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 Müller, 1962

[Paraconodontida MÜLLER, 1962c, p. *W*248] [Diagnosis by J. F. MILLER]

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 Miller, new

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

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 Miller, 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); *1a,b,* right oblique view, transv. sec., about ×20 (Bengtson, 1976).

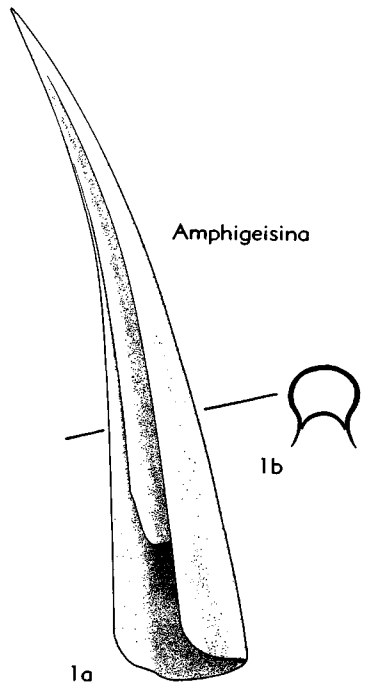

FIG. 63. Amphigeisinidae (p. W111).

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.-L.Ord.*

Furnishina MÜLLER, 1959, p. 451 [**F. furnishi*; 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. furnishi*, 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 roundly triangular. *L.Ord.(Symphysurina 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).

Gapparodus ABAIMOVA, 1978, *M.Cam.-U.Cam.*, see addendum.

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.(*Elvinia* Z.), USA(Nev.); *1a,b*, lat. view, transv. sec., ×80 (Müller, 1959).

Muellerodus MILLER, 1980, p. 27, *nom. subst. pro Muellerina* SZANIAWSKI, 1971, *non* Bassiouni, 1965, an ostracode [**Distacodus (?) cambricus* MÜLLER, 1959, p. 450; OD]. Proclined to reclined elements, cusp in some bending laterally, tip of cusp in some recurved signoidally; 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).

Nogamiconus 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.);

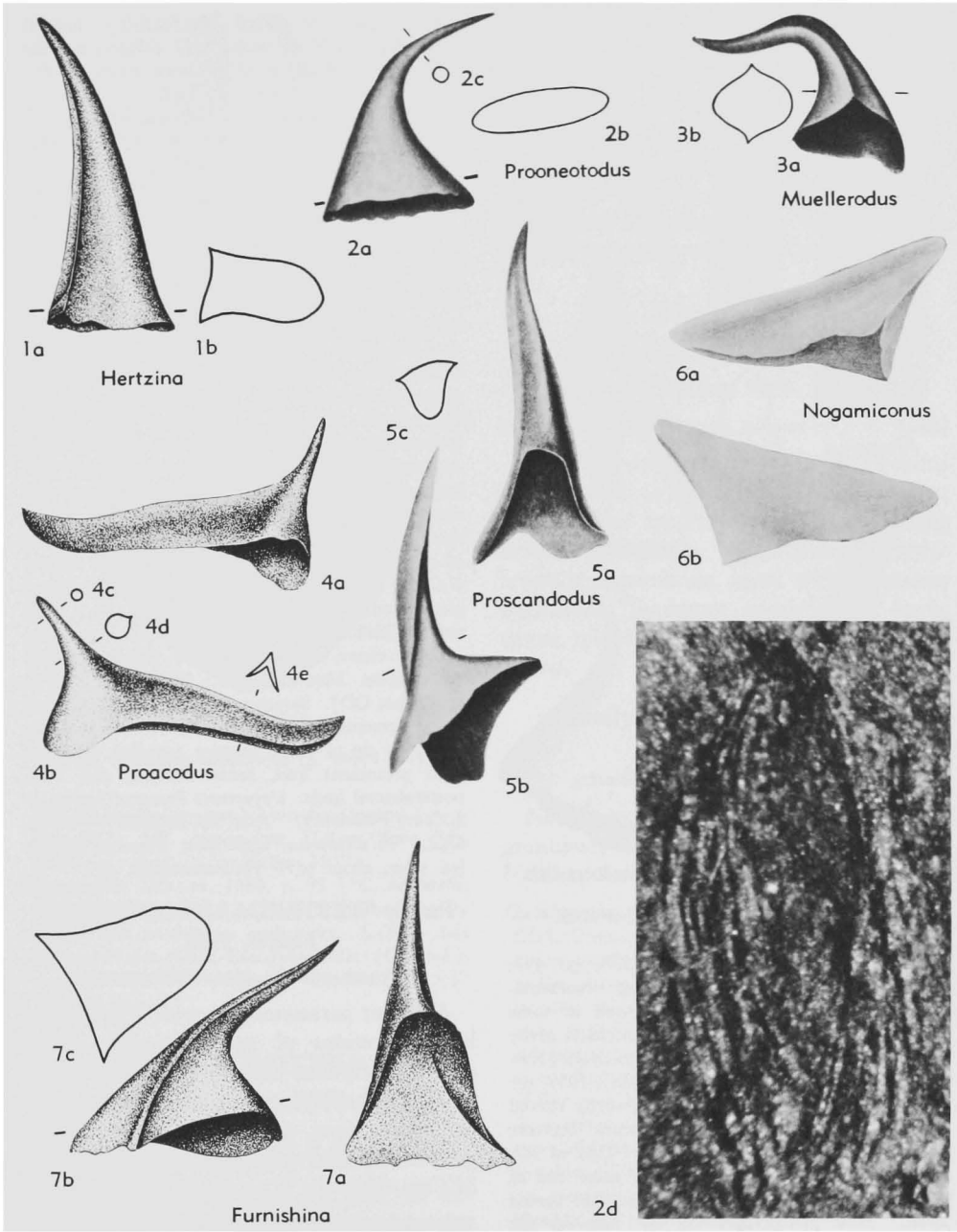

FIG. 64. Furnishinidae (p. *W*112-*W*114).

4a, post. view, ×80; *4b-e*, ant. view with transv. secs., ×80 (Müller, 1959).

Problematoconites MÜLLER, 1959, p. 471 [**P. perforata*; M]. Symmetrical elements, round to oval in cross section; basal cavity large and deep; like *Prooneotodus* 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, ×54 (Müller, 1959).

Prooneotodus MÜLLER & NOGAMI, 1971, p. 17

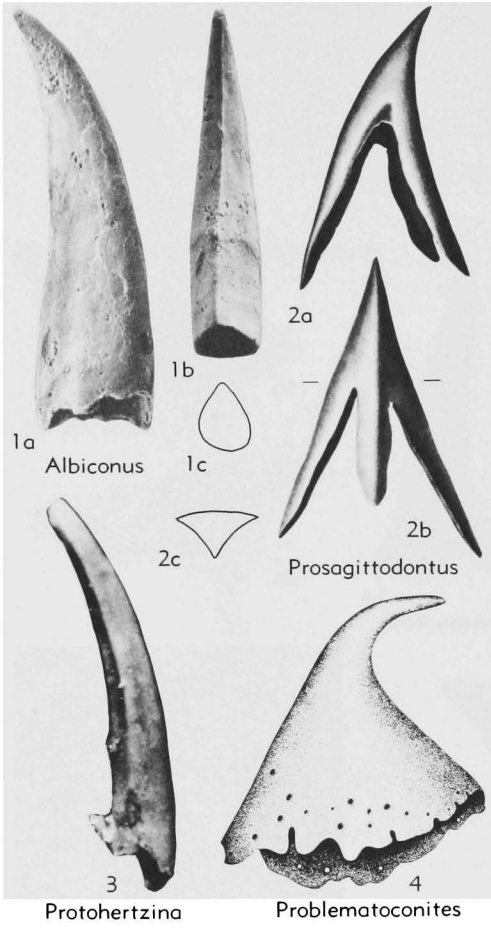

FIG. 65. Furnishinidae (p. *W*112-*W*114).

[**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 coniform 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 Paraconodontida are unimembrate.] *M.Cam.-L.Ord.*, N.Am.(N.Y.-widespread in W. and SW. states of USA-Alberta-Oaxaca)-Eu.(G.Brit.-Sweden-Ger., glacial erratics)-Asia (Sib.-Kazakh.-China-S. Korea-Turkey-Iran)-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*.

Prosagittodontus MÜLLER & NOGAMI, 1971, p. 17 [**Sagittodontus dahlmani* 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. dahlmani* (MÜLLER), holotype, U.Cam.(Zone 5d), Eu.(Ger.); *2a-c*, lat. and post. views, transv. sec., ×40 (Müller, 1959).

Proscandodus 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 posterolateral carinae on each side of cusp producing broadly triangular cross section. *U.Cam.*, N.Am.(Nev.-?S.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 posterolateral keels. *Uppermost Precam.(Yudom.)-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 cusplike 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. bicuspidata*; OD]. Unimembrate elements with 2 or 3 cusplike 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

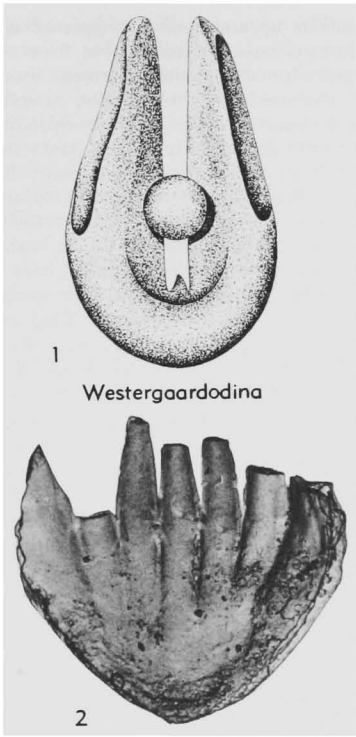

FIG. 66. Westergaardodinidae (p. *W*114-*W*115).

(Sib.-China-Turkey-Iran)-Australia(Queensl.).——FIG. 66,*1*. **W. bicuspidata,* U.Cam.(Zone 5d), Eu.(Ger.); about ×55 Müller, 1959).

Chosonodina MÜLLER, 1964, p. 99 [**C. herfurthi*; OD]. Elements with 5 to 7 denticles; basal cavity double and present on both sides. *L.Ord.,* Asia (Korea)-N.Am.(Okla.-Utah)-Australia (Queensl.).——FIG. 66,*2*. **C. herfurthi,* Asia(Korea); ×37 (Müller, n).

Order CONODONTOPHORIDA Eichenberg, 1930

[Conodontophorida EICHENBERG, 1930, p. 181; =euconodonts of BENGTSON, 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 multimembrate apparatuses. *U.Cam.-U.Trias.*

Superfamily PROCONODONTACEA Miller, new

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

Coniform and rare dolabriform 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.(Corbinia apopsis Subzone)-L.Ord.*

Clavohamulus FURNISH, 1938, p. 326 [**C. densus*; 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 nodes. *L.Ord.,* N.Am.(up. Mississippi River valley-Pa.-widespread in W. and SW. states of USA-Arctic Can.)-NW.Greenl.-Asia(Sib.).——FIG. 67,*3*. **C. densus,* syntype, USA(Minn.); *3a,* basal oblique view; *3b,* post. oblique view; about ×200 (Miller, n).

Hirsutodontus MILLER, 1969, p. 431 [**H. hirsutus*; OD] [=*Strigaconus* DRUCE & JONES, 1971]. Coniform elements, proclined to recurved, rounded in cross section; similar to *Teridontus,* but base with nodes or spines. *U.Cam.(Corbinia apopsis Subzone)-L.Ord.(Symphysurina Zone),* N.Am. (widespread in USA-Alberta)-Greenl.-Asia(Sib.)-Australia(Queensl.).——FIG. 67,*2a*. **H. hirsutus,* L.Ord., USA(Utah); lat. oblique view, ×125

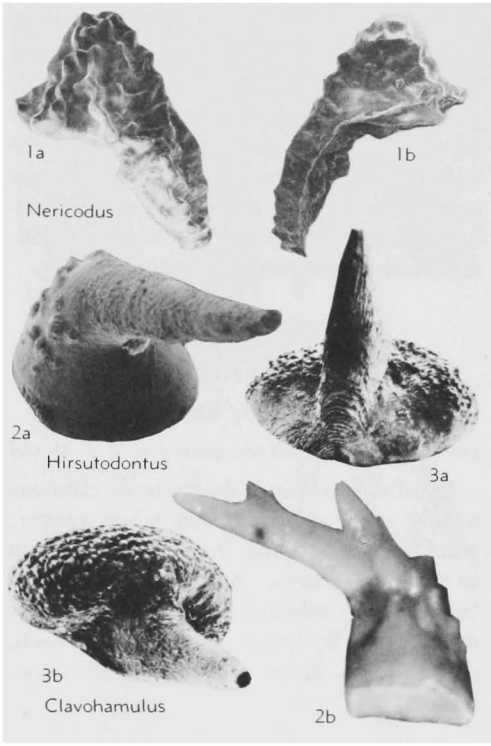

FIG. 67. Clavohamulidae (p. W115-W116).

(Miller, n).——FIG. 67,2*b*. *H. simplex* (DRUCE & JONES), L.Ord., USA(Texas); lat. view, ×100 (Miller, n).

Nericodus LINDSTRÖM, 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; 1a,b,* ant. and post. views, ×50 (Miller, 1980).

Family CORDYLODODONTIDAE Lindström, 1970

[*nom. transl.* MILLER, herein, *ex* Cordylodontinae LINDSTRÖM, 1970, p. 429]

Elements with relatively deep basal cavities; forming probable bimembrate apparatuses 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 dolabrate. *U.Cam.-L.Ord.*

Cordylodus PANDER, 1856, p. 33 [**C. angulatus*; SD ULRICH & BASSLER, 1926, p. 8]. Inferred bimembrate apparatus of two types of dolabrate 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. prion* LINDSTRÖM, 1955. Elements described as *Pravognathus aengensis* LINDSTRÖM, 1955, cannot be definitely excluded from the apparatus of the type species. SWEET & BERGSTRÖM (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 apopsis 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-f*, compressed element, lat. view, transv. sec., and shape of basal cavity; ×100 (Miller, n).

Cambrooistodus 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-Okla.-Alberta).——FIG. 68,*2*. **C. cambricus* (MILLER), USA(Texas); *2a,b*, asymmetrical element, lat. view and transv. sec., ×55 (Miller, 1980).

Eoconodontus MILLER, 1980, p. 21 [**Proconodontus notchpeakensis* 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-

rical element lacking carina, in some with prominent anterior and posterior keel, in some keels lost, resulting in oval cross section. Symmetrical element 2 to 3 times as abundant as asymmetrical element. *U.Cam.(Trempeal.)-L.Ord.*, N.Am.(Pa.-Wis.-widespread in W. and SW. states of USA-Alberta-Dist. Mackenzie-Oaxaca)-Asia(?China-Korea-Sib.-Turkey-Iran)-Australia (Queensl.).——Fig. 68,*1*. **E. notchpeakensis* (Miller), U.Cam., USA (Texas); *1a,b*, symmetrical element, lat. view, transv. sec., ×110; *1c-e*, asymmetrical element, lat. view, transv. secs. near midcusp and base, ×110 (Miller, 1980).

Family ONEOTODONTIDAE Miller, new

Nongeniculate coniform elements, proclined to erect, forming apparent multimembrate 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, ellipsoidal, 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 cornutiformis* 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, n).

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.(Symphysurina Z.)*, N.Am.(Utah-Nev.-Texas-Okla.-Wyo.-Mont.)-Australia(Queensl.).——Fig. 69,*4*. **M. sevierensis* (Miller), USA(Texas); *4a*, basal oblique view; *4b,c*, lat. view, transv. sec. near midcusp; *4d*, shape of basal cavity; about ×95 (Miller, 1980).

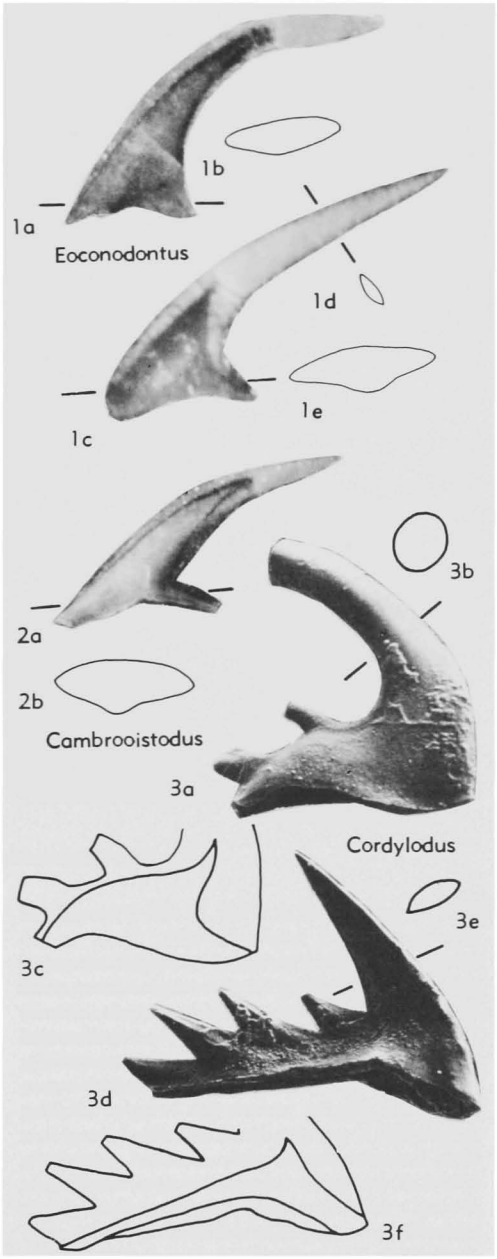

Fig. 68. Cordylododontidae (p. *W*116-*W*117).

?**Pseudopanderodus** Landing, 1979, *U.Cam.*, see addendum.

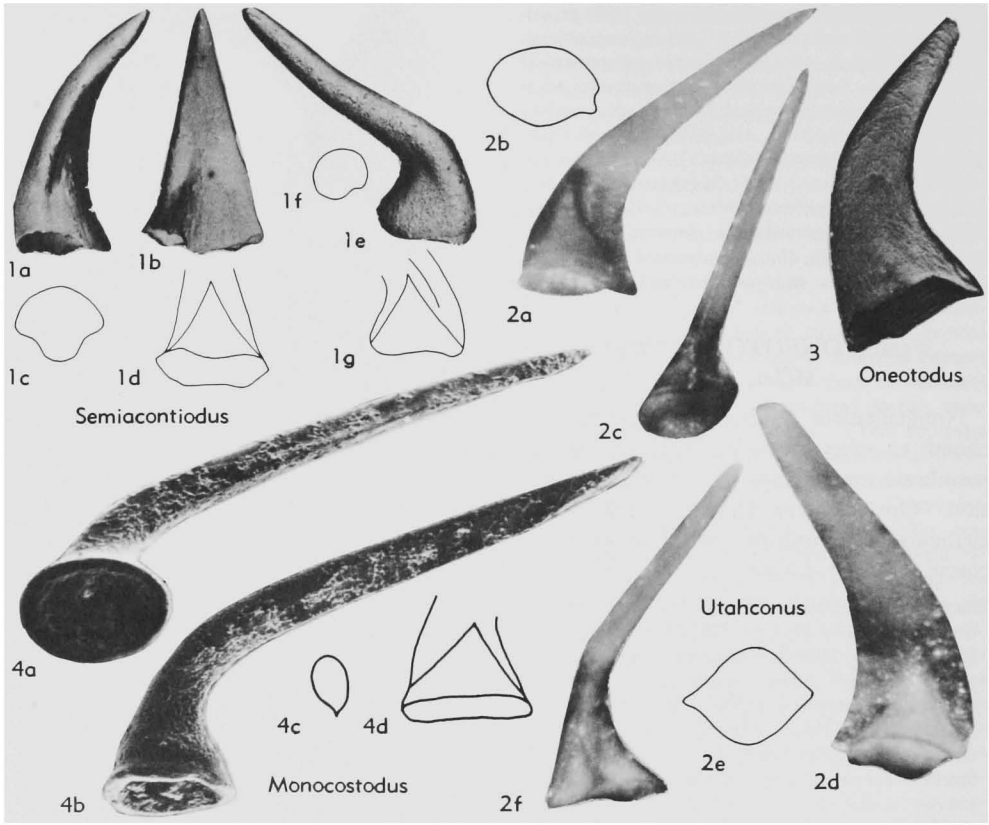

FIG. 69. Oneotodontidae (p. *W*117-*W*118).

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.(Missisquoia Z.-Symphysurina Z.)*, N.Am.(Utah-Wis.-Texas-Okla.-S.Dak.-Pa.-Alberta)-Asia(Sib.-?China).——FIG. 69,*1*. **S. nogamii* (MILLER), USA(Okla.); *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; ×100 (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-f*. **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; ×110 (Miller, 1980).

Superfamily FRYXELLODONTACEA Miller, new

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

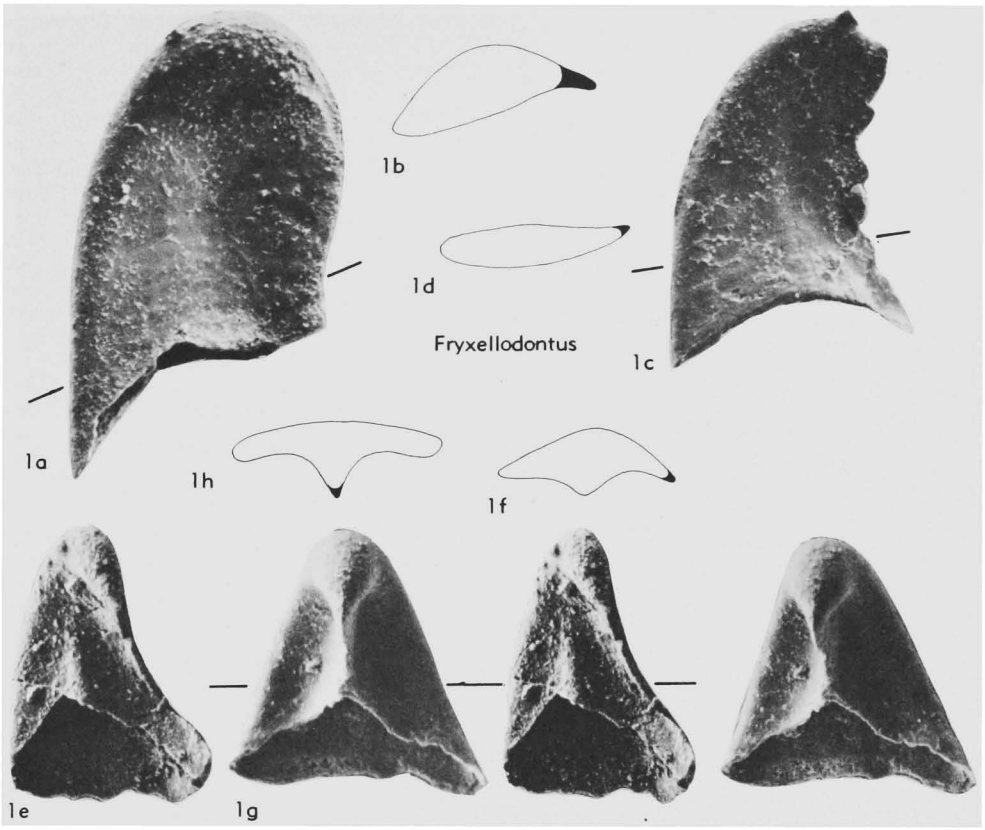

FIG. 70. Fryxellodontidae (p. *W*119).

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 quadrimembrate 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_1 (planar) element laterally compressed in same plane with posterior flap. Sc_2 (serrate) element like Sc_1 but posterior edge of flap serrate, element lacking in one species. *Sb*, Sc_1, Sc_2 elements generally higher than wide, and may be somewhat twisted. *Sb* elements several times more abundant than *Sa*; *Sc* elements several times more abundant than *Sb*. Upper anterior and lateral faces on all elements may have series of paired ridges. *L.Ord.(Mississquoia Z.-Symphysurina Z.)*, N.Am.(N.Y.-Mo.-widespread in W. and SW. states of USA-Arctic Can. islands)-Greenl.-Australia(Queensl.).——FIG. 70,*1*. **F. inornatus*, USA(Okla.); *1a,b*, Sc_1 element, lat. view, transv. sec.; *1c,d*, Sc_2 element, lat. view, transv. sec.; *1e,f*, *Sb* element, post. view (stereopair), transv. sec.; *1g,h*, *Sa* element, post. view (stereopair), transv. sec.; black area on transv. secs. position of prominent ridge; ×110 (Miller, 1980).

Superfamily PRIONIODONTACEA Bassler, 1925

[*nom. transl.* Lindström, 1970, p. 434, *ex* Prioniodontidae Bassler, *nom. correct.* Moore & Sylvester-Bradley, 1957b, p. 28, *pro* Prioniodidae Bassler, 1925, p. 218] [Unless noted otherwise, materials for this superfamily prepared by S. M. Bergström]

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 *(Bergstroemognathus)* missing; many forms with prominent surface microsculpture on lateral and upper surfaces. *Ord.-Dev.*

Family BALOGNATHIDAE Hass, 1959

[*nom. transl.* Lindström, 1970, p. 435, *ex* Balognathinae Hass, 1959, p. 379]

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. ordovicica*; OD]. [=*Ambalodus* Branson & Mehl, 1933b; *Balognathus* Rhodes, 1953a; *Holodontus* Rhodes, 1953a; *Keislognathus* Rhodes, 1955; *Rosagnathus* Rhodes, 1955; *Goniodontus* Ethington, 1959a; *Tvaerenognathus* Bergström, 1962; *?Tripodontus* Knüpfer, 1967]. Apparatus septimembrate, with morphologically different left and right elements in *P* positions. *Pa* 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 quadriramate 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); *1a,b,* sinistral *Pa* element, upper and lower views, ×32, ×35; *1c,* dextral *Pa* 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. clarus*; 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 *Rhodesognathus*; however, no elements similar to others in apparatuses of these genera have been reported from the type strata of *L. clarus,* and it is unlikely that *Lenodus* is synonymous with either of these genera.] *L. Ord.(Arenig.),* Eu.(USSR).——Fig. 71,*3*. **L. clarus,* USSR(Baltic); *3a-c,* post-lat. view, lat. views, ×71; *3d,e,* post.-lat. and lower views, diagr., ×76 (Sergeeva, 1963).

Rhodesognathus 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. [*Rhodesognathus* 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* Cyrtoniodontinae Hass, 1959, p. 378]

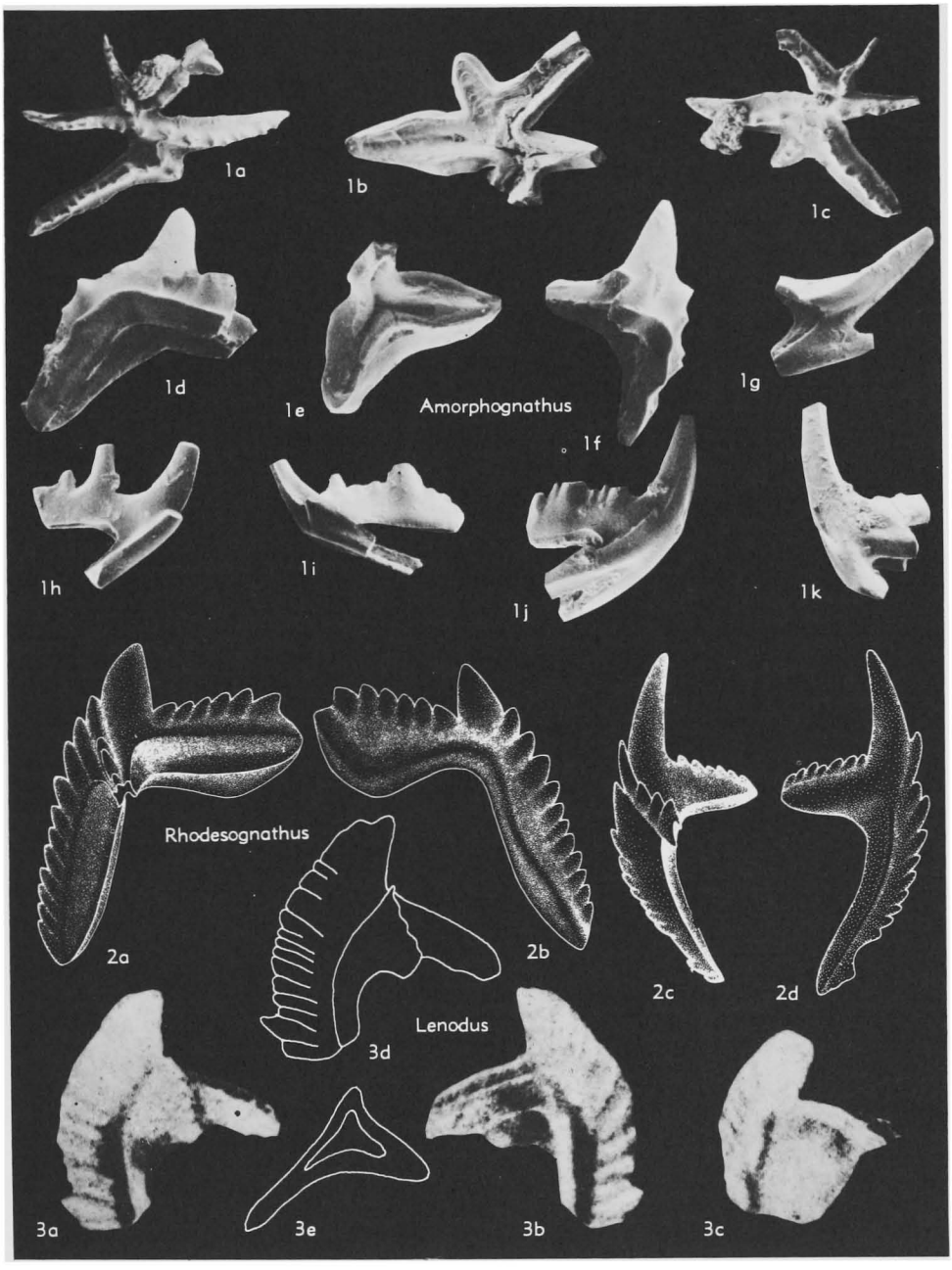

FIG. 71. Balognathidae (p. *W*120).

