Redescription of Upper Devonian Conodont Genera And Species Proposed by Ulrich and Bassler in 1926

GEOLOGICAL SURVEY PROFESSIONAL PAPER 578

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By JOHN W. HUDDLE

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A modern taxonomic revision of the classic paper that initiated biostratigraphic use of conodonts. Forty-four of the original species are considered valid and distinct

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REDESCRIPTION OF UPPER DEVONIAN CONODONT GENERA AND SPECIES PROPOSED BY ULRICH AND BASSLER IN 1926

By JOHN W. HUDDLE

ABSTRACT

The publication of "A classification of the toothlike fossils, conodonts, with descriptions of American Devonian and Mississippian species" by E. O. Ulrich and R. S. Bassler in 1926 lead to the recognition of the stratigraphic usefulness of conodonts and encouraged the study of conodonts by American paleontologists. This classic paper described many species which have a worldwide distribution. Many of Ulrich and Bassler's species need revision and reillustration because later conodont studies showed the importance of some characters not mentioned by Ulrich and Bassler. In addition, the type specimens were not completely exposed when originally photographed. The types have been prepared by W. H. Hass and me and are here redescribed and reillustrated. The specimens came from the Devonian Rhinestreet Shale Member of the West Falls Formation of New York, the Devonian Gassaway Member of the Chattanooga Shale of Alabama, and the Mississippian(?) "Hardin sandstone" of Tennessee.

Many of the original Ulrich and Bassler species are placed in synonymy. Forty-four species described by Ulrich and Bassler are considered valid and distinct, and there are 23 species whose names are valid but the species are unrecognizable. *Panderodella* is considered a nomen dubium.

INTRODUCTION

The work of Ulrich and Bassler (1926) showed that conodonts were useful in stratigraphic studies, and many of the species they described have been recognized in Europe, Africa, and Australia. There is a continuous need to refer to these species. Unfortunately, the faunas they described are poorly preserved and were inadequately prepared by 1965 standards. Moreover, the study of growth patterns of conodonts has lead to the recognition that there are changes in shape during ontogeny. Ulrich and Bassler regarded conodonts as fish and therefore used very minute differences to differentiate species and genera. Many of Ulrich and Bassler's species must be placed in synonomy because they represent growth stages or intraspecific variation.

This report redescribing the Ulrich and Bassler conodont types was planned by the late W. H. Hass. The types were prepared by very careful and tedious work with a sharp needle by Hass during a 3-year period, 1945–1947, and by me in 1963–1964. Photographs were made by N. W. Shupe, R. L. McKinney, and D. H. Massie. Hass prepared a table showing the species from the Rhinestreet Shale Member of the West Falls Formation he considered valid and those he regarded as synonyms. In general I have followed Hass' plan for this report, but I am responsible for the writing, the final placement of species, and the synonymies.

Many of the taxa described here have been discussed with conodont specialists who have visited the U.S. National Museum, Washington, D.C. Their advice has been very helpful, and I am especially indebted to Charles Collinson, Illinois State Geological Survey; Gilbert Klapper, Pan American Petroleum Corp.; M. C. Mound, California Research Corp.; Maurits Lindström, Lund Universitet; and Willi Ziegler, Geologisches Landesamt Nordrhein-Westfalen. Collinson read the manuscript, and his criticism is greatly appreciated.

LOCALITIES AND GEOLOGIC AGES OF THE ULRICH AND BASSLER CONODONT COLLECTIONS

The conodonts described by Ulrich and Bassler (1926) came from three localities. These are the Rhinestreet Shale Member of the West Falls Formation (Devonian) at Weyer, N.Y., the "Hardin sandstone" of Ulrich and Bassler (Mississippian?) near Mount Pleasant, Tenn., and the Gassaway Member (Devonian) of the Chattanooga Shale near New Market, Ala.

RHINESTREET SHALE MEMBER OF THE WEST FALLS FORMATION

The conodonts from the Rhinestreet Shale described by Ulrich and Bassler were collected by Raymond L. Hibbard from the basal 10 inches of the Rhinestreet Shale Member of the West Falls Formation at the Acme Shale Brick Co. pit at Weyer (formerly Shaleton), N.Y. The pit is shown on the U.S. Geological Survey Eden quadrangle map (1:24,000 series, 1947 ed.). Exposed in the top of the pit wall in a few places is about 8 feet of Rhinestreet, and most of the pit is in the underlying Cashaqua Shale Member of the Sonyea Formation. Hass and I made collections at the Acme Shale

Brick pit, but neither of us found the zone of abundant conodonts that Hibbard found.

In redescribing the conodonts from the Rhinestreet Shale Member, the types, including the paratypes in the original collection by Hibbard and the specimens collected later by Hibbard, Hass, and me from the Acme Shale pit, have been studied to determine the variability of the species. The rock enclosing the conodonts is a black hard silty shale. Generally only one side of the conodont can be seen even after careful preparation with a needle. Many of the specimens are broken and parts are missing. Only a few can be removed from the shale, and these are generally the heavier platform type.

The Rhinestreet Shale Member was placed in the Frasnian *Manticoceras* zone (*to* I$\beta\gamma$), by Hass (1959b) because of the presence of *Ancyrodella nodosa* Ulrich and Bassler and *Palmatolepis punctata* (Hinde). House (1962, p. 259), using a cephalopod as evidence, also placed the Rhinestreet Shale Member in the same zone (*to* I$\beta\gamma$). The position of the Rhinestreet Shale Member in the New York Upper Devonian section and its relationship to the Chattanooga Shale near New Market, Ala., is shown in figure 1. The platform-type conodonts found in the three formations from which Ulrich and Bassler described conodonts are shown in figure 2. The ranges of the same species in Germany and the conodont zones in the Upper Devonian of Germany are also shown. The more numerous bar-type conodonts are less useful in determining age, and only the platform genera are given in figures 1 and 2.

"HARDIN SANDSTONE" OF ULRICH AND BASSLER

The second faunule described by Ulrich and Bassler was collected by them from a thin sandstone near Mount Pleasant, Maury County, Tenn. They correlated the sandstone near Mount Pleasant with the Hardin Sandstone Member of Chattanooga Shale of Hardin County, Tenn., and considered it to be basal Mississippian in age. Hass (1956, p. 15–16) restricted the name Hardin Sandstone Member to a sandstone at the base of the Dowelltown Member of the Chattanooga Shale (early Late Devonian) in Hardin, Wayne, Perry, and Lawrence Counties, Tenn., and the adjacent counties of Alabama. The sandstone near Mount Pleasant, Tenn., which supplied the conodonts that Ulrich and Bassler described, is younger than the type Hardin Sandstone Member of the Chattanooga Shale (Hass, 1956, p. 15–16).

The exact locality from which the conodonts Ulrich and Bassler described were collected is not known. They reported (1926, p. 3) only that the collection came from Mount Pleasant, Tenn. Bassler (1932, p. 141) reported a section on a hill 4 miles west of Mount Pleasant, Tenn., which has no Hardin, and the Chattanooga is represented by 1.5 feet of "blue to black phosphate bed with a thin phosphatic shale at the base." He did not report finding conodonts in the section. It is therefore unlikely that this is the type locality of the Ulrich and Bassler species, and the rock description does not agree with the rock enclosing the type specimens. Hass (1956, p. 32, loc. 154) gave a section in a roadcut 3.8 miles west of Mount Pleasant on the road to Hampshire. (See Tennessee Valley Authority, Mount Joy quadrangle map, 1:24,000 series, 1951 ed.) He thought this to be in the vicinity of the Ulrich and Bassler conodont locality and collected two samples about 0.1 mile apart. In October 1933, G. I. Whitlatch, then with the Tennessee Geological Survey, and I collected from what we thought was the Ulrich and Bassler locality. It was the only exposure of the "Hardin Sandstone" near Mount Pleasant we could find. This locality is very near the locality found by Hass. It was about 4 miles west of Mount Pleasant, on the road to Hampshire north of Camp Branch. The exposure was poor. About 2 feet of the "Hardin sandstone" was exposed, and above it we found weathered and slumped gray shale, which we recorded as Maury Formation (?), and about 28 feet of Ridgetop Shale. Bassler probably omitted this section from his 1932 report because it was so poorly exposed.

The conodont types from the "Hardin sandstone" and the probable topotype material collected by Hass, Whitlatch, and myself are in a poorly sorted fine- to coarse-grained sandstone with considerable matrix. Some of the rock is conglomerate with phosphatic pebbles and bone fragments, and part of it is friable sandstone. Most of the conodonts are fractured in many places and cannot be removed from the rock, whereas a few condonots are unbroken and can be dug out of the matrix. Some specimens were freed by crushing the sandstone. Many of the conodonts are weathered, and some are rounded and apparently abraded. There are many broken specimens, and some of the cusp fragments show the fibrous structure which weathering brings out on some Middle Ordovician species. Several of the genera characteristic of the subjacent Ordovician rocks are present. These include *Rhipidognathus*, *Zygognathus*, *Trichonodella*, *Chirognathus*, *Ligonodina*, and *Cordylodus*. Some of these specimens are weathered, abraded, and discolored, but others are fresh and translucent. There are also abraded and discolored fragments of *Polygnathus linguiformis* Hinde, which were probably derived from a Middle Devonian formation now completely removed.

Hass (1956, p. 16) suggested an early Gassaway age for the "Hardin sandstone" from which Ulrich and

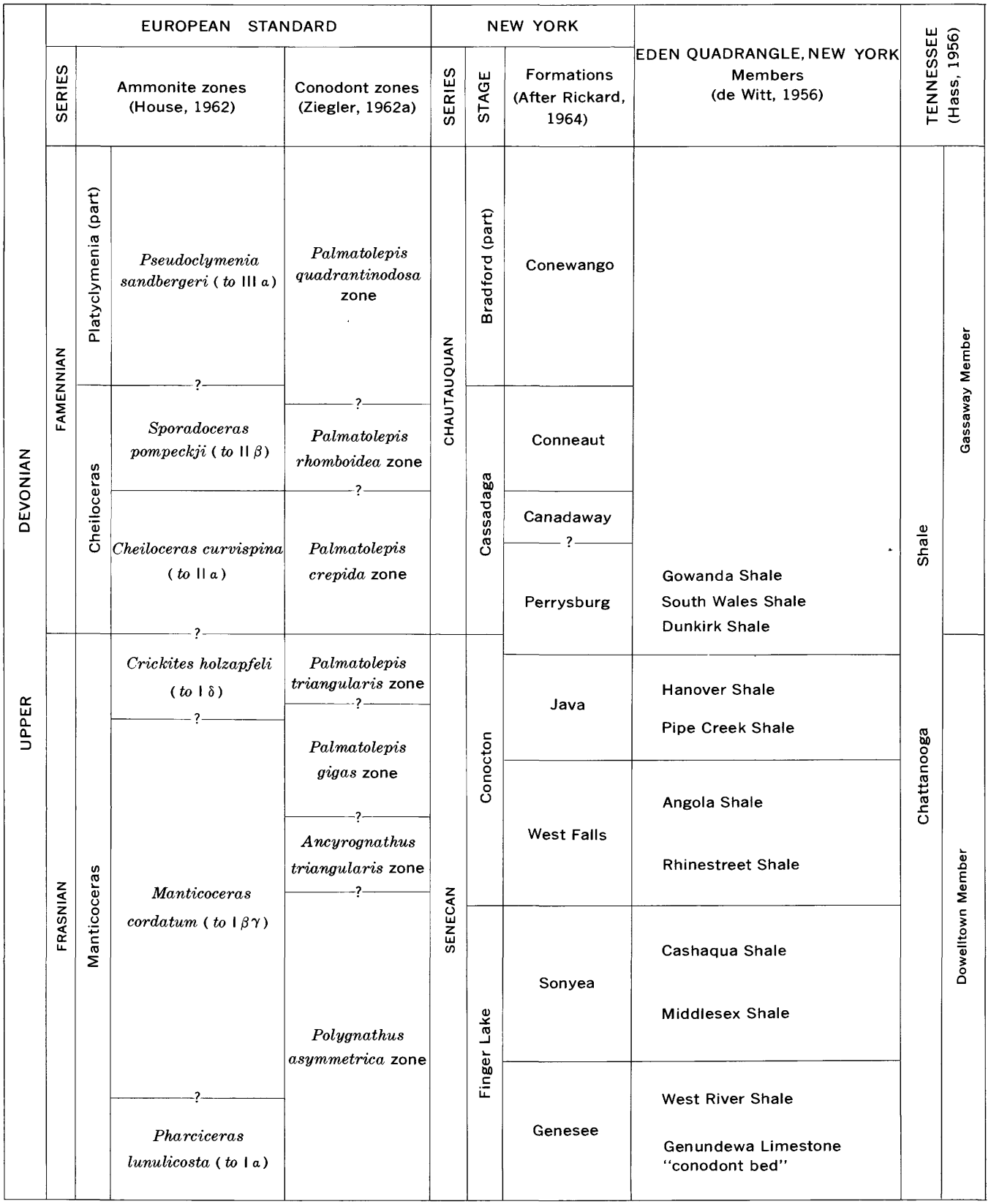

FIGURE 1.—Correlation chart showing the stratigraphic position of the Rhinestreet Shale Member of the West Falls Formation and the Gassaway Member of the Chattanooga Shale. Question marks indicate doubt about the position of zone boundaries in New York.

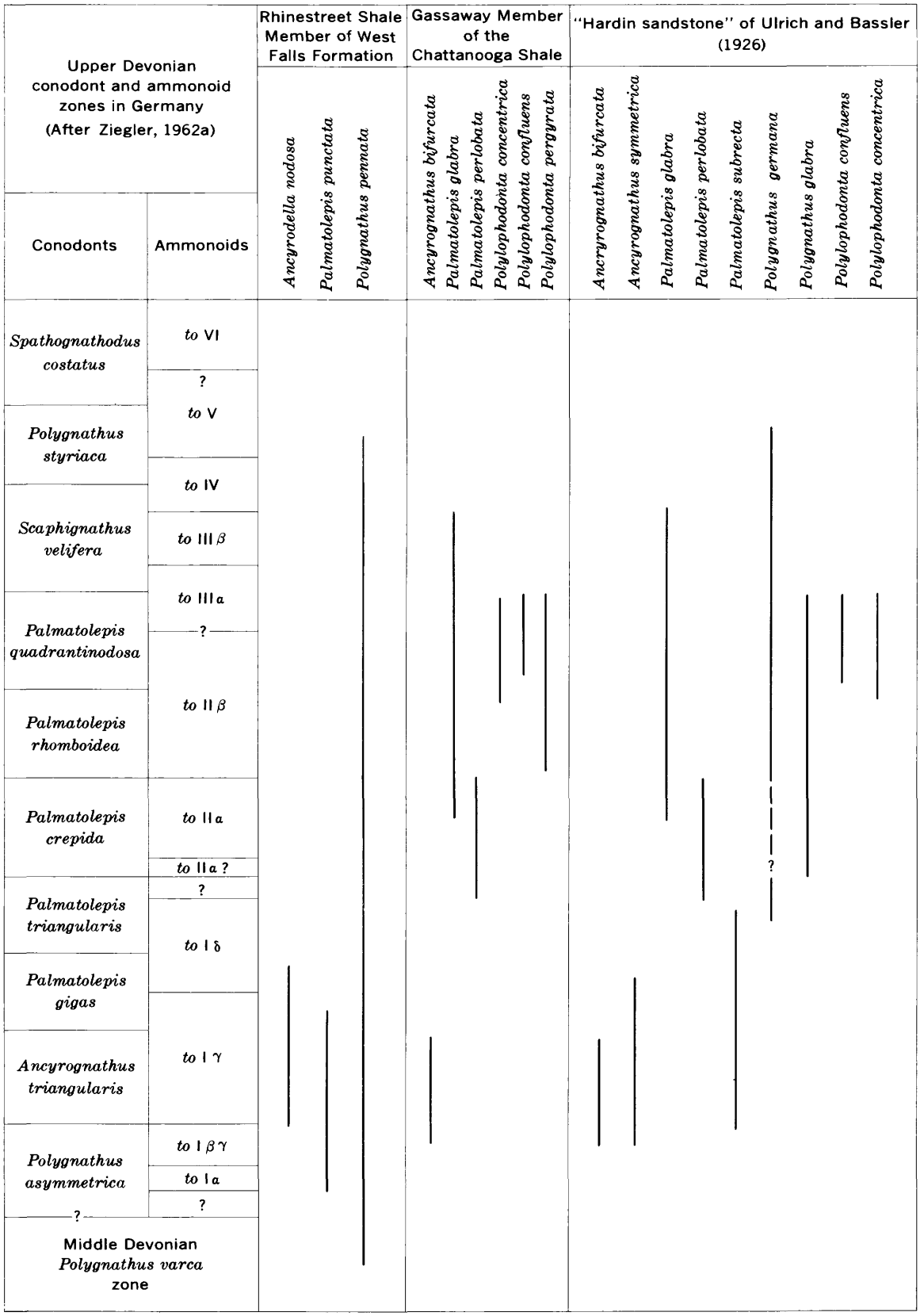

FIGURE 2.—Upper Devonian conodont zones in Germany and the German ranges of platform-type conodonts described in this report (after Ziegler, 1962a).

Bassler described condonts. He regarded *Ancyrognathus bifurcata* Ulrich and Bassler, *Palmatolepis glabra* Ulrich and Bassler, *Palmatolepis perlobata* Ulrich and Bassler, and *Polylophodonta confluens* Ulrich and Bassler as characteristic of the lower faunule in the Gassaway Member. That these species are common in the "Hardin sandstone" is the basis for his assertion that the type Hardin Member sandstone is older than the sandstone from which Ulrich and Bassler's conodonts came. The presence of *Polygnathus pennatula* Ulrich and Bassler suggests an age later than early Gassaway. *Spathognathodus costatus* E. R. Branson, present but not figured here, also indicates a late Devonian age. Also present, but unfigured here, are fragments of *Ancyrodella rotundilobata* Bryant, *Polygnathellus* sp., and *Icriodus* sp. These indicate the reworking of very early Upper Devonian. The faunule of the "Hardin sandstone" is certainly mixed, and it is difficult to assign an age to the bed. I suspect that the "Hardin sandstone" of Ulrich and Bassler at Mount Pleasant, Tenn., is a slightly reworked residuum at the base of the Maury Formation and that all of the conodonts are reworked. Conant and Swanson (1961, p. 25) described several residual sandstones at the base of the Chattanooga and Maury formations, including the bed that supplied the conodonts described from the "Hardin sandstone." This bed is very local and in this paper will be called the "Hardin standstone" of Ulrich and Bassler. It may be Mississippian in age as Ulrich thought, but it contains Ordovician and Upper Devonian conodonts from several zones.

GASSAWAY MEMBER OF THE CHATTANOOGA SHALE

Ulrich and Bassler (1926) described three new species—*Diplododella bilateralis*, *Palmatodella delicatula*, and *Synprioniodina alternata*—from the Chattanooga Shale "13 miles east of north of Huntsville, Ala." (according to Holmes, 1928, p. 24). Butts (1926, p. 160) wrote that these conodonts came from a locality on the Flint River about 4 miles west of New Market, Madison County, Ala. Hass (1956, p. 32) gave the following section:

Quicks Mill on Flint River, about 4 miles west of New Market, Madison County, Ala.

[Section measured along mill race, approx 0.2 mile upstream from Quicks Mill]

Mississippian:
Fort Payne Chert:
Limestone, yellowish-gray.
Maury Formation:

	Feet
Course of large phosphatic nodules embedded in gray siltstone	0.3

Quicks Mill on Flint River, about 4 miles west of New Market, Madison County, Ala.—Continued

	Feet
Devonian:	
Chattanooga Shale:	
Gassaway Member:	
Shale, dark-gray to grayish-black, carbonaceous, tough; iron sulfides present as grains	5.0
Total	5.3

Water level of mill race.

Quicks Mill is at Sulfur Springs on the Flint River in sec. 27, T. 1 S., R. 1 E. (oral commun., Glen Malmberg to L. C. Conant, 1964). The flume is shown on the Tennessee Valley Authority Fisk quadrangle map, Alabama-Tennessee (1:24,000 series, 1948 ed.).

The three species described by Ulrich and Bassler from this locality were illustrated by drawings and later by photographs (Holmes, 1928). These three species are refigured here, and several other species described by Holmes from this locality are refigured because I regard the species named by Holmes as junior synonyms of Ulrich and Bassler species.

The ranges of species (fig. 2) in the Gassaway Member suggest that the member ranges in age from early to late Famennian when compared with the occurrence of these species in the German conodont zones. *Ancyrognathus bifurcata* apparently appears much earlier in Europe than it does in the United States, and *Palmatolepis perlobata* seems to appear later in the United States than in Germany. Probably these discrepancies are due to misidentifications.

SYSTEMATIC PALEONTOLOGY

The phylogenetic relations of many conodont genera are still undetermined, and no classification of conodonts has been generally accepted by conodont workers. The genera are therefore arranged alphabetically for ease of reference.

Ulrich and Bassler designated cotypes for many of the species they described. Later workers have designated lectotypes for a few of these species, and I have designated lectotypes for many of the remainder. Lectotypes were designated for species here placed in synonymy to fix the name in case later workers remove them from synonymy.

The abbreviations "VP" and "IP" after USNM in this report stand for the Vertebrate Paleontology and Invertebrate Paleontology catalogs of the U.S. National Museum, respectively. Assignment to these catalogs has no taxonomic significance but reflects the opinion of Ulrich and Bassler that conodonts were fish remains. Cotypes were given a catalog number and a letter "a," "b," or "c" by Ulrich and Bassler in their report. These types were renumbered at the request of the U.S.

National Museum. In most cases the lectotype retained the original number, but in some cases this was not expedient and a new number was assigned.

Genus ANCYRODELLA Ulrich and Bassler, 1926

1926. *Ancyrodella* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 48.
1957. *Ancyrodella* Ulrich and Bassler. Müller and Müller, Jour. Paleontology, v. 31, no. 6, p. 1090.
1962. *Ancyrodella* Ulrich and Bassler. Ziegler, Neues Jahrb. Geologie u. Paläontologie, Abh., v. 114, no. 2, p. 145.
1962. *Ancyrodella* Ulrich and Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W58.

Type species (by original designation).—*Ancyrodella nodosa* Ulrich and Bassler, 1926.

Geologic range.—Upper Devonian, Frasnian.

Description.—Plate thick, slightly arched and bowed, cordate or sagittate in shape due to strongly developed anterior and posterior lobes. Lateral lobes present in some species. Anterior blade free with deep, broad trough on each side of the fixed blade at the anterior end of the plate. Median carina strong, consisting of more or less fused prominent nodes and extending to the posterior tip of the plate. Secondary carinae extending from the junction of the plate and the blade to the tips of the anterior lobes are present in some species. Oral surface has strong nodes or ridges; aboral surface smooth except for growth lines, a small basal cavity, and a strong median keel. Secondary keels may be present opposite the secondary carinae.

Ancyrodella? malleus Ulrich and Bassler, 1926

Plate 13, figures 5, 6

1926. *Ancyrodella malleus* [part] Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49, pl. 7, fig. 1 (not pl. 7, fig. 2 = *A. nodosa*).
1932. *Ancyrodella malleus* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 13.

Lectotype (here designated).—USNM 11006 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 1); this report (pl. 13, figs. 5, 6).

Type locality.—"Hardin sandstone," near Mount Pleasant, Tenn.

Description.—Anterior part of the plate asymmetrically lobed, posterior part missing; possibly it was a narrow lobe. Carina high, continuous with a low blade rising anteriorly. Oral surface marked by irregularly arranged low nodes. Margin of the plate thickened aborally at the crimp by a high rim which extends around the plate and continues along the blade outlining a groove in the base of the blade. Probably the cavity formed by this rim was occupied by a conodont base which is not preserved. Basal cavity small.

This description is based on the lectotype because no other specimen has been found. Clearly this species does not belong in *Ancyrodella*, but it is left here because it was originally assigned to *Ancyrodella* and is not referable to any other known genus. It is similar to *Palmatolepis* in the shape of the plate and the continuation of the plate along one side of the blade, but the plate is much too thick for that genus, and the aboral rim has not been described on any species of *Palmatolepis*. This species is closely related to *Pseudopolygnathus trigonica* Ziegler. *Ancyrodella? malleus* and *Pseudopolygnathus trigonica* probably belong in a new genus. (Charles Collinson, written commun. 1965).

Occurrence.—Mississippian(?): "Hardin sandstone," Tennessee, maybe reworked.

Ancyrodella nodosa Ulrich and Bassler, 1926

Plate 13, figures 1–4, 7–10

1926. *Ancyrodella nodosa* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 48, pl. 1, figs. 10–13.
1926. *Ancyrodella hamata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 48, pl. 7, fig. 7, text fig. 5, no. 10, p. 44.
1926. *Ancyrodella malleus* [part] Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49, pl. 7, fig. 2 (not fig. 1=*Ancyrodella? malleus*)
1926. *Ancyrodella symmetrica* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49, pl. 8, fig. 1.
1932. *Ancyrodella hamata* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 66, fig. 14.
1935. *Ancyrodella hamata* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 9, no. 4, p. 312, pl. 27, fig. 39.
1948. *Ancyrodella nodosa* Ulrich and Bassler. Youngquist and Miller, Jour. Paleontology, v. 22, no. 4, p. 441, pl. 68, fig. 13, 14.
1956. *Ancyrodella nodosa* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung Notizblatt, v. 84, p. 119, pl. 8, fig. 12, 15.
1957. *Ancyrodella hamata* Ulrich and Bassler. Müller and Müller, Jour. Paleontology, v. 31, no. 6, p. 1091–1092, pl. 136, fig. 4.
1958. *Ancyrodella nodosa* Ulrich and Bassler. Ziegler, Hesse Landesamt Bodenforschung Notizblatt, v. 87, p. 44, pl. 11, fig. 1.

Lectotype (designated by Ziegler, 1958, p. 44).—USNM 11303 VP, specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 10); this report (pl. 13, fig. 7).

Paralectotypes.—USNM 145870 IP, 145871 IP, 145872 IP; this report (pl. 13, figs. 8, 10, 9, respectively).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Plate shaped like an arrowhead, somewhat pinched posteriorly, arched upward; posterior tip depressed downward strongly. Carina laterally bowed slightly. Main carina strong, composed of fused nodes extending to the posterior tip of the plate; secondary carinae strong, composed of fused nodes diverging about 65° anteriorly; wide smooth surface in front of the secondary carinae forming a flaring trough next to the fixed blade. Oral surface marked by distinct nodes

or transverse ridges. Aboral surface smooth except for strong main and secondary keels, a small basal cavity, and a weak crimp less than 0.02 mm wide. The oral outline of the free blade is rounded in side view because the longest denticles are near the middle.

This description is based on a study of the figured types and seven unfigured paratypes of *A. nodosa*. *A. hamata*, *A. symmetrica*, and one of the cotypes of *A. malleus* were placed in synonymy after a study of the types and five topotype specimens from the "Hardin sandstone." The type of *A. symmetrica* was embedded in matrix when it was described by Ulrich and Bassler. They mistakenly described the aboral side as the oral side.

Occurrence.—Mississippian(?): "Hardin Sandstone," probably reworked. Upper Devonian: Rhinestreet Shale Member West Falls Formation, New York; Arkansas Novaculite, Arkansas; Sweetland Creek Shale and Independence Shale Member of Wapsipinicon Limestone, Iowa; Adorf-Stufe (*to* Iδ–*to* Iγ) Rheinischen Schiefergebirge, Germany.

Genus ANCYROGNATHUS Branson and Mehl, 1934

1934. *Ancyrognathus* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 240 [1933b].
1947. *Ancyroides* Miller and Youngquist, Jour. Paleontology, v. 21, no. 6, p. 504.
1957. *Ancyrognathus* Branson and Mehl. Müller and Müller, Jour. Paleontology, v. 31, no. 6, p. 1093–1094.
1962. *Ancyrognathus* Branson and Mehl. Ethington and Furnish, Jour. Paleontology, v. 36, no. 6, p. 1262.
1962. *Ancyrognathus* Branson and Mehl. Ziegler, Neues Jahrb. Geologie u. Paläontologie Abh. v. 114, no. 2, p. 150–155.
1962. *Ancyrognathus* Branson and Mehl. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W58–59.

Geologic range.—Upper Devonian.

Type species.—*Ancyrognathus symmetrica* Branson and Mehl, 1934.

Description.—Plate-type conodont consisting of an anterior lobe with carina and free blade and two subequal posterior lobes with more or less well developed carinae on both posterior lobes. Oral surface covered with nodes or ridges. On the aboral side there are growth lines, a prominent crimp, prominent keels on each lobe, and a three-cornered basal cavity at the junction of the three keels. *Ancyrognathus* differs from *Doliognathus* by the presence of a free blade and by having a smaller basal cavity.

Ancyrognathus asymmetrica (Ulrich and Bassler), 1926

Plate 13, figures 11, 12

1926. *Palmatolepis asymmetrica* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 50, pl. 7, fig. 18.
1962. *Ancyrognathus asymmetrica* (Ulrich and Bassler). Ethington and Furnish. Jour. Paleontology, v. 36, no. 6, p. 1262, pl. 172, fig. 11 [gives synonymy].

Holotype (by original designation).—USNM 11000 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 18); this report (pl. 13, figs. 11, 12).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—The holotype is the only specimen of this species in the Ulrich and Bassler collection, and I found no specimen in the topotype material. The plate is thick and heavy, arched, and three lobed with concave margins. Free blade short, with fused indistinguishable denticles continuing as a carina on the plate but dying out before reaching the junction of the two carinae on the lobes. Posterior lobe has a strong carina of fused nodes. The carina on the outer lobe has four discrete denticles decreasing in size toward the front. Angle between the carinae is 75°. Surface ornamented by a few thick nodes and ridges. Aboral side marked by growth lines and a steep crimp 0.07–0.11 mm wide. Keel sharp, narrow, continuous to the tip of the posterior lobe, and bowed inward. Main keel joined at an acute angle by the secondary keel at the elongate basal cavity. The posterior lobe is continuous with the anterior keel while the outer lobe keel joins at an angle. As pointed out by Ziegler (1962b, p. 153), this specimen is gerontic. The overall length of the holotype from the tip of the blade to the tip of the outer lobe is 2 mm. The outer lobe is 1 mm long, and the distance between the tips of the two lobes is 1.2 mm. The distance from the basal cavity to the anterior tip of the blade is 1 mm.

Occurrence.—Upper Devonian: Sweetland Creek Shale, Iowa; Houy Formation, Texas; *Manticoceras*-Stufe (*to* Iδ) Kellerwald, Germany; *Manticoceras* limestone, Fitzroy basin, Australia; West Africa (Sahara).

Ancyrognathus bifurcata (Ulrich and Bassler), 1926

Plate 13, figures 13–18

1926. *Palmatolepis bifurcata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 50, pl. 7, figs. 16, 17.
1926. *Palmatolepis inequalis* Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 160, pl. 48, fig. 7.
1928. *Palmatolepis inequalis* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 33, pl. 11, figs. 8–10. Lectotype here designated pl. 11, fig. 8=USNM 11458 VP.
1932. *Pelmatolepis bifurcatus* Bassler, Tennessee Div. Geology, Bull. 38, p. 234–235, pl. 26, figs. 16–17 (misspelled).
1934. *Palmatolepis? inequalis* Holmes. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 108, pl. 9, figs. 15–18.
1934. *Ancyrognathus irregularis* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 242, pl. 19, figs. 4, 16 [1933b].
1947. *Ancyrognathus irregularis* Branson and Mehl. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 26, pl. 2, fig. 26.
1951. *Ancyrognathus bifurcata* (Ulrich and Bassler). Hass, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 12 p. 2530, pl. 1, fig. 14.
1956. *Ancyrognathus bifurcata* (Ulrich and Bassler). Hass, U.S. Geol. Survey Prof. Paper 286, pl. 3, figs. 25, 26.

1957. *Ancyrognathus bifurcata* (Ulrich and Bassler). Müller and Müller, Jour. Paleontology, v. 31, no. 6, p. 1095–1096, pl. 142, fig. 5, probably not pl. 142, fig. 11.
1957. *Ancyrognathus bifurcata* (Ulrich and Bassler). Hass, *in* Cloud, Barnes, and Hass, Geol. Soc. America Bull., v. 68, p. 809, pl. 4, fig. 9.
1958. *Ancyrognathus bifurcata* (Ulrich and Bassler). Ziegler, Hesse Landesamt Bodenforschung Notizblatt, v. 87, p. 47–48, pl. 10, figs. 9, 13, 14, 16–18.

Lectotype (designated by Müller and Müller, 1957, p. 1095).—USNM 11010 VP, *Palmatolepis bifurcata* Ulrich and Bassler (1926, pl. 7, fig. 17); this report (pl. 13, fig. 13).

Paralectotype.—USNM 145874 IP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 16); this report (pl. 13, figs. 14, 15).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—Plate heavy, triangular to subquadrate in outline with a short free anterior blade and carinate posterior and lateral lobes. The junction of the main and lateral carinae makes an acute angle open toward the rear. The lateral lobes are well developed on the types, but the strength of the lobes is quite variable, and consequently the posterior margin of the plate may be strongly indented or nearly straight. Oral surface covered by irregularly arranged coarse nodes and ridges. Aboral surface has strong main and secondary carinae, a small distinct basal cavity, and a narrow crimp 0.07–0.11 mm wide.

A. bifurcata differs from *A. asymmetrica* by having a shorter, broader plate, larger free blade, and stronger main carina. *A. triangularis* Youngquist is narrower and more highly arched than *A. bifurcata* and lacks a free blade.

The description is based on a study of the Ulrich and Bassler and Holmes types and 10 topotype specimens.

Occurrence.—Mississippian(?): "Hardin sandstone," probably reworked. Upper Devonian: Gassaway Member of the Chattanooga Shale, Tennessee and Alabama; Ohio Shale, Ohio; New Albany Shale, Indiana; Arkansas Novaculite, Arkansas; Sweetland Creek Shale, Iowa; Houy Formation, Texas; Adorf-Stufe, Germany.

Genus ANGULODUS Huddle, 1934

1934. *Angulodus* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 76.

Type species.—*Angulodus demissus* Huddle.

Geologic range.—Middle Devonian to Lower Mississippian.

Angulodus pergracilis (Ulrich and Bassler), 1926

Plate 2, figures 1, 2

1926. *Bryantodus pergracilis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 27, pl. 10, fig. 11.
1926. *Bryantodus nelsoni* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 28, pl. 10, fig. 9.
1932. *Bryantodus nelsoni* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 9.
1934. *Angulodus gravis* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 77, pl. 3, figs. 3, 4.
1957. *Angulodus gravis* Huddle. Bischoff and Ziegler, Hesse Landesamt Bodenforschung Abh., v. 22, p. 43, pl. 8, figs. 7, 9; pl. 20, figs. 2, 3, 5, 6.

Holotype (by original designation).—USNM 11023 VP, Ulrich and Bassler (1926, pl. 10, fig. 11); this report (pl. 2, fig. 2).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.— Bar heavy, laterally compressed with subcentral cusp; numerous denticles alternating or irregular in size on the posterior bar. Denticles compressed, sharp edged, and closely spaced. Anterior bar nearly straight aborally and deflected inward and downward just anterior to the cusp.

The description is based on a study of the holotypes of *A. pergracilis* and *A. nelsoni* and a reexamination of the types of *A. gravis*.

The species differs from *Angulodus walrathi* Hibbard by the inward deflection of the anterior bar and the heavier bar.

Occurrence.—Mississippian(?): "Hardin sandstone," Tennessee, probably reworked. Upper Devonian: New Albany Shale, Indiana; Eifelian to Frasnian, Germany.

Genus APATOGNATHUS Branson and Mehl, 1934

Apatognathus? sp.

Plate 5, figure 2

?1926. *Hindeodella longidens* [part] Ulrich and Bassler, 1926, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 40, pl. 8, fig. 15 [not pl. 8, fig. 14=*Hindeodella longidens*].

Hypotype.—USNM 145892 IP.

Remarks.—Only the cusp and one bar are preserved. The base of the missing bar makes a sharp angle with the remaining bar similar to the angle characteristic of *Apatognathus*. Not enough of the specimen is preserved to be sure of the generic identification. The specimen figured here (pl. 5, fig. 2) is the specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 15), according to the label but it does not look like their figure. Probably the specimen Ulrich and Bassler figured is lost.

Genus APHELOGNATHUS Branson, Mehl, and Branson, 1951

1951. *Aphelognathus* Branson, Mehl, and Branson, Jour. Paleontology, v. 25, no. 1, p. 9.
1962. *Aphelognathus* Branson, Mehl, and Branson. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W56.

Type species (by original designation).—*Aphelognathus grandis* Branson, Mehl, and Branson, 1951.

Geologic range.—Middle and Upper Ordovician.

Diagnosis.—Bar straight or slightly arched and bowed. Denticles short and round; cusp distinct. Aboral side open, thin walled, expanded below the cusp.

Aphelognathus? crassus (Ulrich and Bassler), 1926

Plate 2, figure 3

1926. *Bryantodus crassus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 27, pl. 10, fig. 14.

Holotype (by original designation).—USNM 11026 VP, Ulrich and Bassler (1926, pl. 10, fig. 14); this report (pl. 2, fig. 3).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype and most of the topotype specimens appear to be waterworn or weathered. I think they have been reworked from Ordovician formations. The base is deeply excavated, and the denticles and cusp are short and rounded as is characteristic of *Aphelognathus*. Probably this is the senior synonym of an Ordovician species, but the holotype is indeterminate. The name is a nomen dubium.

Genus BRYANTODUS Bassler, 1925

1925. *Bryantodus* Bassler, Geol. Soc. America Bull., v. 36, p. 219.

1926. *Bryantodus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 21.

1962. *Bryantodus* Ulrich and Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W55–W56.

Type species (by original designation).—*Bryantodus typicus* Bassler, 1925.

Geologic range.—Middle Silurian to Middle Pennsylvanian.

Description.—Conodont with more or less arched and bowed triangular bars that are broad or flanged orally and thinner along the aboral midline. Distinct cusp and basal cavity with or without lips in the central third of the bar; denticles closely spaced.

Ozarkodina Branson and Mehl and *Polygnathellus* Bassler resemble *Bryantodus*. *Ozarkodina* is distinguished by its thin laterally compressed bar, but there are intermediate species. *Polygnathellus* differs from *Bryantodus* in that the main cusp is less conspicuous, the bar is thick aborally, and the lateral lobes are more prominent.

Bryantodus? conferta (Ulrich and Bassler), 1926

Plate 2, figure 4

1926. *Prioniodella conferta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 21, pl. 10, fig. 25.

1932. *Prioniodella conferta* Bassler, Tennessee Div. Geology Bull. 38, pl. 26, fig. 10.

Holotype (by original designation).—USNM 10989 VP, this report (pl. 2, fig. 4).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The specimen is a bar fragment that cannot be certainly assigned to a genus, but it may belong in *Bryantodus*. The species is a nomen dubium.

