilis* is more robust than *D. costulatus*.

The second aspect, the lack of an arcuatiform element is erroneous. McCracken & Barnes (1981) included an arcuatiform element in their apparatus reconstruction of *D. costulatus*. The discovery of this element led them to suggest that *D. costulatus* and *D. fragilis* are conspecific. In the Prongs Creek section, arcuatiform elements are lacking only in samples that have yielded a low number of *Decoriconus* elements.

The current evidence for the lack of ornamentation on the aequaliform element is conflicting. Barrick (1977) declared that the aequaliform element of *D. fragilis* was not striate. However, Cooper (1976) had illustrated a striate aequaliform element of *D. fragilis*. Herein, the specimens are mainly affected by diagenetic mineralisation and so it is difficult to determine whether striations are present or not.

The general morphology of the elements of *D. costulatus* and *D. fragilis* seem to differ only in that the elements of *D. fragilis* are smoother. Herein, the two species have been retained. Elements described as *D. costulatus* have pronounced striae and occur in the uppermost Ordovician to lowermost Silurian. Elements assigned to *D. fragilis* have generally less pronounced ornamentation and occur in the Llandovery.

Occurrence. Ellis Bay and Becscie Formations, Anticosti island, Québec; Transitional Limestone Unit, Prongs Creek, northern Yukon.

Decoriconus fragilis (Branson & Mehl 1933)
Pl. 21, figs 16-22

* 1933 *Paltodus fragilis* Branson & Mehl, p. 43, pl. 3, fig. 3.
1977 *Decoriconus fragilis* (Branson & Mehl); Barrick, p. 53, pl. 2, figs 15, 21-23.
1990 *Decoriconus fragilis* (Branson & Mehl); Armstrong, p. 71, pl. 7, figs 13-17.
1995 *Decoriconus fragilis* (Branson & Mehl); Simpson & Talent, p. 175-176, pl. 12, figs 10-11.

Holotype. *Paltodus fragilis* Branson & Mehl, 1933, pl. 3, fig. 6. Specimen from the Bainbridge Formation, Lithium, Missouri, U. S. A.

Diagnosis. Refer to Armstrong (1990, p. 71)

Description. The elements of *D. fragilis* have been fully described in the literature by Barrick (1977, p.) and Cooper (1976, p. 213).

Remarks. Refer to the remarks made for *D. costulatus* above.

Occurrence. Eventurel Creek Formation, Lake Timiskaming, Ontario; Jupiter (Ferrum Member) and Chicotte Formations, Anticosti Island, Québec; Road River Group, Prongs Creek, northern Yukon.

Family Protopanderodontidae Lindström, 1970

Remarks. Sweet (1988) considered members of this family to have an apparatus, which consisted of one or multiple morphotypes, commonly nongeniculate coniforms. The surfaces are commonly ornamented with fine striae, with longitudinal carinae, costae, or ridges variably developed. Sweet (1988) included 14 genera within this family, four of which were placed in the Oneotodontidae Miller and two (including *Pseudooneotodus* Drygant) transferred to other families, by Aldridge & Smith (1993). In addition, they included five new genera. The only genus recovered herein from the Protopanderodontidae is *Staufferella* Sweet, Thompson & Satterfield.

Genus *Staufferella* Sweet, Thompson & Satterfield, 1975

Type species. *Distacodus falcatus* Stauffer, 1935a.

Diagnosis. Refer to Sweet, Thompson & Satterfield (1975).

Remarks. This genus has been reviewed by McCracken & Barnes (1981, p. 90), Nowlan & Barnes (1981, p.24), and Nowlan *et al.* (1988, p. 38). Sweet *et al.* (1975) included cones formerly assigned to *Distacodus* Hinde and *Acontiodus* Pander, within *Staufferella,* and detailed three morphotypes termed symmetrical, slightly asymmetrical and markedly asymmetrical (Nowlan & Barnes, 1981). Apparatus reconstructions of *Staufferella* were attempted by Barnes *et al.* (1979), Sweet (1982) and Nowlan *et al.* (1988). Nowlan *et al.* (1988) identified six morphotypes within *Staufferella divisa* Sweet (*c*, *a*, *b*, *e*-1, *e*-2, *e*-3). Their symmetrical *c* element showed marked interspecific variation, whilst the other elements showed only subtle variations between species. The element nomenclature of Nowlan *et al.* (1988) has had to be retained herein, as only a few elements of *Staufferella* have been recovered and so the apparatus can not yet be compared with that of *Panderodus*.

Staufferella cf. *S. inaligera* McCracken & Barnes, 1981

Pl. 23, fig. 19

cf.v1981 *Staufferella inaligera* McCracken & Barnes, p. 90, pl. 2, figs 22, 23.

Description. Refer to the description of the markedly asymmetrical element in McCracken & Barnes (1981, p. 90).

Remarks. *S. inaligera* lacks the basal alae seen in most species of *Staufferella*. *S. divisa* also lacks this feature, but the *c* element of *S. divisa* differs from *S. inaligera* in the degree of compression of the element, pinching of the cusp, and the extent of lateral costae (Nowlan *et al.* 1988). The *e* elements also differ in the subtlety of the costae and the width of the cusp (Nowlan *et al.* 1988). The elements found herein have been compared with *S. inaligera*, as McCracken & Barnes (1981) have previously recovered this species from the upper Ordovician, Ellis Bay Formation on Anticosti Island.

Occurrence. Ellis Bay Formation (Lousy Cove and Laframboise Members), Anticosti Island, Québec.

Order Unknown

Family Fam. Nov. 5

Remarks. The inclusion of *Pseudooneotodus* within the Conodonta has long been debated (for a review see Sansom, 1996). Currently, *Pseudooneotodus* is regarded as belonging within the Conodonta, but has proven difficult to place within with the suprageneric classification. It has been previously been placed within the Protopanderodontida (Sweet, 1988), the Panderodontida (Dzik, 1991), and most recently an Unknown Order (Aldridge & Smith, 1993). Sansom (1996) reviewed the current knowledge of *Pseudooneotodus* and presented a histological study of the elements.

Genus *Pseudooneotodus* Drygant, 1974

Type species. *Oneotodus ? beckmanni* Bischoff & Sannemann, 1958.

Diagnosis. Refer to Barrick (1977, p. 57)

Remarks. The elements of *Pseudooneotodus* are conical with thin walls and deep basal cavities. Barrick (1977) presented a trimembrate apparatus reconstruction for *P. bicornis* Drygant and *P. tricornis* Drygant, which was confirmed by Armstrong (1990).

Pseudooneotodus beckmanni (Bischoff & Sannemann, 1958)
Pl. 26, figs 1,2

* 1958 *Oneotodus ? beckmanni* Bischoff & Sannemann, p. 98, pl. 15, figs 22-25.
1977 *Pseudooneotodus beckmanni* (Bischoff & Sannemann); Cooper, p. 1068, pl. 2, figs 14, 17.
v 1981 *Pseudooneotodus beckmanni* (Bischoff & Sannemann); Nowlan & Barnes, p.23, pl. 2, figs 20, 21.
v 1981 *Pseudooneotodus beckmanni* (Bischoff & Sannemann); McCracken & Barnes, p. 89, pl. 2, figs 30, 31.

Holotype. *Oneotodus ? beckmanni* Bischoff & Sannemann, 1958, pl. 15, fig. 25. Specimen Bi Sa 1958 / 85, from the Lower Devonian of Frankenwald, south central Germany.

Diagnosis. Refer to Bischoff & Sannemann (1958, p. 98).

Description. Squat, conical elements with white matter concentrated at the apex. The apex is often slightly curved with only one tip. The basal outline is sub-circular, but variable.

Remarks. Cooper (1977) and McCracken & Barnes (1981) considered *P. beckmanni* as having a single morphotype, with elements only differing in basal outline.

Occurrence. Ellis Bay (Laframboise Member), Becscie and Jupiter Formations, Anticosti Island, Québec; Transitional Limestone Unit, Prongs Creek (northern Yukon).

Pseudooneotodus tricornis Drygant, 1974

Pl. 26, figs 5-7

*	1974	*Pseudooneotodus tricornis* Drygant, p. 67-68, pl. 2, figs 49, 50.
	1977	*Pseudooneotodus tricornis* Drygant; Barrick, p. 59, pl. 2, fig. 18.
	1977	*Pseudooneotodus tricornis* Drygant; Cooper, p. 1069, pl. 2, figs 15, 16.
	1990	*Pseudooneotodus tricornis* Drygant; Armstrong, p. 114, pl. 18, figs 16-18.

Holotype. *Pseudooneotodus tricornis* Drygant, 1974, p. 67.

Diagnosis. Refer to Barrick (1977, p. 58).

Description. The elements have been fully described by Barrick (1977, p. 58).

Remarks. Three morphotypes of *P. tricornis* have been described by Barrick (1977) and Armstrong (1990). The most diagnostic element is the squat conical element bearing three discrete denticles (Barrick, 1977). The other two morphotypes are unidenticulate squat and slender cones and are apparently identical to the corresponding elements of *P. bicornis*.

Occurrence. Chicotte Formation, Anticosti Island, Québec.

Pseudooneotodus sp. A

Pl. 26, figs 3,4

? 1983 *Pseudooneotodus bicornis* Drygant; Uyeno & Barnes, p. 23, pl. 3, figs 25, 26, 27, 28.

Remarks. The elements are similar to those of *P. beckmanni*, in having broad bases. The apical denticle can be curved or upright. Uyeno & Barnes (1983) recovered identical elements from the Jupiter and Chicotte Formations, which they assigned to *P. bicornis*, as in three samples bidenticulate elements were also recovered. Herein, only unidenticulate elements have been found.

Occurrence. Jupiter Formation, Anticosti Island, Québec.

A.4 Plates

PLATE 1

Figs 1-7 *Aulacognathus bullatus* (Nicoll & Rexroad)
Specimens from Anticosti Island, x60.

1. Upper view of Pa element; D799-93 from sample AI 643.
2. Upper view of Pa element; D797-87 from sample AI 656.
3. View of Pb element; D798-88 from sample AI 656.
4. View of M element; D799-92 from sample AI 653.
5. Posterior view of Sa element; D798-89 from sample AI 643.
6. Posterior view of Sb element; D799-91 from sample AI 653.
7. Inner-lateral view of Sc element; D798-90 from sample AI 643.

Figs 8-14 *Aulacognathus* aff. *A. bullatus* (Nicoll & Rexroad).
All specimens from sample PC 552, Prongs Creek, x60.

8. Upper view of Pa element; D782-50.
9. Lateral view of Pb element; D787-63.
10. View of M element; D787-63.
11. Posterior view of Sa element; D783-51.
12. Posterior view of Sb element; D801-97.
13. Inner-lateral view of Sc element; D783-52.
14. Lateral view of Pb element; D787-62.

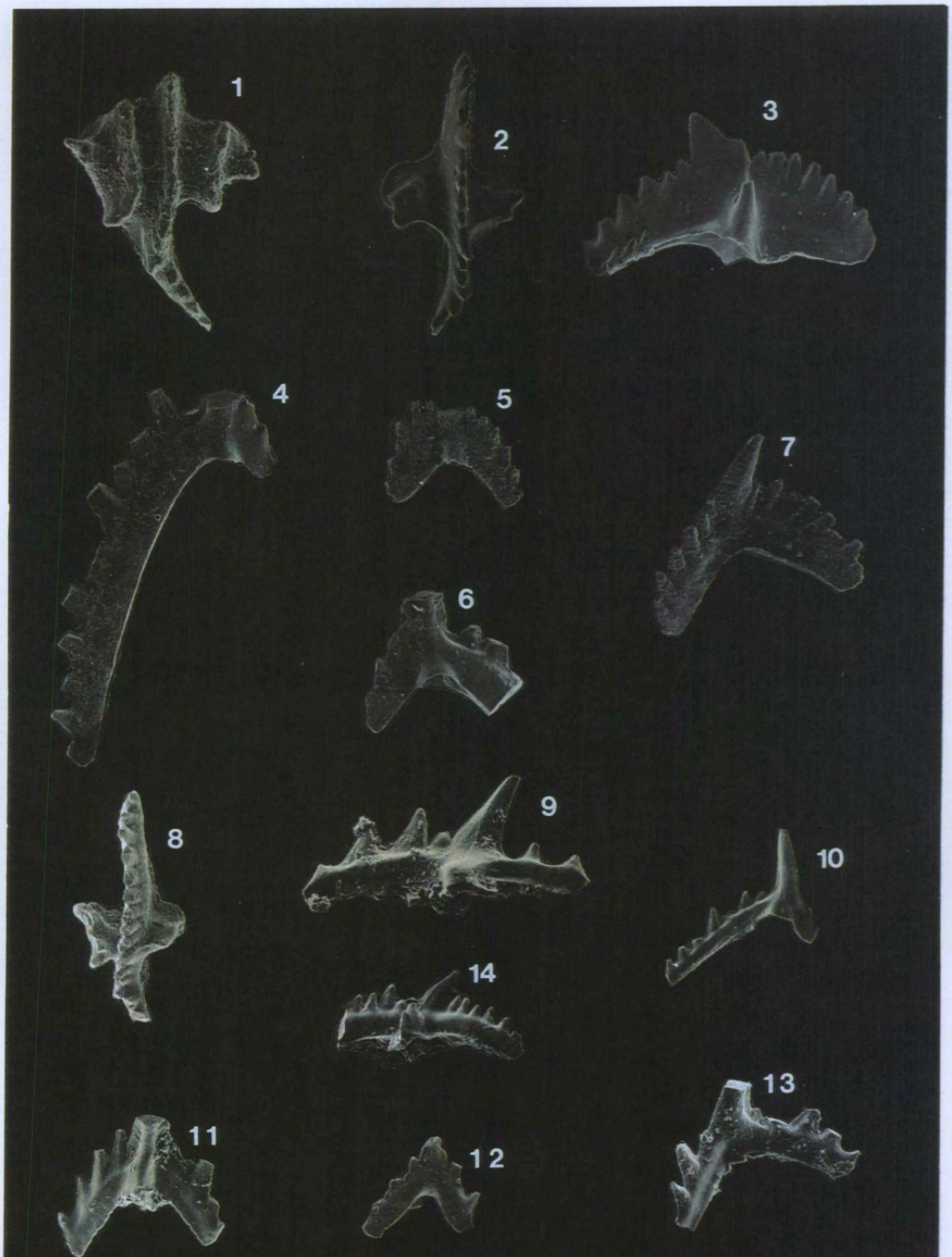

1
2
3
4
5
6
7
8
9
10
11
12
13
14

PLATE 2

Figs 1-3 *Aulacognathus bullatus* (Nicoll & Rexroad)

Specimens from Prongs Creek, x60.

1. Upper view of Pa element; D806-10 from sample PC 569.
2. Upper view of Pa element; D806-11 from sample PC 571.
3. Upper view of Pb element; D806-12 from sample PC 571.

Figs 4, 5 *Aulacognathus kuehni* Mostler

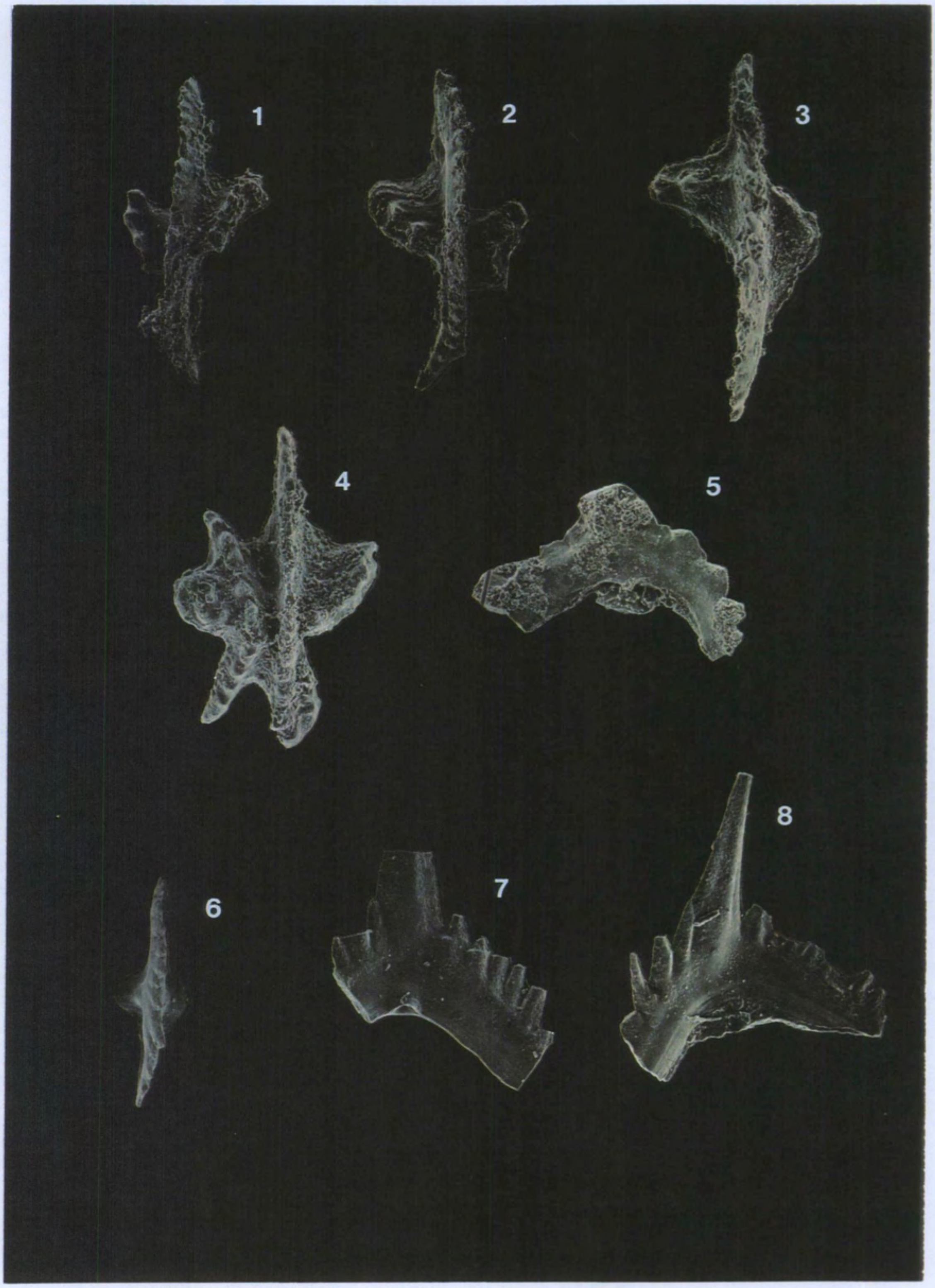
Specimens from sample PC 564, Prongs Creek, x60.

4. Inner-lateral view of Pa element; D759-26.
5. Inner-lateral view of Sc element; D759-27.

Figs 6-8 *Aulacognathus* sp. A

Specimens from sample LT 273, Thornloe Formation, Lake Timiskaming, x60.

6. Upper view of Pa element; D773-25.
7. Posterior lateral view of Sb element; D773-26.
8. Inner-lateral view of Sc element; D773-27.



1
2
3
4
5
6
7
8

PLATE 3

Figs 1, 2 *Kockelella manitoulinensis* (Pollock, Rexroad & Nicoll)

Specimens from sample LT 262, Evanturel Creek Formation, Lake Timiskaming, All x60.

1. Inner-lateral view of Pa element; D833-78.
2. Inner-lateral view of Pb element; D726-27.

Figs 3-5 *Kockelella ranuliformis* (Walliser)

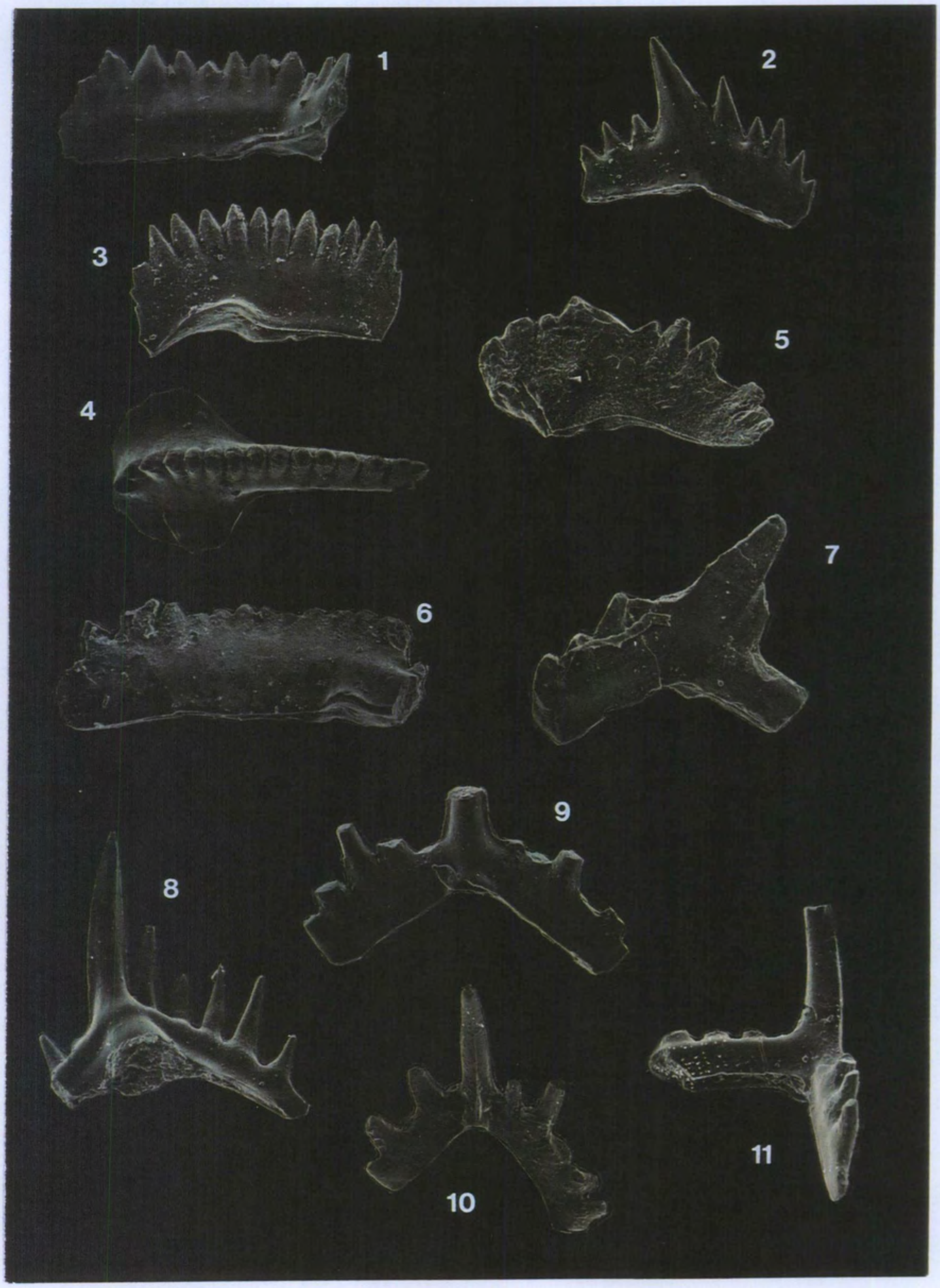
Specimens from the Chicotte Formation, Anticosti Island, x60.

3. Inner-lateral view of Pa element; D727-30 from sample AI 668.
4. Upper view of Pa element; D727-29 from sample AI 668.
5. Inner-lateral view of Pb element; D728-31 from sample AI 661.

Figs 6-11 *Kockelella* sp. B

Specimens from the Earlton Formation, Lake Timiskaming, x60.

6. Inner-lateral view of Pa element; D833-77 from sample LT 264.
7. Inner-lateral view of Pb element; D717-8 from sample LT 264.
8. View of M element; D719-13 from sample LT 265.
9. Posterior view of Sa element; D718-9 from sample LT 264.
10. Posterior view of Sb element; D866-75 from sample LT 264.
11. Inner-lateral view of Sc element; D719-12 from sample LT 265.



1
2
3
4
5
6
7
8
9
10
11

PLATE 4

Figs 1-7 *Kockelella* sp. A (Over & Chatterton)

Specimens from sample LT 278, Thornloe Formations, Lake Timiskaming, x60.

1. Upper view of Pa element; D752-77.
2. Inner-lateral view of Pb element; D752-78.
3. View of M element; D753-79.
4. Inner-lateral view of Sc element; D851-46.

Specimens from sample LT 279, Thornloe Formations, Lake Timiskaming, x60.

5. Upper view of Pa element; D721-16.
6. View of M element; D851-47.
7. Inner-lateral view of Sb element; D851-48.

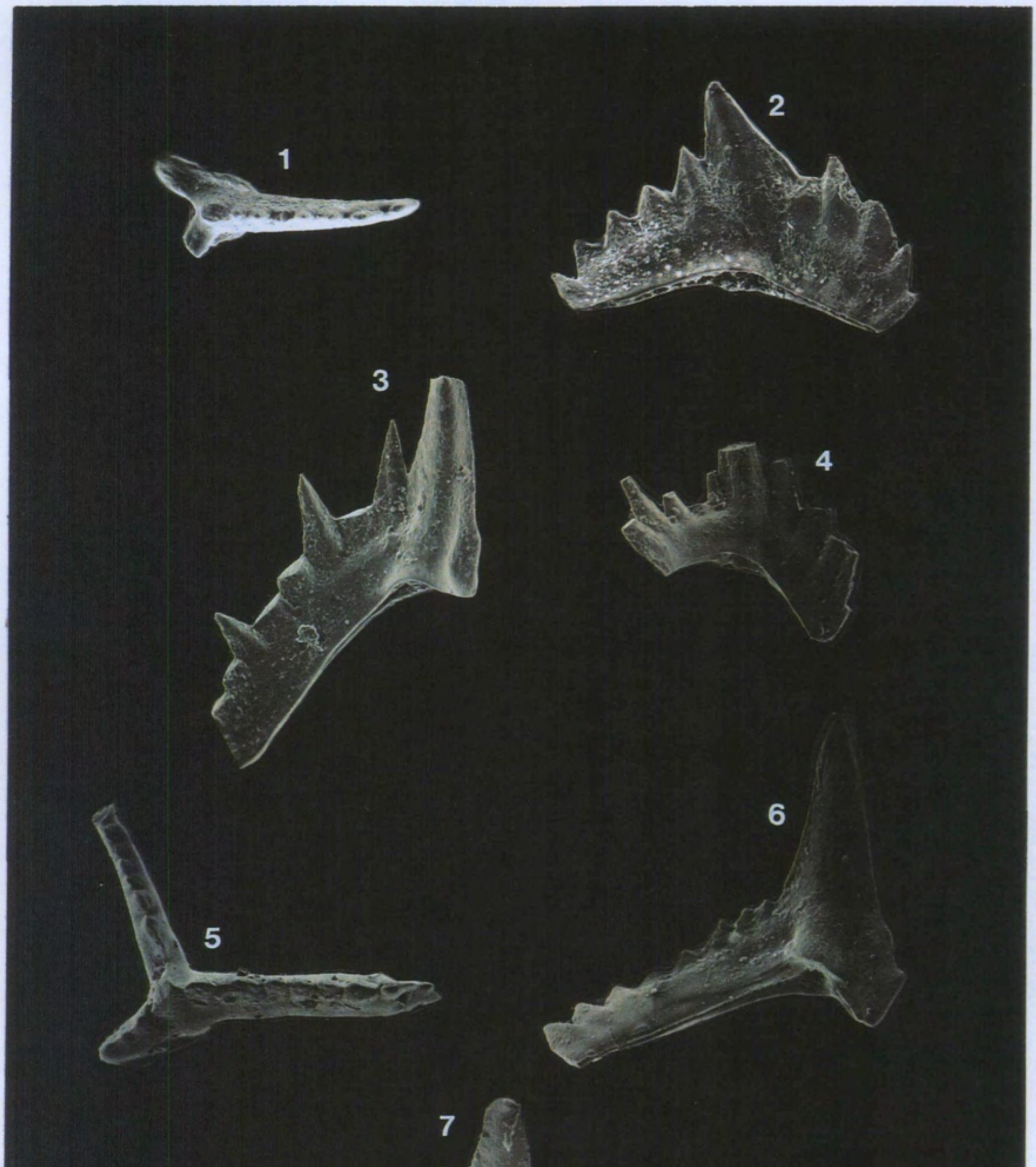

1
2
3
4
5
6
7

PLATE 5

Figs 1-4 *Ozarkodina aldridgei* Uyeno & Barnes

All specimens from sample AI 670, Jupiter Formation (Ferrum Member), Anticosti Island. All x120.