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-

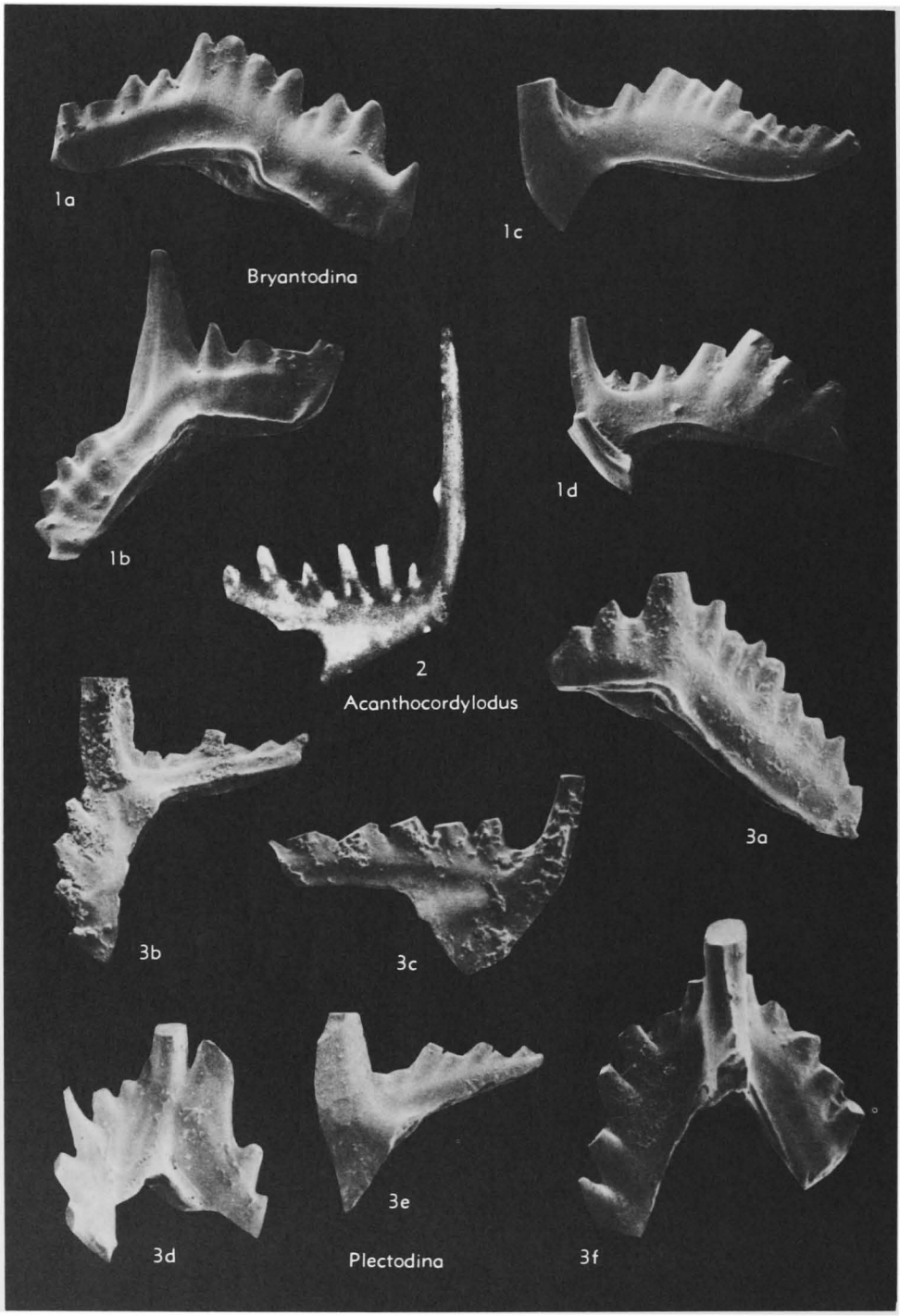

FIG. 72. Cyrtoniodontidae (p. *W*124).

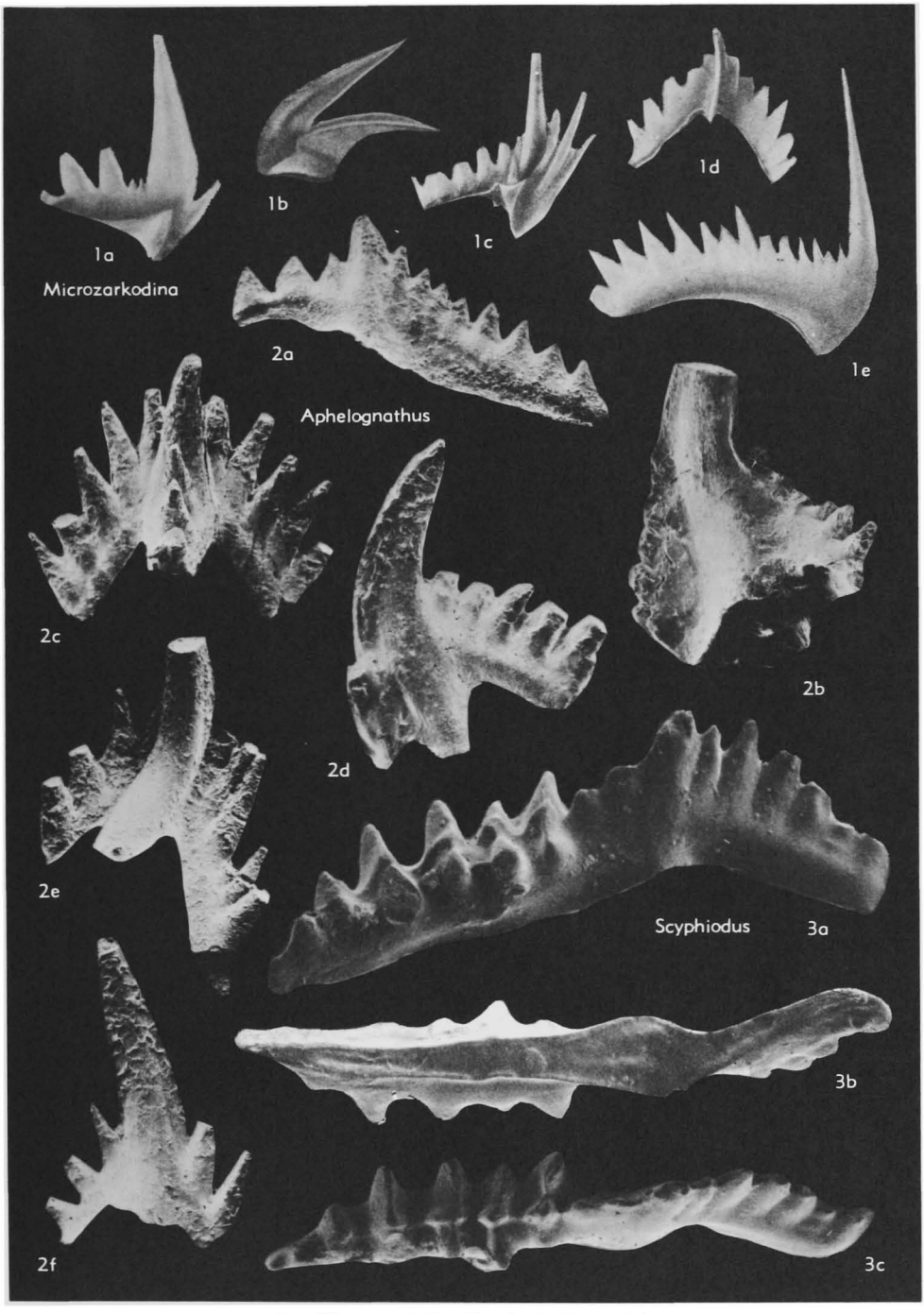

FIG. 73. Cyrtoniodontidae (p. *W*124-*W*125).

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.*

Acanthocordylodus 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 pastinate 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 units, each with prominent cusp, in cross section robust denticles more or less rounded, basal cavity well-developed, extending along entire length of processes. [*Aphelognathus* is similar in many respects to *Plectodina*, but differs in form of the *Pa* element. Apparatus reconstruction: SWEET, THOMPSON, & SATTERFIELD, 1975.] *M.Ord.-U.Ord.*, N.Am.-Asia(Sib.).——FIG. 73,2. **A. grandis*, U. Ord., USA(Colo.); *2a, Pb* element, lat. view, ×70; *2b, M* element, lat. view, ×61; *2c, Sa* element, post. view, ×79; *2d, Sc* element, lat. view, ×61; *2e, Sb* element, post.-lat. view, ×70; *2f, Pa* element, lat. view, ×79 (Shatzer, 1976).

Bryantodina STAUFFER, 1935a, p. 131 [**B. typicalis*; OD] [=*Tortoniodus* STAUFFER, 1935a]. Apparatus probably seximembrate although only five components have been identified so far. *Pa* element carminate, slightly angulate, with basal cavity consisting of subapical pit and narrow slits along processes; denticles of somewhat variable size, confluent along at least half of length; cusp not appreciably larger than many denticles. *Pb* elements digyrate, with prominent cusp and multidenticulate processes. *M* element not identified. *S* elements forming transition series. *Sa* elements alate, with long, sinous posterior process and very short, straight, laterally directed, lateral processes with one or two denticles. *Sb* elements tertiopedate, otherwise similar to *Sa* elements except for asymmetrically developed lateral processes, one lateral process carrying a large denticle rivaling cusp in size. *Sc* elements dolabrate with long, sinous, multidenticulate posterior process and adenticulate anterior process. Basal cavity in ramiform elements narrow and shallow but extending along entire length of processes. [Apparatus reconstruction: WEBERS, 1966.] *M.Ord.*, N.Am.-Asia(Sib.). ——FIG. 72,1. **B. typicalis*, Glenwood F., USA (Minn.); *1a, Pa* element, lat. view, ×57; *1b, Pb* element, lat. view, ×57; *1c, Sc* element, lat. view, ×65; *1d, Sa* element, lat. view, ×64 (Bergström, n).

Microzarkodina LINDSTRÖM, 1971, p. 57 [**Prioniodina flabellum* LINDSTRÖM, 1955; OD]. Apparatus seximembrate, composed of lamellar elements. *P* elements carminate to segminate, with prominent cusp and relatively few denticles, especially on the short anterior process. *M* elements geniculate, coniform, 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. flabellum* (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 [**Prioniodus aculeatus* STAUFFER, 1930, p. 126; OD; =*Plectodina dilata* STAUFFER, 1935a] [=*Trichonodella* BRANSON & MEHL, 1948, *nom. subst. pro Trichognathus* BRANSON & MEHL, 1933a, *non* 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 pastinate 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 all 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, anguloplanate elements with platformlike anterior process bearing 3 rows of denticles and relatively short, subcentral, reclined cusp. Posterior process bladelike with single row of laterally compressed denticles. Basal cavity pitlike beneath cusp, rather deep and wide beneath anterior process, groovelike beneath posterior

process. [As noted by WEBERS (1966, p. 46), elements of *Scyphiodus* show, apart from development of the platformlike anterior process, close similarity to angulate elements described as *Bryantodina maxima* STAUFFER, 1935a. *Scyphiodus* is probably more closely related to *Bryantodina, Plectodina,* and *Phragmodus* than to other Middle and Upper Ordovician genera with platformed pectiniform elements.] *M.Ord.,* N.Am.(W. midcontinent).——FIG. 73,*3*. **S. primus,* Platteville F., USA(Minn.); *3a-c,* lat., lower, and upper views, ×102 (Bergström, n).

Family ICRIODONTIDAE Müller & Müller, 1957

[*nom. transl.* LINDSTRÖM, 1970, p. 436, *ex* Icriodontinae, *nom. transl. et correct.* HASS, 1959, p. 379, *pro* Icriodidae MÜLLER & MÜLLER, 1957, p. 1105] [Materials for this family prepared by GILBERT KLAPPER and S. M. BERGSTRÖM]

Essentially trimembrate apparatus characterized by scaphate *Pa* elements. *Pb* and *S* elements are simple cones or modifications thereof. Apparatus of Ordovician species probably pentamembrate. *M.Ord.-Sil.(Llandov.), Sil.(Ludlov.)-U.Dev.(Famenn.).*

Icriodus BRANSON & MEHL, 1938, p. 159 [**I. expansus*; OD; for discussion of validation of *Icriodus* and type species, see ZIEGLER, 1975, p. 68] [=*Acodina* STAUFFER, 1940, p. 418; *Latericriodus* MÜLLER, 1962a, p. 114; *Caudicriodus* BULTYNCK, 1976, p. 19; *Praelatericriodus* BULTYNCK, 1976, p. 40]. Main process of *Pa* element characteristically consisting of three longitudinal rows of nodes but including forms with transverse ridges; denticulate lateral processes developed near posterior end in some. *Pb* element nongeniculate, laterally compressed coniform element with sharp anterior and posterior keels. *S* elements relatively smooth, simple cones of circular to elliptical cross section. [Reconstruction: KLAPPER & PHILIP, 1971; modified herein.] *Sil.(Pridol.)-U. Dev. (Famenn.),* Eu.-N. Afr.-Asia-N. Am.-Australia.——FIG. 74,*4a,b*. **I. expansus,* disputed M.Dev.-U.Dev. boundary interval (*Schmidtognathus hermanni–Polygnathus cristatus* Z., Rapid Mbr., Cedar Valley Ls.), USA(Iowa); *Pa* element, upper and lower views, ×37 (Klapper, n).——FIG. 74,*4c-e*. *I. steinachensis* AL-RAWI, L.Dev. (McMonnigal Ls.), USA(Nev.); *4c, Pa* element, upper view; *4d,e, Pb* element, inner lat. and outer lat. views, ×37 (Klapper & Philip, 1971).

Antognathus LIPNYAGOV in KOZITSKAYA *et al.*, 1978, *U.Dev.*, see addendum.

Icriodella RHODES, 1953a, p. 285 [**I. superba*; OD] [=*Rhynchognathodus* ETHINGTON, 1959b, p. 1128, *nom. subst. pro Rhynchognathus* ETHINGTON, 1959a, p. 286, *non* JAEKEL, 1929, a fish; *Sagittodontus* RHODES, 1953a]. Apparatus probably pentamembrate, including lamellar elements. *Pa* elements pastinoscaphate with long anterior process bearing double row of denticles, short cusp, short adenticulate lateral process, and bladelike posterior process with one row of confluent denticles. *Pb* elements tertiopedate, more or less pyramidal, with short cusp and adenticulate or weakly denticulate processes. *M* elements bipennate or dolabrate, flaring 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 anterior process adenticulate. Basal cavity large in all elements, especially in *P* elements. *M.Ord.-Sil.(Llandov.),* N.Am.-Eu.——FIG. 74,*1*. **I. superba,* M.Ord.(Lexington Ls.), USA(Ky.); *1a-c, Pa* element, lat., upper, lower views, ×33; *1d,e, M* element, lat. views, ×82; *1f-g, Pb* element, upper and lat. views, ×26; *1h, S* element with 2 denticulate processes, lat. view, ×47; *1i,j, S* element with 3 denticulate processes, lat. and post.-upper views, ×47 (Bergström & Sweet, 1966).

Pedavis KLAPPER & PHILIP, 1971, p. 446 [**Icriodus pesavis* BISCHOFF & SANNEMANN, 1958, p. 96; OD]. Main process of *Pa* element like that of *Icriodus* but additionally with two anteriorly directed 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.)-L.Dev.,* Eu.-Asia-N.Am.-Australia.——FIG. 74,*3*. **P. pesavis* (BISCHOFF & SANNEMANN), L.Dev.(McMonnigal Ls.), USA(Nev.); *3a, Pa* element, upper view; *3b, S* element, lat. view; *3c, Pb* element, lat. view; ×37 (Klapper & Philip, 1971).

Pelekysgnathus THOMAS, 1949, p. 424 [**P. inclinata*; 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 anterior 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. (*Scaphignathus subserratus-Pelekysgnathus inclinatus* Fauna, Maple Mill Sh.), USA(Iowa); *2a, Pa* element, lat. view; *2b, Pb* element, lat. view; *2c, S* element, lat. view; ×37 (*2a,* Klapper, n; *2b,c,* Klapper & Philip, 1972).

Sannemannia AL-RAWI, 1977, *L.Dev.-M.Dev.*, see addendum.

Family OEPIKODONTIDAE Bergström, new

Apparatus basically trimembrate, consisting of lamellar pastinate and modified

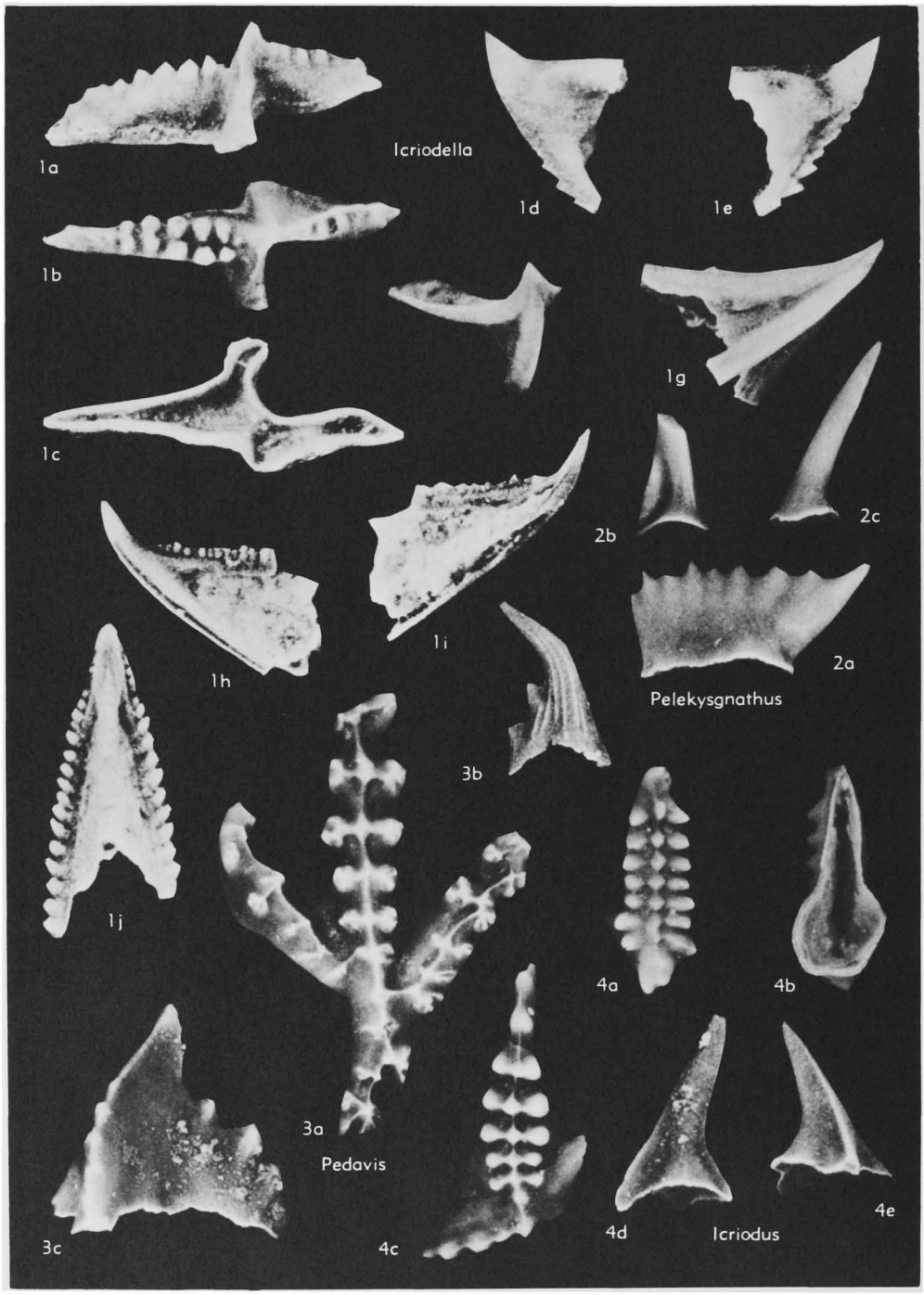

FIG. 74. Icriodontidae (p. *W125*).

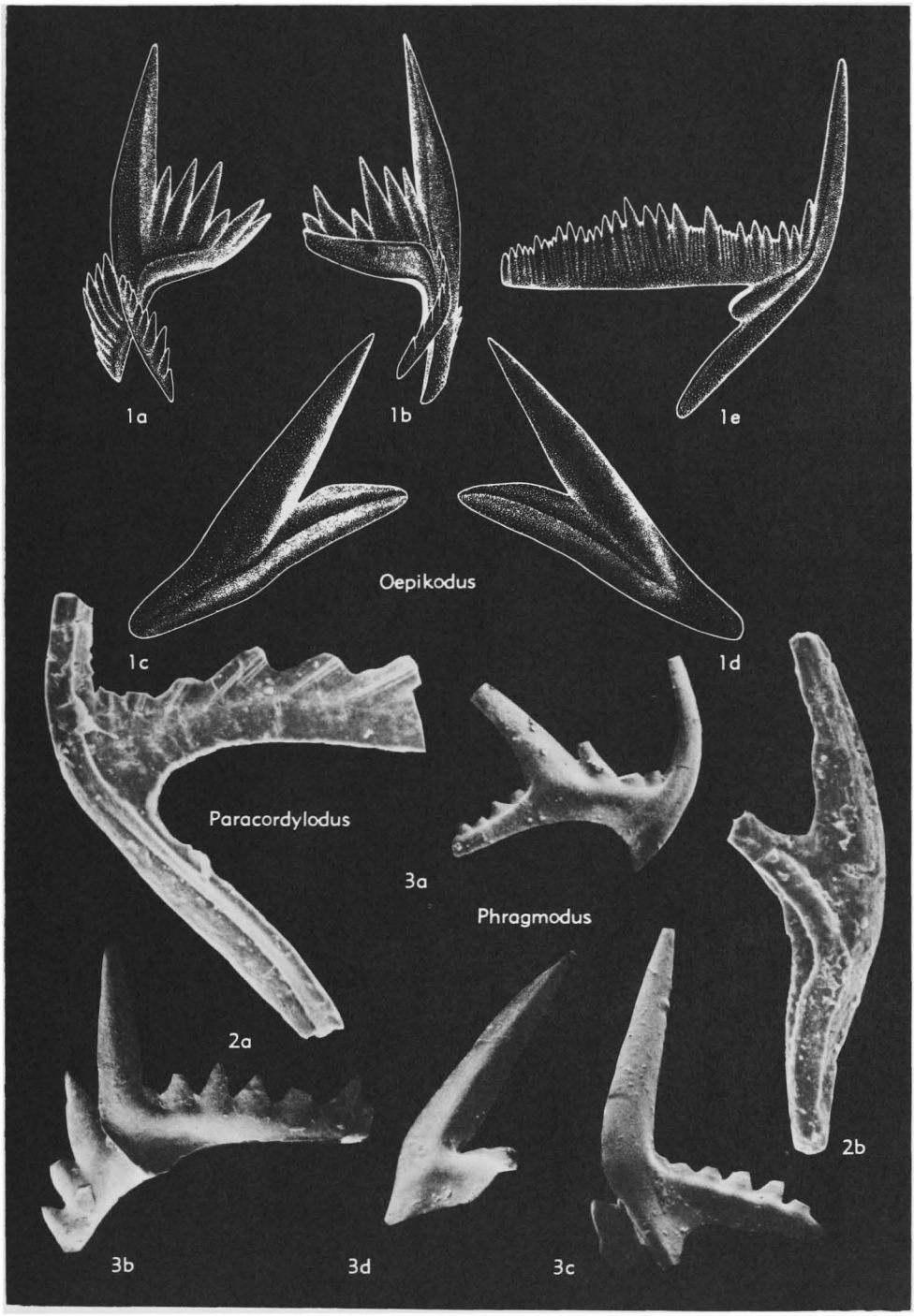

FIG. 75. Oepikodontidae, Paracordylodontidae, Phragmodontidae (p. *W*128-*W*129).

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 *Prioniodus,* 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.(*Dalecarlicus* Z.), Eu.(Sweden); *1a,b,* pastinate element, lat. views; *1c,d,* 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 WAMEL (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; *Falodus* LINDSTRÖM, 1955]. Apparatus multimembrate, composed of lamellar elements. *P* elements of two types; one angulate to bipennate, the other digyrate 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.); *1a,c,* 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* SERPAGLI, 1967, p. 64; OD]. Apparatus type unknown; described elements basically nongeniculate, laterally compressed, lamellar, coniform with proclined to suberect cusp and wide, more

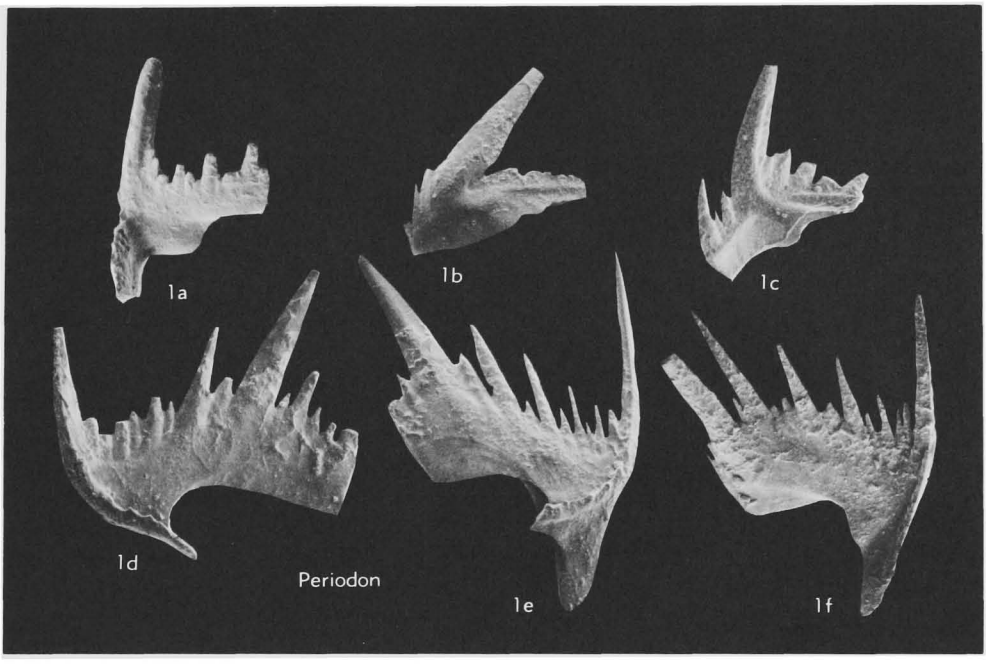

FIG. 76. Periodontidae (p. *W*128).

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,*1*. **H. europaeus* (SERPAGLI), Slandrom 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 dolabrate, 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 dolabrate through tertiopedate and alate to quadriramate 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; ?*Cyrtoniodus* STAUFFER, 1935a; ?*Subcordylodus* 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 pastiniplanate, 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

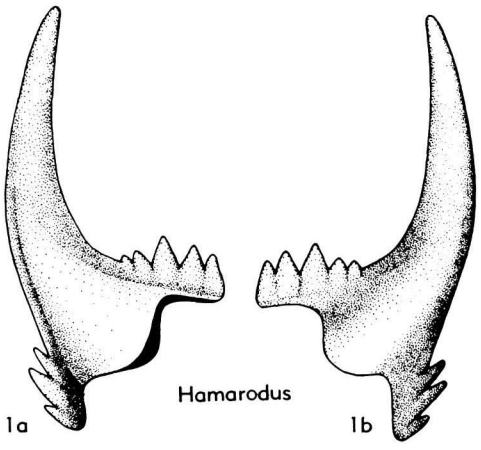

FIG. 77. Periodontidae (p. W128-W129).