Bryantodus? cultratus (Ulrich and Bassler), 1926

Plate 2, figure 5

1926. *Prioniodus cultratus* Ulrich and Bassler [not Holmes, 1928] U.S. Natl. Mus. Proc., v. 68, art. 12, p. 9, pl. 9, fig. 7.

1926. *Prioniodus cultrata* Ulrich and Bassler. Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 160, pl. 48, fig. 11.

Holotype (by original designation).—USNM 11038 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 7); this report (pl. 2, fig. 5).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This is a nomen dubium. The holotype, including the cusp and part of one bar, is probably a fragment of *Bryantodus*. A large cusp, strong aboral lip, and short flattened denticles are preserved on the bar. Perhaps the specimen belongs in *Polygnathellus multidens*.

The specimen identified by Holmes (1928, pl. 9, fig. 4) as *Prioniodus cultratus* Ulrich and Bassler is broken and not identifiable. Probably it is an *Ozarkodina*, but it may belong in *Synprioniodina*.

Bryantodus? insolens Ulrich and Bassler, 1926

Plate 2, figure 6

1926. *Bryantodus insolens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 25, pl. 10, fig. 17.

Holotype (by original designation).—USNM 11015 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 17); this report (pl. 2, fig. 6).

Locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype appears to be a fragment of a *Hindeodella* or *Angulodus*. It is a nomen dubium.

Bryantodus? minutus Ulrich and Bassler, 1926

Plate 2, figure 7

1926. *Bryantodus minutus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 27, pl. 10, fig. 6.

Holotype (by original designation).—USNM 11018 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 6); this report (pl. 2, fig. 7).

Locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype is a fragment of some conodont, perhaps a *Hindeodella*, but the genus and species are indeterminable. *B.? minutus* is a nomen dubium.

Bryantodus nitidus Ulrich and Bassler, 1926

Plate 2, figures 8–16

1926. *Bryantodus nitidus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 24, pl. 4, figs. 12, 13 [not pl. 4, fig. 14=*Prioniodina transitans* (Ulrich and Bassler). 1926].
1926. *Bryantodus conjunctus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 24, pl. 4, fig. 8 [not pl. 4, fig. 9=*Polygnathellus* sp.]
1926. *Bryantodus curvatulus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 28, pl. 9, fig. 13.
?1926. *Bryantodus gracilis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 27, pl. 10, fig. 10.
1926. *Bryantodus multidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 22, pl. 6, fig. 16 [not pl. 6, fig. 15=*Polygnathellus multidens* (Ulrich and Bassler), 1925].
?1926. *Bryantodus subradiatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 26, pl. 10, figs. 12, 13. Fig. 13 designated as the lectotype=USNM 11022 VP.
?1926. *Bryantodus tenuis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 26, pl. 10, fig. 7.
1932. *Bryantodus subradiatus* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, figs. 8, 8'.
1934. *Bryantodus nodus* Huddle. Bull. Am. Paleontology, v. 21, no. 72, p. 75, pl. 4, fig. 12; pl. 4, fig. 10.
?1934. *Bryantodus parvus* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 74–75, pl. 4, fig. 9.
1938. *Bryantodus andersonensis* Stauffer, Jour. Paleontology, v. 12, no. 5, p. 419, pl. 49, fig. 17.
1938. *Bryantodus bryanti* Stauffer, Jour. Paleontology, v. 12, no. 5, p. 420, pl. 49, fig. 18.
1938. *Bryantodus nobilis* Stauffer, Jour. Paleontology, v. 12, no. 5, p. 422, pl. 49, fig. 14.
1945. *Bryantodus nitidus* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 19, no. 6, p. 613, pl. 84, fig. 2.
1947. *Bryantodus nitidus* Ulrich and Bassler. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 27, pl. 2, fig. 11.
1948. *Bryantodus atticaensis* Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, p. 50, pl. 15, fig. 3.
1948. *Bryantodus hanoverensis* Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, p. 50, pl. 15, fig. 14.
1955. *Bryantodus nitidus* Ulrich and Bassler. Sannemann, Senckenbergiana Lethaea, v. 36, p. 128, pl. 2, figs. 10, 11.
1956. *Bryantodus nitidus* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung Notizblatt, v. 84, p. 123, pl. 10, fig. 5.
?1957. *Bryantodus nitidus* Ulrich and Bassler. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 7–8, p. 799, pl. 8, fig. 1.
?1957. *Bryantodus sp.* Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 7–8, p. 799, pl. 8, fig. 2.

Lectotype (here designated).—USNM 11266 VP, specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 12); this report (pl. 2, fig. 8).

Paralectotype.—USNM 145877 IP, specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 13); this report (pl. 2, fig. 9).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar arched and slightly bowed inward; denticles compressed, biconvex in cross section, partly fused, and about as thick as the oral edge of the bar. Posterior denticles generally point backward and are smaller than those on the anterior bar. Anterior denticles vary in size and tend to curve backward. Cusp distinct and includes one or more suppressed denticles in its base. Aboral projection of the cusp small or indistinct. Aboral edge sharp except near the basal cavity.

Remarks.—*B. nitidus* is smaller and less massive; it has smaller, more numerous denticles than *B. typicus* and lacks the shelflike area on the inside of the bar. The length of the bar ranges from 0.5 to 1.6 mm. The description is based on a study of the figured types, four unfigured paratypes, and six topotype specimens collected by W. H. Hass, USGS locality No. 11320PC.

The specimens here referred to *B. nitidus*, which were originally described as *B. conjunctus* and *B. multidens*, clearly fall within the range of variation here allowed in *B. nitidus*. Other species of *Bryantodus* described by Holmes (1928), Huddle (1934), Stauffer (1938), and others are also junior synonyms. These species were based on few specimens, and the range of variation was not determined. *Bryantodus* needs a complete revision. I examined the types of the species described by Stauffer (1938), and Youngquist, Hibbard, and Reimann (1948) and reexamined my own types in the course of preparing this description. *Bryantodus cognatus* Huddle differs from *B. nitidus* by the presence of a sharp lateral ridge on the anterior bar which curves up on the cusp. *B. parvus* Huddle may be a young *B. nitidus*.

Bryantodus tenuis, *B. subradiatus*, and *B. gracilis* from the "Hardin sandstone" are referred to *B. nitidus* doubtfully. They are all small bryantodids with numerous denticles, but they lack the aboral projection of the cusp typical of the Rhinestreet specimens of the species. The aboral projection is not distinct on all the specimens from the Rhinestreet.

Occurrence.—Mississippian(?): "Hardin sandstone", Tennessee, probably reworked. Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; Olentangy Shale, Ohio; New Albany Shale, Indiana; black shale, Montana; Frasnian, France; *Mantioceras*-Stufe and *Cheiloceras*-Stufe (*to* Iδ–*to* IIα), Germany.

Bryantodus typicus Bassler, 1925

Plate 3, figures 1–15; plate 4, figures 12–15

1925. *Bryantodus typicus* Bassler, Geol. Soc. America Bull., v. 36, p. 219.
1926. *Bryantodus typicus* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 21–22, pl. 6, figs. 11, 12.
1926. *Bryantodus? tridentatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 22, pl. 6, fig. 13.
1926. *Bryantodus? inequalis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 22, pl. 6, fig. 14. [not *B. inequalis* Holmes, 1928, a homonym, renamed *B. scalenus* Mound, 1964].
1926. *Bryantodus crassidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 23, pl. 6, figs. 17, 18.
1926. *Bryantodus obliquus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 23, pl. 6, figs. 19–21.
1926. *Bryantodus sinuatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 23, pl. 6, figs. 22–24.
1926. *Bryantodus normalis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 24–25, pl. 4, figs. 25–27.
1926. *Bryantodus coalescens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 25, pl. 4, fig. 28.
1926. *Bryantodus curvatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 26, pl. 4, fig. 20 [not pl. 4, fig. 19 = *Lonchodina subsymmetrica* Ulrich and Bassler].
1926. *Bryantodus incertus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 27–28, pl. 10, fig. 8.
1948. *Bryantodus bassleri* Youngquist, Hibbard, and Reimann. Jour. Paleontology, v. 22, no. 1, p. 50, pl. 15, fig. 11.
1948. *Bryantodus multidens* Ulrich and Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 51, pl. 15, fig. 15. This is an incompletely prepared young specimen.
1948. *Bryantodus typicus* Ulrich and Bassler. Youngquist, Hibbard and Reimann, Jour. Paleontology, v. 22, no. 1, p. 51–52, pl. 15, figs. 4, 9, 12.
1948. *Bryantodus ulrichi* Youngquist, Hibbard, and Reimann. Jour. Paleontology, v. 22, no. 1, p. 52, pl. 15, fig. 8.

Lectotype (here designated).—USNM 11258 VP, specimen figured by Ulrich and Bassler (1926, pl. 6, fig. 11); this report (pl. 3, fig. 1).

Paralectotype.—USNM 145880 IP, specimen figured by Ulrich and Bassler (1926, p. 6, fig. 12); this report (pl. 3, fig. 3).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar-type conodont more or less bowed inward and arched upward. In young specimens the bar is triangular in cross section, sharp aborally, and thickened at top or in the center. In mature and older individuals the bar is flattened, broad or shelved, oval in cross section, or nearly flat aborally. Bar denticles compressed, biconvex in cross section, and commonly fused. There are 4–8 anterior denticles and 3–10 posterior denticles. Cusp broad and much larger than the denticles and includes in its base one or more suppressed denticles, especially on the anterior side. Basal cavity round, small, and below cusp in the central third of the bar and flattened on the outside by projection or lip extending down from the cusp.

The bars range in length from 1.2 to 2.0 mm and average 1.5 mm. This description is based on the examination of 34 figured and unfigured paratypes and the lectotype.

Remarks.—*Bryantodus typicus* includes the types of nine species proposed by Ulrich and Bassler (1926). *B.? tridentatus* (pl. 3, fig. 2) is the distal end of the anterior bar of a large specimen of *B. typicus*, and *B.? inequalis* (pl. 3, fig. 4) is a broken immature specimen. *B. crassidens* (pl. 3, fig. 5), *B. incertus* (pl. 4, fig. 14), and *B. obliquus* (pl. 3, figs. 7, 8) are mature specimens which fall well within the range of variation of *B. typicus* as here understood. Ulrich and Bassler distinguished *B. sinuatus* from *B. obliquus* on the basis of a straighter bar, larger cusp, and prominence of the downward projection of the cusp (lip). These features vary greatly in *B. typicus* and are not considered valid in differentiating species in this group. *B. normalis* and *B. coalescens* are mature specimens in which the denticles and cusp are somewhat more fused than in other examples of *B. typicus*.

Some specimens of *B. typicus* are difficult to distinguish from specimens of *Polygnathellus typicalis*. A specimen of *P. typicalis*, herein figured on plate 4, figures 7, 8, might be referred to *Bryantodus typicus* because of the large size and central position of the cusp and the fusion of the denticles with cusp. I prefer to retain this specimen in *P. typicalis* because of the flat bar base and the presence of nodes on the upper surface of the bar. Specimens of *Polygnathellus* are rare, and they may represent aberrant forms of *Bryantodus typicalis* with which they normally occur. *Polygnathellus typicalis* ranges in length from 1.6 to 2.4 mm, and this is large enough to represent mature and gerontic specimens.

Occurrence.—Mississippian?: "Hardin sandstone", Tennessee, probably reworked. Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York.

Genus DIPLODODELLA Bassler, 1925

1925. *Diplododella* Bassler, Geol. Soc. America Bull., v. 36, p. 219.
1926. *Diplododella* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 41.
1945. *Elsonella* Youngquist, Jour. Paleontology, v. 19, no. 4, p. 358.
1956. *Ellisonia* Müller, Jour. Pateontology, v. 30, no. 4, p. 822.

Type species (by original designation).—*Diplododella bilateralis* Bassler, 1925.

Geologic range.—Ordovician to Triassic.

Diagnosis.—Typically with thin, flattened, bladelike bars in the anterior arch and a posterior bar perpendicular to anterior arch. Cusp at top of arch; denticles compressed, closely spaced or fused, and inserted. Basal cavity tiny or absent.

Description.—Anterior arch composed of two bladelike lateral bars that are thin and sharp edged aborally. Posterior bar thin or rounded. Denticles loosely or closely spaced, discrete or fused; inserted and suppressed denticles are common. Denticles may alternate in size on the anterior arch and on the posterior bar. A few species, including the type species, tend to have a double row of denticles. The basal cavity is tiny or absent, and the base of the bar is sharp without a median groove in most species. In a few species the base of the posterior bar near the cusp is flat, and the denticles are discrete. These species are transitional into *Hibbardella.*

Remarks.—Diplododella differs from *Hibbardella* by having bladelike bars, a tiny basal cavity, and generally close spacing of the denticles. The following species (including synonyms) from published illustrations appear to belong in *Diplododella:*

Diplododella alternata Branson and Mehl
aurita (Sannemann)
bidentata (Tatge)
bilateralis Bassler
brevialata (Walliser)
confertissima (Ulrich and Bassler)
divergens (Huddle)
franca (Sannemann)
inclinata (Rhodes)
insignis (Huddle)
latialata (Walliser)
latipennata (Ziegler)
macrodentata (Thomas)
?magnidentata (Tatge)
?meisseri (Tatge)
ortha (Rexroad)
plana (Thomas)
prava (Helms)
?prima (Walliser)
prima (Youngquist)
separata (Branson and Mehl)
symmetrica (Huddle)
telum (Huddle)
trichonodelloides (Walliser)
truncialata (Walliser)

Diplododella bilateralis Bassler, 1925

Plate 7, figure 8

1925. *Diplododella bilateralis* Bassler, Geol. Soc. America Bull., v. 36, p. 219.
1926. *Diplododella bilateralis* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 41, text fig. 4, no. 21 on p. 16.
1926. *Diplododella bilateralis* Bassler. Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 160, pl. 48, fig. 6.
1928. *Diplododella bilateralis* Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 29, pl. 10, fig. 8.
1932. *Diplododella bilateralis* Bassler, Tennessee Div. Geology, Bull. 38, p. 234, pl. 26, fig. 22.

Holotype.—USNM 11306 VP, specimen figured by Ulrich and Bassler (1926, p. 16, text fig. 4, no. 21) and by Holmes (1928, pl. 10, fig. 8); this report (pl. 7, fig. 8).

Type locality.—Gassaway Member of Chattanooga Shale, Quicks Mill, Ala.

Description.—Conodont consisting of a symmetrical denticulated anterior arch and a denticulated posterior bar. Denticles on anterior arch closely spaced and alternate with two small denticles between the larger denticles. Cusp flattened and curved backwards. Aboral edge of the anterior arch sharp; basal cavity a small triangular pit.

Description based on the holotype, USNM 11306 VP.

Diplododella confertissima (Ulrich and Bassler), 1926

Plate 7, figure 5

1926. *Hibbardella? confertissima* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 38, pl. 3, fig. 5.
1934. *Hibbardella? telum* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 79–80, pl. 3, figs. 10–12.
1948. *Hibbardella angulata* (Hinde). Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 53, pl. 15, figs. 2, 13.

Holotype (by original designation).—USNM 11298 VP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 5); this report (pl. 7, fig. 5).

Type locality.—Rhinestreet Shale of the West Falls Formation, Weyer, N.Y.

Descriptions.—Bars of the anterior arch triangular in cross section, sharp edged aborally. Denticles even, flattened, curved backward; about nine on each anterior bar. Cusp flattened, tapering, sharp edged, and curved backward. Posterior bar present. Basal cavity a tiny triangular pit. The tip of one of the anterior bars is broken in the holotype.

This description is based on the examination of the holotype, three unfigured paratypes, and the types of *H. telum.*

Genus HIBBARDELLA Bassler, 1925

1925. *Hibbardella* Bassler, Geol. Soc. America Bull., v. 36, p. 219.
1926. *Hibbardella* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 37.
1941. *Hibbardella* Bassler. Branson and Mehl, Denison Univ. Sci. Lab. Jour., v. 35, p. 175–176.
1953. *Roundya* Hass, U.S. Geol. Survey Prof. Paper 243–F, p. 88–89.
1956. *Hibbardella* Bassler. Müller, Jour. Paleontology, v. 30, no. 4, p. 825.
1962. *Hibbardella* Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W50.

1962. *Roundya* Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W51.
1964. *Roundya* Hass. Lindström, Conodonts, note 11, p. 176.
1964. *Hibbardella* Bassler. Bergström, Lund Univ. Inst. Mineralogy, Paleontology, and Quaternary Geology Pub. no. 128, p. 24.

Type species (by original designation).—*Prioniodus angulatus* Hinde, 1879.

Geologic range.—Ordovician to Triassic.

Diagnosis.—Conodonts consisting of a denticulated posterior bar, terminal cusp, and symmetrical anterior arch. Bars thick and round. Denticles discrete and rounded.

Description.—Bars in anterior arch thick, rounded, and broad at base near the basal cavity. In some species the tips of the lateral bars are thin and inverted, and the anterior face of the bars is marked by a raised line at the oral edge of an attachment area. Cusp distinct, curved backwards in most species, and round, oval, or triangular in cross section. The denticles in all three bars tend to be rounded and widely spaced, but they are closely appressed in some species. The white matter in the denticles diffuses into the clear bar material. The basal cavity varies in size and depth and extends as a cavity or groove part way along the base of the posterior and anterior lateral bars. The groove is easily seen in well preserved material but is difficult to see in some specimens from the Rhinestreet Shale Member. The basal cavity is largest in Ordovician species and tends to get smaller in Silurian and younger species.

Remarks.—The genera that have a symmetrical anterior arch and a posterior bar were revised by Hass (1953, p. 88–89), Müller (1956b, p. 825), Bergström (1964, p. 24), and Lindström (1964, note 11, p. 176), but these authors do not agree as to the number of genera to be recognized nor the names to be applied. In this paper *Trichonodella*, *Hibbardella*, and *Diplododella* are regarded as valid.

Trichonodella, as defined by Hass (1953) and Lindström (1964), includes forms with a nearly symmetrical or symmetrical anterior arch, a nondenticulate posterior bar, and a large basal cavity extending into the bars and up on the posterior face of the arch.

Hibbardella as here defined includes species with a symmetrical anterior arch, denticulate posterior bar, and large basal cavity. This includes forms assigned to *Roundya* by Hass (1962). Lindström (1964, note 11, p. 176) also used the name *Roundya* because he thought that the presence of a posterior bar in *Hibbardella* had not been established. Müller (1956b, p. 825) reported that there is no posterior bar in *Hibbardella*. The preparation of specimens of *Hibbardella angulata* from the Rhinestreet Shale Member for this study clearly shows the presence of a denticulated posterior bar. This material is conspecific with the holotype of *Prioniodus angulatus* Hinde and probably comes from the same stratigraphic horizon at a locality near the North Evans locality where Hinde collected the holotype.

Diplododella, as here defined, includes the species with a thin, bladelike anterior arch, denticulated posterior bar, and a tiny basal cavity. In most species the denticles are closely appressed, and the denticles appear to be inserted.

Hibbardella and *Diplododella* were probably derived from *Trichonodella*, and several species are difficult to assign to a genus. The following described species (including synonyms) from published illustrations appear to belong in *Hibbardella:*

Hibbardella abnormis Branson and Mehl
angulata (Hinde)
barbara (Stauffer)
barnettana (Hass)
brevialata Branson and Mehl
brevipennata (Sannemann)
brassfieldensis (Branson and Branson)
carinata (Branson and Branson)
caudata (Walliser)
costata (Rexroad)
curvata Holmes
curvidens (E. R. Branson)
delicata (Mehl and Thomas)
detorta (Walliser)
devonica (Stauffer)
distans Huddle
divaricata (Rhodes)
fragilis (Rexroad)
?gracilis Stauffer
?gracilis (Rhodes)
hawkeyensa (Youngquist)
hoffmani (Stauffer)
inclinata (Rhodes)
laminata (Branson and Mehl)
lautissima Huckriede
longipostica Thomas
milleri Rexroad
multidens Ulrich and Bassler
?oxys (Cooper)
pandata Huddle
plana (Helms)
recurvata Thomas
robusta (Branson and Mehl)
subacoda (Cooper)
subequalis Ulrich and Bassler
subgrandis Hibbard
subsymmetrica Müller
toma (Cooper)
triangularis (Bischoff and Ziegler)
tumida (Branson and Mehl)
undulata (Branson and Mehl)
wildungensis (Bischoff and Ziegler)

Hibbardella angulata (Hinde), 1879

Plate 8, figures 2, 7; plate 9, figure 3

1879. *Prioniodus angulatus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 360, pl. 15, fig. 17.
1926. *Hibbardella angulata* (Hinde). [part] Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 37, pl. 3, fig. 2, 4, text fig. 4, no. 15. [not pl. 3, fig. 1, 3=*Hibbardella subequalis* Ulrich and Bassler].
1926. *Lonchodina rectangulata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 37, pl. 10, fig. 4.
1932. *Lonchodina rectangulata* Ulrich and Bassler. Bassler, Tennessee Div. Geology. Bull. 38, p. 234, pl. 26, fig. 7.
1933. *Hibbardella angulata* (Hinde). Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 141, pl. 11, fig. 16.
1934. *Hibbardella angulata* (Hinde). Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 78, pl. 3, figs. 6, 7; pl. 10, fig. 12.
1947. *Hibbardella angulata* (Hinde). Bond, Ohio Jour. Sci., v. 47, no. 1, p. 28, pl. 2, fig. 9.
1947. *Hibbardella angulata* (Hinde). Youngquist, Jour. Paleontology, v. 21, no. 2, p. 100, pl. 24, figs. 16, 17; pl. 25, fig. 7.
not 1948. *Hibbardella angulata* (Hinde). Youngquist, Hibbard and Reimann, Jour. Paleontology, v. 22, no. 1, p. 53, pl. 15, figs. 2, 13=*Hibbardella confertissima*.

Holotype (by monotypy).—British Museum A4180, specimen figured by Hinde (1879, pl. 15, fig. 17) and refigured by Branson and Mehl (1933a, pl. 11, fig. 16).

Hypotypes.—USNM 145886 IP, 145887 IP, specimens figured by Ulrich and Bassler (1926, pl. 3, fig. 2 and fig. 4, respectively).

Locality.—The hypotypes are from the Rhinestreet Shale Member at Weyer, N.Y., and "Hardin sandstone," Mount Pleasant, Tenn.

Diagnosis.—This species is distinguished by a slender cusp that is narrow at the base and expands above. The cusp is round or oval in cross section and grooved on the back side. The bar is thin in young specimens and becomes thicker and more rounded in mature individuals. Basal cavity small. Posterior bar heavy, equal in size to the anterior bars, and grooved aborally. Denticles are present on the posterior bar, but the number is not known.

Descriptions based on a study of the figured types, six unfigured specimens in the Ulrich and Bassler collections, a reexamination of the specimens I figured (1934), and the specimens figured by Youngquist, Hibbard, and Reimann (1948).

Occurrence.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; New Albany Shale, Indiana; Ohio Shale, Ohio.

Hibbardella? brevispina (Ulrich and Bassler), 1926

Plate 6, figure 13

1926. *Prioniodella brevispina* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 20, pl. 10, fig. 21.
1932. *Prioniodella brevispina* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 11.

Holotype.—USNM 10993 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 21); this report (pl. 6, fig. 13).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This fragment of a bar-type conodont is not identifiable. It could be part of the anterior arch of a *Hibbardella* or a fragment of *Lonchodina*, *Prioniodina*, or *Bryantodus*. The small end of the bar seems to be broken and worn. The apparent decrease in size of denticles toward the cusp position is the reason for assigning this specimen to *Hibbardella*. The name is a nomen dubium.

Hibbardella multidens Ulrich and Bassler, 1926

Plate 8, figure 10; plate 9, figure 1

1926. *Hibbardella multidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 38, pl. 3, figs. 8, 9.
1927. *Hibbardella subgrandis* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 204–205, fig. 3b.
1948. *Hibbardella multidens* Ulrich and Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 53, pl. 15, fig. 10.
?1957. *Hibbardella* cf. *H. multidens* Ulrich and Bassler. Rhodes and Dineley, Jour. Paleontology, v. 31, no. 2, p. 362, pl. 38, fig. 14.

Lectotype (here designated).—USNM 145888 IP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 9); this report (pl. 8, fig. 10).

Paralectotype.—USNM 11297 VP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 8); this report (pl. 9, fig. 1).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—This species is distinguished by the low, almost flat, anterior arch and the short slender rounded denticles. Cusp long, slender, and rounded. Basal cavity small. Posterior bar present, but its length is unknown. Height, 1.4–2.6 mm.

The description is based on the study of the types, two unfigured paratypes, and the hypotype figured by Youngquist, Hibbard, and Reimann (1948).

Hibbardella subequalis Ulrich and Bassler, 1926

Plate 6, figures 6, 8; plate 8, figures 3, 8, 9; plate 9, figure 2

1926. *Hibbardella subequalis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 38, pl. 3, fig. 6, 7.
1926. *Lonchodina rectidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 31–32, pl. 5, fig. 13. [not pl. 5, fig. 14=*Lonchodina typicalis* Bassler, 1925].
1926. *Hibbardella angulata* (Hinde). [part] Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, pl. 3, figs. 1, 3. not pl. 3, figs. 2, 4=*Hibbardella angulata* (Hinde)].

?1947. *Hibbardella subequalis* Ulrich and Bassler. Youngquist, Jour. Paleontology, v. 21, no. 2, p. 101, pl. 26, fig. 14.
?1947. *Hibbardella hawkeyensa* Youngquist, Jour. Paleont., v. 21, no. 2, p. 101, pl. 25, fig. 20.

Lectotype (here designated).—USNM 11296 VP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 6); this report (pl. 6, fig. 8).

Paralectotype.—USNM 145889 IP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 7); this report (pl. 9, fig. 2).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—The flat tapering cusp and triangular shape of the bar distinguish this species from *H. angulata* (Hinde). The posterior side of the cusp is not grooved as in *H. angulata.* The bar in *H. subequalis* is thickest orally and thins aborally. A ridge near the middle of the bar marks the edge of the attachment area. Basal cavity small. Height of holotype, 1.6 mm.

The types and three unfigured specimen from the type series were studied to prepare this description.

Hibbardella sp.

Plate 8, figure 1

1926. *Lonchodina typicalis* Ulrich and Bassler, [part] U.S. Natl. Mus. Proc., v. 68, art. 12, p. 31, pl. 5, fig. 2 [not pl. 5, fig. 1=lectotype of *Lonchodina typicalis* Bassler, 1925].

Hypotype.—USNM 145890 IP, specimen figured by Ulrich and Bassler (1926, pl. 5, fig. 2); this paper (pl. 8, fig. 1).

Locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Remarks.—This specimen, considered by Ulrich and Bassler to be a cotype of *Lonchodina typicalis*, has a posterior bar and a symmetrical anterior arch and therefore belongs in the genus *Hibbardella.* It is most similar to *H. multidens* from which it differs by having flatter bars in the anterior arch, long tapering denticles, and a short tapering cusp. Height, 1.8 mm.

This species is known only from a single specimen. Possibly it is a variant of *Hibbardella subequalis* or *H. multidens*, but too few specimens of the two species are known from the Rhinestreet Shale Member to determine the range of variation of either species.

Genus HINDEODELLA Bassler, 1925

1925. *Hindeodella* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1926. *Hindeodella* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 38–39.

Type species (by original designation).—*Hindeodella subtilis* Bassler, 1925.

Geologic range.—Middle Ordovician to Middle Triassic.

Diagnosis.—A denticulated unit consisting of a long posterior bar, a main cusp, a basal cavity, and a short anterior bar. The bar denticles are closely set and commonly of two sizes with a group of smaller sized denticles separating larger sized ones. Main cusp larger than bar denticles. Basal cavity small.

Remarks.—Species of *Hindeodella* are distinguished on the basis of form of anterior bar, arrangement of denticles, and presence or absence of posterior bar deflections. Most species cannot be determined without nearly complete specimens. Complete specimens are rare in acetic acid residues because the long bars are generally fractured and break into several pieces when the residues are washed and sieved. In shales, also, the majority of specimens are fractured and often lack the anterior bar, and the presence of a posterior deflection cannot be determined. Many specimens are therefore indeterminable, and no species has been described after the study of a large number of whole specimens. The amount of variation in most species is unknown, and the validity of many species referred to *Hindeodella* is in doubt.

Hindeodella alternata Ulrich and Bassler, 1926

Plate 5, figures 1, 3

1926. *Hindeodella alternata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, pl. 1, figs. 14, 15.

Lectotype (here designated).—USNM 11300 VP, specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 14); this report (pl. 5, fig. 1).

Paralectotype.—USNM 145891 IP, specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 15); this report (pl. 5, fig. 3).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Posterior bar long, thick, nearly straight except at the compressed distal end where the bar is slightly deflected downward. Denticles on the posterior bar are of two sizes, closely set, and directed posteriorly. The larger sized denticles are biconvex in horizontal cross section, and pointed. The largest of the posterior denticles are on the posterior deflection. There are two to three smaller denticles between the larger ones. Cusp slightly curved, biconvex in cross section, and pointed. Anterior bar short, strongly curved downward below the bar and inward, bearing four to five denticles similar to the posterior bar denticles in size but rounded and curving inward slightly. Aboral side sharp edged, and basal cavity very small. Distance from tip of anterior bar to tip of posterior bar, 1.69–1.86 mm.

Remarks.—This description is based on the types because only one incomplete specimen was found in the collection Ulrich and Bassler studied. This collection

contains eight specimens of *Hindeodella subtilis*. The strong downward projection of the anterior bar and the increase in size in posterior denticles toward the posterior deflection distinguish *H. alternata* from *H. subtilis*. *H. alternata* differs from *H. subequalis* Ulrich and Bassler, which also occurs in the Rhinestreet Shale Member, by having denticles of two sizes on the posterior bar, a posterior deflection, and the largest denticles on this deflection.

Hindeodella decurrens Ulrich and Bassler, 1926

Plate 5, figure 4

1926. *Hindeodella decurrens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 40, pl. 8, fig. 13.

Holotype (by original designation).—USNM 10987 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 13); this report (pl. 5, fig. 4).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This species is known from a single specimen. The bar is heavy and rounded, and the denticles increase in size toward the posterior end of the bar. The anterior bar is deflected strongly downward and inward. The specimen is similar in these characters to *Hindeodella alternata* Ulrich and Bassler; the specimen may belong in this species but is too incomplete to be certain. This is a nomen dubium.

Hindeodella longidens Ulrich and Bassler, 1926

Plate 5, figure 6

1926. *Hindeodella longidens* Ulrich and Bassler, [part] U.S. Natl. Mus. Proc., v. 68, art. 12, p. 40, pl. 8, fig. 14. [not pl. 8, fig. 15 (USNM 145892 VP) = *Apatognathus*?].

1934. *Hindeodella conidens* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 47, pl. 10, fig. 10.

Lectotype (here designated).—USNM 10988 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 14); this report (pl. 5, fig. 6).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—Posterior bar curved downward, flattened, and thickened above and grooved aborally below cusp. Posterior denticles rounded, gently curved, and increased in size posteriorly. There are no small denticles between the larger ones, and there is no sign of suppressed denticles. The end of posterior bar is missing on the holotype, the only known specimen. Cusp large, rounded, and curved. Anterior bar curved inward and downward, broken; bears at least three denticles.

This species is similar to *H. conidens* Huddle, 1934, and differs chiefly by the absence of smaller denticles between the larger ones on the posterior bar. After reexamination of the types, I think that *H. conidens* is a junior synonym of *H. longidens* because the number of small denticles or suppressed denticles present in *H. conidens* is variable.

The conodont fragment illustrated by Ulrich and Bassler (1926, pl. 8, fig. 15) and by this report (pl. 5, fig. 2) is not a *Hindeodella*. It may belong in *Apatognathus* or *Synprioniodina*.

Hindeodella subequalis Ulrich and Bassler, 1926

Plate 5, figure 9

1926. *Hindeodella subequalis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 41, pl. 4, fig. 21.

Holotype.—USNM 11301 VP, specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 21; this report (pl. 5, fig. 9).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—The posterior bar is straight except adjacent to the main cusp where it is curved downward slightly. In transverse section this bar is slightly higher than wide, especially at the distal end of the unit. The bar denticles are closely set and approximately the same size, except at the distal end of the bar. They are directed posteriorly, pointed, short, biconvex in horizontal section, and as wide as the bar at their base. The main cusp is larger but in other respects similar to the posterior bar denticles. The anterior bar is compressed, curved inward slightly, directed downward below the remainder of the unit. This bar supports four to five denticles; these denticles are quite large and resemble those of the posterior bar. The aboral side tends to be sharp edged except adjacent to the small basal cavity, where it is broader and grooved along the midline of the unit.

The anterior bar of the holotype and only specimen seen has been fractured and flattened so that it appears to lie in the plane of the posterior bar and the main cusp. This species is distinguished from *Hindeodella alternata* by not having denticles of two sizes on the posterior bar and by not having a large denticle at the distal end of the posterior bar.

Hindeodella subtilis Bassler, 1925

Plate 5, figures 5, 7, 8, 10–15

1879. *Polygnathus dubia* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 362–364, pl. 16, figs. 13, 14 [not pl. 16, fig. 17= lectotype of *Polygnathus dubia* nor figs. 6–12, 15, 16, 18 assigned to other genera and species].

1899. *Polygnathus dubius* Hinde. Grabau, Buffalo Soc. Nat. Sci. Bull. 6, p. 153, fig. 34h, i.

1925. *Hindeodella subtilis* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.

1926. *Hindeodella subtilis* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 39, pl. 8, figs. 17–19, p. 16, text fig. 4, no. 3.

1926. *Hindeodella similis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 39, pl. 8, fig. 20.
1926. *Hindeodella recta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 40, pl. 8, fig. 16.
1926. *Hindeodella subtilis* Ulrich and Bassler. Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 161, pl. 48, fig. 14.
1926. *Hindeodella tenerrima* Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 161, pl. 48, fig. 8.
1927. *Hindeodella panderi* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 205, fig. 4g.
1928. *Hindeodella subtilis* Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 25, pl. 9, figs. 10, 11.
1928. *Hindeodella germana* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 25, pl. 9, fig. 9.
1928. *Hindeodella tenerrima* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 25, pl. 9, figs. 6, 7.
1931. *Hindeodella subtilis* Bassler. Cooper, Jour. Paleontology, v. 5, no. 2, p. 147, pl. 20, fig. 9.
1931. *Hindeodella recta* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 5, no. 2, p. 149, pl. 20, fig. 11.
1932. *Hindeodella subtilis* Bassler. Bassler, Tennessee Div. Geology Bull. 38, pl. 26, fig. 21.
1933. *Hindeodella subtilis?* Bassler. Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 142, pl. 10, fig. 12.
1934. *Hindeodella aculeata* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 40, pl. 4, figs. 19–21; pl. 5, figs. 2, 3.
?1934. *Hindeodella gracilis* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 43, pl. 5, fig. 11.
1934. *Hindeodella grandis* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 41, pl. 4, fig. 22.
1934. *Hindeodella panderi* Hibbard. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 45, pl. 5, fig. 17.
1934. *Hindeodella tenerrima* Holmes?. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 46, pl. 5, fig. 18.
?1939. *Hindeodella aculeata* Huddle. Cooper, Jour. Paleontology, v. 13, no. 4, p. 389, pl. 46, fig. 36.
1943. *Hindeodella subtilis* Ulrich and Bassler. Cooper and Sloss, Jour. Paleontology, v. 17, no. 2, pl. 28, figs. 22, 32, 33.
1943. *Hindeodella germana* Holmes. Cooper and Sloss, Jour. Paleontology, v. 17, no. 2, pl. 28, fig. 28.
1943. *Hindeodella aculeata* Huddle. Cooper and Sloss, Jour. Paleontology, v. 17, no. 2, pl. 28, fig. 29.
1943. *Hindeodella grandis* Huddle. Cooper and Sloss, Jour. Paleontology, v. 17, no. 2, pl. 28, figs. 31, 37, 39.
?1945. *Hindeodella aculeata* Huddle. Cooper, Jour. Paleontology, v. 19, no. 6, p. 613, pl. 84, figs. 7, 9.
1945. *Hindeodella rotunda* Hibbard. Cooper, Jour. Paleontology, v. 19, no. 6, p. 615, pl. 84, fig. 8.
1947. *Hindeodella subtilis* Bassler. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 29, pl. 1, fig. 25.
?1947. *Hindeodella aculeata* Huddle. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 29, pl. 1, figs. 19, 21.
1955. *Hindeodella germana* Holmes. Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, pl. 2, fig. 4 (not fig. 5).
1957. *Hindeodella germana* Holmes. Bischoff, Hesse Landesamt Bodenforschung Abh., v. 19, p. 27, pl. 6, figs. 32, 34.
1957. *Hindeodella deflecta* Hibbard. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 7–8, p. 800, pl. 8, fig. 6.
1957. *Hindeodella germana* Holmes. Ziegler, *in* Flügel and Ziegler, Naturw. Ver. Steiermark Mitt., v. 87, p. 41, pl. 5, fig. 16.
1961. *Hindeodella germana* Holmes. Freyer, Freiberger Forschungshefte, C 95, p. 45, pl. 1, figs. 27, 28.
1962. *Hindeodella germana* Holmes. Spasov and Stevanović Annales Geol. Peninsule Balkanique, v. 29, p. 58, pl. 1, fig. 12.
1965. *Hindeodella germana* Holmes. Spasov, Acad. Bulgare Sci., Travaux sur la geologie de Bulgarie—ser. Paleontologie, v. 7, p. 86, pl. 1, fig. 10.

Lectotype (here designated).—USNM 10985 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 17); this report (pl. 5, fig. 7).

Paralectotypes.—USNM 145893 IP and 145894 IP, specimens figured by Ulrich and Bassler (1926, pl. 8, figs. 18, 19); this report (pl. 5, figs. 8 and 5, respectively).

Type locality.—Gassaway Member of the Chattanooga Shale, Quicks Mill, Ala.

Description.—Posterior bar long, thin with the thickest part near the upper edge; bears larger denticles separated by two to four smaller denticles. Anterior bar short, strongly curved inward and projects slightly below the posterior bar, bearing 10–14 denticles of two sizes. Cusp distinct, curved posteriorly and inward slightly, slightly flattened laterally or rounded as are the denticles. Aboral side tends to be sharp edged and thin near the posterior end. Basal cavity not seen.

This description is based on a study of the primary types, Holmes' (1928) hypotypes, and 38 specimens in the collection Holmes studied. Eight specimens of *Hindeodella subtilis* were identified in the Ulrich and Bassler study material from the Rhinestreet Shale Member at Weyer, N.Y.

