SYSTEMATIC DESCRIPTIONS

Phylum CONODONTA
Eichenberg, 1930
[nom. transl. CLARK, herein, ex Conodontophorida EICHENBERG, 1930, p. 181, order] [Diagnosis by D. L. CLARK]

Extinct group of marine animals, mostly pelagic during some or all of their lives; most commonly preserved parts microscopic coniform, ramiform, or pectiniform elements occurring in various combinations and apparatus patterns and functioning as internal supports of body. Elements composed principally of carbonate apatite laminae built up by outer accretion; histologically complex. Element apparatuses suggest that most conodonts had bilaterally symmetrical bodies. U.Precam.-U.Trias.

Class CONODONTA
Eichenberg, 1930
[nom. transl. CLARK, herein, ex Conodontophorida EICHENBERG, 1930, p. 181, order]

Diagnosis as for phylum. U.Precam.-U.Trias.

Order PARACONODONTIDA
Miuller, 1962
[Paraconodontida Miuller, 1962c, p. W248] [Diagnosis by J. F. Miuller]

Elements characterized by large, deep, basal cavities and lack of white matter; exterior of some specimens covered with layer of dark organic material (similar layer may line basal cavity); growth lamellae fewer and more widely spaced than in elements of Conodontophorida; only first few growth lamellae continuous on all sides, other lamellae beginning below tip, wrapping around basal margin, extending inside basal cavity, ending below apex of basal cavity (later deposited lamellae beginning successively farther below tip of cusp and ending successively farther below apex of basal cavity); growth pattern from tip downward, rather than from base upward as in elements of Conodontophorida; basal structure (basal funnel) indistinct or absent. All genera probably possessing unimembrate apparatuses. Uppermost Precam.(Yudom.)-M.Ord. [Most species of Cambrian age.]

Superfamily AMPHIGEISINACEA
Miuller, new
[Materials for this superfamily prepared by J. F. Miuller]

Nongeniculate coniform elements distinguished by unusual three-layered wall; inner layer (lining basal cavity) and outer layer (covering element) thin and apparently mostly or entirely organic; middle layer thick and mostly apatite. L.Cam.-M.Cam. transition.

Family AMPHIGEISINIDAE
Miuller, new

Diagnosis as for superfamily. L.Cam.-M.Cam. transition.

Amphigeisina BENGTSON, 1976, p. 187 [*Hertzina? danica POULSEN, 1966, p. 4; OD]. Extremely long (up to 8 mm), slender, proclined, symmetrical coniform elements with basal cavity extending to tip. Anterior face smoothly rounded; posterior face concave; posterolateral edges drawn out into two prominent keels. L.Cam.-M.Cam. transition, Eu.(Sweden-?Eng.)-?Asia(Sib.).—Fig. 63.1. *A. danica (POULSEN), Eu.(Sweden); la,b, right oblique view, transv. sec., about X20 (Bengtson, 1976).
Superfamily FURNISHINACEA
Miller, new

[MATERIALS FOR THIS SUPERFAMILY PREPARED BY J. F. MILLER]

Nongeniculate coniform and unusual multicuspate elements with two-layered wall structure; outer layer thin, composed mostly of organic matter; inner layer thick, composed mostly of apatite. Uppermost Precam. (Yudom.)-M. Ord.

Family FURNISHINIDAE
Müller & Nogami, 1971

[Furnishinidae Müller & Nogami, 1971, p. 18]

Coniform elements with growth lamellae discontinuous on outside of cusp and on inside of basal cavity. Uppermost Precam. (Yudom.)-M. Ord.

Furnishina Müller, 1959, p. 451 [*F. furnishii; OD]. Asymmetrical coniform elements, proclined to erect, some bent laterally; base large and broadly expanded, with distinct cusp above base; basal cavity large and deep; anterior face flat, posterior and anterolateral carinae resulting in triangular cross section, cross section in some modified by secondary lateral carinae. M. Cam.-L. Ord., N. Am. (USA, widespread in W. and SW.)-Eu. (Sweden-Pol.-Ger., glacial erratics)-Asia (Sib.-China-S. Korea-Turkey-Iran)-Australia (Queensl.).—Fig. 64, 7. *F. furnishii, holotype, U. Cam. (Gallatin Ls.), USA (Wyo.); 7a-c, post. lat. views, transv. sec., ×80 (Müller, 1959).

Albiconus Miller, 1980, p. 8 [*A. postcostatus; OD]. Symmetrical coniform elements, proclined to erect; base narrow, tapering gently to tip, tip gently bent posteriorly; basal cavity extending to tip; anterior face flat, posterior margin drawn out into prominent costa; cross section roughly triangular. L. Ord. (Symphysirina Z.), N. Am. (Utah-Nev.-Okla.-Texas-Alberta).—Fig. 65, 1. *A. postcostatus, USA (Utah); 1a, lat. view, ×67; 1b, c, post. view of holotype with transv. sec. at base, ×67 (Miller, 1980).


Hertzina Müller, 1959, p. 454 [*H. americana; OD]. Proclined coniform elements, essentially symmetrical, slender; basal cavity deep, extending nearly to tip, cusp very small; posterior face essentially flat, anterior face rounded, carinae on posterolateral edges. Cam., N. Am. (Nev.-N.Y.)-Eu. (Scand.-Ger., glacial erratics)-Asia (China-Sib.-Kazakh.-S. Korea-Turkey).—Fig. 64, 1. *H. americana, U. Cam. (Elvina Z.), USA (Nev.); 1a, b, lat. view, transv. sec., ×80 (Müller, 1959).

Muellerodus Miller, 1980, p. 27, nom. subst. pro Muellerina Szaifianski, 1971, non Bassiouni, 1965, an ostracode [*Distacodtts (?) cambricus Müller, 1959, p. 450; OD]. Proclined to reclined elements, cusp in some bending laterally, tip of cusp in some recurved sigmoidally; base large, basal cavity deep; anterior and posterior edges rounded, lateral faces each with long, prominent costa. M. Cam.-U. Cam., N. Am. (Nev.-N.Y.)-Eu. (Sweden-Pol.-Ger., glacial erratics)-Asia (China-Turkey).—Fig. 64, 3. *M. cambricus (Müller), holotype, U. Cam. (Zone 1), Eu. (Sweden); 3a, b, lat. view, transv. sec., ×60 (Müller, 1959).

Nogamicus Miller, 1980, p. 28 [*Proacodus? sinensis Nogami, 1966, p. 356; OD]. Asymmetrical elements; basal cavity large and deep, cusp, if present, very small; anterior or posterior keel, or both, present, with one or more lateral carinae. M. Cam.-L. Ord., Asia (China-S. Korea-Turkey)-Australia (Queensl.)-N. Am. (N.Y.-Newf.).—Fig. 64, 6. *N. sinensis (Nogami), holotype, U. Cam. (Kushan beds), Asia (China); 6a, b, lat. views, about ×50 (Nogami, 1966).

Proacodus Müller, 1959, p. 458 [*P. obliquus; OD]. Asymmetrical elements with large base and small cusp; basal cavity large and deep; cusp essentially round except for one lateral costa, costa expanding into carina at base. M. Cam.-L. Ord., N. Am. (Nev.-Utah-Wyo.)-Eu. (Sweden-Ger., glacial erratics)-Asia (China-Sib.).—Fig. 64, 4. *P. obliquus, holotype, U. Cam. (Zone 5d), Eu. (Ger.).
Proconodontida—Furnishinacea

Fig. 64. Furnishinidae (p. W112-W114).

4a, post. view, X80; 4b-e, ant. view with transv. secs., X80 (Müller, 1959).

Problematoconites Müller, 1959, p. 471 [*P. perforata; M]. Symmetrical elements, round to oval in cross section; basal cavity large and deep; like Proconeotodus but lower part of base perforated by small circular holes. U.Cam.-L.Ord., N.Am.(Utah-Nev.-Okla.-Wyo.)-Eu.(Sweden-Ger., glacial erratics)-Asia(Iran)-Australia(Queensl.).—Fig. 65,4. *P. perforatus, holotype, U.Cam.(Zone 5d), Eu. (Ger.); lat. view, X54 (Müller, 1959).

Prooneotodus Müller & Nogami, 1971, p. 17
Conodonta

W114

Conodonta

Fig. 65. Furnishinidae (p. W112-W114).

[Oneotodus gallatini Müller, 1959, p. 457; OD]. Symmetrical elements lacking ornamentation; proclined; base usually large and in some expanded posteriorly in lower portion; basal cavity large and deep; cross section round to oval. [Natural assemblages of P. tenuis (Müller), 1959, are unimembrate, consisting of two oppositely curved sets, each of 4 to 5 conform elements. Sets are curved like a pair of parentheses. Tips of elements are all close together at the same end of the assemblage and bases are somewhat spread apart. These assemblages are the basis for the interpretation that all Paraconodontidae are unimembrate.]

M.Cam.-L.Ord., N.Am. (N.Y.-widely spread in W. and SW. states of USA)-Eu. (Pol.-Sweden-Ger., glacial erratics) -Asia (Sib.-Kazakh.-China) -Australia (Queensl.). —Fig. 64, 2a-c. *P. gallatini (Müller), holotype, U.Cam., USA (Wyo.); lat. view with transv. secs. near tip and base, ×60 (Müller, 1959). —Fig. 64, 2d. P. tenuis (Müller). U.Cam. or L.Ord., Eu. (G.Brit.); natural assemblage on black shale, ×27 (Miller, n); for interpretative diagram of 2d with bases of elements spread apart, see Fig. 53, 5.

Proasgittodontus Müller & Nogami, 1971, p. 17 [*Sagittodontus dahlini Müller, 1959, p. 460; OD]. Symmetrical, proclined, elongate, pyramidal elements; cross section triangular due to carinae on posterior and both lateral edges; base occupying nearly entire unit to exclusion of cusp, basal margin in some highly arched between carinae, basal cavity large and deep. U.Cam.-L.Ord., N.Am. (Nev.-Utah-Wyo.-Eu. (Sweden-Ger., glacial erratics)-Asia (China-Kazakh.-Iran)-Australia (Queensl.). —Fig. 65, 2. *P. dahlini (Müller), holotype, U.Cam. (Zone 5d), Eu. (Ger.); 2a-c, lat. and post. views, transv. sec., ×40 (Müller, 1959).

Prosogittodontus Müller & Nogami, 1971, p. 18 [*Scandodus tortilis Müller, 1959, p. 464; OD]. Asymmetrical, proclined to erect elements; base large and greatly expanded posteriorly; cusp well developed, bent, large basal cavity opening to one side; prominent postoralateral carinae on each side of cusp producing broadly triangular cross section. U.Cam., N.Am. (Nev.-Dak.-Eu. (Sweden-Ger., glacial erratics)-Asia (China). —Fig. 64, 5. *P. tortilis (Müller), holotype, Eu. (Ger.); 5a-c, post. and lat. views, transv. sec., ×40 (Müller, 1959).

Protohertzina Missarzhevsky, 1973, p. 54 [*P. anabarica; OD]. Symmetrical, erect, slender, coniform elements with large basal cavity extending nearly to tip of cusp; anterior rounded, posterior with prominent keel, some elements also with postoralateral keels. Uppermost Precam. (Y/Idom.-L. Cam. (Tommot.), Asia (Sib.-Kazakh.). —Fig. 65, 3. *P. anabarica, uppermost Precam., USSR; lat. view, about ×70 (Missarzhevsky, n).

Family WESTERGAARDODINIDAE Müller, 1959

[Westergaardodinidae Müller, 1959, p. 445]

Aberrant paraconodonts with 2 to 5 cusp-like projections of subequal size. Basal cavity continuous from side to side with growth lamellae interrupted on under side or divided into two lateral cavities with growth lamellae continuous around base. M.Cam.-M.Ord.

Westergaardodina Müller, 1959, p. 465 [*W. bicuspis; OD]. Unimembrate elements with 2 or 3 cusp-like projections; middle projection, if present, usually smaller; basal cavity large, in symmetrical forms may be replaced by 2 lateral cavities, or in asymmetrical forms by single lateral cavity. Small spheres associated with type species may belong to same taxon. M.Cam.-M.Ord., N.Am. (N.Y.-widespread in W. and SW. states of USA)-Eu. (Pol.-Sweden-Ger., glacial erratics)-Asia.
Figure 66. Westergaardodinidae (p. W114-W115).

Westergaardodina

Chosonodina


Order CONODONTOPHORIDA

Eichenberg, 1930

[Conodontophorida Eichenberg, 1930, p. 181; =Euconodontida of Benton, 1976] [Diagnosis by Gilbert Klapper]

Elements characterized by lack of exterior layer of dark organic material; element proper and basal plate or funnel mostly apatite; growth lamellae more numerous and more closely spaced than in elements of Paraconodontida; all growth lamellae continuous around tip (including basal plate or funnel); growth pattern from tip upward and outward in element proper and outward and downward in basal plate or funnel; basal plate or funnel present in best preserved material; white matter usually in cusp and denticles, except in elements of Chirognathacea and some Distacodontacea, in these, white matter greatly reduced or missing and basal cavities shallow. Genera represented by uni- or multimembrane apparatuses. U.Cam.-U.Trias.

Superfamily

PROCONODONTACEA

Miller, new

[Materials for this superfamily prepared by J. F. Miller]

Coniform and rare dolabiform elements mostly with at least some white matter; basal cavities ranging from extremely deep to virtually absent. Apparatuses unimembrate or bimembrate, some with symmetry transitions. Sculpture consisting of keels, costae, spines, nodes, and granules. U.Cam.-L.Ord.

Family CLAVOHAMULIDAE

Lindström, 1970

[Clavohamulidae Lindström, 1970, p. 430]

Nongeniculate coniform elements with granulose, nodose, or spinose sculpture. U.Cam.(Corbiniopsis Subzone)-L.Ord.

Clavohamulus Furnish, 1938, p. 326 [*C. densis; OD]. Unusual coniform elements, proclined; basal cavity usually very shallow and in some reduced to flat or convex attachment area; cusp blunt and in some so reduced as to be longer than high; cross section generally round to oval; spine occurring as posterior process in type species, commonly lacking in other species; surface sculpture of fine granular nodules. L.Ord., N.Am.(up. Mississippi River valley-Pa.-widespread in W. and SW. states of USA-Alberta)-Greenl.-Asia(Sib.). —Fig. 67,3. *C. densis, syntype, USA(Minn.); 3a, basal oblique view; 3b, post. oblique view; about ×200 (Miller, n.).
W116

Conodonts

Clavohamulidae (p. W115-W116).

Nericodus LINDSTROM, 1955, p. 570 [*N. capillamentum; M]. Unusual arched coniform elements with surface highly modified by unevenly distributed nodes, in some joining to form irregular ridges. [This genus is known only from a few incomplete specimens.] L.Ord., Eu.(Sweden).—Fig. 67.1. *N. capillamentum; 1ab, ant. and post. views, ×50 (Miller, 1980).

Family CORDYLODODONTIDAE

Lindström, 1970

[nom. transl. MILLER, herein, ex Cordyloodontinae LINDSTROM, 1970, p. 429]

Elements with relatively deep basal cavities; forming probable bimembrate apparatus usually composed of symmetrical elements with rounded edges and asymmetrical elements with sharp edges and a lateral carina. Cusp composed of white matter. Elements either both coniform or both dolabriform. U.Cam.-L.Ord.

Cordyodus PANDER, 1856, p. 33 [*C. angulatus; SD ULRICH & BASSLER, 1926, p. 8]. Inferred bimembrate apparatus of two types of dolabriform ramiform elements; denticles 1 to 5 or more on posterior edge or on posterior process; basal cavity large, moderately deep to shallow, extending beneath posterior process, in some extending into one or more denticles; tip of basal cavity subparallel to sides of cusp or recurved anteriorly. Rounded element symmetrical or nearly so, cusp and denticles round to oval in cross section. Compressed element usually asymmetrical due to lateral bend of cusp and prominent lateral carina, both features lost in some advanced species, such species with symmetrical compressed elements. Cusp and denticles of compressed element strongly compressed laterally, both with sharp edges. Rounded element more distinctive, usually 2 to 3 times as abundant as compressed element; in advanced species, compressed element rare or absent. [The apparatus of the type species probably includes rounded elements described as C. angulatus PANDER and compressed elements described as C. prior LINDSTROM, 1955. Elements described as Pravognathus aequiganus LINDSTROM, 1955, cannot be definitely excluded from the apparatus of the type species. SWEET & BERGSTROM (1972) suggested that the apparatus of C. angulatus includes elements described as C. rotundatus PANDER, but the latter more likely represents the rounded element of a separate species.] U.Cam.(Corbinia apopispis Subzone)-L.Ord., widespread, N.Am.-Eu.-Asia-Australia.—Fig. 68.3. *C. angulatus, L.Ord., USA (Texas); 3a-c, rounded element, lat. view, transv. sec., and shape of basal cavity; 3d-l, compressed element, lat. view, transv. sec., and shape of basal cavity; ×100 (Miller, 1980).

Cambroostodus MILLER, 1980, p. 9 [*Oistodus cambricus MILLER, 1969, p. 431; OD]. Inferred bimembrate apparatus; elements coniform, proclined to erect. Asymmetrical geniculate element distinctive, large to small, asymmetrical due to bending of cusp laterally; basal cavity very deep to shallow; cusp correspondingly short to long, composed of white matter, strongly compressed laterally, with prominent anterior and posterior keels; carina on concave side of base. Symmetrical nongeniculate element not distinctive, apparently not distinguishable from symmetrical element of Eoconodontus. U.Cam.(Trempeal.), N.Am.(Utah-Nev.-Texas-Okl.-Alberta).—Fig. 68.2. *C. cambricus (MILLER), USA (Texas); 2ab, asymmetrical element, lat. view and transv. sec., ×55 (Miller, 1980).

Eoconodontus MILLER, 1980, p. 21 [*Proconodontus nothpeakensis MILLER, 1969, p. 438; M]. Inferred bimembrate apparatus; elements nongeniculate coniform, proclined to erect; basal cavity large and moderately deep to very deep; cusp very short to long and composed of white matter. Asymmetrical element bent laterally with carina on concave side; cusp strongly compressed laterally, anterior and posterior keels prominent. Symmet-
Conodontophorida—Proconodontacea

Family ONEOTODONTIDAE
Miller, new

Nongeniculate coniform elements, proclined to erect, forming apparent multilmembrate apparatuses by symmetry transition. One element lacking costae, other elements with multiple lateral or posterior costae. U.Cam.-L.Ord.

Oneotodus Lindström, 1955, p. 581 [*Distacodus? simplex Furnish, 1938, p. 328; OD]. Nongeniculate coniform elements forming apparent symmetry-transition series. Elements proclined to erect, cusp composed entirely of white matter; basal cavity shallow, triangular, terminating in conical tip, anterior edge of basal cavity close to anterior margin of cusp, anterior margin of cusp smooth, remainder of cusp smooth or bearing multiple low costae beginning above basal margin and extending to near tip; cross section subcircular, elliptoidal, or flattened to recessed posteriorly, depending on presence and distribution of costae. Apparatus consisting of many symmetry variants, ranging from elements with no costae to those with many. [The holotype of O. simplex (Furnish) is noncostate; slightly younger elements, incorrectly identified as Scolopodus corniforhms Branson & Mehl by various authors, possess numerous costae and are believed to be part of this apparatus. Ethington & Brand (1981) recommended restriction of Oneotodus to the type species until restudy of other species in the genus is made. Some of these species are assignable to Prooneotodus Müller & Nogami, 1971 and Teridontus Miller, 1980.] L.Ord., N.Am.—Fig. 69,3. *O. simplex (Furnish), lectotype, USA (Iowa); lat. view, ×250 (Clark, 1980).

Monocostodus Miller, 1980, p. 26 [*Acodus sevierensis Miller, 1969, p. 418; M]. Slender, erect to reclined, coniform elements; cross section round below about bend in cusp; narrow, sharp costa extending from bend in cusp to tip; costa usually on one or the other side, producing dextral and sinistral specimens, but rare symmetrical specimens have posterior costa, forming a symmetry transition. L.Ord. (Symphysura Z.), N.Am. (Utah-Nev.-

Texas-Okl.-Wyo.-Mont.)-Australia (Queensl.).—Fig. 69,4. *M. sevierensis (Miller), USA (Texas); 4a, basal oblique view; 4b-e, lat. view, transv. sec. near midcusp; 4d, shape of basal cavity; about ×95 (Miller, 1980).

Pseudopanderodus Landing, 1979, U.Cam., see addendum.
**Semiacontiodus** Miller, 1969, p. 420 [*Acontiodus (Semiacontiodus) nogamii; OD*]. Erect to rec­lined coniform elements of two types, arranged in symmetry transition. Symmetrical element much less abundant than asymmetrical element; anterior side lacking costae (also lacking on asymmetrical element); somewhat compressed anteroposteriorly; lateral or posterolateral costa on both sides; posterior costa may be present; fine striae on all sides. Asymmetrical element generally round to oval at base, base in some slightly extended posteriorly; lateral costa on one side or the other, resulting in dextral and sinistral forms; groove often present posterior to costa. L.Ord., N.Am. (Mississippian Z.-Symphy­ginia Z.), N.Am. (Utah-Wis.-Texas-Okl.-S.Dak.-Pa.-Alberta)-Asia (Sib.-?China).—Fig. 69,1. *S. nogamii* (Miller), USA (Okl.); 1a-d, symmetrical element, 1a, lat. oblique view, 1b-d, post. view, transv. sec., shape of basal cavity; 1e-g, asymmetrical element, lat. view, transv. sec., shape of basal cavity; X100 (Miller, 1980).

**Utahconus** Miller, 1980, p. 35 [*Paltodus utahensis* Miller, 1969, p. 436; OD]. Inferred bimem­brate apparatus of coniform elements forming symmetry transition; elements proclined, usually bent to one side; basal cavity round and conical, diameter about equal to height; base a prominent cone modified by one or two large costae extend­ing from basal margin to tip of cusp; cusp large and composed of white matter, costate. Unicostate element usually more abundant; usually asym­metrical with right or left lateral costa, rare sym­metrical specimens with posterior costa. Bicostate element usually asymmetrical with lateral and posterolateral costae, rare symmetrical specimens with lateral costa on each side. L.Ord., N.Am. (Pa.-Wis.-widespread in W. and SW. states of USA-Alberta)-Asia (Turkey)-Australia (Queensl.).—Fig. 69,2a-j. *U. utahensis* (Miller), USA (Utah); 2a-c, unicostate element, lat. view, transv. sec., post. view; 2d-f, bicostate element (slightly broken at anterobasal corner), post. view, transv. sec., lat. view; X110 (Miller, 1980).