1. Inner-lateral view of Pa element; D748-69.
2. Inner-lateral view of Pb element; D749-70.
3. View of M element; D749-71.
4. Inner-lateral view of Sb element; D749-72.

Figs 5-9 *Ozarkodina excavata* (Branson & Mehl)

All specimens from sample AI 661, Chicotte Formation, Anticosti Island, x60.

5. Inner-lateral view of Pa element; D843-10.
6. View of M element; D843-11.
7. Posterior view of Sa element; D843-12.
8. Posterior view of Sb element; D844-13.
9. Inner-lateral view of Sc element; D844-14.

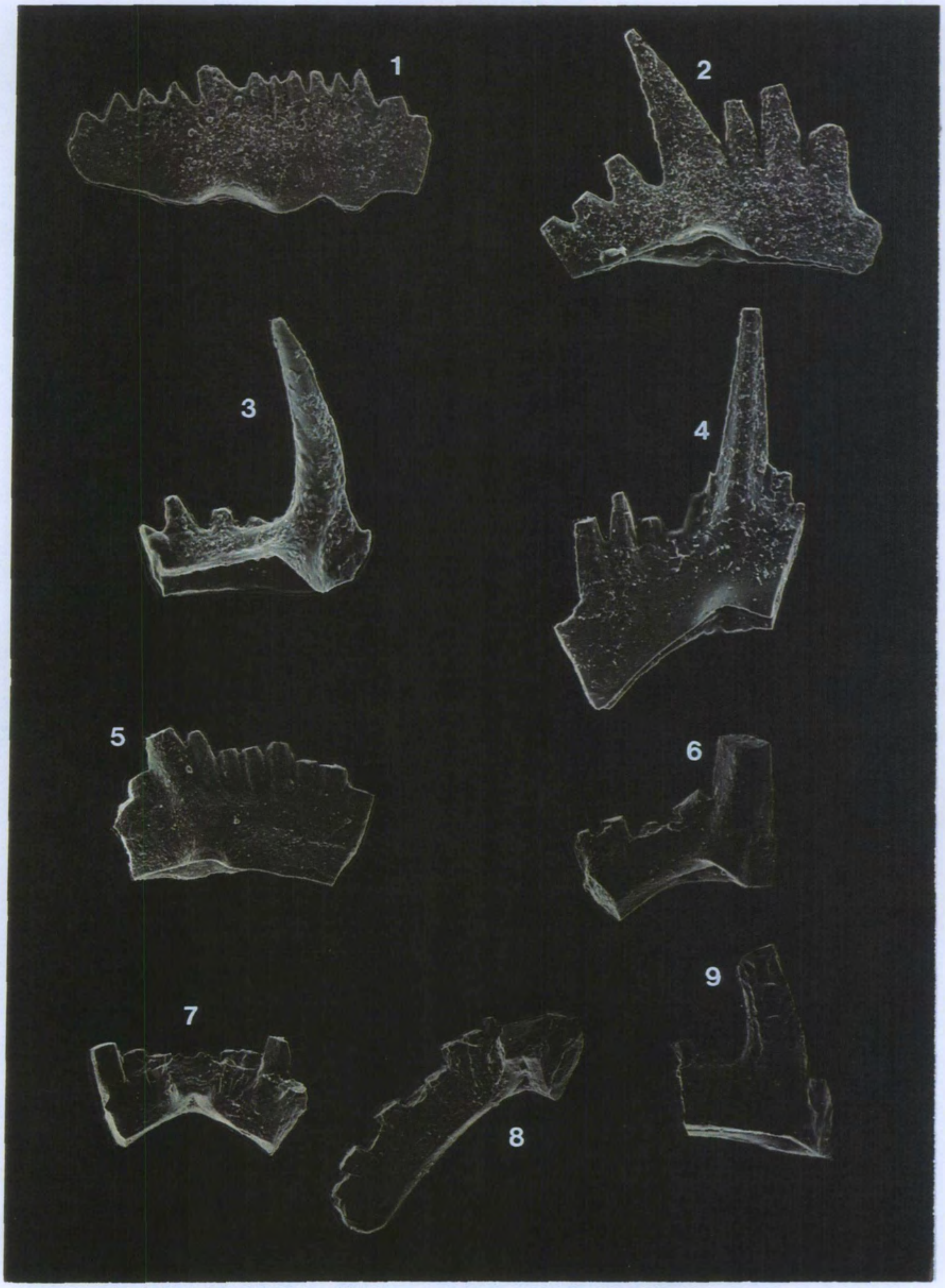

1
2
3
4
5
6
7
8
9

PLATE 6

Figs 1-5 *Ozarkodina gulletensis* (Aldridge)

All specimens x60.

1. Inner-lateral view of Pa element; D855-38 from sample 270, Lake Timiskaming.
2. View of M element; D855-39 from sample AI 653, Anticosti Island.
3. Posterior view of Sa element; D772-24 from sample 270, Lake Timiskaming.
4. Posterior view of Sb element; D849-40 from sample AI 653, Anticosti Island.
5. Inner-lateral view of Sc element; D849-41 from sample AI 653, Anticosti Island.

Figs 6, 7 *Ozarkodina hassi* (Pollock, Rexroad & Nicoll)

All specimens from sample PC 552, Prongs Creek, x60.

6. Inner-lateral view of Pa element; D861-64.
7. Inner-lateral view of Pb element; D862-65.

Figs 8-13 *Ozarkodina oldhamensis* (Rexroad)

All specimens from sample PC 552, Prongs Creek, x60.

8. Inner-lateral view of Pa element; D862-66.
9. Inner-lateral view of Pb element; D863-67.
10. View of M element; D863-68.
11. Posterior view of Sa element; D839-1.
12. Posterior view of Sb element; D839-2.
13. Inner-lateral view of Sc element; D840-3.

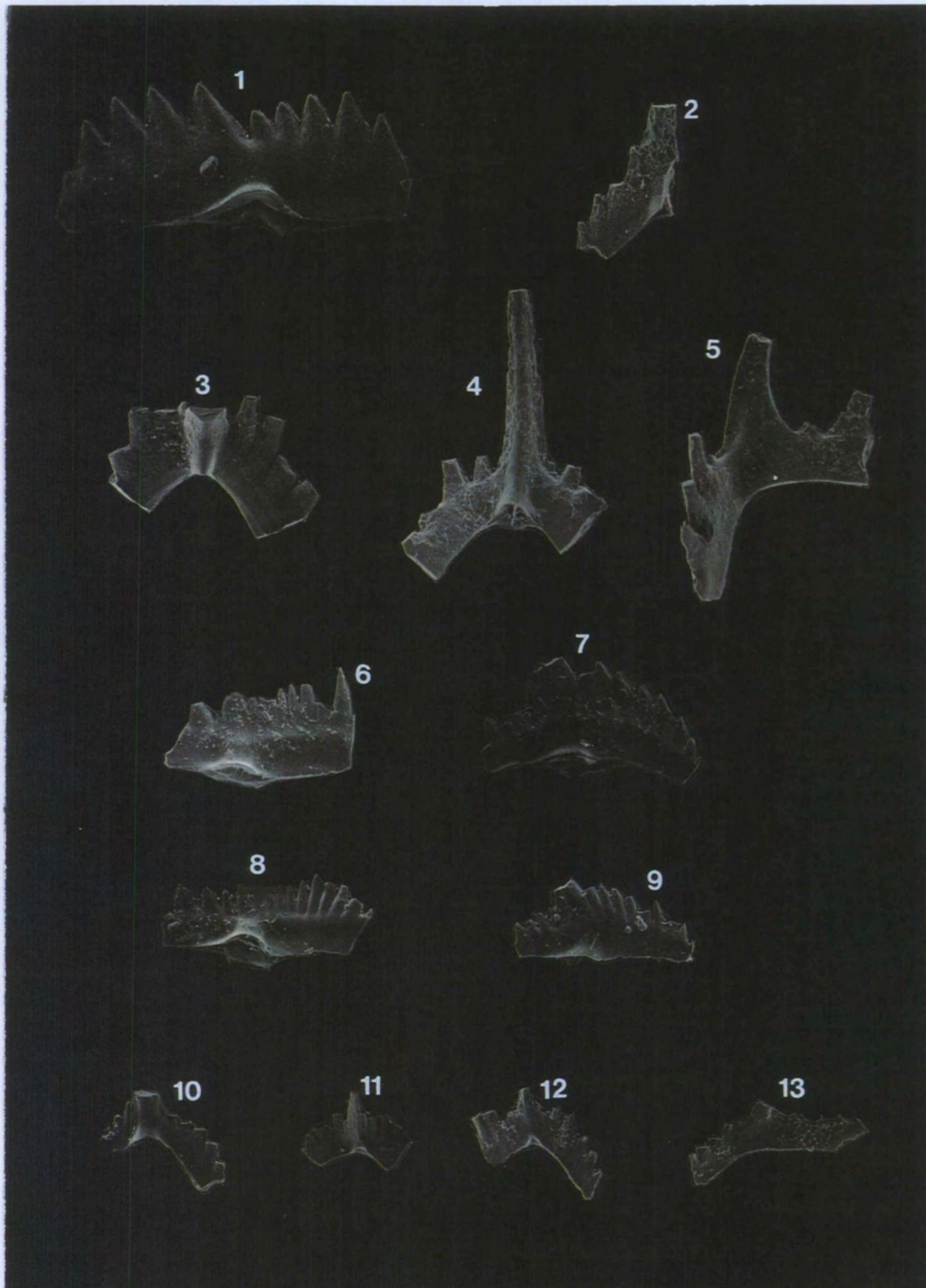

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE 7

Figs 1-4 *Ozarkodina masurensis* Bischoff

All specimens from sample PC 559, Prongs Creek, x60.

1. Inner-lateral view of Pa element; D732-39.
2. Inner-lateral view of Pb element; D733-40.
3. View of M element; D734-41.
4. Inner-lateral view of Sc element; D734-42.

Figs 5-11 *Ozarkodina pirata* Uyeno & Barnes

Specimens from the Jupiter Formation, Anticosti Island, x60.

5. Inner-lateral view of Pa element; D879-1A from sample AI 751.
6. Inner-lateral view of Pa element; D8791B from sample AI 751.
7. Inner-lateral view of Pa element; D713-21 from sample AI 647.
8. Inner-lateral view of Pb element; D713-22 from sample AI 647.
9. View of M element; D713-23 from sample AI 647.
10. Posterior view of Sb element; D714-24 from sample AI 647.
11. Inner-lateral view of Sc element; D879-2 from sample AI 751.

Figs 12-13 *Ozarkodina* cf. *O.* sp. C Armstrong

Specimens from Earlton Formation, Lake Timiskaming.

12. Inner-lateral view of Pa element from sample LT 266 x40; D741-55.
13. Inner-lateral view of Sc element from sample LT 264 x60; D742-57.

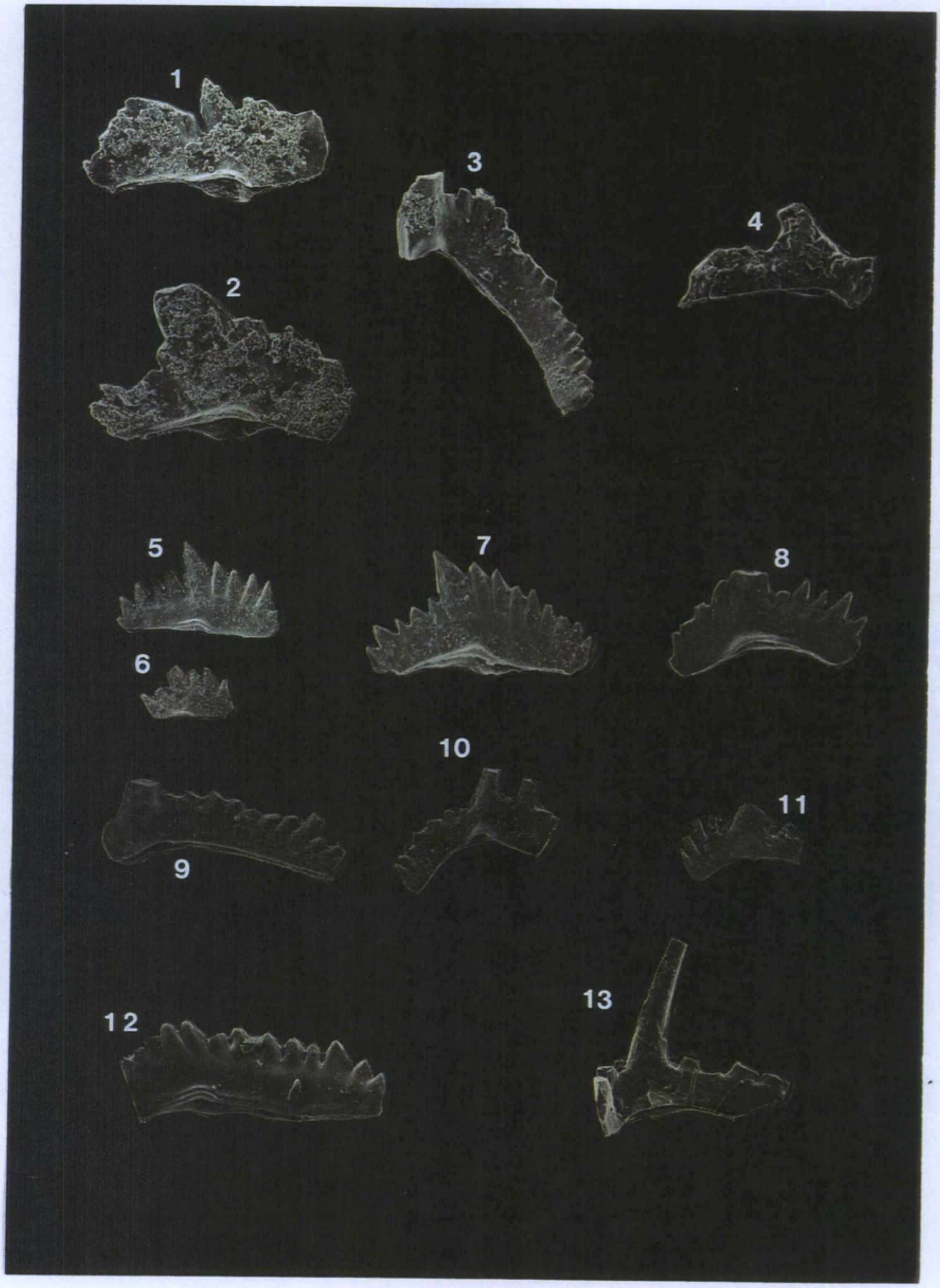

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE 8

Figs 1-5 *Ozarkodina polinclinata* (Nicoll & Rexroad)

Specimens from the Thornloe Formation, Lake Timiskaming. All x90.

1. Inner-lateral view of Pa element; D746-64 from sample LT 270.
2. Inner-lateral view of Pb element; D747-65 from sample LT 278.
3. View of M element; D747-66 from sample LT 278.
4. Posterior view of Sb element; D747-67 from sample LT 273.
5. Inner-lateral view of Sc element; D748-68 from sample LT 273.

Figs 6-9 *Ozarkodina protoexcavata* Cooper

Specimens from the uppermost Becscie Formation and Merrimack Formation, Anticosti Island, x60.

6. Inner-lateral view of Pa element; D844-15 from sample AI 673.
7. Inner-lateral view of Pb element; D845-16 from sample AI 673.
8. View of M element; D845-17 from sample AI 673.
9. Posterior view of Sb element; D878-7 from sample AI 675.

Figs 10, 11 *Ozarkodina* cf. *O. masurensis*

Specimens from sample AI 670, Jupiter Formation, Anticosti Island, x60.

10. Inner-lateral view of Pb element; D880-4.
11. Inner-lateral view of Sc element; D880-3.

Fig. 12 *Ozarkodina* sp. A

Specimens from sample LT 272, Thornloe Formation, Lake Timiskaming, x60.

12. Inner-lateral view of Pa element; D774-28.

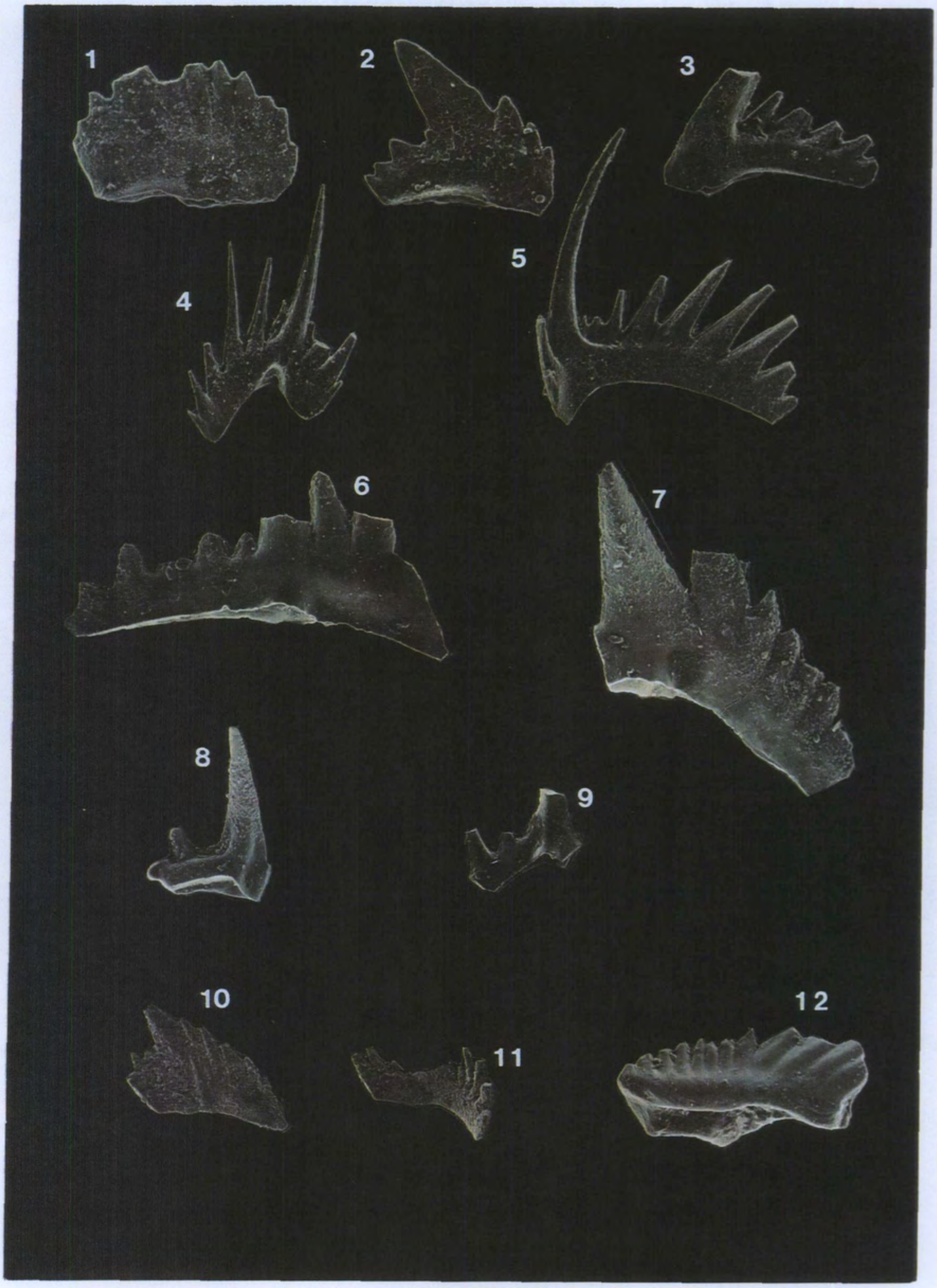

1
2
3
4
5
6
7
8
9
10
11
12

PLATE 9

Figs 1-3 *Oulodus robustus* (Bramson, Mehl & Branson)

All specimens from Anticosti Island, x60.

1. Inner-lateral view of Pa element; D790-69 from sample AI 636.
2. View of Pb? Element; D790-70 from sample AI 636.
3. View of Sc element; D791-71 from sample AI 636.

Figs 4,5 *Oulodus* sp. A

Specimens from Anticosti Island, sample AI 638, x60.

4. View of Pb element; D808-15.
5. Posterior view of M element; D808-16.

Figs 6,7, *Oulodus* sp. B

All specimens from Anticosti Island, sample AI 670, x60.

6. Posterior view of Sa element; D809-17.
7. Inner-lateral view of Sc element; D809-18.

Figs 8,9 *Oulodus* ? *nathani* McCracken & Barnes

All specimens from sample PC 552, Prongs Creek, x60.

8. View of Pa element; D817-37.
9. View of M element; D817-38.

Figs 10-15 *Oulodus* ? *kentuckyensis* (Branson & Branson)

All specimens from sample PC 552, Prongs Creek, x60.

10. View of Pa element; D814-31.
11. View of Pb element; D814-32.
12. View of M element; D815-33.
13. View of Sb element; D816-35.
14. View of Sb element; D816-36.
15. View of Sc element; D815-34.

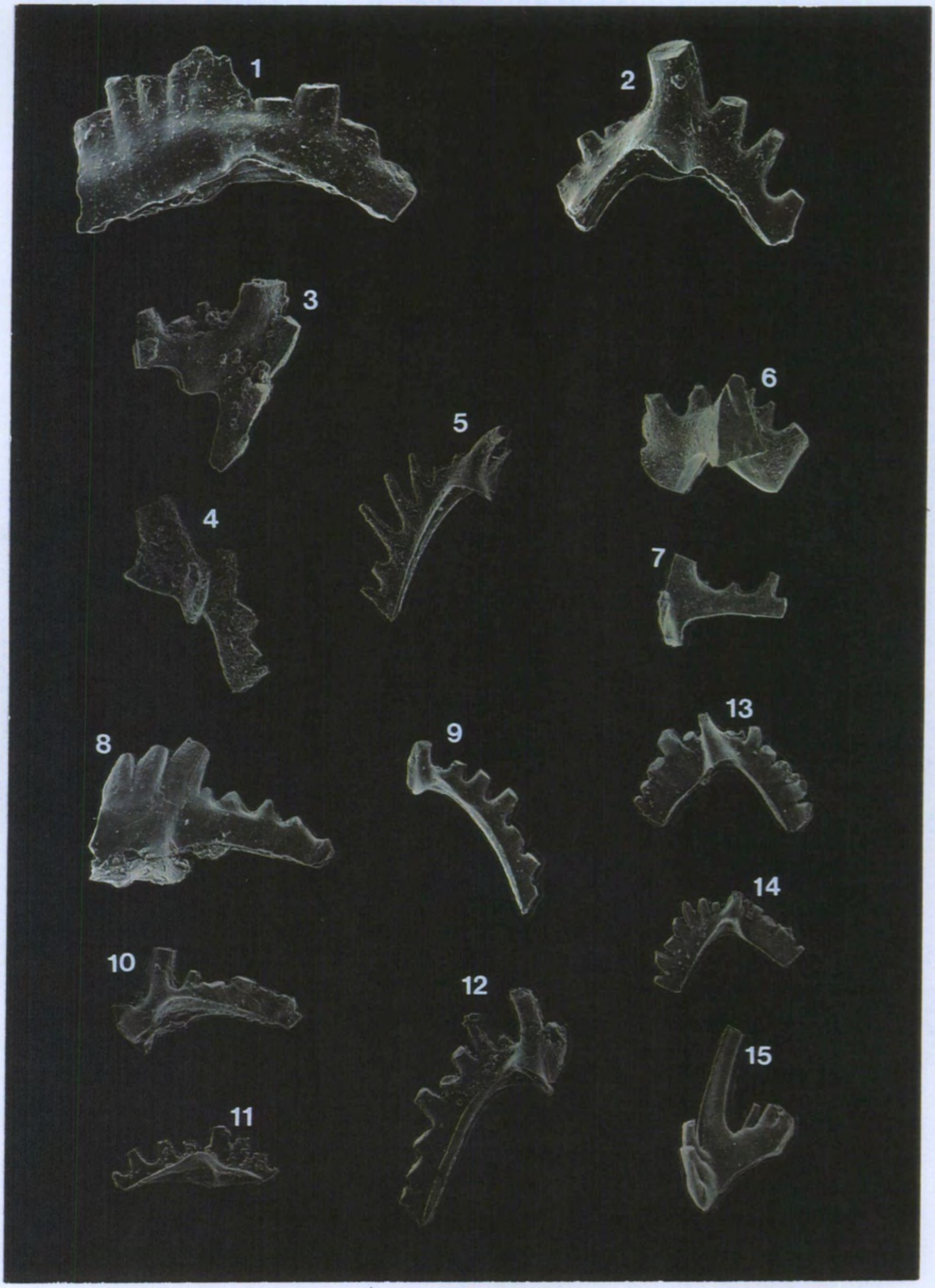

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLATE 10

Figs 1-6 *Oulodus* cf. *O. panuarensis* Bischoff

Specimens from sample PC 552, Prongs Creek.

1. Inner-lateral view of Pa element, x60; D786-59.
2. Inner-lateral view of Pb element, x60; D786-60.
3. View of M element, x60; D734-43.
4. Posterior view of Sa element, x120; D735-44.
5. View of Sb element, x120; D735-45.
6. Inner-lateral view of Sc element, x120; D736-46.

Figs 7-12 *Oulodus petilus* (Nicoll & Rexroad)

All specimens from Lake Timiskaming.

7. Inner-lateral view of Pa element, x60; D831-74 from sample LT 262.
8. Inner-lateral view of Pb element, x60; D737-48 from sample LT 261.
9. View of M element, x60; D738-50 from sample LT 278.
10. Posterior view of Sa element, x40; D738-51 from sample LT 278.
11. View of Sb element, x60; D739-52 from sample LT 253.
12. Inner-lateral view of Sc element, x60; D740-54 from sample LT 264.