Hindeodella germana Holmes agrees well with her hypotypes of *H. subtilis* and other specimens from the Chattanooga Shale and the holotype. I have examined the type of *H. panderi* Hibbard and regard it as a junior synonym of *H. subtilis*. After reexamination of the types of *H. aculeata* Huddle and the additional specimens in the Indiana University Collection and in my own 1932 collection, I am convinced that *H. aculeata* is a junior synonym. *Hindeodella grandis* Huddle is merely a large specimen, possibly gerontic, of *H. subtilis* and is similar to specimens found in the Holmes collection from the Chattanooga Shale. *Hindeodella gracilis* Huddle may be a junior subjective synonym of *H. subtilis* but seems to have the anterior bar less incurved, and most specimens are smaller than the specimens of *H. subtilis* in the upper part of the New Albany Shale and Chattanooga Shale. *H. recta* Ulrich and Bassler is a fragment of the posterior bar of a *Hindeodella*, probably *H. subtilis*, but not enough is present to make a specific identification. *H. tenerrima* Holmes also appears to be a junior subjective synonym of *H. subtilis*. The specimen figured by Holmes (1928, pl. 9,

fig. 6) falls within the range of variation of *H. subtilis*. Another specimen figured by Holmes (1928, pl. 9, fig. 7) is too incomplete for identification.

Occurrence.—Mississippian, pre-Welden shale of Cooper (1939), Oklahoma; Sunbury Shale, Ohio; Germany, Mississippian(?): "Hardin sandstone," Tennessee, probably reworked. Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; New Albany Shale, Indiana; Gassaway Member of the Chattanooga Shale, Tennessee, Alabama; Ohio Shale, Ohio; lower part of Woodford Shale, Oklahoma; Upper Devonian, Germany, France, and Serbia.

Genus LIGONODINA Bassler, 1925

1925. *Ligonodina* Bassler, Geol. Soc. America Bull., v. 36, p. 218.
1926. *Ligonodina* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 12–13.
1931. *Hamulosodina* Cooper, Jour. Paleontology, v. 5, no. 3, p. 239.
1933. *Idioprioniodus* Gunnell, Jour. Paleontology, v. 7, no. 3, p. 265.
1939. *Neocordylodus* Cooper, Jour. Paleontology, v. 13, no. 4, p. 396.
1962. *Ligonodina* Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W50.
1964. *Ligonodina* Bassler. Lindström, Conodonts, p. 150.

Type species (by original designation).—*Ligonodina pectinata* Bassler, 1925.

Geologic range.—Middle Ordovician to Middle Triassic.

Diagnosis.—A pick-shaped conodont with a large cusp and denticulated posterior bar and anticusp. The denticles on the anticusp point inward about at right angles to the plane of the bar and cusp. Basal cavity a small pit beneath the cusp. Aboral side of the posterior bar and anticusp usually grooved along the midline.

Remarks.—Ulrich and Bassler (1926, p. 12) thought that *Ligonodina* had a row of suckerlike impressions on the inside of the anticusp. As pointed out by Cooper (1933, p. 210), these "suckerlike impressions" are broken denticles. The material Ulrich and Bassler studied is fragmentary, and the stumps of broken denticles on the anticusp look like "suckerlike impressions" under a hand lens.

Ligonodina and *Synprioniodina* differ in the orientation of the denticles on the anticusp. *Zygognathus* differs by having a large thin-walled basal cavity, by the twisting of the whole unit, and by the lightness of the bars. *Eoligonodina* Branson, Mehl, and Branson, 1951, probably includes some species belonging in *Zygognathus* and others that could be referred to *Ligonodina*.

Ligonodina? gracilis (Ulrich and Bassler), 1926

Plate 9, figure 6

1926. *Prioniodella gracilis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 20, pl. 10, fig. 22 (the specimen shown in fig. 23 is missing).
1932. *Prioniodella gracilis* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 12.

Lectotype (here designated).—USNM 10992 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 22); this report (pl. 9, fig. 6). The other specimen is lost.

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This bar fragment looks like a piece of a *Ligonodina*, but the genus and the species are not determinable. The name is a nomen dubium.

Ligonodina magnidens Ulrich and Bassler, 1926

Plate 9, figure 8; plate 10, figures 9, 12, 14–16; plate 11, figures 1–4

1926. *Ligonodina magnidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 12, pl. 2, figs. 5, 6.
1926. *Ligonodina deflecta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 13, pl. 2, figs. 3, 4.
1926. *Euprioniodina bryanti* Ulrich and Bassler, [part] U.S. Natl. Mus. Proc., v. 68, art. 12, p. 29, pl. 1, fig. 21 [not pl. 3, figs. 13, 14=*Euprioniodina deflecta* Bassler, 1925].
1926. *Lonchodina? increbescens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 35, pl. 3, figs. 15, 16; pl. 5, fig. 20.
1926. *Lonchodina? prona* Ulrich and Bassler, [part] U.S. Natl. Mus. Proc., v. 68, art. 12, p. 36, pl. 5, fig. 16=lectotype, here designated. [not pl. 5, fig. 17=*Lonchodina arcuata* Ulrich and Bassler, 1926].
1927. *Euprioniodina bassleri* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 201, fig. 4i.
1927. *Euprioniodina devonica* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 203, fig. 4h.
1927. *Prioniodus spicatus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 195, figs. 2a, 2b. [not *Prioniodus spicatus* Hinde, 1879].
1927. *Prioniodus shaletonensis* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 195, fig. 2e.
1927. *Ligonodina triangulata* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 201, fig. 3e.
1927. *Ligonodina seducta* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 199, fig. 3f.
1927. *Prioniodus abnormis* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 197, fig. 1c. [not *Ligonodina abnormis* Branson and Mehl, 1934 [1933c], a junior synonym].
?1947. *Ligonodina magnidens* Ulrich and Bassler?. Youngquist, Jour. Paleontology, v. 21, no. 2, p. 104, pl. 26, fig. 17.
1948. *Ligonodina abnormis* (Hibbard). Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 54, pl. 14, figs. 11, 12. [not fig. 7=*Ligonodina spicata* (Hinde)].

Lectotype (here designated).—USNM 11248 VP, specimen figured by Ulrich and Bassler (1926, pl. 2, fig. 5); this report (pl. 10, fig. 14).

Paralectotype.—USNM 145902 IP, specimen figured by Ulrich and Bassler (1926, pl. 2, fig. 6); this report (pl. 10, fig. 12).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Posterior bar massive, not bent laterally, arched slightly or deflected downward near the posterior end, triangular in cross-section, broad orally, and tapering aborally with attachment scars on lower half. Denticles discrete, closely spaced, irregular in size, with the largest near the posterior deflection. Cusp slender, with slight groove and ridge on the anterior inside edge, rounded on the outside. Anticusp at right angles to the posterior bar, bearing four to five thick rounded denticles in a plane at right angles to the plane of the bar and cusp. Basal cavity a small pit.

Ligonodina magnidens is more massive than *L. pectinata* or *L. panderi*, and its denticles are irregular in size, heavier, thicker at the base, and taper to a point more rapidly. The anticusp in *L. magnidens* points straight downward rather than curving rearward as in *L. panderi* and *L. pectinata*. *Euprioniodina bassleri* Hibbard is a freak specimen with a double cusp.

The description is based on a study of the types and 28 unfigured paratypes. Hibbard's (1927) types and those of Youngquist, Hibbard, and Reimann (1948) were also examined.

Occurrence.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; Iowa?.

Ligonodina panderi (Hinde), 1879

Plate 9, figure 11; plate 10, figures 1–8, 11

1879. *Prioniodus panderi* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 361, pl. 16, fig. 4.
1926. *Ligonodina panderi* (Hinde). Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 13, pl. 2, figs. 1, 2.
1926. *Ligonodina hindei* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 14, pl. 2, figs. 14–16.
1926. *Ligonodina hibbardi* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 14, pl. 2, figs. 7, 8.
1926. *Ligonodina falciformis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 14, pl. 2, figs. 11–13. Lectotype, here designated: The specimen figured by Ulrich and Bassler (1926, pl. 2, fig. 11) = USNM 11249 VP.
1927. *Prioniodus obsoletus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 199, fig. 2d.
1927. *Prioniodus grandis* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 191, fig. 1h.
1927. *Prioniodus irregularis* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 196, fig. 1b.
1927. *Prioniodus mundus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 193, figs. 1e, f.
1927. *Prioniodus patulus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 193, fig. 2f.
1927. *Prioniodus curtus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 196, fig. 3g.
1927. *Prioniodus permagnus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 196, fig. 1g.
1927. *Prioniodus pingus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 193, fig. 2c.
1934. *Ligonodina hindei* Ulrich and Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 60, pl. 7, figs. 13, 22; pl. 12, figs. 13, 14; text fig. 3, no. 5.
1934. *Ligonodina pingus* Hibbard?. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 61, pl. 7, fig. 14.
?1938. *Ligonodina* sp. cf. *L. hindei* Ulrich and Bassler. Stauffer, Jour. Paleontology, v. 12, no. 5, p. 431, pl. 51, fig. 9.
1948. *Ligonodina munda* (Hibbard). Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 55, pl. 14, fig. 9.
1955. *Ligonodina falciformis* Ulrich and Bassler. Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 130, pl. 5, figs. 9, 10; pl. 6, fig. 20.
1956. *Ligonodina falciformis* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung, Notizblatt, v. 84, p. 126, pl. 9, fig. 34.
1957. *Ligonodina hindei*? Ulrich and Bassler. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 7–8, p. 801–802, pl. 10, fig. 1.
1957. *Ligonodina falciformis* Ulrich and Bassler. Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Abh., v. 22, p. 65, pl. 11, figs. 1, 2, 6.
1961. *Ligonodina falciformis* Ulrich and Bassler. Freyer, Freiberger Forschungshefte, C 95, p. 50, pl. 2, fig. 38.

Holotype (only original specimen).—Hinde (1879, pl. 16, fig. 4).

Type locality.—Kettle Point, Ontario.

Description.—Bar heavy, rounded, with a flat base grooved along the midline. Denticles rounded and inclined toward the posterior end of the bar, usually 10 or fewer in number. Cusp large, curved toward the rear, rounded, or with a ridge and a groove along the inside anterior edge. Anticusp heavy, not offset, strongly curved backward under the posterior bar, grooved on the outside and bearing four to five denticles on the inside. Basal cavity a small pit.

This species is similar to *L. pectinata*. It differs by having the massive bar, by having the strong backward inclination of the cusp and denticles, and by having fewer denticles.

The type of *L. panderi* (Hinde) was not found in British Museum, according to Branson and Mehl (1933a, p. 139), and may be lost. Nevertheless, the original figure of the holotype (Hinde, 1879, pl. 16, fig. 4) clearly shows the massive bar and inclination of the denticles and cusp. I think that there is little doubt that *L. hindei*, *L. hibbardi*, and *L. falciformis* are junior subjective synonyms of *L. panderi*. Some are young specimens, and others show the range of variation. Eight of the species described by Hibbard are also junior synonyms.

The description was based on the figured hypotypes and 26 unfigured specimens in the Ulrich and Bassler

collection. Hibbard's 1927 types and my 1934 types were also examined.

Occurrence.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; Olentangy Shale, Ohio; New Albany Shale, Indiana; Frasnian, France; Eifelian to Upper Famennian, Germany.

Ligonodina pectinata Bassler, 1925

Plate 10, figures 10, 13, 17

1925. *Ligonodina pectinata* Bassler, Geol. Soc. America Bull., v. 36, p. 218.
1926. *Ligonodina pectinata* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 13, pl. 2, figs. 9, 10.
1927. *Prioniodus sublimus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 191, fig. 1a.
1927. *Prioniodus expolitus* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 197, fig. 1d.
1927. *Ligonodina curvidens* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 199–200, fig. 2h.
1927. *Ligonodina princeps* Hinde. Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 200, fig. 3b, c. [not *L. princeps* (Hinde), 1879].
1927. *Ligonodina nitida* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 201, fig. 2j.
1948. *Ligonodina pectinata* Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 55, pl. 14, fig. 8.
1948. *Ligonodina munda* (Hibbard). Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 55, pl. 14, fig. 9.

Lectotype (here designated).—USNM 11245 VP, specimen figured by Ulrich and Bassler (1926, pl. 2, fig. 10); this report (pl. 10, fig. 10).

Paralectotype.—USNM 145900 IP, specimen figured by Ulrich and Bassler (1926, pl. 2, fig. 9); this report (pl. 10, fig. 13); USNM 145901 IP, previously unfigured paralectotype (this report, pl. 10, fig. 17).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Posterior bar nearly straight (not arched), with 10–15 long slender nearly erect denticles that are closely spaced and rounded. Posterior tip of the bar flexed inward on some specimens. Cusp long, slender, curved backward, twisted in some specimens, rounded or with a groove and ridge along the inner anterior edge. Anticusp short, not offset, with four to five discrete denticles curved inward and upward. Aboral side of bar flat, grooved along the midline. Basal cavity a small pit.

Ligonodina pectinata is less massive and has more numerous closely spaced slender denticles than *L. magnidens* and *L. panderi*, the two species with which it is associated in the Ulrich and Bassler (1926) collections. The species described by Hibbard, here regarded as junior subjective synonyms of *L. panderi*, came from the same locality as the specimens described by Ulrich and Bassler.

L. pectinata is less common than *L. panderi* and, unlike *L. panderi*, has never been reported from any locality other than the type locality. There seems to be a gradation between the two species, and perhaps they are synonyms. However, the end members of the series are quite distinct, and most specimens can be assigned to one species or the other without question on the basis of a combination of characters. I prefer to recognize two species for the present.

This description is based on the figured types, nine unfigured specimens in the material Ulrich and Bassler studied, and a comparison with the specimens figured by Hibbard (1927) and Youngquist, Hibbard, and Reimann (1948).

Ligonodina peculiaris (Ulrich and Bassler), 1926

Plate 9, figure 5

1926. *Euprioniodina peculiaris* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 30, pl. 10, fig. 3.

Holotype (by original designation).—USNM 11017 VP, this report (pl. 9, fig. 5).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This species is known from a single specimen, probably a large gerontic one. The bar is heavy, slightly bowed, triangular, and keeled along the edge of the attachment scar on the outside (inside not seen). Posterior end of bar deflected downward. Anticusp large with eight denticles and prominent attachment scar. Cusp and denticles flattened and sharp edged. Basal cavity not exposed.

Ligonodina proclinis (Ulrich and Bassler), 1926

Plate 8, figures 4, 5; plate 9, figure 7

1926. *Prioniodus proclinis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 9, pl. 9, figs. 8–10.

Holotype (by original designation on explanation for plate 9 of Ulrich and Bassler, 1926).—USNM 11031 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 8); this report (pl. 9, fig. 7).

Paratypes.—USNM 145907 IP, 145908 IP, specimens figured by Ulrich and Bassler (1926, pl. 9, figs. 9 and 10, respectively); this report (pl. 8, figs. 5 and 4, respectively).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.— Only end views of all the types of this species are exposed. They represent one or more species of *Ligonodina*. The fragments are not large enough to characterize the species, and the name is applicable only to the types. This is a nomen dubium.

Ligonodina rectus (Ulrich and Bassler), 1926

Plate 9, figure 4

1926. *Distacodus rectus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 6–7, pl. 9, fig. 22.

Holotype.—USNM 10982 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 22); this report (pl. 9, fig. 4).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype is a broken cusp and anticusp of a *Ligonodina*. A stub of the posterior bar is present. The species is indeterminate, and the name is a nomen dubium.

Ligonodina reversa (Ulrich and Bassler), 1926

Plate 9, figure 9

1926. *Prioniodus reversus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 10, pl. 9, fig. 4.

Holotype (by original designation).—USNM 11037 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 4); this report (pl. 9, fig. 9).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The type is a fragment of a species of *Ligonodina* consisting of the cusp, anticusp, and part of the posterior bar, including the base of one denticle. Only the outside of the specimen can be seen, and the species cannot be adequately described. Possibly it is a junior subjective synonym of *L. panderi* (Hinde), 1879. The name is a nomen dubium.

Ligonodina? simplex Ulrich and Bassler, 1926

Plate 8, figure 6

1926. *Ligonodina simplex* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 15, pl. 9, fig. 28.

Holotype.—USNM 10983 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 28); this report (pl. 8, fig. 6).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This specimen is a fragment of a conodont cusp probably from a species of *Ligonodina*. The name is applicable only to the type because the genus and species of the specimen are not determinable.

Ligonodina spiculata (Ulrich and Bassler), 1926

Plate 9, figure 10

1926. *Prioniodus spiculatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 9, pl. 9, figs. 2, 3.

1932. *Prioniodus spiculatus* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 1.

Lectotype (here designated).—USNM 11035 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 3); this report (pl. 9, fig. 10). The specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 2) is lost.

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The lectotype and only remaining specimen of this species has a broken cusp and has lost the posterior end of the bar. Cusp narrow and curved backward; base is continuous with the anticusp. Anticusp long, perpendicular to posterior bar, with six denticles not offset on the outside. Posterior bar slender, rimmed along the aboral edge, and flat on the base. The five bar denticles preserved are erect, widely spaced, and slender. Basal cavity a small pit beneath cusp.

Genus LONCHODINA Bassler, 1925

1925. *Lonchodina* Bassler, Geol. Soc. America Bull., v. 36, p. 219.

1926. *Lonchodina* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 30–31.

1962. *Lonchodina* Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W53.

Type species (by original designation).—*Lonchodina typicalis* Bassler, 1925.

Geologic range.—Silurian to Triassic.

Diagnosis.—Bar thick, rounded, or triangular in cross section with wide attachment area; basal side grooved in many species; basal cavity a small pit. Cusp in the central third of the bar or indistinguishable. Denticles rounded or flattened, generally discrete, and widely spaced. The bar is arched upward, laterally bowed, or with sharp inward flexure. Generally nonsymmetrical.

Remarks.—The genus is characterized by the lateral bowing of the bar or sharp inward flexure, the irregularity of arrangement of large and small denticles, and the general lack of symmetry. It is most similar to *Prioniodina*, which is more regular and symmetrical and lacks the strong inward bowing of the bar. These two genera have been accepted as valid by authors since 1926, but some species are difficult to assign. If the bar and denticle arrangement is symmetrical and there is no sharp flexure or lateral bowing, I assign the species to *Prioniodina*. If the bar and denticle arrangement is nonsymmetrical and strongly bowed inward or if there is no distinct cusp, I would assign the species to *Lonchodina*. The cusp is often twisted in *Lonchodina*.

Lonchodina arcuata Ulrich and Bassler, 1926

Plate 11, figures 5–13

1926. *Lonchodina arcuata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 32, pl. 5, fig. 15.

1926. *Lonchodina subangulata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 32–33, pl. 5, fig. 3.

1926. *Lonchodina paucidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 34, pl. 6, fig. 1.
1926. *Lonchodina? projecta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 35, pl. 5, figs. 9–10.
1926. *Lonchodina? prona* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 36, pl. 5, fig. 17 [not pl. 5, fig. 16 = *Ligonodina magnidens*].
1926. *Lonchodina discreta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, p. 36, pl. 10, figs. 1, 2.
1928. *Lonchodina discreta* Ulrich and Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 26, pl. 9, fig. 13.
1932. *Lonchodina discreta* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 6.
1934. *Prioniodina curvata* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 214, pl. 14, fig. 17 [1933b].
1934. *Lonchodina pulchra* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 211, pl. 15, fig. 16 [1933b].
1934. *Lonchodina separata* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 211, pl. 15, figs. 14, 15 [1933b].
1934. *Lonchodina nitela* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 82, pl. 6, figs. 3–6.
1934. *Lonchodina? projecta* Ulrich and Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 83–84, pl. 6, fig. 10 [not pl. 11, fig. 1 = *Lonchodina typicalis* Ulrich and Bassler].
1934. *Lonchodina prava* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 86, pl. 10, fig. 10.
1956. *Lonchodina curvata* (Branson and Mehl). Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Notizblatt, v. 84, p. 150, pl. 14, fig. 21.
1957. *Lonchodina curvata* (Branson and Mehl). Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Abh., v. 22, p. 67, pl. 10, figs. 10a, b.
1957. *Lonchodina curvata* (Branson and Mehl). Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 7–8, p. 802, pl. 10, fig. 3.
1957. *Lonchodina discreta* Ulrich and Bassler. Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Abh., v. 22, p. 67–68, pl. 10, figs. 9a, b, 11, 12, 13.
1962. *Lonchodina arcuata* Ulrich and Bassler. Ethington and Furnish, Jour. Paleontology, v. 36, no. 6, p. 1272–1273, pl. 173, fig. 9.

Holotype (by original designation).—USNM 11279 VP, specimen figured by Ulrich and Bassler (1926, pl. 5, fig. 15); this report (pl. 11, fig. 5).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar heavy, thickest above, thins below and toward the ends; base wide and flat near center of bar, strongly arched, slightly bowed; anterior and posterior bars slightly twisted inward at tips. Cusp and denticles oval in cross section and become sharp edged in mature specimens. Cusp wider and longer than adjacent denticles and twisted so that the flat side of the cusp is at an angle to the plane of the bar. Anterior bar has 5–10 denticles spaced about one-half the width of the denticle apart, and the posterior bar has 5–7 denticles. Anterior denticles curved posteriorly, discrete, decreasing in size toward the ends of the bar; posterior denticles erect or curved posteriorly and discrete. Attachment scars on base and sides of the bar near the ends. Basal cavity a deep elongate pit. Length of the unit ranges from 0.8 to 1.9 mm. The anterior bar is longer than the posterior bar. The distance from the tip of the cusp to a line between the ends of the bar ranges from 0.8 to 1.4 + mm.

This species is quite variable in the lateral bowing, in the twisting of the bar and cusp and in the amount of arching, and in the number of denticles. The description is based on the examination of the types of the species described by Ulrich and Bassler (1926), Holmes (1928), and Huddle (1934) here assigned to junior subjective synonymy and five unfigured paratypes. The species is placed in *Lonchodina* because of the tendency of the cusp and bar to twist and because of the offset of the bar in some specimens. It could with some justification be placed in *Prioniodina*. The species is characterized by strong arching, slight twisting, and a short posterior bar. It is easily confused with species of *Prioniodina* and *Lonchodina* which have been described, and future work may place many of these species in synonomy. Other species listed as junior subjective synonyms were assigned on basis of published illustrations, descriptions, and assignment by original authors.

Occurrence.—Mississippian?: "Hardin sandstone," Tennessee. Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; New Albany Shale, Indiana; Gassaway Member of the Chattanooga Shale, Alabama and Tennessee; Grassy Creek Shale, Missouri; Frasnian, France; Eifelian, Germany; Spanish Sahara, Africa.

Lonchodina perlonga Ulrich and Bassler, 1926

Plate 12, figures 1–3

1926. *Lonchodina perlonga* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art, 12, p. 32, pl. 5 figs. 6, 7.
1926. *Lonchodina delicatula* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 33, pl. 5, fig. 11.
1964. *Oulodus perlonga* (Ulrich and Bassler). Lindström, Conodonts, p. 153.

Lectotype (here designated).—USNM 11281 VP, specimen figured by Ulrich and Bassler (1926, pl. 5, fig. 6); this report (pl. 12, fig. 1).

Paralectotype.—USNM 145912 IP, specimen figured by Ulrich and Bassler (1926, pl. 5, fig. 7); this report (pl. 12, fig. 2).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar slender, slightly to moderately arched and laterally offset at the cusp and not bowed laterally. Base of bar flat and grooved. Cusp prominent, two to three times as thick as the denticles, and strongly twisted at offset in bar. Denticles slightly shorter than cusp, generally curved toward the cusp, and long and

slender. Four to five denticles on the anterior bar and six to eight on the posterior bar. Length of bar, 1.4–1.7 mm. Anterior bar slightly shorter than posterior bar. Height from line through tips of bars to tip of cusp, 1.4–1.9 mm.

The distinguishing features of this species are the sharp bar offset, the long slender denticles, the nearly equal bars, and the low arching of the bars. The description is based on the types and five unfigured paratypes. The denticles of *Lonchodina delicatula* Ulrich and Bassler are shorter than those of the types of *L. perlonga*, but the difference is not considered significant.

Lindström (1964, p. 153) referred *L. perlonga* Ulrich and Bassler to the genus *Oulodus*. The denticles on the anterior and posterior bars are in parallel planes, and the bar is not twisted at the offset. In typical species of *Oulodus*, the bar is twisted, and the anterior and posterior denticles lie in planes that intersect. *L. perlonga* is more similar to other species of *Lonchodina* than it is to species assigned to *Oulodus* and is therefore placed in *Lonchodina*.

Lonchodina subsymmetrica Ulrich and Bassler, 1926

Plate 12, figures 4–13

1926. *Lonchodina subsymmetrica* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 34, pl. 1, fig. 24; pl. 5, fig. 8; pl. 6, figs. 6–7.
1926. *Lonchodina abnormis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 34, pl. 6, figs. 8–10.
1926. *Lonchodina separata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 31, pl. 5, fig. 12.
1926. *Bryantodus curvatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 26, pl. 4, fig. 19 [not pl. 4, fig. 20=*Bryantodus typicus* Ulrich and Bassler].
1934. *Lonchodina subsymmetrica* Ulrich and Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 87, pl. 10, fig. 2.
1948. *Lonchodina ungula* Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 56, pl. 14, fig. 3.
?1955. *Lonchodina subsymmetrica* Ulrich and Bassler. Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 132, pl. 6, fig. 8.
1957. *Lonchodina subsymmetrica* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung, Abh., v. 19, p. 35, pl. 1, figs. 17, 19, 21, 22.
1961. *Lonchodina subsymmetrica* Ulrich and Bassler. Freyer, Freiberger Fortschungshefte, C 95, p. 54, fig. 53.

Lectotype (here designated).—USNM 11287 VP, specimen figured by Ulrich and Bassler (1926, pl. 6, fig. 6); this report (pl. 12, fig. 4).

Paralectotypes.—USNM 145960 IP, 145914 IP, 145915 IP, 145916 IP, specimens figured by Ulrich and Bassler (1926, pl. 1, fig. 24; pl. 5, fig. 8; pl. 6, fig. 5; and pl. 6, fig. 7, respectively); this report (pl. 12, figs. 9, 10, 6, and 5, respectively).

Type locality.—Rhinestreet Shale Member of the West Falls Formation at Weyer, N.Y.

Description.—Bar slender, rounded, about as thick as the base of the denticles, and flattened on base with groove along midline of the basal attachment area. Bar gently arched upward and laterally bowed. Anterior and posterior bar not in the same plane, and the end of the posterior bar is incurved. Base of the cusp has a prominent boss. Cusp and denticles rounded, pointed, and slender; four to eight denticles on the anterior bar and two to six on the posterior bar. Length, 1.1–1.6 mm. Height from tips of bar to tip of the cusp, 1.0–1.5 mm; length of the posterior bar, 0.4–0.5 mm; anterior bar, 0.7–1.0 mm.

This description is based on the examination of the figured types, 11 unfigured paratypes in the Ulrich and Bassler collection, and the hypotypes from the New Albany Shale (Huddle, 1934). The figured and unfigured types of *L. abnormis* Ulrich and Bassler have fewer denticles and are straighter and smaller than the figured types of *L. subsymmetrica*. The prominent boss at the base of the cusp is present, and the offset of the bars is similar; I place *L. abnormis* as a junior subjective synonym. The type of *L. separata* after preparation by Hass clearly belongs in *L. subsymmetrica*. The specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 19) as *Bryantodus curvatus* lacks the offset of the bar but is similar in general appearance and has a boss at the base of the cusp. It is regarded as atypical but falls within the range of variation of *L. subsymmetrica*. *L. ungula* is regarded as a junior synonym after examination of the type. It comes from the same locality and stratigraphic horizon as the types of *L. subsymmetrica*.

Occurrence.—Upper Devonian and Mississippian: Rhinestreet Shale Member of the West Falls Formation, New York; New Albany Shale, Indiana; Famennian to Unterkarbon (*to* IIα–*Cu* IIγ), Germany.

Lonchodina typicalis Bassler, 1925

Plate 12, figures 14–22

1925. *Lonchodina typicalis* Bassler, Geol. Soc. America Bull., v. 36, p. 219.
1926. *Lonchodina typicalis* [part] Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 31, pl. 5, fig. 1 [not pl. 5, fig. 2=*Hibbardella* species].
1926. *Lonchodina rectidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 31–32, pl. 5, fig. 14 [not pl. 5, fig. 13=*Hibbardella subequalis* Ulrich and Bassler, 1926].
1926. *Lonchodina bilateralis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 32, pl. 5, fig. 18.
1926. *Lonchodina subrecta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 33, pl. 5, figs. 4–5.
1926. *Lonchodina perarcuata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 33–34, pl. 5, fig. 19.

1926. *Lonchodina alternata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 35, pl. 6, fig. 4.
1926. *Lonchodina geniculata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 36, pl. 4, fig. 15.
?1926. *Lonchodina irregularis* Holmes, *in* Butts, Alabama Geol. Survey, Spec. Rept. 14, p. 160, pl. 48, fig. 9.
1927. *Lonchodina multidens* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 203, fig. 3i.
?1927. *Lonchodina bidens* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 204, fig. 3a.
1927. *Lonchodina extenta* Hibbard, Am. Jour. Sci., 5th ser., v. 13, no. 75, p. 204, fig. 3d.
?1928. *Lonchodina irregularis* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 26, pl. 9, fig. 12. [Perhaps an *Angulodus*].
1934. *Lonchodina tenuis* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 85, pl. 6, fig. 17.
1934. *Lonchodina multidens* Hibbard. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 82–83, pl. 6, fig. 8.
1934. *Lonchodina? projecta* Ulrich and Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 83–84, pl. 11, fig. 1. [not pl. 6, fig. 10=*Lonchodina arcuata* Ulrich and Bassler].
1947. *Lonchodina multidens* Hibbard. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 31, pl. 2, fig. 3.
1947. *Lonchodina perarcuata* Ulrich and Bassler. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 31, pl. 2, fig. 2.
1947. *Lonchodina* aff. *L. rectidens* Ulrich and Bassler. Miller and Youngquist, Jour. Paleontology, v. 21, no. 6, p. 511, pl. 72, fig. 12.
1948. *Lonchodina subrecta* Ulrich and Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 56, pl. 14, figs. 2, 4.
1948. *Lonchodina bilateralis* Ulrich and Bassler. Youngquist and Miller, Jour. Paleontology, v. 22, no. 4, p. 446, pl. 68, fig. 2.
1948. *Lonchodina pectinella* Youngquist, Hibbard and Reimann, Jour. Paleontology, v. 22, no. 1, p. 55, pl. 14, fig. 14.
1957. *Lonchodina multidens* Hibbard. Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Abh., v. 22, p. 68, pl. 20, fig. 18.
1957. *Lonchodina tenuis* Huddle. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 10, p. 1046, pl. 4, fig. 3.
1957. *Lonchodina* sp. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 10, p. 1046, pl. 4, fig. 4.
1959. *Lonchodina multidens* Hibbard. Helms, Geologie, v. 8, no. 6, p. 643, pl. 1, figs. 13, 14; pl. 4, fig. 16.

Lectotype (here designated).—USNM 11276 VP, specimen figured by Ulrich and Bassler (1926, pl. 5, fig. 1); this report (pl. 12, fig. 20).

Type locality.—Rhinestreet Shale Member of the West Falls Formation at Weyer, N.Y.

Description.—Bar heavy, bowed and arched, thickened above, tapering below, with wide lateral attachment area on large specimens. Posterior bar shorter than anterior, even when the number of denticles is the same. Cusp at the apex of arch and bow generally larger than the other denticles. Cusp and denticles rounded to oval in cross section. Five to seven posterior denticles, and one or two of them are nearly as large or larger than the cusp. Anterior bar strongly curved downward, greater than 180° in some specimens, and has five to eight denticles. Aboral edge sharp. Basal cavity not seen.

This description is based on examination of the figured types and seven unfigured paratypes. The distinguishing features of the species are the large denticles on the posterior bar and the strong arching. The species of *Lonchodina* described by Ulrich and Bassler here regarded as junior subjective synonyms of *Lonchodina typicalis* all come from the same collection and together with the unfigured paratypes establish the range of variation of the species. The specimens I figured in 1934 of *Lonchodina multidens* Hibbard and *Lonchodina tenuis* are right and left forms occurring close together on the same slab. They may have come from the same animal, but *L. tenuis* is smaller and probably younger than the *L. multidens*. I examined the type of *L. irregularis* Holmes and think it may belong in *Angulodus*, but it is similar in shape to *L. typicalis*. The types of *L. multidens* Hibbard and *L. bidens* Hibbard come from the same stratigraphic horizon and same locality as *L. typicalis*. After seeing Hibbard's types I feel sure that *L. multidens* is a junior synonym of *L. typicalis*. *L. bidens* has a split cusp and is not completely exposed. It is questionably referred to *L. typicalis* because the bar and denticles are flatter than in typical examples of *L. typicalis*. *L. geniculata* is arched and flat and lacks the prominent denticles on posterior bar. The type specimen might be referred to *L. typicalis*, as I have here, or to *L. arcuata*. It is represented by a single specimen and probably is not a separate species.

Occurrence.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; Ohio Shale, Ohio; New Albany Shale, Indiana; Sweetland Creek Shale, Iowa; Givetian to *Manticoceras*-Stufe, Germany; Frasnian, Sahara, West Africa.

Genus NEOPRIONIODUS Rhodes and Müller, 1956

1926. *Prioniodus* Pander. Ulrich and Bassler [not Pander, 1856], U.S. Natl. Mus. Proc., v. 68, art. 12, p. 8–9.
1933. *Prioniodus* Pander. Branson and Mehl [not Pander, 1856], Missouri Univ. Studies, v. 8, no. 2, p. 129–130.
1956. *Neoprioniodus* Rhodes and Müller, Jour. Paleontology, v. 30, no. 3, p. 698–699.
1964. *Neoprioniodus* Rhodes and Müller. Rexroad and Furnish, Jour. Paleontology, v. 38, no. 4, p. 673–674.
1964. *Neoprioniodus* Rhodes and Müller. Lindström, Conodonts, p. 149.

Type species (by original designation).—*Prioniodus conjunctus* Gunnell.

Geologic range.—Early Silurian to Middle Permian.

Diagnosis.—Posterior bar straight or arched; cusp and anticusp terminal, with basal cavity beneath cusp. Denticles in posterior bar discrete or fused. Anticusp not denticulated in most species, but some species have

a few denticles, and diffuse white matter may be present.

Remarks.—This genus is distinguished from *Synprioniodina* by its nondenticulated cusp.

Neoprioniodus alatus (Hinde), 1879

Plate 6, figures 1, 2

1879. *Prioniodus*? *alatus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 361, pl. 16, fig. 5.

not 1913. *Prioniodus alatus* Hadding, Lunds Univ. Årssk., N. F. Afd. 2, v. 9, no. 15, p. 32, pl. 1, figs. 9, 10. This is a junior homonym and needs a new name.

1921. *Prioniodus alatus* Hinde. Bryant, Buffalo Soc. Nat. Sci., v. 13, no. 2, p. 15, pl. 4, figs. 1–7.

1926. *Prioniodus alatus* Hinde. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 11, pl. 1, figs. 25, 26.

1933. *Prioniodus alatus* Hinde. Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 134, pl. 11, fig. 13.

1934. *Prioniodus confluens* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 206, pl. 15, figs. 6, 7 [1933b].

1934. *Prioniodus mutabilis* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 207, pl. 15, figs. 1, 2 [1933b].

1934. *Prioniodus alatus* Hinde. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 37, figs. 1–3.

1939. *Prioniodus alatus* Hinde. Cooper, Jour. Paleontology, v. 13, no. 4, 404, pl. 45, fig. 55; pl. 46, figs. 6, 8.

1947. *Prioniodus alatus* Hinde. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 35, pl. 1, fig. 9.

1947. *Prioniodus alatus* Hinde. Youngquist, Jour. Paleontology, v. 21, no. 2, p. 111, pl. 26, fig. 11.

1948. *Prioniodus alatus* Hinde. Youngquist and Miller, Jour. Paleontology, v. 22, no. 4, p. 449, pl. 67, figs. 1, 2.

1948. *Prioniodus alatus* Hinde. Youngquist, Hibbard, and Reinmann, Jour. Paleontology, v. 22, no. 1, p. 58, pl. 14, figs. 15, 16.

1948. *Euprioniodina magnidens* Youngquist, Hibbard and Reiman, Jour. Paleontology, v. 22, no. 1, p. 52, pl. 14, fig. 13.

1955. *Prioniodina alata* (Hinde). Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 151, pl. 3, figs. 5, 6.

1956. *Prioniodina alata* (Hinde). Bischoff, Hesse, Landesamt Bodenforschung, Notizblatt, v. 84, p. 134, pl. 10, figs. 26–28.

1956. *Prioniodus alatus* Hinde. Hass, U.S. Geol. Survey Prof. Paper 286, pl. 4, fig. 24.

1957. *Prioniodina alata* (Hinde). Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Abh., v. 22, p. 104, pl. 9, fig. 7a, b; pl. 21, figs. 20, 22, 24.

1957. *Neoprioniodus alatus* (Hinde). Hass *in* Cloud, Barnes, and Hass, Geol. Soc. America Bull., v. 68, no. 7, p. 809, pl. 4, fig. 3.

1960. *Prioniodina alata* (Hinde)?. Zimmerman, Freiberger Forschungshefte, C 89, p. 194, pl. 8, fig. 1.

1961. *Prioniodina alata* (Hinde). Freyer, Freiberger Forschungshefte, C. 95, p. 77–78, fig. 112.

Hypotypes.—USNM 11242 VP, 145884 IP, specimens figured by Ulrich and Bassler (1926, pl. 1, fig. 25; pl. 1, fig. 26, respectively); this report (pl. 6, figs. 1, 2, respectively).

Locality.—Rhinestreet Shale Members of the West Falls Formation, Weyer, N.Y., and "Hardin sandstone" near Mount Pleasant, Tenn.

Diagnosis.—A "pick-shaped" conodont characterized by a short posterior bar with confluent denticles and a broad, flat, sharp-edged cusp and anticusp. Most specimens lack denticles on the anticusp, but some have anteriorly inclined suppressed denticles; rare individuals have a few free denticles, as on the holotype of *Euprioniodina magnidens* Youngquist, Hibbard, and Reimann. Presumably *Neoprioniodus alatus* was derived from an earlier species of *Synprioniodina* by the suppression of denticles on the anticusp and fusion of adjacent denticles into the cusp.

The description was based on an examination of the hypotype and eight topotype specimens. The length of the hypotypes from the tip of the anticusp to the tip of the bar ranges from 1.6 to 1.94 mm, and the length of the cusp and anticusp from 1.67 to 2.3 mm.

Occurrence.—Mississippian: pre-Welden shale of Cooper (1939), Oklahoma. Upper Devonian: Genesee and West Falls Formations, New York; Ohio Shale, Ohio; New Albany Shale, Indiana; Chattanooga Shale, Alabama, Tennessee; Grassy Creek Shale, Missouri; Sweetland Creek Shale, Iowa; Houy Formation, Texas; Eifelian to *Cheiloceras*-Stufe, Germany.