### Superfamily

**FRYXELLODONTACEA**

**Miller, new**

[Materials for this superfamily prepared by J. F. Miller]
Nongeniculate coniform elements with deep basal cavities, forming multimembrate apparatuses by symmetry transition. White matter present in minor amounts. *L. Ord.*

**Family FRYXELLODONTIDAE**

Miller, new

Diagnosis as for superfamily. *L. Ord.*

**Fryxellodontus** Miller, 1969, p. 426 [*F. inornatus*; OD]. Inferred tri- or quadririmembrate apparatus of unusual coniform elements forming symmetry transition; elements proclined with large, deep, generally compressed basal cavities and little, if any, white matter; posterior edge drawn out into thin flap; small amount of white matter in flap posterior to tip of basal cavity. *Sa* element compressed anteroposteriorly in plane perpendicular to posterior flap; element usually wider than high. *Sb* elements occurring as sinistral and dextral units in about equal numbers; basal cavity compressed in plane forming distinct angle with posterior flap; in some, posterolateral carina corresponding in position with flap. *Sc* (planar) element laterally compressed in same plane with posterior flap. *Sc* (serrate) element like *Sc* but posterior edge of flap serrate, element lacking in one species. *Sh, Scs, Sce* elements generally higher than wide, and may be somewhat twisted. *Sh* elements several times more abundant than *Sa*; *Sc* elements several times more abundant than *Sh*. Upper anterior and lateral faces on all elements may have series of paired ridges. *L. Ord.* (*Mississippi* Z.-*Symphysurina* Z.), *N.Am.* (N.Y.-Mo.-widespread in W. and SW. states of USA-Arctic Can. islands)-*Greenl.-Australia* (*Queensl.).—Fig. 70, *L. * *F. inornatus*, USA (Okla.); *lab, Sc* element, lat. view, transv. sec.; *lc,d, Sc* element, lat. view, transv. sec.; *le,d, Sb* element, post. view (stereopair), transv. sec.; *lg,h, Sa* element, post. view (stereopair), transv. sec.; black area on transv. secs. position of prominent ridge; ×110 (Miller, 1980).
Superfamily PRIONIODONTACEA

Bassler, 1925

Apparatus in most, if not all forms multimembrate, characteristically sexi- or septimembrate, and composed of P, M, and S elements, but variously reduced or modified in some forms; most elements ramiform or pectiniform, multidenticulate, with basal cavity along most of length of processes; white matter abundant in cusps and denticles, only exceptionally (Bergstrømogynathus) missing; many forms with prominent surface microsculpture on lateral and upper surfaces. Ord.-Dev.

Family BALOGNATHIDAE Hass, 1959

Apparatus septimembrate in at least some forms; P element robust, more or less platformlike, with one or several lateral processes and well-developed, wide basal cavity, central rows of denticles on upper surface and characteristic microsculpture laterally (best shown by SEM); M and S elements more delicate than P elements, ramiform, multidenticulate; four main types of S elements form transition series. L.Ord.-Sil. (Llandov.).

Amorphognathus Branson & Mehl, 1933b, p. 126 [*A. ordovicicus; OD]. [Ambalodus Branson & Mehl, 1933b; Bolognathus Rhodes, 1953a; Holodontus Rhodes, 1953a; Keilognathus Rhodes, 1955; Rhizognathus Rhodes, 1955; Goniodontus Ethington, 1959a; Tvaerenognathus Bergström, 1962; ?Tripodontus Knüpper, 1967]. Apparatus septimembrate, with morphologically different left and right elements in P positions. P elements pastiniscaphate, greatly expanded laterally, with simple or bifid lateral processes and wide basal cavity; denticulation of upper surface of all processes restricted to central row without lateral ribs or nodes. Pb elements pastinate with well-developed posterior and lateral processes and short anterior process. M elements tertiopedate with short, weakly denticulate posterior process and longer, denticulate anterior and lateral processes. Sa elements alate with long posterior process and shorter lateral process. Sb elements tertiopedate but otherwise similar to Sa elements. Sc elements bipennate with long, laterally denticulate anterior process. Sd elements quadridamate with long posterior and shorter anterior and lateral processes. In most species, processes of all ramiform elements laterally compressed and narrow basal cavity extending along entire length; denticulation on posterior process of “hindeodelloid” type. [Apparatus reconstruction: Bergström, 1971.] L.Ord., M.Ord.-Sil. (Llandov.), Eu.-N.Am.—Fig. 71.1. *A. ordovicicus, U.Ord.(Maravillas F.), USA (Texas); l,ab, sinistral Pa element, upper and lower views, ×32, ×35; 1c, dextral Pb element, upper view, ×32; 1d,e, sinistral Pb element, ant.-lat. and lower views, ×62; 1f, dextral Pb element, ant.-lat. view, ×62; 1g, M element, lat. view, ×60; 1h, Sc element, lat. view, ×62; 1i, Sa element, lat. view, ×62; 1j, Sb element, lat. view, ×62; 1k, Sd element, lat. view, ×62 (Bergström, n).

Lenodus Sergeeva, 1963, p. 138 [*L. clausus; OD]. Apparatus unknown. Genus based on modified tertiopedate ramiform element with anterior and posterior processes of subequal length and much shorter lateral process; anterior process directed downward, provided with numerous, subequal-sized, confluent denticles, topmost denticle forming short, suberect cusp; posterior process adenticulate; lateral process with upper edge developed into series of nodes; basal cavity deep and wide, occupying under side of processes. [Elements of the type species are basically similar to M elements of Amorphognathus and Rhodosgnathus; however, no elements similar to others in apparatuses of these genera have been reported from the type strata of L. clausus, and it is unlikely that Lenodus is synonymous with either of these genera.] L. Ord.(Arenig.-), Eu.(USSR).—Fig. 71.2. *L. clausus, USSR(Baltic); 3a-c, post-lat. view, lat. views, ×71; 3d,e, post-lat. and lower views, diagr., ×76 (Sergeeva, 1963).

Rhodosgnathus Bergström & Sweet, 1966, p. 392 [*Ambalodus elegans Rhodes, 1953a; OD]. Apparatus probably septimembrate; M and S elements closely similar to, and at present indistinguishable from, those of Amorphognathus. Pa and Pb elements pastinate, lamellar, with short lateral process, large basal cavity beneath processes, and distinct cusp; inner side of posterior process in Pa element may have platformlike flange. [Rhodosgnathus is distinguished from Amorphognathus by its lack of pastiniscaphate elements in Pa position.] M.Ord.-U.Ord., N.Am.-Eu.—Fig. 71.2. *R. sp. cf. R. elegans (Rhodes), M.Ord., Eu. (Sweden); 2a,b, Pa element, lat. views, ×92; 2c,d, Pb element, lat. views, ×92 (Bergström, n).

Family CYRTONIODONTIDAE

Hass, 1959
[nom. transl., Bergström, herein, pro Cyrtoniodontidae Hass, 1959, p. 378]
Apparatus sexi- or septimembrate in most forms, possibly reduced in some genera; $P$ elements carminate, angulate, digyrate, segminate, or pastinate; $M$ elements dolabrate in most forms but in some digyrate or geniculate, coniform; $S$ elements ramiform, multidenticulate, forming transition series from dolabrate to digyrate or tertio-
Fig. 72. Cyrtoniodontidae (p. W124).
pedate to alate elements; basal cavity well developed, extending along most of under side of all elements; denticles closely spaced, at least partly confluent. *Ord.*
Acanthocordylocus Moskalenko, 1973, p. 49 ["A. fidelis; OD]. Apparatus unknown; elements dola­brate with discrete denticles of subequal size on posterior process and long, slender, slightly re­clined cusp, posterior or anterior edge, or both, with series of short but distinct, nodelike denticles. M.Ord.-U.Ord., Asia(Sib.).—Fig. 72.2. *A. fidelis, U.Ord.(Dolborsky F.); lat. view, ×65 (Moskalenko, 1973).

Aphelognathus Branson, Mehl, & Branson, 1951, p. 9 ["A. grandis; OD]. Apparatus probably septimembrate, including lamellar elements. Pa elements angulate, in some species with distinct gap in denticle row immediately anterior to subcentral cusp; denticles robust, confluent along most of length; basal cavity flaring laterally, particularly large beneath cusp, but extending along entire under side of element. Pb elements psammate in some species, bipennate in others, with denticles similar to those in Pa element. M elements dolabrate with laterally flaring base; bipennate in some species. S elements forming transition series from alate through digyrate to dolabrate or bipennate in some species, bipennate in others, with denticles disposed under side of element. Apparatus reconstruction: SWEET, 1966; STAUFFER, 1935a, both beetles; Bergström, 1955.

Microzarkodina Lindström, 1971, p. 57 [*Priomiodina flagellitum Lindström, 1955; OD]. Apparatus seximembrate, composed of lamellar elements. P elements carminate to segmentate, with prominent cusp and relatively few denticles, especially on the short anterior process. M elements genulate, conform, with base extended posteriorly. S elements with long, slender cusp, relatively discrete denticles, and shallow basal cavity. Sa elements alate, without posterior process. Sb elements digyrate. Sc elements dolabrate. Sd elements quadriramate, with poorly developed anterior and lateral processes. [Apparatus reconstruction: Lindström, 1971.] L.Ord.-M.Ord., Eu.-N. Am.—Fig. 73.1. *M. flagellitum (Lindström), L.Ord.(low. Arenig.), Eu.(Sweden): 1a, P element, lat. view; 1b, M element, lat. view; 1c, digyrate Sb element, post-lat. view; 1d, alate Sa element, post. view; 1e, dolabrate Sc element, lat. view; all ×70 (Van Wamel, 1974).

Plectodina Stauffer, 1935a, p. 152 [*Priomiodius aculeatus Stauffer, 1930, p. 126; OD = Plecto­dina dilata Stauffer, 1935a] [=Trichonella Branson & Mehl, 1948, nom. subst. pro Tricho­gnathus Branson & Mehl, 1933a, nom. GEMMIGER & HAROLD, 1868 nec BERTHOLD, 1927, both beetles; Eoligonodina Branson, Mehl, & Branson, 1951; ?Zygognathus Branson, Mehl, & Branson, 1951]. Apparatus basically seximembrate, elements lamellar. P elements carminate to angulate or psammate with laterally partly confluent denticles; in some species, Pa elements with short lateral process or costa; M elements dolabrate or digyrate, with basal cavity wall flaring laterally; S elements forming symmetry transition series from dolabrate or bipennate through digyrate to alate elements; cusp of S elements long, slender; denticles shorter than cusp, discrete along part of length, of relatively uniform size; basal cavity shallow and narrow in all elements, extending along entire processes. [Apparatus reconstruction: Bergström & Sweet, 1966; Sweet & Bergström, 1972.] M.Ord.-U.Ord., N. Am.-Eu.-Australia-Asia(Sib.).—Fig. 72.3. Plecto­dina sp., U.Ord.(Cobourg F.), Can.(Ont.): 3a, Pa element, lat. view; 3b, Pb element, lat. view; 3c, M element, lat. view; 3d, Sc element, lat. view; 3e, Sb element, lat. view; 3f, Sa element, post. view; ×55 (Bergström, n).

Scyphiodus Stauffer, 1935b, p. 617 [*S. primus; OD]. Apparatus unknown, may be unimembrate; genus based on lamellar, anguloplane elements with platformlike anterior process bearing 3 rows of denticles and relatively short, subcentral, re­clined cusp. Posterior process blade-like with single row of laterally compressed denticles. Basal cavity pitlike beneath cusp, rather deep and wide beneath anterior process, groovelike beneath posterior.

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process. [As noted by Weebers (1966, p. 46), elements of Scyphiodus show, apart from development of the platynosphate anterior process, close similarity to angulate elements described as Byr­

stantodina maxima Stauffer, 1935a. Scyphiodus is probably more closely related to Byr­

stantodina, Plectodina, and Phragmodus than to other Middle and Upper Ordovician genera with plattynop­

tiform elements.] M.Ord., N.Am.(W. mid­

continent).—FIG. 73,3. *S. primus, (Plateville F., USA(Minn.); 3a-c, lat., lower, and upper views, X102 (Bergström, n).

Family ICRIODONTIDAE

Müller & Müller, 1957


Essentially trineminate apparatus char­

acterized by scaphe Pa elements. Pb and S elements are simple cones or modifications thereof. Apparatus of Ordovician species probably pentamembrate. M.Ord.-Sil.(Llan­

dov.), Sil.(Ludlov.-U.Dev.)(Famenn.).

Icriodus Branson & Mehl, 1938, p. 159 [*I. ex­
pansus; OD; for discussion of validation of Icriodus and type species, see Ziegler, 1975, p. 68

[=Acodina Stauffer, 1940, p. 418; Lateri­

criodus Müller, 1962a, p. 114; Caudicriod­

ulynck, 1976, p. 19; Pracaudicriodulynck, 1976, p. 40]. Main process of Pa element character­

istically consisting of three longitudinal rows of nodes but including forms with transverse ridges; denticulate lateral processes developed near pos­

terior end in some. Pb element nongeniculate, laterally compressed coniform element with sharp an­


tralia.—Fig. 74,ab. *I. expansus, disputed M.Dev.-U.Dev. boundary interval (Schmidt­

ognathus hermanni-Polygonathus cristas(Z, Rapid Mbr., Cedar Valley Ls.), USA(Iowa); Pa element, upper and lower views, X37 (Klapper, n)—

Fig. 74,4c-e. 1. steinachensis Al-Rawi, L.Dev. (McMon­

nial Ls.), USA(Nev.); 4c, Pa element, upper view; 4d,e, Pb element, inner lat. and outer lat. views, X37 (Klapper & Philip, 1971). Antognathus Ljungberg in KOZITSKAYA et al., 1978, U.Dev., see addendum.

Icriodella Rhodes, 1953a, p. 285 [*I. superba; OD]

[=Rhynchosognathus Ethington, 1959b, p. 1128, nom. subst. pro Rhynchosognathus Ethington, 1959a, p. 286, non Jaekel, 1929, a fish; Sagito­
dontus Rhodes, 1953a]. Apparatus probably pent­

membrane, including lamellar elements. Pa ele­

ments pastinoscaphate with long anterior pro­

cess bearing double row of denticles, short cusp, short adenticulate lateral process, and bladelike posterior process with one row of confluent denticles. Pb ele­

ments tri­

torted, more or less pyramidal, with short cusp and adenticulate or weakly denticulate pro­

cesses. S elements bipennate or dolabrate, flar­

ing laterally, with adenticulate posterior process and weakly denticulate anterior process. S elements tertiopedate, subpyramidal; of two types, one with 3 denticulate processes, the other similar but with ant­

erior process adenticulate. Basal cavity large in all elements, especially in P elements. M.Ord.-

Sil.(Llandover.), N.Am.-Eu.—Fig. 74,l. *I. su­

perba. M.Ord.(Lexington Ls.), USA(Ky.); la-c, Pa element, lat., upper, lower views, X33; 1d,e, M element, lat. views, X82; 1f-g, Pb element, upper and lower views, X26; lk, S element with 2 denticulate processes, lat. view, X47; 1ij, S element with 3 denticulate processes, lat. and post­

uper views, X47 (Bergström & Sweet, 1966).

Pedavis Klapper & Philip, 1971, p. 446 [*Icriodus pedavis Bischoff & San­

nemann, 1958, p. 96; OD]. Main process of Pa element like that of Icriodus but additionally with two anteriorly di­

rected lateral processes and a posterior process. Pb element as in Icriodella but denticulation on processes much better developed. S elements strongly costate cones that may develop 1 or 2 accessory posterior denticles. [Reconstruction: Klapper & Philip, 1971.] Sil.(Ludlov.—U.Dev.), Eu.-Asia-N.Am.-Australia.—Fig. 74,3. *P. pe­
savis (Bischoff & Sannemann). L.Dev.(McMon­
nial Ls.), USA(Nev.); 3a, Pa element, upper view; 3b, S element, lat. view; 3c, Pb element, lat. view; X37 (Klapper & Philip, 1971).

Pelekysgnathus Thomas, 1949, p. 424 [*P. incli­
nata; OD] [=Drepanodina Mound, 1968, p. 480]. Pa element like that of Icriodus but main process characteristically with only a single longitudinal row of nodes. Pb element nongeniculate, laterally compressed coniform element with sharp an­

terior and posterior keels. S elements varying from smooth to costate, unkeeled simple cones of circular to elliptical cross section. [Reconstruc­tion: Klapper & Philip, 1972.] Sil. (Pridol.).-U.Dev.(Famenn.), Eu.-N.Am.-Australia.—Fig. 74,2. *P. inclinatus, U.Dev. (Scaphi­
gnathus subserratus-Pelekysgnathus inclinatus Faun­na, Maple Mill Sh.), USA(Iowa); 2a, Pa element, lat. view; 2b, Pb element, lat. view; 2c, S element, lat. view; X37 (2a, Klapper, n; 2b,c, Klapper & Philip, 1972).


Family OEPIKODONTIDAE

Bergström, new

Apparatus basically trineminate, consisting of lamellar pastinate and modified
FIG. 74. Icriodontidae (p. W125).
Fig. 75. Oepikodontidae, Paracordylodontidae, Phragmodontidae (p. W128-W129).
quadriramate, denticulate, ramiform elements and geniculate, adenticulate, coniform elements. Pastinate elements with well-developed, laterally compressed cusp, diverging downward from cusp one anterior and one posterior process and a lateral process, lateral process in some twisted posteriorly; all processes, or at least the posterior one, with denticles confluent along at least part of their length. Quadriramate elements with slender cusp, long adenticulate anterior process, long, laterally compressed multidenticulate posterior process, and rudimentary, adenticulate lateral processes. Basal cavity in both ramiform elements narrow but extending along entire length of processes. Geniculate element with rather long, reclined cusp and long base considerably extended anteriorly and posteriorly, base in some flaring slightly toward one side; basal cavity small, developed as subapical central pit, narrow and shallow grooves extending from pit along most of base. L. Ord., ?M.Ord.

**Oepikodus** Lindström, 1955, p. 570 [*O. smithensis*; OD]. Diagnosis as for family. [Oepikodus is similar to Prionodus, but is distinguished by the presence of only two basic types of ramiform elements.] L.Ord., ?M.Ord., Eu.-N.Am.-S.Am.-Australia-Asia(China).—Fig. 75.1. *O. smithensis*. L.Ord.(Dulcicardius Z.). Eu.(Sweden); 1a,b, pastinate element, lat. views; 1cd, geniculate element, lat. views; 1e, quadriramate element, lat. view; ×50 (Bergström, n).

**Family PARACORDYLODONTIDAE**

**Bergström, new**

Apparatus probably bimembrate but may contain additional elements; elements lamellar, strongly laterally compressed, geniculate and dolabrate with recurved carinate cusp. Geniculate elements with arched, anteroposteriorly extended base. Dolabrate elements with adenticulate anterior process directed posteriorly and downward and with an essentially straight denticulate posterior process of similar length as anterior process; denticles reclined, strongly laterally compressed, discrete, highest at midlength of process. Basal cavity shallow and small in both types of elements. Cusp, denticles, and anterior process with conspicuous microstriae. L.Ord.

**Paracordylodus** Lindström, 1955, p. 584 [*P. gracilis*; OD]. Diagnosis as for family. [Van Wamell (1974) proposed that the apparatus of Paracordylodus gracilis includes an additional element, but study of available collections of that species from Europe and North and South America has not yet confirmed the correctness of that view. Apparatus reconstruction: Bergström, Epstein, & Epstein, 1972; Sweet & Bergström, 1972.] L.Ord., Eu.-N.Am.-S.Am.—Fig. 75.2. *P. gracilis*, USA (Pa.); 2a, dolabrate element; 2b, geniculate element; ×100 (Bergström, Epstein, & Epstein, 1972).

**Family PERIODONTIDAE**

**Lindström, 1970**

[Periodontidae Lindström, 1970, p. 435]

Apparatus multimembrate, in at least some forms septimembrate; similar to that of representatives of Phragmodontidae but with different type of P elements and most of S elements in transition series having short denticulate processes, rather than adenticulate anterior costae. Ord.

**Periodon** Hadding, 1913, p. 33 [*P. aculeatus*; M] [=Loxognathus Graves & Ellison, 1941; Falodotus Lindström, 1955]. Apparatus multimembrate, composed of lamellar elements. P elements of two types; one angulate to bipennate, the other digrate with posterior process strongly twisted out of plane of anterior process; both types with distinct cusp, multidenticulate processes, and basal cavity extending along entire length of processes. M elements geniculate, coniform, with anteriorly denticulate cusp and posteriorly extended base. S elements forming transition series from dolabrate through bipennate and tertiopedate to alate elements. All S elements with long, denticulate posterior process and basal cavity with prominent zone of recessive basal margin a short distance behind cusp. Denticles of variable size, laterally compressed, more or less confluent; those on posterior process a short distance behind cusp may rival cusp in size. Ord., Eu.-N.Am.-S.Am.-Australia(N.Z.).—Fig. 76.1. *P. grandis* (Ethington), M.Ord.(Prosser F.), USA(Minn.); 1ac, two types of P elements, lat. views, ×61; 1b, M element, lat. view, ×61; 1d-f, three types of S elements, lat. views, ×77, ×102, ×110 (Bergström, n).

**Hamarodus** Viira, 1975, p. 87 [*Distomodus europaeus Serpacci, 1967, p. 64; OD*]. Apparatus type unknown; described elements basically non-geniculate, laterally compressed, lamellar, coniform with proclined to suberect cusp and wide, more
or less triangular base, base flaring toward one side. In some, both anterior and posterior edges of base with small number of short denticles. Basal cavity deep, extending in some elements halfway to tip of cusp. [Hamarodus elements exhibit similarity to those of Distomodus; however, it seems unlikely that these genera are closely related.] U.Ord., Eu.(Baltoscandia-Italy-Eng.-Nor.)-?Asia(Sib.)—Fig. 77, J. *H. europaeans* (Serpagli), Slandron Ls., Eu.(Sweden); 1a, b, lat. views, same specimen, about ×100 (Bergström, n).

**Family PHRAGMODONTIDAE**

Bergström, new

Apparatus unknown in type species of *Phragmodus*, in others septimembrate. P elements pastinate, or angulate and pastinate, with distinct cusp and multidenticulate anterior and posterior processes and lateral process, if present, adenticulate or weakly denticulate. M elements geniculate, coniform or dolabriform, with well-developed cusp and base flaring laterally. S elements superficially similar to each other but forming transition series, expressed in disposition of adenticulate costae on cusp, from dolabriform through tertiopeolate and alate to quadrate units; each of these elements with long, multidenticulate, in some species sinuous posterior process and shallow basal cavity extending along entire length of processes. M.Ord.-U.Ord.

**Phragmodus** Branson & Mehl, 1933b, p. 98 [*P. primus*; OD] [*=Dichognathus Branson & Mehl, 1933a; *Cytoniodus Stauffer, 1935a; *?Subcordyloides Stauffer, 1935a*]. Diagnosis as for family. M.Ord.-U.Ord., N.Am.-Eu.-Asia-Australia.—Fig. 75.3. *P. undatus* Branson & Mehl, M.Ord.(Lexington Ls.), USA(Ky.); 3a, S element, lat. view; 3b, c, two types of P element, lat. views; 3d, M element, lat. view; ×73 (Bergström, n).

**Family POLYPLACOGNATHIDAE**

Bergström, new

Apparatus apparently reduced to bimembrate type by loss of S and M elements; P elements stelliplanate and pastiplanate, lamellar, with well-developed platforms; basal cavity restricted to central narrow groove on under side of processes. L.Ord.-M.Ord.