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; WEBERS, 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 [**Ambalodus lindstroemi* HAMAR, 1964, p. 258; OD] [=*Priomorphognathus* KNÜPFER, 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-

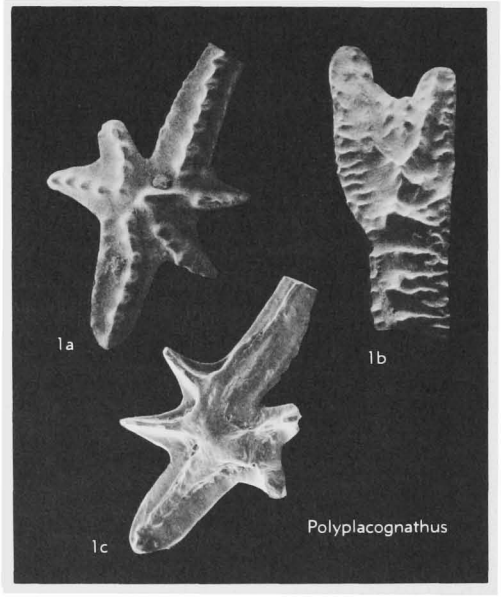

FIG. 78. Polyplacognathidae (p. W129-W131).

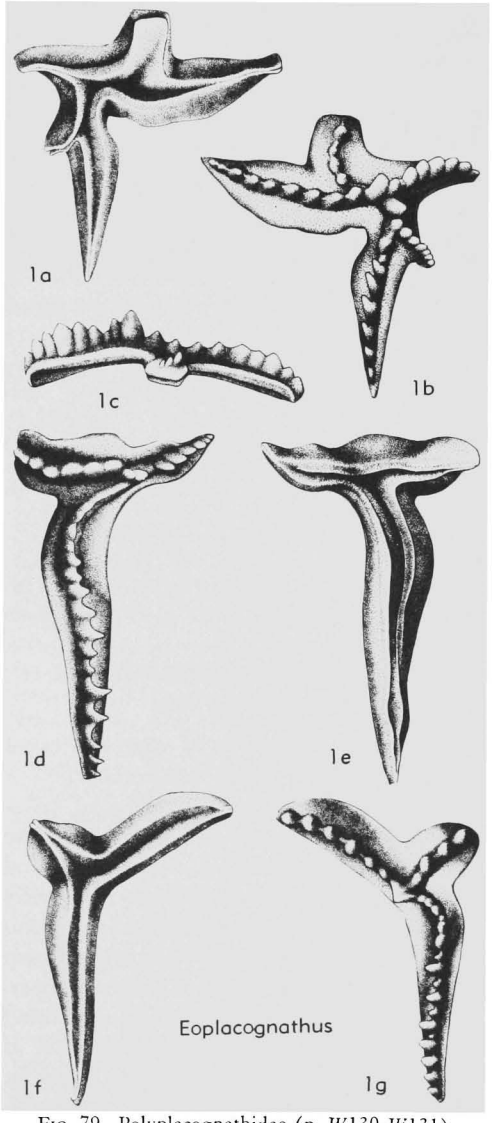

FIG. 79. Polyplacognathidae (p. W130-W131).

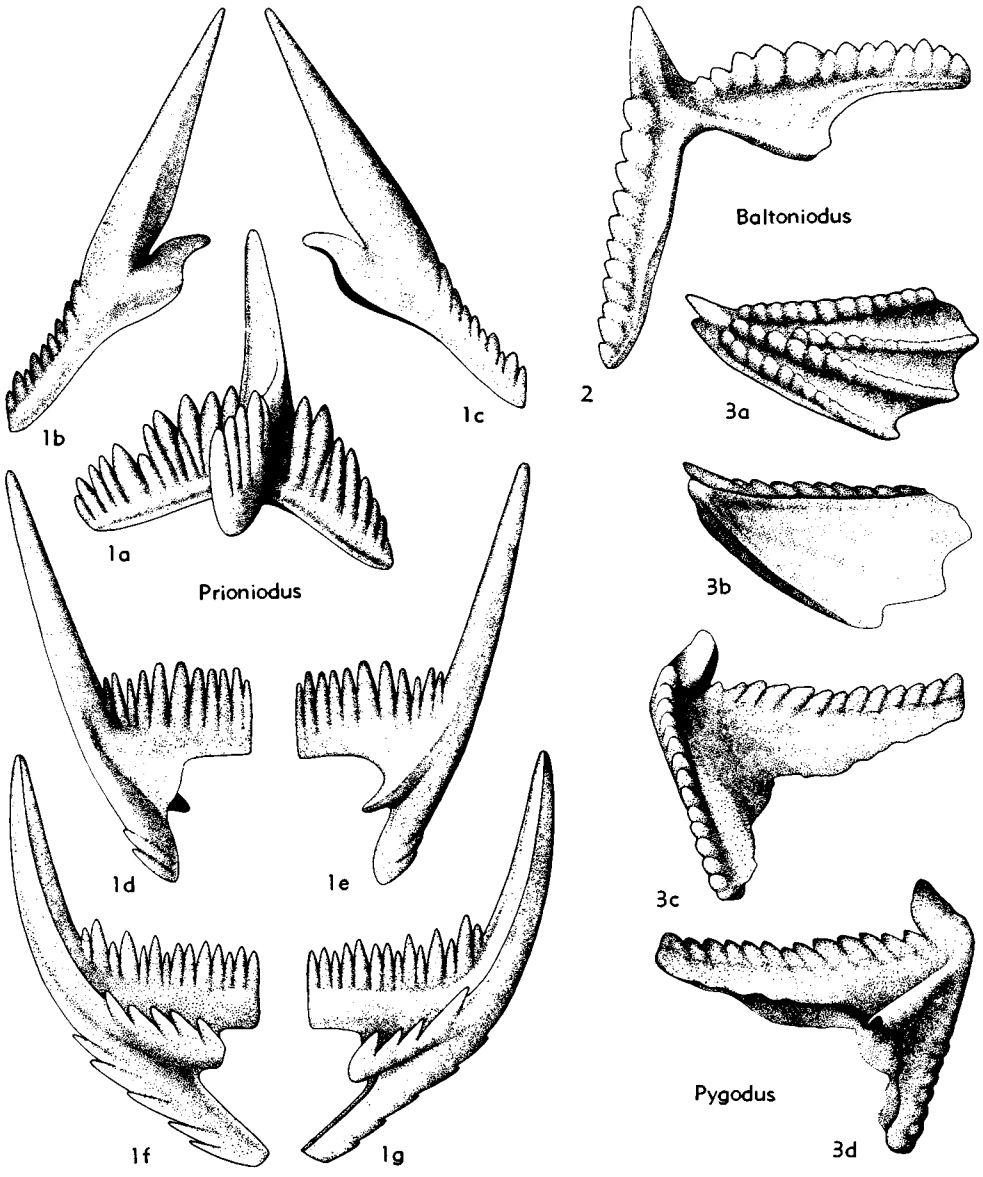

FIG. 80. Prioniodontidae, Pygodontidae (p. *W*132).

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*. Apparatus reconstruction: BERGSTRÖM, 1971, 1973.] *L.Ord.-M.Ord.,* Eu.(Baltoscandia-Pol.-G. Brit.-USSR-Ire.)-N. Am. (Appalachian Mts.-Great Basin-Okla.-Ark.).——FIG. 79,*1*. *E. foliaceus* (FÅHRAEUS), M.Ord.(Folkeslunda Ls.), Eu.(Sweden); *1a-c,* stelliplanate element, lower, upper, lat. views; *1d,e,* sinistral pastiniplanate element, upper, lower views; *1f,g,* dextral pastiniplanate element, lower, upper views; ×50 (Bergström, n).

Family PRIONIODONTIDAE Bassler, 1925

[*nom. correct.* Moore & Sylvester-Bradley, 1957b, p. 28, *pro* Prioniodidae Bassler, 1925, p. 218]

Apparatus sexi- or septimembrate; *P* elements pastinate, with 3 denticulate processes; *M* elements geniculate, in some species denticulate above anterobasal corner; *S* elements forming transition series from bipennate through tertiopedate and alate to quadriramate units, all with denticulate processes, distinct cusp, and basal cavity extending along entire length of processes. *L.Ord.-M.Ord.*

Prioniodus Pander, 1856, p. 29 [**P. elegans*; SD Miller, 1889, p. 315]. Diagnosis as for family. *L.Ord.-M.Ord.*, Eu.-N.Am.-S.Am.-Australia.

P. (Prioniodus) Pander, 1856, p. 29 [=*Belodus* Pander, 1856; *Gothodus* Lindström, 1955; *Tetraprioniodus* Lindström, 1955]. Apparatus seximembrate with only one type of *P* element. Basal 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 transitional forms between *Prioniodus (Baltoniodus)* and *P. (Prioniodus)* have been reported, it appears justified to group these forms pending further study. Apparatus reconstruction: Bergström, 1968, 1971.] *L.Ord., ?M.Ord.*, Eu.-N.Am.-S.Am.-Australia.——Fig. 80,*1*. **P. elegans*, L.Ord.(*Didymograptus balticus* Subzone), Eu.(Sweden); *1a*, *P* element, ant.-lat. view; *1b,c*, *M* element, lat. views; *1d,e*, bipennate *S* element, lat. views; *1f,g*, quadriramate *S* element, lat. views; ×50 (Bergström, n).

P. (Baltoniodus) Lindström, 1971, p. 55 [**Prioniodus navis* Lindström, 1955, p. 590; OD] [?=*Trapezognathus* Lindström, 1955; *Volchodina* Sergeeva, 1974]. Apparatus in most species 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 reconstruction: Bergström, 1971; Lindström, 1971.] *L.Ord.-M.Ord.*, Eu.-N.Am.-S.Am.-Australia.——Fig. 80,*2*. *P. (Baltoniodus) variabilis* Bergström, 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, lamellar 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 diverging from cusp, two of these rows lateral, forming margins of element, other rows central; whole under side of element occupied by wide but shallow basal cavity, in some with basal funnel. *M.Ord.*

Pygodus Lamont & Lindström, 1957, p. 67 [**P. anserinus*; OD] [=*Haddingodus* Sweet & Bergström, 1962]. Diagnosis as for family. [Associated as a rule with the tertiopedate and stelliscaphate elements of several species of *Pygodus*, but always in much lower numbers, are elements originally described as *Tetraprioniodus lindstroemi* and *Hibbardella pyramidalis* by Sweet & Bergström (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 reconstruction: Bergström, 1971.] *M.Ord.*, Eu.-N.Am.-Asia(China)-Australia.——Fig. 80,*3*. **P. anserinus*, Dalby Ls., Eu.(Sweden); *3a,b*, stelliscaphate element, upper and lower views; *3c,d*, tertiopedate element, lat. views; ×40 (Bergström, 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 multidenticulate, carminate, angulate, or segminate; *S* elements ramiform or modified ramiform, forming transition series that, when complete, includes four types of alate,

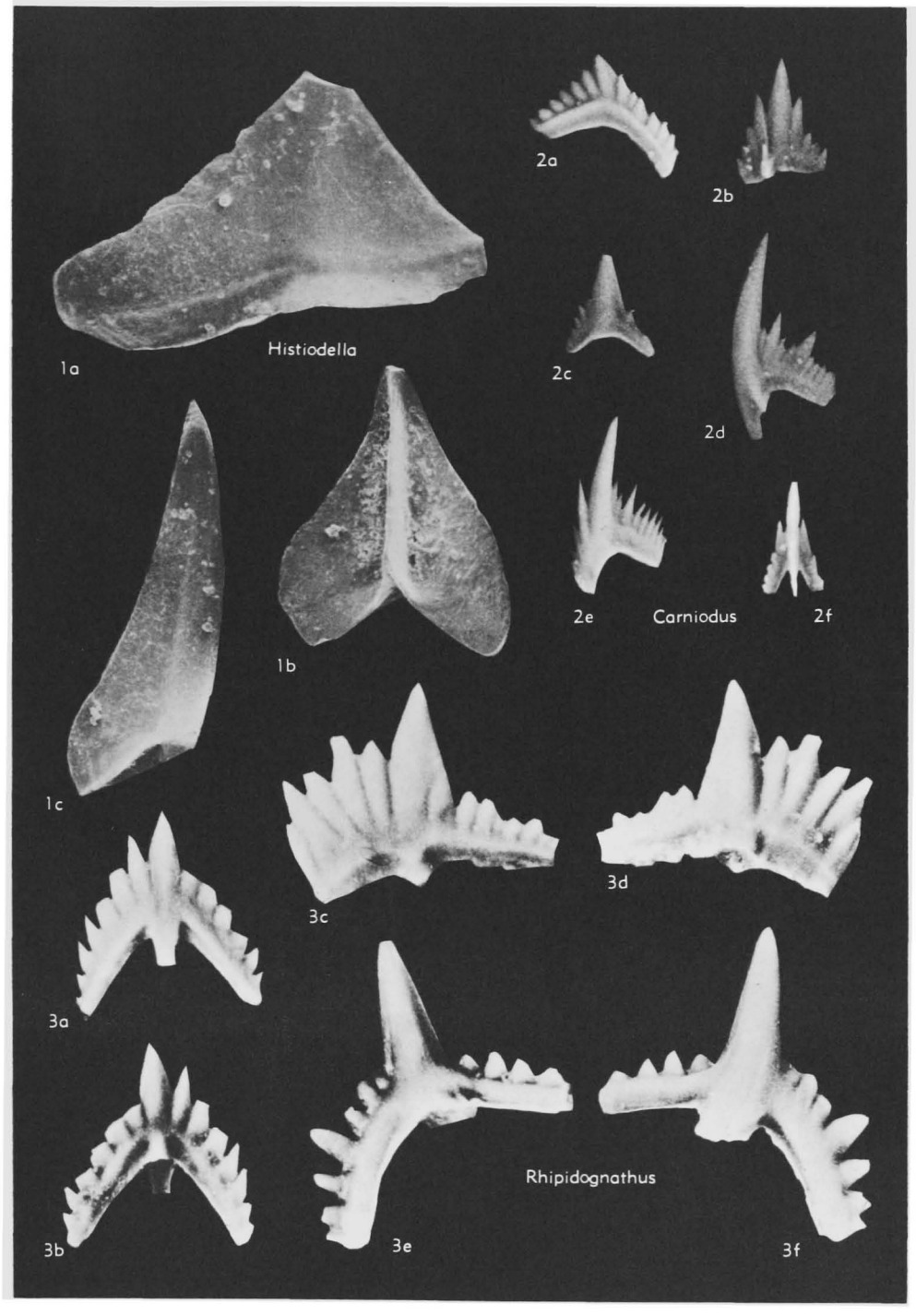

FIG. 81. Rhipidognathidae (p. *W*134-*W*135).

digyrate, and dolabrate elements but may be reduced to include only two types of alate and angulate, dolabrate, digyrate, or modified tertiopedate elements. *L.Ord.-Sil. (Wenlock.).*

Rhipidognathus Branson, Mehl, & Branson, 1951, p. 10 [**R. symmetrica*; 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. discretus* Bergström & Sweet, M.Ord.(Catheys F.), USA (Tenn.); *3a,b*, alate element, ant., post. views; *3c-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 dolabrate, 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 Serpagli, 1974, p. 39 [**Oistodus extensus* 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 coniform, 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: Serpagli, 1974.] *L.Ord.*, N.Am.(N.Y.-Texas-Pa.-Newf.)-S.Am.(Arg.).——Fig. 82,*2*. **B.*

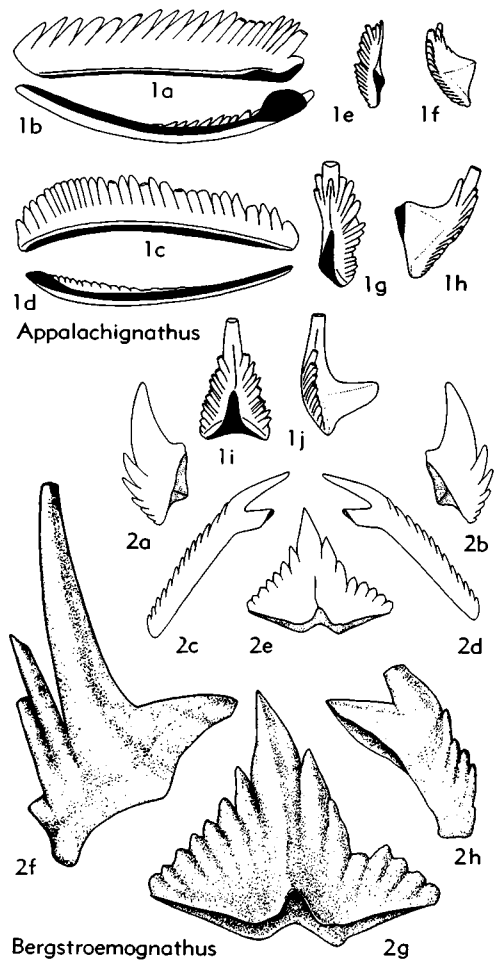

Fig. 82. Rhipidognathidae (p. *W*134-*W*135).

extensus (GRAVES & ELLISON), San Juan F., S.Am. (Arg.); *2a,b,* lat. views of tertiopedate elements, diagr., ×11; *2c,d,* lat. views of segminate element, diagr., ×15; *2e,* post. view of alate element, diagr., ×13; *2f,* tertiopedate element, lat. view, ×54; *2g,* alate element, post. view, ×25; *2h,* segminate element, lat. view, ×67 (Serpagli, 1974).

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.——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; ×36 (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; ×123 (Bergström, n).

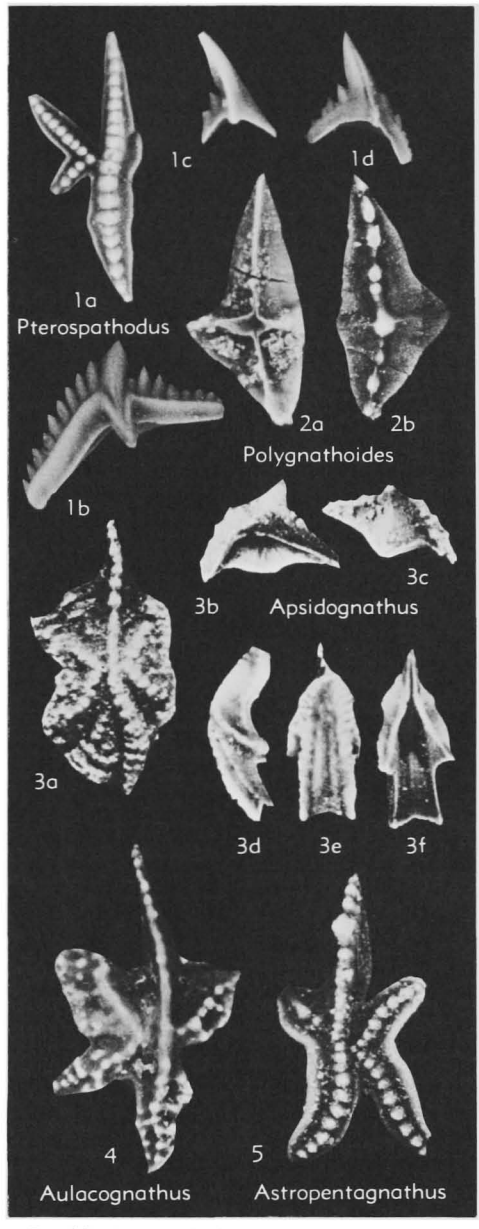

FIG. 83. Pterospathodontidae (p. W135-W136).

Family PTEROSPATHODONTIDAE Cooper, 1977

[Pterospathodontidae COOPER, 1977, p. 1062] [Materials for this family prepared by GILBERT KLAPPER]

Apparatus at least bimembrate; *Pa* element either pastiniscaphate or carminiplanate; *Pb* element either angulate, anguliplanate, or pastiniscaphate. *Sil.(Llandov.-Ludlov.).*

Pterospathodus WALLISER, 1964, p. 66 [**P. amorphognathoides*; OD] [=*Llandoverygnathus* WALLISER, 1972, p. 76]. *Pa* element either pastiniscaphate like that of *Astropentagnathus* but with cavity much more restricted and inner lateral

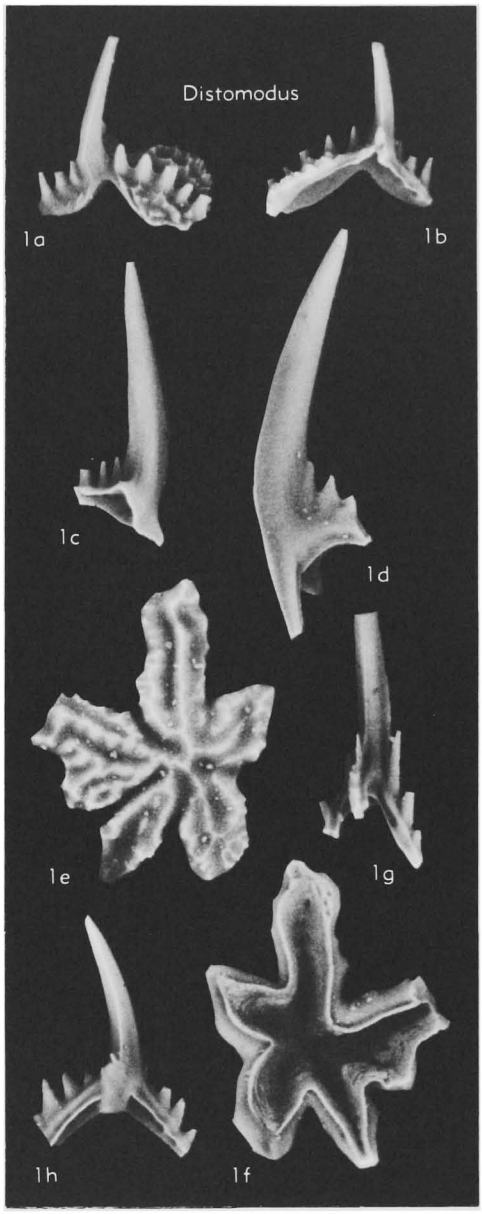

FIG. 84. Distomodontidae (p. *W*137).

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.] *Sil.(Llandov.-low.Wenlock.)*, Eu.-Asia-N.Am.——FIG. 83,*1*. **P. amorphognathoides*, up. Llandov.-low. Wenlock.(*P. amorphognathoides* Z., Clarita F.), USA(Okla.); *1a, Pa* element, upper view; *1b, Pb* element, lat. view; *1c, M* element, lat. view; *1d, S* element, lat. view; ×27 (Barrick & Klapper, 1976).

Apsidognathus WALLISER, 1964, p. 29 [**A. tuberculatus*; OD] [?=*Astrognathus* WALLISER, 1964, p. 30]. Pastiniscaphate *Pa* element like that of *Astropentagnathus* but with bifurcate lateral processes on both sides and more fully developed platform between processes. *Pb* element anguliplanate with well-developed platform having concentric ridges like that of *Pa* element. Homology of arched, scaphate element with two lateral carinae unclear; originally described as *Pygodus lyra* by WALLISER, 1964. [Reconstruction: WALLISER, 1972, p. 76; ALDRIDGE, 1974, p. 299, suggested inclusion of the *Pb* element, *Ambalodus galerus* WALLISER. An additional element may be the type species of *Astrognathus, A. tetractis*.] *Sil.(Llandov.)*, Eu.-Asia-N.Am.——FIG. 83,*3*. **A. tuberculatus, Pterospathodus celloni* Z., Eu.(Aus., Carnic Alps); *3a*, holotype, *Pa* element, upper view; *3b,c, Pb* element, lat. and oblique-upper views; *3d-f*, arched scaphate element, lat., upper, and lower views; ×27 (Walliser, 1964).

Astropentagnathus MOSTLER, 1967, p. 298 [**A. irregularis*; OD]. *Pa* element pastiniscaphate with bifurcate outer lateral process and anteriorly directed inner lateral process. *Pb* element pastiniscaphate with essentially unarched main process and long inner lateral process. [Reconstruction: SCHÖNLAUB, 1971, p. 42; KLAPPER & MURPHY, 1975, p. 24.] *Sil.(Llandov.)*, Eu.-N.Am.——FIG. 83,*5*. **A. irregularis, Pterospathodus celloni* Z. (Roberts Mts. F.), USA(Nev.); *Pa* element, upper view, ×27 (Klapper & Murphy, 1975).

Aulacognathus MOSTLER, 1967, p. 300 [**A. kuehni*; OD] [=*Neospathognathodus* 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.(Llandov.)*, Eu.-N.Am.——FIG. 83,*4*. **A. kuehni, Pterospathodus celloni* Z.(Roberts Mts. F.), USA(Nev.); *Pa* element, upper view, ×27 (Klapper & Murphy, 1975).

Johnognathus MASHKOVA, 1977, *Sil.(up.Llandov.-low.Wenlock.)*, see addendum.

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.(Ludlov.)*, 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, ×27 (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; dolabrate *M* element and *S* symmetry-transition series with large cusp, large cavity, and discrete denticles. *Sil.(Llandov.-low.Wenlock.).*

Distomodus BRANSON & BRANSON, 1947, p. 553 [**D. kentuckyensis*; OD] [=*Hadrognathus* WALLISER, 1964, p. 35; *Exochognathus* 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.* LINDSTRÖM, 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).

Leptochirognathus BRANSON & MEHL, 1943, p. 377 [**L. quadrata*; OD]. Apparatus unknown; genus

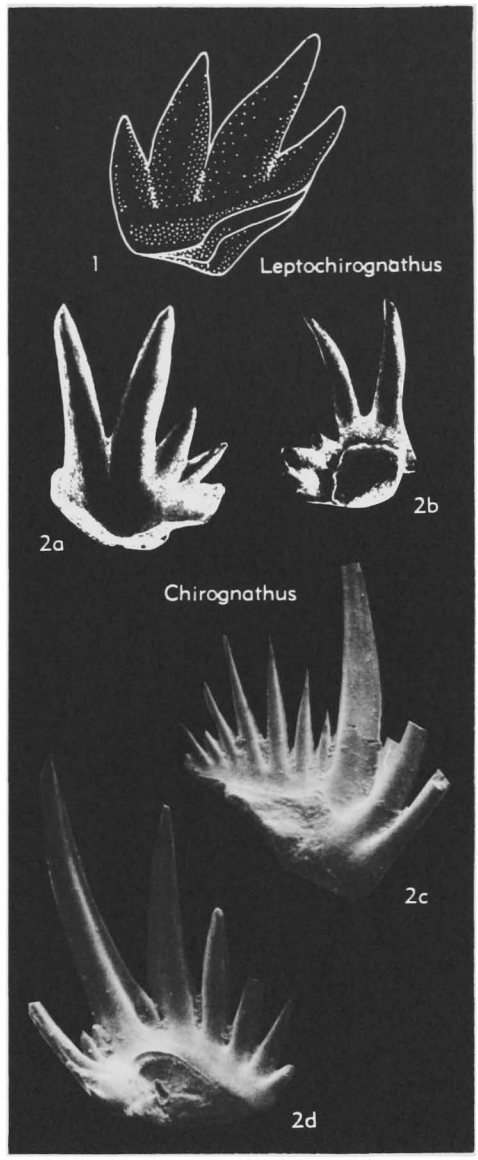

FIG. 85. Chirognathidae (p. *W*137-*W*138).

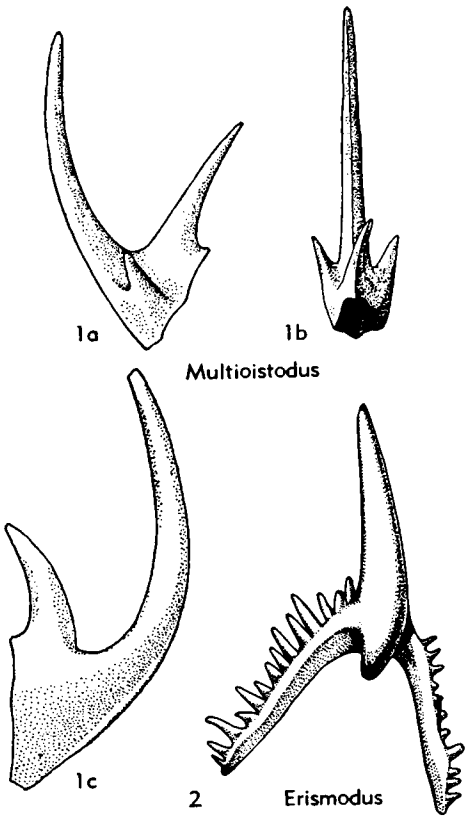

FIG. 86. Multioistodontidae (p. W138-W139).

based on pectiniform, mostly palmate, asymmetrical units consisting of shallowly excavated base with a few denticles along upper margin. Denticles characteristically showing strong lateral compression with sharp edges, wide at base, confluent basally but free apically; usually no distinct cusp. Denticle orientation varying from suberect to almost parallel to base. [*Leptochirognathus* differs from *Chirognathus* in its compressed denticles.] *M.Ord.*, N.Am.-?Asia(Sib.).——FIG. 85,*1*. **L. quadratus*, McLish F., USA(Okla.); ×37 (Hass, 1962).