Neoprioniodus armatus (Hinde), 1879

Plate 6, figure 11; plate 7, figures 1, 4

1879. *Prioniodus armatus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 360–361, pl. 15, figs. 20, 21.

1926. *Prioniodus curvidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 11, pl. 1, figs. 16, 17.

1926. *Euprioniodina conferta* Ulrich and Bassler, U.S. Natl. Mus., Proc., v. 68, art. 12, p. 29, pl. 3, fig. 17.

1928. *Prioniodus altoides* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 24, pl. 9, fig. 3.

1931. *Prioniodus altoides* Holmes. Cooper, Jour. Paleontology, v. 5, no. 2, p. 146, pl. 20, fig. 3.

1931. *Prioniodus macrocornatus* Cooper, Jour. Paleontology, v. 5, no. 3, p. 232, pl. 28, fig. 2.

1933. *Prioniodus armatus* Hinde. Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 135–136, pl. 11, figs. 14, 20.

1933. *Prioniodus dillensis* Matern, Senckenbergiana, v. 15, no. 1–2, p. 13, fig. 8 on p. 19.

1933. *Prioniodus* n. sp. "A". Matern, Senckenbergiana, v. 15, no. 1–2, p. 14, fig. 9 on p. 19.

1934. *Prioniodus obtusus* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 205, pl. 15, figs. 4, 5 [1933b].

1934. *Prioniodus semiseparatus* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 206, pl. 15, figs. 9, 10 [1933b].

1934. *Prioniodus macrocornatus* Cooper. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 38, pl. 1, fig. 6.

1938. *Prioniodus idoneus* Stauffer, Jour. Paleontology, v. 12, no. 5, p. 440, pl. 49, fig. 19.

1938. *Prioniodus bownockeri* Stauffer, Jour. Paleontology, v. 12, no. 5, p. 440, pl. 49, fig. 27.

?1939. *Prioniodus mutabilis* Branson and Mehl. Cooper, Jour. Paleontology, v. 13, no. 4, p. 405, pl. 45, fig. 52.

1943. *Prioniodus altoides* Holmes. Cooper and Sloss, Jour. Paleontology, v. 17, no. 2, pl. 29, fig. 26.

1945. *Prioniodus bellulus* Youngquist, Jour. Paleontology, v. 19, no. 4, p. 365, pl. 55, fig. 4.
1947. *Prioniodus altoides* Holmes. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 34, pl. 1, fig. 5, 7?.
1947. *Prioniodus bellulus* Youngquist. Youngquist and Peterson, Jour. Paleontology, v. 21, no. 3, p. 253, pl. 36, figs. 1–3.
1947. *Prioniodus bellatulus* Miller and Youngquist, Jour. Paleontology, v. 21, no. 6, p. 516, pl. 72, fig. 11.
1948. *Euprioniodina deflecta* Ulrich and Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 52, pl. 14, fig. 1.
1949. *Prioniodus obtusus* Branson and Mehl. Beckmann, Senckenbergiana, v. 30, no. 1–3, p. 162, pl. 1, fig. 8.
1955. *Prioniodus armatus* Hinde. Sannemann, Senckenbergiana, Lethaea, v. 36, no. 1–2, p. 151, pl. 3, figs. 2, 3.
1956. *Prioniodina armata* (Hinde). Bischoff, Hesse Lendesamt Bodenforschung, Notizblatt, v. 84, p. 135, pl. 10, figs. 15–17.
1957. *Prioniodus* cf. *P. idoneus* Stauffer. Rhodes and Dineley, Jour. Paleontology, v. 31, no. 2, p. 367, pl. 38, figs. 11, 12.
1957. *Prioniodina armata* (Hinde). Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Abh., v. 22, p. 105, pl. 9, figs. 4a, b, 6a, b, 9.
?1959. *Neoprioniodus armatus* (Hinde). Helms, Geologie, v. 8, no. 6, p. 644, pl. 4, fig. 18.
1961. *Neoprioniodus armatus* (Hinde). Scott and Collinson, Missouri Geol. Survey Rept. Inv., no. 27, p. 127, pl. 2, figs. 22, 24.
1964. *Neoprioniodus armata* (Hinde). Orr, Illinois Geol. Survey Circ. 361, p. 12, pl. 2, fig. 5.

Hypotypes.—USNM 11243 VP, 145881 IP, 11273 VP, specimens figured by Ulrich and Bassler (1926, pl. 1, figs. 16, 17, and pl. 3, fig. 17, respectively).

Locality.—The figured specimens are from the Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—"Pick-shaped" conodont with a sharp-edged flattened cusp and anticusp; a short, thin, straight posterior bar bears numerous discrete rounded denticles. A few specimens have diffuse white matter, suppressed denticles, or small free denticles on the anticusp. Basal cavity small; base of cusp swollen on the inside. The distance from the tip of the anticusp to the tip of the bar ranges from 1.06 to 1.42 mm, and the length of the cusp and anticusp ranges from 1.20 to 1.60 mm. The length of the cusp and anticusp is greater than that of the bar in three individuals. Description is based on the types of the species described by Ulrich and Bassler and on six topotype specimens.

Remarks.—This species differs from *N. alata* (Hinde) by having a relatively narrower cusp, a thinner bar, and discrete slender denticles. It differs from *Synprioniodina deflecta* by having a broader, flatter cusp, a larger angle between anticusp and bar, a smaller anticusp, more denticles on the posterior bar (10–12), and generally by lacking free denticles on the anticusp.

Prionidous curvidens was distinguished by Ulrich and Bassler (1926) from *P. undosus* on the basis of a straight bar (nonundulating) and nodelike elevations at the base of the denticles on the posterior bar. I do not find the "nodelike elevations." *Euprioniodina conferta* was distinguished because of the presence of free denticles on the anticusp. This is a variable character in *Neoprioniodus*. The shape of the cusp and bar in *Euprioniodina conferta* are the reasons for placing it in synonomy with *Neoprioniodus armatus* rather than *Synprioniodina deflecta* which it also resembles.

Occurrence.—Mississippian(?): Louisiana Limestone, Missouri. Upper Devonian: Genesee and West Falls Formation, New York; Olentangy and Ohio Shales, Ohio; New Albany Shale, Indiana; Chattanooga Shale, Alabama and Tennessee; Sheffield Formation of Fenton (1919) and Sweetland Creek Shale, Iowa; Alto Formation of Savage (1920), Illinois; Eifelian to *Manticoceras*-Stufe, Germany; southwest England.

Neoprioniodus undosus Ulrich and Bassler, 1926

Plate 4, figure 1; plate 6, figure 10; plate 7, figures 2, 3

1926. *Prioniodus undosus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 12, pl. 1, figs. 18–20.
1926. *Prioniodus inutilis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 11, pl. 1, fig. 23.
1948. *Prioniodus undosus* Ulrich and Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 58, pl. 14, fig. 10.

Lectotype (here designated).—USNM 11244 VP, specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 18); this report (pl. 6, fig. 10).

Paralectotypes.—USNM 145882 IP and 145883 IP, specimens figured by Ulrich and Bassler (1926, pl. 1, figs. 19 and 20, respectively); this report (pl. 7, figs. 3 and 2, respectively).

Locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Diagnosis.—Posterior bar thin, narrow, undulating, and bowed. Cusp broad; denticles rounded; anticusp short.

Remarks.—This species differs from *Neoprioniodus armatus* (Hinde) by having a narrower cusp and an undulating bar. *N. undosus* is only known in the Rhinestreet Shale Member where it occurs with *N. armatus*, and perhaps it is a junior synonym. The five specimens in the collection are easily distinguished from the typical *N. armatus*.

Prioniodus inutilis is represented by a single broken specimen. It is placed as a junior synonym of *N. undosus* because the bar appears to undulate and the shape of the cusp is similar.

Description based on the type series of the Ulrich and Bassler species and the hypotype figured by Youngquist, Hibbard, and Reimann (1948).

Geologic and geographic range.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York.

Genus OZARKODINA Branson and Mehl, 1933

Ozarkodina subbrevis (Ulrich and Bassler), 1926

Plate 1, figures 17–19

1926. *Bryantodus subbrevis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 28, pl. 10, fig. 15 [pl. 10, fig. 16 not identifiable].

1926. *Palmatolepis delicatula* Ulrich and Bassler, [part] U.S. Natl. Mus. Proc., v. 68, art. 12, pl. 10, fig. 5 [not p. 16, text fig. 4, no. 20=holotype *Palmatodella delicatula*].

?1926. *Prioniodella multidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 19, pl. 4, figs. 4, 5.

not 1934. *Bryantodus subbrevis* Ulrich and Bassler. Huddle, Bull. Amer. Paleontology, v. 21, no. 72, p. 68, pl. 2, fig. 5.

Lectotype (here designated).—USNM 11027 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 15); this report (pl. 1, fig. 18).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—Although the type of this species clearly belongs in the genus *Ozarkodina*, it is too fragmentary for specific identification. This is not the same species as I illustrated (1934, pl. 2, fig. 5). The specimen illustrated by Ulrich and Bassler (1926, pl. 10, fig. 16) is probably the tip of the bar of an *Ozarkodina*. The holotype *Prioniodella multidens* Ulrich and Bassler is a juvenile specimen, probably of an *Ozarkodina* species, but it might belong in *Bryantodus nitidus* Ulrich and Bassler.

Genus PALMATODELLA Bassler, 1925

1925. *Palmatodella* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.

1926. *Palmatodella* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 41.

1931. *Telumodina* Cooper, Jour. Paleontology, v. 5, no. 3, p. 241.

1938. *Ligonodinoides* Stauffer, Jour. Paleontology, v. 12, no. 5, p. 434.

1962. *Palmatodella* Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W54.

Type species (by original designation).—*Palmatodella delicatula* Bassler, 1925.

Geologic range.—Upper Devonian to Lower Mississippian.

Diagnosis.—Bar-type conodont with the cusp; anterior and posterior bars in the same plane, and two bars forming a sharp angle. The denticles are small, fused, and numerous.

Remarks.—Ulrich and Bassler characterized this genus as a triangular unit with the bars at right angles and with fine fused denticles. When oriented as they oriented it, this genus looks different from other conodont genera, but if *Palmatodella delicatula* is oriented with the cusp vertical, the unit then looks like a *Synprioniodina* with a very long anticusp. The genus is recognizable in either orientation by the sharp angle between the bars. It seems to be a useful genus and should be retained at least temporarily.

Palmatodella delicatula Bassler, 1925

Plate 6, figure 7

1925. *Palmatodella delicatula* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.

1926. *Palmatodella delicatula* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 41, text fig. 4, no. 20 on p. 16 [not pl. 10, fig. 5=*Ozarkodina*?].

1926. *Palmatodella delicatula* Bassler. Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, pl. 48, fig. 13.

1928. *Palmatodella delicatula* Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 29, pl. 10, fig. 10 [photograph of the holotype].

1931. *Palmatodella delicatula* Bassler. Cooper, Jour. Paleontology, v. 5, no. 2, p. 149, pl. 20, fig. 12.

1931. *Palmatodella inflexa* Cooper, Jour. Paleontology, v. 5, no. 3, p. 241, pl. 28, fig. 30.

1931. *Telumodina deckeri* Cooper, Jour. Paleontology, v. 5, no. 3, p. 241, pl. 28, fig. 32.

1931. *Telumodina gracilis* Cooper, Jour. Paleontology, v. 5, no. 3, p. 242, pl. 28, fig. 33.

1931. *Telumodina typicalis* Cooper, Jour. Paleontology, v. 5, no. 3, p. 241, pl. 28, fig. 31.

1932. *Palmatodella delicatula* Bassler. Bassler, Tennessee Div. Geology Bull. 38, pl. 26, fig. 24.

1934. *Palmatodella delicatula* Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 56, pl. 7, fig. 1.

1947. *Palmatodella delicatula* Ulrich and Bassler. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 32, pl. 1, fig. 15.

1955. *Palmatodella delicatula* Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 133, pl. 4, figs. 12–14.

1956. *Palmatodella delicatula* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung Notizblatt, v. 84, p. 128, pl. 10, figs. 10, 11.

?1957. *Palmatodella delicatula* Ulrich and Bassler. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 7–8, p. 804, pl. 11, fig. 3.

1961. *Palmatodella delicatula* Ulrich and Bassler. Freyer, Freiberger Forschungshefte, C 95, p. 60, pl. 3, fig. 73.

not 1962. *Palmatodella* aff. *P. delicatula* Spasov and Stevanović, Annales Geol. Peninsule Balkanique, v. 29, p. 60, pl. 2, figs. 10, 11.

not 1963. *Palmatodella* cf. *P. delicatula* Ulrich and Bassler. Boogaard, Geologie en Mijnbouw, v. 42, no. 8, p. 254, pl. 1, fig. 5.

Holotype (by original designation).—USNM 11307 VP, specimen figured (drawing) by Ulrich and Bassler (1926, p. 16, text fig. 4, no. 20); photographed by Holmes (1928, pl. 10, fig. 10); this report (pl. 6, fig. 7).

Type locality.—Gassaway Member of the Chattanooga Shale at Quicks Mill, Ala.

Diagnosis.—Cusp horizontal, pointing posteriorly. Denticles beneath the cusp fanlike, with the largest near the middle. The horizontal cusp, the very fine fused denticles, and the fanlike arrangement of the posterior denticles are characteristic of the species.

Remarks.—Boogaard (1963, p. 252) has shown that the angle between the anterior and posterior bars of a species he compared with *P. delicatula* ranged from 20° to 140°. The distribution curve is normal, and it is probable that only one species is present. I think that the species Boogaard studied is probably *P. orthogonica* Ziegler. It lacks the characteristic fan of posterior denticles of *P. delicatula*, and the cusp is not horizontal. Regardless of the species assignment of these specimens, Boogaard has shown that the angle between the bars is variable in *Palmatodella* and that other criteria should be used to distinguish species.

Occurrence.—Upper Devonian: Gassaway Member of the Chattanooga Shale, Tennessee, Alabama; Ohio Shale, Ohio; New Albany Shale, Indiana; Woodford Shale, Oklahoma; Upper Devonian (*to* Iα–*to* VI), Germany.

Genus PALMATOLEPIS Ulrich and Bassler, 1926

1926. *Palmatolepis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49.
1956. *Palmatolepis* Ulrich and Bassler. Müller, Senckenbergische Naturf. Gesell. Abh. 494. p. 14–15.
1956. *Palmatolepis* (*Manticolepis*) Müller, Senckenbergische Naturf. Gesell. Abh. 494, p. 16.
1956. *Palmatolepis* (*Deflectolepis*) Müller, Senckenbergische Naturf. Gesell. Abh. 494, p. 16–17.
1959. *Palmatolepis* Ulrich and Bassler. Hass, U.S. Geol. Survey Prof. Paper 294–J, p. 369, footnote.
1959. *Panderodella* Ulrich and Bassler. Hass, U.S. Geol. Survey Prof. Paper 294–J, p. 369, footnote.
1960. *Palmatolepis* Ulrich and Bassler. Ziegler, Fortschr. Geologie Rheinland u. Westfalen, v. 6, p. 5–6.
1962. *Panderodella* Ulrich and Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W60.
1962. *Palmatolepis* Ulrich and Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W60.
1962. *Palmatolepis* Ulrich and Bassler. Ethington and Furnish, Jour. Paleontology, v. 36, no. 6, p. 1279–1280.
1963. *Palmatolepis* Ulrich and Bassler. Helms, Geologie, v. 12, no. 4, p. 465–466.
1963. *Panderolepis* Helms, Geologie, v. 12, no. 4, p. 467.

Type species (by original designation).—*Palmatolepis perlobata* Ulrich and Bassler.

Geologic range.—Late Devonian, Early Mississippian(?).

Description.—*Palmatolepis* is a platform-type conodont with a prominent central node, a sigmoidally curved carina, and a tendency to develop an inner lobe. Oral surface is variously ornamented. The blade is highest at the anterior end, and the denticles decrease in size toward the rear. The denticles are suppressed and indistinct, but they are generally separate at the tips. Species with well-developed inner lateral lobes may have a secondary carina. Aboral surface is marked by growth lines in the central portion, but growth lines are generally absent in a narrow shiny rim, the crimp, at the margin of the platform. The conodont base was attached to the growth-line marked inner area of the aboral surface, but it was not attached to the crimp. The keel is highest at the ends of the plate and may be absent in the middle. A secondary keel is generally present below a secondary carina. Basal cavity generally absent but may be represented by a pit below the central node.

Remarks.—Species of *Palmatolepis* seem to be extremely variable. The most constant characters are the central node and the tendency for a sigmoidal bend in the carina. Many species tend to develop an inner lobe and parapet. Ziegler (1958, 1962a) has shown that there is a large range in the size and shape of the inner lobe, in the general outline, and in the amount of bending in the same species. In several species keels, carinae, and parapets are variable and may be present or absent. The ornamentation of the oral surface of the plate varies considerably in specimens of the same age and tends to coarsen in the large, more mature individuals. Such variations make it difficult to define species and partly accounts for the large number of species that have been proposed. It also requires large collections to define or to identify a species.

Palmatolepis is an important genus because many of its species are guide fossils for the Upper Devonian. Ziegler (1962a) has zoned the Upper Devonian of Germany by using mainly species and subspecies of *Palmatolepis*. Many of the species have worldwide distribution and limited stratigraphic distribution. In spite of the importance of the genus and the fact that it has had monographic treatment by Müller (1956a) and phylogenetic studies by Ziegler (1962b) and Helms (1963), the nomenclature of the palmatolepids is still confused. This is partly due to the fact that the early workers failed to figure enough specimens to show the variation; they described species from small samples and from specimens partly buried in rock and did not determine growth stages. Some of the species proposed by Hinde (1879), Ulrich and Bassler (1926), and Stauffer (1938) have been ignored, and there are now many synonyms. Some species such as *P. serrata* (Hinde) and *P. glabra* Ulrich and Bassler are still doubtful or unrecognizable. In addition to these problems, *Palmatolepis* has many valid, but variable, species, and many synonyms have been proposed.

The large number of species assigned to *Palmatolepis* makes some kind of subdivision appealing to taxonomists. Müller (1956a) divided *Palmatolepis* into three subgenera, and Helms (1963) proposed a fourth subgenus. Hass (1959a, 1962) divided *Palmatolepis* into two genera, *Palmatolepis* and *Panderodella*, but he did this because he wished to preserve the well-known genus *Palmatolepis* rather than to suppress it as a junior subjective synonym of *Panderodella*. Ziegler (1960a, p. 6) found it difficult to assign species to the genera *Panderodella* and *Palmatolepis* on the basis of the presence or absence of an inner lateral lobe because many species have indistinct lobes. Helms (1963, p. 474) regarded the subdivision of the genus suggested by Hass as inappropriate but recognized four subgenera: *Palmatolepis* and *Manticolepis*, approximately equal to the genus *Palmatolepis* of Hass, and *Panderolepis* and *Deflectolepis*, approximately equal to the genus *Panderodella* of Hass.

Ziegler (1962a) and Helms (1963) have used subspecies for intergrading taxa which have different stratigraphic ranges. The taxa are distinguished from one another by minor characters chosen on the basis of observed variability. Ziegler used these subspecies to distinguish conodont zones and to show relationships in rapidly evolving taxa. These phylogenetic studies of Ziegler and Helms are based on the study of large numbers of specimens dissolved out of the relatively thin limestone section representing the Upper Devonian in Germany. It is probable that these limestones were deposited very slowly, and the evolution of *Palmatolepis* can be seen by studying a series of collections taken a few inches or feet apart. The specimens are abundant, well preserved, and in stratigraphic order. The phylogeny developed by Ziegler (1962b) and the one developed by Helms (1963) are slightly different but quite reasonable. It is possible to make more than one reasonable phylogeny by using the same collections but different assumptions in such a variable group of species. It has not yet been established that the species and subspecies have the same ranges in other parts of the world that they have in Germany nor that most of palmatolepid evolution took place in Germany. For the present I prefer not to recognize subspecies. The question as to whether or not *Palmatolepis* Ulrich and Bassler, 1926, is a junior synonym of *Panderodella* Ulrich and Bassler, 1925, as suggested by Hass (1959a, p. 369; 1962, p. W60), has been discussed in detail by Ziegler (1960a) and Helms (1963). Both Ziegler and Helms regard *Panderodella* as a nomen dubium, and as discussed here under *Panderodella* I concur in this decision.

Palmatolepis folia (Ulrich and Bassler), 1926

Plate 14, figure 1

1926. *Polygnathus folium* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 46, pl. 7, fig. 5.

Holotype (by original designation).—USNM 11012 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 5); this report (pl. 14, fig. 1).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This specimen is broken, and the posterior tip of the plate and most of the free blade are missing. Only the aboral side can be seen. It is probably a species of *Palmatolepis*, but the specific characters cannot be seen or exposed. The name is a nomen dubium.

Palmatolepis glabra Ulrich and Bassler, 1926

Plate 14, figures 2–16

?1879. *Polygnathus? serrata* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 365, pl. 17, figs. 4, 5. [nomen dubium].

1926. *Polygnathus* sp. A. Roundy, *in* Roundy, Girty, and Goldman, U.S. Geol. Survey Prof. Paper 146, p. 14, figs. 12a, b.

1926. *Palmatolepis glabra* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 51, pl. 9, figs. 18–20.

1926. *Panderodella truncata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 52, pl. 9, figs. 16, 17 [not pl. 9, fig. 15=lectotype of *Panderodella truncata* Ulrich and Bassler, a nomen dubium].

1928. *Palmatolepis elongata* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 33, pl. 11, fig. 13.

?1933. *Palmatolepis? serrata* (Hinde). Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 151–152, pl. 12, figs. 1, 8 [photographs of Hinde's types].

1934. *Palmatolepis glabra* Ulrich and Bassler. Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 233–234, pl. 18, figs. 9, 22, 26 [1933b].

1934. *Palmatolepis elongata* Holmes. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 108, pl. 9, figs. 8–10.

?1935. *Palmatolepis elongata* Holmes. Cooper, Jour. Paleontology, v. 9, no. 4, p. 314, pl. 27, fig. 40.

?1943. *Palmatolepis glabra* Ulrich and Bassler. Cooper and Sloss, Jour. Paleontology, v. 17, no. 2, p. 29, figs. 5, 36. [not identifiable from figures].

1944. *Palmatolepis glabra* Ulrich and Bassler. Branson and Mehl, *in* Shimer and Shrock, Index fossils of North America, pl. 94, fig. 40.

1947. *Palmatolepis glabra* Ulrich and Bassler. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 33, pl. 11, fig. 25.

1953. *Palmatolepis glabra* Ulrich and Bassler. Hass, U.S. Geol. Survey, Prof. Paper 243–F, p. 86, pl. 15, fig. 4.

1955. *Palmatolepis glabra* Ulrich and Bassler. Sannemann, Neues Jahrb. Geologie u. Paläontologie Abh., v. 100, p. 326, pl. 24, fig. 7.

1955. *Palmatolepis glabra* Ulrich and Bassler. Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 135, pl. 1, fig. 4.

1956. *Palmatolepis glabra* Ulrich and Bassler. Hass, U.S. Geol. Survey Prof. Paper 286, pl. 3, figs. 15–17.

1956. *Palmatolepis glabra* Ulrich and Bassler. Müller, Senckenbergische Naturf. Gesell. Abh. 494, p. 25–26, pl. 7, figs. 8–11, 13–15.

1957. *Palmatolepis glabra* Ulrich and Bassler. Hass, *in* Cloud, Barnes and Hass, Geol. Soc. America Bull., v. 68, pl. 4, fig. 10.

1960. *Palmatolepis glabra glabra* Ulrich and Bassler. Ziegler, Fortschr. Geologie u. Rheinland Westfalen, v. 6, p. 7, pl. 1, figs. 11–13.

1960. *Palmatolepis glabra elongata* Holmes. Ziegler, Fortschr. Geologie Rheinland u. Westfalen, v. 6, p. 8, pl. 1, figs. 10, 14.

1960. *Palmatolepis glabra pectinata* Ziegler, Fortschr. Geologie Rheinland u. Westfalen, v. 6, p. 8–9, pl. 2, figs. 3–5.

1960. *Palmatolepis glabra* Ulrich and Bassler. Zimmerman, Freiberger Forschungshefte, C 89, pl. 2, figs. 2–4, 8–11.

1960. *Palmatolepis distorta* Zimmerman [not Branson and Mehl], Freiberger Forschungshefte, C 89, pl. 2, figs. 1, 5–7.

1960. *Palmatolepis distorta* Branson and Mehl. Clark and Becker, Geol. Soc. America Bull., v. 71, p. 1669–1671, pl. 2, figs. 2, 6–8. [not Branson and Mehl].

1961. *Palmatolepis glabra* Ulrich and Bassler. Freyer, Freiberger Forschungshefte, C 95, p. 62–63, fig. 80, pl. 4, figs. 81–82.

1962. *Palmatolepis glabra* Ulrich and Bassler. Winder, Royal Soc. Canada Trans., sec. 3, ser. 3, v. 56, p. 91, fig. 1, no. 4 [type locality of *P. serrata* (Hinde)].

1962. *Palmatolepis glabra glabra* Ulrich and Bassler. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 58, pl. 4, figs. 14–15.

1962. *Palmatolepis glabra elongata* Holmes. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 58–59, pl. 5, figs. 6–7.

1962. *Palmatolepis glabra pectinata* Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 59, pl. 4, fig. 16; pl. 5, figs. 3–5.

1962. *Palmatolepis glabra* subsp. A Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 59, pl. 5, figs. 1–2.

1963. *Palmatolepis glabra elongata* Holmes. Forti and Nocchi, Riv. Italiana Paleontologia, v. 69, no. 3, p. 323–324, pl. 20, figs. 5a, b.

1963. *Palmatolepis* (*Panderolepis*) *serrata* new subsp. A Helms, Geologie, v. 12, no. 4, pl. 1, fig. 2.

1963. *Palmatolepis* (*Panderolepis*) *serrata acuta* Helms, Geologie, v. 12, no. 4, p. 468–469, pl. 3, figs. 1–4, 6.

Lectotype (*P. glabra* Ulrich and Bassler, designated by Ziegler, 1960a).—USNM 11043 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 20); this report (pl. 14, fig. 2).

Paralectotypes.—USNM 145974 IP, 145975 IP, specimens figured by Ulrich and Bassler (1926, pl. 9, figs. 18 and 19, respectively); this report (pl. 14, figs. 7 and 8, respectively); USNM 145961 IP, 145962 IP, 145963 IP, and 145964 IP, previously unfigured, this report (pl. 14, figs. 3, 4, 6, and 5, respectively).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—Helms (1963, p. 465–466) regarded *Palmatolepis serrata* (Hinde) as the senior subjective synonym of *Palmatolepis glabra* Ulrich and Bassler. The types of both these species were half buried in matrix, and only the inner platforms could be seen in 1963. Helms argued that the characters of the inner platform are sufficient to determine the species and that the characters of the outer platform have only subspecific rank. If this statement is accepted, the identity of the two species is reasonable. However, some of the subspecies of the *Palmatolepis serrata* (=*glabra*) complex have been described as species, and all may be raised to specific rank. It is therefore impossible to be sure of the specific identity of *P. serrata* and *P. glabra* until the types are prepared and the outer platforms are exposed. This fact was recognized in part by Helms when he used open nomenclature and did not describe the nominal subspecies *P. serrata serrata.* The naming of several subspecies in this complex by Ziegler (1960a) and Helms (1963) makes it desirable to describe the lectotypes of *P. glabra* and to discuss the range of variation of *P. elongata* at its type locality.

Lectotype (*P. glabra* Ulrich and Bassler, 1926).—This specimen is a narrow palmatolepid with a sigmoidally curved blade and carina and a prominent central node. The posterior end of the plate is upturned, but the tip end is broken off. Another specimen on the same slab has a narrowly pointed plate. The oral surface is ornamented by very fine lines and by pebbling. The inner platform is almost flat and extends to the anterior end of the blade. The outer platform (prepared in 1964) is flat posterior to the central node, but anterior to the node it rises into a broad rounded parapet which continues forward about one-half the distance from the node to the anterior end of the blade where the outer platform ends abruptly. Length of the lectotype, 2.0 mm; width, 0.7 mm. The length-width ratio is 2.9:1.

The lectotype of *Palmatolepis glabra* is most similar to the subspecies *P. glabra pectinata* Ziegler, 1960, but unfigured specimens of *Palmatolepis* in the Ulrich and Bassler collections have the outline of *Palmatolepis glabra glabra* of Ziegler. Ulrich and Bassler's collection came from the "Hardin sandstone." This sandstone contains a mixed fauna, including some specimens from underlying Ordovician rocks. It is therefore not safe to assume that the collection represents a single population living at a particular time and place. In the collections of topotype material there are specimens which could be referred to *P. glabra glabra* Ulrich and Bassler, *P. glabra elongata* Holmes, *P. serrata acuta* Helms, and *P. quadrantinodosa* Branson and Mehl. I am certain that more than one species of *Palmatolepis* is present in the collection, but there are too few whole specimens to determine the variation of any of them.

Description (*P. elongata* Holmes).—The holotype of *P. elongata* Holmes is embedded in shale, and only the upper surface is exposed. The outer platform is incomplete, and the blade is broken. About 50 unfigured paratypes were examined to prepare the following description:

Long, narrow palmatolepids with the inner platform extending to the anterior end of the blade in most individuals and the outer platform ending about half way between the central node and the end of the blade. Posterior platform narrowly pointed, with the carina extending to the end of the platform in two-thirds of the individuals. Outer platform has a convex outline and is raised and rounded to form a parapet in front of the central node. None of the 12 unfigured paratypes with the outer platform preserved has the triangular raised area that Ziegler (1960a, p. 8) regarded as characteristic of *P. glabra elongata* Holmes. Five of the smaller individuals have the rounded parapet outline which Ziegler (1960a, p. 7) regarded as characteristic of *P. glabra glabra*. The parapet may be straight or curved and parallel or oblique to the carina. The whole specimen ranges in length from 0.9 mm to 1.6 mm and in width from 0.3 to 0.7 mm. The length-width ratio ranges from 2.3 : 1 to 3 : 1. In general the unfigured paratypes of *P. elongata* Holmes look longer, slimmer, and flatter than the lectotype of *P. glabra* Ulrich and Bassler, but the measurements only indicate that *P. glabra* is larger. I find no consistent difference between *P. glabra* and *P. elongata* and regard *P. elongata* as a junior subjective synonym.

Scott and Collinson (1959) described the variation in *Palmatolepis glabra* Ulrich and Bassler from 350 specimens found in a single sample of the Saverton Shale from western Illinois. They describe six morphotypes and many intergrading series of morphologic variations. All the morphotypes were included in *P. glabra* by Scott and Collinson, but they recognized that some morphotypes might be raised to specific rank (1959, p. 588) later. If all 350 specimens come from a single contemporaneous population, I think they should be regarded as a single variable species. The intergrading series seems to require this interpretation. Ziegler (written commun., 1964) thinks that the Saverton Shale has a mixed fauna that includes two or more species (or subspecies) that have different ranges. The fauna could have been mixed by the reworking of older material, or perhaps very slow deposition permitted the accumulation of conodonts over a long period of time. The abundance of perfect delicate conodonts argues against reworking, and the abundance of conodonts in the sample suggests slow deposition. Ziegler's interpretation seems possible, and he has shown that the various subspecies of *Palmatolepis glabra* have slightly different ranges in Germany. For the present, however, I prefer the assumption that the specimens described from the Saverton Shale sample by Scott and Collinson all belong to a single species. Convincing evidence that more than one species is present or that subspecies are needed would be the demonstration of widespread populations of *Palmatolepis glabra* with more limited variation than shown in the Scott and Collinson collection and that some morphotypes have different ranges in widespread areas.

Occurrence.—Upper Devonian: Gassaway Member of the Chattanooga Shale, Tennessee and Alabama; New Albany Shale, Indiana; Ohio Shale, Ohio; Kettle Point Shale, Ontario; Pilot Shale, Utah; Famennian, Italy; *Cheiloceras*-Stufe to *Platyclymenia*-Stufe, Germany.

Palmatolepis marginata clarki? Ziegler, 1962

Plate 14, figures 25, 26

1926. *Polygnathus pennatulus* [part] Ulrich and Bassler, 1926, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 45, pl. 9, fig. 24 [not pl. 7, fig. 8=lectotype *P. pennatula* nor pl. 9, fig. 25=*P. pennata*?].

1938. *Palmatolepis flabelliformis* [part] Stauffer, Jour. Paleontology, v. 12, no. 5, 436, pl. 53, figs. 2, 4 [not pl. 53, fig. 9=lectotype, *P. flabelliformis* Stauffer. Müller and Müller, 1957].

1956. *Palmatolepis flabelliformis* Stauffer. Bischoff, Hesse Landesamt Bodenforschung, Notizblatt, v. 84, p. 128, pl. 9, figs. 4–6, 10, 11.

1960. *Palmatolepis* (*Manticolepis*) *marginata* Stauffer var. B. Clark and Becker, Geol. Soc. America Bull., v. 71, no. 11, p. 1672, pl. 2, figs. 12, 13.

1960. *Palmatolepis* (*Deflectolepis*) *coronata* Müller. Clark and Becker, Geol. Soc. America Bull., v. 71, no. 11, p. 1672, pl. 1, figs. 1–5; pl. 2, fig. 11.

1962. *Palmatolepis marginata clarki* Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 62–65, pl. 2, figs. 20–27, text fig. 4.

Figured specimen.—USNM 145935 IP, specimen figured by Ulrich and Bassler, (1926, pl. 9, fig. 24).

Locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The specimen referred to this subspecies is a small palmatolepid, about 1 mm long. The plate is slightly arched and has a triangular lateral lobe slightly anterior to the azygous node and a strong parapet or raised rim on the narrow outer plate. The ornamentation consists of large nodes on the parapet and smaller nodes arranged near the edges causing a thickening of the margins. The blade is highest at the anterior end, and the carina continues nearly to the posterior tip of the plate. There is no secondary carina. The keel is thin and low in the middle. This specimen has the key characters of the subspecies: thickened ornamented margins

of plate and triangular lateral lobe. It is referred to the subspecies questionably because there is only one specimen. Only a side view was seen by Ulrich and Bassler, and it is not surprising that they referred it to *Polygnathus*. The specimen was prepared by Huddle in 1964.

Occurrence.—Upper Devonian: Olentangy Shale, Ohio; Pilot Shale, Utah; Middle and Upper *Palmatolepis triangularis* zone (*to* I δ ?) (Ziegler, 1962a), Germany.

Palmatolepis perlobata Ulrich and Bassler, 1926

Plate 15, figures 1–10; plate 16, figures 8, 9

?1879. *Polygnathus palmatus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 367, pl. 17, figs. 16, 17. [not recognizable].

1926. *Palmatolepis perlobata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49–50, pl. 7, figs. 19–22.

1926. *Palmatolepis extralobata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 50, pl. 8, fig. 3.

1926. *Palmatolepis peculiaris* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 51, pl. 8, figs. 11 [lectotype, here designated], 12.

1926. *Palmatolepis lobatula* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 50–51, pl. 7, fig. 3; lectotype, here designated [not fig. 4 = *Palmatolepis subrecta* Miller and Youngquist, 1947].

1928. *Palmatolepis perlobatus* Ulrich and Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 34, pl. 11, figs. 16–19.

1932. *Palmatolepis perlobata* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 18.

?1933. *Palmatolepis punctata* (Hinde). Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, pl. 11, figs. 1, 11. [not pl. 11, fig. 6 = *Palmatolepis punctata* (Hinde)].

1934. *Palmatolepis perlobata* Ulrich and Bassler. Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 234, pl. 18, figs. 12, 23, ? 25, not fig. 24 = *Palmatolepis triangularis* Sannemann [fide Ziegler, 1962a, p. 69] [1933b].

not 1934. *Palmatolepis minuta* Huddle [not *Palmatolepis minuta* Branson and Mehl, 1934], Bull. Am. Paleontology, v. 21, no. 72, p. 109–110, pl. 9, fig. 24.

1934. *Palmatolepis pustulosa* Huddle, Bull. Am. Palentology, v. 21, no. 72, p. 106, pl. 9, figs. 1, 2.

1949. *Palmatolepis perlobata* Ulrich and Bassler. Thomas, Geol. Soc. America Bull., v. 60, no. 3, pl. 1, figs. 10, 13, 26.

1955. *Palmatolepis perlobata* Ulrich and Bassler. Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 135, pl. 1, fig. 7.

1956. *Palmatolepis perlobata* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung, Notizblatt, v. 84, p. 129, pl. 9, figs. 1–3.

1956. *Palmatolepis perlobata* Ulrich and Bassler. Müller, Senckenbergische Naturf. Gesell. Abh. 494, p. 15–16.

?1959. *Palmatolepis perlobata schindewolfi* Müller. Helms, Geologie, v. 8, no. 6, p. 649, pl. 5, fig. 13; pl. 2, fig. 9.

1961. *Palmatolepis perlobata* Ulrich and Bassler. Freyer, Freiberger Forschungshefte, C 95, p. 65–66.

1962. *Palmatolepis perlobata perlobata* Ulrich and Bassler. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 69–70, pl. 8, fig. 1, text fig. 6.

1962. *Palmatolepis perlobata* Ulrich and Bassler. Reichstein, Geologie, v. 11, no. 34, pl., fig. 1, 13.

Lectotype.—USNM 10995 VP, designated by Müller (1956a, p. 15), the specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 22), this report (pl. 15, fig. 2).

Paralectotypes.—USNM 145922 IP, 145923 IP, and 145924 IP, specimens figured by Ulrich and Bassler (1926, pl. 7, figs. 19, 20, 21); this report (pl. 15, fig. 1; pl. 16, fig. 8; and pl. 15, fig. 3, respectively).

Type locality.—"Hardin Sandstone" near Mount Pleasant, Tenn.

Description.—A large species of *Palmatolepis* strongly curved sigmoidally with an inner lobe which is relatively narrow and usually has a secondary carina. The inner margin bows outward between the inner lobe and posterior tip of the plate on many specimens. There is a small parapet on the outer plate in front of the central node. Surface of the plate ornamented with fine to coarse nodes and ridges which tend to be coarser in the large specimens. Carina highest anteriorly, decreasing regularly toward the posterior with closely appressed fused denticles. Carina may not reach the posterior tip of the plate. Aboral side has a narrow crimp and growth lines. Primary keel extends the length of the plate, highest near the anterior and posterior tips. Secondary keel below the secondary carina. No basal cavity present.

Remarks.—The paralectotype figured on plate 15, figure 1, lacks a secondary carina, and the primary carina is indistinct behind the central node. The surface ornamentation is rather coarse, and the secondary lobe points nearly perpendicular to the axis of the plate. It is similar to some specimens referred to *P. perlobata schindewolfi*. Müller (1956a, p. 27–28) distinguished *Palmatolepis perlobata* from *P. schindewolfi* on the basis of a secondary carina and coarse ornamentation in *P. perlobata*. Ziegler (1962, p. 70–71) discounted ornamentation for the recognition of species but used the presence or absence of the secondary carina and the direction of the secondary lobe to distinguish subspecies.