**Polyplacognathus** Stauffer, 1935b, p. 615 [*P. ramosus*; OD] [*=Petalognathus Drygant, 1974, non Duméril & Bibron, 1854, a reptile*]. Apparatus composed of paired elements; stelliplanate

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Conodonta

Fig. 77. Periodontidae (p. W128-W129).

elements with one anterior, one posterior, and four lateral processes; pastiniplanate elements crudely Y-shaped with subcentral cusp and one anterior, one posterior, and one lateral process; all elements with central denticle row and abundant nodes, ridges, and small denticles scattered over entire upper surface of processes. [For distinguishing characters between Polyplacognathus and Eoplacognathus see latter genus. Polyplacognathus is separated from Amorphognathus by lack of ramiform elements in the apparatus and by different types of basal cavity, denticulation, and process arrangement. Apparatus reconstruction: Bergström & Sweet, 1966; Schopf, 1966; Weber, 1966.] M.Ord., N.Am.-Eu.-Asia(Sib.).—Fig. 78, 1. *P. ramosus, Platteville F., USA (Minn.); 1a,c, stelliplanate element, upper, lower views; 1b, pastiniplanate element, upper view; ×45 (Bergström, n).

Eoplacognathus Hamar, 1966, p. 52 [*Ambalodrils lindstroemi Hamar, 1964, p. 258; OD] [=Prio-
morphognathus Knüpper, 1967]. Apparatus composed of Pa and Pb elements but left and right elements in each pair not mirror images, morphologically distinct. Pa elements stelliplanate with an anterior process, in some bladelike, a posterior process, and 2 to 3 lateral processes, one lateral process bifid in some. Pb elements pastiniplanate, Y-shaped, with long anterior process bladelike in some distally, short posterior process forming angle with anterior process, and short lateral process de-

Fig. 78. Polyplacognathidae (p. W129-W131).

Fig. 79. Polyplacognathidae (p. W130-W131).
parting from point of junction between anterior and posterior processes, some elements with short cusp at this junction. Single row of relatively low denticles centrally located on each process of all elements; no additional denticle rows or nodes present laterally. (Elements of *Eoplacognathus* are distinguished from corresponding ones in *Polyplacognathus*, with which they have been confused frequently, by their lack of accessory denticulation lateral to the central denticle rows and by process configuration; further, right and left elements in each pair in *Polyplacognathus* are near mirror images and not different as in *Eoplacognathus*.

Family PRIONIODONTIDAE
Bassler, 1925

[=Haddingodus LINDSTROM, 1955; OD] [=Trapezognathus LINDSTROM, 1955; Od] Ap­P. elegans; P. elegans, P. Gothodus ex­P. laclegans, S elements forming transition series from
cyes denticulate above anterobasal corner; 3 denticulate
Messes; 3 denticulate through tertiopedate and alate
L.Ord.-M.Ord.

Prioniodus PANDER, 1856, p. 29 [*P. elegans; SD

P. (Prioniodus) PANDER, 1856, p. 29 [=Belodus
PANDER, 1856; Gothodus LINDSTRÖM, 1955; Tetraptioniodus LINDSTRÖM, 1955]. Apparatus
seximembrate with only one type of P element.
Basa1 cavity narrow, shallow, but extending along
entire length of all processes. M and Sc elements
with distinctly denticulate anterior process. Precise
phylogenetic relations between the various
forms here included in Prioniodus are poorly
known and the genus may possibly not be a
sound taxonomic unit; however, because transi­
tional forms between Prioniodus (Baltoniodus)
and P. (Prioniodus) have been reported, it ap­
pears justified to group these forms pending
further study. Apparatus reconstruction: BERG­
Am.-S.Am.-Australia.—Fig. 80.1. *P. elegans,
L.Ord.(Didymograpthus balticus Subzone), Eu.
(Sweden); 1a, P element, ant.-lat. view; 1b,c, M
element, lat. views; 1d,e, bipeninate S element, lat.
views; 1f,g, quadripartate element, lat. views; ×50 (Bergström, n).

P. (Baltoniodus) LINDSTRÖM, 1971, p. 55 [*Pri­
ioniodus navis LINDSTRÖM, 1955, p. 590; OD]
[?==Trapecognathus LINDSTRÖM, 1955; Volcho­
dina SERGEEVA, 1974]. Apparatus in most spe­
cies septimembrate, including two types of P
elements; one with inner side of posterior process
expanded laterally, forming wide basal cavity;
the other with small basal cavity; basal cavity
in all ramiform elements relatively deep and
wide. M and Sc elements with weakly, if at all,
denticulate anterior process. [Apparatus recon­
struction: BERGSTROM, 1971; LINDSTRÖM, 1971.]
L.Ord.-M.Ord., Eu.-N.Am.-S.Am.-Australia.—
Fig. 80.2. P. (Baltoniodus) variabilis BERGSTROM,
M.Ord.(Dalby Ls.), Eu.(Sweden); Pb element,
lat. view, ×45 (Bergström, n).

Family PYGODONTIDAE
Bergström, new

Apparatus bimembrate (may possibly be
tetramembrate, see below), composed of
modified tertiopedate and stelliscaphate, la­
mellar elements. Tertiopedate elements with
short central cusp, well-developed anterior
and posterior processes, and short, laterally
directed, adenticulate or weakly denticulate,
lateral process; denticles of subequal size,
reclined, laterally compressed, confluent
along most of their length; basal cavity
large and deep, extending over entire under
side of processes. Stelliscaphate elements
triangular in outline, flat to arched, with
short cusp at posterior corner of unit, 3 to
4 rows of low, equal-sized denticles with
characteristic surface microsculpture diverg­
ing from cusp, two of these rows lateral,
forming margins of element, other rows
central; whole under side of element occu­
pied by wide but shallow basal cavity, in
some with basal funnel. M.Ord.

Pygodus LAMONT & LINDSTRÖM, 1957, p. 67 [*P.
anterius; OD] [*Haddingodus SWEET & BERG­
STRÖM, 1962]. Diagnosis as for family. [Asso­
ciated as a rule with the tertiopedate and stelli­
scaphate elements of several species of Pygodus,
but always in much lower numbers, are elements
originally described as Tetraptioniodus lindstroemi
and Hibbardella pyramidalis by SWEET & BERG­
STRÖM (1962). They have some characters in
common with the Pygodus elements, but their
low frequency is difficult to explain if they are
a part of the Pygodus apparatus. Apparatus re­
N.Am.-Asia(China)-Australia.—Fig. 80.3. *P.
anterius, Dalby Ls., Eu.(Sweden); 3a,b, stelli­
scape element, upper and lower views; 3c,d,
tertiopedate element, lat. views; ×40 (Berg­
ström, n).

Family RHIPIDOGNATHIDAE
Lindström, 1970

[Rhipidognathidae LINDSTRÖM, 1970, p. 432]

Apparatus multimembrate, in some forms
trimembrate, in others with up to seven
types of elements; P? elements in most
forms multidenticate, carminate, angulate,
or segminate; S elements ramiform or modi­
fied ramiform, forming transition series that,
when complete, includes four types of alate,
Fig. 81. Rhipidognathidae (p. W134-W135).
digyrates, and dolabrates but may be reduced to include only two types of alate and angulate, dolabrates, digyrates, or modified tertiopedate elements. L.Ord.-Sil. (Wenlock.).

Rhipidognathus Branson, Mehl, & Branson, 1951, p. 10 [*R. symmetria; OD]. Apparatus trimembrate, including alate and two types of angulate elements. Alate elements bilaterally symmetrical to slightly asymmetrical, anteroposteriorly compressed, convex anteriorly and concave posteriorly, without posterior process but with anterobasal boss. One type of angulate elements arched to almost straight, slightly bowed; other type distinctly arched and bowed; both types with stout cusp. All elements with numerous subequal denticles along upper margins of processes; in some forms denticles laterally compressed and partially confluent laterally; in others denticles rounded and discrete. Basal cavity developed as subapical pit and shallow grooves along processes. [Apparatus reconstruction: Bergström & Sweet, 1966.]

M.Ord.-U.Ord., N.Am.—Fig. 81,3. R. discetus Bergström & Sweet, M.Ord.(Catheys F.), USA (Tenn.); 3a–d, alate element, ant., post. views; 3e–f, two types of angulate elements, lat. views; ×31 (Bergström & Sweet, 1966).

Appalachignathus Bergström & others, 1974, p. 227 [*A. delicatulus; OD]. Apparatus apparently septimembrate; Pa elements long, segminate, laterally compressed, with numerous subequal-sized denticles and slitlike basal cavity, cavity conspicuously expanded at posterior end. Pb elements long, bowed, angulate, with numerous subequal-sized denticles and slitlike basal cavity. M? elements laterally compressed, with one convex and one concave side and short cusp flanked by several confluent denticles. S elements of four types forming transition series from alate through digyrate to modified dolabrare, all with more or less confluent denticles, cusp, and relatively narrow basal cavity. [Similar in some respects to Bergstroemognathus, Appalachignathus is distinguished by being clearly lamellar, by having Pb elements, and by the appearance of denticulation in the ramiform elements. Further, available collections suggest that Bergstroemognathus had fewer types of elements in the apparatus than Appalachignathus (see Serpagli, 1974). Apparatus reconstruction: Bergström & others, 1974.] M.Ord., N.Am.—Fig. 82,1. *A. delicatulus, USA; 1a–b, Pa element, lat. and lower views; 1c–d, Pb element, lat. and lower views; 1e–j, three S elements each in post. and lat. views, forming transition series; ×23 (Bergström & others, 1974).

Bergstroemognathus Serpalli, 1974, p. 39 [*Oistodus externus Graves & Ellison, 1941, p. 13; OD]. Apparatus apparently trimembrate, consisting of alate, segminate, and tertiopedate hyaline elements. Alate elements with very short, indistinct, adenticulate posterior process, nearly bilaterally symmetrical, with multidenticulate lateral processes and basal cavity developed as subapical pit beneath cusp and narrow, shallow grooves along processes. Segminate elements basically conform, geniculate, with long denticulate anterior process and reclined posterior cusp; basal cavity relatively wide beneath cusp but developed as shallow, narrow groove along entire anterior process. Tertiopedate elements asymmetrical to nearly symmetrical with prominent cusp, short denticulate or adenticulate posterior process, and short denticulate anterolateral process. Denticles of all elements laterally compressed and more or less confluent, without white matter. [For differences between Bergstroemognathus and Appalachignathus, see Appalachignathus. Apparatus reconstruction: Serpalli, 1974.] L.Ord., N.Am.(N.Y. Texas-Pa.-Newf.)-S.Am.(Arg.).—Fig. 82,2. *B.
Conodonts of the family Phorida-Prioniodontacea

Carniodus Walliser, 1964, p. 30 [C. carnulus; OD]

Pa element characterized by short, slightly arched, compressed blade with prominent central cusp; short, denticulate lateral process extending from cusp in some. Pb element with arched, thick blade, small central cusp, and well-developed, narrow, marginal ledges. M element with low cusp, short, weakly denticulate anticusp, and short posterior process. S symmetry-transition elements characterized by high, slender cusp and long, arched posterior process bearing compressed denticles and secondary cusp generally developed at mid-length. [Reconstruction: Walliser, 1964; Barrick & Klapper, 1976.]

Sil.(Llandov.-low.Wenlock), Eu.-N.Am.-Eu.-Asia(Sib.)-Australia.--Fig. 81, 2. *C. carnulus, up. Llandov.-low.Wenlock. (Pterospathodus amorphognathoides Z., Clarita F.), USA(Okla.); 2a, Pb element, lat. view; 2b, Pa element, lat. view; 2c, M element, lat. view; 2d, Sc element, lat. view; 2e, Sb element, lat. view; 2f, Sa element, post. view; X36 (Barrick & Klapper, 1976).

Histiodella Harris, 1962, p. 207 [H. altifrons; OD]

Apparatus in at least some species tetramembrate, including carminate, modified alate, and digyrate lamellar elements. Carminate elements strongly compressed laterally, in some species subtriangular in lateral view, with straight basal margin and shallow basal cavity extending along most of under side; upper margin smooth, serrated, or developed into series of laterally confluent denticles. Alate and digyrate elements forming transition series; these elements conspicuously compressed anteroposteriorly, lacking posterior process but with winglike lateral processes that may have small serrations or short, confluent denticles; basal cavity shallow and narrow, developed mainly as subapical pit. [Reconstruction of apparatus by McHargue (1974) includes a geniculate element; however, such an element is missing in some large collections of Histiodella and is not included in the apparatus herein.] L.Ord.-M.Ord., N.Am.-Eu.-Asia(Sib.)-Australia.—Fig. 81, 1. *H. altifrons, M.Ord.(Joins F.), USA(Okla.); 1a, carminate element, lat. view; 1b, alate element, post. view; 1c, modified digyrate element, post. view; X123 (Bergström, n).

Family PTEROSPATHODONTIDAE

Cooper, 1977

[PTerospathodontidae Cooper, 1977, p. 102] [Materials for this family prepared by Gilbert Klapper]

Apparatus at least bimembrate; Pa element either pastiniscaphate or carminipla-
process not well developed, or carminiscaphate with offset lateral lobes at midlength. Pb element either anguliplanate with narrow platform ledges and downward projecting apical lips or angulate with offset lobes of basal cavity. [Reconstruction: WALLISER, 1964; BARRICK & KLAPPER, 1976.]


Aulacognathus MOSTLER, 1967, p. 300 [*A. kuehni; OD] [=NeospatilOdus NICOLL & REXROAD, 1969, p. 42]. Pastiniscaphate Pa element like that of Astropentagnathus, but Pb element with prominent cusp and processes on both sides, unlike that of Astropentagnathus. [Reconstruction tentatively indicated by KLAPPER & MURPHY, 1975, p. 24-25; Aulacognathus ceratoides (NICOLL & REXROAD) is the probable Pb element.] Sil.(Llandow.), Eu.-N.Am.—Fig. 83,4. *A. kuehni, PlerospatilOdus celloni Z.(Roberts Mts. F.), USA(Nev.); Pa element, upper view, x27 (Klapper & Murphy, 1975).


Polygnathoides BRANSON & MEHL, 1933a, p. 50 [*P. siluricus; OD]. Pa element carminiplanate with short secondary keels extending from transversely extended pit. Pb element anguliplanate with well-developed platform on inner side and prominent cusp. [Reconstruction: COOPER, 1974b, p. 187, text-fig. 8D.] Sil.(Llandow.), Eu.-N.Am.-Australia. —Fig. 83,2. *P. siluricus, P. siluricus Z.(Roberts Mts. F.), USA(Nev.); 2a,b, Pa element, lower and upper views, x27 (Klapper & Murphy, 1975).
Family DISTOMODONTIDAE
Klapper, new

[Materials for this family prepared by Gilbert Klapper]

Apparatus characteristically seximembrate; Pa element scaphate with 4 to 6 processes centrally joined; Pb element with large cusp, large basal cavity, and expanded base that may develop into platform; dolabriform M element and S symmetry-transition series with large cusp, large cavity, and discrete denticles. Sil. (Llandov.-low.Wenlock.).

DISTOMODONTIDAE

Distomodus Branson & Branson, 1947, p. 553 [*D. kentuckyensis; OD] [Hadrognathus Walliser, 1964, p. 35; Exoc!lOgnathlllls POLLOCK, REXROAD, & NICOLL, 1970, p. 751]. Pa element either with 4 processes joined in cross or 5 to 6 radiating processes; Pb element with anterior process on expanded base, or 3 to 4 processes in elements with platform. [Reconstruction: COOPER, 1974b; BARRICK & KLAPPER, 1976.] Sil. (Llandov.-low.Wenlock.), Eu.-Asia-N.Am.—Fig. 84.1. D. staurognathoides (Walliser), up.Llandov.-low.Wenlock. (Pterospathodus amorphognathoides Z., Clarita F.), USA (Okla.); 1a,b, Pb element, oblique ant.-lat. and post. views; 1c, M element, lat. view; 1d, Sc element, lat. view; 1e,f, Pa element, upper and lower views; 1g, Sa element, post. view; 1h, Sb element, post. view; ×27 (Barrick & Klapper, 1976).

Superfamily CHIROGNATHACEA
Branson & Mehl, 1944

[nom. transl. Linström, 1970, p. 431, ex Chirognathidae BRANSON & MEHL, 1944, p. 237] [Materials for this superfamily prepared by S. M. Bergström]

White matter greatly reduced or absent; basal cavity very shallow, in many forms developed only as flat surface; elements mostly ramiform, commonly forming transition series; denticles discrete or free along most of element. Ord.

Family CHIROGNATHIDAE
Branson & Mehl, 1944

[Chirognathidae BRANSON & MEHL, 1944, p. 237]

Elements more or less palmate, without prominent cusp, apparently forming simple transition series. M.Ord.

Chirognathus Branson & Mehl, 1933a, p. 28 [*C. duodactyla; OD]. Apparatus unknown but probably multimembrate. Elements fibrous (hyaline), palmate, in some more or less angulate, with shallow basal cavity; denticles few, of varying length, discrete along most of element, with more or less rounded cross section. M.Ord., N.Am.-Eu.-Asia. —Fig. 85,2a,b. *C. duodactylus, Harding Ss., USA (Colo.); ant. and post. views, ×27 (Branson & Mehl, 1933).—Fig. 85,2c,d. C. delicatulus Stauffer, Glenwood Sh., USA (Minn.); lat. and post. views, ×68 (Bergström, n).

Leptochoirognathus Branson & Mehl, 1943, p. 377 [*L. quadriata; OD]. Apparatus unknown; genus
Family MULTIOISTODONTIDAE
Bergström, new

Elements of variable shape, with cusp considerably larger than denticles; apparatus relatively complex, in at least some forms septimembrate with P, M, and S elements. Ord.

Multioistodus Cullison, 1938, p. 226 [*M. subdentatus; OD] [=Trirhadicodus Harris, 1964; Dirhadiodus HARRIS, 1964; Neomultioistodus HARRIS & HARRIS, 1965; Tricladidodus MOUND, 1965a]. Apparatus similar to that of Eoneoprioniodus but elements with single, prominent denticle at basal end of each lateral costa as well as on short posterior process. M.Ord., N.Am.—Fig. 86,1. *M. subdentatus; Dutchtown F., USA(Mo.); 1a,b, alate element, lat. and post. views, ×52; 1c, dolabriform element, lat. view, ×52 (Lindström, 1964).

Acanthodina Moskalenko, 1973, p. 52 [*A. nobilis; OD]. Apparatus unknown; elements similar to those of Ptiloconus but posterior edge of cusp has series of small denticles. U.Ord., Asia(Sib.).—Fig. 87,2. *A. nobilis, USSR(Ketsy F.); post-lat. view, ×31 (Moskalenko, 1973).

Eofalodus Harris, 1962, p. 204 [*E. brevis; OD]. Apparatus unknown; genus based on geniculate, coniform, mostly hyaline elements with anteroposteriorly extended, laterally flaring base, reclined to recurved cusp with single denticle at anterobasal corner, and relatively shallow, in lateral view subtriangular, basal cavity. [As noted by Harris (1962, p. 205), elements of Eofalodus show similarity to those of Falodus and Ostiodus, but it is unlikely that Eofalodus is closely related to either of these genera. As suggested by McHargue (1974), it is probably more closely related to Scandodus and Eoneoprioniodus.] M.Ord., N.Am. (Okla.).—Fig. 87,1. *E. brevis, Joints F., USA (Okla.); 1a,d, lat. views; 1b,e, upper and lower views; ×38 (Harris, 1962).

Eoneoprioniodus MOUND, 1965b, p. 195 [*E. cryptodens; OD] [=Trigonodus Nieper, 1969; Triangulodus Van Wamel, 1974]. Apparatus pentamembrate in at least some species, consisting of four types of nongeniculate and one type of geniculate coniform elements, all hyaline. Elements with long, slender, proclined to suberect cusp and short base with shallow basal cavity; by arrangement of conspicuous lateral costae four nongeniculate element types can be distinguished, forming transition series from dolabriform to digyrate and alate to quadriramate types, all modified and lacking distinct denticles, but with costae extended basally into short processes in some forms. [Apparatus reconstruction: Van Wamel, 1974.] L.Ord.—M.Ord., N.Am.-Eu.-Asia(Sib.-Austral.).—Fig. 87,3. *E. cryptodens, M.Ord.(Joins F.), USA(Okla.); 3a, holotype, lat. view, ×42 (Mound, 1965b); 3b-f, five types of elements forming transition series, ×36 (McHargue, 1974).

Erismodus Branson & Mehl, 1933a, p. 25 [*E. typus; OD] [=Microcoelodus Branson & Mehl, 1933b; Ptiloconus Sweet, 1955, nom. subst. pro Pieroconus Branson & Mehl, 1933b, non Hinde in Fox, 1900, a pteropod; Multicornis Moskalenko, 1970]. Apparatus of type species unknown but septimembrate in closely similar forms. All elements fibrous, most relatively robust, with peglike, discrete denticles, shallow basal cavity, and distinct
Cusp. Pa elements angulate, laterally bowed, with relatively long posterior and anterior processes forming wide angle with each other. Pb elements similar to Pa elements but with larger process angle and with abruptly arched posterior process behind cusp. M elements modified bipennate with denticulate anterior cusp margin deflected laterally and upper edge of base provided with one or a few denticles near distal end. S elements forming transition series from alate through digyrate to bipennate, all modified. Sa elements of two types, one symmetrical, one slightly asymmetrical with process angle from 90° to 180°, no posterior process, and anterobasal portion of cusp produced into tonguelike structure in some species. Sb elements markedly asymmetrical with process angle of about 90°. Sc elements also markedly asymmetrical with short, laterally denticulate anterior process and short, denticulate posterior process. [Apparatus reconstruction: Carne, 1975.] M. Ord., N.Am.-Eu.-Asia(Sib.).—Fig. 86.2. E. radicans (Hinde), Chazy., Can.(Que.); Pa element, ant. view, X20 (Hass, 1962).

Pteracodontiodus Harris & Harris, 1965, p. 41 [*P. aquilatus; OD]. Apparatus unknown; only described element symmetrical, consisting of promi-
Conodonta

Apparatus uni- or multimembrate, composed of lamellar and, with few exceptions, nongeniculate elements with distinct cusp and more or less prominent longitudinal costae or striations, or both; some elements with denticles on upper margin of cusp or along lateral costae, or both; transition series, if present, mostly expressed in disposition of surface sculpture and cross section of element. *L.Ord.-U.Dev.* (*Frasn.*).

**Family PANDERODONTIDAE**

Lindström, 1970

[Superfamily PANDERODONTACEA, Lindström, 1970]

Apparatus uni- or multimembrate, composed of lamellar conform elements with relatively deep basal cavity, thick walls, and lateral surfaces with fine longitudinal striations developed especially near basal margin. Most species with only nongeniculate elements, which may form symmetry-transition series expressed by disposition of costae on cusp; others with both geniculate and nongeniculate elements. Upper margin of base may carry single row of denticles or serrations. *L.Ord.-M.Dev.*

**Panderodus** Ethington, 1959a, p. 284 [*Paltodus unicostatus* Branson & Mehl, 1933a, p. 42; OD]. Apparatus apparently basically bimembrate, consisting of one mostly noncostate element and an array of costate elements forming transition series. Elements characteristically adenticulate but some serrated along upper margin of base, with longitudinal groove(s) and costae on lateral faces and wrinkle zone of striations near basal margin. Lateral faces either smooth or having fine longitudinal striations, especially near groove at midheight (best observable with SEM). [Apparatus reconstruction: Bergström & Sweet, 1966, p. 355; Cooper, 1975, p. 993; Carnes, 1975, p. 163; Barrick, 1977; *L.Ord.-M.Dev.*.]