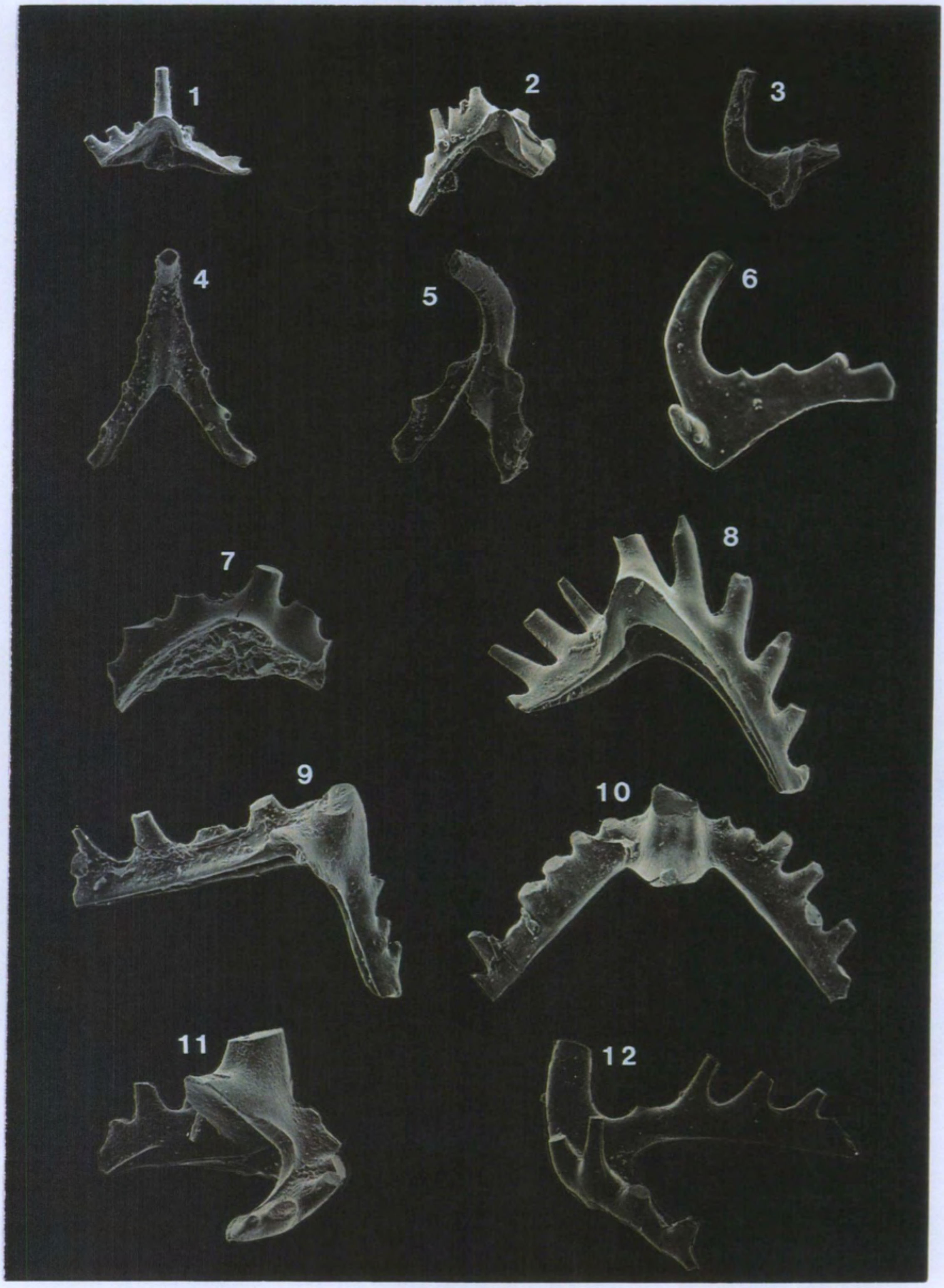

1
2
3
4
5
6
7
8
9
10
11
12

PLATE 11

Figs 1-11 *Pseudolonchodina capensis* (Savage)

Specimens from sample PC 570, Prongs Creek. All x60.

1. Inner-lateral view of Pa element; D777-36.
2. Inner-lateral view of Pb element; D781-47.
3. View of M_1 element; D778-38.
4. View of M_2 element; D778-39.
5. Lateral view of Sa element; D779-41.
6. View of Sa element; D778-40.
7. Upper view of Sa element; D779-42.
8. Posterior view of Sb_1 element; D781-46.
9. Posterior view of Sb_2 element; D780-45.
10. Inner-lateral view of Sc_1 element; D780-44.
11. Inner-lateral view of Sc_2 element; D779-43.

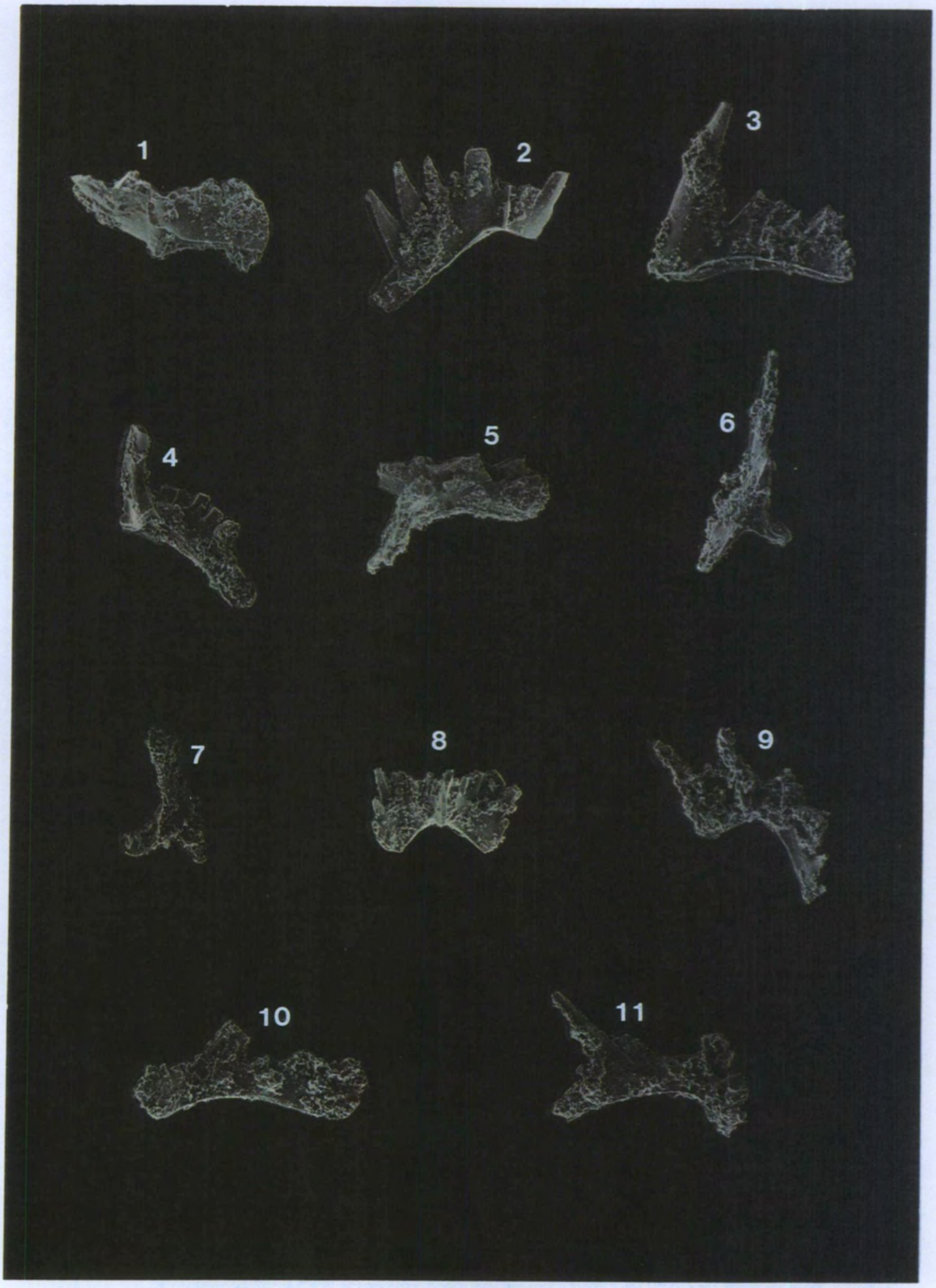

1
2
3
4
5
6
7
8
9
10
11

PLATE 12

Figs 1-8 *Pseudolonchodina expansa* (Armstrong)

All specimens from Prongs Creek. Sample PC 548, x60.

1. Inner-lateral view of Pa element; D818-40.
2. Inner-lateral view of Pb element; D821-49.
3. Inner-lateral view of M_1 element; D818-42.
4. Posterior view of Sa element; D819-43.
5. Posterior view of Sb_1 element; D820-46.
6. Inner-lateral view of Sc_2 element; D821-47.
7. Aboral view of Sa element; D819-44.
8. Posterior view of Sb_1 element; D820-45.

Figs 9-14 *Pseudolonchodina fluegeli* (Walliser)

Specimens from sample PC 561, Prongs Creek. All x 60.

9. Inner-lateral view of Pa element; D881-6.
10. Inner-lateral view of Pb element; D882-7.
11. Inner-lateral view of M_1 element; D882-8B.
12. Aboral view of Sa element; D882-8A.
13. Posterior view of Sb_1 element; D883-9B.
14. Inner-lateral view of Sc_1 element; D883-10.

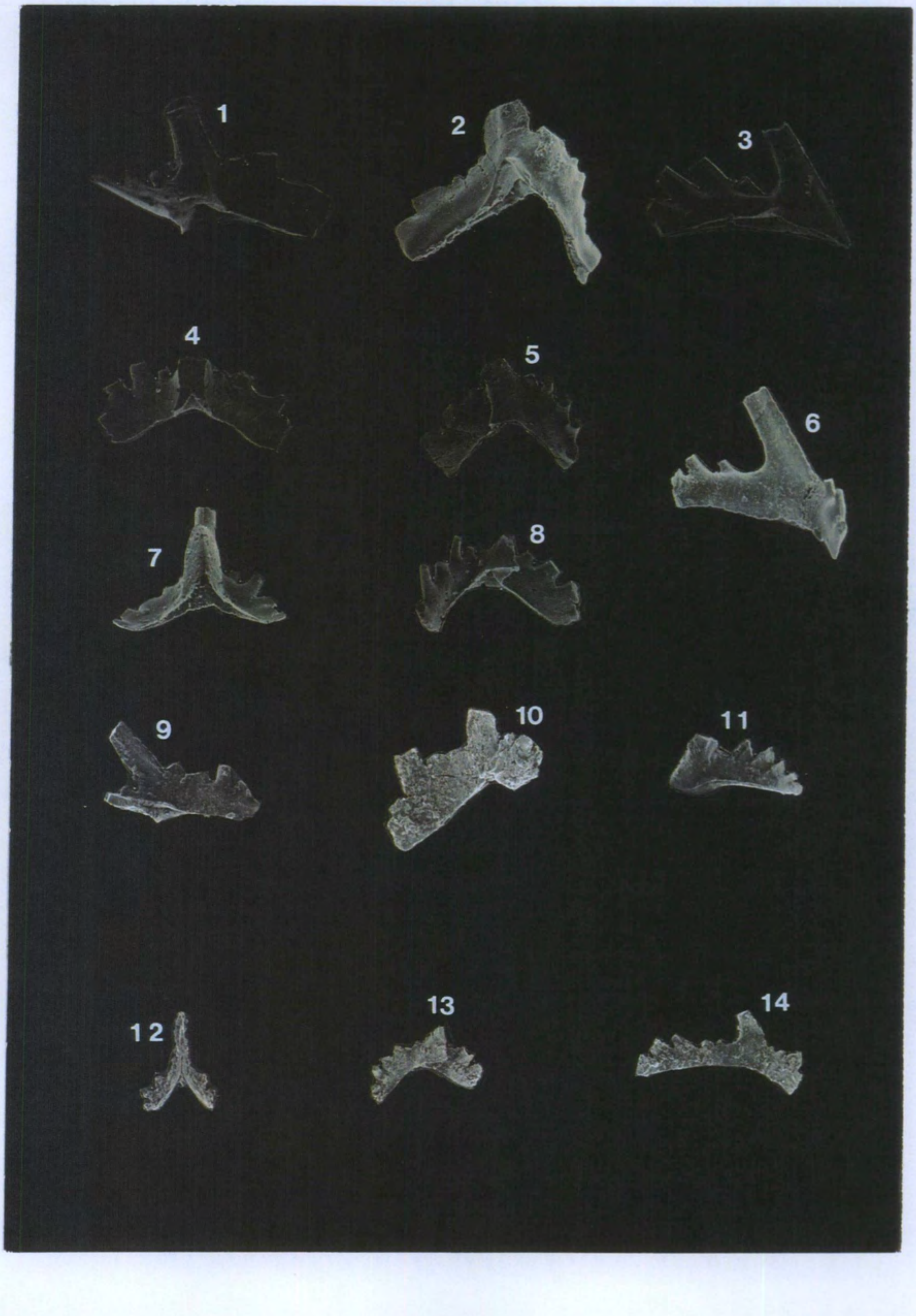

1
2
3
4
5
6
7
8
9
10
11
12
13
14

PLATE 13

Figs 1-6 *Gamachignathus ensifer* McCracken, Nowlan & Barnes
Specimens from the Ellis Bay Formation, Anticosti Island.

1. Inner-lateral view of Pa element, x60; D709-10 from sample AI 664.
2. Inner-lateral view of Pb element, x60; D892-28 from sample AI 625.
3. Pd element, x60; D788-64 from sample AI 628.
4. M element, x60; D710-12 from sample AI 664.
5. Posterior view of Sb element, x60; D710-13 from sample AI 664.
6. Lateral view of Sc element, x120; D711-15 from sample AI 628.

Figs 7-10 *Gamachignathus hastatus* McCracken, Nowlan & Barnes
Specimens from the Ellis Bay Formation, Anticosti Island.

7. Inner-lateral view of Pa element, x120; D744-60 from sample AI 628.
8. Pb element, x120; D745-62 from sample AI 628.
9. Posterior view of Sb element, x90; D745-63 from sample AI 636.
10. Lateral view of Sc element, x60; D893-30 from sample AI 636.

Fig. 11 *Amorphognathus* cf. *A. ordovicicus* Branson & Mehl
Specimen from sample AI 578, Ellis Bay Formation (Laframboise Member), Anticosti Island, x60.

11. Upper view of Pa element; D770-19.

Fig. 12 *Phragmodus undatus* Branson & Mehl
Specimen from sample AI 579, Ellis Bay Formation (Lousy Cove Member), Anticosti Island, x120.

12. Inner-lateral view of Sc element; D723-20.

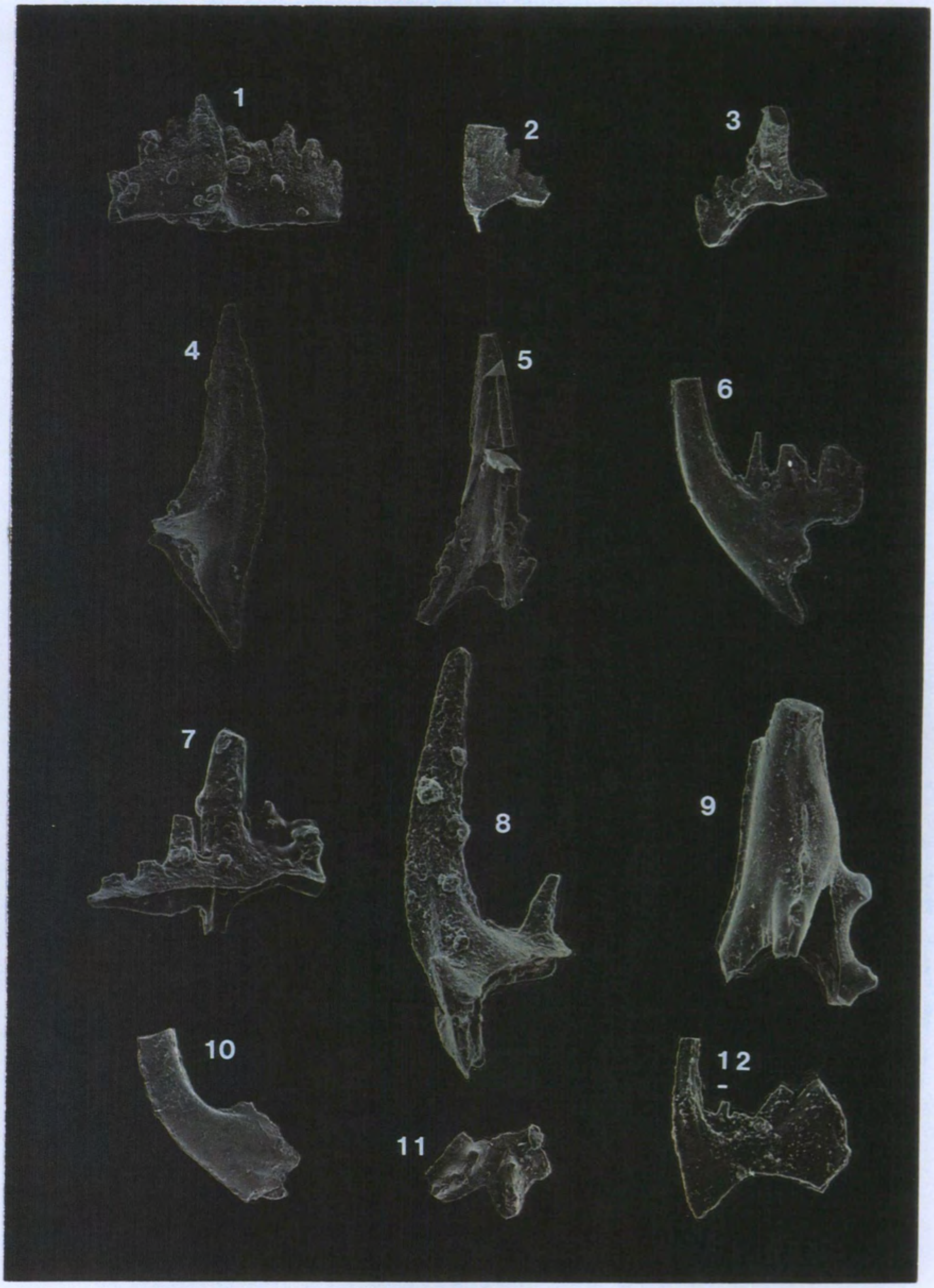

1
2
3
4
5
6
7
8
9
10
11
12

PLATE 14

Figs 1-6 *Distomodus kentuckyensis* Branson & Branson

Specimens from the Prongs Creek. All x60.

1. Upper view of Pa element; D782-49 from sample PC 554.
2. Posterior view of Pb element; D802-98 from sample PC 552.
3. Inner-lateral view of M element; D875-1 from sample PC 547.
4. Posterior view of Sa element; D802-00 from sample PC 552.
5. Posterior view of Sb element; D802-99 from sample PC 552.
6. Inner-lateral view of Sc element; D803-02 from sample PC 552.

Figs 7-13 *Distomodus staurognathoides* (Walliser)

Specimens from the Jupiter and Chicotte Formations, Anticosti Island, x60.

7. Upper view of Pa element; D813-27 from sample AI 665.
8. Oblique view of Pb element; D814-30 from sample AI 656.
9. Inner-lateral view of M element; D877-6 from sample AI 652.
10. Posterior view of Sa element; D709-8 from sample AI 667.
11. Posterior view of Sb element; D709-9 from sample AI 667.
12. Inner-lateral view of Sc element; D813-28 from sample AI 656.
13. Inner-lateral view of Sc element; D813-29 from sample AI 665.

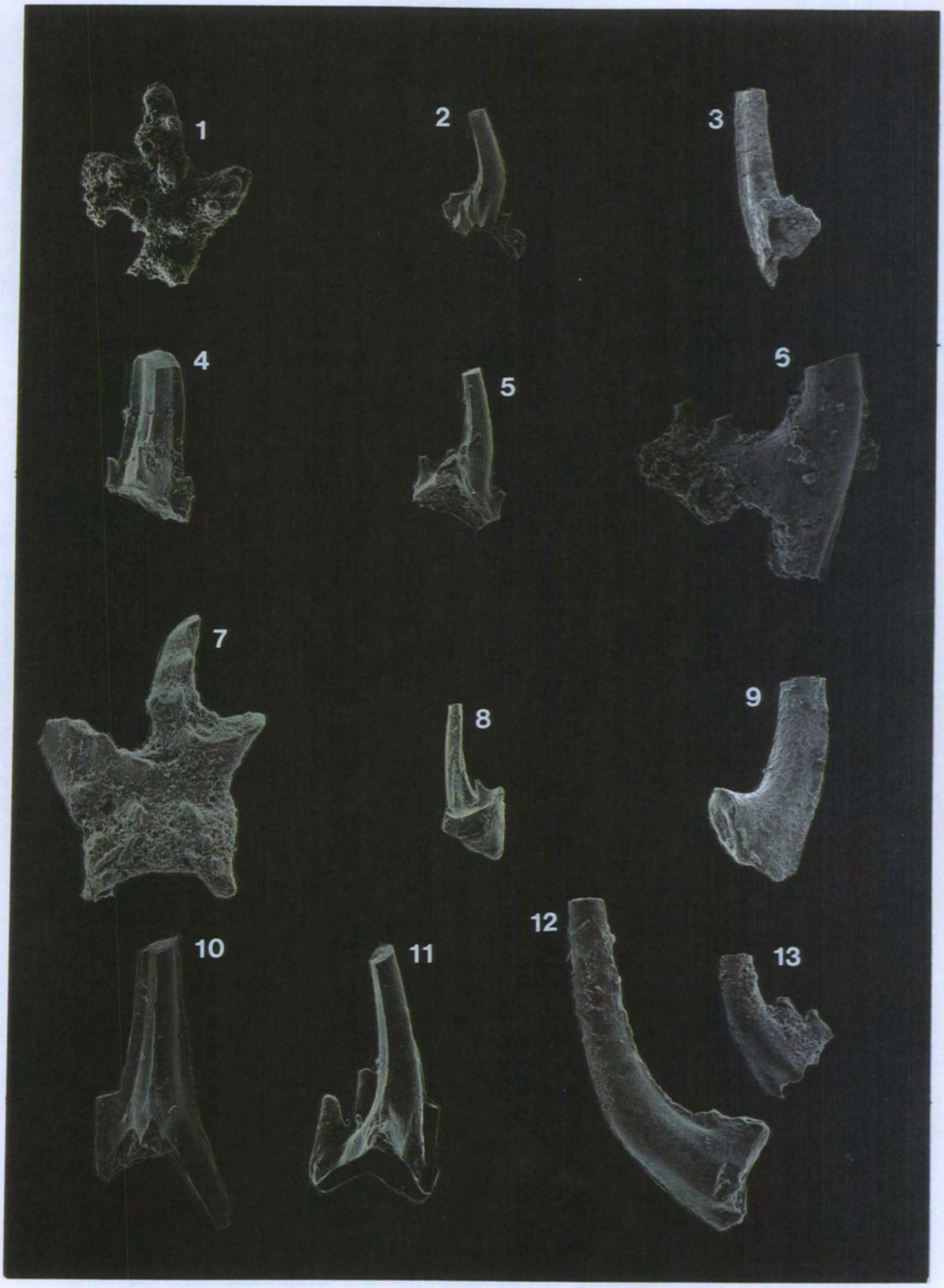

1
2
3
4
5
6
7
8
9
10
11
12
13

PLATE 15

Figs 1-3 *Distomodus* ? sp. A

Specimens from sample LT 267, Lake Timiskaming. All x60.

1. Lateral view of Pa element; D830-72.
2. Inner-lateral view of Pb element; D831-73.
3. Posterior view of M element; D881-5.

Figs 4, 5 *Coryssognathus* cf. *C. dubia* (Rhodes)

Specimens from sample PC 552, Prongs Creek, x60.

4. Inner view of Pb element; D800-95.
5. Outer view of Pb element; D800-94.

Figs 6-9 *Icriodella* (M elements)

All from Lake Timiskaming x60.

6. Lateral view of M element, *I. discreta*; D776-34 from sample LT 261.
7. Lateral view of M element, *I. deflecta*; D776-33 from sample LT 267.
8. Lateral view of M element, *I discreta*; D775-31 from sample LT 267.
9. Lateral view of M element, *I. deflecta*; D776-32 from sample, LT 267.

Fig. 10 *Icriodella* sp. A

Specimen from sample LT 261, Lake Timiskaming, x60.

10. Lateral view of Pa element; D830-71.

Fig. 11 *Icriodella* cf. *I. inconstans* Aldridge

Specimen from sample AI 653, Jupiter Formation (Pavillion Member), Anticosti Island, x60.

11. Upper view of Pa element; D772-22.

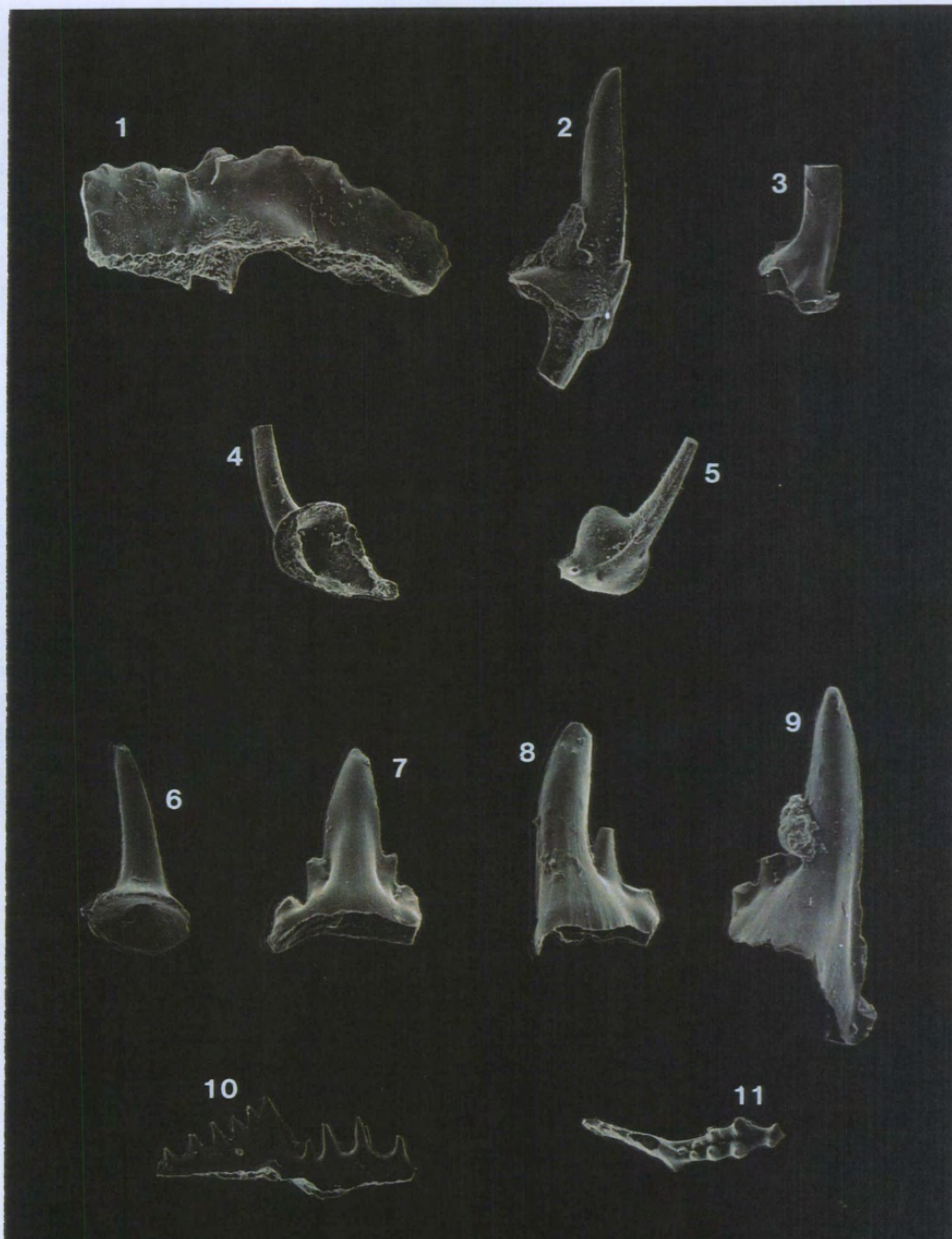

1
2
3
4
5
6
7
8
9
10
11

PLATE 16

Figs 1-7 *Icriodella deflecta* Aldridge

Specimens recovered from sample LT 262, Evanturel Creek Formation, Lake Timiskaming, x60.

1. Upper view of Pa element; D825-57.
2. Inner-lateral view of Pb element; D825-58.
3. View of Pd(?) element; D825-59.
4. Posterior view of M element; D826-60.
5. Posterior view of Sa element; D826-61.
6. Posterior view of Sb element; D826-62.
7. Lateral view of Sc element; D826-63.

Figs 8-14 *Icriodella discreta* Pollock, Rexroad & Nicoll

Specimens recovered from the Evanturel Creek Formation, Lake Timiskaming. All x60.

8. Upper view of Pa element; D827-64 from sample LT 262.
9. View of Pb element; D827-65 from sample LT 262.
10. View of Pd element; D828-66 from sample LT 262.
11. View of M element; D829-67 from sample LT 262.
12. Posterior view of Sa element; D829-68 from sample LT 267.
13. Posterior view of Sb element; D829-69 from sample LT 267.
14. Inner-lateral view of Sc element; D830-70 from sample LT 267.