Topotypes from the "Hardin sandstone" in my collection show only two specimens that have a secondary carina. The other specimens do not have the inner lobe preserved. Eleven examples of *P. perlobata* from the Gassaway Member of the Chattanooga Shale in the collection used by Hass (1956) were examined to determine the variation. Of these, two had forward-pointing lobes without secondary carinae and two had secondary carinae. Six examples had secondary carinae and inner lobes nearly perpendicular to the axis of the plate, and one lacked a secondary carina.

In the collections described by Holmes (1928) from the Chattanooga Shale at Quicks Mill, Ala., 16 specimens of *P. perlobata* had inner lobes perpendicular to axis of plate and secondary carinae, 12 had inner lobes perpendicular to the axis of the plate and no secondary

carina, 1 had a backward-pointing inner lobe and a secondary carina, 1 had a backward-pointing secondary lobe and no secondary carina, and 1 had a forward-pointing inner lobe and a secondary carina. The variation present in the collections before me shows that *Palmatolepis perlobata* varies in the characters that have been used to distinguish subspecies.

Dr. Willi Ziegler very kindly sent me 10 specimens of *Palmatolepis perlobata schindewolfi* from the Upper *crepida* Zone from Siberstollen Kellerwald, Germany, the Lower and Middle *velifera* Zone (samples 7, 10, Ziegler, 1962a, p. 152), and, the Middle *styriaca* Zone (Ziegler, 1962a, table 5). These specimens are smaller and more delicate, and have smaller lobes than the typical *Palmatolepis perlobata* and the ornamentation is much finer. These specimens are easily distinguished from *P. perlobata* by using a combination of characters, all of which are variable. *Palmatolepis schindewolfi* probably is a valid species, but the distinctions between it and *P. perlobata* are difficult to describe.

Synonyms.—*Palmatolepis extralobata* Ulrich and Bassler is clearly a synonym of *P. perlobata* now that the holotype has been prepared and it can be seen that the posterior tip is broken off. The oral surface is not exposed. *Palmatolepis peculiaris* Ulrich and Bassler is represented by cotypes both of which lack the posterior ends of the plates. One specimen (pl. 15, fig. 6), lacks a secondary carina, and the inner lobe is perpendicular; the other (pl. 16, fig. 9), has a secondary carina, and the inner lobe points forward. The one without the carina (pl. 15, fig. 6) is the lectotype. Both cotypes are assigned to *P. perlobata* since Ulrich and Bassler clearly indicated that they distinguished this species on the basis of lack of secondary carinae. This specimen has the fine ornamentation of *P. schindewolfi* Müller, 1956. *Palmatolepis lobatula* Ulrich and Bassler (1926, pl. 7, fig. 3) (this report, pl. 15, fig. 7) is probably a young *P. perlobata*, as indicated by the general shape and secondary keel. The specimen shown by Ulrich and Bassler (1926, pl. 7, fig. 4) and in this paper (pl. 16, fig. 6) could be placed in *P. perlobata* but probably is a *P. subrecta* Miller and Youngquist, 1947.

Palmatolepis minuta Huddle, 1934, has been regarded as a juvenile *P. perlobata* by Sannemann (1955b, p. 135) and later authors. I have reexamined the type of this species and do not concur in this decision. The species is represented by two specimens on the same shale chip with a small specimen of *Siphonodella* sp. No other specimens of *Palmatolepis* have been found in my original collection nor in the collection I made in 1935. I think that *Palmatolepis minuta* Huddle, 1934, has not been reworked and is a Mississippian species of *Palmatolepis*. *Palmatolepis minuta* Huddle, 1934, is a junior homonym of *P. minuta* Branson and Mehl, but I do not wish to rename it until other specimens are found.

Palmatolepis pustulosa Huddle, 1934, was placed correctly in synonymy with *P. perlobata* by Sannemann (1955b, p. 135).

Occurrence.—Upper Devonian: Gassaway Member of the Chattanooga Shale, Tennessee, Alabama; New Albany Shale, Indiana; Maple Mill Shale of Bain (1895), Iowa; Upper *Manticoceras*-Stufe and *Cheiloceras*-Stufe, Germany.

Palmatolepis perlobata? Ulrich and Bassler, 1926

Plate 16, figure 4

1926. *Palmatolepis perlobata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49–50, pl. 7, figs. 19–21.
1926. *Polygnathus? acaulis* [part]. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 47, pl. 8, fig. 4 [not pl. 8, fig. 5=*Polylophodonta pergyrata* (Holmes)].
1932. *Polygnathus acaulis* Ulrich and Bassler. Bassler, Tennessee Div. Geology, Bull. 38, p. 234, pl. 26, fig. 28.

Lectotype (*Polygnathus? acaulis*, here designated).—USNM 11003 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 4); this report (pl. 16, fig. 4).

Locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The lectotype of *Polygnathus acaulis* is a triangular piece of the posterior end of a palmatolepid plate. The size and ornamentation of the piece suggest that it probably came from a *Palmatolepis perlobata*. Hass removed the specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 5) from the sandstone. The oral ornamentation of this specimen shows that it belongs in *Polylophodonta pergyrata* (Holmes).

Palmatolepis punctata (Hinde), 1879

Plate 16, figures 1–3

1879. *Polygnathus punctatus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 367, pl. 17, fig. 14.
1926. *Palmatolepis punctata* (Hinde). Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 51–52, pl. 1, figs. 6, 6′, 7.
1933. *Palmatolepis punctata* (Hinde). Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 149, 151, pl. 11, fig. 6 [not pl. 11, fig. 1=*Palmatolepis palmata* (Hinde)].
1956. *Palmatolepis* (*Manticolepis*) *martenbergensis* Müller, Senckenbergische Naturf. Gesell. Abh., v. 494, p. 19, pl. 1, figs. 3–8; pl. 2, figs. 10–13.
1957. *Palmatolepis triangularis martenbergensis* Müller. Bischoff and Ziegler, Hesse Landesamt Bodenforschung Abh., v. 22, p. 82, pl. 14, figs. 14, 15.
1957. *Palmatolepis triangularis triangularis* Sannemann. Bischoff and Ziegler, Hesse Landesamt Bodenforschung Abh., v. 22, p. 82, pl. 14, fig. 13.
1957. *Palmatolepis* (*Manticolepis*) *martenbergensis* Müller. Müller and Müller, Jour. Paleontology, v. 31, no. 6, p. 1104, pl. 142, fig. 6.

1958. *Palmatolepis martenbergensis* Müller. Ziegler, Hesse Landesamt Bodenforschung, Notizblatt, v. 87, p. 61, pl. 2, figs. 4–7; pl. 3, figs. 1–10.

1958. *Palmatolepis martenbergensis* Müller. Bischoff and Sannemann, Hesse Landesamt Bodenforschung, Notizblatt, v. 86, p. 100–101, pl. 15, fig. 17.

1959. *Palmatolepis unicornis* Miller and Youngquist. Hass, U.S. Geol. Survey Prof. Paper 294–J, pl. 50, fig. 20.

1962. *Palmatolepis martenbergensis* Müller. Bartenstein and Bischoff, Leitfossilien der Mikropaläontologie, p. 53, pl. 5, fig. 13.

Hypotypes.—USNM 11309 VP, 145926 IP, 145927 IP, specimens figured by Ulrich and Bassler (1926, pl. 1, figs. 6, 6′, and 7, respectively); this report (pl. 16, figs. 1, 3, and 2, respectively).

Locality.—Rhinestreet Shale Member of the West Falls Formation, at Weyer, N.Y.

Description.—Plate triangular, carina straight or slightly curved, central node prominent. Inner lobe large, with the greatest width in front of the central node. Carina continues to the posterior tip of the plate in about half the specimens in the collection. Plate flat in most specimens, but some have low folds on the inner lobe and on the anterior part of the inner platform. The oral ornamentation ranges from small nodes and pustules to large nodes and ridges radiating from a point just anterior to the central node. There is no true secondary carina, but many specimens have one or two strong ridges or a sharp low fold just anterior to the central node that looks somewhat like a secondary carina.

Median keel on the aboral side high at the ends and low, indistinct, or absent in the middle. A secondary keel is present on a few specimens, and a secondary keel is suggested on other specimens by the bending of growth lines near the axis of the inner lobe. If there is a fold on the oral side, it is also present on the aboral. Basal cavity generally absent. One specimen has a small slit, and another has a pit in the median keel below the central node. The crimp is 0.05–0.11 mm wide and averages 0.09 mm.

The length of the plate ranges from 0.9 to 2.3 mm and averages 1.54 mm. The line of greatest width of the plate ranges in length from 0.6 to 1.6 mm and averages 1.11 mm. The width-length ratio ranges from 1 : 1.14 to 1 : 1.87 and averages 1 : 1.39. These ranges and averages are based on the measurement of the 3 hypotypes and 48 unfigured specimens from the Ulrich and Bassler collection.

Ziegler (written commun., 1964) has examined all the types listed in the synonymy above and regards *Palmatolepis punctata* (Hinde) as the senior subjective synonym of *Palmatolepis martenbergensis*. He includes only the specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 6) in *P. punctata* (Hinde). The other specimens Ulrich and Bassler figured (1926, pl. 1, figs. 6′, 7) Ziegler placed in *P. transitans*. After examining all the specimens of *Palmatolepis* in the Ulrich and Bassler collection, I can find no basis for recognizing two species in this collection. The straightness of the carina, the oral ornamentation, and the shape of the inner lobe are all variable characters. No two of these characters occur together consistently. Eight of 38 specimens have a slightly curved axis. Ten specimens have small or moderately large nodes, and 20 specimens have strong nodes or ridges. I think that *P. transitans* is also a junior subjective synonym of *P. punctata*, but I have not seen the types or suites of specimens of *P. transitans*, and I am not ready to place *P. transitans* in synonomy.

Occurrence.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; Sweetland Creek Shale and Independence Shale Member of Wapsipinicon Limestone, Iowa; Houy Formation, Texas; *Manticoceras*-Stufe (*to* Iα–*to* I$\beta\gamma$), Germany.

Palmatolepis subcrassa (Ulrich and Bassler), 1926

Plate 14, figure 27

1926. *Panderodella subcrassa* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 53, pl. 9, fig. 14.

1932. *Panderodella subcrassa* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 5.

Holotype.—USNM 11042 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 14); this report (pl. 14, fig. 27).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype and only known specimen is a fragment of a palmatolepid similar to *Panderodella truncata* Ulrich and Bassler but one-third larger. It consists of the blade and part of the carina. A narrow broken edge suggests that a platform extended to the end of the blade. The part of the blade preserved is straight, and there is no azygous node preserved. The holotype probably belongs in *Palmatolepis* but is indeterminate. The name is a nomen dubium.

Palmatolepis subrecta Miller and Youngquist, 1947

Plate 16, figures 5, 6, 7?

1926. *Palmatolepis perlobata* [part] Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 49, 50, pl. 7, fig. 23 [not pl. 7, figs. 19–22=*P. perlobata* Ulrich and Bassler].

1926. *Palmatolepis lobatula* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, pl. 7, fig. 4 [not pl. 7, fig. 3 =*Palmatolepis perlobata* Ulrich and Bassler].

?1926. *Polygnathus* sp. Ulrich and Bassler, U.S. Natl. Mus., Proc. v. 68, art. 12, pl. 9, fig. 23.

1947. *Palmatolepis subrecta* Miller and Youngquist, Jour. Paleontology, v. 21, no. 6, p. 513–514, pl. 75, figs. 7–11.
1962. *Palmatolepis subrecta* Miller and Youngquist. Ethington and Furnish, Jour. Paleontology, v. 36, no. 6, p. 1280, pl. 172, fig. 6. [See this paper for synonomy list.]
1963. *Palmatolepis subrecta* Miller and Youngquist. Ruchholz, Geologie, v. 12, no. 9, pl. 1, figs. 9–10.

Hypotypes.—USNM 145928 IP, 145929 IP, specimens figured by Ulrich and Bassler (1926, pl. 7, figs. 23 and 4).

Locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—A species of *Palmatolepis* with a large triangular inner lobe, a nearly straight carina, and the posterior end of the plate bent downward. The downturned posterior part of the plate distinguishes the species from *P. triangularis* Sannemann, 1955, which has a flat plate according to Ziegler (1962a, p. 80). The specimen figured in this report (pl. 16, fig. 5) is downturned on the posterior end. The other specimen (pl. 16, fig. 6) is apparently crushed flat. Both specimens are embedded in sandstone, and there are no other specimens in the Ulrich and Bassler collection.

Genus PANDERODELLA Bassler, 1925

1925. *Panderodella* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 220.
1926. *Panderodella* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 52.
1956. *Panderodella* Bassler. Müller, Senckenbergische Naturf. Gesell. Abh., v. 494, p. 16.
1959. *Panderodella* Bassler. Hass, U.S. Geol. Survey Prof. Paper 294–J, p. 369, footnote.
1962. *Panderodella* Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W60.

Type species (by original designation).—*Panderodella truncata* Bassler, 1925.

Generic range.—Upper Devonian, Lower Mississippian(?).

Remarks.—This genus of platform conodont was based on fragmentary specimens, two of which certainly belonged in *Palmatolepis glabra* which Ulrich and Bassler described in the same paper as they described *Panderodella truncata*. Müller (1956a, p. 16) selected the most fragmentary specimen as the lectotype of *P. truncata* Bassler and regarded it as a fragment of a species of *Polygnathus*. He chose this specimen to preserve the well-known junior name *Palmatolepis* Ulrich and Bassler, 1926, and to make the senior name *Panderodella* Bassler, 1925, a junior synonym of *Polygnathus* Hinde, 1879. Hass (1959a) emended *Panderodella* to include palmatolepid species with a narrow platform, without a well-developed inner lobe, secondary carina, or secondary keel, but with a sigmoidally curved carina and a prominent azygous node in the carina. Ziegler (1960a, p. 5–6) and Helms (1963, p. 465–466) regard *Panderodella* as a nomen dubium because they regard the lectotype of the type species, *P. truncata* Bassler, as indeterminate. The status of the generic name will be discussed further after the type species has been described.

Panderodella maxillaris Ulrich and Bassler, 1926

Plate 14, figure 17

1926. *Panderodella maxillaris* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 53, pl. 9, fig. 21.

Holotype.—USNM 11041 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 21); this report (pl. 14, fig. 17).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—*P. maxillaris*, like the other species of *Panderodella*, is based on a fragment of a palmatolepid. The fragment of the blade is curved, and the central node is probably present. The inner platform is completely broken off. This species is indeterminate, and the name is a nomen dubium.

Panderodella truncata Bassler, 1925

Plate 14, figure 28

1925. *Panderodella truncata* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 220.
1926. *Panderodella truncata* [part] Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 52, pl. 9, fig. 15 [not pl. 9, figs. 16, 17=*Palmatolepis glabra*.]
1932. *Panderodella truncata* Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 4.
1956. *Panderodella truncata* Ulrich and Bassler. Müller, Senckenbergische Naturf. Gesell. Abh., v. 494, p. 16.

Lectotype.—USNM 11040 VP, selected by Müller (1956a, p. 16), the specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 15); this report (pl. 14, fig. 28).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The lectotype of this species is a fragment of a palmatolepid conodont including part of the blade with a thin ledge representing part of the inner platform. The denticles in the blade decrease posteriorly as in *Palmatolepis*, and the fragment looks like many other fragments in the collection that are referred certainly to *Palmatolepis*. However, the piece is flat, and no azygous node is present. Since this is true, the generic characters of *Panderodella* cannot be established. Presumably the fragment broke in front of the bend in the carina and the azygous node. There is no platform preserved at the anterior end on either side. The assumed orientation of the specimen in the sandstone is inner side up. This assumption is based on the flatness of the part of the platform preserved because the outside would be raised in

most of the species of *Palmatolepis* found in the "Hardin sandstone".

The lectotype of *Panderodella truncata* in my opinion is congeneric with *Palmatolepis*, but as indicated above this cannot be proved. The species is quite unidentifiable. It could be a fragment of any of the following species and perhaps others: *Palmatolepis glabra* Ulrich and Bassler, 1926; *Palmatolepis elongata* Holmes, 1928; *Palmatolepis inflexa* Müller, 1956; *Palmatolepis serrata acuta* Helms, 1963. Fragments of all these species have been found in topotype material collected from "Hardin sandstone." In view of the fragmentary nature of the lectotype selected by Müller, I think it impossible to establish without question the characters of either the genus or the species. The names *Panderodella truncata* and *Panderodella* are valid but cannot be extended beyond the lectotype.

Genus POLYGNATHELLUS Bassler, 1925

1925. *Polygnathellus* Bassler, Geol. Soc. America Bull., v. 36, p. 220.

1926. *Polygnathellus* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 21.

Type species (by original designation):—*Polygnathellus typicalis* Bassler, 1925.

Geologic range.—Devonian, Lower Mississippian(?).

Description.—Conodont with a flanged bar, arched and slightly bowed laterally. Denticles closely spaced, fused, and generally highest near the middle of the arch. Cusp indistinct and usually wider and slightly longer than the adjacent denticles. Flanges extend the length of the bar on the inside and outside in mature specimens; on younger specimens the flange absent or only partly developed on the outside of the bar. Flange smooth or ornamented with ridges or nodes. Aboral surface has broad attachment area sloping upward with prominent keel. Basal cavity a small pit in the keel.

Remarks.—*Bryantodus*, *Prioniodina*, *Nothognathella*, and *Elictognathus* resemble *Polygnathellus*. Most species of *Bryantodus* are easily distinguished from *Polygnathellus* by the basal projection of the cusp and the lack of flanges on the bar. Species of *Bryantodus* with well-developed flanges, such as *Bryantodus typicus*, can be distinguished by the large cusp and smooth flange. Probably *Polygnathellus* was derived from *Bryantodus typicus* by increasing the width of the flanges and by adding ornamentation on the flanges. *Prioniodina* differs by having discrete denticles and a distinct cusp. *Nothognathella* has incomplete flanges and stronger flange ornamentation than *Polygnathellus*. Possibly *Nothognathella* is a junior subjective synonym of *Polygnathellus*. *Elictognathus* is smaller than *Polygnathellus* and has a flange on one side and lateral keels on the other side. Ulrich and Bassler (1926, p. 53) noted a similarity to *Panderodella* and *Polygnathus*, but these two genera have distinct plates and a distinct free blade or carina.

Polygnathellus germanus (Ulrich and Bassler), 1926

Plate 4, figures 9, 11

1926. *Bryantodus germanus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 25, pl. 10, fig. 18.

?1934. *Polygnathellus nothus* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 224–225, pl. 13, figs. 21, 22 [1933b].

not 1928. *Bryantodus germanus* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 28, pl. 10, fig. 5, a junior homonym= *Bryantodus satellitis* Mound, 1964, new name.

Holotype (by original designation).—USNM 11016 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 18); this report (pl. 4, figs. 9, 11).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—Bar heavy, flanged, slightly arched, and nearly straight except for the posterior tip which is bowed inward. Denticles flattened, sharp edged, and closely spaced; nine anterior and five posterior. Cusp large and flattened at the apex of the arch. Inner flange strong and ornamented with a few small nodes; outer flange a low ridge on side of the bar. Aboral surface keeled with lateral faces sloping upward and marked by growth lines and a narrow crimp 0.04–0.07 mm wide. Length of holotype, 1.74 mm.

In addition to the holotype I have referred five topotype specimens to this species. They are all young specimens and show that the holotype is not a young *Polygnathellus typicalis* but a mature specimen. The amount of development of the ridge on the outside of the bar varies considerably in strength.

Polygnathellus nothus Branson and Mehl, 1934, seems to differ in the number and fusion of denticles but is similar in the development of flanges, arching, position of the cusp, and inward bowing of the posterior tip of the bar.

Occurrence.—Lower Mississippian(?): "Hardin sandstone," Tennessee, probably reworked from Upper Devonian.

Polygnathellus multidens (Ulrich and Bassler), 1926

Plate 4, figures 2–5

1926. *Brayantodus multidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 22, pl. 6, fig. 15 [not pl. 6, fig. 16=*Bryantodus nitidus* Ulrich and Bassler, 1926].

1926. *Bryantodus conjunctus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 24, pl. 4, fig. 9=lectotype, here designated, USNM 11267 VP [not pl. 4, fig. 8=*Bryantodus nitidus* Ulrich and Bassler, 1926].

1926. *Polygnathellus typicalis* [part] Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 53–54, pl. 1, fig. 3 [not pl. 1, figs. 1, 2=*Polygnathellus typicalis* Bassler, 1925].

1926. *Polygnathellus curvatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 54, pl. 1, fig. 4.

1948. *Bryantodus obtusicuspus* Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 51, pl. 15, fig. 6.

Lectotype (here designated).—USNM 11261 VP, specimen figured by Ulrich and Bassler (1926, pl. 6, fig. 15); this paper (pl. 4, fig. 2).

Type locality.—Rhinestreet Shale Member of the West Falls Formation at Weyer, N.Y.

Description.—Unit gently arched and slightly bowed, with strong smooth lateral flanges on both sides of the bar. Cusp slightly larger than the adjacent bar denticles. Denticles and cusp flattened, sharp edged, and fused; 8–12 denticles anterior, about 6 posterior. Aboral surface broad, and inclined upward from a median keel. Basal cavity a small pit without lips in the central third of the bar.

The presence of the smooth flange on the inner and outer sides of the bar distinguishes *P. multidens* (Ulrich and Bassler) from *Polygnathellus typicalis* Bassler. The flanges and gentle arching also distinguish it from *Bryantodus typicus* Bassler. *B. typicus* generally has a triangular bosslike aboral extension of the cusp which is absent in *P. multidens*.

The name *P. multidens* was selected from the available synonyms because its type still exists, and the types of the other species hav been lost, except for the syntype of *P. typicalis* figured by Ulrich and Bassler (1926, pl. 1, fig. 3). However, to have chosen this latter specimen as lectotype and used the name *typicalis* would have changed the concept of the *P. typicalis* as established by Ulrich and Bassler.

Ulrich and Bassler's specimen of *Bryantodus conjunctus* has been lost since it was described in 1926 and is now represented by a mold. The mold and Ulrich and Bassler's figure indicate that the type had an inner and outer smooth flange and therefore probably belongs in *P. multidens*. A notation in Bassler's handwriting on the label of the holotype of *Polygnathellus curvatus* indicates that the specimen was damaged after it was photographed in 1926. At present only part of the original mold is intact, and it is referred to *P. multidens* on the basis of Ulrich and Bassler's original figure and description.

The description was based on the figured types and 18 unfigured paratypes.

Polygnathellus typicalis Bassler, 1925

Plate 4, figures 6–8, 10

1925. *Polygnathellus typicalis* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 220.

1926. *Polygnathellus typicalis* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc. v. 68, art. 12, p. 53–54, pl. 1, figs. 1, 2 [not pl. 1, fig. 3=*Polygnathellus multidens* (Ulrich and Bassler), 1926].

1926. *Prioniodella inequalis* Ulrich and Bassler [part], U.S. Natl. Mus. Proc., v. 68, art. 12, p. 19, pl. 4, fig. 2 [not pl. 4, fig. 3, lost; probably a bryantodid]. Lectotype (here designated) the specimen figured by Ulrich and Bassler, 1926, pl. 4, fig. 2=USNM 11255 VP.

1948. *Bryantodus robustus* Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 51, pl. 15, fig. 1.

Lectotype (*Polygnathellus typicalis* Bassler, here designated).—USNM 11304 VP, specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 1); this report, (pl. 4, fig. 10).

Paralectotype.—USNM 145973 IP, specimen figured by Ulrich and Bassler (1926, pl. 1, fig. 2); this report (pl. 4, fig. 7).

Type locality.—Rhinestreet Shale Member of the West Falls Formation at Weyer, N.Y.

Description.—Unit arched, slightly bowed with flanges on the inside and outside of the full length of the bar, and ornamented with irregular nodes and ridges. Cusp slightly larger than the denticles and, like denticles, flattened, fused, and sharp edged. Attachment area aboral, flat, or slightly inclined upward with median keel and a subcentral small pitlike basal cavity. Length of the bar, 1.5–2.1 mm. There are four to seven anterior denticles and three to seven posterior denticles.

The lectotype of *P. inequalis* Ulrich and Bassler figured on plate 4, figure 6, is thought to be a juvenile specimen with incompletely developed flange on the outside. It is the shortest specimen seen. The description is based on the figured types and three unfigured paratypes.

Genus POLYGNATHUS Hinde, 1879

1879. *Polygnathus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 362–364.

1889. *Polygnathus* Hinde. Miller, North American Geology and Paleontology * * *, p. 520.

1926. *Polygnathus* Hinde. Roundy, *in* Roundy, Girty, and Goldman, U.S. Geol. Survey Prof. Paper 146, p. 13.

1939. *Macropolygnathus* Cooper, Jour. Paleontology, v. 13, no. 4, p. 392.

1957. *Ctenopolygnathus* Müller and Müller, Jour. Paleontology, v. 31, no. 6, p. 1048.

1964. *Polygnathus* Hinde. Ziegler, Klapper, and Lindström, Jour. Paleontology, v. 38, no. 2, p. 421–423.

Type species (by subsequent designation).—Miller, 1889, *Polygnathus dubia* Hinde, 1879. Lectotype of *Polygnathus dubia* Hinde, 1879 (pl. 16, fig. 17), designated by Roundy (1926). *Polygnathus dubia* is regarded as a nomen dubium by Ziegler, Klapper, and Lindström (1964), and they are requesting the International Commission on Zoological Nomenclature to suspend the rules in favor of *Polygnathus* and to permit the selection of a new type species, *Polygnathus robusticostata* Bischoff and Ziegler (1957, pl. 3, figs. 5a, b). Pending action by the Commission, I will use *Polygnathus* as it

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has been generally understood since the publication of Ulrich and Bassler's 1926 report.

Geologic range.—Lower Devonian to Middle Triassic.

Description.—Lanceolate conodonts with a nearly symmetrical thick plate divided by a carina which continues anteriorly into a free blade. Oral surface marked by nodes or ridges; or, rarely, smooth. Aboral side has a continuous keel corresponding to the carina, a small basal cavity, growth lines, and a narrow crimp.

Remarks.—The genus is distinguished from *Ancyrodella* by the shape of the plate and by the lack of secondary keels and secondary carinae. *Pseudopolygnathus* differs from *Polygnathus* by the large size of its basal cavity and narrow unequal platforms marked by strong ridges and troughs perpendicular to the carina. *Siphonodella* is distinguished by a strong rostrum and rostral ridges in most species, by a sharp deflection of the axis immediately posterior to the rostrum, and generally by the presence of both nodes and ridges in oral ornamentation. *Palmatolepis* differs by having a central node, sigmoidal curve of the carina, and generally a thinner plate.

Polygnathus crassulus Ulrich and Bassler, 1926

1926. *Polygnathus crassulus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 48, pl. 8, figs. 8–10.

Holotype.—USNM 11001 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, figs. 8–10).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The specimen on which this species is based is lost, and all that remains is a mold of the aboral surface. There are no other known specimens, and it is therefore a nomen dubium.

Polygnathus delicatula Ulrich and Bassler, 1926

Plate 14, figures 20, 22–24; plate 16, figure 19

1926. *Polygnathus delicatulus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 45, pl. 7, figs. 9, 10.

?1935. *Polygnathus delicatula* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 9, no. 4, p. 314, pl. 27, fig. 37.

not 1939. *Polygnathus delicatula* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 13, no. 4, p. 400, pl. 40, figs. 37, 38=*Polygnathus radina Cooper*, 1939.

Lectotype (designated by Klapper, 1966).—USNM 10994 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 9); this report (pl. 14, figs. 22–24).

Paralectotype.—USNM 145932 IP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 10); this report (pl. 14, fig. 20).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—A slender polygnathid with a thick plate, slightly arched and bowed. Free blade nearly as long as the plate. Oral surface marked by faint irregularly spaced ridges, sharp or slightly nodose, perpendicular to the carina. Carina high, fused (broken on lectotype), and flanked by shallow troughs becoming deeper anteriorly. Anterior part of the plate not pinched as in *P. pennata*, but there is a suggestion of rostral ridges. Basal cavity, a large shallow and thick-lipped pit. Length of lectotype, 1.1 mm; width, 0.32 mm; crimp, 0.07 mm; paralectotype length, 1.3 mm; width, 0.28 mm.

This description is based on an examination of the types and 130 specimens in the topotype collection. This species is similar to *Polygnathus pennata* but differs in shape and by having a large thick-walled escutcheon.

Polygnathus germana Ulrich and Bassler, 1926

Plate 14, figures 29, 30

1926. *Polygnathus germanus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 46, pl. 7, figs. 11, 12.

?1931. *Polygnathus germanus* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 5, no. 2, p. 150, pl. 20, fig. 15. Probably some other species.

1934. *Polygnathus nodocostata* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 246, pl. 20, figs. 9–13; pl. 21, fig. 15 [1933b].

1934. *Polygnathus signata* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 98, pl. 8, fig. 11.

1943. *Polynathus nodocostata* Branson and Mehl. Grohskopf, Clark, and Ellison, Missouri, Geol. Survey and Water Resources, 62d bienn. rept., app. 4, p. 16, figs. 14–16.

1947. *Polygnathus nodocastata* Branson and Mehl. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 33, pl. 2, fig. 22.

1961. *Polygnathus nodocostata* Branson and Mehl. Freyer, Freiberger Fortschungshefte, C 95, p. 72.

1961. *Polygnathus nodocostata* Branson and Mehl. Beach, Brigham Young Univ. Geology Studies, v. 8, p. 47, pl. 5, fig. 14.

1961. *Polygnathus nodocostata* Branson and Mehl. Helms, Geologie, v. 10, no. 6, p. 686. [Designates lectotype of *P. nodocostata*].

1961. *Polygnathus nodocostata nodocostata* Branson and Mehl, Helms, Geologie, v. 10, no. 6, p. 687. pl. 1, figs. 17, 21, 23; pl. 2, figs. 16–20; text fig. 6.

1961. *Polygnathus nodocostata incurvata* Helms, Geologie, v. 10, no. 6, p. 686, pl. 1, figs. 14–16; text fig. 5.

?1961. *Polygnathus nodocostata ovata* Helms, Geologie, v. 10, no. 6, p. 688, pl. 1, figs. 25, 26; pl. 2, figs. 24, 27, 28; text fig. 7. Probably this is a junior subjective synonym of *Polygnathus granulosa* Branson and Mehl.

1962. *Polygnathus nodocostata* Branson and Mehl. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 90, pl. 10, figs. 2, 9–15.

Holotype.—USNM 10997 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, figs. 11, 12); this report (pl. 14, figs. 29, 30).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype of *P. germana* is embedded in sandstone, and the oral part of the blade is missing. The nodes are alined parallel to the carina on the outer platform. The carina continues nearly to the tip of the plate. The nodes on the inner plate are arranged in arcuate rows. The anterior trough is deep on the inner plate next to the blade and absent on the outside. Blade of the holotype, 0.32 mm long; plate, 0.37 mm wide and 0.76 mm long. The aboral side has not been seen. No topotype specimens have been found.

It is to be regretted that the original illustration of this species was so poor that it could not be recognized by Branson and Mehl and Huddle. Certainly *P. nodocostata* has been more widely used than *P. germana*, but *P. germana* is clearly the senior subjective synonym and must be used.

Polygnathus glabra Ulrich and Bassler, 1926

Plate 15, figures 13–17

1926. *Polygnathus glaber* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 46, pl. 7, fig. 13.
1955. *Polygnathus glaber* Ulrich and Bassler. Sannemann, Senckenbergiana Lethaea, v. 36, no. 1–2, p. 149, pl. 3, fig. 14.
1956. *Polygnathus glabra* Ulrich and Bassler. Bischoff, Hesse Landesamt Bodenforschung Notizblatt, v. 84, p. 133, pl. 9, figs. 24, 25.
1956. *Polygnathus glabra* Ulrich and Bassler. Bischoff and Ziegler, Hesse Landesamt Bodenforschung Notizblatt, v. 84, p. 157.
1961. *Polygnathus glabra* Ulrich and Bassler. Freyer, Freiberger Forschungshefte, C 95, p. 70–71.
1962. *Polygnathus glabra glabra* Ulrich and Bassler. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 89, pl. 10, figs. 18–20.

Holotype.—USNM 11004 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 13); this report (pl. 15, fig. 13).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description of holotype.—Small polygnathid with smooth oral surface, lanceolate, pointed posteriorly. Blade about one-half as long as the plate. Deep troughs on either side of the carina. The anterior part of the outer platform is broken in the holotype, and the aboral side is not exposed. This is the only specimen found in the Ulrich and Bassler collections.

Bischoff (1956, p. 133) distinguished *P. glabra* from *P. communis* Branson and Mehl on the basis of the shape of the platform and the thick-lipped rounded escutcheon in *P. communis*. Freyer (1961, p. 70) figured different shapes of *P. glabra* in different growth stages and reported transitional forms in the shape and development of the escutcheon between *P. glabra* and *P. communis*. Ziegler (1962a, p. 89–90) recognized two subspecies of *P. glabra*. According to Gilbert Klapper (oral commun., 1963), the keel is depressed and flattened immediately behind the escutcheon in *P. communis* but not in *P. glabra*. Charles Collinson (written commun., 1965) agrees that this is the only reliable distinction. He also reported that examples of *Polygnathus glabra* are rare in collections containing prolific conodonts. This fact and their small size lead him to suggest that *Polygnathus glabra* is based on juveniles or insignificant variations of other species.

Occurrence.—Mississippian(?): "Hardin sandstone," Tennessee (probably reworked). Upper Devonian: *Cheiloceras*-Stufe to *Platyclymenia*-Stufe, Germany (*to* II α–*to* III α). Collinson (written commun., 1965) reports that *Polygnathus glabra* ranges from *to* I to *to* V, and *Polygnathus communis* ranges from *to* V to *Cu* II.

Polygnathus pennata Hinde, 1879

Plate 14, figures 18, 19, 21, 31

1879. *Polygnathus pennatus* Hinde, Geol. Soc. London Quart. Jour., v. 35, p. 366, pl. 17, fig. 8.
1921. *Polygnathus pennatus* Hinde. Bryant, Buffalo Soc. Nat. Sci., v. 13, no. 2, p. 23, pl. 10, figs. 3, 4, 7 [not pl. 10, figs. 1, 2, 5, 6, 8, 9=*Polygnathus rugosa* Huddle].
1926. *Gnathodus*? sp. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 54, pl. 1, fig. 5.
1926. *Polygnathus rimulatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 45, pl. 1, figs. 8, 9. Lectotype here designated the specimen figured by Ulrich and Bassler, pl. 1, fig. 8.
1926. *Polygnathus pennatulus* [part] Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, pl. 9, fig. 25. [not pl. 7, fig. 8=*P. pennatula* nor pl. 9, fig. 24=*Palmatolepis marginata clarki*]
1926. *Polygnathus pennatus* Hinde. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 44, text fig. 5, figs. 6, 7.
1933. *Polygnathus pennata* Hinde. Branson and Mehl, Missouri Univ. Studies, v. 8, no. 2, p. 144–145, pl. 11, fig. 3.
not 1949. *Polygnathus pennatus* Hinde. Beckman, Senckenbergiana, v. 30, no. 1–3 p. 155, pl. 1, figs. 4, 5=*Polygnathus ordinata* Bryant.
not 1956. *Polygnathus rimulata* Ulrich and Bassler. Bischoff and Ziegler, Hesse Landesamt Bodenforschung, Notizblatt, v. 84, p. 158, pl. 12, fig. 7=*Polygnathus decorosa* Stauffer?
1957. *Polygnathus pennata* Hinde. Bischoff and Ziegler, Hesse Landesamt Bodenforschung. Abh., v. 22, p. 94–95, pl. 17, figs. 14, 16–30; pl. 21, fig. 32.
1964. *Polygnathus pennata* Hinde. Orr, Illinois Geol. Survey Cir. 361, p. 18–20, pl. 1, fig. 6; pl. 4, figs. 5–6.
(See this paper for other references.)

Hypotypes.—USNM 11302 VP, 140112 IP, 145934 IP, specimens figured by Ulrich and Bassler (1926, pl. 1, figs. 8, 5, and 9, respectively); this report (pl. 14, figs. 31, 18, and 21, respectively).

Locality.—Rhinestreet Shale Member of the West Falls Formation at Weyer, N.Y.

Descriptions.—Plate lanceolate, asymmetrical, slightly bowed and arched, narrow, and thick with a strong carina composed of fused denticles and nodes flanked by troughs. Outer platform wider than inner in mature specimens. Ornamentation consists of nodes and short ridges perpendicular to the carina, strongest at the raised rim and becoming weaker toward the carina. Many mature specimens have deep anterior troughs and a tendency to develop a rostral ridge. These specimens have a characteristic pinch anteriorly. Free blade shorter than plate with seven to eight fused flattened denticles, highest near the anterior end. Aboral side marked by a high thin keel, small basal cavity, growth lines, and a wide steeply slanted crimp.

This species is quite variable in shape, ornamentation, and the presence or absence of rostral ridges. The specimen shown on plate 14, figure 21, is typical of mature specimens. Younger specimens and some mature specimens are narrower and more nearly symmetrical and lack rostral ridges of typical mature forms.

The length of the plate ranges from 0.48 to 0.97 mm and averages 0.75 mm. The width of the plate ranges from 0.16 to 0.34 mm and averages 0.28 mm. The length of the blade ranges from 0.30 to 0.48 mm and averages 0.39 mm. The blade-plate ratio ranges from 1:1.35 to 1:2.50 and averages 1:1.89. The width-length ratio of the plate ranges from 1:2.21 to 1:3.59 and averages 1:2.73.

This description is based on the examination of the types of *P. rimulata* Ulrich and Bassler and 18 specimens from the original Ulrich and Bassler collection which were measured. The lectotype of *P. rimulata* has elongate nodes near the rim, a deep trough on each side of the high carina, and a rostral ridge on one side (other side broken ?). The plate is 0.74 mm long and 0.27 mm wide. The length-width ratio is 1:2.74, and the free blade is 0.48 mm long. The plate-blade ratio is 1:1.54. This specimen is not typical of *P. pennata* but falls within the range of variation of the species, in my opinion. It was chosen as a lectotype so that the name *rimulata* would be available if later revisers find it valid.

The species differs from *P. decorosa* Stauffer by having a shorter free blade and smaller escutcheon. It differs from *P. rugosa* Huddle by the shape of the plate and ornamentation. *P. rugosa* has sharp ridges which extend almost to the carina. *P. ordinata* Bryant differs in shape and by the presence of strong ridges paralleling the carina on the anterior part of the plate.