?Columbodina Moskalenko, 1973, p. 64). Apparatus uni- or multimembrate; elements robust, laterally compressed, basically of coniform type, with expanded base. Some elements with prominent, more or less laterally compressed and confluent denticles on posterior margin of cusp, other elements adenticulate. Some species with geniculate elements. Basal cavity narrow, may be subdivided into two compartments. [Apparatus reconstruction: Bergström & Sweet, 1966; Moskalenko, 1972.] M.Ord.-U.Ord., N.Am.-Eu.-Asia(Sib.) —Fig. 88.6. *B. compressa (Branson & Mehl), U.Ord.(Galena Gr.), USA(Iowa); 6a,b, adenticulate elements, lat. views; 6c,d, denticulate element, lat. views; 6e, basal cavity of denticulate element; ×33 (Bergström & Sweet, 1966).


Plegagnathus Ethington & Furnish, 1959, p. 544 [*P. nelsoni; OD]. Apparatus unknown; elements of type species lamellar, dolabrate, laterally compressed with relatively short, denticulate posterior process and large basal cavity; all denticles and cusp reclined, denticles of about same size, laterally confluent. U.Ord., N.Am.—Fig. 88.3. *P. nelsoni, Stony Mt. F., Can.(Manit.); lat. view, ×50 (Ethington & Furnish, 1960).

Family SCOLOPODONTIDAE
Bergström, new

Apparatus apparently multimembrate, composed of coniform nongeniculate elements with rounded cross section and shallow basal cavity; distinct surface sculpture of costae and longitudinal striations. L. Ord.-M.Ord.

Scolopodus Pander, 1856, p. 25 [*S. sublaevis; SD Ulrick & Bassler, 1926, p. 7]. Apparatus of type species unknown but apparently including an array of nongeniculate, dominantly hyaline, coniform elements with more or less circular cross section, small base, shallow basal cavity, and proclined to recurved cusp; sides of cusp in most species with numerous lateral costae arranged symmetrically or asymmetrically. [No find of the type species of the genus has been reported since Pander's time and, as discussed by Lindström (1971), there are problems in interpreting the morphology of this species; however, it seems obvious that S. sublaevis is morphologically close to, and congeneric with, the well-known species S. rex Lindström, 1955.] L.Ord., ?M.Ord., N.Am.-S.Am.-Asia.—Fig. 88.5a,b. *S. sublaevis, L.Ord., Eu.( Baltic); lat. view and cross section, magnification unknown (Pander, 1856).—Fig. 88.5c, S. rex Lindström, L.Ord.(Didymograptus balticus Subzone), Eu.(Sweden); lat. view, ×28 (Bergström, n).

Staufelleria Sweet, Thompson, & Satterfield, 1975, p. 43 [*Dictodus falcatus Stauffer, 1935a, p. 142; OD]. Apparatus basically bimembrate, including two principal types of nongeniculate, laterally finely striated, coniform lamellar elements with deep basal cavity. One type bilaterally symmetrical, basally depressed, with unicostate or bicarinate posterior face and prominent anterolateral costae with flaring basal alae. Other type slightly to markedly asymmetrical, with one or two lateral costae and unicostate or bicarinate posterior face of cusp. M.Ord., N.Am.—Fig. 88.4. *S. falcatus (Stauffer), Galena Gr., USA(Iowa); 4a, asymmetrical element, lat. view, ×25; 4b,c, symmetrical element, post. and lat. views, ×38 (Ethington, 1959a).

Family BELODELLIDAE
Khodalevich & Tschernich, 1973

[nom. transl. Bergström & Klapper herein, ex Belodellinae Khodalevich & Tschernich, 1973a, p. 31]

Apparatus uni- or multimembrate, composed of lamellar coniform elements with extremely deep basal cavity and thin wall. Symmetry-transition series developed in at least some genera. L.Ord.-U.Ord.(Frasn.).

Belodella Ethington, 1959a, p. 271 [*Belodella devonica Stauffer, 1940, p. 420; OD] [=Haplobelodella Khodalevich & Tschernich, 1973b, p. 43]. Apparatus multimembrate, in Ordovician species consisting of an adenticulate nongeniculate element, an adenticulate geniculate element, and a symmetry-transition series of denticulate elements; post-Ordovician species lacking geniculate elements. Elements with short cusp and long base. Denticulate elements with numerous relatively small denticles along upper margin of base; shape of basal cross section varying from triangular to elliptical. [Apparatus reconstruction: Barrick, 1977; Carnes, 1975, p. 110-111; Haplobelodella is a name applied to adenticulate nongeniculate elements associated with other elements of the Belodella apparatus.] L.Ord.-U.Ord.(Frasn.). Eu.-N.Afr.-Asia-N.Am.-Australia-S.Am.—Fig. 89.2. B. silicica Barrick, Sil.(Wenlock., Kokkelleda stauros Z., Clarita F.), USA(Okla.); 2a, 5a element; 2b, Sc element; 2c, M element; all lat. views, ×53 (Barrick, 1977).

Coelocerodontus Ethington, 1959a, p. 273 [*C. trigonius; OD]. Apparatus unknown but may be bimembrate in type species, including elements
Conodonta

with triangular or tetragonal cross section, recurved cusp, keeled edges, and basal cavity extending to tip of element. M.Ord.-U.Ord., N.Am.-Eu.—Fig. 89.3. *C. trigonius*, Galena Gr., USA (Iowa); 3a,b, post. and post-lat. views, X48 (Ethington, 1959a).

Stolodus **Lindström**, 1971, p. 51 [*Distacodus stola** Lindström, 1955, p. 556; OD]. Apparatus basically unimembrane but elements showing symmetry transition in arrangement of lateral costae. Elements not strongly compressed laterally, with long and relatively wide base, small proclined to recurved cusp, large basal cavity; prominent lateral costae with, in some forms, short denticles. L.Ord., Eu.-N.Am.-S.Am.-Asia(Sib.).—Fig. 89.I. *S. stola* (Lindström), Eu.(Sweden); 1a,b, lat. views, X50 (Van Wamel, 1974).

Walliserodus **Serpagli**, 1967, p. 104 [*Plecodus debolti** Rexroad, 1967, p. 41; OD; =Acodus curvatus Brannon & Branson, 1947, p. 554]. Apparatus multimembrate, consisting of an asymmetrical, nondenticulate element and a symmetry-transition series of characteristically multistate, adenticulate elements with great variation in cross section and in number and position of costae. Elements nongeniculate and strongly costate. [Apparatus reconstruction: Cooper, 1975; Barrick, 1977.] U.Ord.(Ashgill.)-Sil.(Llandovery.), Eu.-N.Am.—Fig. 89.4. *W. sanctclairi* Cooper, Sil. (up. Llandovery-low. Wenlock., Pterosphadodus amorphognathoides Z., Clarita Fm.), USA(Okla.); 4a, Sa element; 4b, Sd element; 4c, Sc element; 4d, Sb element; 4e, M element; all lat. views, approx. X48 (Barrick, 1977).

**Superfamily DISTACODONTACEA**

**Bassler, 1925**


Apparatus uni- or multimembrate, in many forms bi- or trimembrate, composed of geniculate or nongeniculate coniform elements, or both, with distinct cusp and well-developed basal cavity; much white matter usually present in cusp but restricted or missing in some forms; cusp with prominent costae in many forms; with few exceptions, no denticles on cusp or base. U.Cam.-U.Ord.

**Family ACANTHODONTIDAE**

**Lindström, 1970**

[Acanthodontidae Lindström, 1970, p. 433]

Apparatus apparently composed only of nongeniculate coniform lamellar elements with reclined, laterally compressed cusp,
Conodontphorida—Distacodontacea

portion of posterior margin of cusp serrate; basal cavity shallow. *L.Ord.*

**Acanthodus** Furnish, 1938, p. 336 [*A. uncinatus*; OD]. Diagnosis as for family. *L.Ord.*, N.Am.-Asia (Sib.)-Australia.—Fig. 90,1a. *A. uncinatus*, Onota F., USA (Minn.), diagr. lat. view, X23 (Furnish, 1938).—Fig. 90,1b. A. cf. *A. uncinatus*, Dry Creek Sh., USA (Mont.); lat. view, X52 (Lindström, 1964).

**Family DREPAANOISTODONTIDAE**

**Bergström, new**

Apparatus bi- or trimembrate, composed of laterally compressed geniculate and nongeniculate elements; each cusp laterally smooth or with single longitudinal costa or carina; no conspicuous symmetry transition present based on costae arrangement; white matter abundant or reduced to ropelike growth axis. *Ord.*

**Drepanoistodus** Lindström, 1971, p. 42 [*Oistodus forceps* Lindström, 1955, p. 574; OD]. Apparatus basically bimembrate but some forms with two or more types of nongeniculate elements. Geniculate elements with long reclined cusp and posteriorly extended base. Nongeniculate elements with long, recurved to suberect cusp, one lateral face of which may be carinate. Basal cavity restricted to base. [Van Wamel (1974) regarded both *Paleodorus Pander, 1856* and *Scandodus Lindström, 1955* as synonyms of *Drepanoistodus*; however, he erroneously used *Drepanoistodus* for this group of conodonts despite the fact that the former generic names have many years’ priority over *Drepanoistodus*. Apparatus reconstruction: Bergström & Sweet, 1966; Lindström, 1971.] *Ord.*, Eu.-N.Am.-Asia-Australia.—Fig. 91,1. *D. forceps* (Lindström), L.Ord., Eu. (Sweden); 1a-c, three types of element, lat. views, X52 (Van Wamel, 1974).

**Distacodus** Hinde, 1879, p. 357, nom. subst. pro *Machairodus Pander, 1856*, nom. Kaup, 1833; a mammal [*Machairodus incavus* Pander, 1856; SD Miller, 1889, p. 313] [=Machairodia Smith, 1907]. Apparatus unknown; elements of type species slender, nongeniculate, coniform, bilaterally symmetrical, with sharp anterior and posterior margins and prominent longitudinal carina on each side of cusp. [No additional specimens of *D. incavus* have been reported from Estonia or elsewhere since Pander’s time and the species is poorly known.] *L.Ord.* (Arenig.), Eu. (Est.).—Fig. 92,1. *D. incavus* (Pander), Eu. (Baltic); 1a, lat. views; 1c, cross section of cusp; magnification unknown (Pander, 1856).

**Mixoconus** Sweet, 1955, p. 244 [*M. primus*; OD]. Apparatus unknown. Genus based on suberect to reclined, nongeniculate, hyaline, fibrous coniform elements with very shallow basal cavity. Anterior and posterior faces of cusp rounded, lateral faces bicarinate. Anterior and posterior margins, as well as principal lateral carinae, ba-
Fig. 92. Drepanoistodontidae (p. W143-W145).

sally extended into very short lobes. M.Ord., N.Am.—Fig. 92,4. *M. primus*, Harding Ss., USA(Colo.); 4a,b, lat. views, ×40 (Sweet, 1955).

*Nordiodus* Serpagli, 1967, p. 77 [*N. italicius*; OD]. Apparatus trimembrate, consisting of one geniculate and two types of nongeniculate, lamellar, laterally compressed, bilaterally asymmetrical, coniform elements. Geniculate elements (*Oistodus rhodei* Serpagli) with reclined to recurved, carinate or costate cusp and posteriorly extended base flaring toward one side. One type of nongeniculate element (including holotype of *N. italicius*) very robust with unusually short, stubby, suberect cusp and very large base. Other type of nongeniculate element (*N. proclinatus* Serpagli) also robust with short, proclined cusp and relatively high and wide base. Basal cavity in all elements large, especially in nongeniculate elements, but restricted to base. [As interpreted here, *Nordiodus* has an apparatus reminiscent of *Drepanoistodus* as represented by, for instance, *D. subrectus* Branson & Mehl, 1934a. Representatives of *Nordiodus* are, however, distinguished by their short cusp and very large base.] U.Ord./Ashgill., Eu.(Italy).—Fig. 92,2. *N. italicius*, Italy(Carnic Alps); 2a,b, nongeniculate element, lat. views; 2c, same, lower view; ×106 (Serpagli, 1967).

*Paroistodus* Lindström, 1971, p. 46 [*Oistodus paralleulus* Pander, 1856, p. 27; OD]. Apparatus bimembrate. Geniculate elements with reclined cusp and anteroposteriorty extended base tending to be square in lateral view. Nongeniculate elements with recurved cusp, cusp in some elemets more or less strongly costate. Prominent zone of recessive basal margin commonly developed at anterobasal corner. Basal cavity relatively shallow. [Paroistodus is similar to *Drepanoistodus* and *Paltodus*; for discussion of distinguishing characteristics, see Lindström, 1971. Apparatus reconstruction: Lindström, 1971.] L.Ord., ?M. Ord., Eu.-N.Am.-S.Am.—Fig. 91,2. *P. paralleulus* (Pander), L.Ord.(low.Arenig.), Eu.(Sweden); 2a,b, nongeniculate elements, lat. views; 2c, geniculate element, lat. view; ×49 (Van Wambeke, 1974).

*Scandodus* Lindström, 1955, p. 592 [*S. furnishi*; OD]. Apparatus trimembrate, composed of largely hyaline elements forming a transition series. Geniculate elements slightly recurved to reclined, with somewhat twisted cusp and short base; basal cavity opening toward one side. One type of nongeniculate element with suberect cusp and short base; another type with recurved cusp and relatively longer base. All elements without lateral costae and with basal cavity restricted to base; white matter in cusp usually present only as thin ropelike growth axis. [Scandodus is distinguished from *Oistodus* by lack of prominent lateral costae and dominance of nongeniculate elements in apparatus; from *Drepanoistodus* by being dominantly hyaline and by appearance of geniculate elements; and from *Paltodus* by lack of distinct lateral costae. Apparatus reconstruction: Lindström, 1971.] l. Ord., Eu.-N.Am.—Fig. 91,3. *S. furnishi*, Didymograptus balticus Subzone, Eu.(Sweden); 3a, nongeniculate element, lat. view; 3b,c, geniculate elements, lat. views; ×48 (Bergström, n).

*Stereoconus* Branson & Mehl, 1933a, p. 27 [*S. gracilis*; OD]. Apparatus unknown; described ele-
Family JUANOGNATHIDAE
Bergström, new

Apparatus unknown but includes non-­geniculate and possibly geniculate, coniform, lamellar elements forming symmetry-transition series. Elements elongate, recurved to reclined, with rounded, non­keeled anterior and posterior margins and more or less oval cross section. Cusp usually twisted with prominent lateral costa on each face. Basal cavity shallow. L.Ord.-M.Ord.

Juanognathus Serpagli, 1974, p. 49 [*J. variabilis; OD]. Diagnosis as for family. L.Ord.-M.Ord., S. Am. (Arg.)-N. Am.-Asia (Malaya). —Fig. 93,1.
Conodonta

D. arcatus, but additional material is needed to confirm that reconstruction.] Ord., Eu.-Asia-N. Am.-Australia.—Fig. 94.2. *D. arcatus, L.Ord. (Didymognathus balticus Subzone), Eu.(Sweden); 2a,b, geniculate and nongeniculate elements, lat. views, X50 (Bergström, n).

Family PROCONODONTIDAE
Lindström, 1970

[Proconodontidae Lindström, 1970, p. 429] [Materials for this family prepared by J. P. Miller]

Nongeniculate coniform elements forming inferred unimembrate apparatuses; basal cavity extending to tip, white matter absent; basal cone prominent. U.Cam., 2L.Ord.

Proconodontus Miller, 1969, p. 437 [*P. muilleri; OD]. Large, proclined elements, essentially symmetrical but some slightly bent laterally; anterior keel absent in some; posterior keel variable in length (very short and present only near tip in some), serrate in some; cross section oval. [Based on stratigraphic occurrence and morphology, this genus appears to be the most primitive representative of the order Conodontophorida.] U.Cam., 2L.Ord., N.Am.(N.Y., widespread in W. and SW. states of USA-Alberta-Dist.-Mackenzie, Arctic Islands)-Asia(Iran)-Australia(Queensl.).—Fig. 95.2. *P. muilleri, holotype, U.Cam., USA (Utah); 2a-c, ant. and lat. views, transv. sec., X38 (Miller, 1969).

Family OISTODONTIDAE
Lindström, 1970

[Oistodontidae Lindström, 1970, p. 431] [Oistodus Pander, 1856, p. 27 [*O. lanceolatus; SD Ulrich & Baslker, 1926, p. 7.]. Elements hyaline, lateral costae not developed as distinct processes, cusp with one or several lateral costae. Modified alate element nearly symmetrical. [Apparatus reconstruction: Lindström, 1971.] L.Ord.-M.Ord., Eu.-N.Am.-S.Am.—Fig. 96.3. *O. lanceolatus, L.Ord., Eu.(Sweden), three types of elements recurred cusp considerably longer than base of unit. One type of element with strong, symmetrical or asymmetrical, lateral costae; other type with more or less twisted, carinate or grooved cusp; basal cavity of moderate size, restricted to base. [Absence of geniculate elements in the apparatus distinguishes Protopanderodus from Drepanosistodus, Palodus, and Paroistodus. Apparatus reconstruction: Lindström, 1971.] Ord., Eu.-N. Am.-S. Am.-Asia.—Fig. 94.1, 44P. rectus (Lindström), L.Ord., Eu.(Sweden); 1a,b, elements with prominent costae, lat. views, X52, X37; 1c, element with noncostate, twisted cusp, lat. view, X44 (Van Wamel, 1974).

Drepanodus Pander, 1856, p. 20, non Menge, 1869, Arachnida [*D. arcatus; SD Miller, 1889, p. 313]. Apparatus composed of two types of element; one long and slender, recurred to inclined, nongeniculate; the other inclined, more or less geniculate. Cusp acostate in most elements, slightly twisted in some. Basal cavity subtriangular in lateral view, moderately deep. [Apparatus reconstruction: Lindström, 1971, 1973; Van Wamel, 1974. Van Wamel referred three different types of nongeniculate elements to the apparatus of
forming transition series; 3a, lat. views, ×56, ×35; 3c, post. view, ×110 (Van Wamel, 1974).

**Oelandodus** **Van Wamel**, 1974, p. 71 [*Oistodus elongatus* **Lindström**, 1955, p. 574; OD]. Apparatus trimembrate, including three types of lamellar, geniculate, and coniform elements. Elements strongly compressed laterally, recurved to reclined, some with carinate cusp. Base long, basal cavity relatively shallow and subtriangular in lateral view. [Apparatus reconstruction: Van Wamel, 1974.] L.Ord., Eu.-N.Am.—Fig. 96.1. *O. elongatus* (Lindström), Planilimbata Ls., Eu.(Sweden); 1a-c, lat. views of geniculate elements, all ×75 except 1c, ×115 (Van Wamel, 1974).

**Protoprioniodus** **McTavish**, 1973, p. 47 [*P. simplicissimus*; OD]. Elements with abundant white matter. Lateral costae forming short processes in some. Cusp in acosteate element reclined. [Protoprioniodus and Oelandodus exhibit close similarity to Oistodus in important respects, and further study may show that these genera should be regarded as synonyms. Apparatus reconstruction: McTavish, 1973.] L.Ord., Australia-N.Am.-S.Am.—Fig. 96.2. *P. simplicissimus*, Emanuel F., Australia(W.Australia); 2a, tertioedate element holotypc, lat. view; 2b, geniculate element, lat. view; 2c, alate element, lat. view; ×48 (McTavish, 1973).

**Family STRACHANOGNATHIDAE**

Bergström, new

Apparatus basically unimembrate but with several types of closely similar, nongeniculate, lamellar, coniform elements characterized by slender, suberect to recurved cusp, short base, and presence of single denticle anterior to cusp, denticle may rival cusp in size; basal cavity of modest size, restricted to base, with apex beneath denticle in front of cusp. Ord.

**Strachanognathus** **Rhodes**, 1955, p. 131 [*S. parvus*; OD]. Diagnosis as for family. [As noted by Bergström (1962), there is a certain degree of intraspecific variation in morphology of elements of the type species of the genus; however, there is no evidence that its apparatus includes other types of elements.] Ord., Eu.-N.Am.—Fig. 97.2. *S. parvus*, M.Ord.(Dalby Ls.), Eu. (Sweden); 2a,d,d, lat. views; 2b, ant. view; ×65 (Bergström, 1962).

**Family TERIDONTIDAE** Miller, new

[Materials for this family prepared by J. F. Miller]

Nongeniculate coniform elements, proclined to reclined, forming unimembrate apparatuses or multimembrate apparatuses by symmetry transition. Sculpture consists
Conodonta

Characterized by a quinqui- or seximembrate apparatus composed of P, M, and S elements; Pa element unrecognized in some species. Plat­
form development in pectiniform elements at most a lateral flange. Denticles discrete and not appreciably compressed in most species. Basal cavity large, at least under cusp. M.Ord.-V.Penn.

Superfamily HIBBARDELLACEA

Müller, 1956

of one or more costae on lateral or posterior faces, or costae absent; faint striae typically present on well-preserved specimens. Base round unless modified by costae; basal cavity shallow, with a white basal cone. Most of cusp composed of white matter. U.Cam.-L.Ord.

Teridontus Miller, 1980, p. 33 [*Oncotodus nakamura\(\text{\textquotesingle}\) Nogami, 1967, p. 216; OD]. Symmetrical coniform elements, usually erect to reclined, forming probable unimembrate apparatuses. Costae lacking, cross section circular to slightly oval; faint striae covering most of cusp in some. U.Cam.-L.Ord., Asia-Australia-Eu.-N.Am.—Fig. 95,1. *T. nakamura (Nogami), L.Ord., USA (Texas); 1a-c, lat. view, shape of basal cavity, transv. sec., ×154 (Miller, 1980).

Family ULRICHODINIDAE

Bergström, new

Apparatus unknown, possibly unimembrate; elements nongeniculate, coniform, suberect, bilaterally symmetrical, with lat­
eral carinae, rounded anterior margin, and sharp posterior margin; base low, not appreciably extended anteroposteriorly, with characteristic indentation anteriorly; basal cavity shallow, restricted to base. L.Ord., N.Am.-Asia.

Ulrichodina Furnish, 1938, p. 334 [*U. prima; OD]. Diagnosis as for family. L.Ord., N.Am.-Asia(Sib.-Malaya).—Fig. 97,1. *U. prima, Shakopee Dol., USA(Wisc.); 1a,b, ant. and ant-lat. views, ×63; 1c,d, lat. view and cusp cross section, ×38 (Furnish, 1938).