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; *Dirhadicodus* HARRIS, 1964; *Neomultioistodus* HARRIS & HARRIS, 1965; *Tricladiodus* 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*, dolabrate 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(Ketsky 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 *Oistodus,* 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*, Joins F., USA (Okla.); *1a,d*, lat. views; *1b,c*, 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 dolabrate through 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.)-Australia.——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 Pteroconus* 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

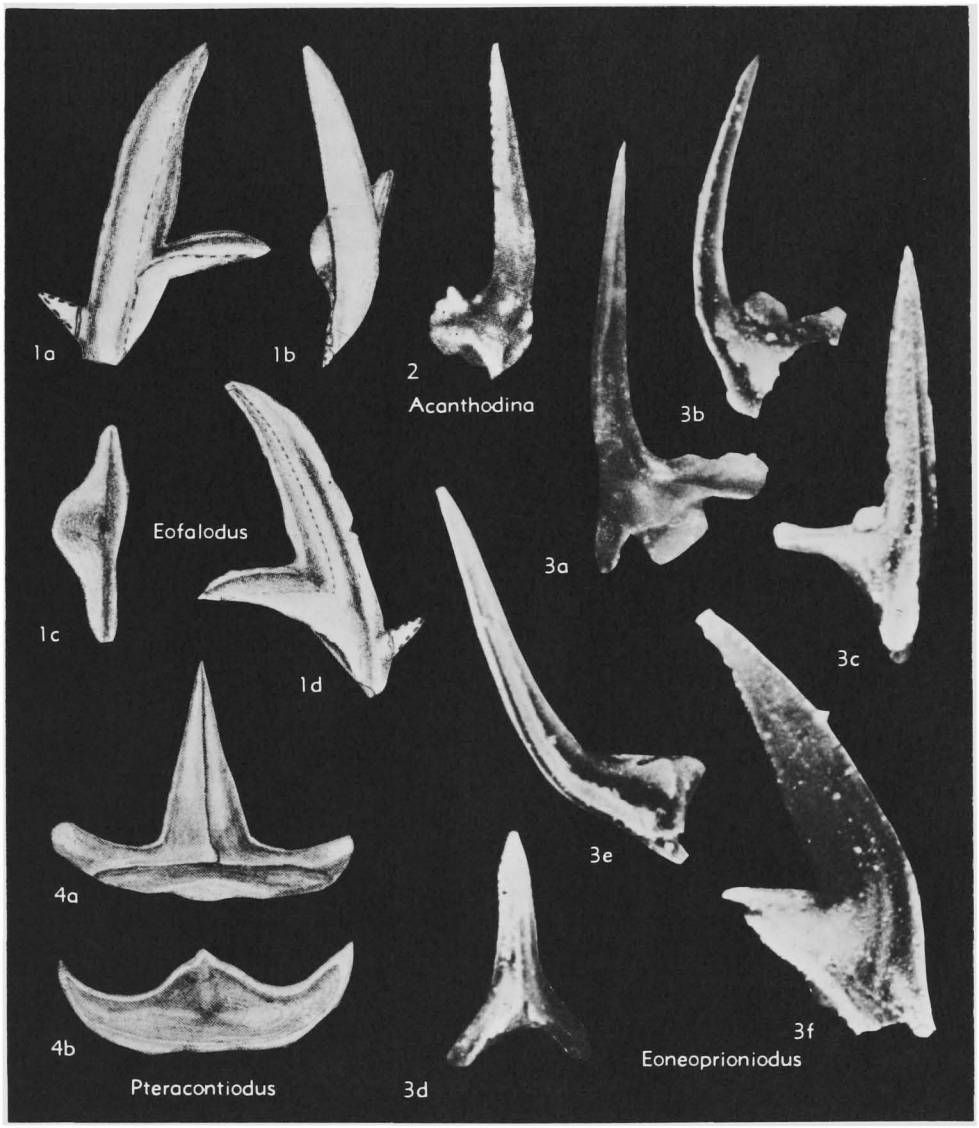

FIG. 87. Multioistodontidae (p. *W*138-*W*140).

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: CARNES, 1975.] *M. Ord.*, N.Am.-Eu.-Asia(Sib.).——FIG. 86,2. *E. radicans* (HINDE), Chazy., Can.(Que.); *Pa* element, ant. view, ×20 (Hass, 1962).

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

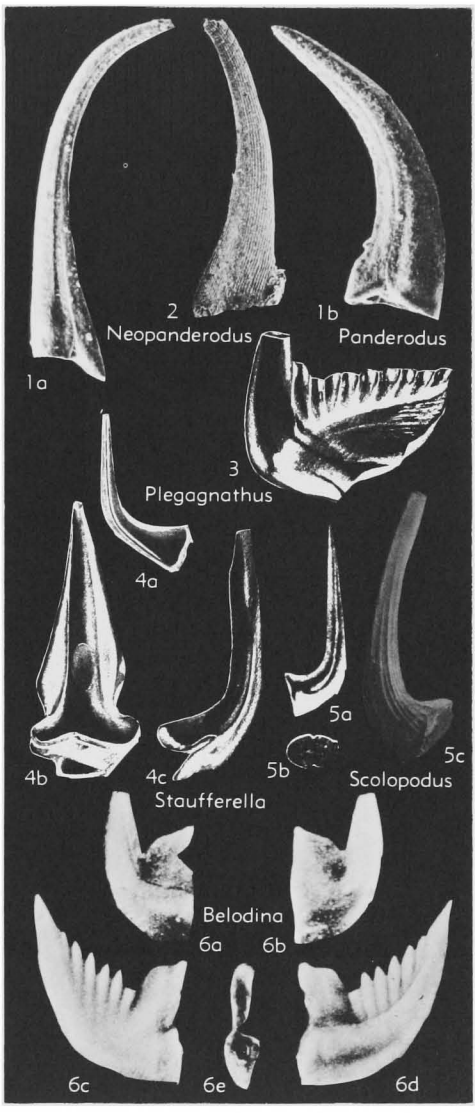

FIG. 88. Panderodontidae, Scolopodontidae (p. *W*140-*W*141).

nent, suberect to recurved, in cross section subtriangular to subrhomboidal cusp with short, low, denticlelike lateral process on each side of unit; basal cavity deepest beneath cusp but extending along under side of processes. *L.Ord.*, N.Am.—— FIG. 87,*4*. **P. aquilatus*, West Spring Creek F., USA(Okla.); *4a,b*, post. and lower views, ×35 (Harris & Harris, 1965).

Superfamily PANDERODONTACEA Lindström, 1970

[*nom. transl.* BERGSTRÖM & KLAPPER herein, *ex* Panderodontidae LINDSTRÖM, 1970, p. 433] [Materials for this superfamily prepared by GILBERT KLAPPER and S. M. BERGSTRÖM]

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

[Panderodontidae LINDSTRÖM, 1970, p. 433]

Apparatus uni- or multimembrate, composed of lamellar coniform 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.*, Eu.-N.Afr.-Asia-N.Am.-Australia.——FIG. 88,*1*. **P. unicostatus* (BRANSON & MEHL), Sil.(up.Llandov.-low.Wenlock., *Pterospathodus amorphognathoides* Z., Clarita F.), USA(Okla.); *1a, Sa* element, obverse lat. view; *1b, M* element, obverse lat. view; ×44 (Barrick, 1977).

Belodina ETHINGTON, 1959a, p. 271 [**Belodus grandis* STAUFFER, 1935b, p. 603; OD; =*Belodus compressus* BRANSON & MEHL, 1933b, p. 114] [=*Eobelodina* SWEET & others, 1959, p. 1050;

?Culumbodina 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).

Neopanderodus ZIEGLER & LINDSTRÖM, 1971, p. 633 [**N. perlineatus*; OD] [=*Parallelocostata* KHODALEVICH & TSCHERNICH, 1973a, p. 28]. Elements like those of *Panderodus* but lateral faces bearing uniform, coarse, longitudinal striations, wrinkle zone less well developed. [Apparatus reconstruction: ZIEGLER, 1975, p. 230.] *L.Dev.(Ems.)-M.Dev.(Givet.)*, Eu.-Asia-N.Am.——FIG. 88,*2*. **N. perlineatus*, holotype, M.Dev.(Eifel.), Eu.(Ger., Rhenish Slate Mts.); reverse lat. view, ×22 (Ziegler & Lindström, 1971).

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 ULRICH & 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.*, Eu.-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).

Staufferella SWEET, THOMPSON, & SATTERFIELD, 1975, p. 43 [**Distacodus falcatus* STAUFFER, 1935a, p. 142; OD]. Apparatus basically bimembrate, including two principal types of nongeniculate, longitudinally 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.Dev.(Frasn.)*.

Belodella ETHINGTON, 1959a, p. 271 [**Belodus devonicus* 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.Dev.(Frasn.)*, Eu.-N.Afr.-Asia-N.Am.-Australia-S.Am.——FIG. 89,*2*. *B. silurica* BARRICK, Sil.(Wenlock., *Kockelella stauros* Z., Clarita F.), USA(Okla.); *2a, Sa* 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

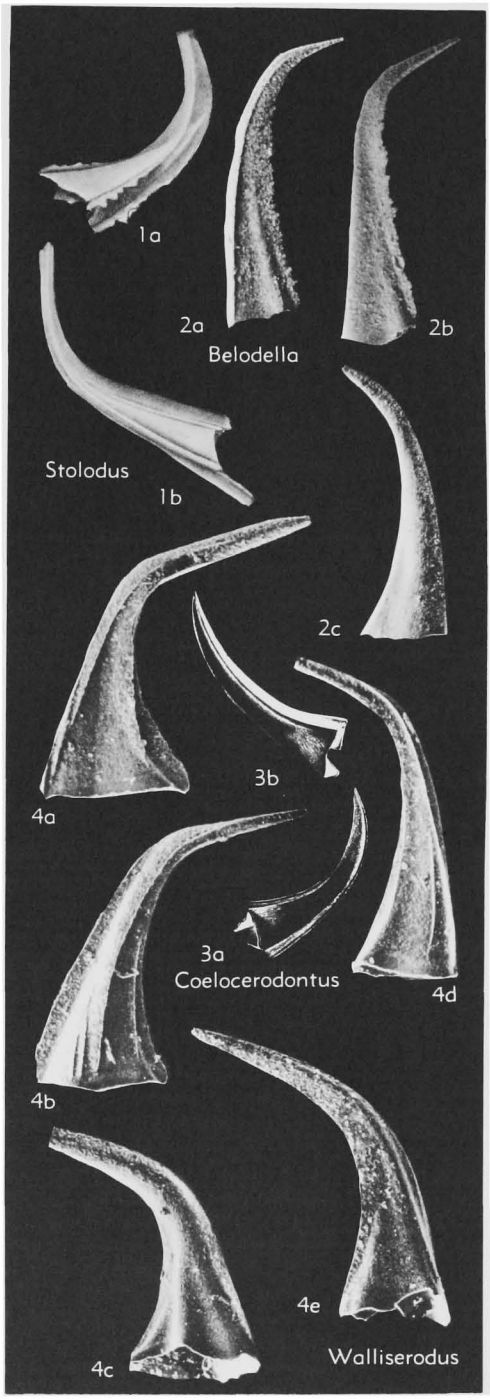

FIG. 89. Belodellidae (p. *W*141-*W*142).

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, ×48 (Ethington, 1959a).

Stolodus LINDSTRÖM, 1971, p. 51 [**Distacodus stola* LINDSTRÖM, 1955, p. 556; OD]. Apparatus basically unimembrate 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,*1*. **S. stola* (LINDSTRÖM), Eu.(Sweden); *1a,b*, lat. views, ×50 (Van Wamel, 1974).

Walliserodus SERPAGLI, 1967, p. 104 [**Paltodus debolti* REXROAD, 1967, p. 41; OD; =*Acodus curvatus* BRANSON & BRANSON, 1947, p. 554]. Apparatus multimembrate, consisting of an asymmetrical, nondenticulate element and a symmetry-transition series of characteristically multicostate, 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.(Ludlov.)*, Eu.-N.Am.——FIG. 89,*4*. *W. sancticlairi* COOPER, Sil. (up. Llandov.-low. Wenlock., *Pterospathodus 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. ×48 (Barrick, 1977).

Superfamily DISTACODONTACEA Bassler, 1925

[*nom. transl.* LINDSTRÖM, 1970, p. 429, *ex* Distacodontidae BASSLER, *nom. correct.* HASS, 1958, p. 141, *pro* Distacodidae BASSLER, 1925, p. 218] [Materials for this superfamily prepared by S. M. BERGSTRÖM unless noted otherwise]

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,

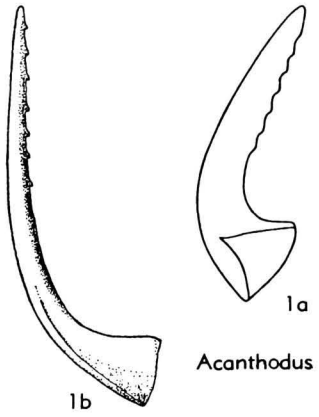

FIG. 90. Acanthodontidae (p. W143).

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*, Oneota F., USA(Minn.), diagr. lat. view, ×23 (Furnish, 1938).——FIG. 90,*1b*. *A.* cf. *A. uncinatus*, Dry Creek Sh., USA(Mont.); lat. view, ×52 (Lindström, 1964).

Family DREPANOISTODONTIDAE 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 *Paltodus* 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, ×52 (Van Wamel, 1974).

Distacodus HINDE, 1879, p. 357, *nom. subst. pro Machairodus* PANDER, 1856, *non* KAUP, 1833; a mammal [**Machairodus incurvus* 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. incurvus* 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. incurvus* (PANDER), Eu.(Baltic); *1a,b*, 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-

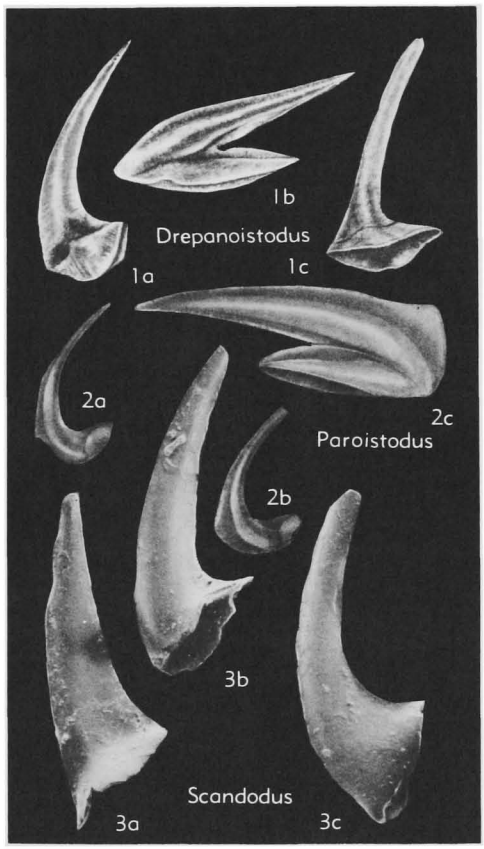

FIG. 91. Drepanoistodontidae (p. W143-W144).

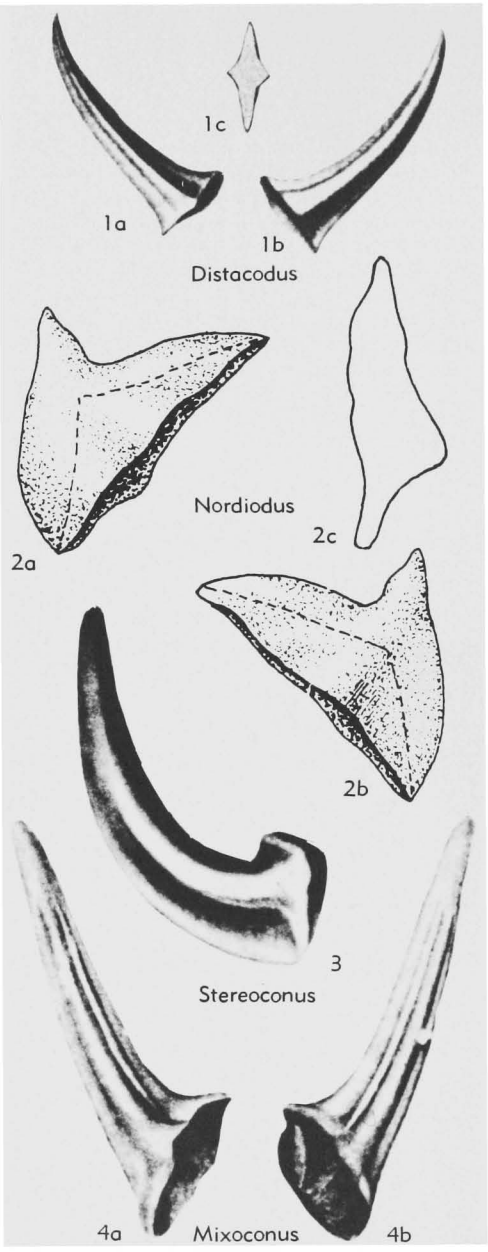

FIG. 92. Drepanoistodontidae (p. W143-W145).

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. italicus*; OD]. Apparatus trimembrate, consisting of one geniculate and two types of nongeniculate, lamellar, laterally compressed, bilaterally asymmetrical, coniform elements. Geniculate elements (*Oistodus rhodesi* 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. italicus*) 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. suberectus* 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. italicus*, Italy(Carnic Alps); *2a,b*, nongeniculate element, lat. views; *2c*, same, lower view; ×106 (Serpagli, 1967).

Paroistodus LINDSTRÖM, 1971, p. 46 [**Oistodus parallelus* PANDER, 1856, p. 27; OD]. Apparatus bimembrate. Geniculate elements with reclined cusp and anteroposteriorly extended base tending to be square in lateral view. Nongeniculate elements with recurved cusp, cusp in some elements 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. parallelus* (PANDER), L.Ord.(low.Arenig.), Eu.(Sweden); *2a,b*, nongeniculate elements, lat. views; *2c*, geniculate element, lat. view; ×49 (Van Wamel, 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-

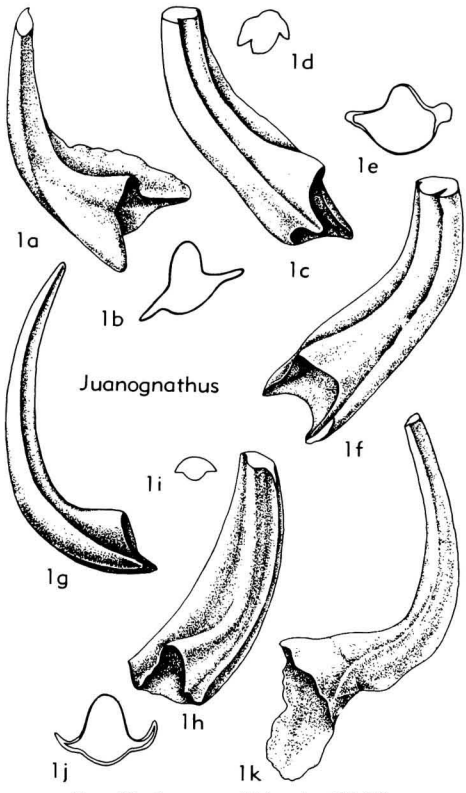

FIG. 93. Juanognathidae (p. *W*145).

ments hyaline, fibrous, nongeniculate, bilaterally symmetrical, laterally carinate, with rounded posterior margin, short base, and shallow basal cavity. [Affinity to *Drepanoistodus* and related genera is currently obscure.] *M.Ord.*, N.Am.-Asia(Sib.). ——FIG. 92,*3*. **S. gracilis*, Harding Ss., USA (Colo.); lat. view, ×35 (Sweet, 1955).

Family JUANOGNATHIDAE Bergström, new

Apparatus unknown but includes nongeniculate 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*. **J. variabilis*, L.Ord.(San Juan F.), S.Am.(Arg.); *1a,c,f-h,k*, elements of transition series, post.-lat. views; *1b,d,e,i,j*, cross sections; *a,b*, ×50; *c-f,k*, ×66; *g*, ×52; *h-j*, ×34 (Serpagli, 1974).

Family PROTOPANDERODONTIDAE Lindström, 1970

[*nom. transl.* BERGSTRÖM herein, *ex* Protopanderodontinae LINDSTRÖM, 1970, p. 433]

Apparatus bimembrate, composed of laterally compressed, lamellar, nongeniculate elements; some forms with cusp smooth laterally, others with prominent longitudinal costae and furrows arranged symmetrically or asymmetrically; cusp more or less twisted in one type of element; white matter abundant in cusp. *Ord.*

Protopanderodus LINDSTRÖM, 1971, p. 50 [**Acontiodus rectus* LINDSTRÖM, 1955; OD]. Apparatus composed of symmetrical and asymmetrical elements forming transition series. Elements with

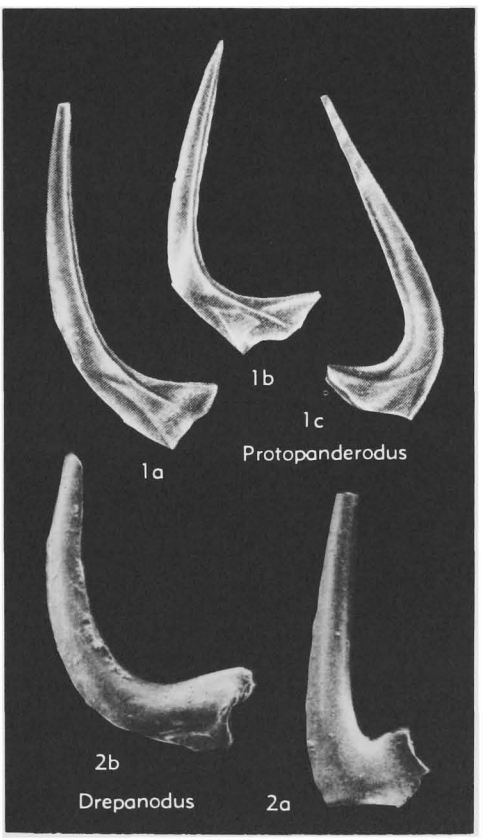

FIG. 94. Protopanderodontidae (p. *W*145-*W*146).

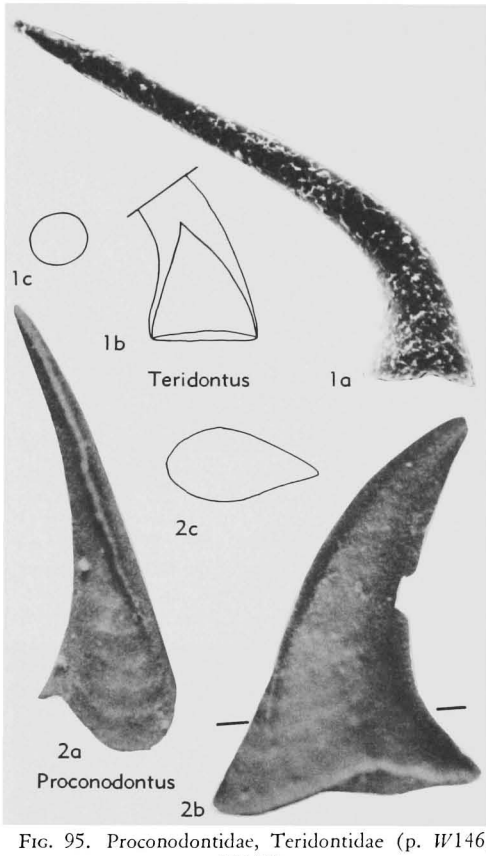

FIG. 95. Proconodontidae, Teridontidae (p. W146, W148).

recurved 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 *Drepanoistodus, Paltodus,* and *Paroistodus*. Apparatus reconstruction: LINDSTRÖM, 1971.] *Ord.,* Eu.-N.Am.-S.Am.-Asia.——FIG. 94,*1*. **P. rectus* (LINDSTRÖM), L.Ord., Eu.(Sweden); *1a,b,* elements with prominent costae, lat. views, ×52, ×37; *1c,* element with noncostate, twisted cusp, lat. view, ×44 (Van Wamel, 1974).

Drepanodus PANDER, 1856, p. 20, *non* MENGE, 1869, Arachnida [**D. arcuatus*; SD MILLER, 1889, p. 313]. Apparatus composed of two types of element; one long and slender, recurved to reclined, nongeniculate; the other reclined, 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 *D. arcuatus,* but additional material is needed to confirm that reconstruction.] *Ord.,* Eu.-Asia-N. Am.-Australia.——FIG. 94,*2*. **D. arcuatus,* L.Ord. (*Didymograptus balticus* Subzone), Eu.(Sweden); *2a,b,* geniculate and nongeniculate elements, lat. views, ×50 (Bergström, n).

Family PROCONODONTIDAE Lindström, 1970

[Proconodontidae LINDSTRÖM, 1970, p. 429] [Materials for this family prepared by J. F. MILLER]

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

Proconodontus MILLER, 1969, p. 437 [**P. mülleri*; 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., ?L.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. muelleri,* holotype, U.Cam., USA (Utah); *2a-c,* ant. and lat. views, transv. sec., ×38 (Miller, 1969).

Family OISTODONTIDAE Lindström, 1970

[Oistodontidae LINDSTRÖM, 1970, p. 431]

Apparatus trimembrate, composed of a symmetry-transition series of coniform geniculate elements, two elements in some of modified tertiopedate and alate type; cusp long, slender, reclined to recurved; basal cavity shallow but extending along entire under side of element; modified tertiopedate and alate elements with prominent costae, developed as short lateral processes in some; other geniculate element acostate or multicostate; white matter abundant or missing. *L.Ord.-M.Ord.*

Oistodus PANDER, 1856, p. 27 [**O. lanceolatus*; SD ULRICH & BASSLER, 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

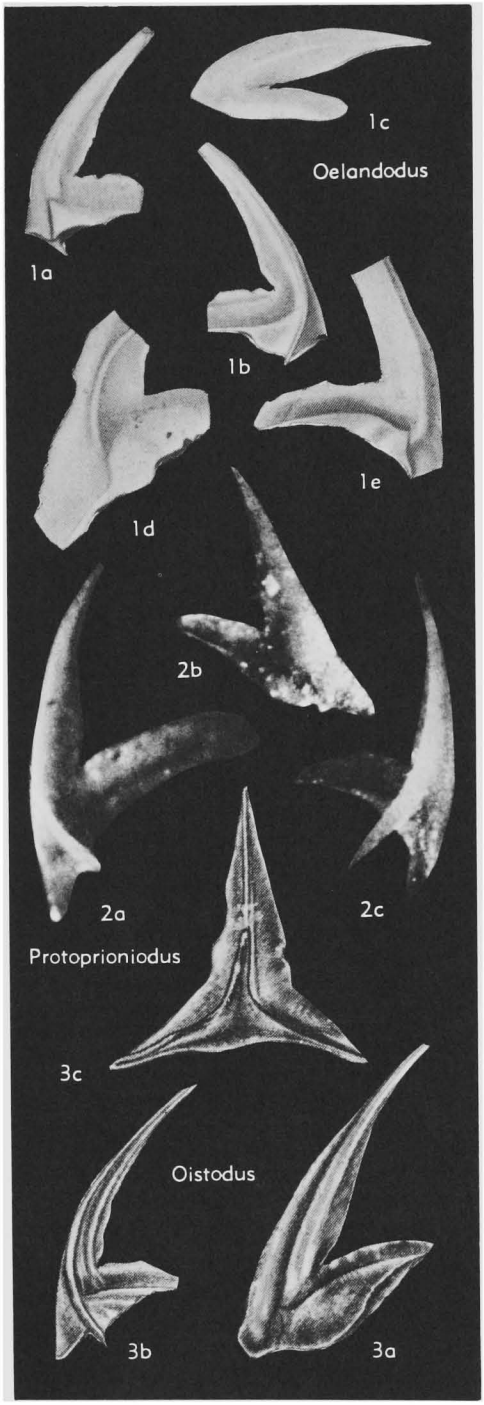

FIG. 96. Oistodontidae (p. *W*146-*W*147).

forming transition series; *3a,b,* 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-e,* 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 acostate 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,* tertiopedate element holotype, 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,c,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

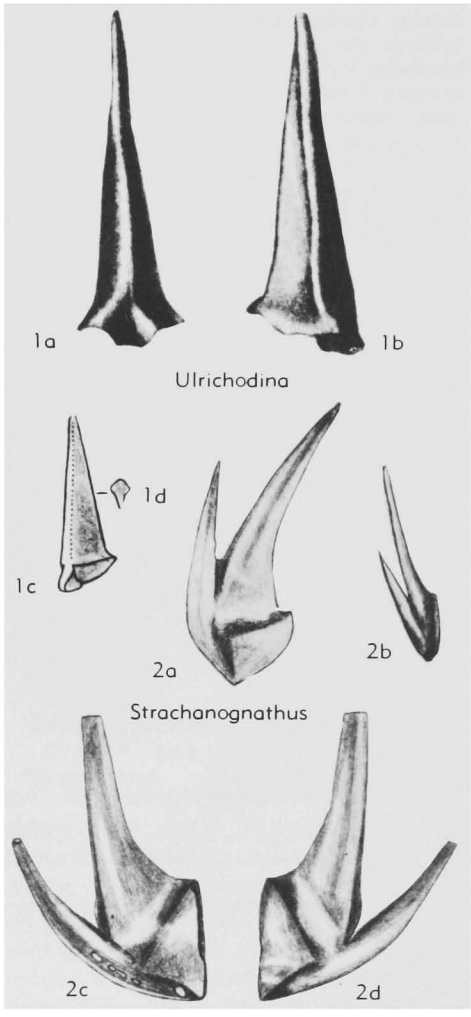

FIG. 97. Strachanognathidae, Ulrichodinidae (p. W147, W148).