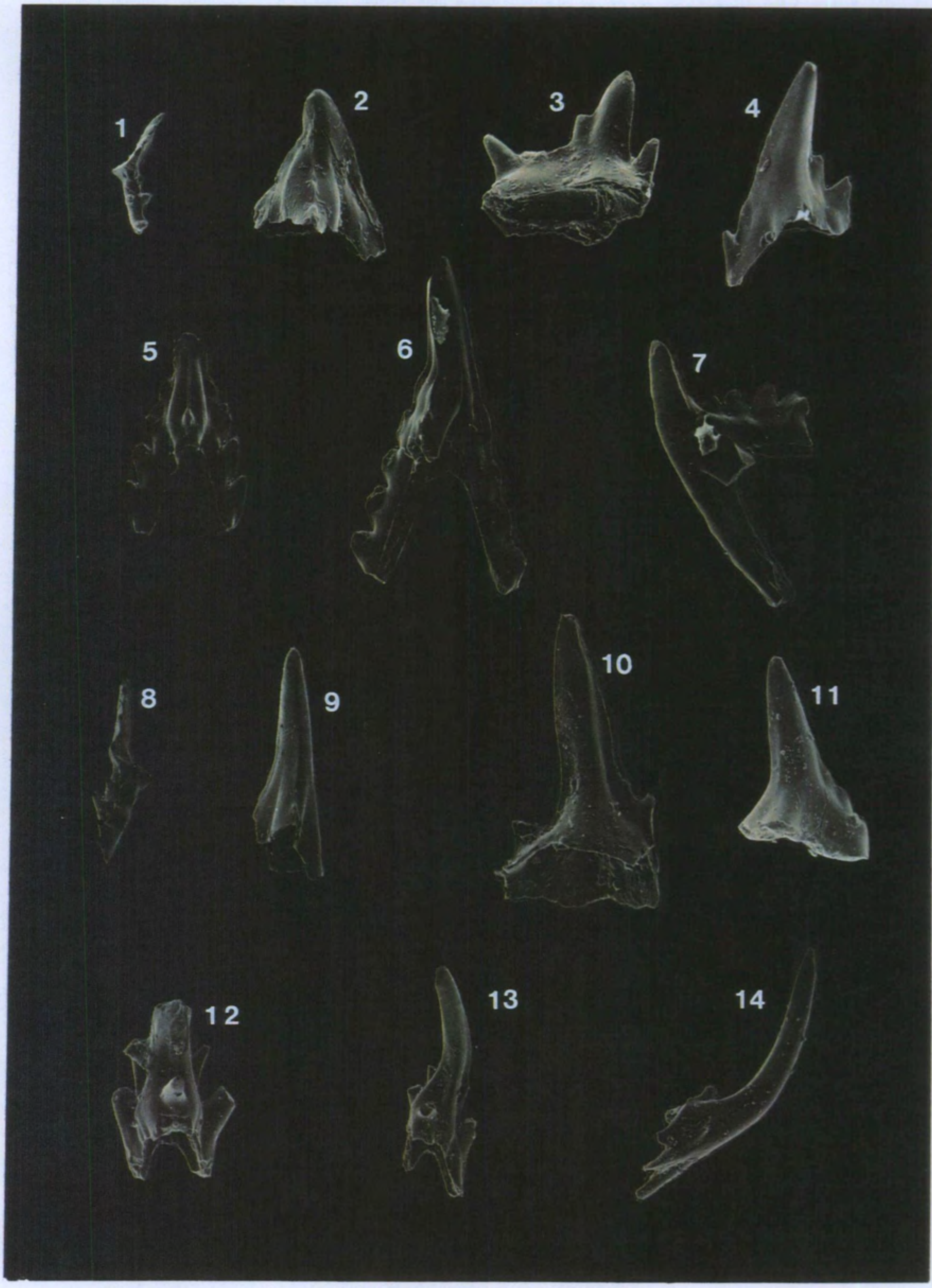

1
2
3
4
5
6
7
8
9
10
11
12
13
14

PLATE 17

Figs 1-7. *Apsidognathus tuberculatus* Walliser

Specimens from sample AI 644, Chicotte Formation, Anticosti Island.

1. Upper view of Platform element, x30; D803-3.
2. Upper view of Lyriform element, x30; D804-6.
3. Upper view of Ambalodiform element, x60; D852-30.
4. View of unknown element, x60; D804-4.
5. Upper view of Coniform element, x60; D805-8.
6. Upper view of Coniform element, x60; D805-7.
7. Upper view of Coniform element, x60; D805-9.

Figs 8-15. *Pterospathodus* ? sp. A.

Specimens from sample LT 278, Thornloe Formation, Lake Timiskaming. All x60.

8. Lateral view of Pa element; D856-50.
9. View of Pb element; D857-52.
10. View of Pb element; D856-51.
11. View of M element; D857-53.
12. Outer view of Pa element; D856-49.
13. Posterior view of Sb element; D857-54.
14. Posterior view of Sb element; D858-56.
15. Inner-lateral view of Sc element; D859-57.

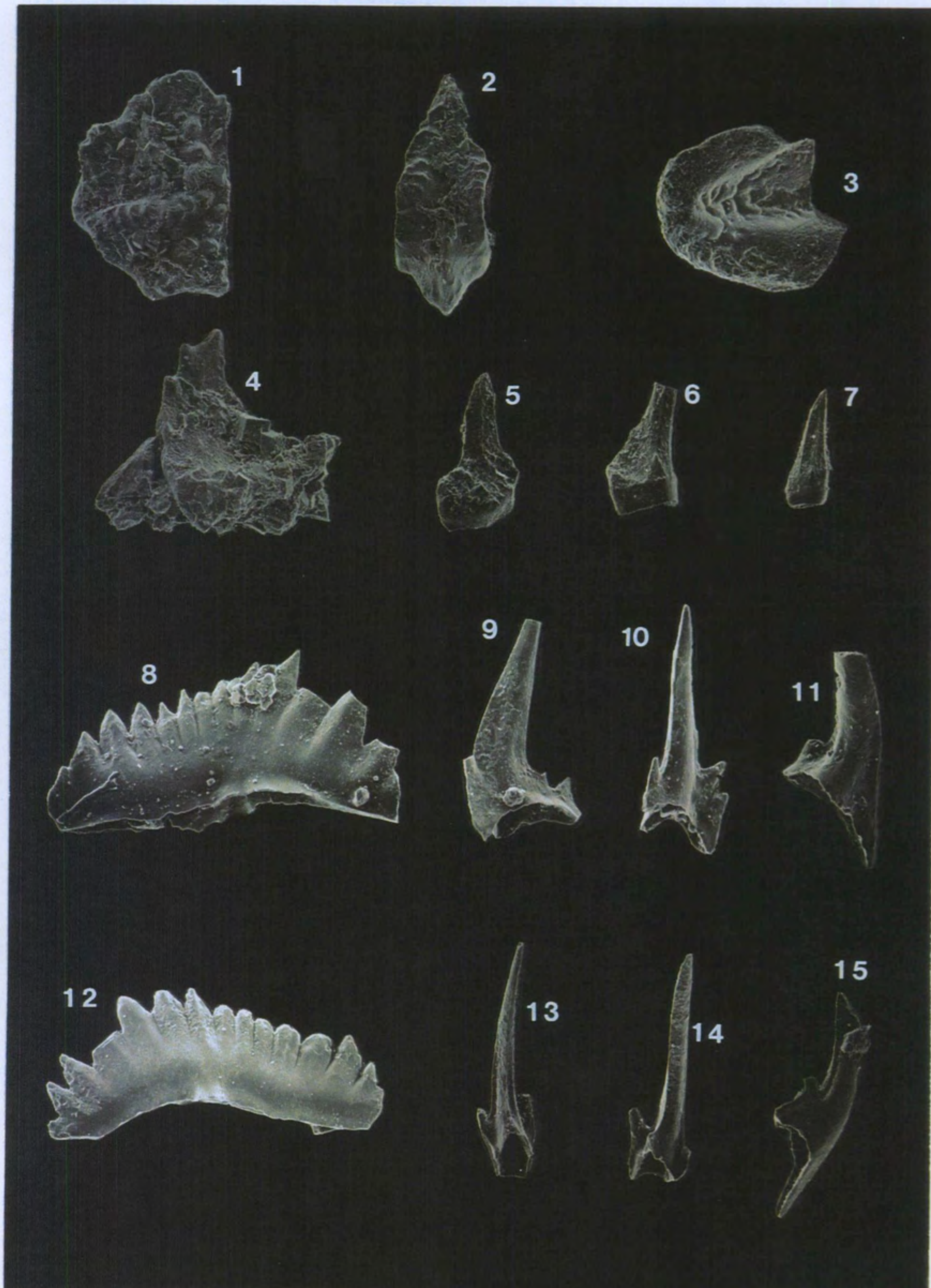

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLATE 18

Figs 1-11. *Astropentagnathus irregularis* Mostler

Specimens from sample PC 562, Prongs Creek, x60.

1. Upper view of Pa element; D836-85.
2. Upper view of Pc element; D836-86.
3. View of Pb element; D715-1.
4. Inner-lateral view of Pc element; D837-87.
5. Inner-lateral view of Pc element; D715-00.
6. Posterior view of M element; D837-88A.
7. Posterior view of Sb_1 element; D715-2.
8. Posterior view of Sb_2 element; D837-88B.
9. Posterior view of Sb_2 element; D837-89A.
10. Inner-lateral view of Sc_1 element; D838-90.
11. Inner-lateral view of Sc_2 element; D837-89B.

Figs 12- 16. *Astropentagnathus araneum* McCracken

Recovered from sample PC 561, Road River Group, Prongs Creek, x60.

12. Upper view of Pa element; D853-34.
13. Upper View of Pc element; D713-20.
14. Posterior view of Sb_1 element; D853-35.
15. Inner-lateral view of Sb_2element; D854-36.
16. View of Sc element; D854-37.

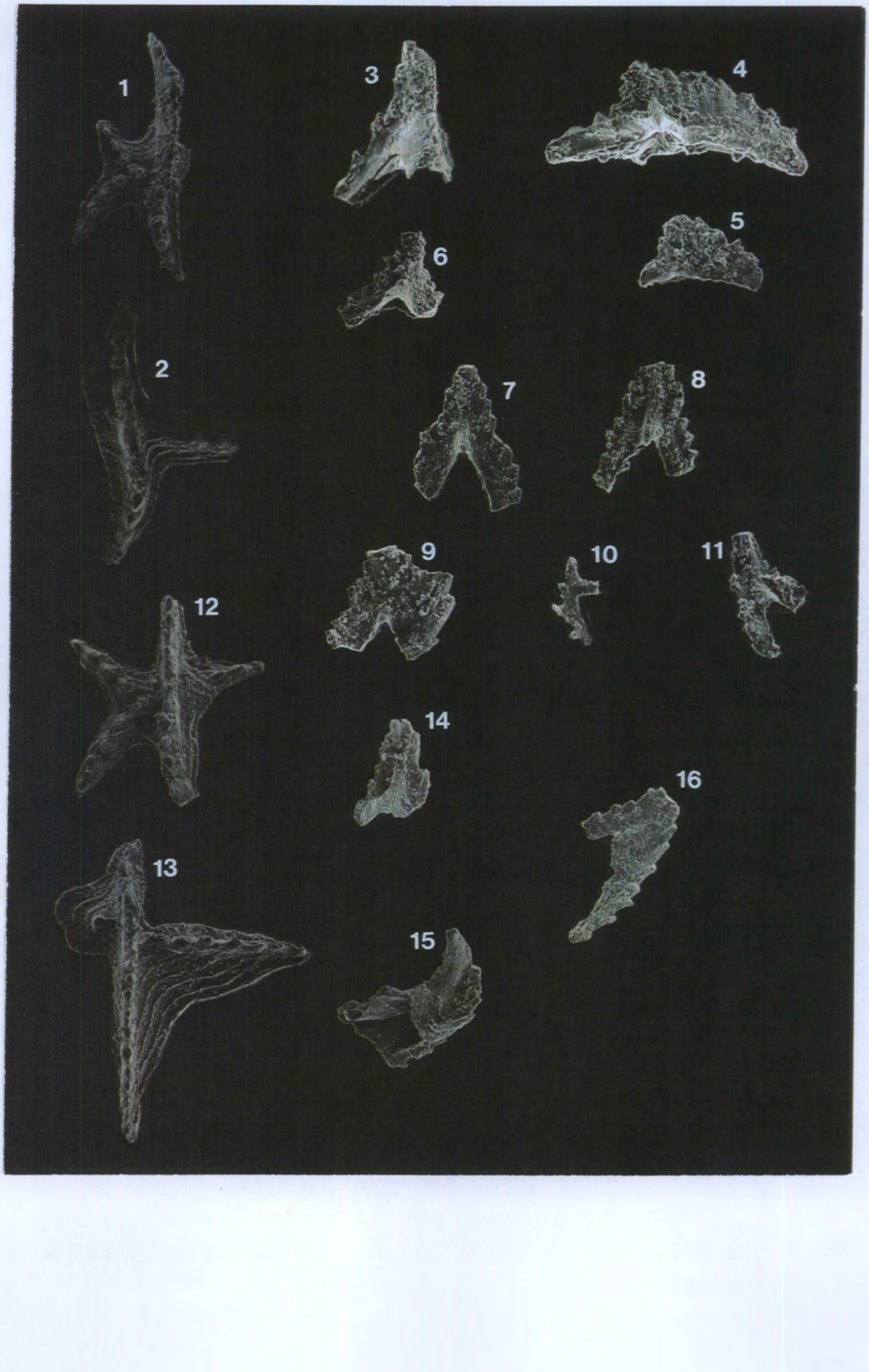

1
3
4
5
6
2
7
8
9
10
11
12
14
16
13
15

PLATE 19

Figs 1-6. *Pranognathus* cf. *P. tenuis* (Aldridge)

All specimens from sample PC 559, Prongs Creek, x60.

1. Inner-lateral view of Pa element; D840-4.
2. Inner-lateral view of Pc element; D731-36.
3. Inner-lateral view of Pd element; D731-37.
4. Posterior view of M element; D841-7A.
5. Posterior view of Sb_1 element; D731-35.
6. Inner-lateral view of Sc element; D842-8.

Figs 7-13. *Pterospathodus celloni* (Walliser)

All specimens from sample PC 561, Prongs Creek, x60.

7. Upper view of Pa element; D833-79.
8. Inner-lateral view of Pb element; D903-2.
9. Inner-lateral view of Pc element; D903-1.
10. Inner-lateral view of Pd element; D904-4.
11. Posterior view of M element; D904-3.
12. Posterior view of Sb element; D905-5.
13. Inner-lateral view of Sc element; D905-6.

14. Figs 14,15. *Pterospathodus rhodesi* Savage

Specimens from sample PC 574, Prongs Creek. Both x30.

14. Upper view of Pa element; D785-57.
15. Lateral view of Pb element; D786-58.

Figs 16, 17. *Carniodus carnulus* elements

Specimens from sample AI 668, Chicotte Formation, Anticosti Island, x60

16. Lateral view of element; D848-28A.
17. Lateral view of element; D848-28 B.

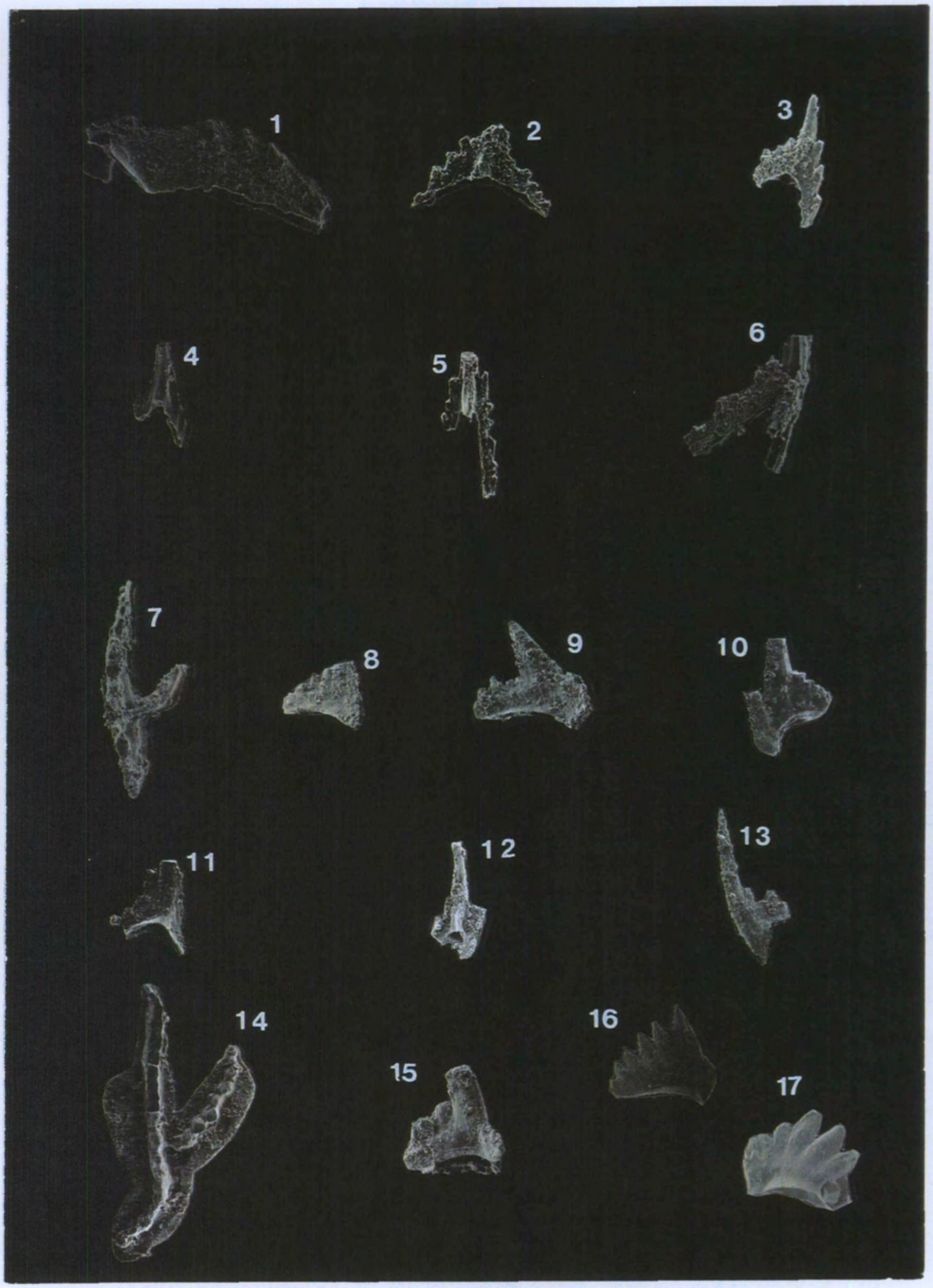

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

PLATE 20

Figs 1-7 *Walliserodus blackstonensis* McCracken

Specimens from sample PC 570, Prongs Creek. All x60.

1. Lateral view of aequaliform element; D901-45A.
2. Lateral view of aequaliform element; D901-45B.
3. Lateral view of falciform element; D900-44A.
4. Lateral view of falciform element; D900-44B.
5. Lateral view of arcuatiform element; D900-43B.
6. Lateral view of graciliform element; D900-43A.
7. Lateral view of arcuatiform element; D901-46.

Figs 8-13 *Walliserodus curvatus* (Branson & Branson)

Specimens from sample PC 548, Prongs Creek, x60.

8. Lateral view of aeqaliform element; D871-88.
9. Lateral view of falciform element; D872-90A.
10. Lateral view of falciform element; D872-90B.
11. Lateral view of graciliform element; D872-91.

12 Lateral view of falciform element; D873-92.

13 Lateral view of tortiform element; D872-89A.

Figs 14-23 *Walliserodus sancticlairi* Cooper

Specimens from sample PC 559, Prongs Creek, x60.

14 Lateral view of aequaliform element; D895-34B.

15 Lateral view of aequaliform element; D895-34A.

16 Lateral view of aequaliform element; D895-33B.

17 Lateral view of aequaliform element; D895-33A.

18 Lateral view of arcuatiform element; D894-32B.

19 Lateral view of arcuatiform element; D894-32A.

20 Lateral view of graciliform element; D896-35B.

21 Lateral view of graciliform element; D896-35A.

22 Lateral view of tortiform element; D894-31B.

23 Lateral view of tortiform element; D894-31A.

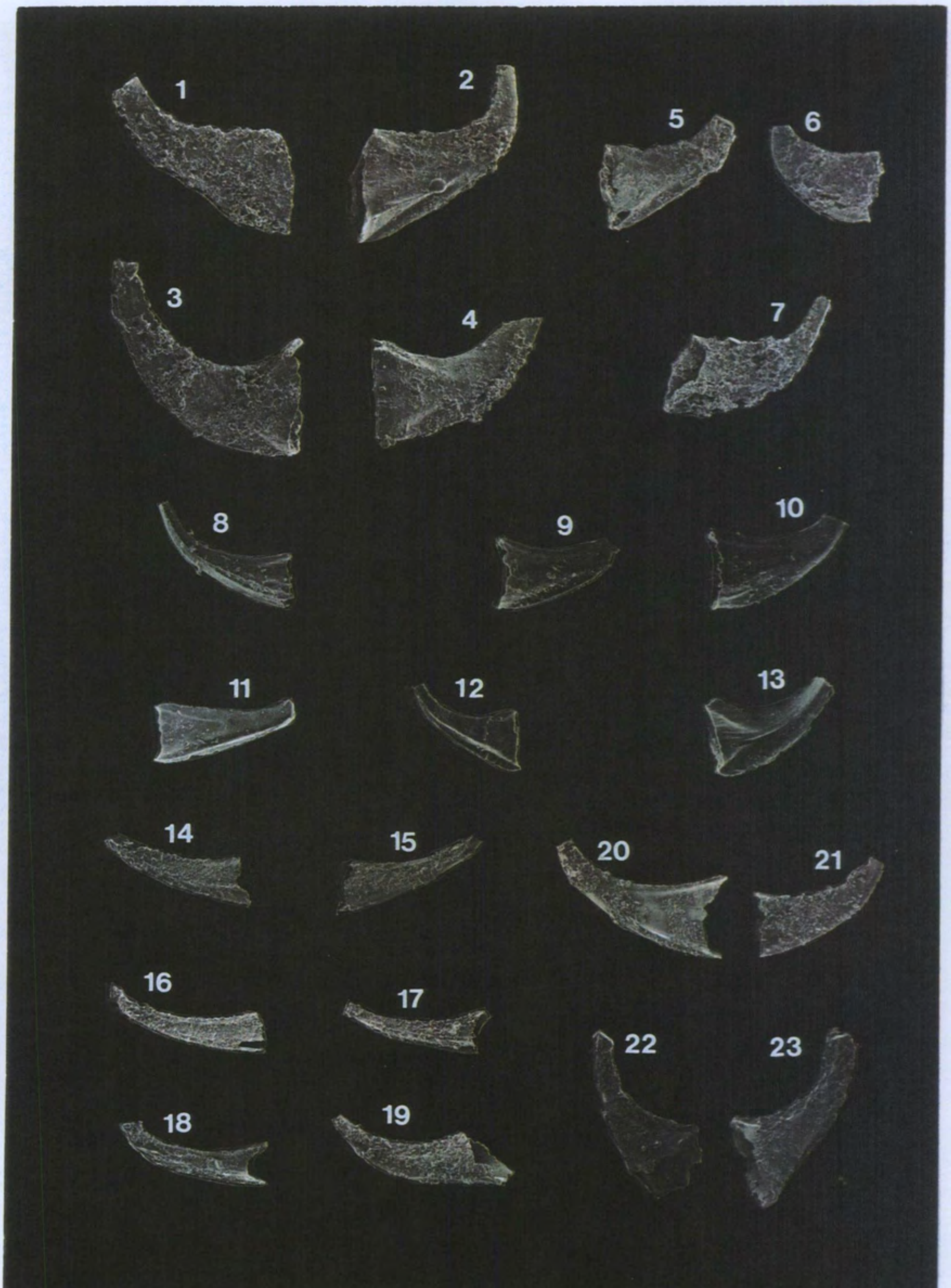

1
2
5
6
3
4
7
8
9
10
11
12
13
14
15
20
21
16
17
22
23
18
19

PLATE 21

Figs 1-5. *Dapsilodus obliquicostatus* (Branson & Mehl)

Specimens from sample PC 559, Prongs Creek, x60.

1. Lateral view of aequaliform element; D885-14B.
2. Lateral view of graciliform element; D885-14A.
3. Lateral view of graciliform element; D870-86.
4. Lateral view of arcuatiform element; D869-84.
5. Lateral view of arcuatiform element; D870-85.

Figs 6-9. *Dapsilodus* ? sp. B McCracken

Specimens from sample PC 561, Prongs Creek. All x60.

6. Lateral view of graciliform element; D887-18B.
7. Lateral view of graciliform element; D887-18A.
8. Lateral view of graciliform element; D887-17B.
9. Lateral view of arcuatiform element; D887-17A.

Figs 10-15. *Decoriconus costulatus* (Rexroad)

Specimens from sample PC 548, Prongs Creek, x60.

10. Lateral view of aequaliform element; D868-80.
11. Lateral view of aequaliform element; D888-20.
12. Lateral view of graciliform element; D888-19B.
13. Lateral view of graciliform element; D888-19A.
14. Lateral view of arcuatiform element; D868-79B.
15. Lateral view of arcuatiform element; D868-79A.

Figs 16-22. *Decoriconus fragilis* (Branson & Mehl)

Specimens from sample PC 552, Prongs Creek, x60.

16. Lateral view of aequaliform element; D884-12A.
17. Lateral view of aequaliform element; D884-12B.
18. Lateral view of graciliform element; D885-13B.
19. Lateral view of graciliform element; D885-13A.
20. Lateral view of arcuatiform element; D884-11B.
21. Lateral view of arcuatiform element; D88411A.

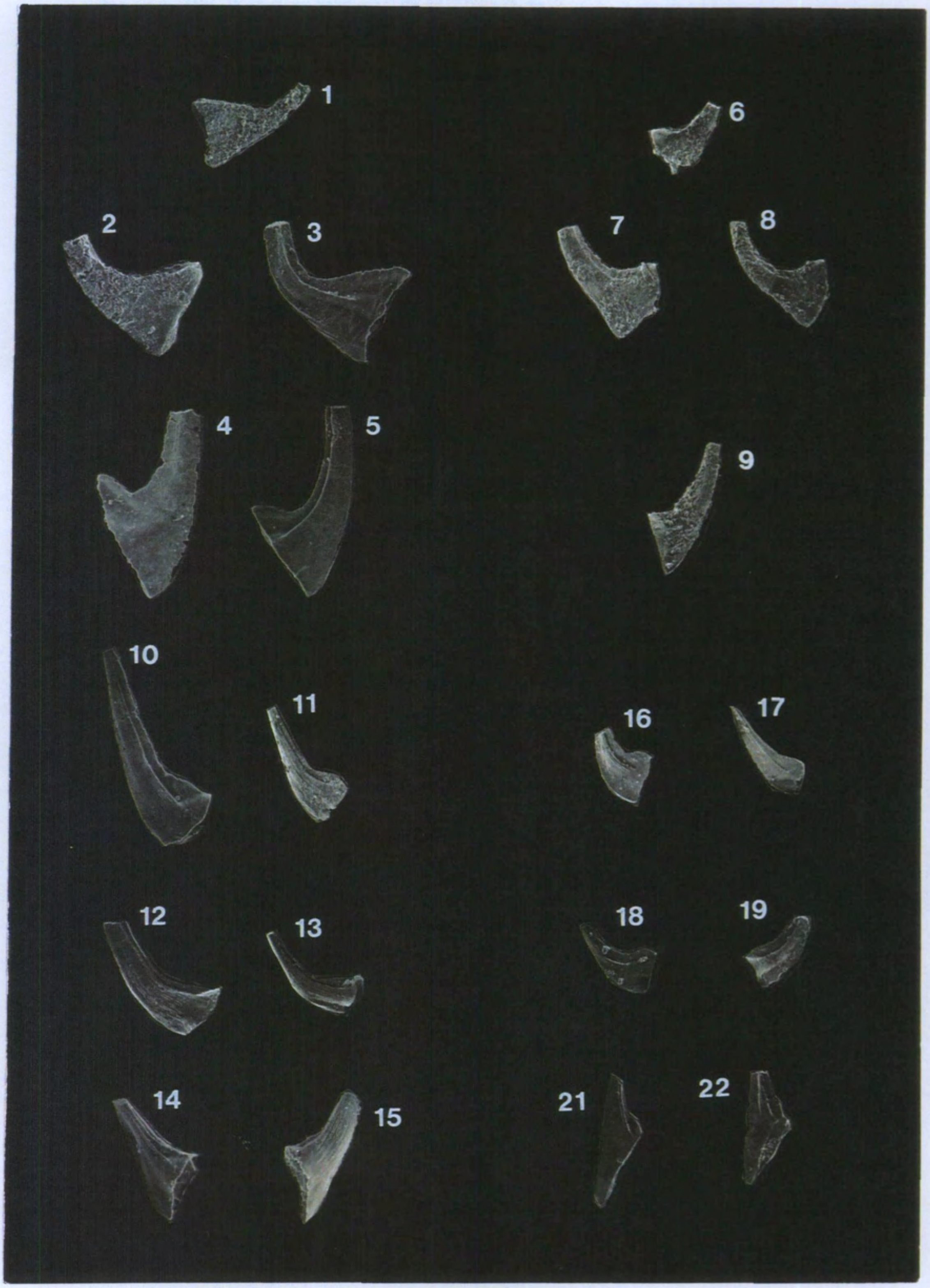

1
6
2
3
7
8
4
5
9
10
11
16
17
12
13
18
19
14
15
21
22

PLATE 22

Figs 1-3. Thelodonts

Specimens from the Evanturel Creek Formation, Lake Timiskaming.