Superfamily HIBBARDELLIDAE

Müller, 1956

[nom. transl. Klapper, herein, ex Hibbardellidae Müller, 1956b, p. 824] [Superfamily diagnosis by Gilbert Klapper]

Apparatus basically seximembrate and composed of P, M, and S elements; Pa element unrecognized in some species. Platform development in pectiniform elements at most a lateral flange. Denticles discrete and not appreciably compressed in most species. Basal cavity large, at least under cusp. M.Ord.-U.Penn. [Prioniodinacea Bassler, 1925 (nom. transl. Lindström, 1970, ex Prioniodinidae Bassler, 1925) does not compete as the name for this super­family. According to the reviser principle, in a divided taxon the name must remain with a component that includes the type, and the apparatus of Prioniodina subcurvata Bassler is unknown at present. Conse­quently, Prioniodina is treated here in Super­family and Family Unknown and any higher taxonomic category based on it must remain bound to the genus.]

Family HIBBARDELLIDAE

Müller, 1956

[Hiibbardellidae Müller, 1956b, p. 824] [Materials for this family prepared by Gilbert Klapper and S. M. Bergström]

Characterized by a quinqui- or seximem-
Conodontophorida—Hibbardellacea

Hibbardellidae

**Fig. 98.** Hibbardellidae (p. W149-W150).

**Hibbardella** Bassler, 1925, p. 219 [*Prioniodus angulatus* Hinde, 1879, p. 360; OD]. Apparatus in some species quinquimembrate. *Sa* element with denticulate posterior process. This process distinguishes the genus from *Oulodus*, the *Sa* element of which has an adenticulate posterior process. Reconstruction: Klapper & Philip, 1972, p. 101.] **M.Dev.-U.Dev., N.Am.-Australia.**—Fig. 98,1. *H. angulata* (Hinde), U.Dev.(Frasn., Sadler Ls.), Australia(W. Australia); la, *Pb* element, lat. view; lb, *Sa* element, post. view; lc, *Scb* element, lat. view; ld, *Sce* element, lat. view; le, *M* element, lat. view; ×27 (Klapper & Philip, 1971).


**Oulodus** Branson & Mehl, 1933b, p. 116 [*Cordyloides serratus* Stauffer, 1930, p. 124; OD; =O. medioeris Branson & Mehl, 1933b] [=Barbarodina Stauffer, 1935b; Gyrognathus Stauffer,
Apparatus usually sexi- or septimembrate but reduced to Pa elements and thus unimembrate in some species. Platformed Pa elements segmiplanate in Gondolellidae and Xaniognathidae, pastiniplanate or anguliplanate in Ellisoniidae; bladelike Pa elements carminate, angulate, or segminate. Pa elements of this superfamily not closely related to Pa elements of Polygnathacea. Ramiform elements multidenticulate. U. Carb.-U. Trias.

Family GONDOLELLIDAE
Lindström, 1970

Apparatus apparently septimembrate, Pa element segmiplanate, Pb element angu-

Pristognathus STONE & FURNISH, 1959, p. 226 [*P. bighornensis; OD]. Apparatus unknown; genus based on lamellar, twisted, digyrate elements with prominent lateral flange and central row of equally sized denticles on upper side. Cusp about same size as process denticles. Basal cavity shallow, groovelike, extending along under side of most of unit. Denticles oval in cross section, confluent basally but free along most of element. U. Ord., N. Am.—Fig. 99.1. *P. bighornensis, Stony Mt. F., Can.; 1a, b, lat. views, ×50 (Ethington & Furnish, 1960).

Superfamily GONDOLELLACEA
Lindström, 1970

1935a; Delotaxis KLAPPER & PHILIP, 1971]. Apparatus in at least some species seximembrate. Pa elements angulate or digyrate (oulodontiform); latter with longer of two processes arched, straight or slightly bowed, forming angle of about 90° with downwardly directed, laterally strongly deflected, shorter process. Pb elements digyrate. M elements dolobrate or bipennate with wall of basal cavity expanded laterally toward one side. S elements forming transition series from alate through digyrate to dolabrate or bipennate. Denticles in all elements discrete, mostly peglike. Basal cavity large, extending along entire under side of processes. [Apparatus reconstruction: SWEET & SCHÖNLAUB, 1975.] M. Ord.-L. Dev., N. Am.-Eu.-Asia(Sib.).—Fig. 98.3. *O. serratus (STAUFFER), M. Ord.(Decorah F.), USA(Iowa); 3a, Pa element, lat. view, ×58; 3b, Pb element, lat. view, ×44; 3c, M element, lat. view, ×56; 3d, Sc element, lat. view, ×42; 3e, Sb element, post. view, ×58; 3f, Sa element, post. view, ×60 (Sweet & Schönlaub, 1975).

Pristognathus STONE & FURNISH, 1959, p. 226 [*P. bighornensis; OD]. Apparatus unknown; genus based on lamellar, twisted, digyrate elements with prominent lateral flange and central row of equally sized denticles on upper side. Cusp about same size as process denticles. Basal cavity shallow, groovelike, extending along under side of most of unit. Denticles oval in cross section, confluent basally but free along most of element. U. Ord., N. Am.—Fig. 99.1. *P. bighornensis, Stony Mt. F., Can.; 1a, b, lat. views, ×50 (Ethington & Furnish, 1960).

Fig. 99. Hibbardellidae (p. W150).

Fig. 100. Gondolellidae (p. W151, W152).

**Gondolella** Stauffer & Plummer, 1932, p. 41 [*G. elegantiula; OD*] [=*Illinella* Rhodes, 1952, p. 898]. Apparatus probably at least trimembrate; septimembrate according to von Bitter (1976a). *Pa* element segminiplanate, pectiniform. Free blade absent; long narrow gondola-shaped platform along entire axis; prominent reclined cusp
terminal or near posterior termination; platform absent in some, when platform present, carina distinct with denticles at anterior; grooves and transverse ridges on platform; keel and basal pit prominent on lower side. *M. Penn.(Atoke-)L. Perm., N.Am.; U.Carb.-L.Perm., W.Eu.-Afr.-Australia: Asia M.-N.Z.—Fig. 100, J. *G. curvata Stauffer & Plummer, *M. Penn.(Labette Sh.), USA (Okla.); 1a, apparatus based on natural assemblage, ×15; 1b, c, upper and lower views of Pa elements, ×25, ×60 (Rhodes & Austin, n).

**Family ELLISONIDAE Clark, 1972**  
[nom. transl. Sweeney, herein, ce superfamily Ellisioniacea Clark 1972a, p. 157] [Materials for this family prepared by W. C. Sweeney]

Apparatus basically seximembrate, but reduced to Pa elements and thus unimembrate in some species. Pa elements angulate in species with seximembrate apparatus and pastiniplanate or anguliplanate with well-developed anterior and posterior processes in species with unimembrate apparatus. *U.Carb.-U.Trias.*

**Ellisonia MÜLLER, 1956b, p. 822 [*E. triassica; OD] = [Neohindeodella KOZUR, 1968; ?Didymodella MOSHER, 1969, nom. subst. pro Dickodella MOSHER, 1968, non SERPAGLI, 1967; ?Oncadella MOSHER, 1968; Neoplectopathodus KOZUR & MOSTLER, 1970; Stepianovites KOZUR, 1975a].** Apparatus seximembrate: Pa angulate; Pb digyrate, bowed out; M digyrate; Sa alate with long denticle posterior process; Sb digyrate; Sc bipenate with long posterior process and shorter, laterally deflected anterior process. Denticles of elements representing late growth stages discrete; three distal denticles of posterior processes of Sa and Sc elements tending to be longer, stouter, and more widely spaced than more proximal denticles on same processes. [Type specimens of Didymodella alternata (Mosher) and Oncadella pacidentata (Mostler) appear to be Pb and Sc elements, respectively, of the apparatus of a distinctive species that may, when better understood, be referable to Ellisonia.] *L.Penn.-U.Trias., N.Am.; U.Carb.-U.Trias., Eu.-Asia-Australia.—Fig. 101,3. *E. triassica, L.Trias., USA (Nev.); 3a, Sa element, lat. view, ×63; 3b, Sb element, post. view, ×46; 3c, Sc element, lat. view, ×46; 3d, Pb element, post. view, ×94; 3e, Pa element, inner-lat. view, ×49; 3f, M element, post. view, ×46 (Sweet, n).

**Anastrophognathus BENDER, 1970, p. 500 [*A. sagittalis; OD].** Apparatus unknown; genus based on apparently bowed pastinate element with posterior and outer-lateral processes of similar length and development joining straight anterior process to form near bilaterally symmetrical structure Y-shaped in upper or under view. [This genus may be related to **Furnishius and Pseudofurnishius.**] *M.Trias., Eu.-N.Am.-Asia—Fig. 102,1. *A. sagittalis, Eu.(Greece); 1a, upper side; 1b, under side; about ×65 (Kozur & Mostler, 1972).

**Furnishius CLARK, 1959, p. 310 [*F. trierattus; OD] = [Maelygnathus Igo, KOIKE, & YIN, 1965].** Apparatus seximembrate: Pa digyrate with one long and one short lateral process twisting distally in opposite directions; M digyrate, bowed out; Sa alate with no posterior process; Sb digyrate with subequal lateral processes in essentially same plane; Sc bipenate with in-curved anterior process. Under side of all elements cuneiform with small basal pit and narrow grooves beneath processes, pit and grooves surrounded by prominent zone of recessive basal margin, upper edge of margin at midheight on process sides. In some samples, the array of elements just described is accompanied by pastinate elements, which are structures on which Furnishius is based. Except for an irregularly denticulate outer lateral process, however, they are similar to the angulate Pa elements noted above. They may either have replaced angulate Pa elements in the apparatus of some Furnishius individuals or they may represent dimorphs in the skeletal apparatus of which they are the only mineralized elements.] *L.Trias., N.Am.-Asia.—Fig. 101,2. *F. trierattus, USA (Nev.); 2a, Sa element, post. view, ×46; 2b, Sb element, oblique post. view, ×46; 2c, Sc element, lat. view, ×46; 2d, Pb element, post. view, ×63; 2e, angulate Pa element, lat. view, ×46; 2f, pastinate Pa element, lat. view, ×63 (Sweet, n).

**Gladigondolella MÜLLER, 1962a, p. 116 [*Polygnathus tethydis HUCKRIEDE, 1958; OD] = [Cragognathodus MOSHER, 1968].** Apparatus apparently unimembrate, composed of anguliplanate elements with thick, coarsely pitted, adenticulate platform and, on under side, longitudinally grooved keel extending full length of element and expanding to form small basal pit slightly posterior of midlength. [KOZUR & MOSTLER (1971) concluded that the apparatus of *G. tethydis* was septimembrate; however, the array of nonplatform elements they listed as components forms a complete and typical seximembrate apparatus of Ellisonia type. Because anguliplanate elements assignable on form to Gladigondolella intergrade morphologically with closely similar angulate elements assumed to have occupied Pa positions in Ellisonia apparatuses, and because anguliplanate elements do not always occur with the array of ramiform elements included in Gladigondolella by Kozur & Mostler, it is concluded that Gladigondolella had a unimembrate apparatus, as apparently did many other Permian and Triassic conodonts that developed from Ellisonia or Cypridodella. ] *Trias., Eu.-Asia-N.Am.—Fig. 103,1. *G. tethydis (Huckriede), M.Trias., Asia(Timor); 1a, lat. view, ×34; 1b, under side, ×36 (Sweet, n).
Conodontophorida—Gondolellacea

Hadrodontina Stæsche, 1964, p. 271 [*H. anceps; OD]. Apparatus probably seximembrate, like that of Furnishius, but under sides of elements flattened rather than cuneiform, and dimorphic Pa element (=form-species *H. biserialis* Stæsche, 1964) not pastinate but angulate, with secondary row of denticles on outer side parallel to main denticle series. *L.Trias.*, Eu.-Middle East.—Fig. 101,1.

*H. anceps*, Eu.(Italy); 1a, Sa element, post. view; 1b, Sb element, post. view; 1c, M element, post. view; 1d, Pa element without secondary denticle row, inner-lat. view; 1e, Pa element with secondary denticle row, outer-lat. view; *X*47 (Sweet, n).

Mosherella Kozur, 1972, p. 14 [*Neospathodus newpassensis* Mosher, 1968, p. 931; OD]. Apparatus unimembrate, composed of angulate ele-
ments with long anterior and short posterior processes. [According to Kozun, Mosherella was derived from Pseudofurnishius, this being indicated by complete reduction in Mosherella elements of lateral platforms that characterize Pseudofurnishius elements.] U.Trias., N.Am.-Eu.-Asia.—Fig. 102, 2. *M. newpassensis* (Mosher), USA(Nev.); lat. view, X94 (Sweet & others, 1971).

**Pachycladina** Stae sche, 1964, p. 277 [*P. obliqua*; OD]. Apparatus seximembrate: *Pa* carminate to palmate, with smooth-surfaced, laterally expanded midlateral ribs; *Pb* digyrate, with processes of subequal length curving faintly in opposite directions distally and tending to develop laterally expanded, platformlike midlateral ribs; *M* digyrate, with processes of unequal length; *Sa* alate, with no posterior process; *Sb* digyrate, bowed, a slightly asymmetric version of *Sa*; *Sc* bipennate, with long posterior process and short, in-curved anterior process. Elements hyaline, with thick growth axes in all denticles. Lower surface of all elements cuneiform, with small basal pit and broadly expanded zones of recessive basal margin forming scarlike areas on inner and outer sides of *Pa* elements but only on inner sides of those in other positions. [The apparatus of Pachycladina is reminiscent of that of Parachirognathus, but appears to have been more differentiated, and the elements are more robust and have peglike rather than laterally compressed and fused denticles. These differences may prove to be of only specific significance and attributable to differences in geographical distribution. However, representatives of the two genera occur together in both North America and Europe, Parachirognathus dominating in the former and Pachycladina in the latter.] L.Trias., Eu.-N.Am.—Fig. 102, 4. *P. obliqua*, Eu.(Italy): 4a, *Sa* element, post. view; 4b, *Sb* element, post. view; 4c, *Sc* element, lat. view; 4d, *Pa* element, lat. view; 4e, *M* element, post. view; X42 (Sweet, n).

**Parachirognathus** Clark, 1959, p. 311 [*P. ethingtoni*; OD]. Known apparatus bi- or trimembrate: *Sa* element alate with no posterior process, grading to closely similar, bowed bipennate *Sc* element. All elements hyaline, with small basal pits surrounded by narrow flattened areas grading on inner sides of elements into broad, semicircular zones of recessive basal margin, upper edges of margin marked by arched rib at base of denticle series. L.Trias., N.Am.-Eu.—Fig. 103, 2. *P. ethingtoni*, USA(Nev.); *Sb* element, post. view, X50 (Sweet & others, 1971).

**Pseudofurnishius** van den Boogaard, 1966, p. 5 [*P. murchianus*; OD]. Apparatus unimembrate, apparently composed entirely of pastiniplanate or stelliplanate elements with platform extensions only on lateral processes. M.Trias.-V.Trias., Eu.-Middle East-Afr.—Fig. 102, 3. *P. murchianus*, holotype, M.Trias., Eu.(Spain); 3a, lat. view, X102; 3b, upper side, X109 (van den Boogaard, 1966).

**Family XANIOGNATHIDAE**

**Sweet**, new

[Materials for this family prepared by W. C. Swartz]

Apparatus basically seximembrate, but reduced to *Pa* elements in some species and thus unimembrate. Carminate or angulate *Pa* elements of seximembrate species with short, fragile, unribbed posterior processes; segminate or segminiplanate *Pa* elements of unimembrate species lacking posterior processes. *Perm.-Trias.*

**Xaniognathus** Sweet, 1970, p. 261 [*X. curvatus*; OD]. Apparatus seximembrate: *Pa* carminate or angulate, with long, longitudinally ribbed anterior process and very short fragile, unribbed posterior process; *Pb* digyrate, bowed out, with one long and one very short lateral process; *M* digyrate; *Sa* alate, with long denticulate posterior process and cusp longer than any denticle of posterior series; *Sb* digyrate, arched; *Sc* bipennate, arched, with anterior process that may bifurcate distally. U.Perm.-L.Trias., Asia-Eu.-N.Am.—Fig. 104, 2. *X. curvatus*, L.Trias., Asia(Pak.); 2a, *Sa* element, lat. view, X86; 2b, posteriorly incomplete *Sc* element, lat. view, X78; 2c, *Sb* element, post. view, X64; 2d, *Pb* element, oblique outer view, X97; 2e, *Pa* element, lat. view, X119; 2f, *M* ele-

Fig. 103. Ellisoniidae (p. W152, W154).
Conodontophorida—Gondolellacea

Chirodella Hirschmann, 1959, p. 71 [*Metalonchodina triquetra Tatge, 1956, p. 137; OD] [?—Corundina Hirschmann, 1959]. Genus based on very small, outward bowed, digyrate elements with one long denticulate process and another evidenced only by an adenticulate costa or one bearing just one or two denticles; under side sharply keeled, with little indication of basal cavity or pit. [Elements of the type species are commonly associated with tiny, fragile digyrate and bipennate elements that bear numerous needlelike denticles, and with similarly small angulate or carminate elements with prominent cusp, very short processes, and flattened to broadly grooved under sides. The former have been referred by most authors to Hindeodella (or Neohindeodella), and the latter to Corundina. It is probable that all these elements

Fig. 104. Xaniognathidae (p. W154-W156).
represent the apparatus of a single species, which would be closely related to *Xaniognathus* and *Cypridodella*. M.Trias.-U.Trias., Eu.—Fig. 105, 5. *C. trigoneta* (TATGE), M.Trias., Eu.(W.Ger.); oblique outer-lat. view, \( \times 200 \) (Sweet, n).

**Cypridodella** MOSHER, 1968, p. 920 [*C. confoexa; OD] [=Pollognatius KOZUR, 1968; Hibbardelloides KOZUR & MOSTLER, 1970; Grodella KOZUR & MOSTLER, 1970; *Pezegella KOZUR & MOSTLER, 1970; Psendozarkodina KOZUR, 1973]. Apparatus seximembrate: Pa angulate, with long, longitudinally ribbed anterior process and fragile, unribbed posterior process; Pb digyrate, bowed out, with one long and one very short lateral process; M digyrate; Sa alate, with long denticulate posterior process and cusp appreciably shorter than first or second denticle of posterior series; Sb digyrate, arched; Sc bipennate, arched; anterior process of either Sa or Sb element bifurcating distally in some. [This apparatus differs from that of *Xaniognathus* primarily in conformation of the Sa element.] Trias., Asia-Eu.-N.Am.—Fig. 104, 1. *C. magnidentata* (TATGE), M.Trias., Eu.(W. Ger.); 1a, Sa element, lat. view; 1b, Sb element, post. view; 1c, Sc element, lat. view; 1d, Pb element, oblique outer view; 1e, Pa element, lat. view; 1f, M element, post. view; 1a-d,f, \( \times 97 \); 1e, \( \times 62 \) (Sweet, n).

**Epigondolella** MOSHER, 1968, p. 935 [*Polygnathus abneptis HUCKRIEDE, 1958, p. 156; OD] [=Tardogondolella BENDER, 1970; Ancyrogondolella BUDUROV, 1972; Paragondolella KOZUR & MOCK, 1972; Carinella BUDUROV, 1973]. Apparatus unimembrate, apparently composed entirely of semiplanate elements with more or less free anterior blade and platform margins marked by node- or spine-like projections or denticles (developed from pair of denticles projecting laterally and directed posteriorly). [Prominent zones of recessive basal margin apparently developed along a straight or bifurcate axis posterior to basal pit in intermediate to late stages of growth. Elements representing such growth stages were referred to *Ancyrogondolella* and *Carinella* by BUDUROV and
have been included in *Gladigondolella* by some other authors. Kozur & Mock based *Parignon­
dolella* on platformless segminate elements inter­
preted as representatives of a species derived from *E. bidensita* Mosher. Platform reduction, how­
ever, was evidently a phylogenetic tendency in *Epigondolella*, hence *Parignon­
dolella* is here regarded as merely the ultimate stage in the evolu­
tion of *Epigondolella*, not as a separate genus.] M.Trias.-U.Trias., Eu.-Asia-N.Am.—Fig. 105,1. *
E. abnepsis* (Huckriede), M.Trias., Eu.(Aus.); 1a, upper side; 1b, under side; ×61 (Sweet, n).

*Asperatus* Neogondolella BENDER & STOPPEL, 1965, p. 343 [Gondolella mombergensis Tatge, 1956; M] [=Metapolygnathus Hayashi, 1968; Paragon­
dolella Mosher, 1968; Celigondolella Kozur, 1968]. Apparatus unimembrate, apparently com­
posed entirely of segminiplanate elements supposed to have occupied Pa positions. [Elements typical of *Neogondolella* may have a relationship with Cypridodella and Xanigognathus like that between Gladigondolella and *Ellisionia*, or elements of *Neogondolella* and *Neospathodus* may represent dimorphs of species of *Cypridodella* or *Xanig­
gnathus*. If the latter is true, taxonomy in the entire plexus will need great revision.] Perm.-
Trias., Eu.-Asia-N.Am.-Australia.—Fig. 105,5. *N. mombergensis* (Tatge), M.Trias., Eu.(W. Ger.); 2a, lat. view, ×64; 3b, under side, ×61 (Sweet, n).

membrate, apparently composed entirely of segmi­
nate elements with distinct mid-lateral ribs; ele­
ments supposed to have occupied Pa position. [See comments under *Neogondolella*.] Perm.-Trias.,
Asia-Eu.-N.Am.-Australia.—Fig. 105,4. *N. cristagalli* (Huckriede), L.Trias., Asia(Pak.); lat.
view, ×100 (Sweet, 1976).

*Platyvillosum* Clark, Sincavage, & Stone, 1964, p. 376 [*P. asperatus; OD] [=Eurygnathodus Staesche, 1964; ?Foliella Budurov & Pantic, 1973]. Apparatus unimembrate, apparently com­
posed entirely of arched segminiplanate elements with irregularly nodose, radially or transversely
ribbed upper surfaces, these surfaces subcircular,
quadrate, or larchrymiform in upper view. Ele­
ments supposedly occupying Pa position. L.Trias.,
N.Am.-Eu.—Fig. 105,2a. P. costatus (Staes­
che), USA(Nev.); upper side, ×50 (Sweet & others, 1971).—Fig. 105,2b. *P. asperatus, USA (Nev.); upper side, ×50 (Sweet & others, 1971).

*Sweetocristatus* Szaniwski in Szaniwski & Mat­
kowski, 1979, L.Perm., see addendum.

Superfamily POLYNATHACEA

Bassler, 1925
Conodonta

W158

Conodonta


Family CAVUSGNATHIDAE

Austin & Rhodes, new

[Materials for this family prepared by R. L. Austin and F. H. T. Rhodes]

Apparatus seximembrate: pectiniform element scaphate; *Pb* element angulate; *M* element dolabrate or digyrate; *Sa* element alate and *Sb* bipennate, of two types. [Of the genera in this family, only *Adetognathus* and *Cavusgnathus* are known from multi-element assemblages. The remaining genera are tentatively included on the basis of structural similarity.] U.Dev.-L.Perm.