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 [**Oneotodus nakamurai* 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. nakamurai* (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 lateral 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 HIBBARDELLACEA 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

[Hibbardellidae MÜLLER, 1956b, p. 824] [Materials for this family prepared by GILBERT KLAPPER and S. M. BERGSTRÖM]

Characterized by a quinqui- or seximem-

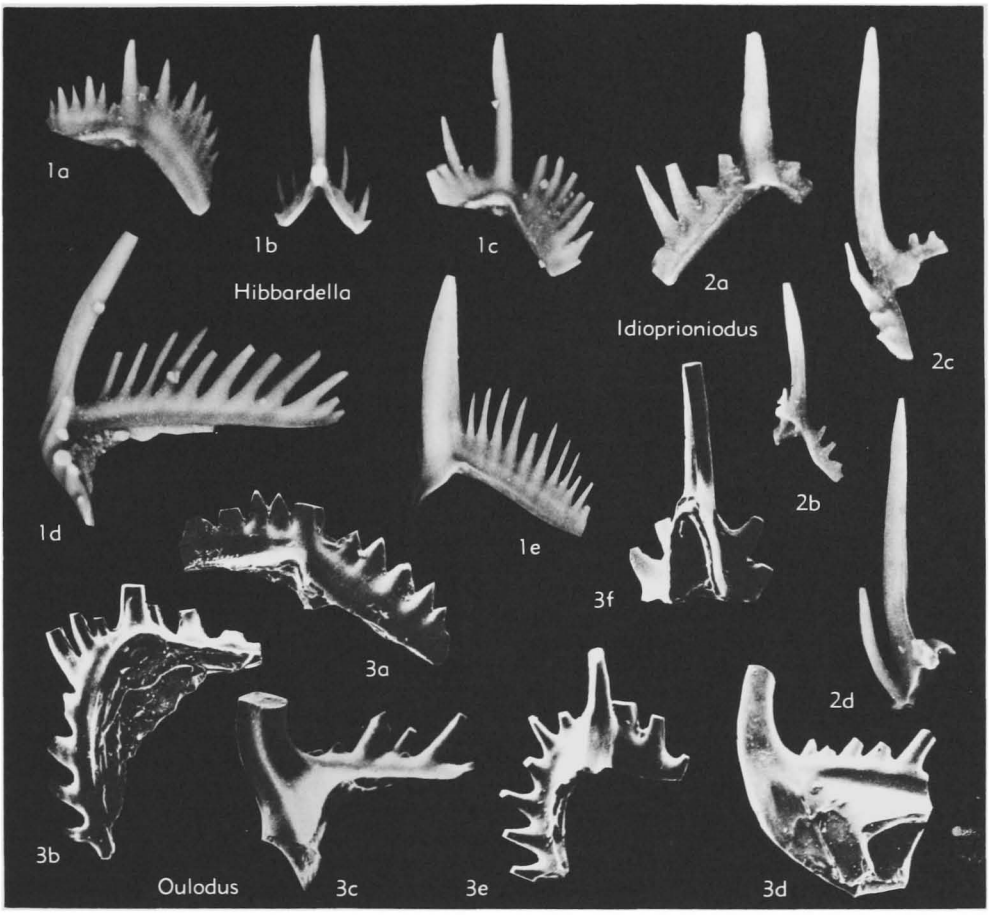

FIG. 98. Hibbardellidae (p. *W*149-*W*150).

brate apparatus; *Pa* element sigmoidal and carminate, angulate, or digyrate; *Pb* element angulate or digyrate; *M* element dolabrate or bipennate; *S* elements in a symmetry-transition series from alate through digyrate to bipennate units. *M.Ord.-U.Penn.*

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); *1a, Pb* element, lat. view; *1b, Sa* element, post. view; *1c, Sb* element, lat. view; *1d, Sc* element, lat. view; *1e, M* element, lat. view; ×27 (Klapper & Philip, 1971).

Idioprioniodus GUNNELL, 1933, p. 265 [**I. typus*; OD] [=*Metalonchodina* BRANSON & MEHL, 1941c, p. 105; *Duboisella* RHODES, 1952, p. 895; *Neoprioniodus* RHODES & MÜLLER, 1956, p. 698]. Apparatus basically seximembrate. *Pb* element angulate, *M* element dolabrate, and *S* elements forming symmetry-transition series of 4 elements ranging from alate through digyrate to bipennate. Denticles massive, characteristically keeled, and somewhat compressed in *M* element. [Apparatus reconstruction: VON BITTER, 1972; BAESEMANN, 1973; MERRILL & MERRILL, 1974.] *Carb.,* Eu.; *U.Miss.-U.Penn.,* N.Am.——FIG. 98,*2*. **I. typus,* U.Penn.(Missour., Kansas City Gr.), USA(Kans.); *2a, Pb* element, lat. view; *2b, Sa* element, post. view; *2c, Sc* element, lat. view; *2d, Sb* element, lat. view; ×27 (Baesemann, 1973).

Oulodus BRANSON & MEHL, 1933b, p. 116 [**Cordylodus serratus* STAUFFER, 1930, p. 124; OD; =*O. mediocris* BRANSON & MEHL, 1933b] [=*Barbarodina* STAUFFER, 1935b; *Gyrognathus* STAUFFER,

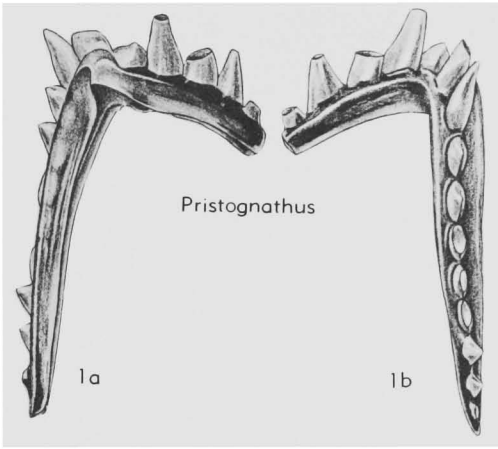

FIG. 99. Hibbardellidae (p. W150).

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.)-Australia.——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 equal-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

[Gondolellacea LINDSTRÖM, 1970, p. 438] [Diagnosis prepared by GILBERT KLAPPER]

Apparatus usually sexi- or septimembrate but reduced to *Pa* elements and thus unimembrate in some species. Platformed *Pa* elements segminiplanate 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

[Gondolellidae LINDSTRÖM, 1970, p. 438] [Materials for this family prepared by GILBERT KLAPPER, R. L. AUSTIN, and F. H. T. RHODES]

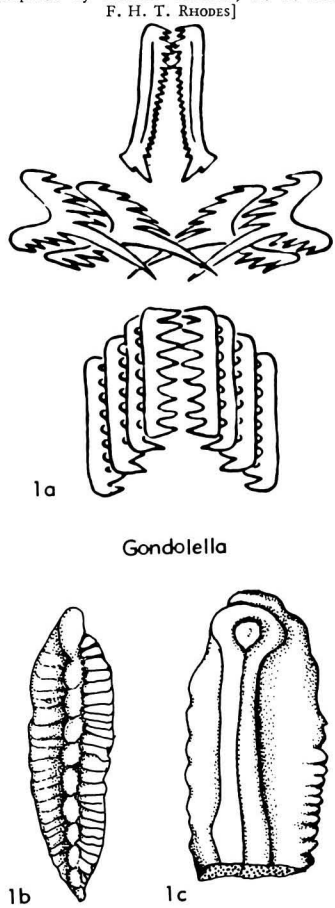

FIG. 100. Gondolellidae (p. W151, W152).

Apparatus apparently septimembrate, *Pa* element segminiplanate, *Pb* element angu-

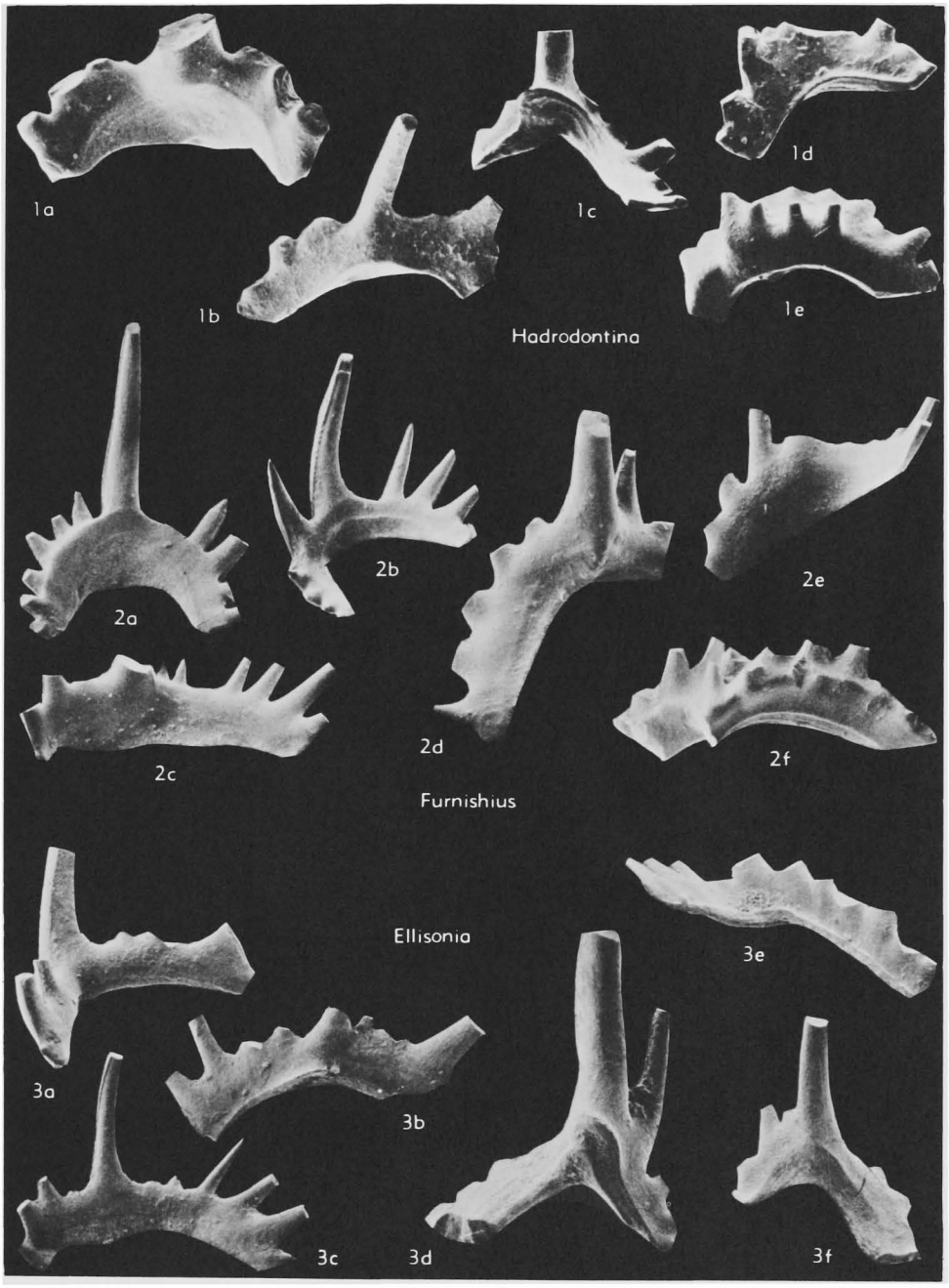

FIG. 101. Ellisoniidae (p. *W*152-*W*153).

late, *M* element ramiform, *S* elements form symmetry-transition series. *M.Penn.-L.Perm.*

Gondolella STAUFFER & PLUMMER, 1932, p. 41 [**G. elegantula*; 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.(Atokan)-L. Perm.*, N.Am.; *U.Carb.-L.Perm.*, W.Eu.-Afr.-Australia-Asia M.-N.Z.——Fig. 100,*1*. *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 ELLISONIIDAE Clark, 1972

[*nom. transl.* Sweet, herein, *ex* superfamily Ellisoniacea Clark, 1972a, p. 157] [Materials for this family prepared by W. C. Sweet]

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 Dichodella* Mosher, 1968, *non* Serpagli, 1967; *?Oncadella* Mosher, 1968; *Neoplectospathodus* Kozur & Mostler, 1970; *Stepanovites* Kozur, 1975a]. Apparatus seximembrate: *Pa* angulate; *Pb* digyrate, bowed out; *M* digyrate; *Sa* alate with long denticulate posterior process; *Sb* digyrate; *Sc* bipennate 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 paucidentata* (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. triserratus*; OD] [=*Malaygnathus* 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* bipennate 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. triserratus*, 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] [=*Cratognathodus* 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 nonplatformed 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).

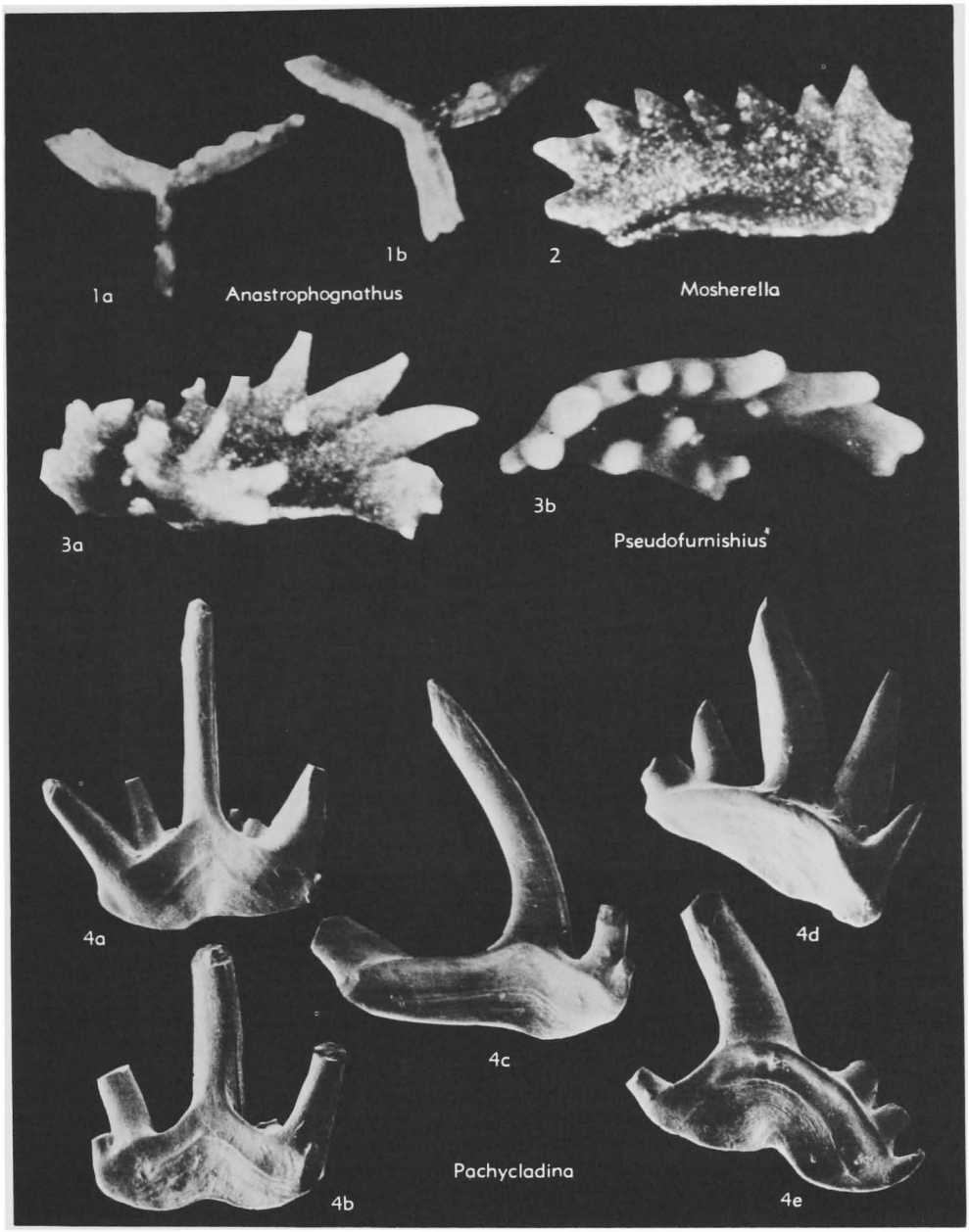

FIG. 102. Ellisoniidae (p. *W*152-*W*154).

Hadrodontina STAESCHE, 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* STAESCHE, 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; ×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 KOZUR, *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, ×94 (Sweet & others, 1971).

Pachycladina STAESCHE, 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 geographic 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; ×42 (Sweet, n).

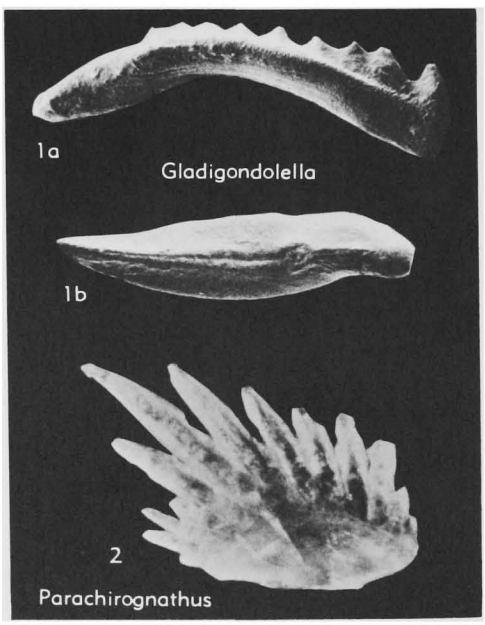

FIG. 103. Ellisoniidae (p. *W*152, *W*154).

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, ×50 (Sweet & others, 1971).

Pseudofurnishius VAN DEN BOOGAARD, 1966, p. 5 [**P. murcianus*; OD]. Apparatus unimembrate, apparently composed entirely of pastiniplanate or stelliplanate elements with platform extensions only on lateral processes. *M.Trias.-U.Trias.,* Eu.-Middle East-Afr.——FIG. 102,3. **P. murcianus,* holotype, M.Trias., Eu.(Spain); *3a,* lat. view, ×102; *3b,* upper side, ×109 (van den Boogaard, 1966).

Family XANIOGNATHIDAE
Sweet, new

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

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, ×86; *2b,* posteriorly incomplete *Sc* element, lat. view, ×78; *2c, Sb* element, post. view, ×64; *2d, Pb* element, oblique outer view, ×97; *2e, Pa* element, lat. view, ×119; *2f, M* ele-

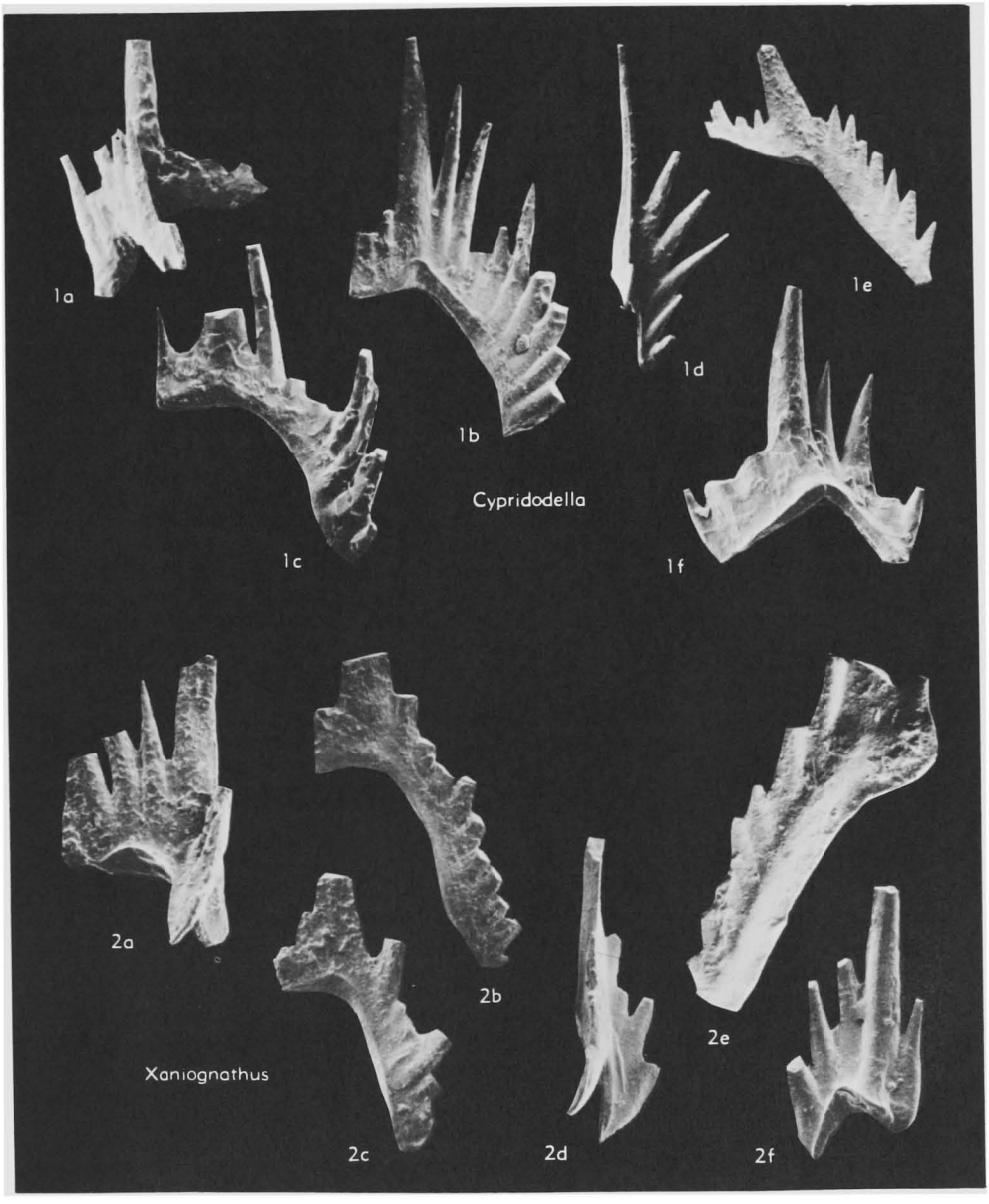

FIG. 104. Xaniognathidae (p. *W*154-*W*156).

ment, post. view, ×97 (Sweet, n).

Chirodella HIRSCHMANN, 1959, p. 71 [**Metalonchodina triquetra* TATGE, 1956, p. 137; OD] [?=*Cornudina* 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 *Cornudina*. It is probable that all these elements

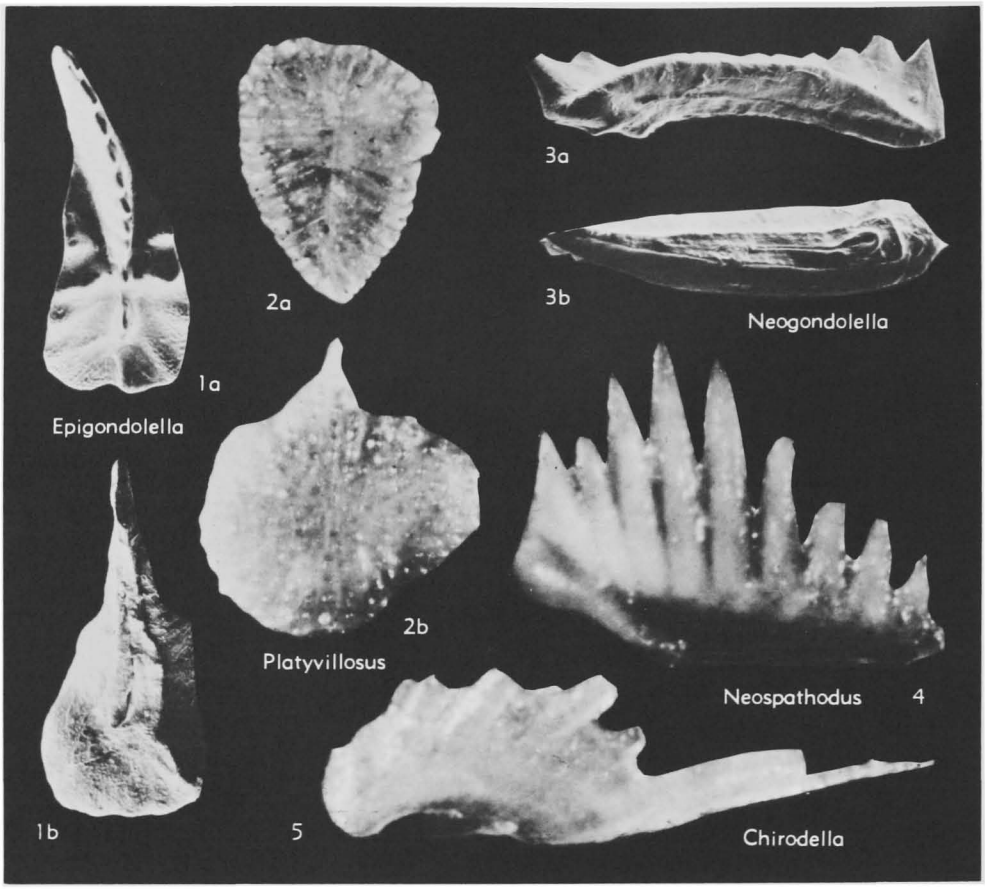

FIG. 105. Xaniognathidae (p. *W*155-*W*157).

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. triquetra* (TATGE), M.Trias., Eu.(W.Ger.); oblique outer-lat. view, ×200 (Sweet, n).

Cypridodella MOSHER, 1968, p. 920 [**C. conflexa*; OD] [=*Pollognathus* KOZUR, 1968; *Hibbardelloides* KOZUR & MOSTLER, 1970; *Grodella* KOZUR & MOSTLER, 1970; *?Veghella* KOZUR & MOSTLER, 1970; *Pseudozarkodina* 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*, ×97; *1e*, ×62 (Sweet, n).

Epigondolella MOSHER, 1968, p. 935 [**Polygnathus abneptis* HUCKRIEDE, 1958, p. 156; OD] [=*Tardogondolella* BENDER, 1970; *Ancyrogondolella* BUDUROV, 1972; *Parvigondolella* KOZUR & MOCK, 1972; *Carinella* BUDUROV, 1973]. Apparatus unimembrate, apparently composed entirely of segminiplanate elements with more or less free anterior blade and platform margins marked by node- or spinelike 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 *Parvigondolella* on platformless segminate elements interpreted as representatives of a species derived from *E. bidentata* MOSHER. Platform reduction, however, was evidently a phylogenetic tendency in *Epigondolella,* hence *Parvigondolella* is here regarded as merely the ultimate stage in the evolution of *Epigondolella,* not as a separate genus.] *M.Trias.-U.Trias.,* Eu.-Asia-N.Am.——FIG. 105,*1*. **E. abneptis* (HUCKRIEDE), M.Trias., Eu.(Aus.); *1a,* upper side; *1b,* under side; ×61 (Sweet, n).

Neogondolella BENDER & STOPPEL, 1965, p. 343 [**Gondolella mombergensis* TATGE, 1956; M] [=*Metapolygnathus* HAYASHI, 1968; *Paragondolella* MOSHER, 1968; *Celsigondolella* KOZUR, 1968]. Apparatus unimembrate, apparently composed entirely of segminiplanate elements supposed to have occupied *Pa* positions. [Elements typical of *Neogondolella* may have a relationship with *Cypridodella* and *Xaniognathus* like that between *Gladigondolella* and *Ellisonia,* or elements of *Neogondolella* and *Neospathodus* may represent dimorphs of species of *Cypridodella* or *Xaniognathus*. If the latter is true, taxonomy in the entire plexus will need great revision.] *Perm.–Trias.,* Eu.-Asia-N.Am.-Australia.——FIG. 105,*3*. **N. mombergensis* (TATGE), M.Trias., Eu.(W. Ger.); *3a,* lat. view, ×64; *3b,* under side, ×61 (Sweet, n).