1. Thelodont, x180; D712-17 from sample LT 269.
2. Thelodont, x 60; D720-14 from sample LT 261.
3. Thelodont, x 120; D720-15 from sample LT 261.

Figs 4-5. Clusters

Specimens from Prongs Creek.

4. Cluster of *Panderodus* elements, x 120; D750-73 from sample PC 564.
5. Cluster of *Pseudolonchodina* elements, x 60; D723-21 from sample PC 562.

Figs 6-10. Genus et. sp. indet.

Specimens from sample PC 547, Prongs Creek. All x30.

6. Lateral view of Pa element; D783-53.
7. Lateral view of. Pb element; D784-54.
8. Lateral view of M element; D784-55.
9. Lateral view of M element; D785-56A.
10. Lateral view of M element; D785-56B.

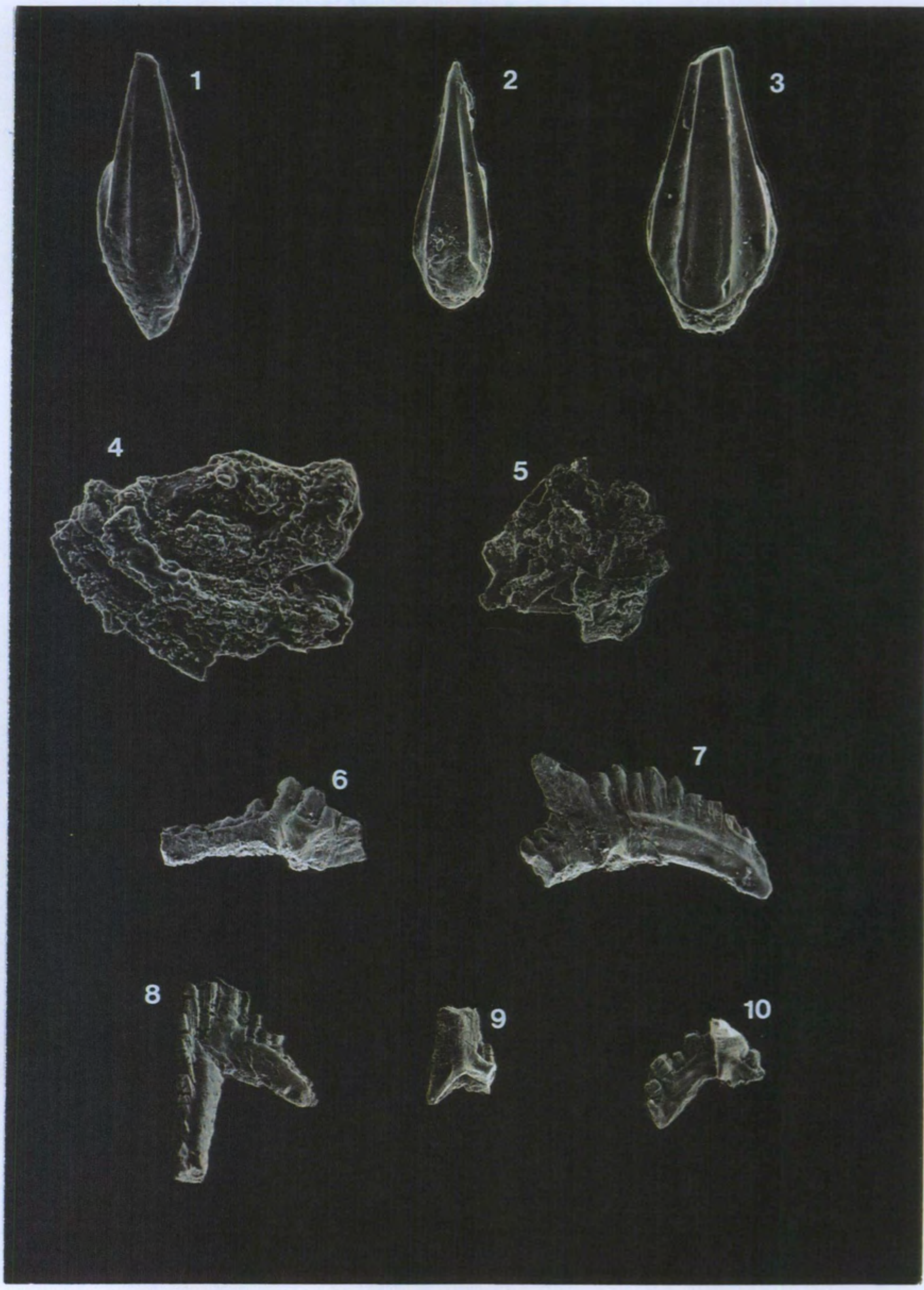

1
2
3
4
5
6
7
8
9
10

PLATE 23

Figs 1-8 *Panderodus acostatus* (Branson & Branson)
Specimens from Anticosti Island, x60.

1. Lateral view of falciform element; D867-78 from sample AI 647.
2. Lateral view of aequaliform element; D769-16 from sample AI 618.
3. Lateral view of truncatiform element; D769-17 from sample AI 618.
4. Lateral view of graciliform element; D770-18 from sample AI 618.
5. Lateral view of graciliform element; D768-14 from sample AI 618.
6. Lateral view of arcuatiform element; D866-76 from sample AI 647.
7. Lateral view of arcuatiform element; D867-77 from sample AI 647.
8. Lateral view of arcuatiform element with a serrate edge; D771-21 from sample AI 625.

Figs 9-17 *Panderodus langkawiensis* (Igo & Koike)
Specimens from sample PC 561, Prongs Creek, x60.

9. Lateral view of falciform element; D897-38A.
10. Lateral view of aequaliform element; D897-37.
11. Lateral view of falciform element; D897-38B.
12. Lateral view of graciliform element; D898-40A.
13. Lateral view of graciliform element; D898-40B.
14. Lateral view of arcuatiform element; D899-42B.
15. Lateral view of arcuatiform element; D899-42A.
16. Lateral view of graciliform element; D898-39B.
17. Lateral view of graciliform element; D898-39A.

Fig. 18 *Panderodus* sp. C
Specimen from sample PC 547, Prongs Creek, x60.

18. Posterior view of graciliform element; D876-3A.

Fig. 19 *Staufferella* cf. *S. inaligera* McCracken & Barnes.
Specimen D767-11 from AI 594, Ellis Bay Formation, Anticosti Island, x60.

19. Lateral view of element.

Fig. 20 *Walliserodus* cf. *W. curvatus* (Branson & Branson)
Specimen D764-5 from sample AI 628, Ellis Bay Formation, Anticosti Island, x60.

20. Lateral View of element;

Fig. 21 *Drepanoistodus suberectus* (Branson & Mehl)
Specimen D764-4 from sample AI 628, Ellis Bay Formation, Anticosti Island, x60.

21. Lateral view of element, x60.

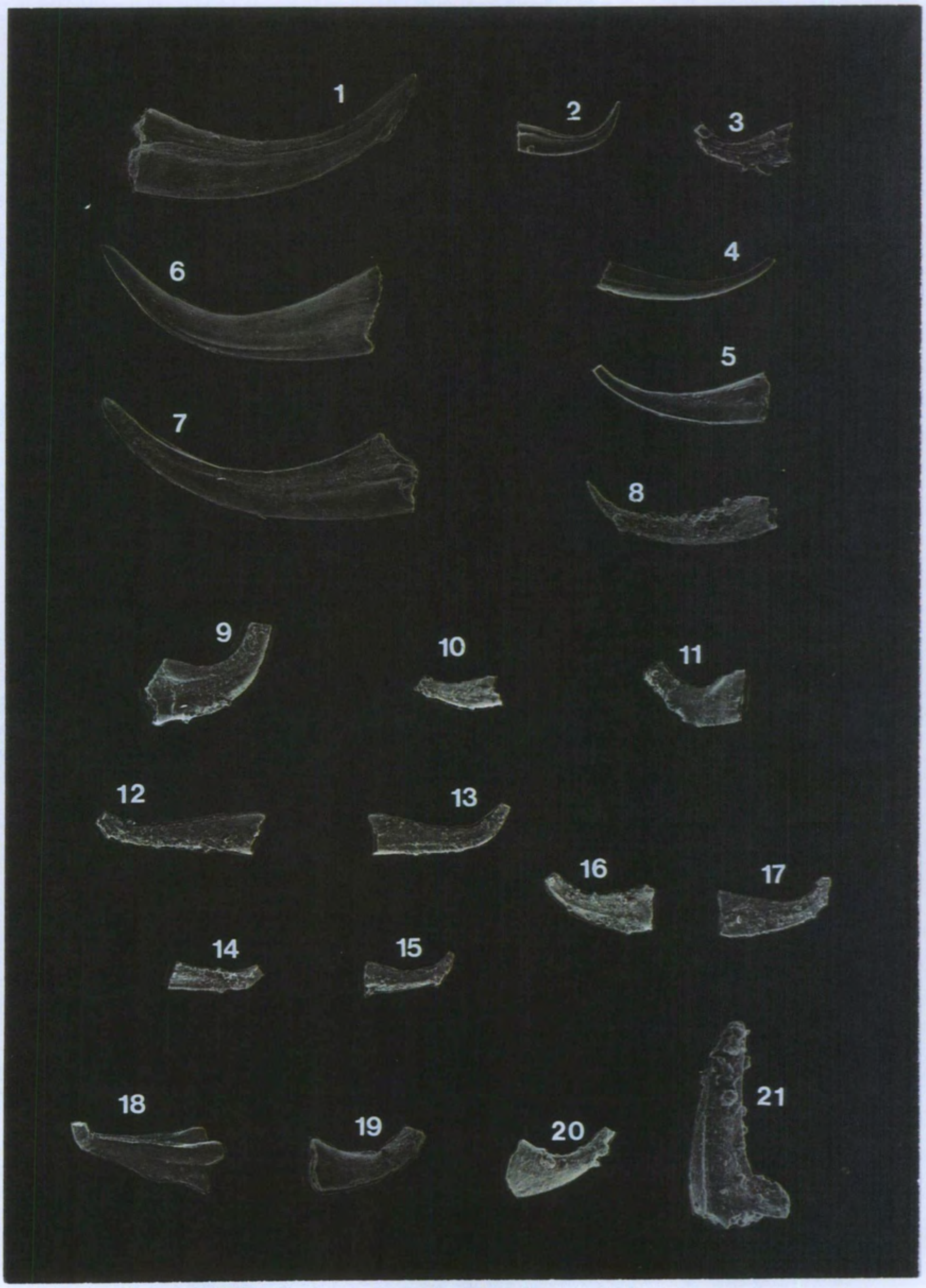

1
2
3
6
4
5
7
8
9
10
11
12
13
16
17
14
15
18
19
20
21

PLATE 24

Figs 1-6 *Panderodus panderi* (Stauffer)

Specimens from sample AI 670, Jupiter Formation (Ferrum Member), Anticosti Island, x60.

1. Lateral view of falciform element; D791-73.
2. Lateral view of falciform element; D792-74.
3. Lateral view of truncatiform element; D792-75.
4. Lateral view of truncatiform element; D793-76.
5. Lateral view of graciliform element; D793-77.
6. Lateral view of graciliform element; D793-78.

Figs 7-15 *Panderodus acostatus* (Branson & Branson)

Specimens from sample AI 670, Jupiter Formation (Ferrum Member), Anticosti Island, x60.

7. Lateral view of tortiform element; D850-43A.
8. Lateral view of tortiform element; D850-43B.
9. Lateral view of falciform element; D796-84.
10. Lateral view of falciform element; D797-85.
11. Lateral view of aequaliform element; D797-86.
12. Lateral view of truncatiform element; D849-42.
13. Lateral view of graciliform element; D850-44A.
14. Lateral view of graciliform element; D850-44B.
15. Lateral view of arcuatiform element; D850-45.

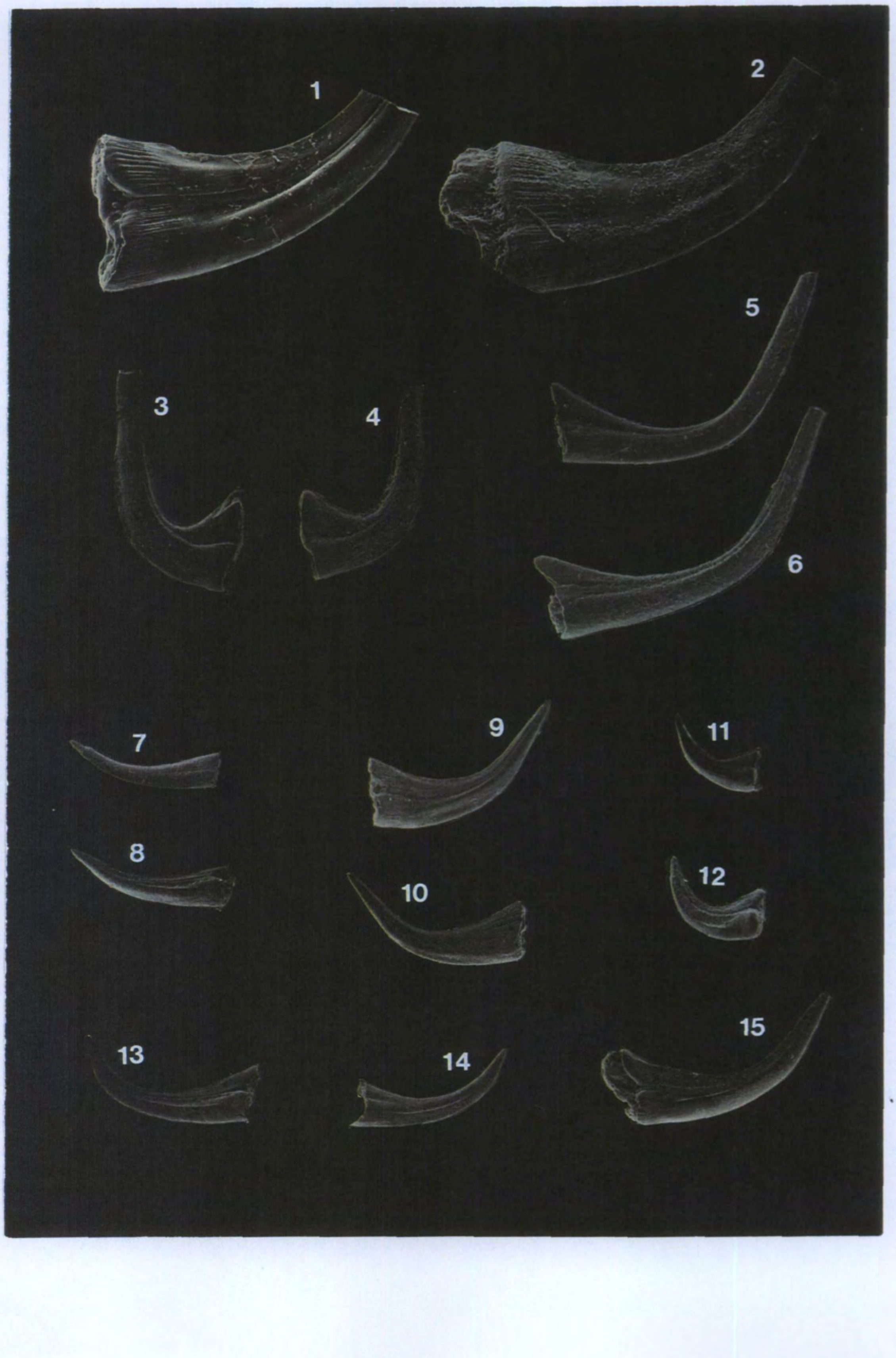

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLATE 25

Figs 1-5 *Panderodus unicostatus* (Branson & Mehl)

Specimens from Lake Timiskaming, x60.

1. Lateral view of falciform element from sample 265; D889-22.
2. Lateral view of falciform element from sample 265; D891-26.
3. Lateral view of graciliform element from sample 264; D891-25.
4. Lateral view of graciliform element from sample 253; D890-23.
5. Lateral view of arcuatiform element from sample 253; D890-24.

Figs 6-10 *Panderodus* sp. A

Specimens from sample LT 262, Lake Timiskaming, x60.

6. Lateral view of falciform element; D796-82.
7. Lateral view of aequaliform element; D795-81.
8. Lateral view of truncatiform element; D796-83.
9. Lateral view of arcuatiform element; D794-79.
10. Lateral view of graciliform element; D795-80.

Figs 11, 12 *Panderodus* sp. B

Specimens from sample LT 265, Lake Timiskaming. All at x60.

11. Lateral view of falciform element; D889-21A.
12. Lateral view of arcuatiform element; D889-21B.

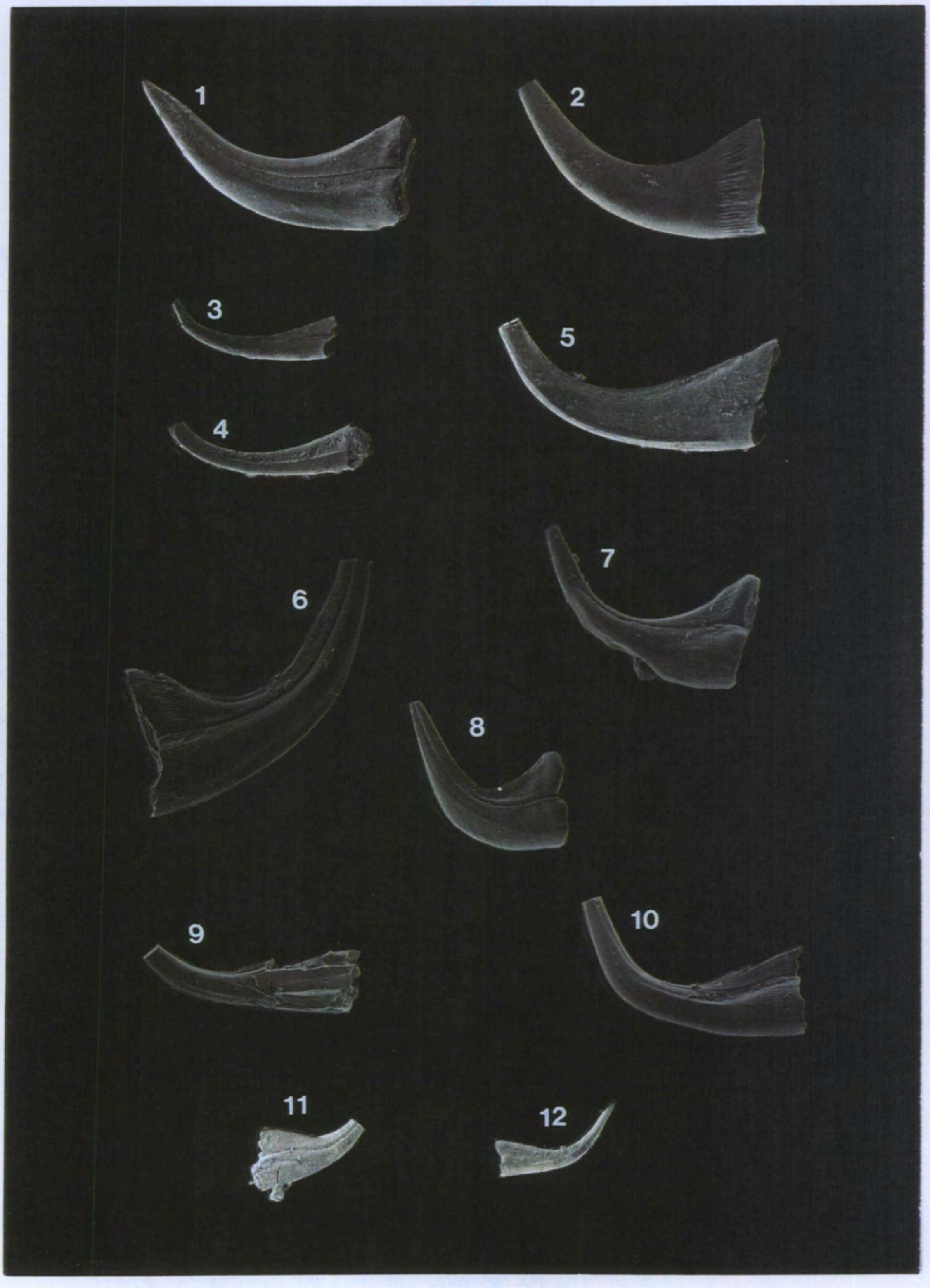

1
2
3
5
4
7
6
8
10
9
11
12

PLATE 26

Figs 1, 2 *Pseudooneotodus beckmanni* (Bischoff & Sannemann).

Specimens from sample AI 611, Anticosti Island, x60.

1. Lateral view of element; D768-12.
2. Upper view of element; D768-13.

Figs 3, 4 *Pseudooneotodus* sp. A.

Specimens from the Jupiter Formation (Pavillion Member), Anticosti Island, x60.

3. Lateral view from sample AI 665; D877-5.
4. Upper view from sample AI 654; D853-33.

Figs 5-7 *Pseudooneotodus tricornis* Drygant.

Specimens from the Chicotte Formation, Anticosti Island.

5. Upper view of tridenticulate squat conical element, x120; D726-28 from sample AI 661.
6. Lateral view of unidenticulate slender conical element, x60; D852-32 from sample AI 668.
7. Upper view of unidenticulate squat conical element, x60; D852-31 from sample AI 668.

Fig. 8 *Belodina* ? sp. A

Sample from sample PC 552, Prongs Creek, x120.

8. Lateral view of unknown element; D801-96.

Figs 9, 10 *Pseudobelodella silurica* Armstrong

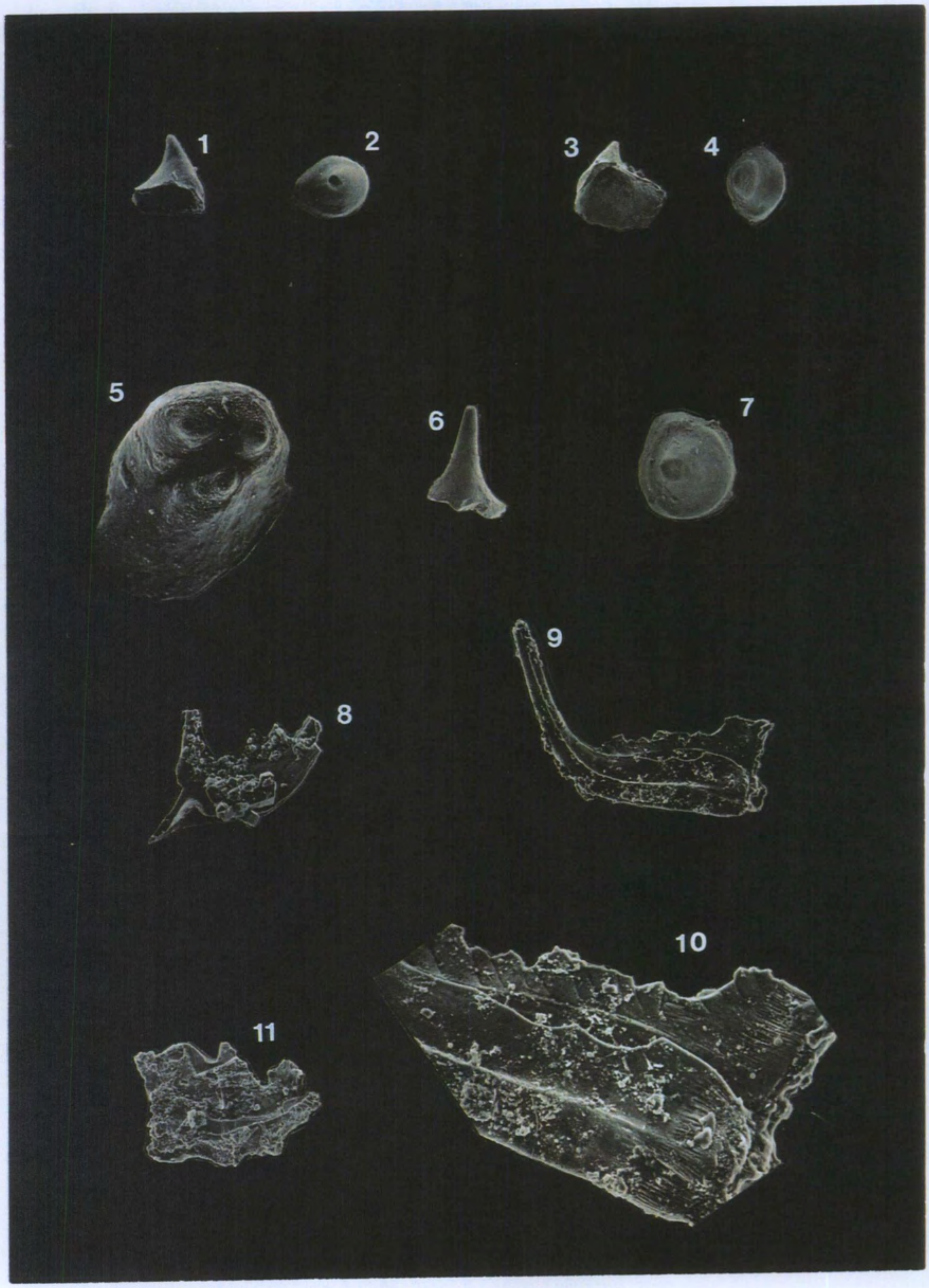
Specimen D728-32 from sample PC 570, Prongs Creek.

9. Lateral view, x90.
10. Lateral view of sym. P element, x240.

Fig. 11 *Belodina* ? sp. B

Specimen D724-23 from sample PC 542, Prongs Creek.