*Cavusgnathus* Harris & Hollingsworth, 1933, p. 200 [*C. alta;* OD] [=Lewistownella Scott, 1934; *Windsorognathus* Austin & Mitchell, 1975].


*Adetognathus* Lane, 1967, p. 931 [*Cavusgnathus latus* Gunnell, 1933, p. 286; OD]. Apparatus seximembrate: *Pa* element scaphate; *Pb* angulate; *M* dolabrate; *Sa* alate, with posterior process; *Sc* bipennate, of two types. [Presence of denticulate posterior process in *Sa* elements of Missourian age distinguishes them from homologous elements in *Ozarkodina.* The *Pb* element can be distinguished from other homologous elements of Missourian age because it is less arched and has fewer but relatively larger denticles. *M* elements are distinguished from other homologous elements of Missourian age by the outward curvature of the anterolateral process, which differs from those of specimens of both *Ozarkodina* and *Idiognathodus.* One of the *Sc* elements is distinguished from
homologous elements of Ozarkodina and Idiognathodus by strong downward deflection of the larger anterolateral process. In homologous elements of Adetognathus, elements may or may not have slight downward deflection of the anterolateral process. The second Sc element is distinguished by strong inward curvature of the posterior process, in contrast to presence or absence of slight inward curvature in other forms. The anterolateral process of the first Sc element may have a slight downward deflection, whereas the corresponding process in the second Sc element does not. The Sa element is distinguished from homologous elements in species of Ozarkodina of Missourian age by the presence of a denticulate posterior process. Apparatus reconstruction: BAESEMANN, 1973.]

**Capricornognathus** AUSTIN & MITCHELL, 1975, p. 47

[*Taprognathus capricornis* DRUCE, 1970, p. 102; OD]. Apparatus unknown. Pectiniform element scaphate with free medial blade half length of specimen or less; free blade increases in elevation to posterior with conspicuous posterior denticate; platform with 1, 2, or 3 low parapets or transverse ridges and shallow medial trough; anterior carina and short posterior free blade present in some; basal cavity asymmetrical and flexed. [Pectiniform elements of Capricornognathus resemble those of Cavusgnathus.] L.Carb. (low.Visean), Eu.-Australia.—Fig. 108,3. *C. capricornis* (DRUCE), Eu.(Ire.); 3a,b, Pa element, upper and lower views, X40 (Austin & Mitchell, 1975).

**Cloghergnathus** AUSTIN & MITCHELL, 1975, p. 48

[*C. globenskii*; OD]. Apparatus unknown. Pectiniform element scaphate; short free blade of uniform elevation, lateral in position, joining either right or left side of platform; lanceolate curved platform with medial trough and transverse ridges; flared asymmetrical basal cavity. [This element resembles the pectiniform Pa element of Adetognathus, which is probably a homeomorph.] U.Miss., N.Am.; L.Carb. (low.Visean), Eu.—Fig. 108,3. *C. globenskii*, holotype, Eu.(Ire.); 3a,b, Pa element, upper and lower views, X40 (Austin & Mitchell, 1975).

**Clydagnathus** RHODES, AUSTIN, & DRUCE, 1969, p. 84 [*C. cauformis*; OD]. Apparatus unknown. Pectiniform element scaphate with denticles of free blade highest at posterior end; short fixed blade joining platform on outer right margin; carina restricted to posterior, in some continuing as short free blade; medial trough; basal cavity asymmetrical. [This element resembles pectiniform elements of Cavusgnathus and Adetognathus.] U.Dev.-L.Miss., N.Am.; U.Dev.-L.Carb. (low.Tournais.), Eu.—Fig. 108,7. *C. gilwen-
free blade having high posterior denticle; other blade denticles of uniform elevation; elongate symmetrical lanceolate platform having parapet; basal cavity narrow to flared. U.Dev.-L.Miss., N.Am.; U.Dev.-L.Carb. (low.Tournais.), Eu.-Asia M.—Fig. 108.2. *P. variabilis*, low.Tournais., Eu.(Wales); 2a-c, Pa element, lat., lower, and upper views, X25 (Austin & Hill, 1973).

**Taphrognathus** Branson & Mehl, 1941a, p. 181, *non* Welles, 1947, an amphibian [*T. varians*; OD]. Apparatus unknown. Pectiniform element scaphate with free blade from half to one-third total length of specimen; right side of platform continuing as short carina; trough along midline of platform; ridges transverse. Miss.(Keokuk F.-mid.St.Louis F.), N.Am.; L.Carb., Eu.—Fig. 108.1. *T. varians*, low.Viscan, Eu.(Scot.); 1a-c, Pa element, upper, lower, and lat. views, X37 (Rhodes, Austin, & Druce, 1969).
Family IDIOGNATHODONTIDAE
Harris & Hollingsworth, 1933

[nom. transl. et correct. HASS, 1959, p. 379, pro Idiognathidae Harris & Hollingsworth, 1933, p. 200] [Materials for this family prepared by R. L. Austin and F. H. T. Rhodes]

Apparatus either sexi- or septimembrate. Pectiniform elements scaphate (Pa) and angulate (Pb); M dolabrately; ramiform elements either alate (Sa) or bipennate (Sb and Sc). U.Dev.-L.Perm.

Idiognathodus Gunnell, 1931, p. 249 [*I. claviformis; OD] [=Scottognathus Rhodes, 1953a (partim), nom. subst. pro Scottella Rhodes, 1952, non Enderlein, 1910, a dipteran]. Apparatus sexi- or septimembrate; Pa element scaphate, Pb angulate, M dolabrately, Sa alate, Sb bipennate, Sc bipennate. Pa element diagnostic; long free blade at least half length of element, carina partly or completely suppressed and transverse ridges strong, especially in posterior portion of upper surface. L.Penn.-L.Perm., N.Am.; U.Carb.(Namur.-Westphal.), Eu.-Afr.-Asia M.-Australia-N.Z.-S.Am.

---Fig. 109.1. I. delicatus Gunnell, L.Penn., USA(IlI.); Pa element, upper view, X28 (Merrill & King, 1971); for a reconstruction of assemblage, see Fig. 53.3.

Gnathodus Pander, 1856, p. 33, non Fieber, 1866, an hemipteran [*G. mosquensis; OD] [=Dryphasis Cooper, 1939; Westfalicus Moore & Sylvester-Bradley, 1957b]. Apparatus probably seximembrate; Pa element scaphate, Pb angulate, M dolabrately, Sa alate, Sb bipennate, Sc bipennate. Pa pectiniform element diagnostic; free blade medial, straight or curved, usually at least half length of element; carina distinct; sculpture of upper surface variable, either isolated nodes, parapets, adcarinal grooves, transverse ridges, or combination of these. L.Miss.(Kinderhook.)-L.Penn., N.Am.; L.Carb.(Tournais.-Namur.), Eu.-Asia M.-Afr.-Australia-N.Z.-S.Am.

---Fig. 109.3. G. bilineatus (Roundy), Visean, Eu.(Belg.); Pa element, upper view, X63 (Austin & others, 1974); for a reconstruction of assemblage, see Fig. 53.2.

Idiognathoides Harris & Hollingsworth, 1933, p. 201 [*I. sinnata; OD] [=Polynathodella Harton, 1933; Declinognathodus Dunn, 1966; Oxiognathus Ellison, 1972]. Apparatus unknown, probably sexi- or septimembrate. Pectiniform element scaphate with medial or lateral blade almost half length of element, in some continuing as deflected carina merging with a parapet or terminating against parapet; sculpture of upper surface as parapets or transverse ridges and a trough. L.Penn.-M.Penn., N.Am.; U.Carb.(Namur.-Westphal.), Eu.-Australia-Asia M.---Fig. 109.5. I. noduliferus (Ellison & Graves), Eu.(G.Brit.); Pa element, upper view, X28 (Austin, 1972).

Neognathodus Dunn, 1970, p. 336 [*Polynathus bassleri Harris & Hollingsworth, 1933, p. 198; OD]. Apparatus unknown, probably either sexi- or septimembrate. Pectiniform element scaphate
Paragnathodus Higgins, 1975, p. 70 [*Spathognathodus commutatus Branson & Mehl, 1941c, p. 98; OD] [=Paragnathodus Meischner, 1970, nom. nud.]. Apparatus unknown, possibly resembling that of Gnathodus. Pectiniform element scaphate with free medial blade equaling platform in length or longer; platform oval to circular in form, unornamented or ornamented with one or few nodes, nodes in some linear; carina commonly thickened. [This element resembles the pectiniform element of Prognathodus.] U.Miss.-L.Penn. (Visean-low. Namur.), N.Am.-Eu. —Fig. 109, 2. *P. commutatus (Branson & Mehl), Visean, Eu. (Eng.); Pa element, upper view, X40 (Higgins, 1975).


Streptognathodus Stauffer & Plummer, 1932, p. 47 [*S. excellus; OD] [=Scottognathus Rhodes, 1953b (parium), nom. subst. pro Scottella Rhodes, 1952, non Enderlein, 1910, a dipteran]. Apparatus either sexi- or septimembrate; Pa element scaphate, Pb angulate, M dolabrate, Sa alate, Sb bipennate, Sc bipennate. Pa element with long free blade, platform with median trough and transverse ridges. [Median trough distinguishes Streptognathodus from Idiognathodus.] L.Penn.-L.Per., N.Am.-Eu.-Afr.-Australia-N.Z. —Fig. 109, 4. S. antiquus (Stauffer & Plummer), U. Penn., USA (Kans.); Pa element, upper view, X52 (von Bitter, 1972).

Family POLYGNATHIDAE Bassler, 1925


Apparatus seximembrate; Pa element carminate, planate, or scaphate; Pb angulate or anguliplanate; M dolabrate; S symmetry-transition series bearing confluent denticles. U.Ord.-U.Carb.

Polygnathus Hinde, 1879, p. 361 [*P. dubius; SD Miller, 1889, p. 520; neotype selected by Huddie, 1970, p. 1037] [==Hindeodella Bassler, 1925,

Fig. 110. Polygnathidae (p. W162-W164, W166).

with long free blade up to half length of element meeting platform centrally or subcentrally; platform in some reduced or absent on outer margin; parapets or transverse ridges flanking one or both sides of platform; carina extending to, or near, posterior tip of element; adcarinal grooves deep; basal cavity large, deep, asymmetrical. L.Penn.-L.Perm., N.Am.; U.Carb. (Namur.-Westphal.), Eu. —Fig. 109, 1. *N. bassleri (Harris & Hollingsworth), L.Penn., USA (Okl.); 1a-c, Pa element, lat., upper, and lower views, X40 (Dunn, 1970).
Conodontoporida—Polygnathacea

p. 219; *Ctenopolygnathus* Müller & Müller, 1957, p. 1084]. Pa element carminiplanate (carminiscaphate in earliest species); Sa element alate with denticulate posterior process. [Reconstruction: Klapper & Philip, 1971, 1972.] L.Dev. (Ems.)–L.Miss.(low. Visian), Eu.-N. Afr.-Asia-N. Am.-Australia.—Fig. 110.2. *P. dubius*, U.Dev. (L. Mesotaxis asymmetrica Z., Genundewa Ls.), USA(N.Y.); 2a, Pa element, upper view; 2b, Pb element, lat. view; 2c, M element, lat. view; 2d,
Sa element, lat. view; 2e, Sc element, lat. view; 2f, Sb element, lat. view; ×40 (Klapper & Philip, 1971).


**Ancyrodelloides** Bischoff & Sannemann, 1958, p. 91 [*A. trigonica*; OD]. Like Ancyrodella but upper platform surface of Pa element smooth adjacent to carina and secondary carinae. [Only Pa element is recognized.] L.Dev. (Eu.-Asia M.-N.Am. (Alaska).—Fig. 111.7. *A. trigonica*, Tentaculitenkalk, Eu. (Ger.); Pa element, upper view, ×17 (Bischoff & Sannemann, 1958).

**Ancyrognathus** Branson & Mehl, 1934a, p. 240 [*A. symmetricus*; OD] (=Ancyrodes Miller & Youngquist, 1947, p. 504). Pa element pastiniplanate; outer lateral lobe directed somewhat posteriorly, but absent in late species. [Only Pa element is recognized.] U.Dev. (Famenn.), Eu.-N.Afr.-N.Am.-Australia.—Fig. 111.5. *A. triangularis Youngquist*, U.Dev. (L. Ancyrognathus Z., Sweetland Creek Sh.), USA (Iowa); Pa element, upper view, ×27 (Klapper & Furnish, 1963).

**Ancyrolepis** Ziegler, 1959, p. 77 [*A. cruciformis*; OD]. Pa element modified pastiniplanate with weak inner lobe and strong outer lobe; secondary keel present at least on outer lobe. [Only Pa element is recognized.] M.Dev. (Givet.-Low.Famenn.), Eu.-N.Am.-Australia.—Fig. 111.6. *A. cruciformis*, holotype, U.Dev. (L. Palmatolepis crepida Z.), Eu. (Ger., Dill syncline); Pa element, upper view, ×23 (Ziegler, 1959).

**Bispathodus** Müller, 1962a, p. 114 [*Spathodus spinulosicostatus* Branson, 1934, p. 305; OD]. Pa element carminate or carminiscaphate, commonly with accessory denticles on right side of blade; accessory denticles discrete or connected to main denticle row by transverse ridges. [Only Pa element is recognized.] M.Dev. (Givet.-Low.Famenn.), Eu.-Asia-N.Am.-Australia.—Fig. 111.4. B. costatus (Branson), holotype, L.Miss. (Hannibal F.), USA (Mo.); 4a-c, Pa element in lat., upper, and lower views, ×23 (Ziegler, Sandberg, & Austin, 1974).

**Eognathodus** Philip, 1965, p. 99 [*E. sulcatus*; OD]. Pa element carminiscaphate (but cavity reduced in late species) with double denticle row; Sa element alate, lacking distinct posterior process. [Reconstruction: Klapper & Philip, 1971.] L. Dev.-M. Dev., Eu.-Asia-N.Am.-Australia.—Fig. 111.3. *E. sulcatus*, holotype, L.Dev. (Coopers Creek F.), Australia (Vic.); 3a,b, Pa element, lat. and upper views, ×23 (Philip, 1965).

**Hemilistrona** Chauff & Dombrowski, 1977, U.Dev., see addendum.

**Kimognathus** Mashkova, 1978, L.Dev., see addendum.

**Mesotaxis** Klapper & Philip, 1972, p. 100 [*Polygnathus asymmetricus* Bischoff & Ziegler, 1957, p. 88; OD]. Apparatus like Polygnathus but Pb...
Conodontophorida—Polygnathaceae

W165

element with well-developed platform ledge on inner side, M element with lower margin of both processes much straighter, and Sc element with posterior process higher. [Reconstruction: Klapper & Philip, 1972.] U.Dev.(Frasn.), Eu.-N.Am.-Australia.—Fig. 111,1. *M. asymmetrica, U. Dev.(L. Mesotaxis asymmetrica Z., Gogo F.), Australia(W.Australia); 1a, Pa element, upper view; 1b,c, Pb element, oblique-lat. and upper views; 1d, M element, lat. view; 1e, Sa element, lat. view; 1f, Sc element, lat. view; 1g, Sb element, lat. view; X27 (Klapper & Philip, 1971).

Nodognathus Cooper, 1939, p. 397 [*N. spicata; OD]. Apparatus unknown. Pectiniform element carminiscaphate with free anterior and posterior blades; lateral expansions adjacent to prominent basal cavity commonly supporting long node or short transverse ridge. [Nodognathus may grade into Pseudopolygnathus.] L.Miss.(Kinderhook), N.Am.—Fig. 112,3. *N. spicata, holotype, USA (Okla.); 3a-c, lat., upper, and lower views, X27 (Cooper, 1939).

Ozarkodina Branson & Mehl, 1933a, p. 51 [*O. typica; OD; =Hindeodella confuens Branson & Mehl, 1933a, p. 45; =Plectospathodus Branson & Mehl, 1933a, p. 47; Spathognathodus Branson & Mehl., 1941c, p. 98, nom. subst. pro Spathodus Branson & Mehl, 1933a, p. 46, non Bouleneger, 1901, a fish; Ctenognathodus Fay, 1959, p. 195, nom. subst. pro Ctenognathodus Pander, 1856, p. 32, non Fairmaire, 1843, a beetle]. Pa element carminate or carminiscaphate; Sa element alate and lacking distinct posterior process. [Reconstruction: Jeppsson, 1969; Lindström, 1970, p. 439-440.] U.Ord.-L.Dev., Eu.-N.Afr.-Asia-N.Am.-Australia.—Fig. 111,8. *O. confuens (Branson & Mehl), Sil.(Ludlov.), Eu.(Sweden, Scania); 8a, Pa element, lat. view, X45; 8b, Sb element, lat. view; 8c, Pb element, lat. view; 8d, Sc element, lat. view; 8e, Sa element, post. view; 8f, M element, lat. view; all X27 except 8a (Jeppsson, 1975).

Conodonta

Pandorinellina Müller & Müller, 1957, p. 1082, nom. subst. pro Pandorina Stauffer, 1940, p. 428, non Bory de St. Vincent, 1827, a protozoan, nec Scacchi, 1833, a molluscous [*Pandorina insita Stauffer, 1940, p. 429; OD] (=Cripterognathus Walliser, 1972, p. 78). Pa element carminate; Sα element dentate with posterioric process. [Reconstruction: Klapper & Philip, 1972. ] Dev., Eu.-N.Afr.-Asia-N.Am.-Australia.—Fig. 110.J. *P. insita (Stauffer), U.Dev.(P. insita Fauna, State Quarry Ls.), USA(Iowa): 1α, Pa element, lat. view; 1β, Pb element, lat. view; 1c, M element, lat. view; 1d, Sα element, post. view; 1e, Sε element, lat. view; 1f, Sb element, lat. view; all ×40 (Klapper & Philip, 1971).

Polyphodontophila Branson & Mehl, 1934a, p. 242 [*Polygnathus gyratilineatus Holmes, 1928, p. 31; OD; St. —Polygnathus gyratilineatus Holmes in Butts, 1926, p. 160; for discussion of type species, see Glenister & Klapper, 1966, p. 831]. Pa element like that of Polygnathus (especially P. nodocostatus group) but platform upper surface with strong concentric arrangement of ridges or rows of nodes. [Only Pa element is recognized.] U.Dev.(Famenn.). Eu.-N.Am.-Australia.—Fig. 113.J. 3. P. contusus (Ulrich & Bassler), L. Palmatolepis marginifera Z.(Virgin Hills F.), Australia(W.Australia); Pa element, upper view, ×30 (Glenister & Klapper, 1966).

Pseudopolygnathus Branson & Mehl, 1934b, p. 297 [*P. prima; OD] (=Macropolygnathus Cooper, 1939). Apparatus unknown. Pectiniform element scaphate with free medial blade half to one-third element length; platform symmetrical or asymmetrical with nodes or sturdy ridges, carina distinct; basal cavity usually prominent with longer dimension generally transverse to element axis, small basal pit rare. U.Dev.-L.Miss.(Kindershock, N.Am.-Eu.-Australia).—Fig. 112.J. *P. primus, low.Tournaisians, Eu.(Wales): 2a-c, lat., upper, and lower views, ×32 (Rhodes, Austin, & Druce, 1969).

Rhachistognathus Dunn, 1966, p. 1301 [*R. primus; OD]. Apparatus unknown but probably either sexi- or septimembrate. Pectiniform element scaphate with laterally compressed, long, free blade of uniform elevation, joining platform at mid-length of element; platform lanceolate with parapet or discontinuous carina, parapet or nodes often radiating outward. U.Carb.(Namur-Westphal.), N.Am.-Eu.—Fig. 112.J.*R. primus, L.Penn. (Bird Spring F.), USA(Nev.): 4a-c, lat., upper, and lower, and lower views, ×40 (Dunn, 1966).

Rhodalepis Druce, 1969, p. 116 [*R. inornata; OD]. Apparatus like that of Polygnathus but upper surface lacking carina and nodes or ridges, and lower surface with broad, flat inverted area (similar to pseudokeel in early species of Siphonodella). [Only Pa element is recognized.] U.Dev. (Famenn.). Australia.—Fig. 112.J. *R. inornata, low. Ningbing Ls., Australia(W. Australia, Bonaparte Gulf basin); 1a, b, lower and upper views, magnification not stated (Druce, 1969).

Scaphignathus Helms, 1959, p. 655 [*S. velifer; M; for discussion see Beinert & others, 1971, p. 82-83]. Pa element carminiplanate with blade commonly offset from carina. [Only Pa element is recognized.] U.Dev.(Famenn.). Eu.-N.Am.-Australia.—Fig. 113.Ja. *S. velifer, S. velifer Z.(Virgin Hills F.), Australia(W.Australia); Pa element, upper view, ×45 (Glenister & Klapper, 1966).—Fig. 113.Jb-d. S. suberratus (Branson & Mehl), Scaphignathus suberratus-Pelekynognathus inclinatus Fauna (Trident Mbr., Three Forks F.), USA(Mont.); Pa element, lat., lower, and upper views, ×28 (Beinert & others, 1971).


Siphonodella Branson & Mehl, 1944, p. 245, nom. subst. pro Siphonognathus Branson & Mehl, 1934b, p. 295, non Richardson, 1858, a fish [*Siphonognathus duplicata Branson & Mehl, 1934b, p. 296; OD]. Pa element carminiplanate like that of Polygnathus but keel generally absent just posterior of basal pit. [Only Pa element is recognized.] U.Dev.(up.Famenn.).-L.Miss.(Tournaisis.), Eu.-N.Am.-Australia.—Fig. 113.J. S. crenulata (Cooper), L.Miss.(basal Lodgepole Ls.), USA(Mont.): 5a-b, Pa element, lower and upper views, ×27 (Klapper, 1971).

Tortodus Weddige, 1977, M.Dev., see appendix.

Family ANCHIGNATHODONTIDAE

Clark, 1972

[nom. transl. herein, Sweet & Clark, ex superfamly Anchignathodontacea Clark, 1972a, p. 157] [Materials for this family prepared by W. C. Sweet and D. L. Clark]

Apparatus of generalized, long-ranging species seximembrate, but reduced to quadrimembrate or Pa elements and thus unimembrate in specialized species. Scaphate Pa element with broadly expanded base and short anterior free blade, smooth on upper side in all species with seximembrate apparatuses, bearing denticles, nodes, or transverse ridges in majority of species with unimembrate apparatuses. Pb element typically bowed and angulate, with anterior process shorter than posterior process; M elements digyrate; Sα elements aleate, with-
out posterior process in most species; $S_b$ digyrate, with one lateral process deflected strongly upward and posteriorly; $S_c$ bipen­nate. $L.Carb.-L.Trias.$

**Hindeodus** Rexroad & Furnish, 1964, p. 671 [*Trichonodella imperfecta Rexroad, 1957; OD; =Spa­thognathodus cristulus Youngquist & Mil­ler, 1949, p. 621*] [=**Anchignathodus Sweet, 1970**]. Apparatus heximembrate: $P_a$ element scaphate, $P_b$ angulate, $M$ dolabrate or digyrate with one lateral process denticulate, $S_a$ alate with no posterior process, $S_b$ digyrate, and $S_c$ bipen­nate. [The originally designated type species was based on the $S_a$ element of a heximembrate apparatus including elements of *Spa­thognathodus cristulus Youngquist & Miller, 1949* ($P_a$), *Osarkodina curvata Rexroad, 1958b* ($P_b$), *Neoprioniodus camurus Rexroad, 1957* ($M$), *Falcodus? alatoide Rexroad & Burton, 1961* ($S_b$), and *Hindeodella* sp. of *Rexroad & Furnish, 1964* ($S_c$); hence, *H. cristulus* (Youngquist & Miller) has priority as the type species of multielement *Hindeodus.*] $L.Miss.-L.Trias., N.Am.-Asia-Eu.-S.Am.$——Fig. 114.1. *H. cristulus* (Youngquist & Miller), Miss., USA (Iowa); 1a, $S_a$ element, post. view; 1b, $S_b$ element, post. view; 1c, $S_c$ element, lat. view; 1d, $M$ element, post-lat. view; 1e, $P_b$ ele­ment, outer lat. view; 1f, $P_a$ element, lat. view; $X30$ (Rexroad & Furnish, 1964).