Neospathodus MOSHER, 1968, p. 929 [**Spathognathodus cristagalli* HUCKRIEDE, 1958, p. 161; OD] [=*Neospathognathodus* BUDUROV, 1968, *nom. neg.; ?Misikella* KOZUR & MOCK, 1974; *Merrillina* KOZUR & MOCK, 1974]. Apparatus unimembrate, apparently composed entirely of segminate elements with distinct mid-lateral ribs; elements 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, 1970).

Platyvillosus CLARK, SINCAVAGE, & STONE, 1964, p. 376 [**P. asperatus*; OD] [=*Eurygnathodus* STAESCHE, 1964; *?Foliella* BUDUROV & PANTIC, 1973]. Apparatus unimembrate, apparently composed entirely of arched segminiplanate elements with irregularly nodose, radially or transversely ribbed upper surfaces, these surfaces subcircular, quadrate, or larchrymiform in upper view. Elements supposedly occupying *Pa* position. *L.Trias.,* N.Am.-Eu.——FIG. 105,*2a*. *P. costatus* (STAESCHE), USA(Nev.); upper side, ×50 (Sweet & others, 1971).——FIG. 105,*2b*. **P. asperatus,* USA (Nev.); upper side, ×50 (Sweet & others, 1971).

Sweetocristatus SZANIAWSKI in SZANIAWSKI & MATKOWSKI, 1979, *L.Perm.,* see addendum.

Superfamily POLYGNATHACEA Bassler, 1925

[*nom. transl.* LINDSTRÖM, 1970, p. 438, *ex* Polygnathidae BASSLER, 1925, p. 219] [Diagnosis by GILBERT KLAPPER]

Apparatus basically seximembrate, but may be reduced to *Pa* elements and thus unimembrate in specialized species. Ramiform elements multidenticulate and albid. [The apparatus is closely similar to that of Prioniodontacea, differing in that the *Pa* element is or can be derived, directly or indirectly, from the *Pa* element of multielement *Ozarkodina.*] *U.Ord.-L.Trias.*

Family KOCKELELLIDAE Klapper, new

[Materials for this family prepared by GILBERT KLAPPER]

Apparatus seximembrate: *Pa* element scaphate or planate; *Pb* angulate; *M* dolabrate; *Sa* symmetrical; *S* symmetry-transition series bearing discrete denticles. *Sil. (up.Llandov.-Ludlov.).*

Kockelella WALLISER, 1957, p. 34 [**K. variabilis*; OD]. *Pa* element carminiscaphate or stelliscaphate with posterior basal cavity; lateral processes characteristically developed. [Reconstruction: WALLISER, 1964, p. 14; BARRICK & KLAPPER, 1976.] *Sil.(up. Llandov.-Ludlov.),* Eu.-N. Afr.-Asia-N. Am.-Australia.——FIG. 106,*2*. *K. patula* WALLISER, Sil. (Wenlock., *K. amsdeni* Z., Clarita Fm.), USA (Okla.); *2a,b, Pa* element, upper and lower views; *2c, Pb* element, lat. view; *2d, M* element, lat. views; *2e, Sc* element, lat. view; *2f, Sb* element, lat. view; *2g, Sa* element, post. view; ×27 (Barrick & Klapper, 1976).

Ancoradella WALLISER, 1964, p. 28 [**A. ploeckensis*; OD]. *Pa* element modified stelliplanate, resembling that of late species of *Kockelella* with well-developed lateral processes, but unit not scaphate. [Only the *Pa* element is recognized.] *Sil.(Ludlov.),* Eu.-N.Am.-Australia.——FIG. 106, *1a,b*. **A. ploeckensis,* holotype, *A. ploeckensis* Z., Eu.(Aus., Carnic Alps); *1a,b, Pa* element, upper and lower views, ×27 (Walliser, 1964).

Family CRYPTOTAXIDAE Klapper & Philip, 1972

[Cryptotaxidae KLAPPER & PHILIP, 1972, p. 100] [Materials for this family prepared by GILBERT KLAPPER]

Apparatus seximembrate: *Pa* element carminate or carminiplanate; *Pb* carminate and sigmoidal; *M* dolabrate; *Sa* asymmetrical with inverted processes; *S* symmetry-transition series bearing discrete denticles. *M.Dev.-U.Dev.(Famenn.).*

Cryptotaxis KLAPPER & PHILIP, 1971, p. 444 [**Spathognathodus culminidirectus* SCOTT, 1961,

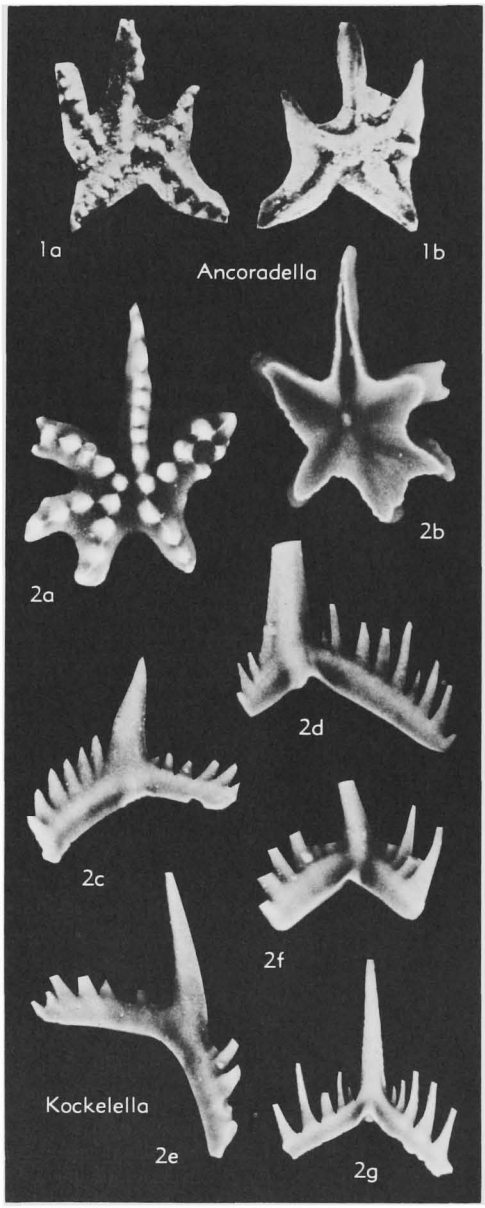

FIG. 106. Kockelellidae (p. W157).

p. 1226; OD]. *Pa* element carminate; *Pb* element carminate and slightly arched. [Reconstruction: KLAPPER & PHILIP, 1971.] *U.Dev.(Famenn.)*, N.Am.——FIG. 107,*1*. **C. culminidirecta* (SCOTT), *Protognathodus* Fauna (Louisiana Ls.), USA (Mo.); *1a, Pa* element, lat. view; *1b, M* element, lat. view; *1c, Pb* element, lat. view; *1d, Sc* element, lat. view; *1e, Sb* element, lat. view; *1f, Sa* element, lat. view; ×27 (Klapper & Philip, 1971).

Parapolygnathus KLAPPER & PHILIP, 1971, p. 445 [**Polygnathus angusticostatus* WITTEKINDT, 1966, p. 631; OD]. Like *Cryptotaxis* but *Pa* element carminiplanate. [Reconstruction: KLAPPER & PHILIP, 1971; but see SPARLING, 1981.] *M.Dev.-U.Dev.*, Eu.-N.Am.-Australia.——FIG. 107,*2*. **P. angusticostatus* (WITTEKINDT), M. Dev. (Eifel., Dundee Ls.), Can.(Ont.); *2a, Pa* element, upper view; *2b, Pb* element, lat. view; *2c, M* element, lat. view; *2d, Sc* element, lat. view; *2e, Sb* element, lat. view; *2f, Sa* element, lat. view; ×27 (Klapper & Philip, 1971).

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 *Sc* bipennate, of two types. [Of the genera in this family, only *Adetognathus* and *Cavusgnathus* are known from multielement 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; *Windsorgnathus* AUSTIN & MITCHELL, 1975]. Known apparatus at least quinquimembrate: *Pa* scaphate, *Pb* angulate, *M* digyrate, *Sa* alate, *Sb* bipennate. Apparatus distinguished by *Pa* element having short free blade, conspicuous central trough, and transverse ridges; short fixed blade usually joining outer side of platform. [The *Pa* element resembles scaphate *Pa* element of *Adetognathus*.] *U.Miss.*, N.Am.; *U.Carb.*, S.Am.; *Carb.(Visean-Westphal.)*, Eu.-Afr.-Asia M.-Australia-N.Z.——FIG. 108,*6*. *C. naviculus* HINDE, U.Miss. (Chester., Goddard Fm.), USA(Okla.); *6a-c, Pa* element, lat., upper, and lower views, ×31 (Lane and Straka, 1974).

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.] *U.Miss.-L.Perm.,* N.Am.-Eu. ——FIG. 108,*4a.* **A. lautus* (GUNNELL), L.Perm., USA(Okla.); *Pa* element, upper view, ×40 (Dunn, 1970).——FIG. 108,*4b. A. gigantus* (GUNNELL), L.Penn., USA(Texas); *Pa* element, lat. view, ×40 (Dunn, 1970).

Capricornognathus AUSTIN & MITCHELL, 1975, p. 47 [**Taphrognathus 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 denticle; 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,*5.* **C. capricornis* (DRUCE), Eu.(Ire.); *5a,b, Pa* element, upper and lat. views, ×30 (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, ×40 (Austin & Mitchell, 1975).

Clydagnathus RHODES, AUSTIN, & DRUCE, 1969, p. 84 [**C. cavusformis*; 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. gilwernensis* RHODES, AUSTIN, & DRUCE, low.Tournais., Eu.(Wales); *7a,b, Pa* element, lat. and upper views, ×25 (Austin & Hill, 1973).

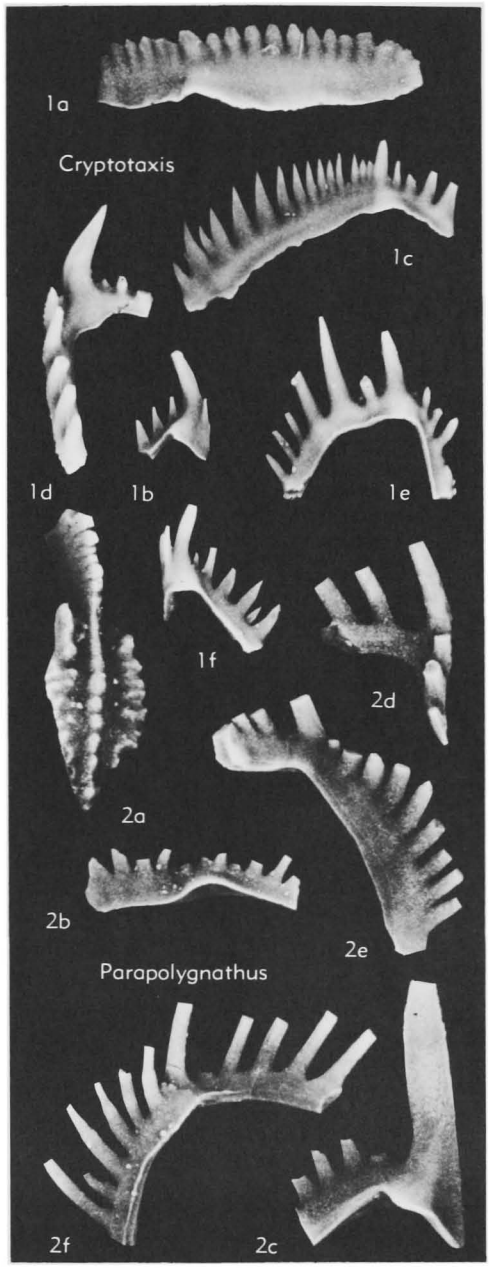

FIG. 107. Cryptotaxidae (p. *W*157-*W*158).

Patrognathus RHODES, AUSTIN, & DRUCE, 1969, p. 178 [**P. variabilis*; OD]. Apparatus unknown. Pectiniform element scaphate with free medial blade from half to one-third length of specimen;

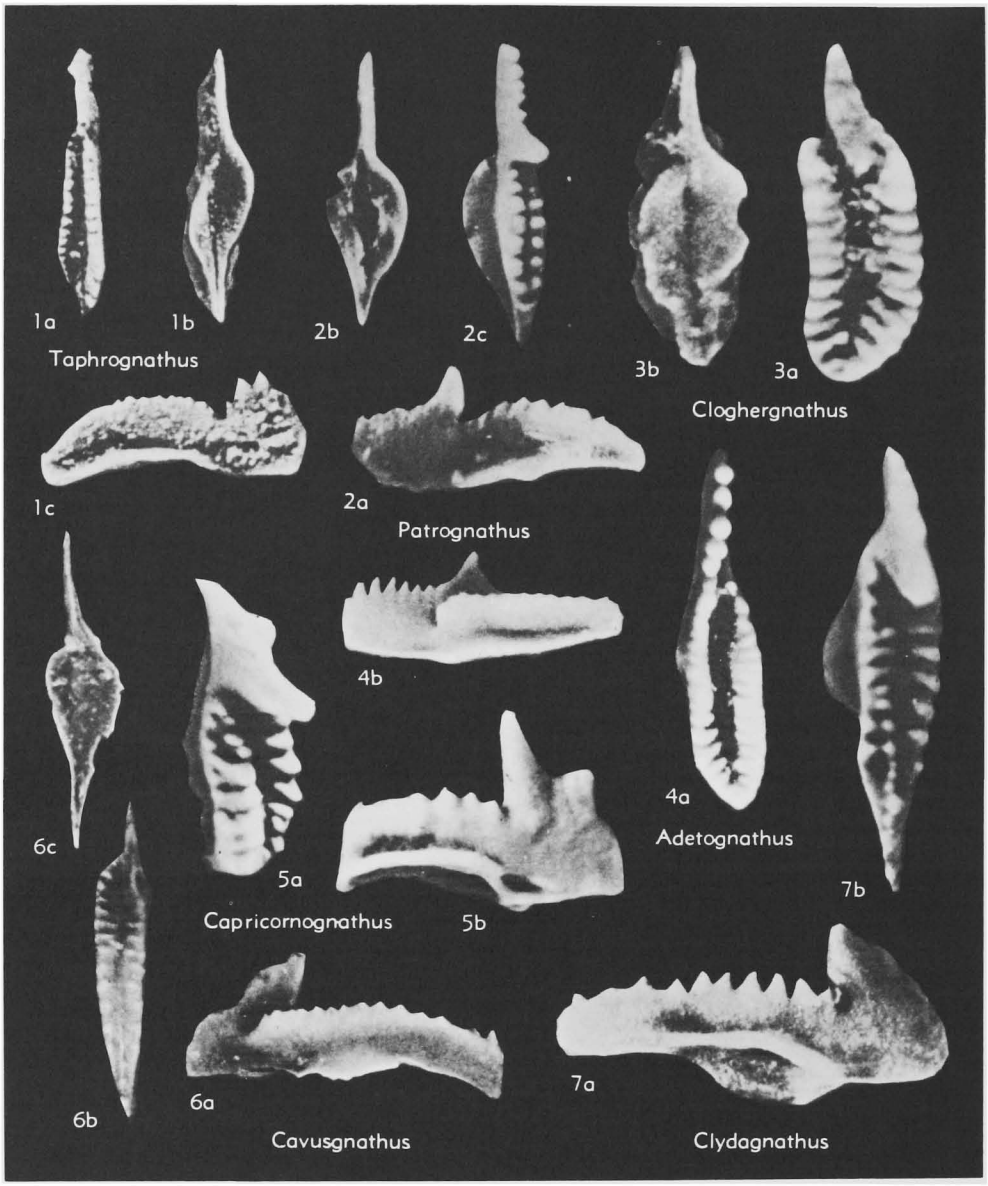

FIG. 108. Cavusgnathidae (p. *W*158-*W*160).

free blade having high posterior denticle; other blade denticles of uniform elevation; elongate symmetrical lanceolate platform having parapets; 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, ×25 (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.Visean, Eu.(Scot.); *1a-c, Pa* element, upper, lower, and lat. views, ×37 (Rhodes, Austin, & Druce, 1969).

Family IDIOGNATHODONTIDAE Harris & Hollingsworth, 1933

[*nom. transl. et correct.* Hass, 1959, p. 379, *pro* Idiognathinae 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* dolabrate; ramiform elements either alate *(Sa)* or bipennate (*Sa* and *Sc*). *U.Dev.-L.Perm.*

Idiognathodus Gunnell, 1931, p. 249 [**I. clavi-formis*; 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* dolabrate, *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,*7*. *I. delicatus* Gunnell, L.Penn., USA(Ill.); *Pa* element, upper view, ×28 (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] [=*Dryphenotus* Cooper, 1939; *Westfalicus* Moore & Sylvester-Bradley, 1957b]. Apparatus probably seximembrate; *Pa* element scaphate, *Pb* angulate, *M* dolabrate, *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, ×63 (Austin & others, 1974); for a reconstruction of assemblage, see Fig. 53,*2*.

Idiognathoides Harris & Hollingsworth, 1933, p. 201 [**I. sinuata*; OD] [=*Polygnathodella* Harlton, 1933; *Declinognathodus* Dunn, 1966; *Oxignathus* 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, ×28 (Austin, 1972).

Neognathodus Dunn, 1970, p. 336 [**Polygnathus bassleri* Harris & Hollingsworth, 1933, p. 198; OD]. Apparatus unknown, probably either sexi- or septimembrate. Pectiniform element scaphate

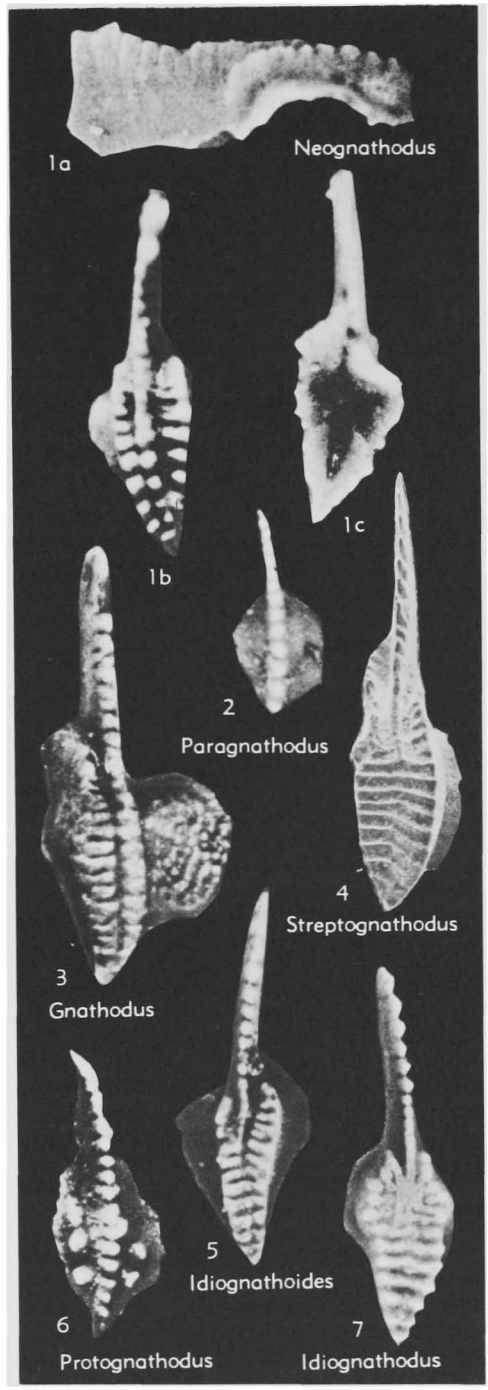

Fig. 109. Idiognathodontidae (p. *W*161-*W*162).

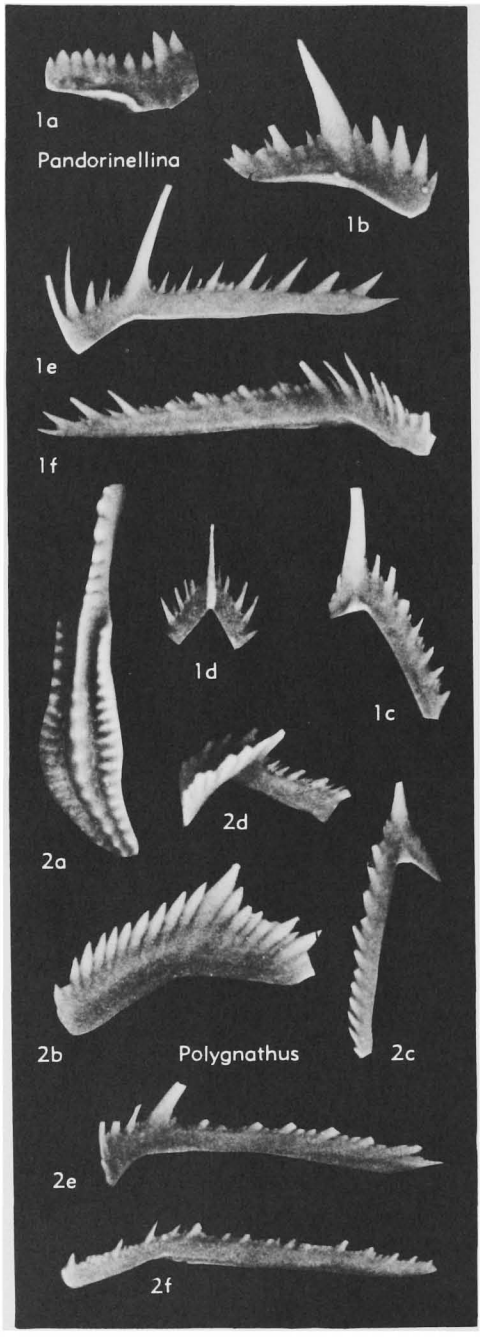

FIG. 110. Polygnathidae (p. *W*162-*W*164, *W*166).

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(Okla.); *1a-c*, *Pa* element, lat., upper, and lower views, ×40 (Dunn, 1970).

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 *Protognathodus*.] *U.Miss.-L.Penn. (Visean-low.Namur.)*, N.Am.-Eu.——FIG. 109,*2*. **P. commutatus* (BRANSON & MEHL), Visean, Eu. (Eng.); *Pa* element, upper view, ×40 (Higgins, 1975).

Protognathodus ZIEGLER, 1969, p. 352 [**Gnathodus kockeli* BISCHOFF, 1957, p. 25; OD]. Apparatus unknown. Pectiniform element scaphate with free medial blade, usually half element length; round symmetrical platform smooth or ornamented with nodes; carina distinct; basal cavity large. *U.Dev.-L.Miss.(Tournais.)*, N.Am.-Eu.-Afr.——FIG. 109, *6*. **P. kockeli* (BISCHOFF), U.Dev., Eu.(Ger.); *Pa* element, upper view, ×50 (Ziegler, 1969).

Streptognathodus STAUFFER & PLUMMER, 1932, p. 47 [**S. excellus*; OD] [=*Scottognathus* RHODES, 1953b *(partim)*, *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. Perm.*, N. Am.-Eu.-Afr.-Australia-N. Z.——FIG. 109,*4*. *S. antiquus* (STAUFFER & PLUMMER), U. Penn., USA(Kans.); *Pa* element, upper view, ×52 (von Bitter, 1972).

Family POLYGNATHIDAE Bassler, 1925

[Polygnathidae BASSLER, 1925, p. 219] [=Spathognathodontidae HASS, *nom. transl.* LINDSTRÖM, 1970, p. 439, *ex* Spathognathodontinae HASS, 1959, p. 378] [Materials for this family prepared by GILBERT KLAPPER, R. L. AUSTIN, and F. H. T. RHODES]

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 HUDDLE, 1970, p. 1037] [=*Hindeodella* BASSLER, 1925,

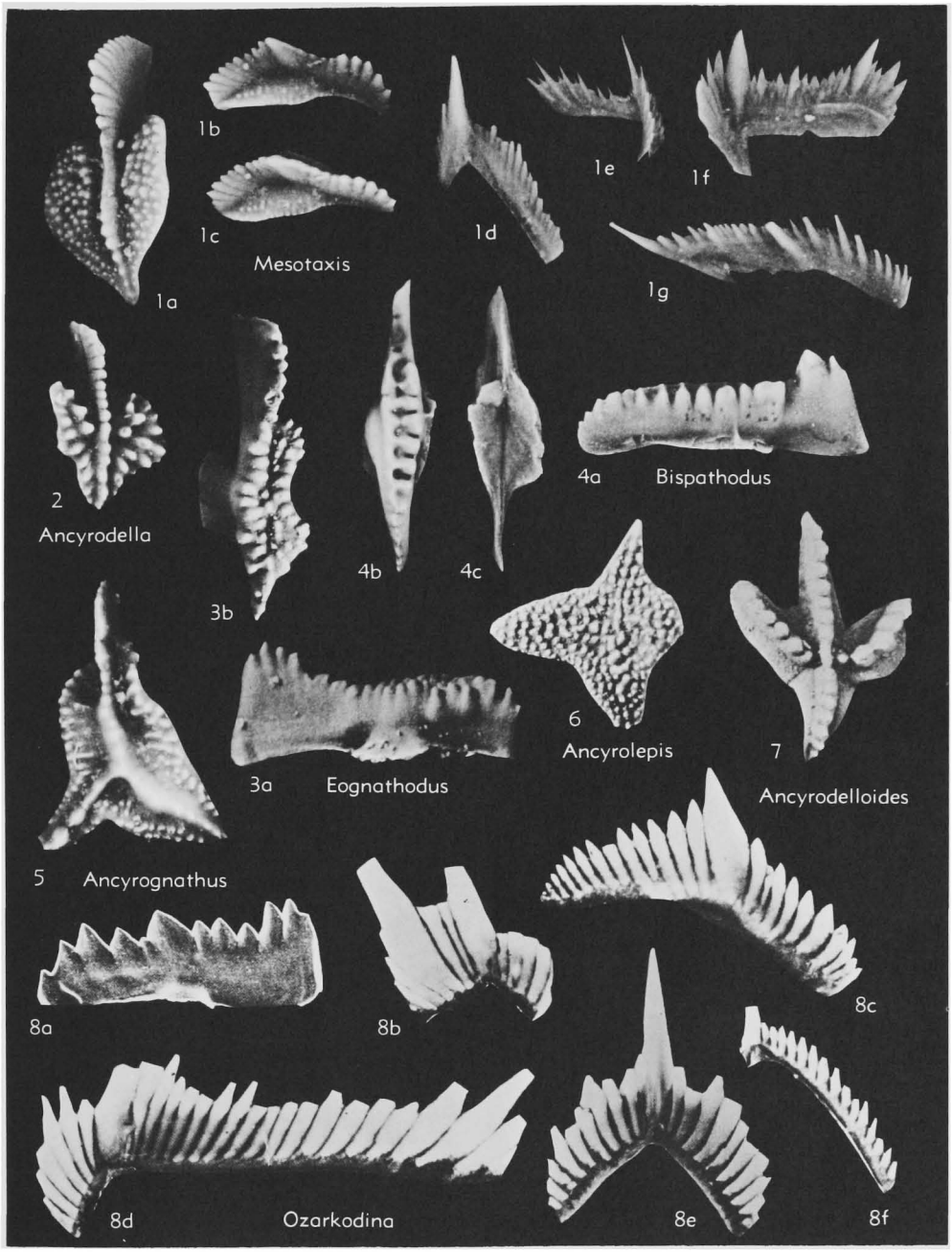

FIG. 111. Polygnathidae (p. *W*162-*W*163).

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. Visean)*, 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).

Ancyrodella Ulrich & Bassler, 1926, p. 48 [**A. nodosa*; OD] [=*Ancyropenta* Müller & Müller, 1957, p. 1092]. *Pa* element modified stelliplanate with posterior lobe and two anteriorly directed lobes. *Sa* element alate with denticulate posterior process. [Reconstruction: Klapper & Philip, 1972.] *U.Dev.(Frasn.)*, Eu.-N.Afr.-Asia-N.Am.-Australia.——Fig. 111,2. *A. rotundiloba alata* Glenister & Klapper, U.Dev.(L. *Mesotaxis asymmetrica* Z., Snyder Creek Sh.), USA(Mo.); *Pa* element, upper view, ×27 (Klapper, n).

Ancyrodelloides Bischoff & Sannemann, 1958, p. 91 [**A. trigonicus*; 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. trigonicus*, Tentaculitenkalk, Eu.(Ger.); *Pa* element, upper view, ×17 (Bischoff & Sannemann, 1958).