Occurrence.—Mississippian(?): "Hardin sandstone," probably reworked. Upper Devonian: Genessee and West Falls Formations, New York; Alto Formation of Savage (1920), Illinois; Houy Formation, Texas; Adorf-Stufe, Germany. Middle Devonian: Givet-Stufe, Germany.

Polygnathus pennatula Ulrich and Bassler, 1926

Plate 15, figures 11, 12

1926. *Polygnathus pennatulus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 45, pl. 7, fig. 8, text fig. 5, no. 7, [not pl. 9, fig. 24=*Palmatolepis marginata clarki?* Ziegler, nor pl. 9, fig. 25=*Polygnathus*, young specimen probably *P. pennata* Hinde].

1926. *Polygnathus pinnatuloideus* Holmes, *in* Butts, Alabama Geol. Survey, Spec. Rept. 14, p. 160, pl. 48, fig. 12 [not *P. pennatuloideus* Holmes, 1928].

1928. *Polygnathus pennatulus* Ulrich and Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 33, pl. 11, fig. 15.

?1931. *Polygnathus pennatulus* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 5, no. 2, p. 150, pl. 20, fig. 14 [not determinable].

1932. *Polygnathus pennatulus* Ulrich and Bassler. Bassler, Tennessee Div. Geology, Bull. 38, p. 234, pl. 26, fig. 15.

1934. *Polygnathus triangularis* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 247, pl. 21, figs. 16, 20 [1933b].

not 1941. *Polygnathus triangularis?* Ellison and Graves, Missouri Univ. School of Mines and Metallurgy Bull., Tech. Ser., v. 14, no. 3, pl. 2, fig. 18.

?1945. *Polygnathus triangulatus* Branson and Mehl. Cooper (misspelled), Jour. Paleontology, v. 19, no. 6, p. 614, pl. 84, fig. 17.

1949. *Polygnathus triangularis* Branson and Mehl. Thomas, Geol. Soc. America Bull., v. 60, no. 3, p. 435, pl. 2, fig. 30.

Lectotype (here designated).—USNM 10996 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 8); this paper (pl. 15, fig. 12). The other specimens figured by Ulrich and Bassler (1926, pl. 9, figs. 24, 25) are *Palmatolepis marginata clarki* Ziegler, 1962, and *Polygnathus sp.* (probably *pennata*), USNM 145935 IP and USNM 145936 IP, respectively.

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—Thick polygnathid with a subtriangular, slightly arched and bowed plate, and a high carina flanked by deep troughs. Oral surface of plate marked by sharp ridges perpendicular to the carina on the posterior part, less distinct anteriorly. Free blade short, bearing about six fused denticles, broken on the lectotype. Trough deep and short. Aside from the size, the lectotype of *P. pennatula* is quite similar to the specimen of *P. triangularis* figured by Branson and Mehl (1933b, pl. 21, fig. 20) in outline, size of trough, slight bowing of carina, and strength of ornamentation. The lectotype of *P. pennatula* is smaller and less mature than the specimens figured by Branson and Mehl (1933b, pl. 21, figs. 16 and 20).

Description based on the lectotype and three specimens from Gassaway Member of Chattanooga Shale in the collection studied by Holmes (1928).

Occurrence.—Mississippian(?): "Hardin sandstone," probably reworked. Lower Carboniferous: Germany? (Bischoff, 1957), Upper Devonian: Gassaway Member of the Chattanooga Shale; Grassy Creek Shale, Missouri; Maple Mill Shale of Bain (1895), Iowa.

Polygnathus sublata Ulrich and Bassler, 1926

Plate 16, figures 10, 11, 14–18

1926. *Polygnathus sublatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 47, pl. 8, fig. 2.
1934. *Polygnathus varinodosa* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 249, pl. 20, fig. 15; pl. 21, figs. 9, 11, 12, 18 [1933b].
?1947. *Polygnathus sublatus* Ulrich and Bassler. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 34, pl. 2, fig. 23.
?1947. *Polygnathus varinodosa* Branson and Mehl. Youngquist and Peterson, Jour. Paleontology, v. 21, no. 3, p. 252, pl. 38, fig. 10.

Holotype.—USNM 11009 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 2); this report (pl. 16, figs. 10, 11).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—Plate thick with subequal inner and outer platforms; oral surface marked by irregularly arranged nodes and short ridges. Carina does not reach posterior tip on holotype but almost reaches in other specimens. Carina prominent, raised, thickened without lateral troughs except near the anterior end of the plate on the outside. Free blade broken off the holotype, short, high in middle with four or five fused denticles on paratypes. Aboral side has sharp keel which is low in the middle and high at the ends. Crimp narrow. Basal cavity, a small narrow pit.

The holotype is gerontic and considerably larger than the topotypes. It is 1.96 mm long and 1.03 mm wide. An unfigured paratype is 1.8 mm long and 0.8 mm wide. The other specimens are broken or young and were not measured.

I have not seen the Branson and Mehl types of *Polygnathus varinodosa*, and this species is placed in synonymy on the basis of published figures.

Material studied.—The holotype, two unfigured paratypes (USNM 11009 b, c) and six topotype specimens.

Occurrence.—Mississippian(?): "Hardin sandstone," probably reworked. Upper Devonian: Ohio Shale, Ohio; Grassy Creek Shale, Missouri; Sheffield Formation of Fenton (1919), Iowa.

Genus POLYLOPHODONTA Branson and Mehl, 1934

1934. *Polylophodonta* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 242 [1933b].
1962. *Polylophodonta* Branson and Mehl. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 95–96.

Type species.—*Polylophodonta gyratilineata* Holmes, 1928, a junior synonym of *P. pergyrata* Holmes, 1926 (in Butts).

Geologic range.—Upper Devonian.

Diagnosis.—Polygnathids with a thick plate, short free blade, concentric ornamentation, and no carina on the posterior part of the plate. Basal cavity small or absent. The distinguishing characters are the concentric ornamentation and the lack of a carina on the posterior part of the plate. There is a short trough on one side of the short fixed blade, but this is also present in some very similar species of *Polygnathus*. The genus has only a few species with a very limited range.

Polylophodonta concentrica (Ulrich and Bassler), 1926

Plate 17, figures 3–7, 10

1926. *Polygnathus concentricus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 47, pl. 8, figs. 6, 7.
1926. *Polygnathus trilobatus* Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 160, pl. 48, fig. 16.
1928. *Polygnathus concentricus* Ulrich and Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 32, pl. 11, figs. 5–7.
1928. *Polygnathus trilobatus* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 31, pl. 11, fig. 4.
1932. *Polygnathus concentricus* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 19.
1934. *Polylophodonta concentrica* (Ulrich and Bassler). Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 243, pl. 20, fig. 2 [1933b].
?1934. *Polylophodonta rugosa* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 244, pl. 20, figs. 4, 5 [1933b].
1934. *Polygnathus concentrica* Ulrich and Bassler, Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 105, pl. 9, fig. 18.
1949. *Polylophodonta acuta*? Thomas, Geol. Soc. America Bull., v. 60, no. 3, p. 419, pl. 1, fig. 31.

Lectotype (here designated).—USNM 11002 VP, specimen figured by Ulrich and Bassler (1926, pl. 8, fig. 6); this report (pl. 17, fig. 3).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Description.—Plate thick, tongue shaped, and arched lengthwise and crosswise with the highest point near the middle of the plate. Inner and outer platforms nearly equal; axis slightly bowed laterally. Blade short; carina dies out before reaching the middle of the plate but continues on the posterior half as a wide rounded ridge highest near the middle of the plate and crossed by concentric rows of nodes or broken ridges. There is

considerable variation in the strength and arrangement of the nodes and short sinuous ridges, but they always have a concentric pattern. There is a small trough on one side of the blade at the anterior end of the plate.

Occurrence.—Mississippian(?): "Hardin sandstone," probably reworked. Upper Devonian: Gassaway Member of the Chattanooga Shale, Alabama, Georgia, Tennessee, and Kentucky; Grassy Creek Shale, Missouri; New Albany Shale, Indiana; Maple Mill Shale of Bain (1895), Iowa.

Polylophodonta confluens (Ulrich and Bassler), 1926

Plate 17, figures 1, 2, 8, 9, 11

1926. *Polygnathus confluens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 46, pl. 7, figs. 14, 15.
1926. *Polygnathus rhomboideus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 46, pl. 7, fig. 6.
1928. *Polygnathus rhomboideus* Ulrich and Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 32, pl. 11, figs. 11, 12.
1934. *Polygnathus linguiformis* Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 244, pl. 20, figs. 6, 7 [not pl. 20, fig. 1=*Polylophodonta gyratilineatus* (Holmes)] [1933b].
1934. *Polygnathus rhomboidea*? Ulrich and Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 99, pl. 8, fig. 18.
1956. *Polyophodonta confluens* (Ulrich and Bassler). Hass, U.S. Geol. Survey Prof. Paper 286, pl. 3, fig. 10.
1957. *Polylophodonta confluens* (Ulrich and Bassler). Hass, *in* Cloud, Barnes, and Hass, Geol. Soc. America Bull., v. 68, no. 7, p. 809, pl. 4, fig. 12.
1959. *Polylophodonta confluens* (Ulrich and Bassler). Hass, U.S. Geol, Survey Prof. Paper 294–J, pl. 50, fig. 18.
1961. *Polylophodonta confluens* (Ulrich and Bassler). Helms, Geologie, v. 10, no. 6, p. 698, pl. 3, figs. 13, 14; text fig. 14.
1961. *Polylophodonta linguiformis* Branson and Mehl. Helms, Geologie, v. 10, no. 6, p. 699, pl. 3, figs. 1, 24; text fig. 16.

Lectotype (here designated).—USNM 10998 VP, specimen figured by Ulrich and Bassler (1926, pl. 7, fig. 14); this report (pl. 17, fig. 1).

Description.—Relatively narrow arched plate with a short carina confined to the anterior part of the plate and with rows of nodes or short ridges arranged like horseshoes around the carina on the anterior part of the plate and in transverse ridges across the posterior part of the plate.

P. confluens has definite rows of nodes parallel to the carina on the anterior part of the plate and transverse ridges or nodes on the posterior part of the plate. The axial line is straighter and less raised, and the outline of the plate is smoother than in *P. concentricus*, which tends to have a slightly bowed axis, concentric rows of nodes, and a trilobate outline.

Aboral side concave with a low continuous keel highest at the ends. Basal cavity a small slit just anterior to the lowest point or absent. Crimp narrow, 0.05–0.09 mm wide. The aboral side not exposed on types.

The length of nine specimens ranged from 1.86 to 2.30 mm, and the width from 0.80 to 1.24 mm.

The description is based on the examination of the Ulrich and Bassler and Holmes types and on one topotype specimen.

Remarks.—*Polylophodonta concentrica* is characterized by its tendency to have a trilobate outline, by concentric ornamentation of nodes and short ridges, and by a bowed, thickened axial ridge in the position of the carina. There is a trough at the anterior end of the plate only on the outside. There is considerable variation in outline and ornamentation, but most specimens can be assigned to one of the three closely related species, *P. concentrica*, *P. confluens*, and *P. pergyrata*.

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Occurrence.—Mississippian(?): "Hardin sandstone," probably reworked. Upper Devonian: Gassaway Member of the Chattanooga Shale, Tennessee, Alabama; Grassy Creek Shale, Missouri; New Albany Shale, Indiana; Houy Formation, Texas; *Platyclymenia*-Stufe (*to* III) Thuringia, East Germany.

Polylophodonta pergyrata (Holmes), 1926

Plate 12, figures 23, 24; plate 16, figures 12, 13; plate 17, figure 12

1926. *Polygnathus*? *acaulis* Ulrich and Bassler, U.S. Natl. Mus. Proc. v. 68, p. 47, pl. 8, fig. 5 (not pl. 8, fig. 4, lectotype).
1926. *Polygnathus pergyratus* Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 160, pl. 48, fig. 15.
1928. *Polygnathus gyratilineata* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 31, pl. 11, figs. 1, 2. Ziegler (1962, p. 96) designated specimen figured by Holmes (1928, pl. 11, fig. 1) as lectotype.
1928. *Polygnathus pergyratus* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 31, pl. 11, fig. 3.
1934. *Polylophodonta gyratilineata* (Holmes). Branson and Mehl, Missouri Univ. Studies, v. 8, no. 3, p. 242–243, pl. 20, fig. 3 [1933b].
1934. *Polygnathus gyratilineata* Holmes, Huddle, Bull. Amer. Paleontology, v. 21, no. 72, p. 106, pl. 9, fig. 20.
1961. *Polylophodonta gyratilineata* (Holmes). Helms, Geologie, v. 10, no. 6, p. 699, pl. 1, fig. 8, text fig. 15.
1962. *Polylophodonta confluens* (Ulrich and Bassler). Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W61, text fig. 36, no. 9.
1962. *Polylophodonta linguiformis* Branson and Mehl. Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 97, pl. 9, figs. 16, 17.
1962. *Polylophodonta gyratilineata* (Holmes). Ziegler, Hesse Landesamt Bodenforschung Abh., v. 38, p. 96, pl. 9, figs. 17, 19, 20.

Type (only figured specimen).—USNM 11455 VP, specimen figured in Butts (1926, pl. 48, fig. 15) and Holmes (1928, pl. 11, fig. 3); this report (pl. 12, fig. 24).

Type locality.—Gassaway Member of the Chattanooga Shale, Quicks Mill, Ala.

Description.—Plate broad, thick, high in the center with the carina only on the anterior part of plate; posterior tip rounded or pointed. Axis of the posterior part of the plate flat on most specimens and raised slightly on a few. Anterior trough short, more prominent on one side of the fixed blade than the other. Oral surface ornamented by concentric ridges, nearly continuous on most specimens, but sometimes a few ridges break into pustules. The free blade is short, ranging from 0.35 to 0.71 mm on eight unfigured paratypes. The length and width of 11 unfigured paratypes were measured. The length of these paratypes ranged from 1.24 to 2.84 mm and averaged 1.98 mm. The width of the same specimens ranged from 0.67 to 1.33 mm and averaged 1.07 mm. The ratio of length to width of these specimens ranged from 1.65:1 to 2.13:1 and averaged 1.84:1. The relatively wide plate is characteristic of the species.

Remarks.—*Polylophodonta pergyrata* is characterized by large gently arched plates ornamented with nearly continuous concentric ridges. These ridges are present on the smallest (youngest) specimens found and are present on the largest (gerontic) specimens. There is no evidence to indicate that *P. pergyrata* is a growth stage of *P. confluens* or *P. concentrica;* therefore *P. pergyrata* is here regarded as a distinct species.

Occurrence.—Upper Devonian: Gassaway Member of the Chattanooga Shale, Alabama; Grassy Creek Shale, Missouri; New Albany Shale, Indiana; upper *Cheiloceras*-Stufe (*to* IIβ), lower part of the lower *Platyclymenia*-Stufe (*to* IIIα), Germany.

Genus PRIONIODINA Bassler, 1925

1925. *Prioniodina* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1925. *Prioniodella* Bassler, Geol. Soc. America Bull., v. 36, no. 1, 219.
1926. *Prioniodina* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art 12, p. 18.
1926. *Prioniodella* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 18.
1954. *Prioniodina* Bassler. Lindström, Geol. Fören. Stockholm, Förh., v. 76, p. 585–586.
1959. *Prioniodina* Bassler. Sweet, Turco, Warner, and Wilkie, Jour. Paleontology, v. 33, no. 6, p. 1059–1060.
1962. *Prioniodina* Bassler. Ethington and Furnish, Jour. Paleontology, v. 36, no. 6, p. 1282–1283.
1964. *Prioniodina* Bassler. Lindström, Conodonts, p. 150.

Type species (by original designation).—*Prioniodina subcurvata* Bassler, 1925.

Geologic range.—Middle Silurian to Middle Triassic.

Description.—Arched conodonts with anterior and posterior bars and a subcentral cusp. Bar rounded, arched and straight, or slightly bowed inward. Cusp near the top of the arch in the central third or indistinguishable. Posterior bar about one-third the length of the anterior bar. Cusp and denticles subparallel, rounded, pointed, discrete, and separated or closely appressed. Basal cavity a pit continuous with an aboral groove on the flat attachment area in Devonian species. Ordovician species have an open thin-walled basal cavity that extends nearly the length of the bars with the deepest part below the cusp. Post-Ordovician species tend to close the basal groove and to form a flat attachment surface.

Remarks.—*Prioniodina* is distinguished by the presence of posterior and anterior bars, arching, a subcentral cusp, and discrete denticles. It is similar to *Bryantodus* from which it is distinguished by the shape of the bar and the confluence of the denticles. *Lonchodina* differs in the offset of the anterior and posterior bars, by having stronger lateral bowing, and in the irregularity of the denticles. *Synprioniodina* differs by having a terminal cusp and an anticusp instead of an anterior bar. *Ozarkodina* is distinguished by the flattened bar and by appression and confluence of the denticles.

Lindström (1954, p. 586) did not think that either the size of the cusp or the relative lengths of the bars were sufficient criteria to distinguish *Prioniodina* and *Euprioniodina.* He has been followed by most of the European workers in regarding *Euprioniodina* a junior subjective synonym of *Prioniodina.* Probably Lindström was misled by the incomplete description given by Ulrich and Bassler. Nevertheless, to include such species as *Euprioniodina deflecta* Bassler and *E. perangulata* Ulrich and Bassler (here referred to *Synprioniodina*) in *Prioniodina* is to include in the genus forms quite different in shape and arrangement of the parts from the type species of the genus, *P. subcurvata* Bassler, 1925, and I regard *Synprioniodina* as a distinct genus.

Prioniodella is suppressed as a synonym of *Prioniodina* because the type species, *Prioniodella normalis*, is a junior synonym of *Prioniodina subcurvata.*

Prioniodina robusta (Ulrich and Bassler), 1926

Plate 1, figure 23

1926. *Prioniodella robusta* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 26, pl. 10, fig. 24.

Holotype.—USNM 10990 VP, specimen figured by Ulrich and Bassler (1926, pl. 10, fig. 24); this report (pl. 1, fig. 23).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—Preparation of this specimen shows that it has a cusp and a twisted bar which is arched and bowed. Clearly it belongs in *Prioniodina*, but it is not well enough preserved for adequate description of the species and no other specimens are known. Possibly it is a junior synonym of *Prioniodina arcuata.*

Prioniodina subcurvata Bassler, 1925

Plate 1, figures 1–8

1925. *Prioniodina subcurvata* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1925. *Prioniodella normalis* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1926. *Prioniodina separata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 18, pl. 4, figs. 17, 18. Lectotype, here designated as the specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 18).
1926. *Prioniodina subcurvata* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 18, pl. 4, figs. 22–24.
1926. *Prioniodella normalis* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 19, pl. 4, figs. 1, 1′.
1926. *Bryantodus semiseparatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 24, pl. 4, fig. 16.
1928. *Euprioniodina germana* Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 28, pl. 10, fig. 7.

Lectotype (here designated).—USNM 11252 VP, specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 23); this report (pl. 1, fig. 2).

Paralectotypes.—USNM 145939 IP, 145940 IP, specimens figured by Ulrich and Bassler (1926, pl. 4, figs. 22 and 24, respectively); this report (pl. 1, figs. 1 and 3, respectively).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar rounded, arched slightly to moderately, straight or slightly bowed, with attachment areas on the sides of the ends of the bars and on the aboral surface. Basal cavity, a small pit and continues into grooves along the aboral surface of the bar. Cusp slightly larger than the denticles, oval in cross section. Denticles closely spaced, discrete; 6–8 on the posterior bar and 8–13 on the anterior bar. Length of bar, 1.1–1.3 mm; height from a line drawn between the tips of bar to tip of cusp, 0.8–0.9 mm; length anterior bar, 0.7–0.9 mm; length posterior bar, 0.4–0.6 mm. The description is based on the examination of eight specimens including the figured types and seven unfigured paratypes.

Cleaning the type of *Prioniodella normalis* Ulrich and Bassler exposed the cusp on the holotype. Now that the whole specimen is exposed, it clearly is a junior subjective synonym of *Prioniodina subcurvata*. *Prioniodina separata* Ulrich and Bassler was distinguished on the basis of position of cusp, arching of the bar, and shape of the denticles, but these differences are slight, and they seem to me to fall within the range of variation seen in other specimens in this collection. The cusp is subcentral rather than near the posterior end as in other examples of *P. subcurvata*. *Euprioniodina germana* Holmes is larger than the type specimens of *P. subcurvata* but seems to belong in the same species. The holotype of *B. semiseparatus* agrees well with the types of *P. subcurvata* and is a junior subjective synonym.

Occurrence.—Upper Devonian: West Falls Formation, New York; Gassaway Member of the Chattanooga Shale, Alabama.

Prioniodina transitans (Ulrich and Bassler), 1926

Plate 1, figures 9–12

1926. *Bryantodus transitans* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 26, pl. 4, figs. 10, 11.
1926. *Bryantodus nitidus?* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 24, pl. 4, fig. 14 [not pl. 4, figs. 12, 13 = *Bryantodus nitidus* Ulrich and Bassler, 1926.]
?1926. *Prioniodella aequidens* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 19, pl. 4, figs. 6, 7.

Lectotype (here designated).—USNM 11262 VP, specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 11); this report (pl. 1, fig. 10).

Paralectotype.—USNM 145942 IP, specimen figured by Ulrich and Bassler (1926, pl. 4, fig. 10); this report (pl. 1, fig. 9).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar flattened, gently arched, and slightly bowed inward. Cusp and denticles flattened, sharp edged, and discrete. Cusp slightly larger than denticles in the posterior third of the bar. Aboral edge of bar flattened; basal cavity a large pit below cusp and extends into grooves along the midline. There are eight to nine anterior denticles and four to six posterior denticles. The length of the unit is 0.9–1.4 mm; the posterior bar is 0.4–0.5 mm long and the anterior is 0.6–0.9 mm long; the height from a line drawn between the tips of the bars to tip of the cusp is 0.6–0.7 mm.

This species is very similar to *Bryantodus nitidus* and *Prioniodina subcurvata*. The denticles are not closely appressed as in *B. nitidus* but are more closely spaced than *P. subcurvata*. *P. transitans* is less arched than *P. subcurvata* and lacks the basal projection of the cusp and sharp aboral edge of *B. nitidus*. The description is based on the three figured specimens, and the species is doubtfully distinct. The type specimen of *Prioniodella aequidens* has about the same size and arrangement of denticles but apparently lacks the distinct cusp of *Prioniodina transitans*. It is a broken specimen and is doubtfully referred to *P. transitans*.

Prioniodina transversa (Ulrich and Bassler), 1926

Plate 1, figures 14, 21

1926. *Lonchodina transversa* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 34–35, pl. 6, figs. 2, 3.

Lectotype (here designated).—USNM 11289 VP, specimen figured by Ulrich and Bassler (1926, pl. 6, fig. 3); this report (pl. 1, fig. 21).

Paralectotype.—USNM 145944 IP, specimen figured by Ulrich and Bassler (1926, pl. 6, fig. 2); this report (pl. 1, fig. 14).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar thick, nearly straight, and slightly bowed; posterior bar slightly deflected downward; basal surface inclined toward inside and marked by grooves and attachment scars. Cusp about twice as large as adjacent denticles, straight, parallel sided, and oval in cross section. Denticles similar to cusp in shape; six to eight on anterior bar, four to five on posterior bar. Basal cavity a small pit.

The distinctive features of this species are the nearly straight bar and nearly erect denticles. The description is based on the two type specimens and one unfigured paratype. *Lonchodina subsymmetrica* is similar, but this species is strongly bowed and has a boss below the cusp. I think that *P. transversa* is a distinct species, but it may be an extreme variant of *P. subcurvata.*

Genus SYNPRIONIODINA Bassler, 1925

1925. *Synprioniodina* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1925. *Euprioniodina* Bassler, Geol. Soc. America Bull., v. 36, no. 1, 219.
1926. *Synprioniodina* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 42.
1926. *Euprioniodina* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 29.
1962. *Synprioniodina* Bassler. Hass, *in* Moore, Treatise on invertebrate paleontology, pt. W, Miscellanea, p. W50.
1964. *Synprioniodina* Bassler. Lindström, Conodonts, p. 149.

Type species (by original designation).—*Synprioniodina alternata* Bassler, 1925.

Geologic range.—Silurian to Mississippian.

Diagnosis.—Posterior bar arched and bowed with anteriorly directed, closely spaced, discrete or fused denticles; terminal cusp and denticulated anticusp. The posterior bar and anticusp form an acute aboral angle in most species. Basal cavity beneath the cusp expanded on the inner side. Denticles apparently inserted, and suppressed denticles are common.

There has been considerable confusion over the validity and relationships of the genera *Prioniodus*, *Euprioniodina*, *Synprioniodina*, and *Prioniodina*. Öpik (1936, p. 107) and Lindström (1954, p. 588) have shown that the type species of *Prioniodus* Pander had a central cusp and anterior, posterior, and lateral bars. It is quite unlike the species placed in *Prioniodus* by Hinde (1879), Ulrich and Bassler (1926), and Branson and Mehl (1933 a, b, c). Rhodes and Müller (1956, p. 698–699) proposed a new generic name, *Neoprioniodus*, for the species excluded from *Prioniodus* by the recognition by Öpik and Lindström of the true characters of *Prioniodus.*

Lindström (1954, p. 585–586) regarded *Euprioniodina* as a junior synonym of *Prioniodina.* Sannemann (1955b, p. 151) placed both *Euprioniodina* and *Synprioniodina* as junior synonyms of *Prioniodina.* Many subsequent workers, including Ethington and Furnish (1962), have accepted this synonymy. Hass (1962) accepted *Prioniodina*, *Euprioniodina*, *Synprioniodina*, and *Neoprioniodus* as valid and distinct. Lindström (1964, p. 149–150) recognized *Neoprioniodus* and *Synprioniodina* but suppressed *Euprioniodina* as a junior synonym of *Prioniodina.*

Prioniodina is a distinct genus with a bar, which is bowed and arched, and a cusp and basal cavity in the middle third of the unit. The anterior bar is distinctly a bar and not an anticusp. *Synprioniodina* and *Neoprioniodus* differ from *Prioniodina* by the lack of a district anterior bar and by the presence of an anticusp with denticles inclined forward. *Neoprioniodus* is distinquished by its nondenticulate anticusp.

Synprioniodina alternata Bassler, 1925

Plate 6, figures 3–5, 12

1925. *Synprioniodina alternata* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1926. *Synprioniodina alternata* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 42, text fig. 4, no. 22, p. 16.
1926. *Prioniodus disparilis* Ulrich and Bassler, 1926, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 10, pl. 9, fig. 12.
1926. *Prioniodus parvidentatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 9, pl. 9, fig. 1.
1926. *Synprioniodina alternata* Bassler. Holmes, *in* Butts, Alabama Geol. Survey Spec. Rept. 14, p. 160, pl. 48, fig. 4.
1928. *Synprioniodina alternata* Bassler. Holmes, U.S. Natl. Mus. Proc., v. 72, art. 5, p. 30, pl. 10, figs. 11, 12. [Fig. 12 is the first photograph of the holotype.]
1931. *Synprioniodina alternata* Bassler. Cooper, Jour. Paleontology, v. 5, no. 2, p. 149, pl. 20, fig. 13.
1932. *Synprioniodina alternata* Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 23.
1932. *Prioniodus disparilis* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 3.
1932. *Prioniodus parvidentatus* Ulrich and Bassler. Bassler, Tennessee Div. Geology Bull. 38, p. 234, pl. 26, fig. 2.
1934. *Euprioniodina devexa* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 52, pl. 11, fig. 4.
1934. *Euprioniodina fornicata* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 51, pl. 6, fig. 16.
1934. *Synprioniodina decurrens* Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 55, pl. 11, fig. 11.
1939. *Synprioniodina alternata* Ulrich and Bassler. Cooper, Jour. Paleontology, v. 13, no. 4, p. 417, pl. 47, figs. 18, 19.
1947. *Euprioniodina prona* Huddle. Bond, Ohio Jour. Sci., v. 47, no. 1, p. 28, pl. 1, figs. 11, 12.

1957. *Synprioniodina forsenta* Stauffer. Lys and Serre, Inst. Français Pétrole Rev., v. 12, no. 10, p. 1051, pl. 7, fig. 6.
?1959. *Prioniodina alternata* (Ulrich and Bassler). Helms, Geologie, v. 8, no. 6, p. 652–653, pl. 2, fig. 15 [probably not pl. 4, fig. 29].

Holotype (by original designation).—USNM 11308 VP, specimen subsequently figured by Ulrich and Bassler (1926, p. 16, text fig. 22); this report (pl. 6, fig. 5).

Type locality.—Gassaway Member of the Chattanooga Shale, Quicks Mill, near New Market, Ala.

Description.—Bar heavy, slightly bowed and arched, with flat attachment area on the aboral third of the bar. Cusp large, flattened on the outside, and grooved near the base. Anticusp flat on the outside and twisted outward; denticles few, some suppressed. Denticles in posterior bar slender, rounded, alternating in size or with a few small denticles near the cusp more or less suppressed. The inside of the bar of the two specimens figured by Holmes is buried in shale. Length of the holotype, 1.9 mm.

Remarks.—The presence or absence of suppressed denticles, the spacing of the denticles, the inclination of the cusp, the shape of the bar, and the twisting of the anticusp all seem to be variable characters. Helms (1959, p. 652–653) and Ethington and Furnish (1962, p. 1283) have placed *S. alternata* in *Prioniodina* and reported a transition between *S. alternata* and *S. prona* (Huddle). They think the alternation of denticles is the distinguishing character and find it variable. However, *S. alternata* differs from *S. prona* in the inclination of the cusp and bowing of the posterior bar and by having a flat area at the base of the cusp on the outside and outward twisting of the anticusp. The anticusp tends to be shorter, and the inner lip of the cusp is smaller and less protruding in *S. alternata* than in *S. prona*. It is true that individual specimens of each of these species have one or more characters like the other, but most specimens can be assigned to one or the other species. *S. alternata* appears earlier in the Upper Devonian and Mississippian black shales in the central United States than *S. prona* and disappears earlier. It therefore seems worthwhile to distinguish these two apparently closely related species.

Description based on the holotype and hypotype figured by Holmes (1928), and a reexamination of my 1934 types. The length of the holotype from the tip of the anticusp to the tip of the bar is 1.42 mm.

Occurrence.—Mississippian: Sunbury Shale, Ohio; pre-Welden Shale, Oklahoma. Mississippian?: "Hardin sandstone," probably reworked. Upper Devonian: Gassaway Member of the Chattanooga Shale, Tennessee; New Albany Shale, Indiana; Ohio Shale, Ohio; Frasnian, France; Upper Devonian (*to* Iδ–*to* VI), Thuringia, East Germany.

Synprioniodina deflecta (Bassler), 1925

Plate 7, figures 6, 9–11

1925. *Euprioniodina deflecta* Bassler, Geol. Soc. America Bull., v. 36, no. 1, p. 219.
1926. *Euprioniodina deflecta* Bassler. Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 29, pl. 3, figs. 11, 12.
1926. *Euprioniodina bryanti* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 29–30, pl. 3, figs. 13, 14 [not pl. 1, fig. 21=*Ligonodina magnidens* Ulrich and Bassler].

Lectotype (here designated).—USNM 11272 VP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 11); this report (pl. 7, fig. 6).

Paralectotype.—USNM 145885 IP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 12); this report (pl. 7, fig. 11).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Remarks.—Bar rounded to triangular, with attachment scars on both sides, straight or slightly bowed and arched. Cusp terminal, inclined forward, and flattened on the outside with swollen base on the inside. Anticusp short, with a three to four free denticles. Bar denticles rounded, slender, inclined anteriorly, six to eight in number. Length, 1.4–2.1 mm.

The types of *E. bryanti* are embedded in shale, and only the inside is exposed. Ulrich and Bassler pointed out that the anticusp of *E. bryanti* is inclined more sharply to the rear than in *S. deflecta*, but the other differences cited by them as distinguishing the two species are due to a comparison of the inside of *S. bryanti* with the outside of *S. deflecta*. I regard the inclination of the anticusp as a variable character and consider *S. bryanti* a junior subjective synonym of *S. deflecta*.

Synprioniodina perangulata (Ulrich and Bassler), 1926

Plate 6, figure 9; plate 7, figure 7

1926. *Euprioniodina perangulata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 30, pl. 3, fig. 10.
1926. *Prioniodus proclinatus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 10–11, pl. 1, fig. 22.
1934. *Euprioniodina perangulata* Ulrich and Bassler. Huddle, Bull. Am. Paleontology, v. 21, no. 72, p. 52–53, pl. 11, fig. 5.
1948. *Euprioniodina perangulata* Ulrich and Bassler. Youngquist, Hibbard, and Reimann, Jour. Paleontology, v. 22, no. 1, p. 53, pl. 15, fig. 5.

Holotype.—USNM 11275 VP, specimen figured by Ulrich and Bassler (1926, pl. 3, fig. 10); this report (pl. 6, fig. 9).

Type locality.—Rhinestreet Shale Member of the West Falls Formation, Weyer, N.Y.

Description.—Bar heavy and triangular, with strong attachment areas; cusp broad, flat, and sharp edged; anticusp long and denticulated. Base of cusp rounded and swollen on the inside, flat and continuous with the anticusp on the outside. Basal cavity a small pit. A more complete specimen is shown by Youngquist, Hibbard, and Reimann (1948, pl. 15, fig. 5), but the tips of the cusp and the anticusp are not exposed on their specimen. The specimen I figured from the lower New Albany Shale in 1934 has a thinner bar than the holotype and seems to be a less mature specimen. The denticulated anticusp of the holotype of *Prioniodus proclinatus* was buried in shale when described by Ulrich and Bassler. Hass exposed it by careful needle work. Broken denticles or incipient denticles are indicated by white matter.

The name *S. perangulata* was selected because the type is better preserved than the type of *S. proclinatus*.

S. perangulata is distinguished from other species of the genus by its long denticulated anticusp. If oriented with the anticusp horizontal, it looks like *Palmatodella*. *S. perangulata* superficially resembles *Hibbardella subequalis* but lacks the symmetrical posterior arch and the posterior bar of the latter.

Occurrence.—Upper Devonian: Rhinestreet Shale Member of the West Falls Formation, New York; New Albany Shale, Indiana.

Genus TRICHONODELLA Branson and Mehl, 1948

1948. *Trichonodella* Branson and Mehl, Jour. Paleontology, v. 22, no. 4, p. 527. A new name to replace *Trichognathus* Branson and Mehl, 1933, a homonym of *Trichognathus* Berthold, 1827.

1954. *Trichonodella* Branson and Mehl. Lindström, Geol. Fören. Stockholm Förh., v. 76, no. 4, p. 598–599.

1957. *Trichonodella* Branson and Mehl. Bischoff and Ziegler, Hesse Landesamt Bodenforschung Abh., v. 22, p. 118–119.

1959. *Trichonodella* Branson and Mehl. Sweet, Turco, Warner, and Wilkie, Jour. Paleontology, v. 33, no. 6, p. 1063–1064.

1964. *Trichonodella* Branson and Mehl. Lindström, Conodonts, p. 147.

Type species (by original designation).—*Trichognathus prima* Branson and Mehl, 1933.

Geologic range.—Ordovician to Devonian.

Diagnosis.—A symmetrical or nearly a symmetrical anterior arch with a nondenticulate posterior extension or expansion of the posterior margin of the cusp; strong recurved cusp.

Remarks.—Distinguished from *Hibbardella* and *Diplododella* by the nondenticulate posterior extension and from *Plectospathodus* by the greater arching and the basal, rather than lateral, position of the basal cavity.

Trichonodella tridentata (Ulrich and Bassler), 1926

Plate 1, figure 22

1926. *Ligonodina tridentata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 15, pl. 9, fig. 5.

Holotype.—USNM 11029 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 5); this report (pl. 1, fig. 22).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—The holotype and only known specimen is broken. The anterior arch is apparently symmetrical, but only parts of three denticles are preserved on one side of the arch and only the "suckers" representing the base of the two denticles are preserved on the other. The posterior extension is smooth and undenticulated. The cusp is slightly twisted, making the conodont unsymmetrical. The specimen is worn, especially on the cusp, and shows not only the typical laminar structure of conodonts but also a suggestion of fibrous structure. This specimen is probably reworked from an underlying Ordovician limestone into the "Hardin sandstone."

Genus indeterminate

Genus? concavus Ulrich and Bassler, 1926

Plate 1, figure 15

1926. *Prioniodus concavus* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 10, pl. 9, fig. 11.

Holotype.—USNM 11036 VP.

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This specimen is indeterminate. It appears to be a fragment of a hindeodellid or a *Bryantodus*.

Genus? inequalis Ulrich and Bassler, 1926

Plate 1, figure 13

1926. *Prioniodus inequalis* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 10, pl. 9, fig. 6.

Holotype.—USNM 11034 VP, specimen figured by Ulrich and Bassler (1926, pl. 9, fig. 6).

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This specimen is not determinable generically. It may be an end view of a *Ligonodina* or the cusp of a *Hibbardella*.

Genus? informata Ulrich and Bassler, 1926

Plate 1, figure 20

1926. *Prioniodella informata* Ulrich and Bassler, U.S. Natl. Mus. Proc., v. 68, art. 12, p. 20, pl. 10, figs. 19, 20.

Syntypes.—USNM 10991 a and b VP, specimens figured by Ulrich and Bassler (1926, pl. 10, figs. 19, 20).

Both specimens are lost, but the mold of USNM 10991b VP is present.

Type locality.—"Hardin sandstone" near Mount Pleasant, Tenn.

Remarks.—This species is unrecognizable.

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PLATES 1–17

PLATE 1

[All figures × 30. Figs. 13, 20, 23 retouched. Figs. 13, 15–18, 20, 22, 23 from "Hardin sandstone," Tennessee. Figs. 1–4, 6–12, 14, 19, 21 from Rhinestreet Shale Member of the West Falls Formation, New York. Fig. 5 from Gassaway Member of the Chattanooga Shale, Alabama]

FIGURES

1–8. *Prioniodina subcurvata* Bassler (p. 44).
1. Inner lateral view, paralectotpype, Ulrich and Bassler, 1926, pl. 4, fig. 22 =USNM 145939 IP.
2. Outer lateral view, lectotype, Ulrich and Bassler, 1926, pl. 4, fig. 23=USNM 11252 VP.
3. Inner lateral view, paralectotype, Ulrich and Bassler, 1926, pl. 4, fig. 24 =USNM 145940 IP.
4. Outer lateral view, holotype, *Prioniodella normalis* Bassler. Ulrich and Bassler, 1926, pl. 4, figs. 1, 1′=USNM 11254 VP.
5. Inner lateral view, holotype, *Euprioniodina germana* Holmes, 1928, pl. 10, fig. 7=USNM 11449 VP.
6. Outer lateral view, holotype, *Bryantodus semiseparatus* Ulrich and Bassler, 1926, pl. 4, fig. 16=USNM 11268 VP.
7. Inner lateral view, paralectotype, *Prioniodina separata* Ulrich and Bassler 1926, pl. 4, fig. 17=USNM 145941 IP.
8. Outer lateral view, lectotype, *Prioniodina separata* Ulrich and Bassler, 1926, pl. 4, fig. 18=USNM 11253 VP.