**Aethotaxis** Baesemann, 1973, p. 697 [*A. advena; OD*]. Apparatus quadrimembrate: $S_a$ symmetrical; $S_b$ nearly symmetrical, with short posterior process; $S_c$ bipen­nate, of two forms distinguished by $90^\circ$ flexure of anterior process and position of posterior process just behind cusp. [The $X$ element of Baesemann was not considered by him to be closely comparable to previously described elements; however, it bears a striking re­semblance to some forms of *Apatognathus* and therefore occupies an $S_a$ position.] $U.Penn., N.Am.$——Fig. 115.1. *A. advena; 1a, $S_a$ element, holotype, lat. view; 1b, $S_b$ element, lat. view; 1c, $S_c$ elements, lat. views; 1d, $M$ element, lat. view; 1e, $P_b$ ele­ment, post. view; $X34$ (Baesemann, 1973).

**Diplognathodus** Kosur & Merrick in Kosur, 1975a, p. 9 [*Spa­thognathodus coloradoensis Murray & Chronic, 1965, p. 606; OD*]. Apparatus seximembrate, $P_a$ scaphate with free blade equal in length to fused or partly fused carina of platform; basal cavity subelliptical in outline, deepest portion located behind anterior blade; $P_b$ angulate, $M$ dolobrate, $S_a$ alate with well-developed posterior process, $S_b$ and $S_c$ bipen­nate. $U.Penn.-L.Perm., N.Am.; U.Carb.-U.Perm., Eu.- Asia.$——Fig. 115.2. *D. sp., L.Perm., USA(Nev.); 2a, $P_a$ element, lat. view, $X110; 2b, P_b$ element, lat. view, $X110; 2c, M$ element, lat. view, $X80; 2d, S_a$ element, post. view, $X175; 2e, S_c$ element, lat. view, $X70$ (Clark, n).

**Fig. 114. Anchignathodontidae (p. W167-W169).**

**Iranognathus** Kosur, Mostler, & Rahimi-Yazd, 1976, U.Perm., see addendum.

**Isarcicella** Kosur, 1975a, p. 11 [*Spa­thognathodus isarcicus Huckriede, 1958; OD*]. Apparatus unknown, but probably unimembrate with variable single element. Genus based on tiny, subquadrate, posteriorly truncate, scaphate elements with bases
broadly expanded laterally; may be smooth on upper surfaces or bear 1 or 2 long denticles on either or both sides. [Laterally adenticulate elements, which are numerous in known collections, have been referred by several authors to Anchignathodus Sweet, 1970 a junior subjective synonym of Hindeodus Rexroad & Furnish, 1964. Such elements resemble laterally denticulate forms closely, are common in samples that lack any ramiform components of Hindeodus, and are thus included here in Isarcicella.] L.Trias., Eu.-Asia-Middle East.—Fig. 114.2. *I. isarica (Hucker­ bie) [Huckrie) Eu.(Italy); lat. view, x65 (Sweet, n).

Neostreptognathodus Clark, 1972a, p. 155 [*Strep­

tognathodus sulcoplicatus Youngquist, Hawley, & Miller, 1951, p. 363; OD] [? = Vi­jovites Kozur in Kozur & Mostler, 1976]. Apparatus unknown. Pa element scaphate, pectiniform with slender free anterior blade from one-third to one-half total length of element; trough along midline; edges smooth to parapet-form. [This element is a homeomorph of Carboniferous Streptognathodus.] Perm., N.Am.-S.Am.-Eu.—Fig. 114.4. *N. sulcoplicatus (Youngquist, Hawley, & Miller), L.Perm., USA(Wyo.); upper view, x80 (Clark, n).


Sweetognathus Clark, 1972a, p. 155 [*Stapha­
gnathodus whitei Rhodes, 1963, p. 404; OD]. Apparatus probably unimembrate; pectiniform element scaphate with short free anterior blade in young forms; blade approaching length of total unit in older forms. FAint rostrum in juveniles, developing to heavy rostrum and carina at maturity. L.Per., ?U.Per., N.Am.-S.Am.-Asia. —Fig. 114,3. *S. whitei (Rhodes), L.Per., USA(Nev.); upper view, X30 (Clark, n).

Superfamily UNKNOWN
Family BACTROGNATHIDAE
Lindström, 1970

[Bactrognathidae Lindström, 1970, p. 44] [Materials for this family prepared by R. L. Austin and F. H. T. Rhodes]

Apparatus unknown. Pectiniform element carminate, pastiniplanate, pastiniscaphate, or scaphate. [Possibly a member of the superfamily Polygnathacea.] U.Dev.-L.Miss.

Bactrognathus Branson & Mehl, 1941c, p. 98 [*B. hamatus; OD]. Apparatus unknown. Pectiniform element carminate with straight anterior process and laterally deflected posterior process that is only one-third as long as anterior process. Under side of both processes longitudinally grooved; basal cavity cup-shaped. L.Miss.(Osag. or Tournais.), N.Am.-Eu.—Fig. 116,1. *B. hamatus, holotype, Pierson Ls., USA(Mo.); la-c, upper, lower, and lat. views, X25 (Branson & Mehl, 1941c).


Doliognathus Branson & Mehl, 1941c, p. 100 [*D. lata; OD]. Apparatus unknown. Pectiniform element pastiniplanate with long and straight anterior process; posterior and lateral processes shorter, diverging at angle of approximately 120°; platforms decreasing uniformly in width to pointed extremities but extending to end of processes; transverse ridges or parapets at margin; carina of anterior process distinct, low, nodes fused, becoming prominent anteriorly to form blade; generally fewer nodes forming carina of posterior and lateral processes; basal pit small and situated at junction of processes; keel under each process. L.Miss.(low.Osag. or up.Tournais.), N.Am.-Afr.-Eu.—Fig. 116,3. *D. lata, Pierson Ls., USA(Mo.); 3a, paratype, upper view; 3b,c, holotype, upper and lower views; X17 (Branson & Mehl, 1941c).

Dollymae Hass, 1959, p. 394 [*D. sagittula; OD]. Apparatus unknown. Element pastiniscaphate with anterior free blade bearing either 1 or 2 median rows of denticles; terminal cusp at posterior extremity; 2 denticulate lateral processes, commonly developed at lateral side of free blade; basal cavity large, apex located near posterior of element. L.Miss.(Osag. or up.Tournais.), N.Am.-Eu.-Asia

Fig. 116. Bactrognathidae (p. W169-W170).

Minor.—Fig. 116,4. *D. sagittula, Chappel Ls., USA(Texas); 4a,b, upper and lower views, X30
**Conodonta**

**FIG. 117. Elictognathidae, Mestognathidae (p. W170-W172).**

(Eustaphus) Pierce & Langenheim, 1974, p. 155

[*E. burlingtonensis; OD*]. Apparatus unknown. Pectiniform element segminiscaphate with distinct, low-crowned denticles; posterior cusp bladelike; basal cavity open, elongate, gradually tapering toward anterior. L.Miss. (up. Tourlais.), N.Am.-Eu.—Fig. 116.6. *E. burlingtonensis*, Bullion Ls., USA (Nev.); 6a-c, upper, lower, and lat. views, ×40 (Pierce & Langenheim, 1974).

**Scaliognathus** Branson & Mehl, 1941c, p. 101 [*S. anchoralis; OD*]. Apparatus unknown. Pectiniform element planate and anchor-shaped with anterior and two lateral processes, each bearing median row of nodes and faint marginal transverse ridges; basal cavity near posterior end. L.Miss. (low. Osag. or up. Tourlais.), N.Am.-Eu.-S.Am.-Australia-Afr.—Fig. 116.2. *S. anchoralis*, holotype, Pierson Ls., USA (Mo.); 2a,b, upper and lower views, ×25 (Branson & Mehl, 1941c).

**Stauognathus** Branson & Mehl, 1941c, p. 102 [*S. cruciformis; OD*]. Apparatus unknown. Pectiniform element segminiscaphate with 4 processes; anterior process longest, straight or gently curved; posterior process shortest and deflected laterally relative to anterior process; 2 lateral processes of unequal length; all processes tapering uniformly to bluntly pointed tips; upper surface of processes bearing median grooves and transverse ridges. L.Miss. (low. Osag. or up. Tourlais.), N.Am.-Eu.-Afr.—Fig. 116.5. *S. cruciformis*, holotype, Sycamore Ls., USA (Okla.); 5a,b, upper and lower views, ×25 (Branson & Mehl, 1941c).

**Family ELICTOGNATHIDAE**

Austin & Rhodes, new

[MATERIALS FOR THIS FAMILY PREPARED BY R. L. AUSTIN & F. H. T. RHODES]

Total apparatus unknown. Ramiform element digyrate; pectiniform element anguliplanate. [Possibly a member of the superfamily Polygnathacea.] *U. Dec.-L.Miss.*

**Elictognathus** Cooper, 1939, p. 386 [*Solenognathus bialata* Branson & Mehl, 1934b, p. 273; OD] [=Solenodella Branson & Mehl, 1944, nom. subst. pro Solenognathus Branson & Mehl, 1934b, non Agassiz, 1846, nec Bleeker, 1856-57, nec Pictet & Humbert, 1866, all fishes]. Apparatus unknown. Pectiniform element anguliplanate, compressed, anterior process directed downward relative to posterior process. Element slightly arched; basal part of posterior extremity flexed inward in some; inner side near lower margin in some with narrow platform and denticulate parapet; cusp prominent, or 2 or 3 prominent denticles; basal cavity elongate and small, keel distinct. L.Miss. (Kinderhook, or Tourlais.), N.Am.-Eu.-Australia.—Fig. 117.1. *E. bialata* (Branson & Mehl), Haul' F., USA (Texas); 1a,b, outer and inner lat. views, ×36 (Cooper, 1939).

**Dinodus** Cooper, 1939, p. 386 [*D. leptus; OD*]. Apparatus unknown. Ramiform element digyrate with laterally compressed denticles; thin anterior process turning down and curving beneath remainder of element; unit broadest adjacent to lower margin; denticles needlelike, closely set, laterally confluent; cusp indistinct; basal cavity small. L. Miss., N.Am.-Eu.—Fig. 117.4. *D. fragosus* (Branson), Haul' F., USA (Texas); lat. view, ×25 (Hass, 1962).

**Falcodus** Huddles, 1934, p. 87 [*F. angulus; OD*]. Apparatus unknown. Ramiform element digyrate; thin denticulate posterior process continuing to near downward deflection, where 1 or 2 large denticles common; denticles laterally confluent along length; lower margin of posterior process...
angled downward from basal cavity to posterior end; thin anterior process angled downward about 90°; denticles laterally compressed and closely set; basal pit small. U.Dev.-L.Miss. (Kinderhook or low Tournais.), N.Am.-Eu.—Fig. 117.2. *F. angulus*, holotype, up. New Albany Sh., USA (Ind.); outer lat. view, x25 (Huddle, 1934).

**Pinacognathus** Branson & Mehl, 1944, p. 244, nom. subst. pro Pinacodus Branson & Mehl, 1934b, non Davis, 1883, a fish [*Pinacodus pro-
**Conodonta**

**fundus BRANSON & MEHL, 1934b; OD]. Apparatus unknown. Pectiniform element angulate with prominent main cusp; anterior process high, short, compressed, bearing fused denticles; posterior process shorter, denticulate upper edge falling steeply in elevation toward posterior; basal cavity small and expanded laterally. *L.Miss.(Kinderhook, or low.Dinant), N.Am.-Eu.—Fig. 117.5. *F. profundus (BRANSON & MEHL), Bachelor F., USA (Mo.); lat. view, x30 (Austin, n).

**Family MESTOGNATHIDAE**

Austin & Rhodes, new

[Materials for this family prepared by R. L. Austin & F. H. T. Rhodes]

Apparatus unknown. Pectiniform element planate with short, free, lateral blade, distinctive carina on platform, small basal cavity. *U.Miss.(Visean)-L.Penn.(Namur.)*

**Mestognathus** BIRCHOFF, 1957, p. 36 [*M. beckmanni; OD]. Apparatus unknown. Pectiniform element planate; short free element on lateral margin; highest at posterior; carina present and distinct in most specimens; transverse ridges on posterior platform; small basal pit and groove on lower surface. [The element resembles the pectiniform Pa element of *Cavusgnathus*, but the small basal cavity is distinctive.] *U.Miss.(Visean)-L.Penn.(Namur.)*

**Conodon** M.Ord. (Pakerort Stage, ?Varangu Mbr.), Eu.(Bal­tic); Sb, lat. views; Sa, cross section of cusp; magnification unknown (Pander, 1856).

Angulodus HUDLE, 1934, p. 76 [*A. demissus; OD*] [=Cerconiodontina STAFFER, 1938, p. 424]. Sh element bipennate with downward projecting anterior process in vertical plane of posterior process. Denticles confluent and commonly alternating in size. *Dev.-Penn., Eu.-N.Am.-Australia.—Fig. 118.11. *A. demissus, holotype, U.Dev.(low.New Albany Sh.), USA(Ind.); Sh element, lat. view, x17 (Huddle, 1934).

**Family UNKNOWN**

[Materials for this section prepared by R. L. Austin, S. M. BERGSTROM, D. L. CLARK, GIBERT KLAPPER, and F. H. T. RHODES]

Brief entries for several genera proposed since completion of the text and not assignable to family are included in the addendum.

**Acodus** PANDER, 1856, p. 21 [*A. erectus; SD ULRICH & BASLLER, 1926, p. 7] [=Aeconiodus PANDER, 1856]. Apparatus unknown; genus based on nongeniculate, conform elements with slightly recurved cusp, short base, and shallow basal cavity. Cusp somewhat compressed laterally with anterior and posterior edges; one lateral face with prominent central carina, other face evenly convex. [Estonian specimens identified as *A. erectus* have recently been illustrated by VIIRA (1975, fig. 17a, 17b). They appear to be the first new specimens of this species figured since Pander's time. As noted by SWEET & BERGSTROM (1972), data from Estonia (VIIRA, 1966) suggest that elements of *A. erectus* are associated with, and have the same range as, those of *Aeconiodus latus* PANDER, 1856, type species of *Aeconiodus*. Accordingly, it is possible that all these elements were components of the same apparatus and *Acodus* and *Aeconiodus* are synonyms; see also LINDBRIT (1973).]

**Angulodus** BRANSON & MEHL, 1934a, p. 201 [*A. varians; OD*]. Sa element with anterior and posterior processes forming symmetrical arch, but cusp twisted posteriorly; both processes flexed inward, commonly with cyclic alternation of diagonal off-set denticles. *U.Dev.-U.Miss., Eu.-N.Am.-Australia.—Fig. 119.3. *A. varians, U.Dev.(Bispalothus costatus Z.), Australia(W.Australia); Sa element, inner view, x45 (Glenister & KLAPPER, 1966).

**Brannchla** HASS, 1959, p. 381 [*Spathodus inornatus BRANSON & MEHL, 1934a, p. 159]. Pa element carinate with basal cavity near posterior end; other elements unknown. *U.Dev.(up. Famenn.)-L.Miss.(Tournais.), Eu.-N.Am.—Fig. 120.5, *B. inornata (BRANSON & MEHL), holotype, U.Dev.(Saverton Sh.), USA(Mo.); Pa element, lat. view, x27 (KLAPPER, n).

**Bryantodus** BASLLER, 1925, p. 219 [*B. typicus; OD]. Anguliplanate *Pb element with massive cusp, narrow platform ledges, and downward projecting apical lip. *U.Dev.(Frasm.), N.Am.(N.Y.)—Fig. 120.12. *B. typicus, lectotype, Rhine­street Sh., USA(N.Y.); Pb element, lat. view, x20 (Huddle, 1968).

**Caenodontus** BEHNKEN, 1975, p. 298 [*C. serratus; OD]. Apparatus unimembrate; erect, nongeniculate, conform element with denticulate posterior edge; anterior edge rounded; basal cavity occupying more than half of element. [The genus is homeomorphic with Ordovician *Belodina*.] *U. Perm., N.Am.—Fig. 119.1. *C. serratus, USA(Texas); lat. view, x100 (BEHNKEN, 1975).

**Cornodus** FANKE, 1966, p. 20 [*C. erectus; OD]. Apparatus unknown but apparently unimembrate; conform elements lamellar, nongeniculate, rounded to reclined, with more or less oval cross section and relatively shallow basal cavity. No costae or carinae. *M.Ord., Eu.—Fig. 121.1. *C. erectus, Eu.(Sweden); Sa, toptype, lat. view, x75; Ib,c, long. and transv. cross sections, x75 (BERGSTROM, n).

**Coryssognathus** LINK & DRUCE, 1972, p. 31 [*C.
Fig. 119. Family Unknown (p. W172-W179).

dentatus; OD; =*Pelekygnathus dubius* JEPSSON, 1972, p. 62]. Pa element resembling that of *Pelekygnathus*, but cusp at anterior end. [If apparatus includes elements identified by JEPSSON (1972) as *Distomodus dubius* (Rhodes), as suggested by COOPER (1974b), *Coryssognathus* should then be referred to the Distomodontidae.]

*Silo*(LladloI'). Eu.-Australia.--Fig. 120.3. *C. dubius* (JEPSSON), holotype, Eu.(Sweden, Scania); Pa element, lat. view, X27 (Jeppsson, 1972).

*Curtognathus* BRANSON & MEHL, 1933b, p. 87 [*Curtognathus typa; OD*] [=*Polycaulodus* BRANSON & MEHL, 1933b; *Trucheroognathus* BRANSON & MEHL, 1933b; *Cardiodella* BRANSON & MEHL, 1944, nom. subst. pro *Cardiopodus* BRANSON & MEHL, 1933b, non TROUSSART, 1881, a mammal]. Apparatus unknown, of elements similar to the following form-genera of BRANSON & MEHL: *Cardiodella, Curtognathus, Polycaulodus, Microcoelodus, Trucheroognathus*. Elements forming morphologically intergradational series, apparently consistently associated. Elements fibrous (hyaline), pectiniform, under side flat or weakly excavated, denticles discrete, rounded in cross section. Cardiodelliform elements broadly triangular to V-shaped in upper view, slightly arched, with central cusp and a few denticles on each process. Curtognathiform elements strongly arched with several subequal denticles on upper side and no prominent cusp. Polycaulodontiform elements almost straight with few denticles on upper side. Trucheroognathiform elements essentially straight with somewhat irregularly oriented denticles on upper side. M. Ord., N.Am.—Fig. 118,12. *C. timidus* BRANSON & MEHL, Glenburnie Sh., Can.(Ont.); 12a,b, cardiodelliform element, ant. and post. views; 12c,e,
Fig. 120. Family Unknown (p. W172-W179).

Conodonta

microcoelodontiform element, post. and ant. views; 12d, curtognathiform element, post. view; 12f, tracherognathiform element, lat. view; 12g, polycaulodontiform element, lat. view; X 40 (Votaw, 1971).

Dapsilodus Cooper, 1976, p. 211 [*Distacodus obliquicostatus Branson & Mehl., 1933a, p. 41; OD]. Apparatus multimembrate, composed of lamellar coniform elements, consisting of acodontiform M element and S symmetry-transition series. Sx element modified distaconodontiform element with lateral costae even with or extending behind posterior keel. Sb and Sc elements slightly and strongly twisted distaconodontiform elements respectively. [Apparatus reconstruction: Serpalli, 1971; Cooper, 1976; Barrick, 1977.] Sil., N. Am.-Eu.-N.Afr.-Australia.—Fig. 120.2. *D. obliquicostatus (Branson & Mehl.), Sil.(Wenlock., St. Clair Ls.), USA(III.); 2a, Sb-Sc element, lat. view, X 43; 2b, c, M elements, inner lat. and outer lat. views, X 37, X 33 (Cooper, 1976).

longitudinal groove near posterior keel on both sides. Basal cavity shallow, extending one-third of element height. [Apparatus reconstruction: COOPER, 1975; BARRICK, 1977.]

**Family Unknown**

Apparatus unknown; genus based on lamellar, pectiniform, pinnate elements with distinct cusp and anterior and posterior processes. Anterior process blade-like with central row of subequal denticles laterally partly confluent. Posterior process somewhat wider, slightly flaring laterally, with denticles of irregular size. Anterior margin of cusp extending downward into adenticulate offset or short lateral process. Basal cavity large and wide, extending over entire under side of element. [Representatives of *D. exilis* show some similarity to *Pa* elements of *Amorphognathus*, but are distinguished by lack of well-developed platforms and lateral processes. *Dichodella* has denticulation similar to that of pinnate elements of *Phragmodus* and *Plectodina* and is distinguished from *Prioniodus* (*Baltiodina*) by the weak development of the third process.]

**Dichodella** SERPAGLI, 1967, p. 62 [*D. exilis*; OD].

Apparatus unknown; genus based on lamellar, pectiniform, pinnate elements with distinct cusp and anterior and posterior processes. Anterior process blade-like with central row of subequal denticles laterally partly confluent. Posterior process somewhat wider, slightly flaring laterally, with denticles of irregular size. Anterior margin of cusp extending downward into adenticulate offset or short lateral process. Basal cavity large and wide, extending over entire under side of element. [Representatives of *D. exilis* show some similarity to *Pa* elements of *Amorphognathus*, but are distinguished by lack of well-developed platforms and lateral processes. *Dichodella* has denticulation similar to that of pinnate elements of *Phragmodus* and *Plectodina* and is distinguished from *Prioniodus* (*Baltiodina*) by the weak development of the third process.]

**Elsonella** YOUNGQUIST, 1945, p. 358 [*E. prima*; OD] [=Neorhapidognathus *Mound*, 1968, p. 494].

*Sa* element with highly fused denticles; surface covered with minute pits [LINDSTROM, 1964, p. 157]. *U.Dev., N.Am.*—Fig. 119.4. *E. prima*, lectotype, Frasn.(Amana beds), USA (Iowa); *Sa* element, post. view, X34 (Klapper, 1966).