11. Lateral view of element, x60.


1
2
3
4
5
6
7
8
9
10
11

Appendix B

Abundance tables and percentages

B.1 Anticosti Island **B1**

Point Laframboise (AI 1) and Lac Wickenden Road sections (AI 17a). B1
Abundance Charts B1
Percentages B2
Cap a l'Aigle section (AI 2). B3
Abundance Charts B3
Percentages B4
Becscie, Merrimack and Gun River Formations at various localities. B5
Abundance Charts B5
Percentages B6
Gun River and Jupiter Formations at various localities. B7
Abundance Charts B7
Percentages B8
Upper Jupiter and Chicotte Formations at Brisants Jumpers (AI5) and other localities. B9
Abundance Charts B9
Percentages B10

B.2 Lake Timiskaming **B11**

Abundance Charts B11
Percentages B12

B.1 Prongs Creek **B13**

Transitional Limestone Unit. B13
Abundance Charts B13
Percentages B14
Road River Group. B15
Abundance Charts B15
Percentages B16

Abundance Charts - Point Laframboise Section (AI 1), Anticosti Island

Weight:	1354.9	1001.1	946.5	865.2	889.2	1290.9	1782.9	1324.2	1044.2	1453.3	1274.8	1450	1292.1	1372.9	1586.1	1412.5	1505.5	1465.2	1830.1	1460.5	1810.6	1825	1642.4	1581.3	1534.6	1787.3	1435	1532.4		1757
Formation:	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Becsc.	Becsc.	Becsc.	Becsc	Besc.	Becsc.	Becsc.	Becsc.	Becsc.	Becsc.		Ellis
Member:	Lousy	Lousy	Lousy	Lousy	Lousy	Lousy	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P		Laf.
Sample Number:	AI 628	AI 629	AI 630	AI 634	AI 641	AI 636	AI 635	AI 594	AI 612	AI 595	AI 620	AI 605	AI 606	AI 596	613	AI 607	AI 602	AI 621	AI 611	AI 614	AI 615	618	AI 616	AI 617	AI 622	AI 627	610	AI 626		AI 664
Decoriconus costulatus																														
			1															1	1	1		4						2		
Drepanoistodus suberectus																														
	1																													
Gamachignathus ensifer																														
Pa	7		1			1					1					3														6
Pb						1																								3
Pd	2																													
M	8					2	3			1	1						1													6
Sa																														
Sb	6		5			3	1	1							1	2														3
Sc	4					3		1			1	2				1														6
Gamachignathus hastatus																														
Pa	1					1																								1
Pb	1		1			1		3																						1
Pd																														
M	1																													
Sa																														
Sb	3					3	3																							2
Sc	1					2	1																							
Icriodella deflecta																														
Pa																			2f	2f		1f		1						
Pb																				2				1						
Pd																														
M																								1						
Sa																														
Sb																						1								
Sc																														
Kockelella manitoulinensis																														
Pa																					1									
Oulodus ? kentuckyensis																														
Pa													1?								1?									
Pb																														
M																														
Sa																														
Sb																														
Sc																														
Oulodus ? nathani																														
Pa																														
Pb																														
M																														
Sa																														
Sb															1						1									
Sc																														
Oulodus robustus																														
Pa			1			3	2	1									1													
Pb						4																								2
M																														
Sa																														
Sb						1	2	2									3													3
Sc						4	2										1													2
Ozarkodina hassi																														
Pa															1				3	2	2	4				2f				
Pb													1							1	1	2								
M																														
Sa																			2			2								
Sb																					1	3								
Sc																			2			2								
Ozarkodina oldhamensis																														
Pa														1					1		6	3	1	1						1
Pb																					1	2		1						1
Panderodus acostatus																														
	5																	1	23	14		64		5		14	1	28		3
Pseudoneotodus beckmanni																														
	1							2				2				1		1	32	16								2		2
Staufferella cf. S. inaligera																														
	5	1						1										2	11											
Walliserodus cf. W. curvatus																														
	1										1							2												1
Walliserodus curvatus																														
																						11		3		7				
SubTotal	47	1	9	0	0	29	14	11	0	1	4	4	1	1	3	7	6	7	75	36	13	98	1	13	0	21	1	32	0	43
Fragments	20	2	8	0	2	31	23	16	1	2	1	2	0	0	0	8	2	1	29	10	8		0	7	0	3	0	1		27
Total	67	3	17	0	2	60	37	27	1	3	5	6	1	1	3	15	8	8	104	46	21	98	1	20	0	24	1	33	0	70
Balls										#							#													
Scolecodont																		#								#				
Ostracod																		#												
Gastropod																		#		#										

Weight:	1354.9	1001.1	946.5	865.2	889.2	1290.9	1782.9	1324.2	1044.2	1453.3	1274.6	1450	1292.1	1372.9
Formation:	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis
Member:	Lousy	Lousy	Lousy	Lousy	Lousy	Lousy	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.	Laf.
Sample Number:	AI 628	AI 629	AI 630	AI 634	AI 641	AI 636	AI 635	AI 594	AI 612	AI 595	AI 620	AI 605	AI 606	AI 596
Decoriconus costulatus			1											
Drepanoistodus suberectus	1													
Gamachignathus ensifer	27		6			10	4	2		1	3	2		
Gamachignathus hastatus	7		1			7	4	3						
Icriodella deflecta														
Kockelella manitoulinensis													1	
Oulodus? kentuckyensis														
Oulodus? nathani														
Oulodus robustus			1			12	6	3						
Ozarkodina hassi													1	
Ozarkodina oldhamensis														1
Panderodus acostatus	5													
Pseudooneotodus beckmanni	1							2				2		
Staufferella cf.S. inaligera	5	1						1						
Walliserodus cf. W. curvatus	1										1			
Walliserodus curvatus														
Total	47	1	9	0	0	29	14	11	0	1	4	4	2	1
Decoriconus costulatus			11%											
Drepanoistodus suberectus	2%													
Gamachignathus ensifer	57%		67%			34%	29%	18%		100%	75%	50%		
Gamachignathus hastatus	15%		11%			24%	29%	27%						
Icriodella deflecta														
Kockelella manitoulinensis													50%	
Oulodus ? kentuckyensis														
Oulodus ? nathani														
Oulodus robustus			11%			41%	43%	27%						
Ozarkodina hassi													50%	
Ozarkodina oldhamensis														100%
Panderodus acostatus	11%													
Pseudooneotodus beckmanni	2%							18%				50%		
Staufferella cf. S. inaligera	11%	100%						9%						
Walliserodus cf. W. curvatus	2%										25%			
Walliserodus curvatus														

Weight:	1586.1	1412.5	1505.5	1465.2	1930.1	1460.5	1810.6	1825	1642.4	1581.3	1534.6	1787.3	1435	1532.4		1757
Formation:	Ellis	Ellis	Ellis	Ellis	Becsc.	Becsc.	Becsc.	Becsc.	Besc.	Becsc.	Becsc.	Becsc.	Becsc.	Becsc.		Ellis
Member:	Laf.	Laf.	Laf.	Laf.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.	Fox P.		Laf.
Sample Number:	613	AI 607	AI 602	AI 621	AI 611	AI 614	AI 615	618	AI 616	AI 617	.AI 622	AI 627	610	AI 626		AI 664
Decoriconus costulatus				1	1	1		4						2		
Drepanoistodus suberectus																
Gamachignathus ensifer	1	6	1													24
Gamachignathus hastatus					2	2										4
Icriodella deflecta						2		2		3						
Kockelella manitoulinensis							1									
Oulodus? kentuckyensis							1									
Oulodus? nathani	1						1									
Oulodus robustus			5													7
Ozarkodina hassi	1				7	3	4	13				2				
Ozarkodina oldhamensis					1		7	5	1	2						2
Panderodus acostatus				1	23	14		64		5		14	1	28		3
Pseudooneotodus beckmanni		1		1	32	16								2		2
Staufferella cf.S. inaligera				2	11											
Walliserodus cf. W. curvatus				2												1
Walliserodus curvatus								11		3		7				
Total	3	7	6	7	77	38	14	99	1	13	0	23	1	32	0	43
Decoriconus costulatus				14%	1%	3%		4%						6%		
Drepanoistodus suberectus																
Gamachignathus ensifer	33%	86%	17%													56%
Gamachignathus hastatus					0%	5%										9%
Icriodella deflecta						5%		2%		23%						
Kockelella manitoulinensis							7%									
Oulodus ? kentuckyensis							7%									
Oulodus ? nathani	33%						7%									
Oulodus robustus			83%													16%
Ozarkodina hassi	33%				9%	8%	29%	13%				9%				
Ozarkodina oldhamensis					1%		50%	5%	100%	15%						5%
Panderodus acostatus				14%	30%	37%	0%	65%		38%		61%	100%	88%		7%
Pseudooneotodus beckmanni		14%		14%	42%	42%								6%		5%
Staufferella cf. S. inaligera				29%	14%											
Walliserodus cf. W. curvatus				29%												2%
Walliserodus curvatus								11%		23%		30%				

Weight:	1144.9	501.8	1217.3	1283.7	796.1	944.4	1377.8	1083.7	1307.3	1106.5
Formation:	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Becsc.	Becsc.
Member:	Lousy	Lousy	Lousy	Laf.	Laf.	Laf.	Laf.	Laf.	Fox P.	Fox P.
Lithology;	Micrite	Marl	Plat.	Onc.	Mud.	Onc.	Onc.	Marl	Grain.	Grain.
Sample Number:	AI 625	AI 579	AI 603	AI 604	AI 575	AI 578	AI 637	AI 609	AI 608	AI 577
Amorphognathus cf. A. ordovicicus										
Pa						1				
Gamachignathus ensifer										
Pa	7			2	1			2		
Pb	2				1	1				
Pd										
M	5			1	2	1				
Sa										
Sb	2			3		1	1			
Sc	2			1		1	2	3		
Gamachignathus hastatus										
Pa										
Pb	1				2					
Pd										
M										
Sa										
Sb	4			2						
Sc	1									
Icriodella deflecta										
Pa									2	
Pb									2	
Pd										
M									2	
Sa										
Sb										
Sc										
Icriodella discreta										
Pa									1	
M									1	
Sc									1	
Kockelella manitoulinensis										
Pa									1	
Oulodus ? kentuckyensis										
Pa										
Pb										
M										
Sa										
Sb										
Sc									1	
Oulodus robustus										
Pa				3?						
Pb										
M										
Sa										
Sb				2						
Sc				1						
Ozarkodina hassi										
Pa						1				
Pb									1	1
M									1	
Sa										
Sb										
Sc										
Ozarkodina oldhamensis										
Pa									2	
Pb										
M										
Sa										
Sb										
Sc										
Panderodus panderi										
	3									
Panderodus acostatus										
	38								7	
Serrate elements	5*									
Phragmodus undatus										
		1								
Pseudoneootodus beckmanni										
							3			
Staufferella cf. S. inaligera										
					2					
Walliserodus cf. W. curvatus										
					2	3	2			
Walliserodus curvatus										
									2	
Subtotal	65	1	0	12	10	9	8	5	22	1
Fragments:	17	1	0	11	11	1	5	0	11	3
Total:	82	2	0	23	21	10	13	5	33	4
Balls					#					
Scolecodont	#								#	
Ostracod					#					
Gastropod										

Percentages - Cap a l'Aigle Section (AI 2), Anticosti Island

Weight:	1144.9	501.8	1217.3	1283.7	796.1	944.4	1377.8	1083.7	1307.3	1106.5
Formation:	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Ellis	Becsc.	Becsc.
Member:	Lousy	Lousy	Lousy	Laf.	Laf.	Laf.	Laf.	Laf.	Fox P.	Fox P.
Lithology;	Micrite	Marl	Plat.	Onc.	Mud.	Onc.	Onc.	Marl	Grain.	Grain.
Sample Number:	AI 625	AI 579	AI 603	AI 604	AI 575	AI 578	AI 637	AI 609	AI 608	AI 577
Amorphognathus cf. A. ordovicicus						1				
Gamachignathus ensifer	18			7	4	4	3	5		
Gamachignathus hastatus	6			2	2					
Icriodella deflecta									6	
Icriodella discreta									3	
Kockelella manitoulinensis									1	
Oulodis ? kentuckyensis									1	
Oulodus robustus				6						
Ozarkodina hassi						1			2	1
Ozarkodina oldhamensis									2	
Panderodus panderi	3									
Panderodus acostatus	43								7	
Phragmodus undatus		1								
Pseudoneootodus beckmanni							3			
Staufferella cf. S. inaligera					2					
Walliserodus cf. W. curvatus					2	3	2			
Walliserodus curvatus									2	
Total	70	1	0	15	10	9	8	5	24	1
Amorphognathus cf. A. ordovicicus						11%				
Gamachignathus ensifer	26%			47%	40%	44%	38%	100%		
Gamachignathus hastatus	9%			13%	20%					
Icriodella deflecta									25%	
Icriodella discreta									13%	
Kockelella manitoulinensis									4%	
Oulodis ? kentuckyensis									4%	
Oulodus robustus				40%						
Ozarkodina hassi						11%			8%	100%
Ozarkodina oldhamensis									8%	
Panderodus panderi	4%									
Panderodus acostatus	61%								29%	
Phragmodus undatus		100%								
Pseudoneootodus beckmanni							38%			
Staufferella cf. S. inaligera					20%					
Walliserodus cf. W. curvatus					20%	33%	25%			
Walliserodus curvatus									8%	

Locality/Stop:	AI 3	AI 3	AI 3	AI 3	AI 15	AI 17c	AI 15a
Weight:	886.7	952	1063.2	669	298.3	1123	1161.5
Formation:	Becsc.	Becsc.	Merri.	Merri.	Merri	Gun R.	Gun R.
Member:						Sandtop	La chute
Sample Number:	AI 672	AI 673	AI 674	AI 675	AI 666	AI 751	AI 676
Icriodella deflecta							
Pa	2F		11	7F			
Pb			10				
Pd							
M		3	6	2			
Sa			1				
Sb		3					
Sc							
Icriodella discreta							
Pa		2	14				
Pb		11	16	4			
Pd		1					
M		7	15	3			
Sa							
Sb			3	3			
Sc		2	11	4			
Oulodus ? kentuckyensis							
Pa			1				
Pb			1				
M						1	
Sa				1			
Sb			1	1			
Sc							
Oulodus cf. O. panauensis							
Pa	1	3					
Pb		1	1				
M		10	1				
Sa		1		1			
Sb	2	5					
Sc	1	10	1	2			
Ozarkodina hassi							
Pa		3					
Pb		1					
Ozarkodina oldhamensis							
Pa			15	4			
Pb			4	2			
M							
Sa							
Sb				2			
Sc				1			
Ozarkodina pirata							
Pa	2	4	3	2		6	
Pb		8	1	4			
M		5	1	3		3	
Sa			1				
Sb		2	3	3		1	
Sc		1	3			3	
Ozarkodinia protoexcavata							
Pa		1					
Pb		2		1			
M		2					
Sa							
Sb		1		3			
Sc							
Panderodus acostatus							
pt		3	11	2		7	
pf	3	11	22	11		17	
ae		1		1			
qt			2	2		2	
qg	7	16	57	11		26	
qa		1	11	1		9	
Panderodus panderi							
pt							
pf							
ae							
qt							
qg						1	
qa							
Pseudolonchodina fluegeli ?							
Pb				1			
Sub Total	16	121	227	75	0	76	0
Fragments:	11	168	241	70		33	
Total:	27	289	468	145	0	109	0

Locality/Stop:	AI 3	AI 3	AI 3	AI 3	AI 15	AI 17c	AI 15a
Weight:	886.7	952	1063.2	669	298.3	1123	1161.5
Formation:	Becsc.	Becsc.	Merri.	Merri.	Merri	Gun R.	Gun R.
Member:						Sandtop	La chute
Sample Number:	AI 672	AI 673	AI 674	AI 675	AI 666	AI 751	AI 676
Icriodella deflecta	2	6	28	9			
Icriodella discreta		23	59	14			
Oulodus ? kentuckyensis			3	2		1	
Oulodus cf. O. panauensis	4	30	3	3			
Ozarkodina hassi		4					
Ozarkodina oldhamensis			19	9			
Ozarkodina pirata	2	20	12	12		13	
Ozarkodina protoexcavata		6		4			
Panderodus accostatus	10	32	103	28		61	
Panderodus panderi						1	
Pseudolonchodina fluegeli ?				1			
Total	18	121	227	82		76	
Icriodella deflecta	11%	5%	12%	11%			
Icriodella discreta		19%	26%	17%			
Oulodus ? kentuckyensis			1%	2%		1%	
Oulodus cf. O. panauensis	22%	25%	1%	4%			
Ozarkodina hassi		3%					
Ozarkodina oldhamensis			8%	11%			
Ozarkodina pirata	11%	17%	5%	15%		17%	
Ozarkodina protoexcavata		5%		5%			
Panderodus acostatus	56%	26%	45%	34%		80%	
Panderodus panderi						1%	
Pseudolonchodina fluegeli ?				1%			

Weight(g)	1424.8	1524	1374.7	1447	778	1740.7	1845.9	1627.4	1100.4
Locality/Stop :	AI 16	AI 9	AI 16	AI 9	AI 10b	AI 13	AI 13	AI 11c	AI 4
Formation:	Gun Riv.	Gun.Riv.	Jupiter	Jupiter	Jupiter	Jupiter	Jupiter	Jupiter	Jupiter
Member:	Macgilvray	Macgilvray	Goéland	Goéland	Goéland	East P.	East P.	East P.	Cybèle
Sample Number:	AI 650	AI 749	AI 649	AI 750	AI 677	AI 645	AI 646	AI 647	AI 678
Decoriconus fragilis									
								7	
Distomodus cf. D. staurognathoides									
Pa									
Pb									
Pd									
M			1	1					
Sa				1					
Sb	1			2					
Sc			1	2				1	
Oulodus cf. O. panuarensis									
Pa			2						
Pb									
M			1	3					
Sa									
Sb			1	1					
Sc			1	3				1	
Ozarkodina oldhamensis									
Pa			1						
Ozarkodina pirata									
Pa			4	6			1	24	
Pb			2	3				4	
M			3	1			1	11	
Sa									
Sb			1	1				1	
Sc	1		1	1		2		12	
Panderodus acostatus									
	6	2	142	51	3		10	166	3
Panderodus panderi									
	2		17	10				4	
Pseudooneotodus beckmanni									
			1	3				1	
Panderodus staufferi									
Pt				3					
Pb				3					
ae				1					
qt									
qg				14					
qa				5					
Walliserodus curvatus									
			3			2f	7	2	
Subtotal	10	2	179	115	3	2	12	232	3
Fragments	2	0	112	66	0	0	6	140	0
Total	12	2	291	181	3	2	18	372	3
Graptolite			#	#				#	
Scolecodont			#	#					
Ostracod	#				#			#	#
Gastropods					#			#	
Brachiopods					#			#	#
Crinoid ossicles								#	

Percentages - Gun River and Jupiter Formations, Anticosti Island

Weight(g)	1424.8	1524	1374.7	1447	778	1740.7	1845.9	1627.4	1100.4
Locality/Stop:	AI 16	AI 9	AI 16	AI 9	AI 10b	AI 13	AI 13	AI 11c	AI 4
Formation:	Gun Riv.	Gun.Riv.	Jupiter	Jupiter	Jupiter	Jupiter	Jupiter	Jupiter	Jupiter
Member:	Macgilvray	Macgilvray	Goéland	Goéland	Goéland	East P.	East P.	East P.	Cybéle
Sample Number:	AI 650	AI 749	AI 649	AI 750	AI 677	AI 645	AI 646	AI 647	AI 678
Decoriconus fragilis								7	
Distomodus cf. D. staurognathoides	1		2	6				1	
Oulodus cf. O. panuarensis			5	7				1	
Ozarkodina oldhamensis			1						
Ozarkodina pirata	1		11	12		2	2	52	
Panderodus acostatus	6	2	142	51	3		10	166	3
Panderodus panderi	2		17	10				4	
Pseudooneotodus beckmanni			1	3				1	
Panderodus staufferi				26					
Walliserodus curvatus			3			2	7	2	
Total	10	2	182	115	3	4	19	234	3
Decoriconus fragilis								3%	
Distomous cf. D. staurognathoides	10%		1%	5%				0%	
Oulodus cf. O. panuarensis			3%	6%				0%	
Ozarkodina oldhamensis			1%						
Ozarkodina pirata	10%		6%	10%		50%	11%	22%	
Panderodus acostatus	60%	100%	78%	44%	100%		53%	71%	100%
Panderodus panderi	20%		9%	9%				2%	
Pseudooneotodus beckmanni			1%	3%				0%	
Panderodus staufferi				23%					
Walliserodus curvatus			2%			50%	37%	1%	

Abundance Charts - Brisants Jumpers Locality (Al 5), Anticosti Island

Weight(g)	1329.2		1253.2	1091.8	1323.1	1382.2	1378.2	1579.1	871.1	1582.8	1037.5	1824.9	1389.3	1892.7	1355.5	1071.9	1413.6	1456.8	1792.4		1556.4	3297	1013.2	1843.6	2882.2
Locality	Al 611b		Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5		Al 6	Al 7	Al 820	Al 820	Grand lac
Formation	Jup		Jup	Jup	Jup	Jup	Jup	Jup	Jup	Jup	Jup	Jup	Jup	Jup	Jup	Chicotte	Chicotte	Chicotte	Chicotte		Chicotte	Chicotte	Chicotte	Chicotte	Chicotte
Member	Ferrum		Ferrum	Pav	Pav	Pav	Pav	Pav	Pav	Pav	Pav	Pav	Pav	Pav	Pav										
Sample Number	Al 670		Al 640	Al 642	Al 652	Al 639	Al 643	Al 651	Al 654	Al 656	Al 658	Al 663	Al 665	Al 657	Al 659	Al 655	Al 668	Al 667	Al 669		Al 644	Al 661	Al 660	Al 646	Al 638
Apsidognathus tuberculatus																		1f			1+2f		2f		
Platform																					1				
Lyriform																					1				
Ambalodiform																									
Astrognathiform																					3				
Coniform															1						1				
Lenticular																									
Compressed																					1				
unknown																									
Astropentagnathus irregularis																									
Pa														5	2										
Pb																									
Pc																									
M																									
Sa																									
Sb 1+2																									
Sc																									
Aulacognathus bullatus																									
Pa					4		7	2		3	5	6	7			2									
Pb							1	1		1	2	2	2												
M												5	4												
Sa							1																		
Sb					1					1			4												
Sc					1		1	2				6													
Decoriconus fragilis																									
	2																								2
Distomodus staurognathoides																									
Pa										2	2	1	3				1f					1f	1f		
Pb	2									1												1			
Pd																									
M					2		1				3				1						1				
Sa					1		1			1	1	3			1		1	1			1	1			
Sb	2											2						1							
Sc	1				1		1	1		1		1	2	2	1		1				3			1	
Icriodella cf. *I. inconstans*																									
Pa												1													
Kockelella ranuliformis																									
Pa										17							7	2			1	4	1		
Pb																	2				4	1			
M																									
Sa																									
Sb																									
Sc																									
Oulodus petilus																									
Pa	1				1		1			1							1	1							
Pb								2									1								
M	2							1		1															
Sa																									
Sb					1		1										2								
Sc	2				1			2				6		1			1								
Ozarkodina aldridgei																									
Pa	1																								
Pb	3																								
M	1																								
Sa	2																								
Sb	1																								
Sc	2																								
Ozarkodina gulletensis																									
Pa										1		5	1				3					1			
Pb																						2			
M												2f										1			
Sa										1		5	1				1								
Sb												3	1									1			
Sc												4	2												
Ozarkodina polinclinata																									
Pa					1								1				2							1	9
Pb						1					1						2								1
M					2	1	1						1				7								3
Sa																									
Sb													1				5								5
Sc					2		1				1		2				6								5
Panderodus panderi																									
	121		2	3	19	5	20	2	2	7	0	8	8	2	0	0	17	8	0	0	0	2	1	1	4
Panderodus acostatus																									
	224	0	4	12	76	13	37	44	11	69	26	102	109	11	7	3	84	14	5	0	0	5	5	0	0
Panderodus langkawiensis																									
																						2			
Pseudooneotodus tricornis																									
uni slender																	1								
uni squat																	9				2	3			5
tri																	5	3			3	2			6
Pseudooneotodus sp. A																									
								1	1			2	1												
Panderodus staufferi																									
pl						1	3							2				2				1			
pf					3		1										3	1			3	2			
ae					1		1											1				1		1	
qf					2	1	2											1				2			
qg					2		11							2			1	2			7	3			
qa					3	1	3											2				2			
Pterospathodus celloni																									
Pa															1		9				2	3		1	3
Pb																	2				3	1	1		6
Pc																	8				1	2			5
Pd																	4								
M																	3					1			5
Sa/Sb																					1				
Sc																	2						1		1
Carniodus																	3				1			1	1
Pseudolonchodina fluegeli																									
Pa	6				1		1					2					1				1				
Pb	3											3					1							3	
M1	7			1	6								1	1			1								
Sa	5			1	1					1			1				1								
Sb1 + 2	3		1		1							3	1												
Sc1 +2	9									2		3	2	1										1	
M2																									
Ozarkodina excavata																									
Pa																						1	1f		
Pb																									
M																						1			
Sa																						1			
Sb																						1			
Sc																						1			
Ozarkodina cf. *O.* [illegible]																									
Pb	1																								
Sc	1																								
Oulodus sp. A																									
Pb																									3
M																									4
Sc																									1
Oulodus sp. B																									
Sa	1																								
Sc	1																								
Walliserodus curvatus																									
	8									1		4	7				24		1			2		7	47
Sub Total	410		7	17	133	23	96	58	14	94	41	176	162	27	14	5	221	39	6		40	51	9	17	118
Fragments			9	5	58	12	58	24	10	41	31	124	129	20	3	4		30	5		70				
Total	410		16	22	191	35	154	82	24	135	72	300	291	47	17	9	221	69	11		110	51	9	17	118
Scolecodont	#							#		#													#		
Ostracod	#						#				#	#	#		#										
Gastropod											#		#		#										
Brachiopod	#						#						#				#								
Crinoid Ossicles													#						#						
Cephalopods													#												
Bryozoan fragments							#																		