9–12. *Prioniodina transitans* (Ulrich and Bassler) (p. 44).
9. Inner lateral view, paralectotype, *Bryantodus transitans* Ulrich and Bassler, 1926, pl. 4, fig. 10=USNM 145942 IP.
10. Outer lateral view, lectotype, *Bryantodus transitans* Ulrich and Bassler, 1926, pl. 4, fig. 11=USNM 11262 VP.
11. Outer lateral view, *Bryantodus nitidus*? Ulrich and Bassler, 1926, pl. 4, fig. 14 =USNM 145943 IP.
12. Outer lateral view, holotype of *Prioniodella aequidens* Ulrich and Bassler, 1926, pl. 4, figs. 6, 7=USNM 11256 VP.

13. Genus? *inequalis* Ulrich and Bassler (p. 47).
End view, holotype *Prioniodus inequalis* Ulrich and Bassler, 1926, pl. 9, fig. 6 =USNM 11034 VP.

14, 21. *Prioniodina transversa* (Ulrich and Bassler) (p. 44).
14. Outer lateral view, paralectotype *Lonchodina transversa* Ulrich and Bassler, 1926, pl. 6, fig. 2=USNM 145944 IP.
21. Outer lateral view, lectotype *Lonchodina transversa* Ulrich and Bassler, 1926, pl. 6, fig. 3=USNM 11289 VP.

15. Genus? *concavus* Ulrich and Bassler (p. 47).
Holotype *Prioniodus concavus* Ulrich and Bassler, 1926, pl. 9, fig. 11=USNM 11036 VP.

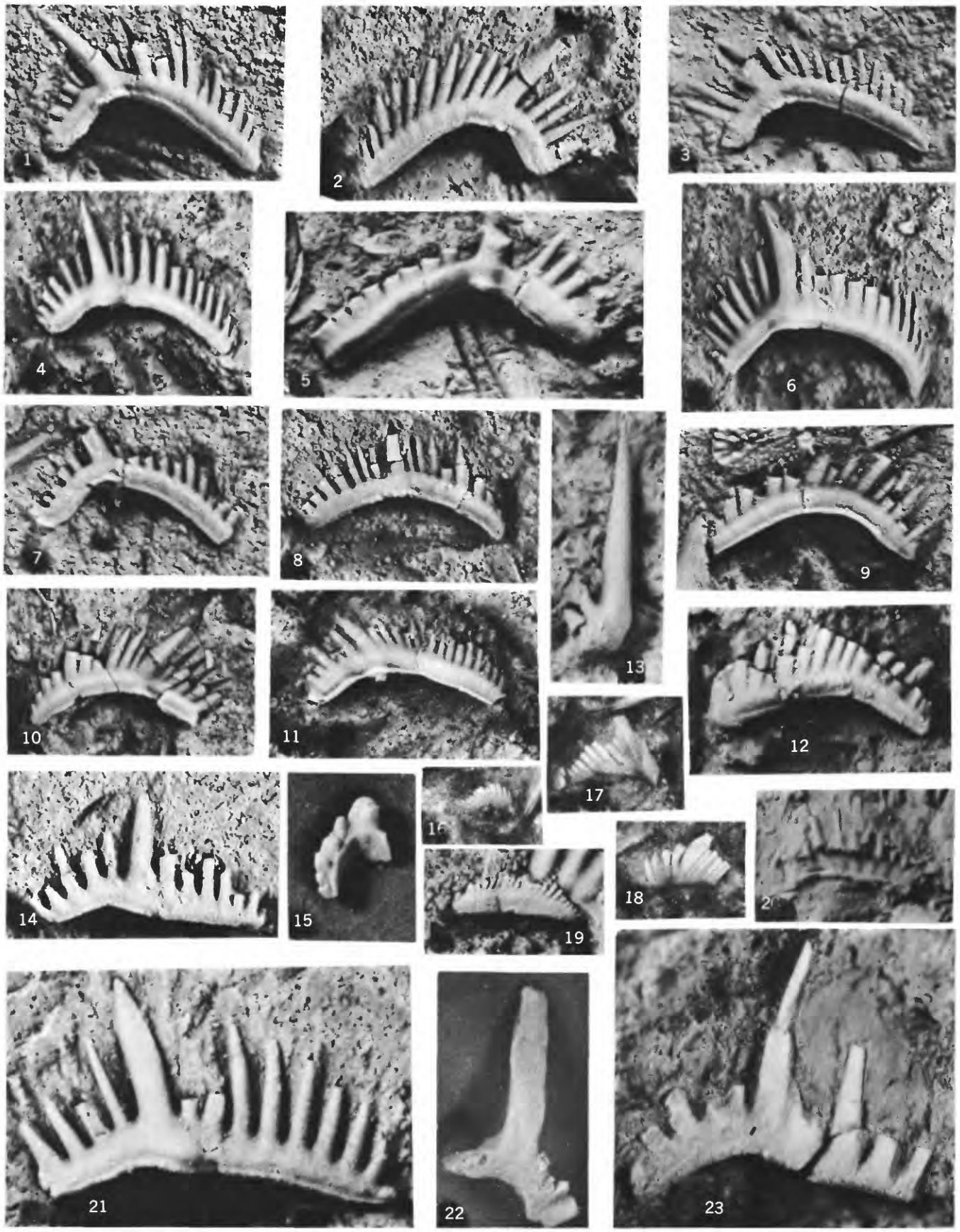
16. Not identifiable, the paralectotype of *Bryantodus subbrevis* Ulrich and Bassler, 1926, pl. 10, fig. 16=USNM 145945 IP.

17, 18, 19. *Ozarkodina subbrevis* (Ulrich and Bassler) (p. 27).
17. The paralectotype of *Palmatodella delicatula* Ulrich and Bassler, 1926, pl. 10, fig. 5=USNM 145946 IP.
18. Lectotype *Bryantodus subbrevis* Ulrich and Bassler, 1926, pl. 10, fig. 15 =USNM 11027 VP.
19. Holotype of *Prioniodella multidens* Ulrich and Bassler, 1926, pl. 4, figs. 4, 5 =USNM 11257 VP.

20. Genus? *informata* Ulrich and Bassler (p. 47).
Syntype *Prioniodella informata* Ulrich and Bassler, 1926, pl. 10, fig. 20=USNM 10991b VP.

22. *Trichonodella tridentata* (Ulrich and Bassler) (p. 47).
Holotype *Ligonodina tridentata* Ulrich and Bassler, 1926, pl. 9. fig. 5=USNM 11029 VP.

23. *Prioniodina robusta* (Ulrich and Bassler) (p. 43).
Holotype of *Prioniodella robusta* Ulrich and Bassler, 1926, pl. 10, fig. 24=USNM 10990 VP.



PRIONIODINA, OZARKODINA, TRICHONODELLA, AND INDETERMINATE GENERA

PLATE 2

[All figures × 30 except figure 7=× 35. Figs. 6 and 15 retouched. Figs. 1–7, 12–16 from "Hardin sandstone," Tennessee. Figs. 8–11 from Rhinestreet Shale Member of the West Falls Formation, New York]

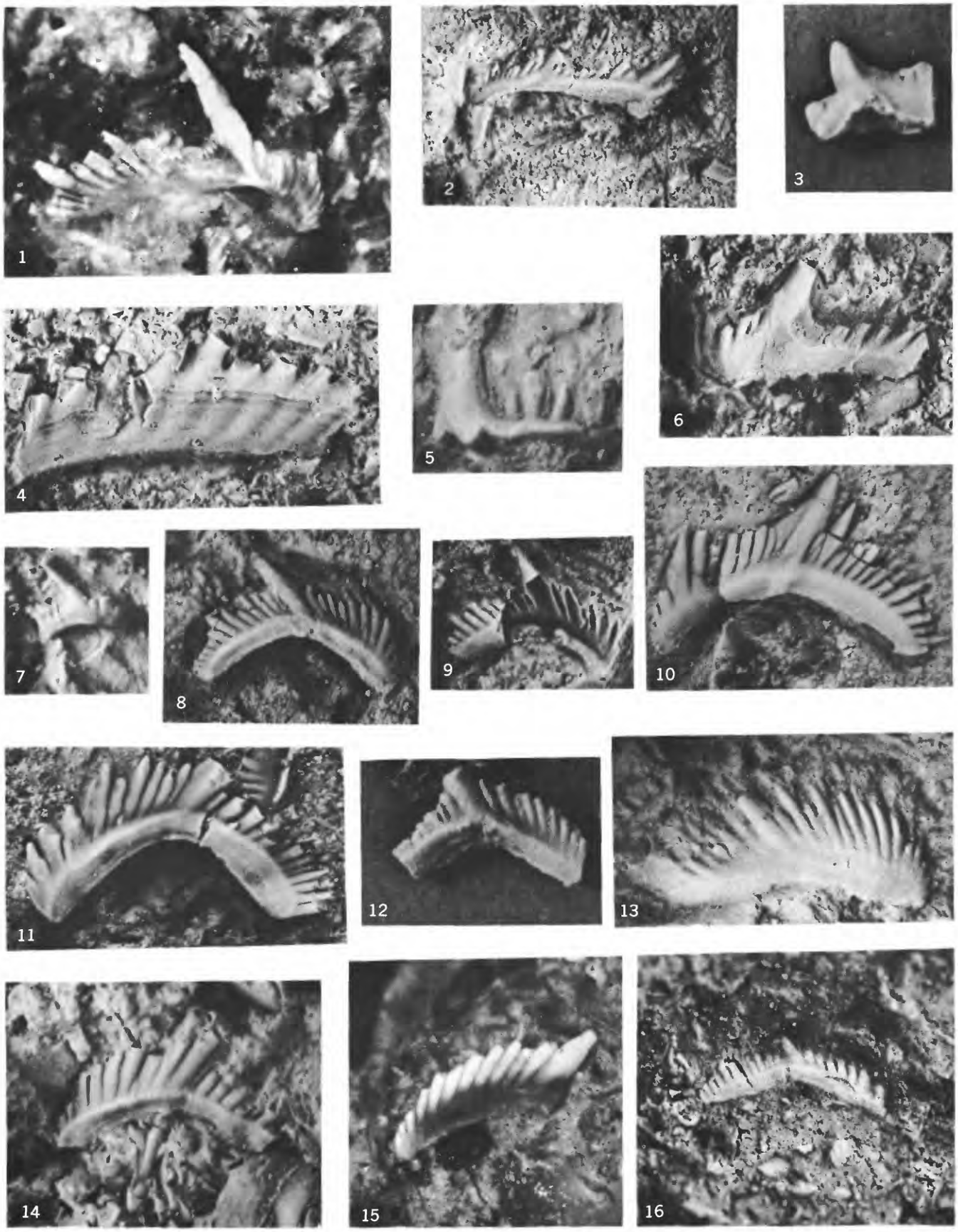
FIGURES 1, 2. *Angulodus pergracilis* (Ulrich and Bassler) (p. 8).

1. Outer lateral view, holotype *Bryantodus nelsoni* Ulrich and Bassler, 1926, pl. 10, fig. 9=USNM 11020 VP; photographed in immersion oil.
2. Outer lateral view, holotype *Bryantodus pergracilis* Ulrich and Bassler, 1926, pl. 10, fig. 11=USNM 11023 VP.

3. *Aphelognathus? crassus* (Ulrich and Bassler) (p. 9).
   Lateral view of holotype *Bryantodus crassus* Ulrich and Bassler, 1926, pl. 10, fig. 14=USNM 11026 VP.
4. *Bryantodus? conferta* (Ulrich and Bassler) (p. 9).
   Holotype, *Prioniodella conferta* Ulrich and Bassler, 1926, pl. 10, fig. 25=USNM 10989 VP.
5. *Bryantodus? cultratus* (Ulrich and Bassler) (p. 9).
   Holotype, *Prioniodus cultratus* Ulrich and Bassler, 1926, pl. 9, fig. 7=USNM 11038 VP.
6. *Bryantodus? insolens* Ulrich and Bassler, 1926, pl. 10, fig. 17, holotype =USNM 11015 VP (p. 9).
7. *Bryantodus? minutus* Ulrich and Bassler, 1926, pl. 10, fig. 6, holotype =USNM 11018 VP; × 35 (p. 9).

8–16. *Bryantodus nitidus* Ulrich and Bassler (p. 10).

8. Outer lateral view, lectotype, Ulrich and Bassler, 1926, pl. 4, fig. 12=USNM 11266 VP.
9. Paralectotype, Ulrich and Bassler, 1926, pl. 4, fig. 13=USNM 145877 IP.
10. Outer lateral view, paralectotype, *Bryantodus multidens* Ulrich and Bassler, 1926, pl. 6, fig. 16=USNM 145878 IP.
11. Inner lateral view, paralectotype, *Bryantodus conjunctus* Ulrich and Bassler, 1926, pl. 4, fig. 8=USNM 145947 IP.
12. Inner lateral view, paralectotype, *Bryantodus gracilis* Ulrich and Bassler, 1926, pl. 10, fig. 10=USNM 11021 VP.
13. Outer lateral view, lectotype, *Bryantodus subradiatus* Ulrich and Bassler, 1926, pl. 10, fig. 12=USNM 145879 IP; questionably referred to *B. nitidus*.
14. Outer lateral view, paralectotype, *Bryantodus subradiatus* Ulrich and Bassler, 1926, pl. 10, fig. 13=USNM 11022 VP; questionably referred to *B. nitidus*.
15. Outer lateral view, holotype, *Bryantodus curvatulus* Ulrich and Bassler, 1926, pl. 9, fig. 13=USNM 11032 VP; photographed in immersion oil.
16. Outer lateral view, holotype, *Bryantodus tenuis* Ulrich and Bassler, 1926, pl. 10, fig. 7=USNM 11025 VP; questionably referred to *B. nitidus*.



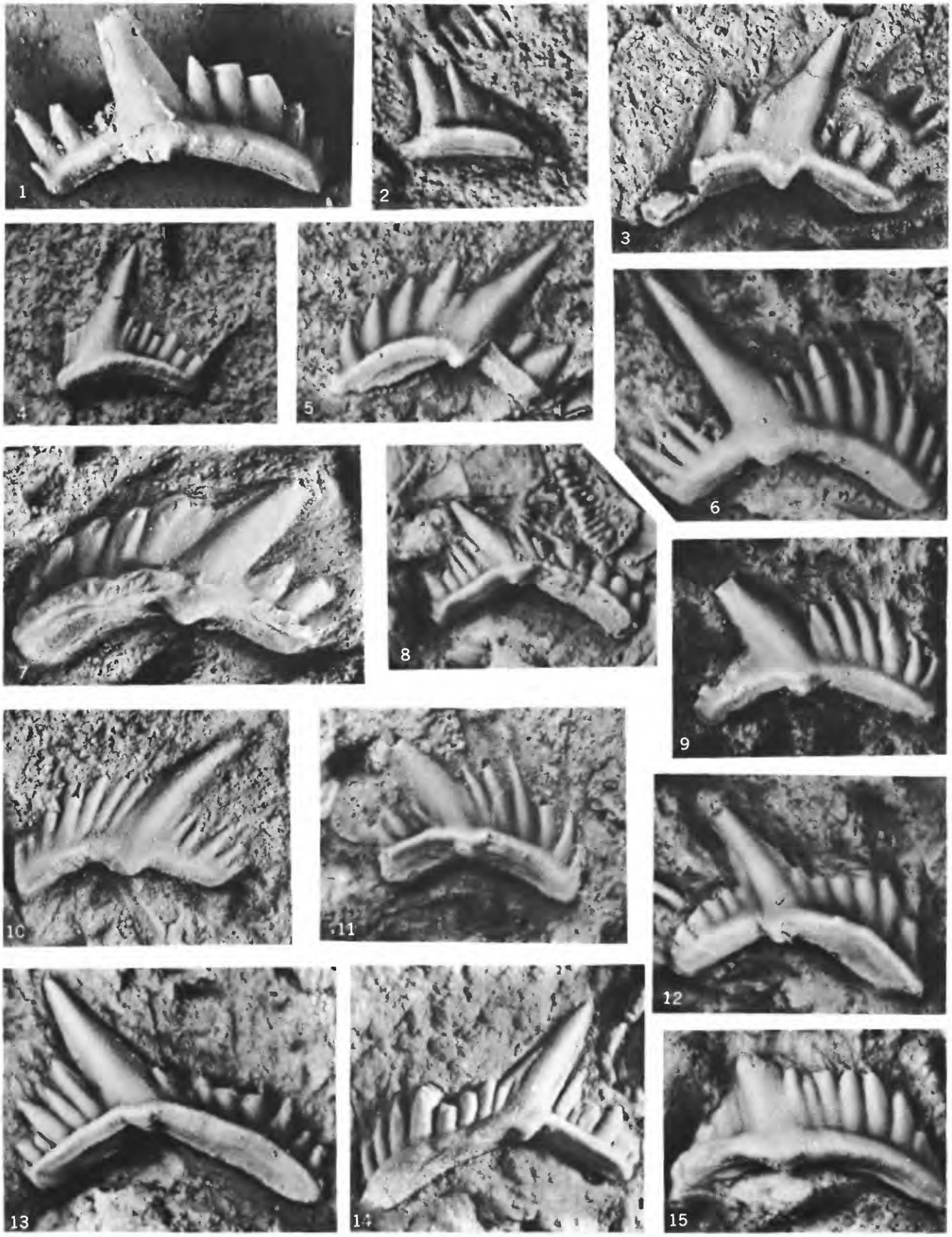
ANGULODUS, ALPHELOGNATHUS?, BRYANTODUS?, AND *BRYANTODUS*

PLATE 3

[All figures approximately × 30, except fig. 8=× 16. Figs. 4, 7, and 14 retouched. All figured specimens from the Rhinestreet Shale Member of the West Falls Formation, New York]

FIGURES 1–15. *Bryantodus typicus* Bassler. Outer lateral views (p. 11).

1. Lectotype, *Bryantodus typicus* Bassler.
   Ulrich and Bassler, 1926, pl. 6, fig. 11=USNM 11258 VP.
2. Holotype, *Bryantodus? tridentatus* Ulrich and Bassler, 1926, pl. 6, fig. 13=USNM 11259 VP.
3. Paralectotype, *Bryantodus typicus* Ulrich and Bassler, 1926, pl. 6, fig. 12=USNM 145880 IP.
4. Holotype, *Bryantodus? inequalis* Ulrich and Bassler, 1926, pl. 6, fig. 14=USNM 11260 VP.
5. Cotype, *Bryantodus crassidens* Ulrich and Bassler, 1926, pl. 6, fig. 17=USNM 145948 IP.
6. Cotype, *Bryantodus crassidens* Ulrich and Bassler, 1926, pl. 6, fig. 18=USNM 11263 VP.
7. Cotype, *Bryantodus obliquus* Ulrich and Bassler, 1926, pl. 6, fig. 19=USNM 11264 VP.
8. Cotype, *Bryantodus obliquus* Ulrich and Bassler, 1926, pl. 6, fig. 20=USNM 145949 IP.
9. Cotype, *Bryantodus obliquus* Ulrich and Bassler, 1926, pl. 6, fig. 21=USNM 145950 IP.
10. Cotype, *Bryantodus sinuatus* Ulrich and Bassler, 1926, pl. 6, fig. 22=USNM 11265 VP.
11. Cotype, *Bryantodus sinuatus* Ulrich and Bassler, 1926, pl. 6, fig. 23=USNM 145951 IP.
12. Cotype, *Bryantodus sinuatus* Ulrich and Bassler, 1926, pl. 6, fig. 24=USNM 145952 IP.
13. Cotype, *Bryantodus normalis* Ulrich and Bassler, 1926, pl. 4, fig. 25=USNM 145953 IP.
14. Cotype, *Bryantodus normalis* Ulrich and Bassler, 1926, pl. 4, fig. 26=USNM 11269 VP.
15. Cotype, *Bryantodus normalis* Ulrich and Bassler, 1926, pl. 4, fig. 27=USNM 145954 IP.



BRYANTODUS

PLATE 4

[All figures approximately × 30. Figs. 9, 11, 14 from "Hardin sandstone," Tennessee. All others from Rhinestreet Shale Member of the West Falls Formation, New York]

FIGURE

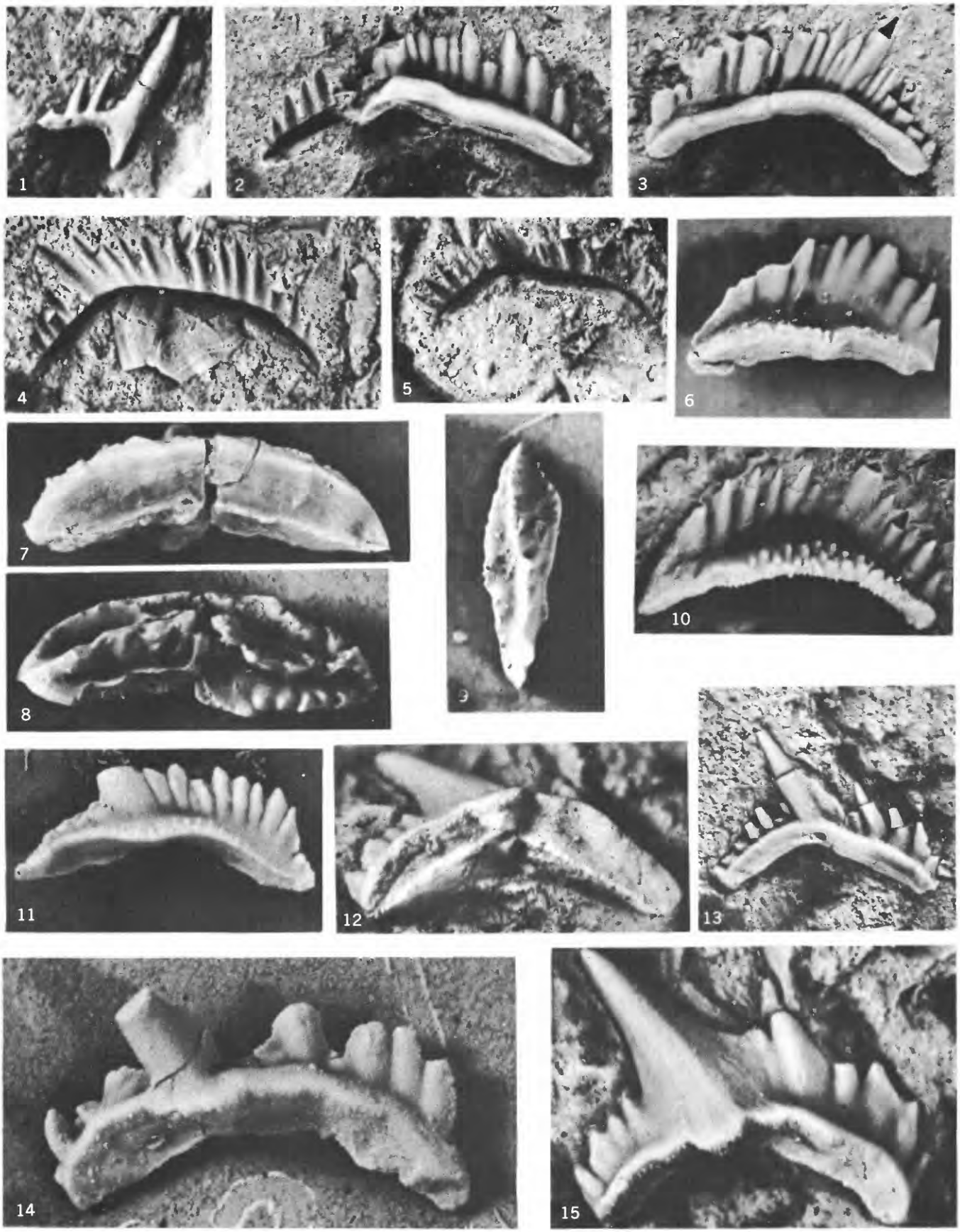
1. *Neoprioniodus undosus* Ulrich and Bassler (p. 26).
   Outer lateral view, holotype, *Prioniodus inutilis* Ulrich and Bassler, pl. 1, fig. 23=USNM 11241 VP.

2–5. *Polygnathellus multidens* (Ulrich and Bassler) (p. 36).
   2. Outer lateral view, lectotype, *Bryantodus multidens* Ulrich and Bassler, 1926, pl. 6, fig. 15=USNM 11261 VP.
   3. Inner lateral view, *Polygnathellus typicalis* Bassler. Ulrich and Bassler, 1926, pl. 1, fig. 3=USNM 145930 IP.
   4. Mold of the internal side, lectotype, *Bryantodus conjunctus* Ulrich and Bassler, 1926, pl. 4, fig. 9=USNM 11267 VP.
   5. Outer lateral mold, holotype, *Polygnathellus curvatus* Ulrich and Bassler, 1926, pl. 1, fig. 4=USNM 11305 VP.

6–8, 10. *Polygnathellus typicalis* Bassler (p. 37).
   6. Inner lateral view, holotype, *Prioniodella inequalis* Ulrich and Bassler, 1926, pl. 4, fig. 2=USNM 11255 VP.
   7. Aboral view, paralectotype, *Polygnathellus typicalis* Bassler. Ulrich and Bassler, 1926, pl. 1, fig. 2=USNM 145973 IP.
   8. Oral view of specimen shown in figure 7.
   10. Lateral view, lectotype, *Polygnathellus typicalis* Bassler. Ulrich and Bassler, 1926, pl. 1, fig. 1=USNM 11304 VP.

9, 11. *Polygnathellus germanus* (Ulrich and Bassler) (p. 36).
   9, 11. Oral and lateral views of the holotype of *Bryantodus germanus* Ulrich and Bassler, 1926, pl. 10, fig. 18=USNM 11016 VP.

12–15. *Bryantodus typicus* Bassler (p. 11).
   12, 15. Aboral and lateral view of holotype, *Bryantodus coalescens* Ulrich and Bassler, 1926, pl. 4, fig. 28=USNM 11270 VP.
   13. Inner lateral view, *Bryantodus curvatus* Ulrich and Bassler, 1926, pl. 4, fig. 20=USNM 11271 VP.
   14. Inner lateral view, *Bryantodus incertus* Ulrich and Bassler, 1926, pl. 10, fig. 8=USNM 11019 VP.



NEOPRIONIODUS, POLYGNATHELLUS, AND *BRYANTODUS*

PLATE 5

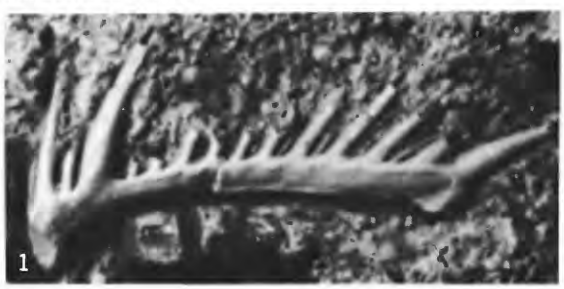
[All figures approximately × 30. Figs. 7, 10, 11, 14 retouched. Figs. 1, 3, 9 from Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 2, 4–8, 10, 11 from "Hardin sandstone," Tennessee. Figs. 12–15 from Gassaway Member of the Chattanooga Shale, Alabama]

Figures 1, 3. *Hindeodella alternata* Ulrich and Bassler. Outer lateral views (p. 15).

1. Lectotype, *Hindeodella alternata* Ulrich and Bassler,1926, pl. 1, fig. 14=USNM 11300 VP.
3. Paralectotype, *Hindeodella alternata* Ulrich and Bassler, 1926, pl. 1, fig. 15=USNM 145891 IP.
2. *Apatognathus*? sp., paralectotype, *Hindeodella longidens* Ulrich and Bassler, 1926, pl. 8, fig. 15=USNM 145892 IP (p. 8).
4. *Hindeodella decurrens* Ulrich and Bassler (p. 16).
   Outer lateral view, holotype, Ulrich and Bassler, 1926, pl. 8, fig. 13=USNM 10987 VP.
6. *Hindeodella longidens* Ulrich and Bassler, 1926, pl. 8, fig. 14, outer lateral view, lectotype=USNM 10988 VP (p. 16).
9. *Hindeodella subequalis* Ulrich and Bassler, 1926, pl. 4, fig. 21, outer lateral view, holotype=USNM 11301 VP (p. 16).

5, 7, 8, 10–15. *Hindeodella subtilis* Bassler (p. 16).

5. Outer lateral view, paralectotype, Ulrich and Bassler, 1926, pl. 8, fig. 19=USNM 145894 IP; photographed in immersion oil.
7. Outer lateral view, lectotype, Ulrich and Bassler, 1926, pl. 8, fig. 17=USNM 10985 VP.
8. Paralectotype, Ulrich and Bassler, 1926, pl. 8, fig. 18 =USNM 145893 VP; photographed in immersion oil.
10. Outer lateral view, holotype, *Hindeodella similis* Ulrich and Bassler, 1926, pl. 8, , fig. 20=USNM 11299 VP; photographed in immersion oil.
11. Outer lateral view, holotype, *Hindeodella recta* Ulrich and Bassler, 1926, pl. 8, fig. 16=USNM 10984 VP.
12. Outer lateral view, hypotype, Holmes, 1928, pl. 9, fig. 10=USNM 11438 VP.
13. Outer lateral view, hypotype, *Hindeodella germana* Holmes, 1928, pl. 9, fig. 9=USNM 11437 VP.
14. Outer lateral view, hypotype, Holmes, 1928, pl. 9, fig. 11 =USNM 145955 IP.
15. Inner lateral view, cotype, *Hindeodella tenerrima* Holmes, 1928, pl. 9, fig. 6=USNM 11435 VP.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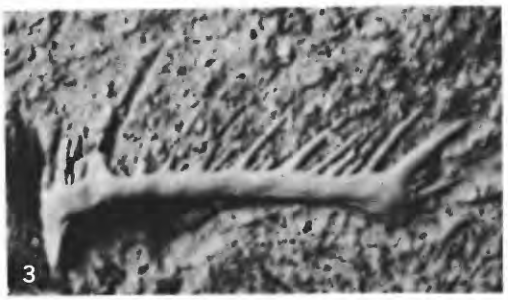
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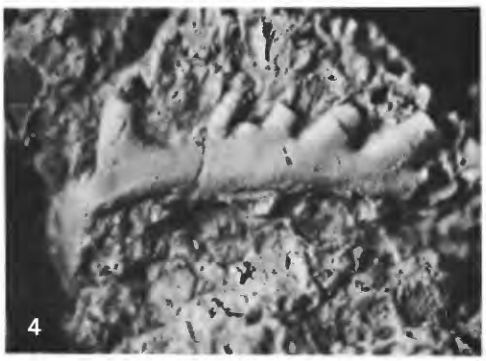
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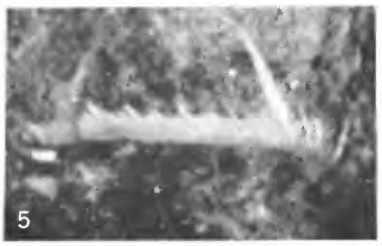
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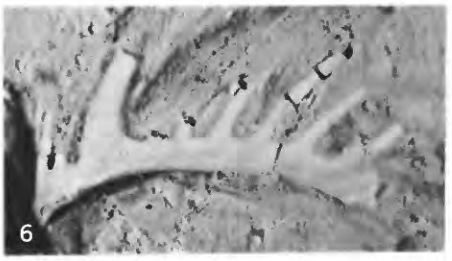
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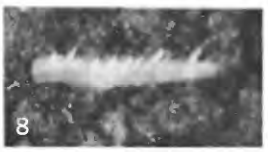
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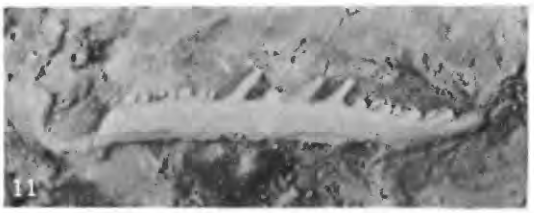
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HINDEODELLA AND *APATOGNATHUS*?

PLATE 6

[All figures approximately × 30. Fig. 10 retouched. Figs. 1, 2, 6, 8–11 from Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 4, 12, 13 from the "Hardin sandstone," Tennessee. Figs. 3, 5, 7 from the Gassaway Member of the Chattanooga Shale, Alabama]

FIGURES

1, 2. *Neoprioniodus alatus* (Hinde). Outer lateral views (p. 25).

1. Hypotype, *Prioniodus alatus* Ulrich and Bassler, 1926, pl. 1, fig. 25=USNM 11242 VP.
2. Hypotype, Ulrich and Bassler, 1926, pl. 1, fig. 26=USNM 145884 IP.

3, 4, 5, 12. *Synprioniodina alternata* Bassler (p. 45).

3. Outer lateral view, hypotype, Holmes, 1928, pl. 10, fig. 11 =USNM 145957 IP.
4. Outer lateral view, holotype, *Prioniodus parvidentatus* Ulrich and Bassler, 1926, pl. 9, fig. 1=USNM 11033 VP.
5. Outer lateral view, holotype, *Synprioniodina alternata* Bassler. Ulrich and Bassler, 1926, text fig. 4, no. 22, p. 16=USNM 11308 VP.
12. Holotype, *Prioniodus disparilis* Ulrich and Bassler, 1926, pl. 9, fig. 12=USNM 11030 VP; photographed in immersion oil.

6, 8. *Hibbardella subequalis* Ulrich and Bassler (p. 14).

6. End view anterior arch, cotype, *Lonchodina rectidens* Ulrich and Bassler, 1926, pl. 5, fig. 13=USNM 145958 IP.
8. End view anterior arch, lectotype, *Hibbardella subequalis* Ulrich and Bassler, 1926, pl. 3, fig. 6=USNM 11296 VP.

7. *Palmatodella delicatula* Bassler (p. 27).

Outer lateral view, holotype, Ulrich and Bassler, 1926, text fig. 4, no. 20, p. 16=USNM 11307 VP.

9. *Synprioniodina perangulata* (Ulrich and Bassler) (p. 46).

Lateral view, holotype, *Euprioniodina perangulata* Ulrich and Bassler, 1926, pl. 3, fig. 10=USNM 11275 VP.

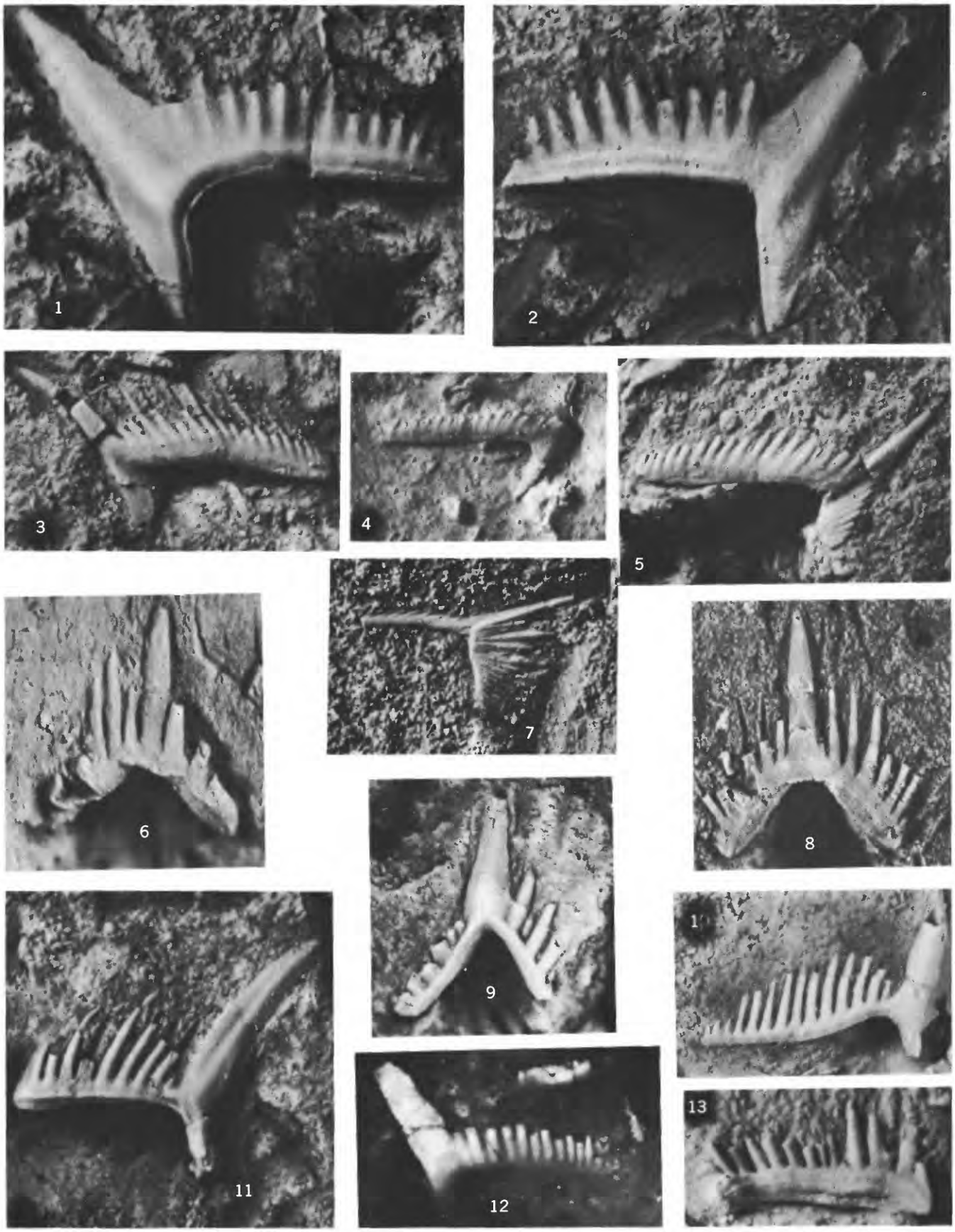
10. *Neoprioniodus undosus* Ulrich and Bassler (p. 26).

Outer lateral view, lectotype, *Prioniodus undosus* Ulrich and Bassler, 1926, pl. 1, fig. 18=USNM 11244 VP.

11. *Neoprioniodus armatus* (Hinde) (p. 25).

Outer lateral view, cotype, *Prioniodus curvidens* Ulrich and Bassler, 1926, pl. 1, fig. 16=USNM 11243 VP.

13. *Hibbardella? brevispina* (Ulrich and Bassler), 1926, pl. 10, fig. 21, holotype=USNM 10993 VP (p. 14).