Ancyrognathus Branson & Mehl, 1934a, p. 240 [**A. symmetricus*; OD] [=*Ancyroides* 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.(Frasn.-low.Famenn.)*, Eu.-N.Afr.-N.Am.-Australia.——Fig. 111,5. *A. triangularis* Youngquist, U.Dev.(*A. triangularis* 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.)-U.Dev.(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 spinulicostatus* 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.] *U.Dev.(Famenn.)-L.Miss.(Tournais.)*, 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(Vict.); *3a,b, Pa* element, lat. and upper views, ×23 (Philip, 1965).

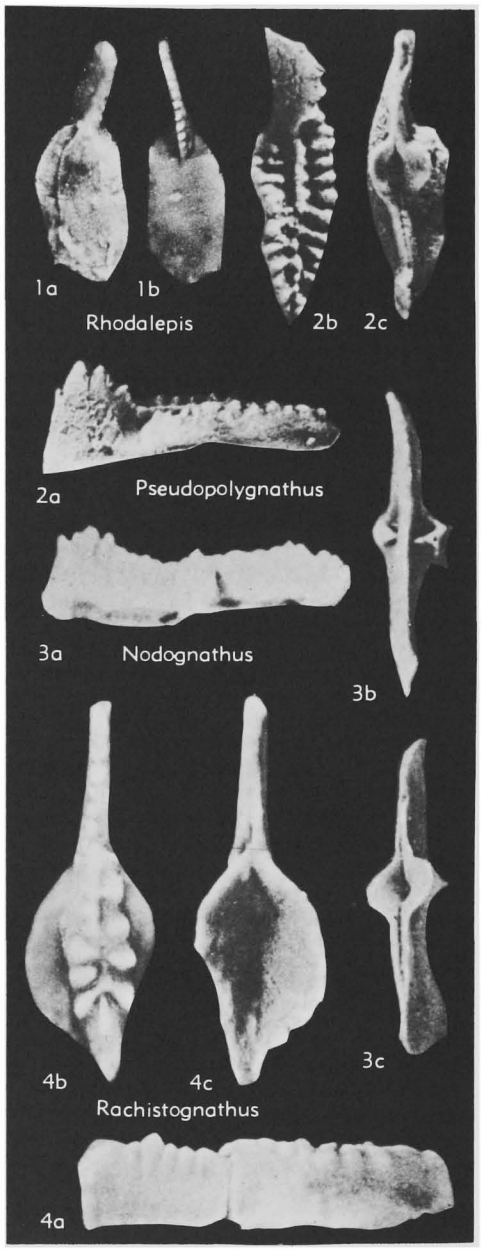

Fig. 112. Polygnathidae (p. *W*165, *W*166).

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*

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; ×27 (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. spicatus*, holotype, USA (Okla.); *3a-c*, lat., upper, and lower views, ×27 (Cooper, 1939).

Ozarkodina BRANSON & MEHL, 1933a, p. 51 [**O. typica*; OD; =*Hindeodella confluens* 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* BOULENGER, 1900, a fish; *Ctenognathodus* FAY, 1959, p. 195, *nom. subst. pro Ctenognathus* 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. confluens* (BRANSON & MEHL), Sil.(Ludlov.), Eu.(Sweden, Scania); *8a, Pa* element, lat. view, ×45; *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 ×27 except *8a* (Jeppsson, 1975).

Palmatolepis ULRICH & BASSLER, 1926, p. 49 [**P. perlobata*; OD] [=*P. (Manticolepis)* MÜLLER, 1956a, p. 16; *P. (Deflectolepis)* MÜLLER, 1956a, p. 16; *P. (Panderolepis)* HELMS, 1963, p. 467; *P. (Conditolepis)* BOOGAARD & KUHRY, 1979, p. 50; *Klapperina* LANE, MÜLLER, & ZIEGLER, 1979, p. 217]. Apparatus like that of *Mesotaxis* but carminiplanate *Pa* element with distinct central (azygous) node; *Sc* element with anticusp joining posterior process at much lower angle than that formed by two processes in *Sc* element of *Mesotaxis*. [Reconstruction: KLAPPER & PHILIP, 1972.] *U.Dev.*, Eu.-N.Afr.-Asia-N.Am.-Australia. ——FIG. 113,*2a*. **P. perlobata perlobata* ULRICH & BASSLER, U.Dev.(L. *Palmatolepis marginifera* Z., Bugle Gap Ls.), Australia(W.Australia); *Pa* element, upper view, ×30 (Glenister & Klapper, 1966).——FIG. 113,*2b*. *Palmatolepis* sp.; *M* element, lat. view, ×30 (Glenister & Klapper, 1966).

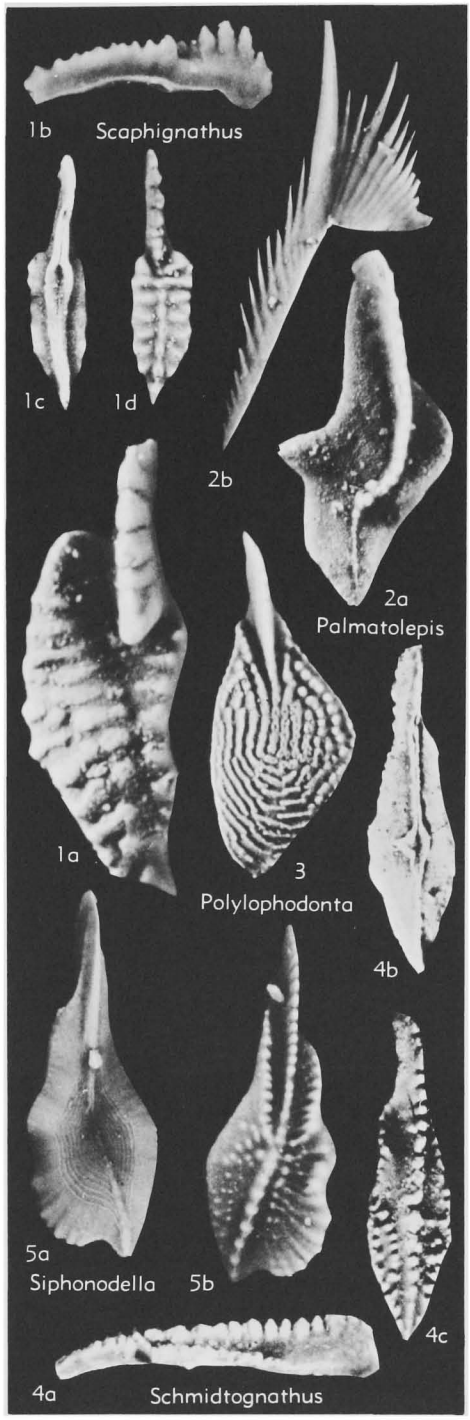

FIG. 113. Polygnathidae (p. *W*156, *W*166).

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 molluscan [**Pandorina insita* STAUFFER, 1940, p. 429; OD] [=*Criteriognathus* WALLISER, 1972, p. 78]. *Pa* element carminate; *Sa* element alate with denticulate posterior process. [Reconstruction: KLAPPER & PHILIP, 1972.] *Dev.*, Eu.-N.Afr.-Asia-N.Am.-Australia.——FIG. 110,*1*. **P. insita* (STAUFFER), U.Dev.(*P. insita* Fauna, State Quarry Ls.), USA(Iowa); *1a, Pa* element, lat. view; *1b, Pb* element, lat. view; *1c, M* element, lat. view; *1d, Sa* element, post. view; *1e, Sc* element, lat. view; *1f, Sb* element, lat. view; all ×40 (Klapper & Philip, 1971).

Polylophodonta BRANSON & MEHL, 1934a, p. 242 [**Polygnathus gyratilineatus* HOLMES, 1928, p. 31; OD; =*Polygnathus pergyratus* 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,*3*. *P. confluens* (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.(Kinderhook.* or *Tournais.)*, N.Am.-Eu.-Australia-S.Am.-Africa-Asia M.——FIG. 112,*2*. **P. primus*, low.Tournais., 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 midlength of element; platform lanceolate with parapets or discontinuous carina, parapet or nodes often radiating outward. *U.Carb.(Namur.-Westphal.)*, N.Am.-Eu.——FIG. 112,*4*. **R. primus*, L.Penn. (Bird Spring F.), USA(Nev.); *4a-c*, lat., upper, and lower views, ×40 (Dunn, 1966).

Rhodalepis DRUCE, 1969, p. 116 [**R. inornata*; OD]. *Pa* element 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,*1*. **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,*1a*. **S. velifer*, *S. velifer* Z.(Virgin Hills F.), Australia(W.Australia); *Pa* element, upper view, ×45 (Glenister & Klapper, 1966).——FIG. 113,*1b-d*. *S. subserratus* (BRANSON & MEHL), *Scaphignathus subserratus-Pelekysgnathus inclinatus* Fauna (Trident Mbr., Three Forks F.), USA(Mont.); *Pa* element, lat., lower, and upper views, ×28 (Beinert & others, 1971).

Schmidtognathus ZIEGLER, 1966, p. 664 [**S. hermanni*; OD]. *Pa* element carminiplanate like that of *Polygnathus* but pit larger, asymmetrical, with distinct constriction in outer margin. [Only *Pa* element is recognized with certainty.] *?M.Dev., U. Dev.(Frasn.)*, Eu.-N.Am.——FIG. 113,*4*. **S. hermanni*, holotype, disputed M.Dev.-U.Dev. boundary interval (Flinzkalk, *Schmidtognathus hermanni–Polygnathus cristatus* Z.), Eu.(Ger., Rhenish Slate Mts.); *4a-c, Pa* element, lat., lower, and upper views, ×23 (Ziegler, 1966).

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.(Tournais.)*, Eu.-N.Am.-Australia.——FIG. 113,*5*. *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* superfamily 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; *Sa* elements alate, with-

out posterior process in most species; *Sb* digyrate, with one lateral process deflected strongly upward and posteriorly; *Sc* 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 seximembrate: *Pa* element scaphate, *Pb* angulate, *M* dolabrate or digyrate with one lateral process adenticulate, *Sa* alate with no posterior process, *Sb* digyrate, and *Sc* bipennate. [The originally designated type species was based on the *Sa* element of a seximembrate apparatus including elements of *Spathognathodus cristulus* Youngquist & Miller, 1949 *(Pa)*, *Ozarkodina curvata* Rexroad, 1958b *(Pb)*, *Neoprioniodus camurus* Rexroad, 1957 *(M)*, *Falcodus? alatoides* Rexroad & Burton, 1961 *(Sb)*, and *Hindeodella* sp. of Rexroad & Furnish, 1964 *(Sc)*; 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*, *Sa* element, post. view; *1b*, *Sb* element, post. view; *1c*, *Sc* element, lat. view; *1d*, *M* element, post.-lat. view; *1e*, *Pb* element, outer lat. view; *1f*, *Pa* element, lat. view; ×50 (Rexroad & Furnish, 1964).

Aethotaxis Baesemann, 1973, p. 697 [**A. advena*; OD]. Apparatus quadrimembrate: *Sa* symmetrical; *Sb* nearly symmetrical, with short posterior process; *Sc* bipennate, of two forms distinguished by 90° 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 *Sa* position.] *U.Penn.*, N.Am.(Kans.).——Fig. 115,*1*. **A. advena; 1a*, *Sa* element, holotype, lat. view; *1b,c*, *Sc* elements, lat. views; *1d*, *Sb* element, lat. view; *1e*, *Sa* element, post. view; ×34 (Baesemann, 1973).

Diplognathodus Kozur & Merrill in Kozur, 1975a, p. 9 [**Spathognathodus coloradoensis* Murray & Chronic, 1965, p. 606; OD]. Apparatus seximembrate, *Pa* 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; *Pb* angulate, *M* dolobrate, *Sa* alate with well-developed posterior process, *Sb* and *Sc* bipennate. *U.Penn.-L. Perm.*, N.Am.; *U.Carb.-U.Perm.*, Eu.-Asia.——Fig. 115,*2*. *D.* sp., L.Perm., USA(Nev.); *2a*, *Pa* element, lat. view, ×110; *2b*, *Pb* element, lat. view, ×110; *2c*, *M* element, lat. view, ×80; *2d*, *Sa* element, post. view, ×175; *2e*, *Sc* element, lat. view, ×70 (Clark, n).

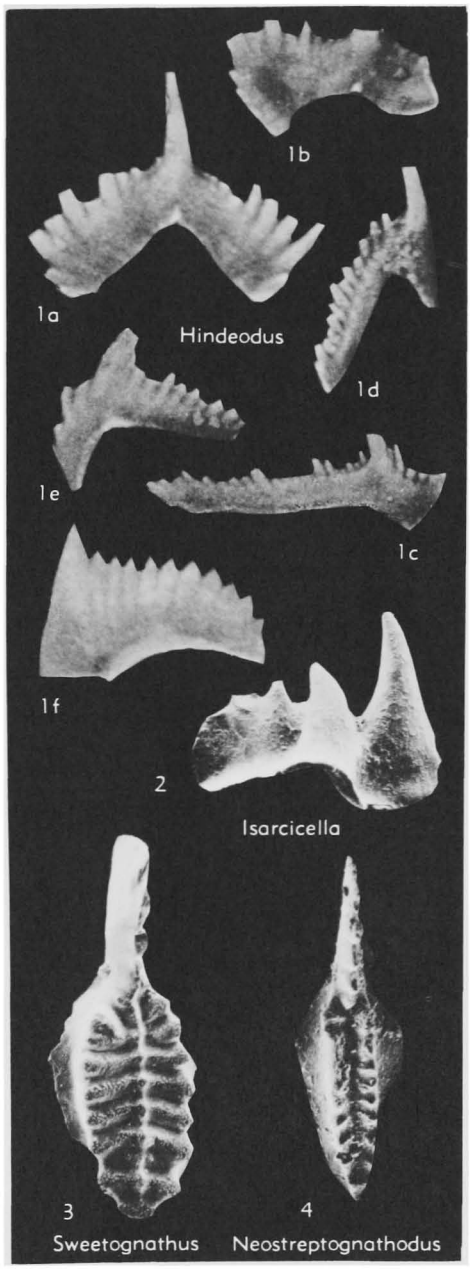

Fig. 114. Anchignathodontidae (p. *W*167-*W*169).

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

Isarcicella Kozur, 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

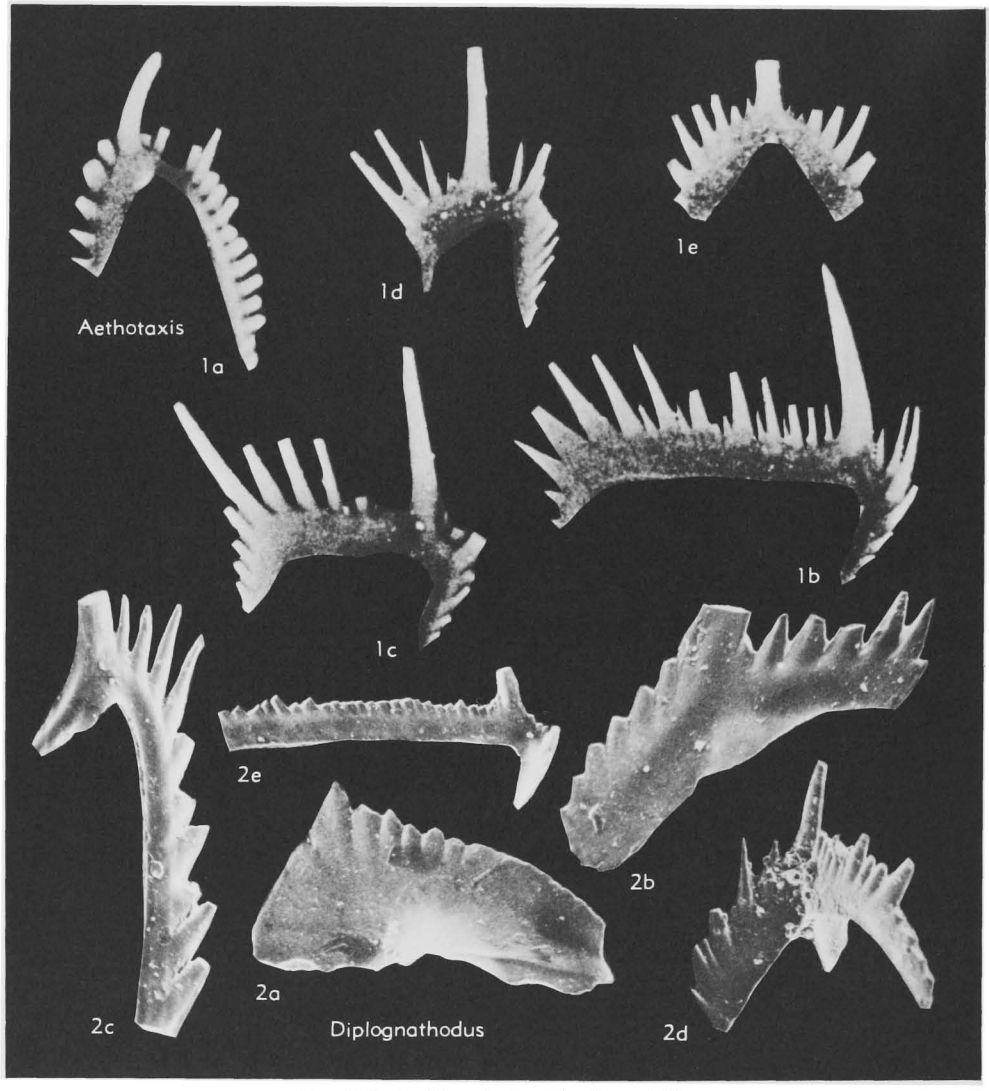

FIG. 115. Anchignathodontidae (p. *W*167).

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. isarcica* (HUCKRIEDE), Eu.(Italy); lat. view, ×65 (Sweet, n).

Neostreptognathodus CLARK, 1972a, p. 155 [**Streptognathodus sulcoplicatus* YOUNGQUIST, HAWLEY, & MILLER, 1951, p. 363; OD] [?=*Vjalovites* 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, ×80 (Clark, n).

Rabeignathus KOZUR, 1978, *L.Perm.,* see addendum.

Sweetognathus CLARK, 1972a, p. 155 [**Spatho-*

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.Perm., ?U.Perm.*, N.Am.-S.Am.-Asia. ——FIG. 114,*3*. **S. whitei* (RHODES), L.Perm., USA(Nev.); upper view, ×65 (Clark, n).

Superfamily UNKNOWN

Family BACTROGNATHIDAE Lindström, 1970

[Bactrognathidae LINDSTRÖM, 1970, p. 441] [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. hamata*; 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.); *1a-c*, upper, lower, and lat. views, ×25 (Branson & Mehl, 1941c).

Apatella CHAUFF & KLAPPER, 1978, *U.Dev.*, see addendum.

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. latus*, Pierson Ls., USA (Mo.); *3a*, paratype, upper view; *3b,c*, holotype, upper and lower views; ×17 (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 Minor.——FIG. 116,*4*. **D. sagittula*, Chappel Ls., USA(Texas); *4a,b*, upper and lower views, ×30

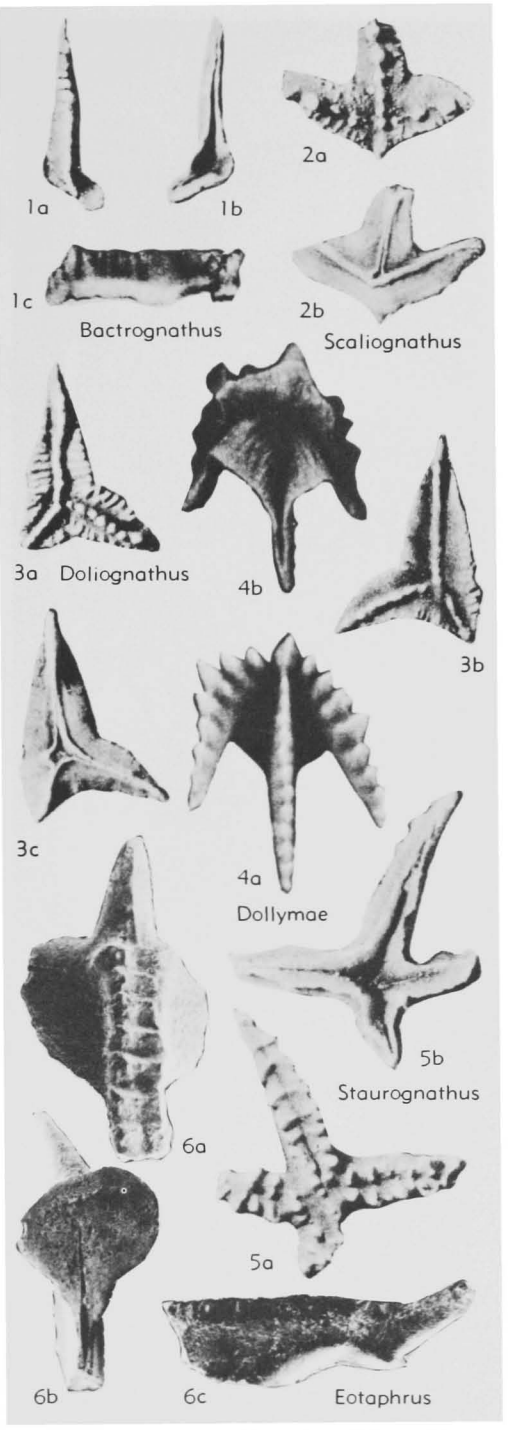

FIG. 116. Bactrognathidae (p. *W*169-*W*170).

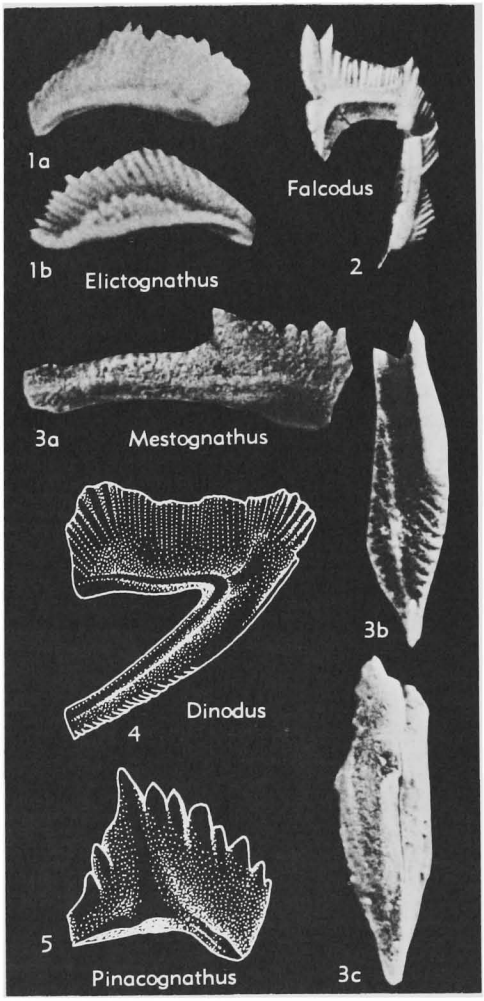

FIG. 117. Elictognathidae, Mestognathidae (p. W170-W172).

(Hass, 1959).

Eotaphrus 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.Tournais.)*, 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.Tournais.)*, 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).

Staurognathus BRANSON & MEHL, 1941c, p. 102 [**S. cruciformis*; OD]. Apparatus unknown. Pectiniform element scaphate 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.Tournais.)*, 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.Dev.-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 Tournais.)*, N.Am.-Eu.-Australia.——FIG. 117,*1*. **E. bialata* (BRANSON & MEHL), USA(Okla.); *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), Houy F., USA(Texas); lat. view, ×25 (Hass, 1962).

Falcodus HUDDLE, 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

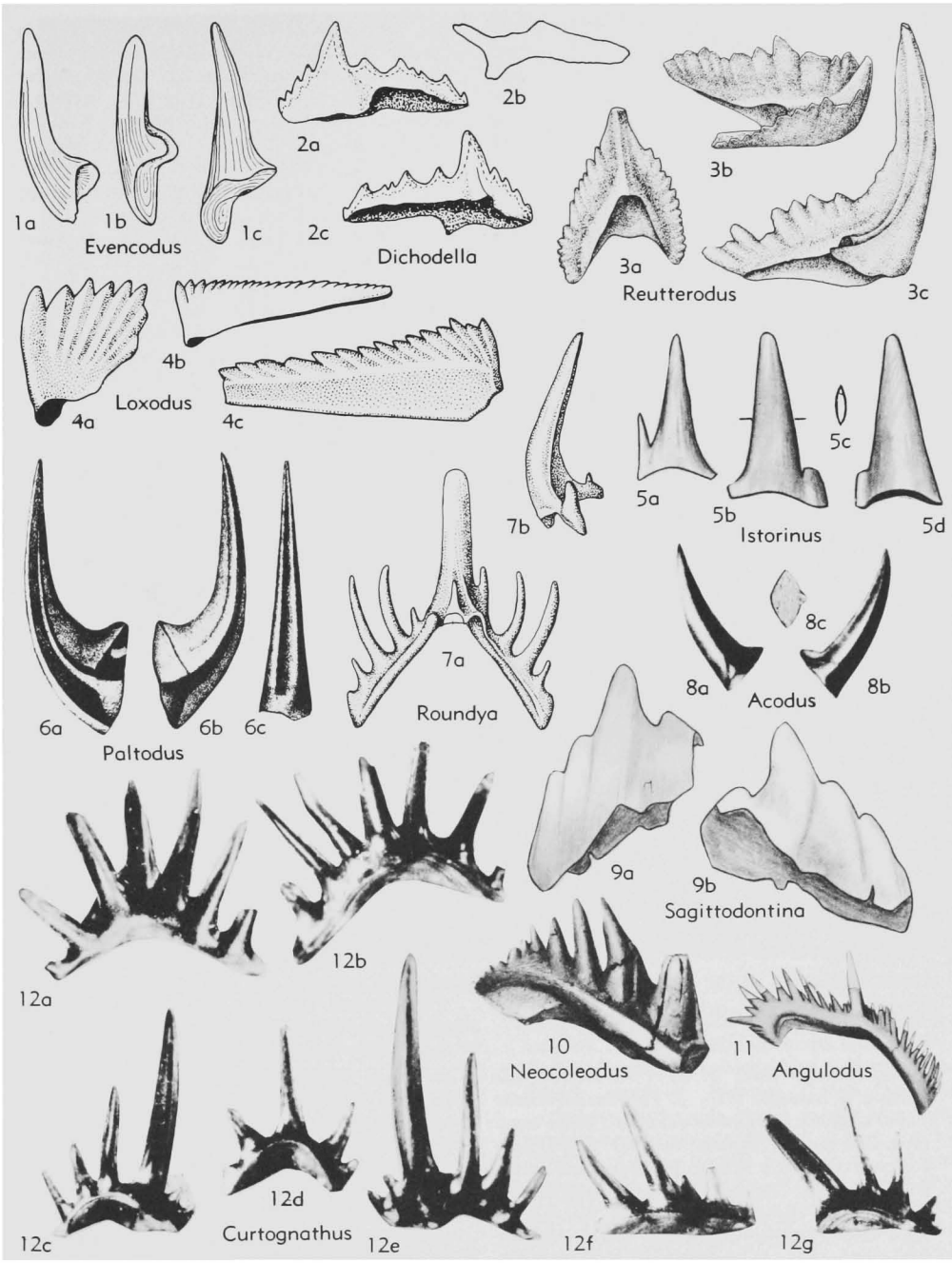

FIG. 118. Family Unknown (p. *W*172-*W*178).

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, ×25 (Huddle, 1934).

Pinacognathus BRANSON & MEHL, 1944, p. 244, *nom. subst. pro Pinacodus* BRANSON & MEHL, 1934b, *non* DAVIS, 1883, a fish [**Pinacodus pro-*

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*. **P. profunda* (BRANSON & MEHL), Bachelor F., USA (Mo.); lat. view, ×30 (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 BISCHOFF, 1957, p. 36 [**M. beckmanni*; OD]. Apparatus unknown. Pectiniform element planate; short free blade 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.)*, N.Am.(Can.)-Eu.——FIG. 117,*3*. **M. beckmanni*, (Dinant.), Eu.(Wales); *3a-c*, lat., upper, and lower views, ×245 (Rhodes, Austin, & Druce, 1969).

Family UNKNOWN

[Materials for this section prepared by R. L. AUSTIN, S. M. BERGSTRÖM, D. L. CLARK, GILBERT 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 & BASSLER, 1926, p. 7] [?=*Acontiodus* PANDER, 1856]. Apparatus unknown; genus based on nongeniculate, coniform 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 & BERGSTRÖM (1972), data from Estonia (VIIRA, 1966) suggest that elements of *A. erectus* are associated with, and have the same range as, those of *Acontiodus latus* PANDER, 1856, type species of *Acontiodus*. Accordingly, it is possible that all these elements were components of the same apparatus and *Acodus* and *Acontiodus* are synonyms; see also LINDSTRÖM (1973).] *L.Ord.-Sil.(Llandov.), ?Sil.(Wenlock.)*, Eu.-Asia (Sib.)-?N.Am.——FIG. 118,*8*. *A. acutus* PANDER, L.Ord.(Pakerort Stage, ?Varangu Mbr.), Eu.(Baltic); *8a,b*, lat. views; *8c*, cross section of cusp; magnification unknown (Pander, 1856).