Weight(g):	1329.2		1253.2	1091.8	1323.1	1362.2	1376.2	1579.1	971.1	1562.8	1037.5	1824.9	1369.3	1692.7	1355.5	1071.9	1413.6	1456.8	1792.4		1556.4	3297	1013.2	1843.6	2682.2
Locality:	Al S11b		Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5	Al 5		Al 6	Al 7	Al S20	Al S20	Grand lac
Formation:	Jup		Jup	Jup	Jup	Jup	Jup	Jup	Jup.	Jup	Jup	Jup	Jup	Jup	Jup	Chicotte	Chicotte	Chicotte	Chicotte		Chicotte	Chicotte	Chicotte	Chicotte	Chicotte
Member:	Ferrum		Ferrum	Pav	Pav	Pav	Pav	Pav	Pav.	Pav	Pav	Pav	Pav	Pav	Pav										
Sample Number:	Al 670		Al 640	Al 642	Al 652	Al 639	Al 643	Al 651	Al 654	Al 656	Al 658	Al 653	Al 665	Al 657	Al 659	Al 655	Al 668	Al 667	Al 669		Al 644	Al 661	Al 663	Al 648	Al 638
Apsidognathus tuberculatus	0		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		6	0	0	0	0
Astropentagnathus irregularis	0		0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0		0	0	0	0	0
Aulacognathus bullatus	0		0	0	6	0	10	5	0	5	7	19	17	0	0	2	0	0	0		0	0	0	0	0
Decoriconus fragilis	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	2
Distomodus staurognathoides	5		0	0	4	0	3	1	0	5	6	7	5	2	3	0	2	2	0		5	2	0	1	0
Icriodella cf. I. inconstans	0		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0		0	0	0	0	0
Kockelella ranuliformis	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2	0		5	5	1	0	0
Oulodus petila	5		0	0	3	0	2	5	0	2	0	5	0	1	0	0	5	1	0		0	0	0	0	0
Ozarkodina aldridgei	9		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Ozarkodina gulletensis	0		0	0	0	0	0	0	0	2	0	17	5	0	0	0	4	0	0		0	5	0	0	0
Ozarkodina polinclinata	0		0	0	5	2	2	0	0	0	2	0	5	0	0	0	22	0	0		0	0	0	1	23
Panderodus panderi	121		2	3	19	5	20	2	2	7	0	8	8	2	0	0	17	8	0		0	2	1	1	4
Panderodus acostatus	224		4	12	76	13	37	44	11	69	26	102	109	11	7	3	84	14	5		0	5	5	0	0
Panderodus langkawiensis	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	2	0	0	0
Pseudooneotodus tricornis	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	3	0		5	5	0	0	11
Pseudooneotodus sp. A	0		0	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0		0	0	0	0	0
Panderodus staufferi	0		0	0	11	3	21	0	0	0	0	0	0	4	0	0	4	9	0		10	11	0	1	0
Pterospathodus celloni	0		0	0	0	0	0	0	0	0	0	0	0	0	1	0	31	0	0		7	7	2	2	21
Pseudolonchodina fluegeli	33		1	2	9	0	1	0	0	3	0	11	5	2	0	0	4	0	0		1	0	0	4	0
Ozarkodina excavata	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	5	0	0	0
Ozarkodina cf. O. masurensis	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Oulodus sp. A	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	8
Oulodus sp. B	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Walliserodus curvatus	6		0	0	0	0	0	0	0	1	0	4	7	0	0	0	24	0	1		0	2	0	7	47
Total	409		7	17	133	23	96	58	14	94	41	176	162	27	14	5	221	39	6		39	51	9	17	116
Apsidognathus tuberculatus	0		0	0	0	0	0	0	0	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%		15%	0%	0%	0%	0%
Astropentagnathus irregularis	0		0	0	0	0	0	0	0	0%	0%	0%	0%	19%	14%	0%	0%	0%	0%		0%	0%	0%	0%	0%
Aulacognathus bullatus	0		0%	0%	5%	0%	10%	9%	0%	5%	17%	11%	10%	0%	0%	40%	0%	0%	0%		0%	0%	0%	0%	0%
Decoriconus fragilis	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	0%	0%	0%	2%
Distomodus staurognathoides	1%		0%	0%	3%	0%	3%	2%	0%	5%	15%	4%	3%	7%	21%	0%	1%	5%	0%		13%	4%	0%	6%	0%
Icriodella cf. I. inconstans	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%		0%	0%	0%	0%	0%
Kockelella ranuliformis	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	5%	0%		13%	10%	11%	0%	0%
Oulodus petila	1%		0%	0%	2%	0%	2%	9%	0%	2%	0%	3%	0%	4%	0%	0%	2%	3%	0%		0%	0%	0%	0%	0%
Ozarkodina aldridgei	2%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	0%	0%	0%	0%
Ozarkodina gulletensis	0%		0%	0%	0%	0%	0%	0%	0%	2%	0%	10%	3%	0%	0%	0%	2%	0%	0%		0%	10%	0%	0%	0%
Ozarkodina polinclinata	0%		0%	0%	4%	9%	2%	0%	0%	0%	5%	0%	3%	0%	0%	0%	10%	0%	0%		0%	0%	0%	6%	20%
Panderodus panderi	30%		29%	18%	14%	22%	21%	3%	14%	7%	0%	5%	5%	7%	0%	0%	8%	21%	0%		0%	4%	11%	6%	3%
Panderodus acostatus	55%		57%	71%	57%	57%	39%	76%	79%	73%	63%	58%	67%	41%	50%	60%	38%	36%	83%		0%	10%	56%	0%	0%
Panderodus langkawiensis	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	4%	0%	0%	0%
Pseudooneotodus tricornis	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%	8%	0%		13%	10%	0%	0%	9%
Pseudooneotodus sp. A	0%		0%	0%	0%	0%	0%	2%	7%	0%	0%	1%	1%	0%	0%		0%	0%	0%		0%	0%	0%	0%	0%
Panderodus staufferi	0%		0%	0%	8%	13%	22%	0%	0%	0%	0%	0%	0%	15%	0%	0%	2%	23%	0%		26%	22%	0%	6%	0%
Pterospathodus celloni	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	14%	0%	0%		18%	14%	22%	12%	18%
Pseudolonchodina fluegeli	8%		14%	12%	7%	0%	1%	0%	0%	3%	0%	6%	3%	7%	0%	0%	2%	0%	0%		3%	0%	0%	24%	0%
Ozarkodina excavata	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	10%	0%	0%	0%
Ozarkodina cf. O. masurensis	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	0%	0%	0%	0%
Oulodus sp. A	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	0%	0%	0%	7%
Oulodus sp. B	0%		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	0%	0%	0%	0%
Walliserodus curvatus	1%		0%	0%	0%	0%	0%	0%	0%	1%	0%	2%	4%	0%	0%	0%	11%	0%	17%		0%	4%	0%	41%	41%
Total	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1

Weight(g):	3740	4260	3355	2660	4700	2260	3355	3455	3620	2390	4300	3310	2575	3735	3550	4373	3470
Locality:	LT 2	LT 2	LT 2	LT 17	LT 17	LT 17	LT 3	LT 3	LT 3	LT 25	LT 25	LT 8	LT 8	LT 8	LT 7	LT 7	LT 7
Formation:	Wabbi	Wabbi	Wabbi	Wabbi	Wabbi	Wabbi	Earlton	Earlton	Earlton	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe
Sample Number:	LT 261	LT 263	LT 262	LT 267	LT 268	LT 269	LT 265	LT 264	LT 266	LT 253	LT 270	LT 273	LT 271	LT 272	LT 279	LT 278	LT 280
Aulacognathus bullatus																	
Pa										2	4			5			
Pb										3							
M											1						
Sa																	
Sb										1				3			
Sc										1	1						
Aulacognathus sp. A																	
Pa												1					
Pb																	
M																	
Sa																	
Sb												1					
Sc												1					
Decoriconus fragilis																	
			1														
Distomodus? sp. A																	
Pa				9													
Pb				4													
M				4													
Icriodella deflecta																	
Pa	2	2	2	3	7												
Pb		1	1	1													
Pd			1														
M			6	10	1												
Sa	1	1	1	1													
Sb	1		5														
Sc			3	3													
Icriodella discreta																	
Pa	1	1	2	2	4												
Pb	4	2	2	1	2	2											
Pd	1	1	2														
M	1	3	7	8	4	2											
Sa				1													
Sb	3		2	8	2	1											
Sc	1		1	5	1												
Icriodella sp. A																	
Pa	2																
Kockelella manitoulinensis																	
Pa			10														
Pb			3														
Kockelella sp. B																	
Pa							1	7	1								
Pb							1	4									
M							2										
Sa								3									
Sb							1	3									
Sc							1										
Kockelella sp. A (Over & Chatterton)																	
Pa															4	8	
Pb																2	
M															1	2	
Sa																	
Sb															1		
Sc																1	
Oulodus petilus																	
Pa			1					1									
Pb	4		4				1	3	2	2	4			1	1	3	
M			2				3	3	1	1		2			1	3	
Sa	1						2	4	1	1			1	4	2	3	
Sb	3		2					3		3			1	2			
Sc	5		4				2	3		3	2		2	3	1	2	
Ozarkodina gulletensis																	
Pa										4	12						
Pb											5						
M																	
Sa										1	3						
Sb																	
Sc										2	3						
Ozarkodina hassi																	
Pa	1		2														
Pb	3		1														
Ozarkodina oldhamensis																	
Pa			1														
Pb	1		1		1												
Ozarkodina polinclinata																	
Pa										1	2						
Pb										3		1		1	1	1	
M										1		1		1		1	
Sa															1		
Sb												1					1
Sc										1		3			1		1
Ozarkodina sp. A																	
Pa														1			
Ozarkodina cf. O. sp. C Armstrong																	
Pa								2	5								
Pb							1	3	2								
M							1										
Sc								1									
Panderodus acostatus																	
pt																	
pf					1	1											
ae																	
qt																	
qg						1											
qa					1												
Panderodus panderi																	
pt													1				
pf											1						
ae																	
qt										1	1						
qg												1	1				
qa											1						
Panderodus unicostatus																	
pt									1								
pf							2		3								2
ae																	
qt																	
qg								1	1	1							
qa								1		1							
Panderodus staufferi																	
pt												1					
pf												1		1		1	
ae																	
qt																1	
qg														1		1	
qa												1					
Panderodus sp. A																	
pt			1														
pf			1														
ae			1														
qt		1	1														
qg		1	2														
qa			1														
Panderodus sp. B																	
pt							1										
pf																	
ae																	
qt																	
qg																	
qa							1										
Pterospathodus ? sp. A																	
Pa										6	12				5	14	
Pb										1						3	
M																3	
Sa																1	
Sb															1	3	
Sc										1						3	
Walliserodus curvatus																	
															1	3	
Thelodonts																	
	2					5											
Fragments	14	8	18	23	3	0	4	11	8	12	6	1	2	9	1	2	0
Total	35	13	74	60	22	7	19	42	17	41	52	15	6	23	21	58	4

Percentages - Lake Timiskaming Section

Weight(g):	3740	4260	3355	2660	4700	2260	3355	3455	3620	2390	4300	3310	2575	3735	3550	4373	3470
Locality:	LT 2	LT 2	LT 2	LT 17	LT 17	LT 17	LT 3	LT 3	LT 3	LT 25	LT 25	LT 8	LT 8	LT 8	LT 7	LT 7	LT 7
Formation:	Wabbi	Wabbi	Wabbi	Wabbi	Wabbi	Wabbi	Earlton	Earlton	Earlton	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe	Thornloe
Sample Number:	LT 261	LT 263	LT 262	LT 267	LT 268	LT 269	LT 265	LT 264	LT 266	LT 253	LT 270	LT 273	LT 271	LT 272	LT 279	LT 278	LT 280
Aulacognathus bullatus										7	6			8			
Aulacognathus sp. A												3					
Decoriconus fragilis			1														
Distomodus? spe				17													
Icriodella deflecta	4	4	19	18	8												
Icriodella discreta	11	7	16	25	13	5											
Icriodella sp. A	2																
Kockelella manitoulinensis			13														
Kockelella sp. B							6	17	1								
Kockelella sp. A (Over & Chatterton)															6	13	
Oulodus petilus	13		13				8	17	4	10	6	2	4	10	5	11	
Ozarkodina gulletensis										7	23						
Ozarkodina hassi	4		3														
Ozarkodina oldhamensis	1		2		1												
Ozarkodina polinclinata										6	2	6		2	3	2	2
Ozarkodina sp. A														1			
Ozarkodina cf. O. sp. C Armstrong							2	6	7								
Panderodus acostatus					2	2											
Panderodus panderi										1	3	1	2				
Panderodus unicostatus							1	2	5	2							2
Panderodus staufferi												3		2		3	
Panderodus sp. A		2	7														
Panderodus sp. B							2										
Pterospathodus sp. A										8	12				6	27	
Walliserodus curvatus															1	3	
Total	35	13	74	60	24	7	19	42	17	41	52	15	6	23	21	59	4
Aulacognathus bullatus										17%	12%			35%			
Aulacognathus sp. A												20%					
Decoriconus fragilis			1%														
Distomodus ? sp. A				28%													
Icriodella deflecta	11%	31%	26%	30%	33%												
Icriodella discreta	31%	54%	22%	42%	54%	71%											
Icriodella sp. A	6%																
Kockelella manitoulinensis			18%														
Kockelella sp. B							32%	40%	6%								
Kockelella sp. A (Over & Chatterton)															29%	22%	
Oulodus petilus	37%		18%				42%	40%	24%	24%	12%	13%	67%	43%	24%	19%	
Ozarkodina gulletensis										17%	44%						
Ozarkodina hassi	11%		4%														
Ozarkodina oldhamensis	3%		3%		4%												
Ozarkodina polinclinata										15%	4%	40%		9%	14%	3%	50%
Ozarkodina sp. A														4%			
Ozarkodina cf. O. sp. C Armstrong							11%	14%	41%								
Panderodus acostatus					8%	29%											
Panderodus panderi										2%	6%	7%	33%				
Panderodus unicostatus							5%	5%	29%	5%							50%
Panderodus staufferi												20%		9%		5%	
Panderodus sp. A		15%	9%														
Panderodus sp. B							11%										
Pterospathodus sp. A										20%	23%				29%	46%	
Walliserodus curvatus															5%	5%	

Lithology:	TL	TL	TL	TL	TL	TL	TL	TL	TL	TL	TL
Weight in g:	5685	5350	6405	4285	4645	1995	3910	4360	2147	2026	2060
Sample Number:	PC 546	PC 547	PC 548	PC 552	PC 553	PC 554	PC 555	PC 556	PC 557	PC 558	PC 559
Aulacognathus aff. A. bullatus											
Pa				1	2		2	1		1	
Pb				1	1		1				
M				4	1		1				
Sa				1							
Sb				5						1	
Sc				1	1						
Dapsilodus obliquicostatus											
	2	46	42	54	46	34	144	301	335	554	205
Decoriconus costulatus											
	4	39	123								
Decoriconus fragilis											
				416	379	47	16	89	112	176	9
Coryssognathus cf. C dubia											
				8							
Distomodus kentuckyensis											
Pa		2				2					
Pb	1			3	3						
Pd											
M		1									
Sa				1							
Sb		1		4				1			
Sc	1	1		9	1			2			2?
Oulodus ? kentuckyensis											
Pa				10	3		2	2	2	3	
Pb				19	1			2			
M				14	1			3			
Sa											
Sb				2				1	1	1	
Sc				12					3		
Oulodus ? nathani											
Pa				5							
Pb				1							
M				3							
Sa											
Sb											
Sc											
Oulodus cf. O. panuarensis											
Pa	1			1	2						3
Pb				1	9	1			1		
M				11	1			1			3
Sa		1		12	1			1		1	1
Sb	1	1	2	14	2					1	
Sc			2	14	3			1		1	10
Ozarkodina hassi											
Pa				6							
Pb				5							
Ozarkodina oldhamensis											
Pa				43	19	1	1			9	
Pb				30	15		1	2		2	
M				46	10		1	1		1	
Sa				30							
Sb				49	8	2	1			1	
Sc				39							
Ozarkodina masurensis											
Pa											6
Pb											15
M											6
Sa											
Sb											3
Sc											10
Panderodus langkawiensis											
							6		73	158	1
Panderodus panderi											
	7	2	5	24	17				3	2	1
Panderodus staufferi											
						3	5				
Panderodus unicostatus											
	48	61	58	401	375	34	36	146	176	87	4
Panderodus sp. C											
		13									
Pranognathus cf. P. tenuis											
Pa											2
Pb											2
Pc											1
Pd											3
M											4
Sa/Sb											13
Sc											7
Pseudolonchodina sp.											
Pa		18	17	210	198	10	59	123	141	130	5
Pb		16	14	168	154	12	41	75	96	98	1
M1	2	28	24	206	187	15	51	152	175	172	1
Sa	3	13	25	194	176	13	63	76	98	106	2
Sb1+ 2	1	18	20	208	195	10	76	136	161	193	1
Sc1+2	5	38	34	406	387	30	87	197	225	282	3
M2											
Pseudolonchodina expansa	x	x	x	x	x	x	x	x	x	x	
Pseudolonchodina fluegeli	x	x	x	x	x	x	x	x	x	x	x
Pseudooneotodus beckmanni											
		4		1							
Walliserodus sp.											
	1	40	111	5661	5401	282	828	967	992	830	250
Walliserodus curvatus	x	x	x	x	x	x	x	x	x	x	x
Walliserodus sancticlairi											x
Genus sp. indet.											
		8									
Belodina ? sp. A											
				1							
Total	77	343	477	8354	7599	496	1422	2280	2594	2810	572

Percentages - Prongs Creek Section (1)

Lithology:	TL	TL	TL	TL	TL	TL	TL	TL	TL	TL	TL
Weight in g:	5685	5350	6405	4285	4645	1995	3910	4360	2147	2026	2060
Sample Number:	PC 546	PC 547	PC 548	PC 552	PC 553	PC 554	PC 555	PC 556	PC 557	PC 558	PC 559
Aulacognathus aff. A. bullatus				13	5		4	1		2	
Dapsilodus obliquicostatus	2	46	42	54	46	34	144	301	335	554	205
Decoriconus costulatus	4	39	123								
Decoriconus fragilis				416	379	47	16	89	112	176	9
Coryssognathus cf. C. dubia				8							
Distomodus kentuckyensis	2	5		17	4	2		3			2
Oulodus ? kentuckyensis				57	5		2	8	6	4	
Oulodus ? nathani				9							
Oulodus cf. O. panuarensis	2	2	4	53	28	1		3	1	3	17
Ozarkodina hassi				11							
Ozarkodina oldhamensis				237	52	3	4	3		13	
Ozarkodina masurensis											40
Panderodus langkawiensis							6		73	158	1
Panderodus panderi	7	2	5	24	17				3	2	1
Panderodus staufferi						3	5				
Panderodus unicostatus	48	61	58	401	375	34	36	146	176	87	4
Panderodus sp. C		13									
Pranognathus cf.P. tenuis											32
Pseudolonchodina sp.	11	131	134	1392	1297	90	377	759	896	981	13
Pseudooneotodus beckmanni		4		1							
Walliserodus curvatus	1	40	111	5661	5401	282	828	967	992	830	250
Walliserodus sancticlairi											
Genus sp. indet.		8									
Belodina ?				1							
Total	77	351	477	8355	7609	496	1422	2280	2594	2810	574
Aulacognathus aff. A. bullatus				0%	0%		0%	0%		0%	
Dapsilodus obliquicostatus	3%	13%	9%	1%	1%	7%	10%	13%	13%	20%	36%
Decoriconus costulatus	5%	11%	26%								
Decoriconus fragilis				5%	5%	9%	1%	4%	4%	6%	2%
Coryssognathus cf.C.dubia				0%							
Distomodus kentuckyensis	3%	1%		0%	0%	0%		0%			0%
Oulodus ? kentuckyensis				1%	0%		0%	0%	0%	0%	
Oulodus ? nathani				0%							
Oulodus cf. O. panuarensis	3%	1%	1%	1%	0%	0%		0%	0%	0%	3%
Ozarkodina hassi				0%							
Ozarkodina oldhamensis				3%	1%	1%	0%	0%		0%	
Ozarkodina masurensis											7%
Panderodus langkawiensis							0%		3%	6%	0%
Panderodus panderi	9%	1%	1%	0%	0%				0%	0%	0%
Panderodus staufferi						1%	0%				
Panderodus unicostatus	62%	17%	12%	5%	5%	7%	3%	6%	7%	3%	1%
Panderodus sp.C		4%									
Pranognathus cf. P. tenuis											6%
Pseudolonchodina sp.	14%	37%	28%	17%	17%	18%	27%	33%	35%	35%	2%
Pseudooneotodus beckmanni		1%		0%							
Walliserodus curvatus	1%	11%	23%	68%	71%	57%	58%	42%	38%	30%	44%
Walliserodus sancticlairi											
Genus sp. indet.		2%									
Belodina ?				0%							

Lithology:	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Weight in g:	1755	1980	1995	1929	2084	5035	5330	5715	5225	5815	4840	5235	5505	5475	4960
Sample Number:	PC 560	PC 561	PC 562	PC 563	PC 564	PC 565	PC 566	PC 567	PC 568	PC 569	PC 570	PC 571	PC 572	PC 573	PC 574
Astropentagnathus araneum															
Pa		10	4												
Pb		2													
Pc		1													
M															
Sb1 + 2		4													
Sc		2													
Astropentagnthus irregularis															
Pa		20	12												
Pb		6	6												
Pc		28	13												
M		9	20												
Sb		13	24												
Sc		5	8												
Aulacognathus bullatus															
Pa			1	2	2			2		1		1		1	2
Pb					2	1						1			1
M				3											
Sa															
Sb			1		2			1	1						1
Sc			1	1	1										
Aulacognathus kuehni															
Pa					1										
Pb					1										
M															
Sa															
Sb															
Sc					1										
Dapsilodus obliquicostatus															
	13														
Dapsilodus sp. B (McCracken)															
		24													
Decoriconus fragilis															
			1			13				2					
Distomodus staurognathoides															
Pa		1													1
Pb	1	1													
Pd															
M										1					
Sa															
Sb	1														
Sc	1	3	1												
Oulodus cf. O. panaurensis															
Pa															
Pb															
M	1														
Sa															
Sb															
Sc															
Ozarkodina masurensis															
Pa															
Pb	1														
M															
Sa															
Sb	1														
Sc	1														
Panderodus langkawiensis															
		406	199	92	102	8	3	84	62	79	586	199	68	440	240
Panderodus panderi															
						1	4			2					
Pseudobelodella silurica															
											1				
Pseudolonchodina sp.															
Pa	1	104	29	4	8	2		9	16		30	6	10	29	6
Pb	2	116	23	1	10	1	2	7	14	4	16	9	7	35	
M1	9	194	49	5	17	7	3	17	24	4	25	16	4	42	4
Sa	2	107	13	1	21	4	2	4	11	1	36	8	15	37	5
Sb1 + 2	3	86	18	3	16	5	2	8	21	2	20	9	9	26	
Sc1 + 2	3	225	55	3	16	4	3	12	12	2	49	29	30	64	3
M2?						2		22	22	1	8	2		3	2
Pseudolonchodina capensis							x	x	x	x	x	x	x	x	x
Pseudolonchodina expansa	x			x											
Pseudolonchodina fluegeli		x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pterospathodus celloni															
Pa		15	14	19	4	1	1	18	5	4	15	12	4	57	15
Pb		4	6	6	9			2	1		9	4	3	12	1
Pc		9	11	12	5		1	4	7	2	18	6	5	35	6
Pd		3	5	1											3
M		17	19	19	21			6	2	2	5	8	1	37	1
Sa/Sb		14	15	28	10	2	1	7	8	3	25	15	6	63	8
Sc		17	19	14	5	1		7	1		11	13	4	17	1
Camiodus elements		17	23	14	5	4		12	2	4	31	25	3	65	5
Pterospathodus rhodesi															
Pa															2
Pb															1
Walliserodus sancticlairi															
		3	5			14	1								
Walliserodus blackstonensis															
								59	47	35	604	94	106	1094	7
Panderodus Cluster															
					1					1					
Pseudolonchodina Cluster															
			1												
Total	40	1466	595	228	260	70	23	281	256	150	1489	457	275	2057	315

Percentages - Prongs Creek Section (2)

Lithology:	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Weight in g:	1755	1980	1995	1929	2084	5035	5330	5715	5225	5815	4840	5235	5505	5475	4960
Sample Number:	PC 560	PC 561	PC 562	PC 563	PC 564	PC 565	PC 566	PC 567	PC 568	PC 569	PC 570	PC 571	PC 572	PC 573	PC 574
Astropentagnathus araneum		18	4												
Astropentagnathus irregularis		81	83												
Aulacognathus bullatus			3	6	7	1		3	1	1		2		1	4
Aulacognathus kuehni					3										
Dapsilodus obiquicostatus	13														
Dapsilodus ? sp. B McCracken		24													
Decoriconus fragilis			1			13				2					
Distomodus staurognathoides	3	5	1							1					1
Oulodus cf. O. panarensis	1														
Ozarkodina masurensis	3														
Panderodus langkawiensis		406	199	92	102	8	3	84	62	79	586	199	68	440	240
Panderodus panderi						1	4			2					
Pseudobelodella silurica											1				
Pseudolonchodina sp.	20	832	187	17	88	25	12	79	120	14	184	79	75	236	20
Pterospathodus celloni		79	89	99	54	4	3	44	24	11	83	58	23	221	35
Carniodus Elements		17	23	14	5	4		12	2	4	31	25	3	65	5
Pterospathodus rhodesi															3
Walliserodus sancticlairi		3	5			14	1								
Walliserodus blackestonensis								59	47	35	604	94	106	1094	7
Total	40	1465	595	228	259	70	23	281	256	149	1489	457	275	2057	315
Astropentagnathus araneum		1%	1%												
Astropentagnathus irregularis		6%	14%												
Aulacognathus bullatus			1%	3%	3%	1%		1%	0%	1%		0%		0%	1%
Aulacognathus kuehni					1%										
Dapsilodus obiquicostatus	33%														
Dapsilodus sp. B McCracken		2%													
Decoriconus fragilis			0%			19%				1%					
Distomodus staurognathoides	8%	0%	0%							1%					0%
Oulodus cf. O. panarensis	3%														
Ozarkodina masurensis	8%														
Panderodus langkawiensis		28%	33%	40%	39%	11%	13%	30%	24%	53%	39%	44%	25%	21%	76%
Panderodus panderi						1%	17%			1%					
Pseudobelodella silurica											0%				
Pseudolonchodina sp.	50%	57%	31%	7%	34%	36%	52%	28%	47%	9%	12%	17%	27%	11%	6%
Pterospathodus celloni		5%	15%	43%	21%	6%	13%	16%	9%	7%	6%	13%	8%	11%	11%
Carniodus Elements		1%	4%	2%	2%	6%		4%	1%	3%	2%	5%	1%	3%	2%
Pterospathodus rhodesi															1%
Walliserodus sancticlairi		0%	0%			29%	4%								
Walliserodus blackestonensis								21%	40%	23%	41%	21%	39%	53%	2%

Appendix C

Localities and conodont samples

C.1 Introduction **C1**

C.2 Sampling areas **C2**

C.2.1 Anticosti Island (Québec) C2

C.2.1a Samples collected during field work C3

C.2.1b Samples collected during the Third International Brachiopod Congress Field Trip, Anticosti Island (Led by P. Copper & J. Jisuo) C7

C.2.2 Lake Timiskaming (Ontario) C10

C.2.3 Prongs Creek (northern Yukon Territories) C14

Appendix C

Localities and conodont samples

C.1 Introduction

Within this thesis conodont samples of Ordovician and Silurian age have been studied from three areas: Anticosti Island (Québec), Lake Timiskaming (Ontario), Prongs Creek (Yukon Territories).

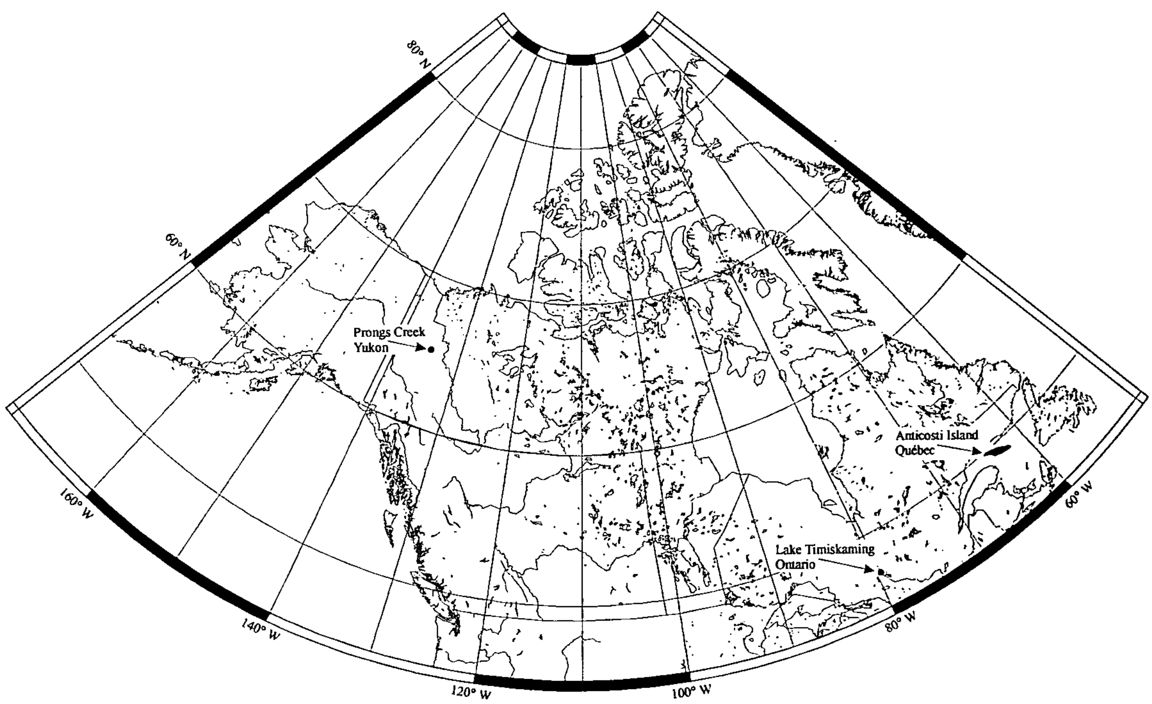


Figure C.1 A map of Canada showing the locations of Lake Timiskaming, Anticosti Island and Prongs Creek.

C.2 Sampling areas

C.2.1 Anticosti Island (Québec)

The samples were collected in 1995 by G. Radcliffe. Sample descriptions are taken from field notes by G. Radcliffe.