**Euprioniodina** BASSLER, 1925, p. 219 [*E. deflecta*; OD].

*M* element dolabrate with both processes having discrete denticles. *U.Dev.(Famenn.), N.Am. (N.Y.)*—Fig. 120.13. *E. deflecta*, lectotype, Rhinestreet Sh., USA (N.Y.); *M* element, lat. view, X20 (Huddle, 1968).

**Evencodus** MOSKALENKO, 1970, p. 42 [*E. sibiricus*; OD].

Apparatus not known with certainty; genus based on nongeniculate, hyaline coniform elements, present with suberect to proclined, in cross section rounded, laterally multicoate cusp, very shallow basal cavity; anterobasal portion of unit characterized by lack of well-developed platforms and is distinguished from *D. sibiricus*.—Fig. 118.1. *E. sibiricus*, lectotype, Frasn.(Amana beds), USA (Texas); X25 (Serpagli, 1967).

**Hindeodelloides** HUBBELL, 1934, p. 48 [*H. bicristatus*; OD].

Apparatus unknown. Ramiformal element bipennate; posterior process long, denticulate, anterior process shorter, both with closely set denticles, denticles alternating in length and size in some. *L.Miss.(low.Dinant.), N.Am.-Eu.*—Fig. 122.3. *H. bicristatus*, New Albany Sh., USA (Ind.); outer lat. view, X25 (Hass, 1962).

**Hindeodina** HUBBELL, 1959, p. 382 [*H. simplaria*; OD].

Apparatus unknown. Ramiform element bipennate with elongate straight to slightly curved posterior process bearing discrete denticles; short denticulate anterior process deflected downward and occasionally inward. Cusp indistinct and distinguished only through position above basal cavity; lower margin sharp-edged; lips of basal pit extremely small or absent. *U.Dev.-U.Miss., N.Am.-Eu.*—Fig. 122.4a. *H. simplaria*, holotype, L.Miss.(Chappel Ls.), USA (Texas); inner lat. view, X30 (Hass, 1959).—Fig. 122.4b. *H. unca*, holotype, L.Miss.(Chappel Ls.), USA (Texas); upper view, X30 (Hass, 1959).

**Istorinus** KNÜPPER, 1967, p. 31 [*I. erectus*; OD].

Apparatus unknown; elements with suberect, lat-
Conodonta

Fig. 122. Family Unknown (p. W175, W179).

Cephalic complex generally compressed cusp with sharp anterior and posterior edges; small suberect denticle in front of cusp. Basal cavity deep, extending through entire unit. [Original illustrations (Knüpf, 1967, pl. 1) show the types of the genus to be essentially complete and not fragments of rami-form elements.] U.Ord., Eu.(Thuringia).—Fig. 118,5. *J. erectus; 5a,b,d, lat. views, small denticle anterior to main cusp; 5c, cross-section shape; X59 (Knüpf, 1967).

Kladognathus Rexroad, 1958b, p. 19 [*Cladognathus prima Rexroad, 1957, p. 28; OD] [=Cladognathodus Rexroad & Collinson, 1961 (obj.), nom subst. pro Cladognathus Rexroad, 1957, non Burmeister, 1847, a beetle]. Apparatus unknown, although unlikely to contain pectiniform element. Ramiform element bipennate with long, thin, posterior process surmounted by discrete denticles; long reclined cusp at anterior extremity of posterior process. Anterior process bifid, separated into subsidiary processes at point 1 or 2 denticles anterior of cusp. Under side of bars grooved. U.Miss. (Chester, or up.Dinant.), N.Am.-Eu.—Fig. 122, 8. *K. primus (Rexroad), USA(Ill.); inner lat. view, X72 (Rexroad, 1958b).

Lambdagnathus Rexroad, 1958b, p. 19 [*L. fragilidens; OD]. Apparatus unknown. Ramiform element tertiopeate. Arched denticulate posterior
process longest and deepest of 3 processes; lateral and anterolateral processes relatively thin and deep, denticulate, of unequal length, developed at right angles to posterior process; reclined cusp same elevation as proximal denticles of the 3 processes; basal pit triangular; under side of specimen more or less sharp edged. U.Miss.(Chester, or up.Dinant.), N.Am.(Ill., Ind., Ky.-) Eu.—Fig. 122,6. *L. fragilident, holotype, Glen Dean Ls., USA(III.); 6a,b, oblique and upper views, ×40 (Rexroad, 1958b).

Ligonodina BASSLER, 1925, p. 218 [*L. pectinata; OD]. Sc element bipennate, with anterolateral process and its denticles flexed posteriorly, denticles discrete. U.Dev.(Frasn.), N.Am.(N.Y.).—Fig. 119,6. *L. pectinata, lectotype, Rhinestreet Sh., USA(N.Y.); Sc element, lat. view, ×20 (Huddle, 1968).

Lonchodina BASSLER, 1925, p. 219 [*L. typicalis; OD]. Sh element with anterior and posterior processes incurved distally; denticles discrete. U.Dev.(Frasn.), N.Am.(N.Y.).—Fig. 119,11. *L. typicalis, lectotype, Rhinestreet Sh., USA(N.Y.); Sh element, lat. view, ×20 (Huddle, 1968).

Loxodus Furnish, 1938, p. 338 [*L. bransoni; OD]. Apparatus unknown, may be unimembrate. Elements lamellar, segminate, strongly compressed laterally, highest anteriorly, denticulate, without distinct cusp. Denticles relatively short, confluent along most of element length, about equal in size. Basal cavity narrow but slightly expanded at anterior end. [Loxodus elements are not known to be associated with other ramiform or pectiniform elements that might be parts of the same apparatus.] L.Ord., N.Am.-Asia(Sib.).—Fig. 118,d. *L. bransoni, Oneota Dol., USA(Iowa); 4a, ant. part of element, lat. view, ×48; 4b,c, lat. views, ×25, ×48 (Hass, 1962).

Magnilateralla REXROAD & COLLINSON, 1963, p. 11 [*M. robusta; OD]. Apparatus unknown but unlikely to contain pectiniform element. Ramiform element bipennate; anterolateral process large and denticulate, directed down and to the rear, largest denticles part way back on process; posterior process gently curved and denticulate; basal pit generally present at junction of processes, grooves extending in some along under side of either process. U.Miss.(up.Dinant.), N.Am.-Eu.—Fig. 122,7. *M. robusta, holotype, Glen Dean F., USA(III.); 7a-c, outer lat., lower, and post. views, ×40 (Rexroad & Collinson, 1963).

Mehlina YOUNGQUIST, 1945, p. 363 [*M. irregularis; OD]. N.Am.-Eu.—Fig. 120,9. *M. gradata (syntype of M. irregularis), U.Dev.(Frasn., Amana beds), USA(Iowa); lat. view, ×27 (Klapper, n).

Metapriodontus HUDDLE, 1934, p. 57 [*M. biangulatus; OD]. Apparatus unknown. Ramiform element bipennate; anterior process short, denticulate; posterior process elongate, curved, with discrete denticles, largest denticle near posterior deflection; cusp long and reclined; basal pit small. U.Dev.-L.Ord.(Kinderhook, or low.Dinant.), N.Am.-Eu.—Fig. 122,1. *M. biangulatus, holotype, N.Am.-Eu. (New Albany Sh.), USA(Ind.); lat. view, ×18 (Huddle, 1934).

Neocoleodus BRANSON & MEHL, 1933a, p. 24 [*N. spicatus; OD]. Apparatus unknown; genus based on fibrous, hyaline, angulate, pectiniform elements with narrow basal cavity. Denticles discrete, rounded in cross section, decreasing in size posteriorly. N.Am.—Fig. 118,10. *N. spicatus, Harding Sh., USA(Colo.); lat. view, ×17 (Branson & Mehl, 1933a).

Oistodella BRADSHAW, 1969, p. 1155 [*O. pulchra; OD]. Apparatus unknown. Elements lamellar, basically conform, geniculate, with denticles along posterior cusp margin; laterally compressed and costate on one side with reclined, relatively robust cusp and anteroposteriorly extended base that flares to one side. Basal cavity shallow but occupying entire length of base. Denticles distinct, although short and confluent along part of element; size decreasing upward on cusp. [Apart from denticulation, representatives of Oistodulis pulchra show considerable similarity to “Oistodus” angulatus BRADSHAW, 1969, with which they are associated in the type strata, and it is possible that these forms belong to the same apparatus.] L.Ord., ?M.Ord., N.Am.—Fig. 121,2. *O. pulchra, L.Ord.(Fort Peña F.), USA(Texas); lat. view, ×63 (Bradshaw, 1969).

Oligodus COOPER, 1939, p. 398 [*O. curtus; OD]. Apparatus unknown. Pectiniform element angulate with fused denticles. Process curved inward, especially posterior to basal cavity; flange on under side prominent, nodose near posterior extremity; under side wide and deep, especially in posterior half. [Affinity is doubtful; the genus is like Pinacognathus according to COOPER, 1939; possibly synonymous with Bryantodus according to RHODES, 1953a.]. L.Ord.(Kinderhook), N.Am.—Fig. 122,10. *O. curtus, USA(Okla.); inner lat. view, ×40 (Hass, 1962).

6a,b, lat. views; 6c, anterior view, magnification unknown (Pander, 1856).

**Playfordia** *Glenister & Klapper*, 1966, p. 827

[*Pelekysgnathus? primitivus* Bischoff & Ziegler, 1957, p. 83; OD]. Pa element with single row of denticles and large basal cavity. [This element suggests reference to Icriodontidae; other elements are unknown.] U.Dev.(Frasn.), Eu.-N.Am.-Australia.—Fig. 119.5. *P. primitivus* (Bischoff & Ziegler), L. Mesotaxii asymetrica Z. (Gogo F.), Australia (W.Australia); lat. view, ×45 (Glenister & Klapper, 1966).

**Polygnathellus** Bischoff, 1925, p. 220 [*P. typicalis*; OD] =*Nothognathella Branson & Mein., 1934a, p. 226]. Pb element anguliplanate with platform ledges on both sides; inner ledge commonly broader. [Possibly this element is part of the apparatus of a *Palmatolepis* or *Mesotaxis* species.] U.Dev., Eu.-N.Am.-Australia.—Fig. 120.10. *P. typicalis*, lectotype, Frasn.(Rhinestreet Sh.), USA (N.Y.); lat. view, ×20 (Huddle, 1968).

**Pravognathus** Stauffer, 1936, p. 79, nom. subst. pro *Heterognathus* Stauffer, 1935b, non GÉRARD, 1854, a fish, nec SCHMARRA, 1859, a rotifer, nec KING, 1864, a beetle, nec REY, 1888, a beetle] [*Heterognathus idoneus* Stauffer, 1935b; OD]. Apparatus not known with certainty. According to WEBERS (1966, p. 45), apparatus of type species includes two kinds of rather long, laterally compressed, carminate elements, each essentially straight with slightly twisted and arched central region; cusp longer than denticles, slender, subcentral, erect; numerous short, discrete denticles of somewhat variable size anterior and posterior to cusp; basal cavity extending along entire length of element, largest beneath cusp. M.Ord., N.Am.—Fig. 120.8. *P. idoneus* (STAUFFER), Platteville Fm., USA(Minn.); lat. view, ×74 Bergström, n.]

**Prioniodina** Bischoff, 1925, p. 219 [*P. subcurvata*; OD] =*Prioniodella Basler, 1925, p. 219]. An- gulate Pb element like that of *Lonchodina* but unit not so strongly bowled inwardly and denticles more uniform. U.Dev.(Frasn.), N.Am.(N.Y.).—Fig. 119.10, *P. subcurvata*, lectotype, Rhinestreet Sh., USA(N.Y.); Pb element, lat. view, ×30 (Huddle, 1968).

**Pseudooneotodus** Drygant, 1974, p. 66 [*Onoetodus? beckmanni* Bischoff & SANNEMANN, 1958, p. 98; OD]. Characterized by short, stout cones with deep basal cavity, walls that thicken apically, and relatively smooth surface. One to three apical denticles present. [Diagnosis: BARRICK & KLAPPER, 1976.] U.Old.-L.Dev., Eu.-N.Am.—Fig. 120,11a. *P. bicornis* Drygant, Sil.(Wenlock., Kockeella amdeni Z., Clarita F.), USA(Okla.); lat. view, ×64 (Barrick, 1977).—Fig. 120,11b. *P. tricornis* Drygant, Sil.(up.Llandov.-low.Wenlock., *Pterospadodus amorphognathoides* Z., Clarita F.), USA(Okla.); lat. view, ×100 (Barrick, 1977).

**Ptilognathus** Elias, 1956, p. 114 [*P. fayi*; OD]. Apparatus unknown. Ramiform element alate; posterior process long with laterally confluent, posteriorly directed denticles; lateral processes dent- iculate and short. U.Miss., N.Am.—Fig. 122.2. *P. fayi, Goddard Sh., USA(Okla.) lat. view, ×20 (Hass, 1962).

**Reuterodorus** Serpagli, 1974, p. 79 [*R. andinus*; OD]. Apparatus apparently triembricate, including nongeniculate coniform element and two types of ramiform elements, all lamellate and forming symmetry-transition series. Coniform elements asymmetrical, robust, subrecte, laterally compressed, with conspicuous longitudinal lateral costa near anterior margin. Ramiform elements asymmetrical, digyrate to bipennate, with 1 or 2 multidenticulate, lateral processes and no posterior process; denticles of irregular size and confluent at least basally; basal cavity developed as subapical pit and shallow groove along under side of processes. [Apparatus reconstruction: Serpagli, 1974.] L.Dev., S.Am.(Arg.)-N.Am.(Texas).—Fig. 118.3. *R. andinus*, San Juan Ls., S.Am.(Arg.); 3a,b, ramiform elements, post. and lat. views, ×67, ×49; 3c, coniform element, oblique post. view, ×49 (Serpagli, 1974).

**Rotundacodina** Carls & GANDL, 1969, p. 206 [*R. noquerensis*; OD]. Simple coniform element. [This element may be part of an *Ieriodus* or *Pelekysgnathus* apparatus, or both.] L.Dev., Eu.-N.Am.—Fig. 119.2. *R. noquerensis*, Nogueras beds, Eu.(Sp., Aragon); 3a,b, Pb element, outer and inner lat. views, ×30 (Carls & Gandl, 1969).

**Roudyana** Hass, 1953, p. 88 [*R. barnettana*; OD]. Apparatus unknown, but probably multibranched. Ramiform element alate; lateral processes bearing discrete robust denticles and forming anterior arch; posterior process short and denticulate; basal cavity large. ?Miss., U.Miss.-L.Penn., N.Am.-Eu.-Afr.-Asia M.-Australia.—Fig. 118.7. *R. barnettana*, U.Miss.(Barnett F.), USA(Texas); 7a,b, post. and lat. views, ×25 (Hass, 1962).

**Sagittodonta** Knüpper, 1967, p. 37 [*S. robusta*; OD]. Apparatus unknown; genus based on fragmentary angulate, pectiniform elements with stout, subcentral cusp and short, denticulate anterior and posterior processes. Basal cavity deep, extending over entire under side of element. U.Old., Eu. (Thuringia).—Fig. 118.9. *S. robusta*, 9a,b, lat. views, ×54 (Knüpper, 1967).

**Scutula** SANNEMANN, 1955, p. 154 [*S. venusta*; OD] =*Avignatodus Lys & Serre, 1957, p. 797; ?Gnamptognathus Ziegler, 1958, p. 53]. Modified tertiopedate, quadramirate, and multiramirate symmetrical and asymmetrical elements (of a probable symmetry-transition series) characterized by thin, confluent denticles. [These elements are possibly part of the apparatus of a *Palmatolepis* species.] U.Dev., Eu.-N.Afr.-N.Am.-Australia.—Fig. 119.9, S. bipennata Sannemann, L. *Palmato­lepis marginijera* Z. (Bugle Gap Ls.), Australia.
(W. Australia); quadriramate element, lat. view, ×45 (Glenister & Klapper, 1966).

Serratognathus Lee, 1970, p. 335 [*S. bilobatus; OD]. Apparatus unknown; may be unimembrate. Elements bilaterally symmetrical, slate, anteriorly convex and posteriorly concave, lacking basal cavity; convex side with about 10 horizontal rows of short, densely spaced denticles; concave side with numerous radially disposed ribs; posterior process missing; midportion of anterior and posterior face smooth, without denticles and ribs. L. Ord., Asia (Korea-China).—FIG. 119,8. *S. bilobatus; lat., post., and ant. views, magnification unknown (Lee, 1970).

Subbryantodus Branson & Mehl, 1934b, p. 285 [*S. arcuatus; OD]. Apparatus unknown. Pectiniform element angulate with short, straight posterior process; longer anterior process directed downward; denticles laterally confluent; basal cavity small, widest beneath center of distinct main cusp. U. Dev. - L. Miss., cosmop.—FIG. 122,5. *S. arcuatus, L. Miss. (Bachelor F.), USA (Mo.); S a,b, lat. views, ×40 (Branson & Mehl, 1934b).

Symprioniodina Bassler, 1925, p. 219 [*S. alternata; OD]. M element dolabrate; both processes with confluent denticles, characteristically alternating in size. U. Dev. (Famenn.), N. Am. (Ala.).—FIG. 120,6. *S. alternata, holotype, Gassaway Mbr., Chattanooga Sh., USA (Ala.); lat. view, ×20 (Huddle, 1968).

Tokognathus Nieper, 1969, p. 122 [*T. proclinatus; OD]. Apparatus unknown; genus based on symmetrical lamellar elements with moderately deep, unexpanded, elongated base with triangular cross section. Cusp slightly proclined to erect, with smooth anterior margin and anterolateral costa on each lateral face. Posterior process long with numerous subequal, laterally compressed, basally fused denticles. (The type of T. proclinatus is similar to elements referred to Oeopikodus cf. O. quadratus by McHargue (1974, pl. 2, fig. 6), and also to elements of Belodella Ethington (1959a). Thus, Tokognathus may be a synonym of either Oeopikodus or Belodella.) L. Ord., Australia (Queensl.).—FIG. 120,4. *T. proclinatus, Nora F.; S a,b, lat. and post.-lat. views, ×171; 4c, base in lat. view, ×278; 4d, cusp, upper-lat. view, approx. ×970 (Bergström, n.).

Tripodellus Sannemann, 1955, p. 155 [*T. flexuosus; OD]. S element modified triotopedate with anterior, lateral, and posterior processes. (This element is possibly part of the apparatus of a Palmatolepis species.) U. Dev. (Famenn.), Eu. - Australia.—FIG. 120,7. T. robusta Bischoff, L. Palmatolepis marginifera Z., Virgin Hills F., Australia (W. Australia); lat. view, ×30 (Glenister & Klapper, 1966).

PROBLEMATIC NAMES

A number of generic names published in articles on conodonts are no longer used by conodont workers. Some of these names are based on nonexistent types, some are for specimens that definitely are not conodonts, and others are for specimens of uncertain or unknown taxonomic status. Among these are the following:

Archeognathus Cullison, 1938
Arcrugnathus Cooper in Cooper and Sloss, 1943
Astacodermia Harley, 1861
Bransonnella Harlton, 1933
Centrognathodus Branson and Mehl, 1944
Centrognathus Branson and Mehl, 1934a
Coleodus Branson and Mehl, 1933a
Cornuramia Smith, 1907
Dermatolithis Ehrenberg, 1854
Fortscottella Gunnell, 1931
Gnathodella Matern, 1933
Hamulosodina Cooper, 1931
Holmesella Gunnell, 1931
Icriodontidae.
Icriodina Branson and Branson, 1947
Icthyodus Harris and Hollingsworth, 1933
Lepodus Branson and Mehl, 1933a
Lepognathodus Fay, 1958
Ligononoidides Stauffer, 1938
Lonchodus Pander, 1856
Multidentodus Harlton, 1933
Nurella Pomesano Cherchi, 1967
Pachyosmia Smith, 1907
Palmatodella Bassler, 1925 [see Boogaard & Kuhy, 1979, p. 26]
Panderodella Bassler, 1925
Prionognathodus Fay, 1958
Prionognathus Pander, 1856
Pseudocodex Harris, 1962
Rhombocorniculum Walliser, 1958
Scolopodella Stauffer and Plummer, 1932
Scotlandia Cossmann, 1909
Stephanodella Matern, 1933
Subprioniodus Smith, 1907
Telumodina Cooper, 1931
Valentia Smith, 1907

ADDENDUM: Conodont Genera Proposed Since Text Completion


Gapparodus Abaimova, 1978, p. 79 [*Hertzina?
Conodonta

**Conodonta Müller, 1959; OD.** *M.Cam.-U.Cam.* Family Furnishinidae.

**Hemilistrona Chauff & Dombrowski, 1977, p. 111 ["H. depkei; OD.** *U.Dev.(up.Famenn.). Family Polygnathidae.**

**Iranognathus Kožur, Mostler, & Rahimi-Yazd, 1976, p. 7 ["I. unicostatus; OD.** *U.Perm. Family Anchignathodontidae.**

**Johnognathus Mashkova, 1977, p. 127 ["J. huddlei; OD.** *Sil.(up.Llandow.-low.Wenlock.). Family Pterospathodontidae.**

**Kimognathus Mashkova, 1978, p. 93 ["K. alexei; OD.** *L.Dev. Family Polygnathidae.**

**Laterignathus Aristov & Alekseev, 1976, p. 192 ["L. barskovi; OD.** *L.Carb.(Tournais.). Family unknown.**

**Macrodus Fahraeus & Nowlan, 1978, p. 461 ["M. dianae; OD.** *L.Ord. Family unknown.**

**Parabelodina Sweet, 1979, p. 64 ["P. denticulata; OD.** *U.Ord. Family unknown.**

**Pavlovites Kožur in Kožur & Mostler, 1976, p. 21 ["P. artinskianus; OD.** *L.Perms.(up.Artinsk.). Family unknown. [Taxonomic status uncertain.]**

**Polonodus Dzik, 1976, p. 423 ["Ambalodus disclusus Viira, 1975; OD.** *L.Ord.-M.Ord. Family unknown.**

**Pseudobelodina Sweet, 1979, p. 68 ["Belodina kirki Stone & Furnish, 1959; OD.** *M.Ord.-U.Ord. Family unknown.**

**Pseudopanderodus Landing, 1979, p. 1025 ["P. fisheri; OD.** *U.Cam. Family ?Oncotodontidae.**


**Sannemannia Al-Rawi, 1977, p. 58 ["S. pesanseris; OD.** *L.Dev.-M.Dev.(Eifel.). Family Icriodontidae.**

**Scalpellodus Dzik, 1976, p. 421 ["Protopanderodus larus Van Wamel, 1974; OD.** *M.Ord. Family unknown.**

**Spinodus Dzik, 1976, p. 424 ["Cordyodus spinatus Hadding, 1913; OD.** *M.Ord. Family unknown.**

**Sweetocristatus Szaniawski in Szaniawski & Martkiewski, 1979, p. 253 ["S. arcticus; OD.** *L.Perms.(up.Artinsk.). Family Xaniognathidae.**

**Tasmanognathus Burrett, 1979, p. 32 ["T. careyi; OD.** *M.Ord. Family unknown.**