Angulodus HUDDLE, 1934, p. 76 [**A. demissus*; OD] [=*Cervicornoides* STAUFFER, 1938, p. 424]. *Sb* 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.); *Sb* element, lat. view, ×17 (Huddle, 1934).

Apatognathus 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 diagonally offset denticles. *U.Dev.-U.Miss.*, Eu.-N. Am.-Australia.——FIG. 119,*3*. **A. varians*, U.Dev. (*Bispathodus costatus* Z.), Australia(W.Australia); *Sa* element, inner view, ×45 (Glenister & Klapper, 1966).

Branmehla HASS, 1959, p. 381 [**Spathodus inornatus* BRANSON & MEHL, 1934a, p. 185]. *Pa* element carminate 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, ×27 (Klapper, n).

Bryantodus BASSLER, 1925, p. 219 [**B. typicus*; OD]. Anguliplanate *Pb* element with massive cusp, narrow platform ledges, and downward projecting apical lip. *U.Dev.(Frasn.)*, N.Am.(N.Y.). ——FIG. 120,*12*. **B. typicus*, lectotype, Rhinestreet Sh., USA(N.Y.); *Pb* element, lat. view, ×20 (Huddle, 1968).

Caenodontus BEHNKEN, 1975, p. 298 [**C. serrulatus*; OD]. Apparatus unimembrate; erect, nongeniculate, coniform 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. serrulatus*, USA (Texas); lat. view, ×100 (Behnken, 1975).

Cornuodus FÅHRAEUS, 1966, p. 20 [**C. erectus*; OD]. Apparatus unknown but apparently unimembrate; coniform elements lamellar, nongeniculate, recurved 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); *1a*, topotype, lat. view, ×75; *1b,c*, long. and transv. cross sections, ×75 (Bergström, n).

Coryssognathus LINK & DRUCE, 1972, p. 31 [**C.*

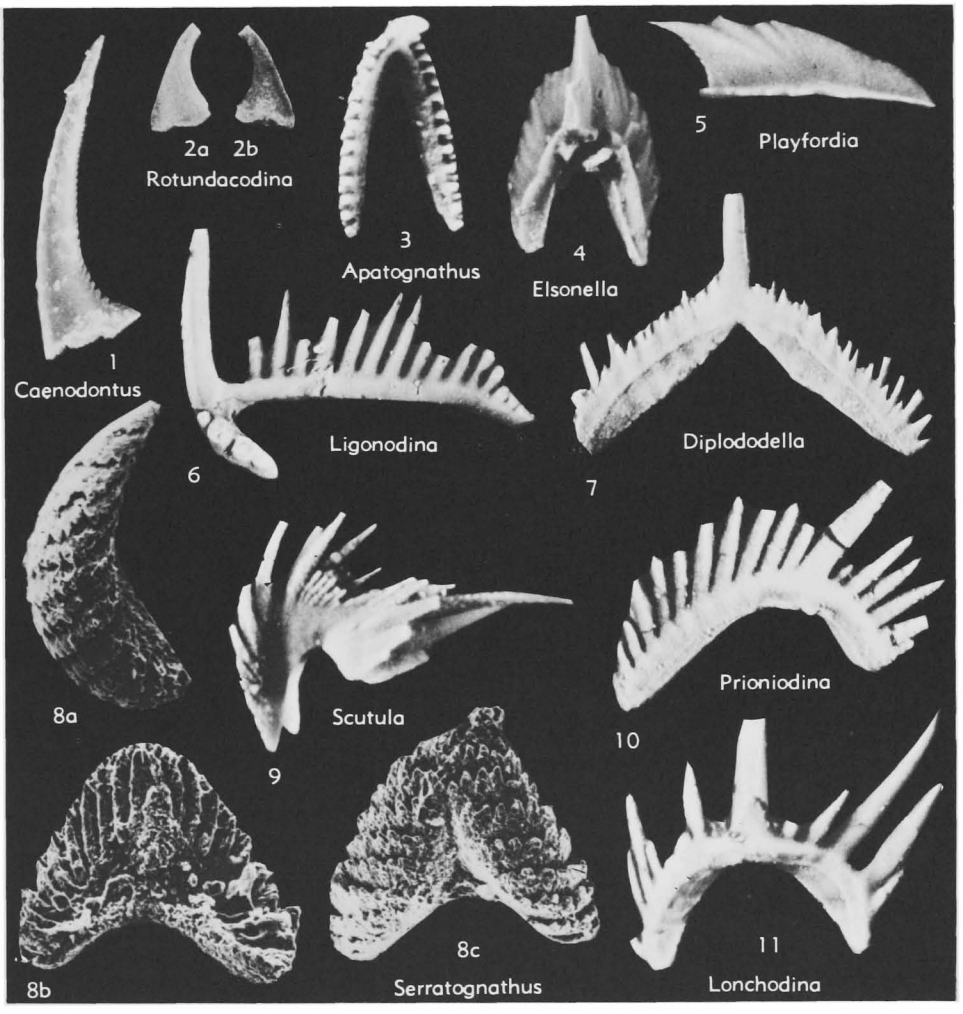

FIG. 119. Family Unknown (p. *W*172-*W*179).

dentatus; OD; =*Pelekysgnathus dubius* JEPPSSON, 1972, p. 62]. *Pa* element resembling that of *Pelekysgnathus,* but cusp at anterior end. [If apparatus includes elements identified by JEPPSSON (1972) as *Distomodus dubius* (RHODES), as suggested by COOPER (1974b), *Coryssognathus* should then be referred to the Distomodontidae.] *Sil. (Ludlov.),* Eu.-Australia.——FIG. 120,*3*. **C. dubius* (JEPPSSON), holotype, Eu.(Sweden, Scania); *Pa* element, lat. view, ×27 (Jeppsson, 1972).

Curtognathus BRANSON & MEHL, 1933b, p. 87 [**Curtognathus typa*; OD] [=*Polycaulodus* BRANSON & MEHL, 1933b; *Trucherognathus* BRANSON & MEHL, 1933b; *Cardiodella* BRANSON & MEHL, 1944, *nom. subst. pro Cardiodus* BRANSON & MEHL, 1933b, *non* TROUESSART, 1881, a mammal]. Apparatus unknown, of elements similar to the following form-genera of BRANSON & MEHL: *Cardiodella, Curtognathus, Polycaulodus, Microcoelodus, Trucherognathus.* 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. Trucherognathiform elements essentially straight with somewhat irregularly oriented denticles on upper side. *M. Ord.,* N.Am.——FIG. 118,*12*. *C. tumidus* BRANSON & MEHL, Glenburnie Sh., Can.(Ont.); *12a,b,* cardiodelliform element, ant. and post. views; *12c,e,*

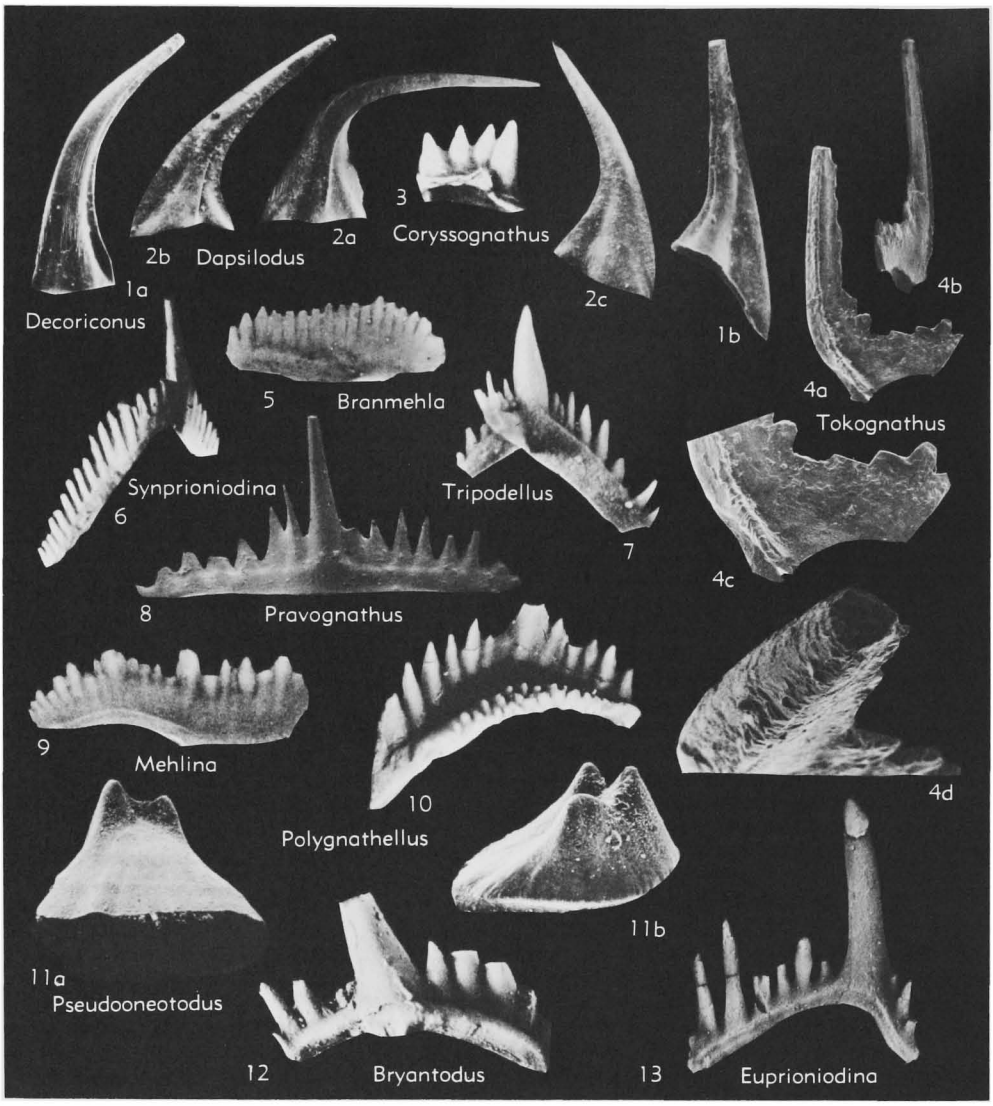

FIG. 120. Family Unknown (p. *W*172-*W*179).

microcoelodontiform element, post. and ant. views; *12d,* curtognathiform element, post. view; *12f,* trucherognathiform element, lat. view; *12g,* polycaulodontiform element, lat. view; ×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. *Sa* 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: SERPAGLI, 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(Ill.); *2a, Sb-Sc* element, lat. view, ×43; *2b,c, M* elements, inner lat. and outer lat. views, ×37, ×33 (Cooper, 1976).

Decoriconus COOPER, 1975, p. 992 [**Paltodus costulatus* REXROAD, 1967, p. 40; OD]. Multimembrate apparatus comprising symmetry-transition series of small, twisted, generally striate, lamellar coniform elements. Each element bearing narrow

longitudinal groove near posterior keel on both sides. Basal cavity shallow, extending one-third of element height. [Apparatus reconstruction: COOPER, 1975; BARRICK, 1977.] *U.Ord.(Ashgill.)-Sil.*, N.Am.-Eu.——FIG. 120,*1*. *D. fragilis* (BRANSON & MEHL), Sil.(Wenlock., St. Clair Ls.), USA (Ill.); *1a, Sa-Sb* element, lat. view; *1b, Sc* element, lat. view; ×93 (Cooper, 1976).

Dichodella SERPAGLI, 1967, p. 62 [**D. exilis*; OD]. Apparatus unknown; genus based on lamellar, pectiniform, pastinate elements with distinct cusp and anterior and posterior processes. Anterior process bladelike 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 pastinate elements of *Phragmodus* and *Plectodina* and is distinguished from *Prioniodus (Baltoniodus)* by the weak development of the third process.] *U.Ord.*, Eu.(Italy, Eng.).——FIG. 118,*2*. **D. exilis,* U.Ord.(Ashgill.), Eu.(Italy, Carnic Alps); *2a,c,* lat. views; *2b,* lower view; ×66 (Serpagli, 1967).

Diplododella BASSLER, 1925, p. 219 [**D. bilateralis*; OD]. *Sa* element alate with denticulate posterior process; denticulation like that of *Angulodus. U.Dev.(Famenn.),* N.Am.(Ala.).——FIG. 119,*7*. **D. bilateralis,* holotype, Gassaway Mbr., Chattanooga Sh., USA(Ala.); *Sa* element, ant. view, ×30 (Huddle, 1968).

Elsonella YOUNGQUIST, 1945, p. 358 [**E. prima*; OD] [=*Neorhipidognathus* MOUND, 1968, p. 494]. *Sa* element with highly fused denticles; surface covered with minute pits (LINDSTRÖM, 1964, p. 157). *U.Dev.*, N.Am.——FIG. 119,*4*. **E. prima,* lectotype, Frasn.(Amana beds), USA (Iowa); *Sa* element, post. view, ×34 (Klapper, 1966).

Euprioniodina BASSLER, 1925, p. 219 [**E. deflecta*; OD]. *M* element dolabrate with both processes having discrete denticles. *U.Dev.(Frasn.),* N.Am.(N.Y.).——FIG. 120,*13*. **E. deflecta,* lectotype, Rhinestreet Sh., USA(N.Y.); *M* element, lat. view, ×20 (Huddle, 1968).

Evencodus MOSKALENKO, 1970, p. 42 [**E. sibiricus*; OD]. Apparatus not known with certainty; genus based on nongeniculate, hyaline coniform elements with suberect to proclined, in cross section rounded, laterally multicostate cusp, very shallow basal cavity; anterobasal portion of unit characteristically extended into tonguelike structure directed downward. [MOSKALENKO (1972, fig. 5) referred three types of coniform elements to the apparatus of *E. sibiricus*. Other forms assigned to *Evencodus* have an appearance that does not exclude fish affinities.] *M.Ord.*, Asia(Sib.).——FIG. 118,*1*. **E. sibiricus,* Krivoluksky horiz., USSR (Sib.); *1a-c,* three types of coniform elements, lat. views, approx. ×20 (Moskalenko, 1972).

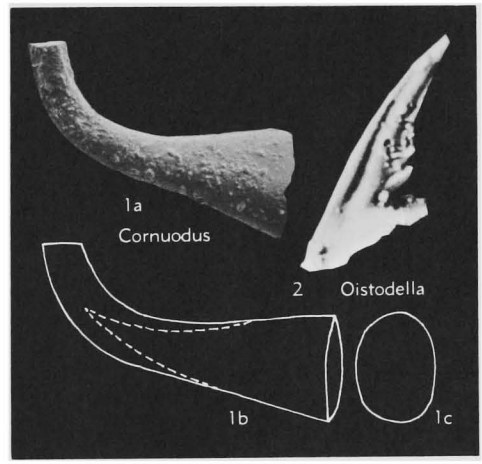

FIG. 121. Family Unknown (p. *W172*, *W177*).

Geniculatus HASS, 1953, p. 77 [**Polygnathus? claviger* ROUNDY, 1926; OD]. Apparatus unknown. Pectiniform element anguliplanate; geniculate, asymmetrical, broadest at vertex where cusp and basal cavity located; with a few large, medial, distinct denticles; keel along midline of under side. *U.Miss.(up.Dinant.),* N.Am.-Asia M.-Eu.——FIG. 122,*9*. **Geniculatus claviger* (ROUNDY), Barnett F., USA(Texas); upper view, ×21 (Hass, 1953).

Hindeodelloides HUDDLE, 1934, p. 48 [**H. bicristatus*; OD]. Apparatus unknown. Ramiform 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.-Afr.——FIG. 122,*3*. **H. bicristatus,* New Albany Sh., USA (Ind.); outer lat. view, ×25 (Hass, 1962).

Hindeodina HASS, 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, ×30 (Hass, 1959).——FIG. 122,*4b*. *H. uncata,* holotype, L.Miss.(Chappel Ls.), USA (Texas); upper view, ×30 (Hass, 1959).

Istorinus KNÜPFER, 1967, p. 31 [**I. erectus*; OD]. Apparatus unknown; elements with suberect, lat-

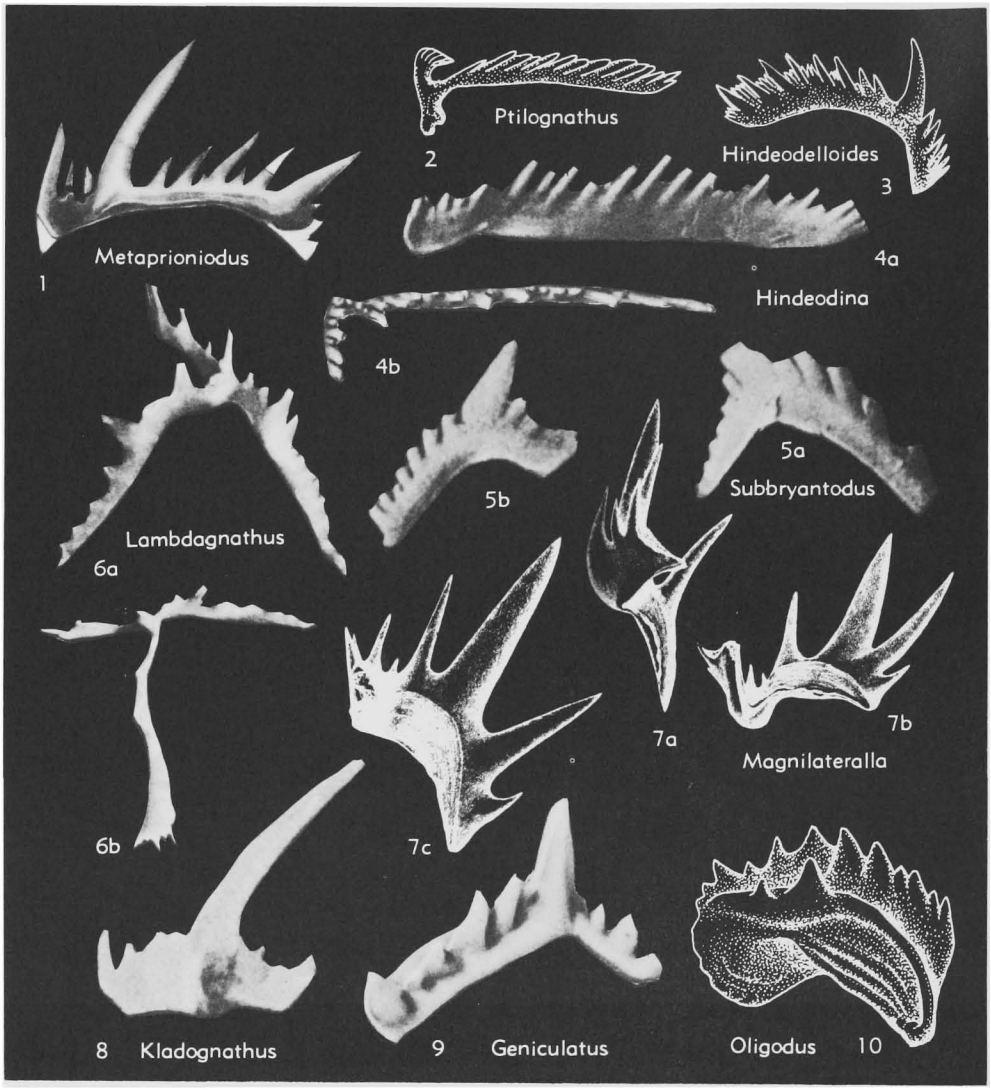

FIG. 122. Family Unknown (p. *W*175, *W*179).

erally compressed cusp with sharp anterior and posterior edges; small suberect denticle in front of cusp. Basal cavity deep, extending through entire unit. [Original illustrations (KNÜPFER, 1967, pl. 1) show the types of the genus to be essentially complete and not fragments of ramiform elements.] *U.Ord.*, Eu.(Thuringia).——FIG. 118,*5*. **I. erectus; 5a,b,d,* lat. views, small denticle anterior to main cusp; *5c,* cross-section shape; ×59 (Knüpfer, 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, ×72 (Rexroad, 1958b).

Lambdagnathus REXROAD, 1958b, p. 19 [**L. fragilidens*; OD]. Apparatus unknown. Ramiform element tertiopedate. 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. fragilidens*, holotype, Glen Dean Ls., USA(Ill.); *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]. *Sb* 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.); *Sb* 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,*4*. **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 (Ill.); *7a-c*, outer lat., lower, and post. views, ×40 (Rexroad & Collinson, 1963).

Mehlina Youngquist, 1945, p. 363 [**M. irregularis*; OD; =*M. gradata* Youngquist, 1945, p. 363; first reviser, Müller & Müller, 1957, p. 1083]. *Pa* element carminate with basal pit at midlength and inverted basal cavity posteriorly. [Other elements are unknown.] *U.Dev.(Frasn.)-L.Miss. (Tournais.)*, Eu.-Australia-N.Am.——Fig. 120,*9*. **M. gradata* (syntype of *M. irregularis*), U.Dev. (Frasn., Amana beds), USA(Iowa); lat. view, ×27 (Klapper, n).

Metaprioniodus 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.Miss.(Kinderhook. or low.Dinant.)*, N.Am.-Eu. ——Fig. 122,*1*. **M. biangulatus*, holotype, L.Miss. (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. *M.Ord.*, N.Am.——Fig. 118,*10*. **N. spicatus*, Harding Ss., USA(Colo.); lat. view, ×17 (Branson & Mehl, 1933a).

Oistodella Bradshaw, 1969, p. 1155 [**O. pulchra*; OD]. Apparatus unknown. Elements lamellar, basically coniform, 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 *Oistodella 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.Miss.(Kinderhook.)*, N.Am. ——Fig. 122,*10*. **O. curtus*, USA(Okla.); inner lat. view, ×40 (Hass, 1962).

Paltodus Pander, 1856, p. 24 [**P. subaequalis*; SD Ulrich & Bassler, 1926, p. 7]. Apparatus apparently bimembrate, including geniculate and nongeniculate lamellar coniform elements. Geniculate elements with anteroposteriorly extended base and reclined cusp. Nongeniculate elements with triangular base and suberect to recurved cusp, cusp costate in some. Basal cavity relatively wide, flaring toward one side, restricted to base. [This interpretation follows Lindström (1971, 1973). Apparatus reconstruction: Lindström, 1971.] *L. Ord.*, Eu.-N.Am.-Australia.——Fig. 118,*6*. **P. subaequalis*, L.Ord.(?Pakerort Stage), Eu.(Baltic);

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. primitiva* (BISCHOFF & ZIEGLER), L. *Mesotaxis asymmetrica* Z. (Gogo F.), Australia(W.Australia); lat. view, ×45 (Glenister & Klapper, 1966).

Polygnathellus BASSLER, 1925, p. 220 [**P. typicalis*; OD] [=*Nothognathella* BRANSON & MEHL, 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* GIRARD, 1854, a fish, *nec* SCHMARDA, 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 BASSLER, 1925, p. 219 [**P. subcurvata*; OD] [=*Prioniodella* BASSLER, 1925, p. 219]. Angulate *Pb* element like that of *Lonchodina* but unit not so strongly bowed 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 [**Oneotodus? 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.Ord.-L.Dev.,* Eu.-N.Am.——FIG. 120,*11a.* *P. bicornis* DRYGANT, Sil.(Wenlock., *Kockelella amsdeni* Z., Clarita F.), USA(Okla.); lat. view, ×64 (Barrick, 1977).——FIG. 120,*11b.* *P. tricornis* DRYGANT, Sil.(up.Llandov.-low.Wenlock., *Pterospathodus 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 denticulate and short. *U.Miss.,* N.Am.——FIG. 122,*2.* **P. fayi,* Goddard Sh., USA(Okla.); lat. view, ×20 (Hass, 1962).

Reutterodus SERPAGLI, 1974, p. 79 [**R. andinus*; OD]. Apparatus apparently trimembrate, including nongeniculate coniform element and two types of ramiform elements, all lamellar and forming symmetry-transition series. Coniform elements asymmetrical, robust, suberect, 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.Ord.,* 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. noguerensis*; OD]. Simple coniform element. [This element may be part of an *Icriodus* or *Pelekysgnathus* apparatus, or both.] *L.Dev.,* Eu.-N.Am.——FIG. 119,*2.* **R. noguerensis,* Nogueras beds, Eu.(Sp., Aragón); *2a,b, Pb* element, outer and inner lat. views, ×30 (Carls & Gandl, 1969).

Roundya HASS, 1953, p. 88 [**R. barnettana*; OD]. Apparatus unknown, but probably multimembrate. Ramiform element alate; lateral processes bearing discrete robust denticles and forming anterior arch; posterior process short and denticulate; basal cavity large. *?L.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).

Sagittodontina KNÜPFER, 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.Ord.,* Eu. (Thuringia).——FIG. 118,*9.* **S. robusta; 9a,b,* lat. views, ×54 (Knüpfer, 1967).

Scutula SANNEMANN, 1955, p. 154 [**S. venusta*; OD] [?=*Avignathus* LYS & SERRE, 1957, p. 797; *?Gnamptognathus* ZIEGLER, 1958, p. 53]. Modified tertiopedate, quadriramate, and multiramate 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. bipennate* SANNEMANN, L. *Palmatolepis marginifera* 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, alate, 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.); *5a,b*, lat. views, ×40 (Branson & Mehl, 1934b).

Synprioniodina 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. O12 [**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 *Oepikodus* 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 *Oepikodus* or *Belodella*.] *L.Ord.*, Australia (Queensl.).——FIG. 120,*4*. **T. proclinatus*, Nora F.; *4a,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 tertiopedate 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
Arcugnathus COOPER in COOPER and SLOSS, 1943
Astacoderma HARLEY, 1861
Bransonella 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
Icriodina BRANSON and BRANSON, 1947
Icthyodus HARRIS and HOLLINGSWORTH, 1933
Lepodus BRANSON and MEHL, 1933a
Lepognathodus FAY, 1958
Ligonodinoides STAUFFER, 1938
Lonchodus PANDER, 1856
Multidentodus HARLTON, 1933
Nurrella POMESANO CHERCHI, 1967
Pachysomia SMITH, 1907
Palmatodella BASSLER, 1925 [see BOOGAARD & KUHRY, 1979, p. 26]
Panderodella BASSLER, 1925
Prionognathodus FAY, 1958
Prionognathus PANDER, 1856
Ptiloncodus 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

Antognathus LIPNYAGOV in KOZITSKAYA *et al.*, 1978, p. 17 [**A. volnovachensis*; OD]. *U.Dev.(up. Famenn.)*. Family Icriodontidae.

Apatella CHAUFF & KLAPPER, 1978, p. 153 [**A. ziegleri*; OD]. *U.Dev.(up.Famenn.)*. Family Bactrognathidae.

Complexodus DZIK, 1976, p. 423 [**Balognathus pugionifer* DRYGANT, 1974; OD]. *M.Ord.* Family unknown.

Erraticodon DZIK, 1978, p. 64 [**E. balticus*; OD]. *M.Ord.* Family unknown.

Gapparodus ABAIMOVA, 1978, p. 79 [**Hertzina?*

bisulcata 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 KOZUR, MOSTLER, & RAHIMI-YAZD, 1976, p. 7 [**I. unicostatus*; OD]. *U.Perm.* Family Anchignathodontidae.

Johnognathus MASHKOVA, 1977, p. 127 [**J. huddlei*; OD]. *Sil.(up.Llandov.-low.Wenlock.)*. Family Pterospathodontidae.

Kimognathus MASHKOVA, 1978, p. 93 [**K. alexeii*; OD]. *L.Dev.* Family Polygnathidae.

Laterignathus ARISTOV & ALEKSEEV, 1976, p. 192 [**L. barskovi*; OD]. *L.Carb.(Tournais.)*. Family unknown.

Macerodus FÅHRAEUS & NOWLAN, 1978, p. 461 [**M. dianae*; OD]. *L.Ord.* Family unknown.

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

Pavlovites KOZUR in KOZUR & MOSTLER, 1976, p. 21 [**P. artinskiensis*; OD]. *L.Perm.(up.Artinsk.)*. Family unknown. [Taxonomic status uncertain.]

Polonodus DZIK, 1976, p. 423 [**Ambalodus clivosus* 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 ?Oneotodontidae.

Rabeignathus KOZUR, 1978, p. 144 [**Gnathodus bucaramangus* RABE, 1977; OD]. *L.Perm.* Family Anchignathodontidae.

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 [**Cordylodus spinatus* HADDING, 1913; OD]. *M.Ord.* Family unknown.

Sweetocristatus SZANIAWSKI in SZANIAWSKI & MATKOWSKI, 1979, p. 253 [**S. arcticus*; OD]. *L.Perm.(up.Artinsk.)*. Family Xaniognathidae.

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

Tortodus WEDDIGE, 1977, p. 326 [**Polygnathus kockelianus* BISCHOFF & ZIEGLER, 1957; OD]. *M.Dev.(Eifel.-Givet.)*. Family Polygnathidae.