Sample numbers that are prefixed with GR refer to sample number assigned in the field. The sample numbers were then changed to Durham Univesrity numbers, which are prefixed with the letter D. In the rest of this thesis the Durham University number has been used but prefixed with the letters AI (Anticosti Island).

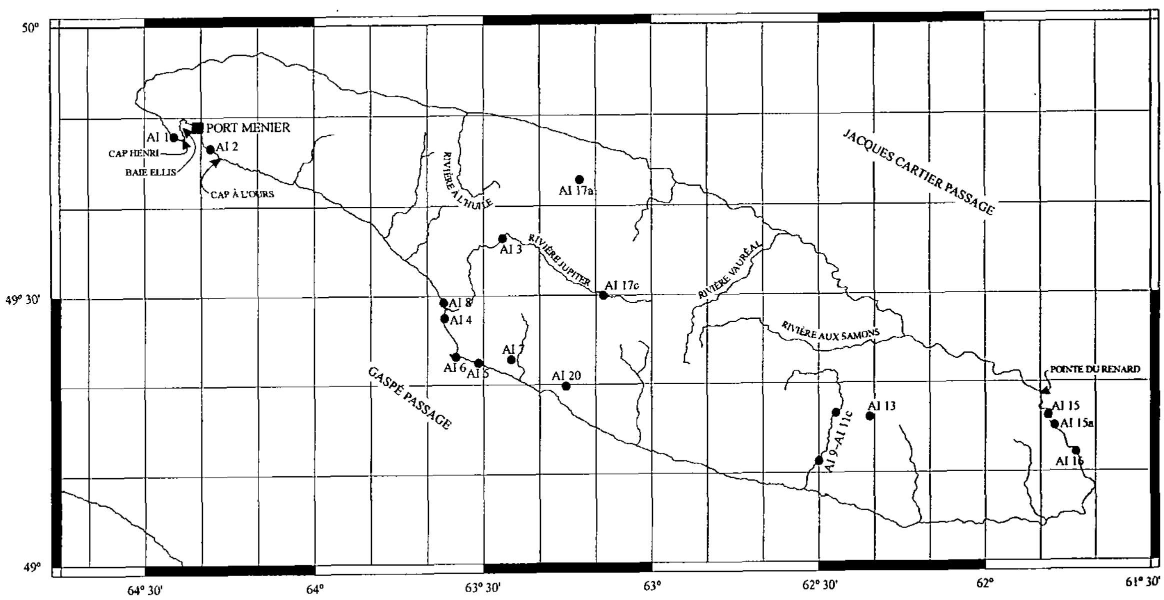


Figure C.2 Conodont sampling localities on Anticosti Island: Point Laframboise (AI 1), Cap à 1' Aigle (AI 2), Jupiter 24 Lodge (AI 3), Cap Ottawa (AI 4), Brisants Jumpers (AI 5), Pointe du sud-ouest (AI 6), Rivière du Brick Road (AI 7), Cap Jupiter (AI 8), Rivière Dauphine Road (AI 9, AI 10b, AI 11b, AI 11c), Main Sandtop Road (AI 13), Baie Innommée (AI 15), Meeting of Sandtop road and Ruis de la Chute (AI 15a), Cap Sandtop (AI 16), Lac Wickenden Road (AI 17a, AI 17c), and Rivière Galiote Road (AI 20).

C.2.1a Samples collected during field work

Locality AI 1				
Location:	Point Laframboise			
Section 1				
Sample number	Formation	Member	Height	Description
(GR/15/1) D628	Ellis Bay	Lousy Cove	0.3m	-
(GR/15/2) D629	Ellis Bay	Lousy Cove	0.54m	-
(GR/15/3) D630	Ellis Bay	Lousy Cove	1.46m	-
(GR/15/5) D634	Ellis Bay	Lousy Cove	2.12m	-
(GR/15/6) D641	Ellis Bay	Lousy Cove	2.95m	Uppermost bed
(GR/15/9) D636	Ellis Bay	Laframboise	3.02m	O.P.B.
(GR/15/7) D635	Ellis Bay	Laframboise	3.18m	O.P.B.
Section 2				
Sample number	Formation	Member	Height	Description
(GR/1/159) D594	Ellis Bay	Laframboise	0.08m	Very top of oncolite bed
(GR/1/162) D612	Ellis Bay	Laframboise	0.1m	Lying on top of oncolite bed
(GR/1/164) D595	Ellis Bay	Laframboise	0.22m	Inter bioherm 12cm above onc.
(GR/1/160) D620	Ellis Bay	Laframboise	0.5m	Inter bioherm 40cm above onc.
(GR/1/161) D605	Ellis Bay	Laframboise	0.66m	Inter bioherm 55cm above onc. Competent ledge.
(GR/1/173) D606	Ellis Bay	Laframboise	0.94m	Inter bioherm 30cm above recessive beds (?)
(GR/1/174) D596	Ellis Bay	Laframboise	1.26m	Inter bioherm 30cm above 173
(GR/1/175) D613	Ellis Bay	Laframboise	1.95m	Inter bioherm 70cm above 174
(GR/1/176) D607	Ellis Bay	Laframboise	2.30m	Inter bioherm 35cm above 175
(GR/1/177) D602	Ellis Bay	Laframboise	2.50m	Inter bioherm Uppermost bed of marls below sand.

(GR/1/156) D621	Ellis Bay	Laframboise	2.56m	Inter bioherm marl layer above 157. 250cm above onc.
Section 3				
Sample number	Formation	Member	Height	Description
(GR/1/166) D615	Ellis Bay	Laframboise	-	marl layer directly below sand
(GR/1/165) D618	Becscie	-	-	5cm above base of sand
(GR/1/167) D616	Becscie	-	-	Nodular band 35cm above base of sand
(GR/1/168) D617	Becscie	-	-	Unit 5 of Becscie
(GR/1/169) D622	Becscie	-	-	Base of unit 6 (bottom 5cm)
(GR/1/170) D627	Becscie	-	-	Base of unit 7
(GR/1/171) D610	Becscie	-	-	135cm above base of unit 7
(GR/1/172) D626	Becscie	-	-	160cm above sample 171
Section 4				
Sample number	Formation	Member	Height	Description
(GR/1/153) D611	Becscie?	-	-	1st sand bed interbedded with bioherms
(GR/1/154) D614	Becscie?	-	-	1st sand body that interfingers with bioherms
(GR/1/155) D619	Ellis Bay	Laframboise	-	marly layer from centre of bioherm.

Locality AI 2				
Location:	Cap à l'Aigle			
Sample number	Formation	Member	Height	Description
(GR/4/191) D625	Ellis Bay	Lousy Cove	-	Top of bluff. Anse aux navet. Grey micrite near top of Lousy cove.
(GR/4/189) D579	Ellis Bay	Lousy Cove	-	shaley bed directly below platey bed.
(GR/4/182) D603	Ellis Bay	Lousy Cove	-	(uppermost bed) plately bed
(GR/4/181) D604	Ellis Bay	Laframboise	-	O.P.B.
(GR/4/184) D575	Ellis Bay	Laframboise	-	O.P.B.shale directly below the true O.P.B.
(GR/4/183) D578	Ellis Bay	Laframboise	-	True O.P.B.

(GR/4/186) D637	Ellis Bay	Laframboise	-	O.P.B. 5cm above sample 183
(GR/4/185) D577	Becscie	-	-	1st bed of crinoidal grainstone interbedded with the bioherms.
(GR/4/187) D609	Ellis Bay	Laframboise	-	Carbonate interbioherm sediment interbedded with crinoidal grainstone.
(GR/4/188) D608	Becscie	-	-	1st bed which clearly overlies the reefs.

Locality AI 3			
Location:	Rivière Jupiter (down stream of Jupiter 24 Lodge)		
Sample number	Formation	Member	Description
(GR/16/15) D672	Becscie	-	base of bed 1
(GR/17/25) D673	Becscie	-	Top of bed 4
(GR/17/28) D674	Merrimack	-	bed 6 9cm from base of bed 6
(GR/17/27) D675	Merrimack	-	base of bed 8

Locality AI 4			
Location:	Cap Ottawa		
Sample number	Formation	Member	Description
(GR/18/29) D678	Jupiter	Cyble	-

Locality AI 5				
Location:	Brisants Jumpers			
Sample number	Formation	Member	Height	Description
GR/20/45 D640	Jupiter	Ferrum	0.26m	10-0cm below top.
GR/20/42 D642	Jupiter	Pavillion	1.17m	-

GR/20/41 D652	Jupiter	Pavillion	1.42m	114cm above base of Pavillion member.
GR/20/47 D639	Jupiter	Pavillion	2.28m	-
GR/20/48 D643	Jupiter	Pavillion	2.80m	25cm above base of unit 3
GR/20/49 D651	Jupiter	Pavillion	4.23-432m	Unit 5-all through bed
GR/20/43 D654	Jupiter	Pavillion	4.73m	7cm below base of unit 6
GR/21/54 D656	Jupiter	Pavillion	5.33m	Base of bed 10
GR/21/53 D658	Jupiter	Pavillion	6.75m	Bed 25 (sand)
GR/21/60 D653	Jupiter	Pavillion	7.92m	-
GR/21/61 D665	Jupiter	Pavillion	8.93m	Bed 40 shale
GR/21/56 D657	Jupiter	Pavillion	9.79m	Bed 52
GR/21/57 D659	Jupiter	Pavillion	9.95m	Bed 54 sand in marl
GR/21/58 D655	Chicotte	-	10.07m	Very base of .chicotte, bed 55
GR/21/71 D669	Chicotte	-	11.15m	192cm below top of chicotte
GR/21/70 D667	Chicotte	-	12.04m	103cm below top of chicotte
GR/21/69 D668	Chicotte	-	12.95m	12cm below top of chicotte

Locality AI 6			
Location:	Pointe du sud-ouest		
Sample number	Formation	Member	Description
(GR//51) D644	Chicotte	-	-

Locality AI 7			
Location:	Rivière du Brick road just south of Chalet Brick		
Sample number	Formation	Member	Description
(GR//194) D661 and D662	Chicotte	-	-

C.2.1b Samples collected during the Third International Brachiopod Congress Field Trip, Anticosti Island (Led by P. Copper & J. Jisuo)

Stop AI 9			
Location:	Rivière Dauphiné Road		
Sample number	Formation	Member	Description
(GR/27/96) D749	Gunriver	Macgilvray	Uppermost bed.
(GR/27/97) D750	Jupiter	Goéland	Basal bed.

Stop AI 10b			
Location:	Rivière Dauphiné Road		
Sample number	Formation	Member	Description
(GR/27102) D677	Jupiter	Goéland (middle upper part)	-

Stop AI 11b			
Location:	Rivière Dauphiné Road		
Sample number	Formation	Member	Description
(GR/27/107) D670	Jupiter	Ferrum, 10-12 m above the base of the member.	-

Stop AI 11c			
Location:	Rivière Dauphiné Road		
Sample number	Formation	Member	Description
(GR/27/108) D647	Jupiter	East Point	No reefs at this outcrop. Contains *Pentamerids*, *Stegarhyncus*, crinoids, and corals.

Stop AI 13			
Location:	Main Sandtop Road, 2.4 km E of Box Road turn off.		
Sample number	Formation	Member	Description
(GR/28/113) D646	Jupiter	East Point	-
(GR/28/114) D645	Jupiter	East Point	-

Stop AI 15			
Location:	Baie Innommée, western access.		
Sample number	Formation	Member	Description
(GR/28/117) D666	Merrimack	Middle part, Unit 1-3	-

Stop AI 15a			
Location:	Meeting of Sandtop road and Ruis de la chute.		
Sample number	Formation	Member	Description
(GR/28/123) D676	Gun River	La chute	1m below the boundary with the Innommée member.

Stop AI 16			
Location:	Cap Sandtop (small creek above Cap Sandtop. ~1m below the road).		
Sample number	Formation	Member	Description
(GR/28/125) D650	GunRiver	Macgilvray	Uppermost bed of the Macgilvray member (70cm below road).
(GR/28/124) D649	Jupiter	Goéland	Fallen block of *Pentamerus* beds, basal Goéland member.

Stop AI 17a			
Location:	Lac wickenden road (about 5km from junction with main east west trending road).		
Sample number	Formation	Member	Description
(GR/29/128) D664	Ellis Bay	Laframboise	O.P.B.

Stop AI 17c			
Location:	Junction of Rivière Jupiter and Lac wickenden road		
Sample number	Formation	Member	Description
(GR/29/129) D751	Gun River	Sandtop	Many silicified horn corals.

Stop AI 20			
Location:	Rivière Galiote road, 5 km E of the Rivière du Brick bridge.		
Sample number	Formation	Member	Description
(GR/29/135) D648	Chicotte	-	-
(GR/29/136) D663	Chicotte	-	-

C.2.2 Lake Timiskaming (Ontario)

Seven sections were collected through the Lower Silurian of Lake Timiskaming by A. D. McCracken and T. E. Bolton in 1994 for the Geological Survey of Canada. The samples were processed using standard conodont preparation techniques (at the Geological Survey of Canada, Ottawa).

Sample numbers that are prefixed with O have been given by the Geological Survey of Canada (G.S.C.) In the rest of this thesis the G.S.C. sample numbers have been abbreviated (last three digits only) and prefixed with the letters LT (Lake Timiskaming).

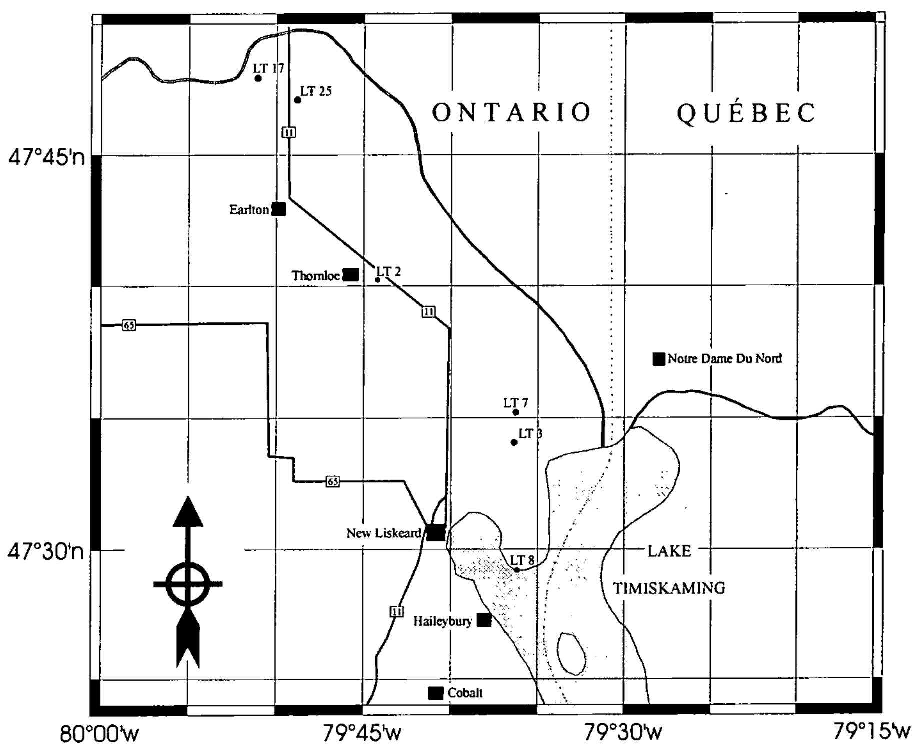


Figure C.3 Conodont sampling localities in the Lake Timiskaming area: Loach Quarry (LT 2), Highway 65 Roadcut (LT 3), Middleton Quarry (LT 7), Dawson Point (LT 8), Evanturel Creek (LT 17) and McNamara Quarry (LT 25).

Locality LT 2		
Location:	Loach Quarry	
Group:	Wabi	
Formation:	Evanturel Creek	
G.S.C. Sample number:	Height (A.B.S.):	Description:
O-106261	0.0m	-
O-106262	2.3 m	Thin bedded limestone.
O-106263	3.3 m	5cm bed of fossiliferous limestone.

Locality LT 3		
Location:	Highway 65 Roadcut	
Latitude:	473400N	
Longitude:	0793700W	
Formation:	Earlton	
G.S.C. Sample number:	Height (A.B.S.):	Description:
O-106264	0.90-1.05m	Fossiliferous, ostracode limestone.
O-106265	0.70-0.75m	Oolitic Limestone.
O-106266	1.12-1.27m	Burrowed limestone.

Locality LT 7		
Location:	Middleton Quarry	
Latitude:	474000N	
Longitude:	0794500W	
Formation:	Thornloe	
G.S.C. Sample number:	Height (A.B.S.):	Description:

O-106279	0.0m	Brown / grey, fossiliferous limestone with muddy matrix.
O-106278	1.5m	Medium brown, fine grained limestone.
O-106280	5.3m	Light brown calcilutite.

Locality LT 8		
Location:	Dawson Point	
Latitude:	472900N	
Longitude:	0793600W	
Formation:	Thornloe	
G.S.C. Sample number:	Height (A.B.S.):	Description:
O-106273	0.0m	Med. brown calcmicrite with brachiopods crinoids, trace fossils, and Favositid corals.
O-106271	4.7m	Brown, crinoidal, burrowed calcilutite.
O-106272	6.0m	Resistant crinoidal limestone.

Locality LT 17		
Location:	Evanturel Creek	
Latitude:	473400N	
Longitude:	0793700W	
Formation:	Evanturel Creek	
G.S.C. Sample number:	Height (A.B.S.):	Description:
O-106267	1.1-1.2m	Nodular dolomitic limestone
O-106268	1.75-1.8m	V. fossiliferous limestone with clams, ostracodes, gastropods.
O-106269	2.95-2.98m	Limestone with ostracodes.

Locality LT 25	
Location:	McNamara Quarry
Latitude:	474500N

Longitude:	0794900W	
Formation:	Earlton	
G.S.C. Sample number:	Height (A.B.S.):	Description:
O-106253	2.65m	5cm of thin bedded fossiliferous limestone with crinoid ossicles and brachiopods.
O-106270	3.53-3.7m	5cm bed of brown / buff limestone with numerous trilobite tails and zygobol. ostracods.

C.2.3 Prongs Creek (northern Yukon Territories)

Conodont samples were collected by A.D. McCracken in 1986 from Upper Prongs Creek section (a tributary off the main creek). A preliminary report documenting tentative identifications was published in 1989. The descriptions below are taken from A.D. McCracken's field notes.

Sample numbers that are prefixed with C have been given by the Geological Survey of Canada (G.S.C.) In the rest of this thesis the G.S.C. sample numbers have been abbreviated (last three digits only) and prefixed with the letters PC (Prongs Creek).

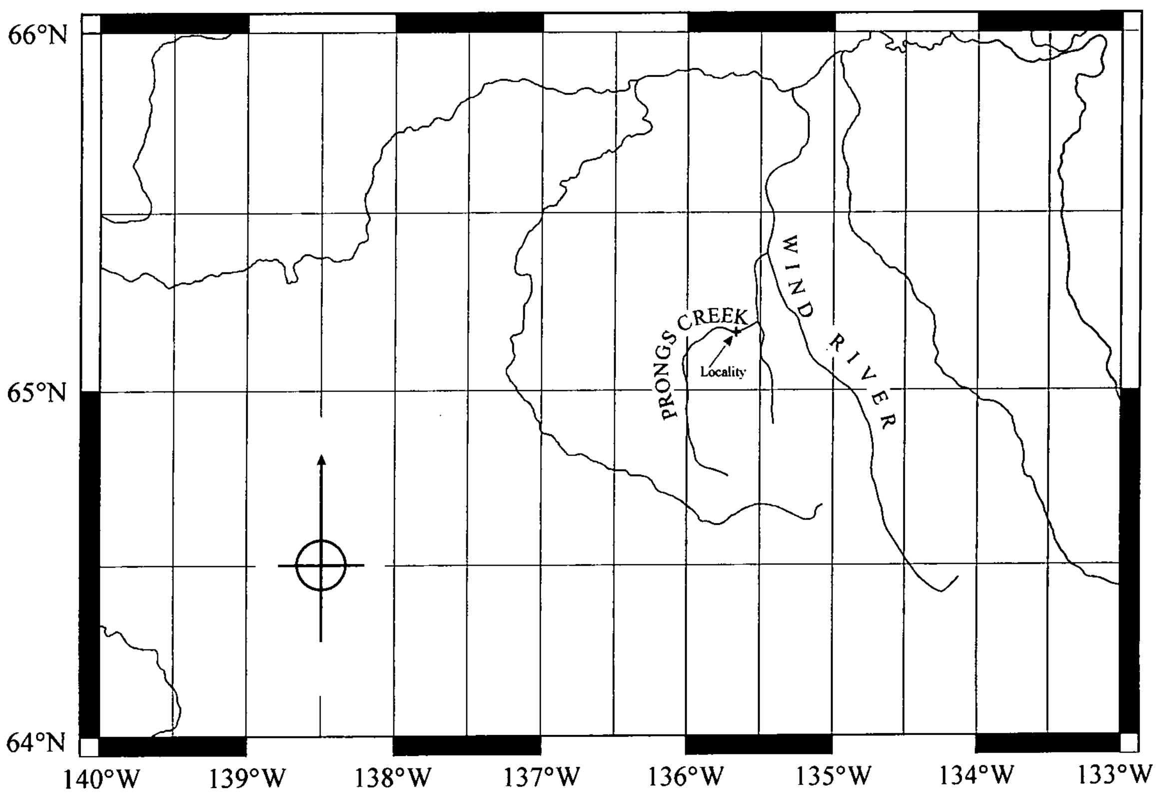


Figure C.4 The location of the Prongs Creek section.

Locality PC 1		
Location:	Upper Prongs Creek, tributary off the main Prongs Creek	
Latitude:	65° 17 ' N	
Longitude:	135° 42 ' W	
Section 3		
Platformal Limestone Unit		
G.S.C. Sample number:	Height (A.B.S.):	Description:
C-150542	8.0m	Light grey / medium grey calclutite.
C-150543	18.7m	Light grey / dark grey, styolitic, calcarenite.
C-150544	23.0m	Light grey / medium grey, calclutite.
C-150545	27.0m	Light grey / medium grey, mottled calcarenite. Fossiliferous with pyrite.
Transitional Limestone Unit		
G.S.C. Sample number:	Height (A.B.S.):	Description:
C-150546	30.5m	Light grey / medium grey, calclutite. Burrow mottling.
C-150547	31.0m	Uppermost 6cm of coral unit.
C-150548	31.05 - 31.15m	-
Section 1		
Transitional Limestone Unit		
G.S.C. Sample number:	Height (A.B.S.):	Description:
C-150552	0.5m	Grey, medium bedded, calcarenite. No fossils visible.
C-150553	1.0m	Grey, medium bedded, calcarenite with very abundant brachiopods, and trilobite pygidia.
C-150554	1.2m	Grey, thin bedded, calcarenite with abundant brachiopods.
C-150555	1.7m	Thin bedded, grey, calcarenite with trilobite pygidia and a gastropod.
C-150556	2.0m	Thin bedded, grey, calcarenite.
C-150557	2.6m	Thin to medium bedded with fewer fossils than below. The Hummocky bed surface.
C-150558	2.7m	Thin bedded, grey calcarenite, with numerous brachiopods and trilobites.
Road River Group		
G.S.C. Sample number:	Height (A.B.S.):	Description:

C-150559	3.7m	Upper 15 cm of 50 cm massive bed of grey, fine calacarenite with no fossils.
C-150560	6.2m	15 cm bed with same lithology as 559, plus pyrite nodules.
C-150561	7.7m	Grey, medium bedded, dense calcarenite, with small pyrite nodules but lacking fossils.
C-150562	8.9m	Grey, very dense calcarenite (30cm thick bed), with pyrite nodules, faint laminae, and no fossils.
C-150563	9.4m	50 cm bed of the same lithology as below.
C-150564	10.3m	15 cm bed of the same lithology as below.
C-150565	11.6m	20 cm bed of same lithology as below.
C-150566	12.1m	20 cm bed, with same lithology as below.
C-150567	12.8m	30cm thick bed with the same Lithology as below.
C-150568	13.0m	30cm thick bed, with same lithology as below with Laminae.
C-150569	13.5m	15cm thick bed, with same lithology as below, but lacks laminae.
C-150570	14.4m	30 cm thick bed, with same lithology as below and lacks laminae.
C-150571	15.4m	Sample from the upper 20 cm of a 50 cm unit (2 beds) of the same lithology as below, with no laminae.
C-150572	16.8m	Sample from the upper 20 cm of 40 cm bed.
C-150573	18.5m	Sample from a 15cm thick bed, of the same lithology as below with laminae and iron staining.
C-150574	20.0m	Lithology as below, with no laminae.
C-150575	39.5m	Sample from above the *spiralis* Biozone, from a 4cm thick bed.

Appendix D

Sample preparation and collections studied

D.1 Sample Preparation **D1**

D.1.1 Sample Preparation at the University of Durham D1

D.1.2 Sample Preparation at the Geological Survey of Canada D1

D.2 Collections viewed **D2**

D.3 Samples On Loan **D3**

Appendix D

Sample preparation and collections studied

D.1 Sample Preparation

D.1.1 Sample Preparation at the University of Durham

Samples from Anticosti Island were processed by the author at the University of Durham using the following method. The samples were broken up in to small pieces (by using a hammer or crushing machine dependent on the rock type) and placed in a clean bucket. A solution of 10 % acetic acid was then added to the bucket (solution made by diluting 80% acetic acid with hot tap water). After one week, the spent acid was decanted through a coarse top sieve (1mm) with a 60 micron sieve below. The coarse fraction was returned to the bucket and fresh acid was added. This process was continued until the rock had been totally digested. The fine fraction was collected and dried after each sieving and then separated using a heavy liquid, bromoform (tribromomethane). The heavy residues were dried again and then picked for conodont elements using a standard grid tray and a fine brush wetted with water.

D.1.2 Sample Preparation at the Geological Survey of Canada

The samples from Lake Timiskaming and Prongs Creek were processed at the Geological Survey of Canada labs in Ottawa and Calgary respectively. The rock samples were dissolved using the standard technique outlined above (10-15% acetic acid). The sieve sized used was 150. The residues were then separated using tetrabromethane. Further processing of some samples was undertaken with the use of Methylene Iodide and /or magnetic separation. The lake Timiskaming samples were fully picked at the Geological Survey of Canada, whereas the Prongs Creek samples were only partially picked. Completion of picking was undertaken by the author at the University of Durham.

D.2 Collections viewed

During the course of this project the author has been able to visit the following institutions in order to study the conodont collections housed there:

University of Leicester

M. Idris thesis collection (kind permission of Prof. R. J. Aldridge).

University of Birmingham

Dr. Ivan Sansom's collection of *Panderodus* elements.

The Geological Survey of Canada, Calgary

The following collections were viewed with the kind permission of Dr. G. S. Nowlan and Dr. T. T. Uyeno:

Nowlan & Barnes (1981): Conodonts from the Vauréal Formation, Anticosti Island.

Uyeno & Barnes (1983): Conodonts from the Jupiter and Chicotte Formations, Anticosti Island.

Nowlan (1982): Conodonts from the Ordovician - Silurian boundary at the eastern end of Anticosti Island.

Nowlan, McCracken & Chatterton (1988) conodonts from the Ordovician - Silurian boundary strata, Whittaker Formation, Mackenzie Mountains, Northwest Territories.

Unpublished conodont samples (collected by Dr. G. S. Nowlan) from Manitoulin Island and the Gaspé Peninsula.

The Geological Survey of Canada, Ottawa

Figured specimens from the following publications were viewed by the kind permission of Mrs. B. J. Dougherty (Curator, The National Type Fossil Collection):

Nowlan & Barnes (1981), Uyeno & Barnes (1983), Nowlan (1981, 1982, 1983), and Nowlan, McCracken & Chatterton (1988)

D.3 Samples On Loan

Samples loaned to the author by Dr. A. D. McCracken (Geological Survey of Canada) include:

Conodont samples from the McCracken & Barnes (1981) collection.

Conodont samples from the Lower Silurian of Lake Timiskaming, Ontario.

Ordovician - Silurian conodont samples from Prongs Creek, The Yukon.