NEOPRIONIODUS, SYNPRIONIODINA, HIBBARDELLA, PALMATODELLA, AND *HIBBARDELLA?*

PLATE 7

[All figures approximately × 30. Fig. 5 retouched. Fig. 8 from Gassaway Member of the Chattanooga Shale, Alabama. All other figured specimens from Rhinestreet Shale Member of the West Falls Formation, New York]

FIGURES 1, 4. *Neoprioniodus armatus* (Hinde) (p. 25).

1. Outer lateral view, cotype, *Prioniodus curvidens* Ulrich and Bassler, 1926, pl. 1, fig. 17=USNM 145881 IP.
4. Outer lateral view, holotype, *Euprioniodina conferta* Ulrich and Bassler, 1926, pl. 3, fig. 17=USNM 11273 VP.

2, 3. *Neoprioniodus undosus* Ulrich and Bassler (p. 26).

2. Outer lateral view, paralectotype, *Prioniodus undosus* Ulrich and Bassler, 1926, pl. 1, fig. 20=USNM 145883 IP.
3. Outer lateral view, paralectotype, *Prioniodus undosus* Ulrich and Bassler, 1926, pl. 1, fig. 19=USNM 145882 IP.

5. *Diplododella confertissima* (Ulrich and Bassler) (p. 12).

End view of the anterior arch, holotype, Ulrich and Bassler, 1926, pl. 3, fig. 5=USNM 11298 VP.

7. *Synprioniodina perangulata* (Ulrich and Bassler) (p. 46).

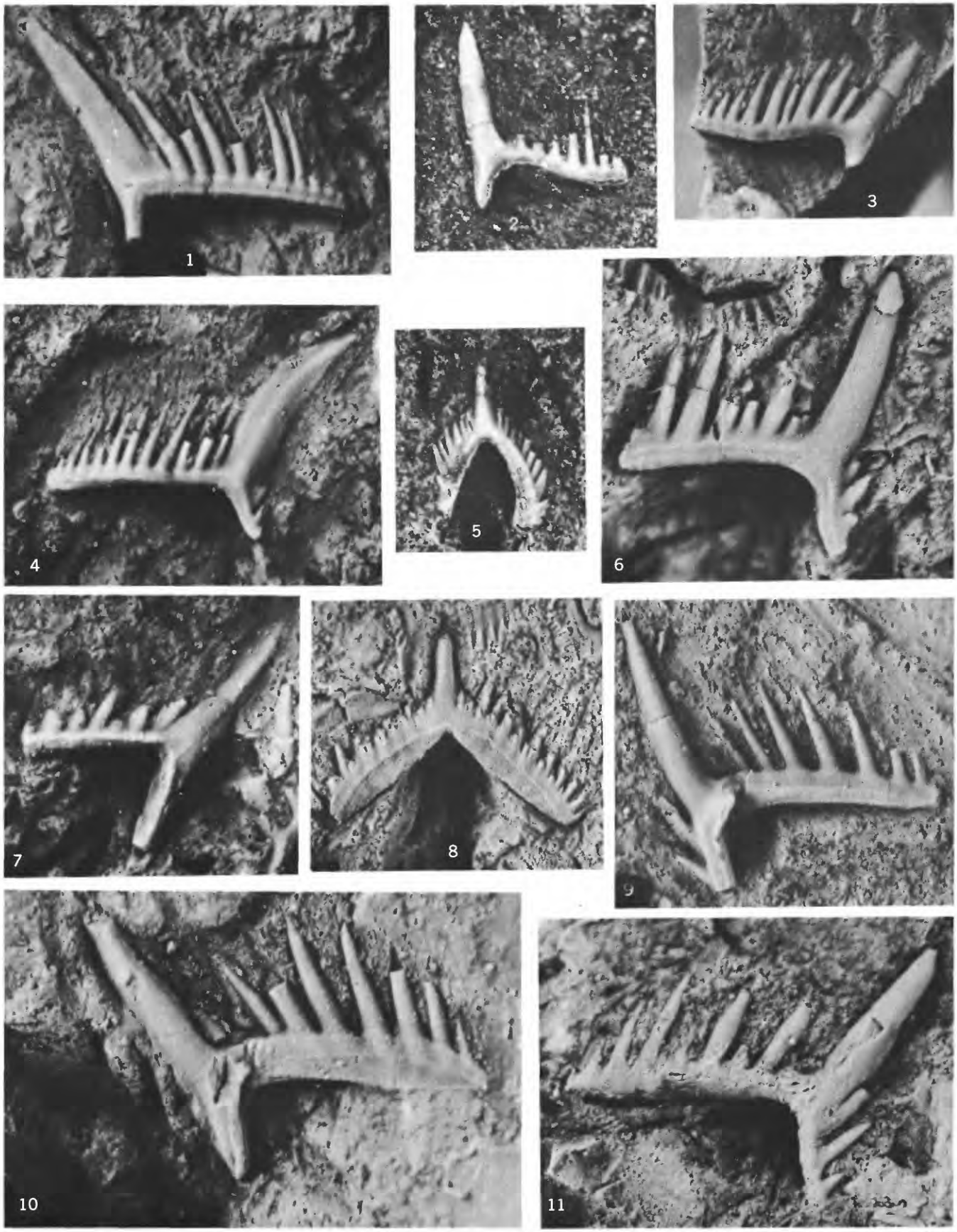
Outer lateral view, holotype, *Prioniodus proclinatus* Ulrich and Bassler, 1926, pl. 1, fig. 22=USNM 11240 VP.

8. *Diplododella bilateralis* Bassler (p. 12).

End view of anterior arch of the holotype, *Diplododella bilateralis* Bassler. Ulrich and Bassler, 1926, text fig. 4, no. 21 on p. 16 =USNM 11306 VP.

6, 9–11. *Synprioniodina deflecta* (Bassler) (p. 46).

6. Outer lateral view, lectotype, *Euprioniodina deflecta* Ulrich and Bassler, 1926, pl. 3, fig. 11=USNM 11272 VP.
9. Inner lateral view, cotype, *Euprioniodina bryanti* Ulrich and Bassler, 1926, pl. 3, fig. 14=USNM 145956 IP.
10. Inner lateral view, cotype, *Euprioniodina bryanti* Ulrich and Bassler, 1926, pl. 3, fig. 13=USNM 11274 VP.
11. Outer lateral view, paralectotype, *Euprioniodina deflecta* Ulrich and Bassler, 1926, pl. 3, fig. 12=USNM 145885 IP.



NEOPRIONIODUS, DIPLODODELLA, AND *SYNPRIONIODINA*

PLATE 8

[All figures approximately × 30. Fig. 4 retouched. Figs. 1–3, 8–10 from Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 4–7 from "Hardin sandstone," Tennessee]

FIGURE 1. *Hibbardella* sp. (p. 15).
End view of anterior arch, paralectotype, *Lonchodina typicalis* Bassler. Ulrich and Bassler, 1926, pl. 5, fig. 2=USNM 145890 IP.

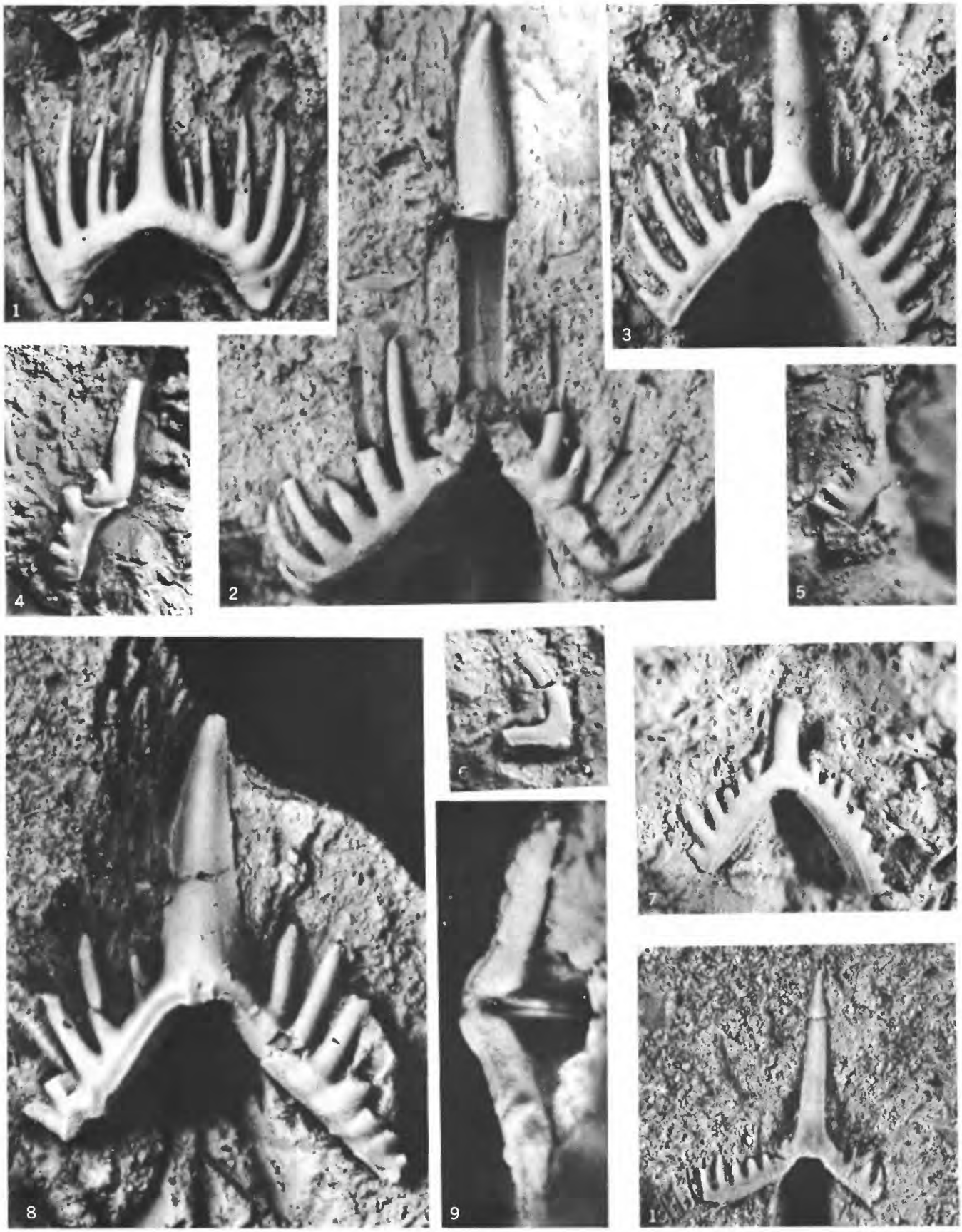
2, 7. *Hibbardella angulata* (Hinde) (p. 14).
2. End view, anterior arch of a hypotype, Ulrich and Bassler, 1926, pl. 3, fig. 2=USNM 145886 IP.
7. End view, anterior arch, holotype, *Lonchodina rectangulata* Ulrich and Bassler, 1926, pl. 10, fig. 4=USNM 11024 VP.

3, 8, 9. *Hibbardella subequalis* Ulrich and Bassler (p. 14).
3. End view hypotype, *Hibbardella angulata* Ulrich and Bassler, 1926, pl. 3, fig. 1=USNM 11295 VP.
8. End view anterior arch, hypotype, *Hibbardella angulata* (Hinde). Ulrich and Bassler, 1926, pl. 3, fig. 3=USNM 145959 IP.
9. Aboral view of the same specimen.

4, 5. *Ligonodina proclinis* (Ulrich and Bassler) (p. 20).
4. End view of the anterior end of the paratype, Ulrich and Bassler, 1926, pl. 9, fig. 10=USNM 145908 IP.
5. End view anterior end, paratype, Ulrich and Bassler, 1926, pl. 9, fig. 9=USNM 145907 IP.

6. *Ligonodina? simplex* Ulrich and Bassler, 1926, pl. 9, fig. 28, holotype =USNM 10983 VP (p. 21).

10. *Hibbardella multidens* Ulrich and Bassler, 1926, pl. 3, fig. 9, lectotype =USNM 145888 IP, end view anterior arch (p. 14).



HIBBARDELLA, LIGONODINA, AND *LIGONODINA*?

PLATE 9

[All figures approximately × 30, except fig. 2=× 34. Figs. 3, 5, 9 retouched. Figs. 1, 2, 3, 8, and 11 from Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 4–7, 9, and 10 from "Hardin sandstone," Tennessee]

FIGURE 1. *Hibbardella multidens* Ulrich and Bassler, 1926, pl. 3, fig. 8, paralectotype mold of the anterior arch=USNM 11297 VP (p. 14).

2. *Hibbardella subequalis* Ulrich and Bassler, 1926, pl. 3, fig. 7, paralectotype =USNM 145889 IP, mold of the anterior arch (p. 14).

3. *Hibbardella angulata* (Hinde) (p. 14).
   End view anterior arch, hypotype, Ulrich and Bassler, 1926, pl. 3, fig. 4 =USNM 145887 IP.

4. *Ligonodina rectus* (Ulrich and Bassler) (p. 21).
   Holotype, *Distacodus rectus* Ulrich and Bassler, 1926, pl. 9, fig. 22=USNM 10982 VP.

5. *Ligonodina peculiaris* (Ulrich and Bassler) (p. 20).
   Lateral view, holotype, *Euprioniodina peculiaris* Ulrich and Bassler, 1926, pl. 10, fig. 3=USNM 11017 VP.

6. *Ligonodina? gracilis* (Ulrich and Bassler) (p. 18).
   Lateral view, lectotype, *Prioniodella gracilis* Ulrich and Bassler, 1926, pl. 10, fig. 22=USNM 10992 VP.

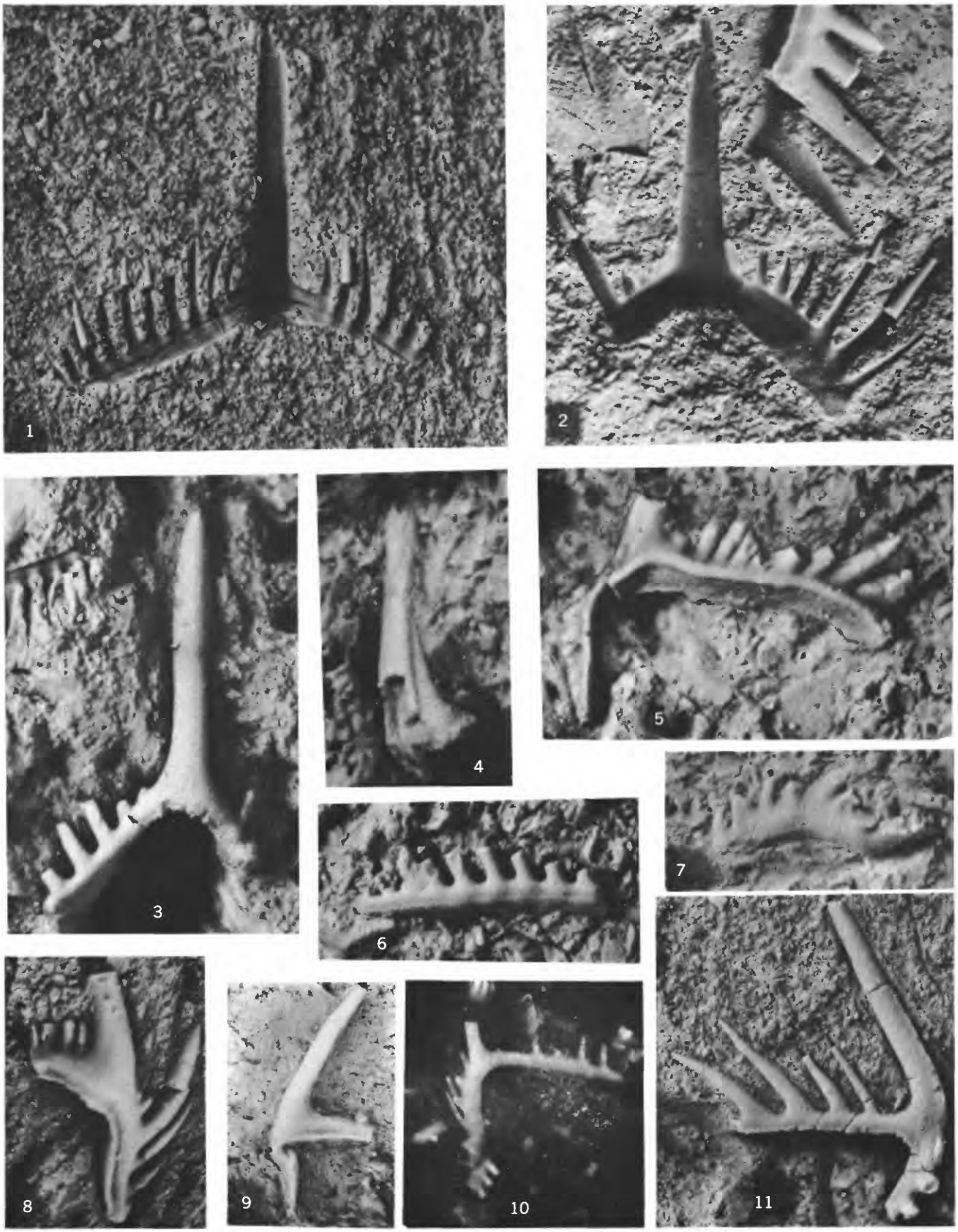
7. *Ligonodina proclinis* (Ulrich and Bassler) (p. 20).
   End view, holotype, *Prioniodus proclinis* Ulrich and Bassler, 1926, pl. 9, fig. 8=USNM 11031 VP.

8. *Ligonodina magnidens* Ulrich and Bassler (p. 18).
   Lateral view, lectotype, *Lonchodina? prona* Ulrich and Bassler, 1926, pl. 5, fig. 16=USNM 11293 VP.

9. *Ligonodina reversa* (Ulrich and Bassler), 1926, pl. 9, fig. 4, lateral view, holotype, USNM 11037 VP (p. 21).

10. *Ligonodina spiculata* (Ulrich and Bassler), 1926, pl. 9, fig. 3, lectotype=USNM 11035 VP (p. 21).

11. *Ligonodina panderi* (Hinde) (p. 19).
    Inner lateral view, *Ligonodina hibbardi* Ulrich and Bassler, 1926, pl. 2, fig. 7=USNM 11251 VP.



HIBBARDELLA, LIGONODINA, AND *LIGONODINA*?

PLATE 10

[All figures approximately × 20. All figured specimens from Rhinestreet Shale Member of the West Falls Formation, New York]

FIGURES 1–8, 11. *Ligonodina panderi* (Hinde) (p. 19).

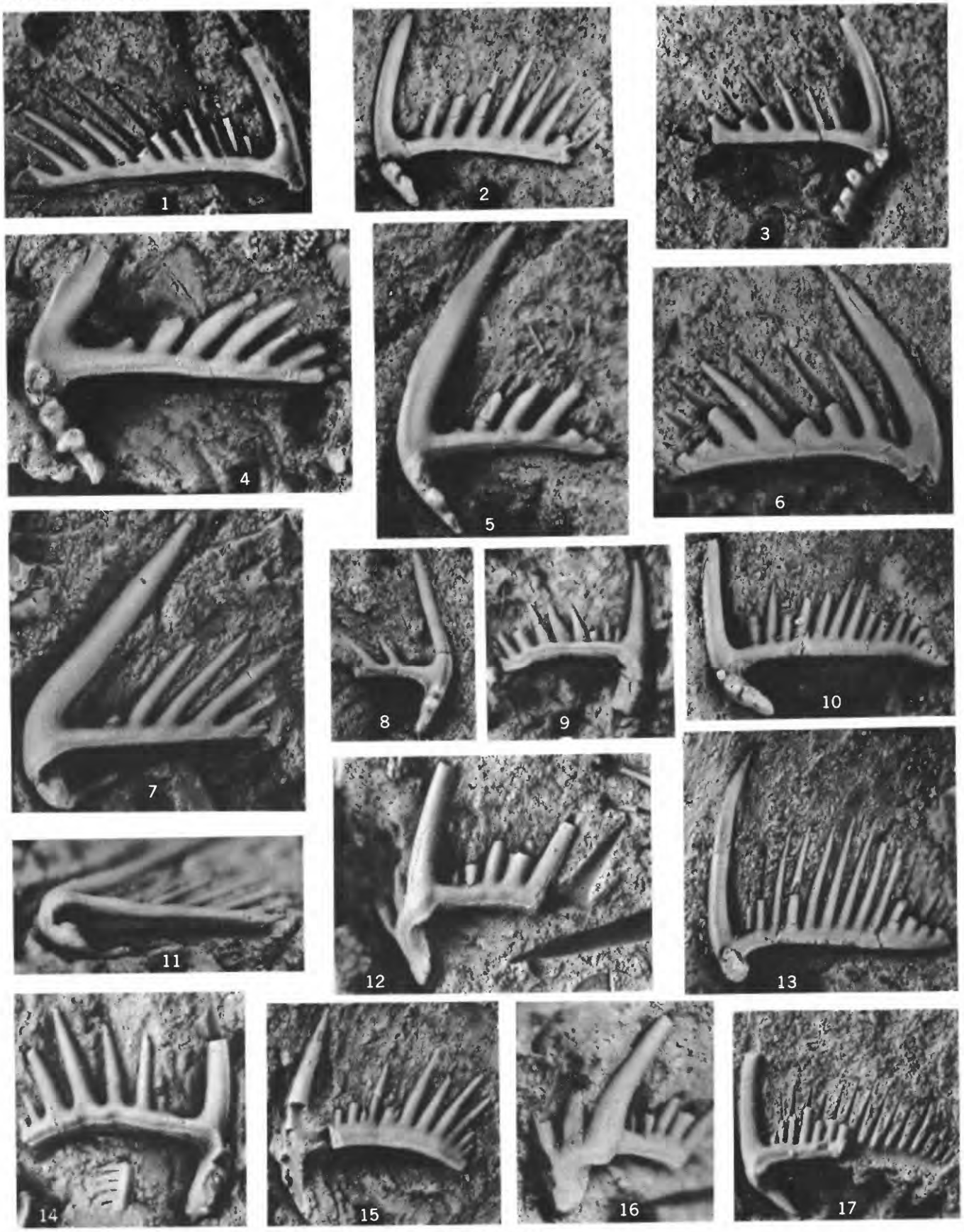
1. Inner lateral view, lectotype, *Ligonodina falciformis* Ulrich and Bassler, 1926, pl. 2, fig. 11=USNM 11249 VP.
2. Inner lateral view, paralectotype, *Ligonodina falciformis* Ulrich and Bassler, 1926, pl. 2, fig. 12=USNM 145895 IP.
3. Inner lateral view, paralectotype, *Ligonodina falciformis* Ulrich and Bassler, 1926, pl. 2, fig. 13=USNM 145896 IP.
4. Inner lateral view, *Ligonodina hindei* Ulrich and Bassler, 1926, pl. 2, fig. 14=USNM 11250 VP.
5. Inner lateral view, *Ligonodina hindei* Ulrich and Bassler, 1926, pl. 2, fig. 15=USNM 145897 IP.
6. Inner lateral view, *Ligonodina hindei* Ulrich and Bassler, 1926, pl. 2, fig. 16=USNM 145898 IP.
7. Outer lateral view, *Ligonodina hibbardi* Ulrich and Bassler, 1926, pl. 2, fig. 8=USNM 145899 IP.
8. Inner lateral view, hypotype, *Ligonodina panderi* (Hinde). Ulrich and Bassler, 1926, pl. 2, fig. 2=USNM 11246 VP.
11. Aboral view of the specimen shown in figure 7.

9, 12, 14–16. *Ligonodina magnidens* Ulrich and Bassler (p. 18).

9. Outer lateral view, *Lonchodina increbescens* Ulrich and Bassler, 1926, pl. 3, fig. 16=USNM 145905 IP.
12. Outer lateral view, paralectotype, *Ligonodina magnidens* Ulrich and Bassler, 1926, pl. 2, fig. 6=USNM 145902 IP.
14. Inner lateral view, lectotype, *Ligonodina magnidens* Ulrich and Bassler, 1926, pl. 2, fig. 5=USNM 11248 VP.
15. Outer lateral view, *Euprioniodina bryanti* Ulrich and Bassler, 1926, pl. 1, fig. 21=USNM 145904 IP.
16. View of the anterior end of the specimen shown in figure 12.

10, 13, 17. *Ligonodina pectinata* Bassler (p. 20).

10. Inner lateral view, lectotype, Ulrich and Bassler, 1926, pl. 2, fig. 10=USNM 11245 VP.
13. Inner lateral view, paralectotype, Ulrich and Bassler, 1926, pl. 2, fig. 9=USNM 145900 IP.
17. Outer lateral view, previously unfigured paralectotype =USNM 145901 IP.



LIGONODINA

PLATE 11

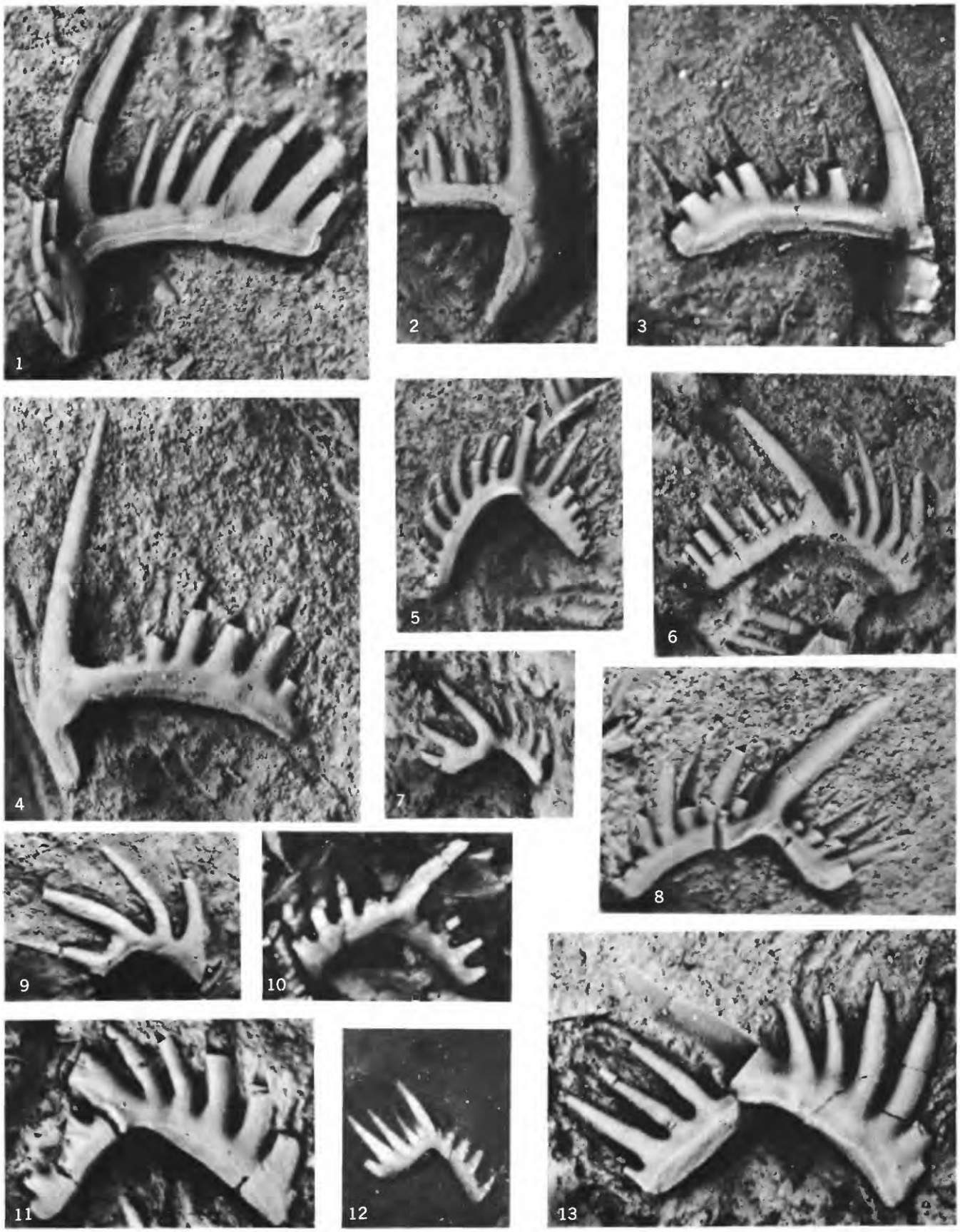
[All figures approximately × 30. Figs. 1–6, 8, 9, 11, and 13 from Rhinestreet Shale Member of the West Falls Formation, New York. Fig. 7 from Gassaway Member of the Chattanooga Shale, Alabama. Figs. 10 and 12 from "Hardin sandstone," Tennessee]

FIGURES 1–4. *Ligonodina magnidens* Ulrich and Bassler (p. 18).

1. Inner lateral view, *Lonchodina*? *increbescens* Ulrich and Bassler, 1926, pl. 5, fig. 20=USNM 145906 IP.
2. Outer lateral view, *Lonchodina*? *increbescens* Ulrich and Bassler, 1926, pl. 3, fig. 15=USNM 11291 VP.
3. Inner lateral view, *Ligonodina deflecta* Ulrich and Bassler, 1926, pl. 2, fig. 4=USNM 145903 IP.
4. Outer lateral view, *Ligonodina deflecta* Ulrich and Bassler, 1926, pl. 2, fig. 3=USNM 11247 VP.

5–13. *Lonchodina arcuata* Ulrich and Bassler (p. 21).

5. Inner lateral view, holotype, Ulrich and Bassler, 1926, pl. 5, fig. 15=USNM 11279 VP.
6. Outer lateral view, holotype, *Lonchodina subangulata* Ulrich and Bassler, 1926, pl. 5, fig. 3=USNM 11282 VP.
7. Outer lateral view, hypotype, *Lonchodina discreta* Holmes, 1928, pl. 9, fig. 13=USNM 11440 VP.
8. Inner lateral view, paralectotype, *Lonchodina*? *prona* Ulrich and Bassler, 1926, pl. 5, fig. 17=USNM 145910 IP.
9. Outer lateral view, holotype, *Lonchodina paucidens* Ulrich and Bassler, 1926, pl. 6, fig. 1=USNM 11286 VP.
10. Outer lateral view, *Lonchodina discreta* Ulrich and Bassler, 1926 pl. 10, fig. 2=USNM 145911 IP.
11. Inner lateral view, *Lonchodina*? *projecta* Ulrich and Bassler, 1926, pl. 5, fig. 10=USNM 145909 IP.
12. Outer lateral view, *Lonchodina discreta* Ulrich and Bassler, 1926, pl. 10, fig. 1=USNM 11014 VP.
13. Inner lateral view, *Lonchodina*? *projecta* Ulrich and Bassler, 1926, pl. 5, fig. 9=USNM 11292 VP.



LIGONODINA AND *LONCHODINA*

PLATE 12

[All figures approximately × 20. Fig. 11 retouched. Figs. 1–14, 16–22 from Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 15, 23, and 24 from Gassaway Member of the Chattanooga Shale, Alabama]

FIGURES 1–3. *Lonchodina perlonga* Ulrich and Bassler (p. 22).

1. Outer lateral view, lectotype, Ulrich and Bassler, 1926, pl. 5, fig. 6=USNM 11281 VP.
2. Inner lateral view, paralectotype, Ulrich and Bassler, 1926, pl. 5, fig. 7=USNM 145912 IP.
3. Inner lateral view, holotype, *Lonchodina delicatula* Ulrich and Bassler, 1926, pl. 5, fig. 11=USNM 11284 VP.

4–13. *Lonchodina subsymmetrica* Ulrich and Bassler (p. 23).

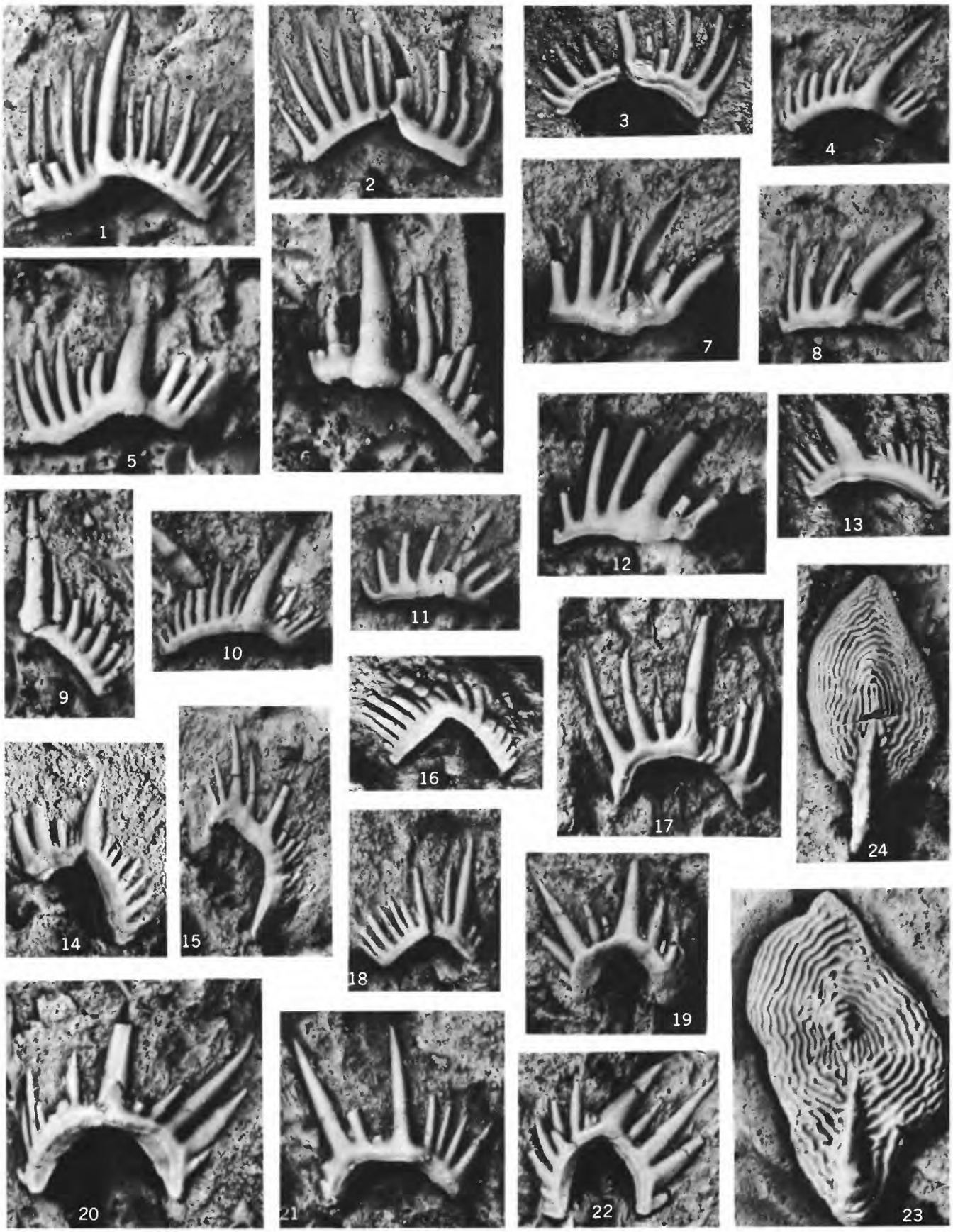
4. Outer lateral view, lectotype, Ulrich and Bassler, 1926, pl. 6, fig. 6=USNM 11287 VP.
5. Outer lateral view, paralectotype, Ulrich and Bassler, 1926, pl. 6, fig. 7=USNM 145916 IP.
6. Outer lateral view, paralectotype, Ulrich and Bassler, 1926, pl. 6, fig. 5=USNM 145915 IP.
7. Outer lateral view, syntype, *Lonchodina abnormis* Ulrich and Bassler, 1926, pl. 6, fig. 8=USNM 11288 VP.
8. Outer lateral view, syntype, *Lonchodina abnormis* Ulrich and Bassler, 1926, pl. 6, fig. 10=USNM 145918 IP.
9. Outer lateral view of a broken specimen, paralectotype, *Lonchodina subsymmetrica* Ulrich and Bassler, 1926, pl. 1, fig. 24=USNM 145960 IP.
10. Outer lateral view, paralectotype, *Lonchodina subsymmetrica* Ulrich and Bassler, 1926, pl. 5, fig. 8=USNM 145914 IP.
11. Outer lateral view, holotype, *Lonchodina separata* Ulrich and Bassler, 1926, pl. 5, fig. 12=USNM 11277 VP.
12. Outer lateral view, *Lonchodina abnormis* Ulrich and Bassler, 1926, pl. 6, fig. 9=USNM 145917 IP.
13. Outer lateral view, *Bryantodus curvatus* Ulrich and Bassler, 1926, pl. 4, fig. 19=USNM 145919 IP.

14–22. *Lonchodina typicalis* Bassler (p. 23).

14. Outer lateral view, holotype, *Lonchodina alternata* Ulrich and Bassler, 1926, pl. 6, fig. 4=USNM 11290 VP.
15. Outer lateral view, holotype, *Lonchodina irregularis* Holmes, 1928, pl. 9, fig. 12 =USNM 11439 VP.
16. Outer lateral view, holotype, *Lonchodina geniculata* Ulrich and Bassler, 1926, pl. 4, fig. 15=USNM 11294 VP.
17. Outer lateral view, *Lonchodina subrecta* Ulrich and Bassler, 1926, pl. 5, fig. 4 =USNM 11283 VP.
18. Outer lateral view, *Lonchodina rectidens* Ulrich and Bassler, 1926, pl. 5, fig. 14 =USNM 145920 IP.
19. Outer lateral view, holotype, *Lonchodina bilateralis* Ulrich and Bassler, 1926, pl. 5, fig. 18=USNM 11280 VP.
20. Outer lateral view, lectotype, *Lonchodina typicalis* Ulrich and Bassler, 1926, pl. 5, fig. 1=USNM 11276 VP.
21. Outer lateral view, *Lonchodina subrecta* Ulrich and Bassler, 1926, pl. 5, fig. 5 =USNM 145921 IP.
22. Outer lateral view, holotype, *Lonchodina perarcuata* Ulrich and Bassler, 1926, pl. 5, fig. 19=USNM 11285 VP.

23, 24. *Polylophodonta pergyrata* (Holmes) (p. 42).

23. Oral view, lectotype, *Polygnathus gyratilineatus* Holmes, 1928, pl. 11, fig. 1 =USNM 11454 VP.
24. Oral view, type specimen of *Polygnathus pergyratus* Holmes, 1928, pl. 11, fig. 3 =USNM 11455 VP.



LONCHODINA AND *POLYLOPHODONTA*

PLATE 13

[All figures × 30 except fig. 9 = ×20. Figs. 1–6, 11–15 from "Hardin sandstone," Tennessee. Figs. 7–10 from Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 16–18 from Gassaway Member of the Chattanooga Shale, Alabama]

FIGURES 1–4, 7–10. *Ancyrodella nodosa* Ulrich and Bassler (p. 6).

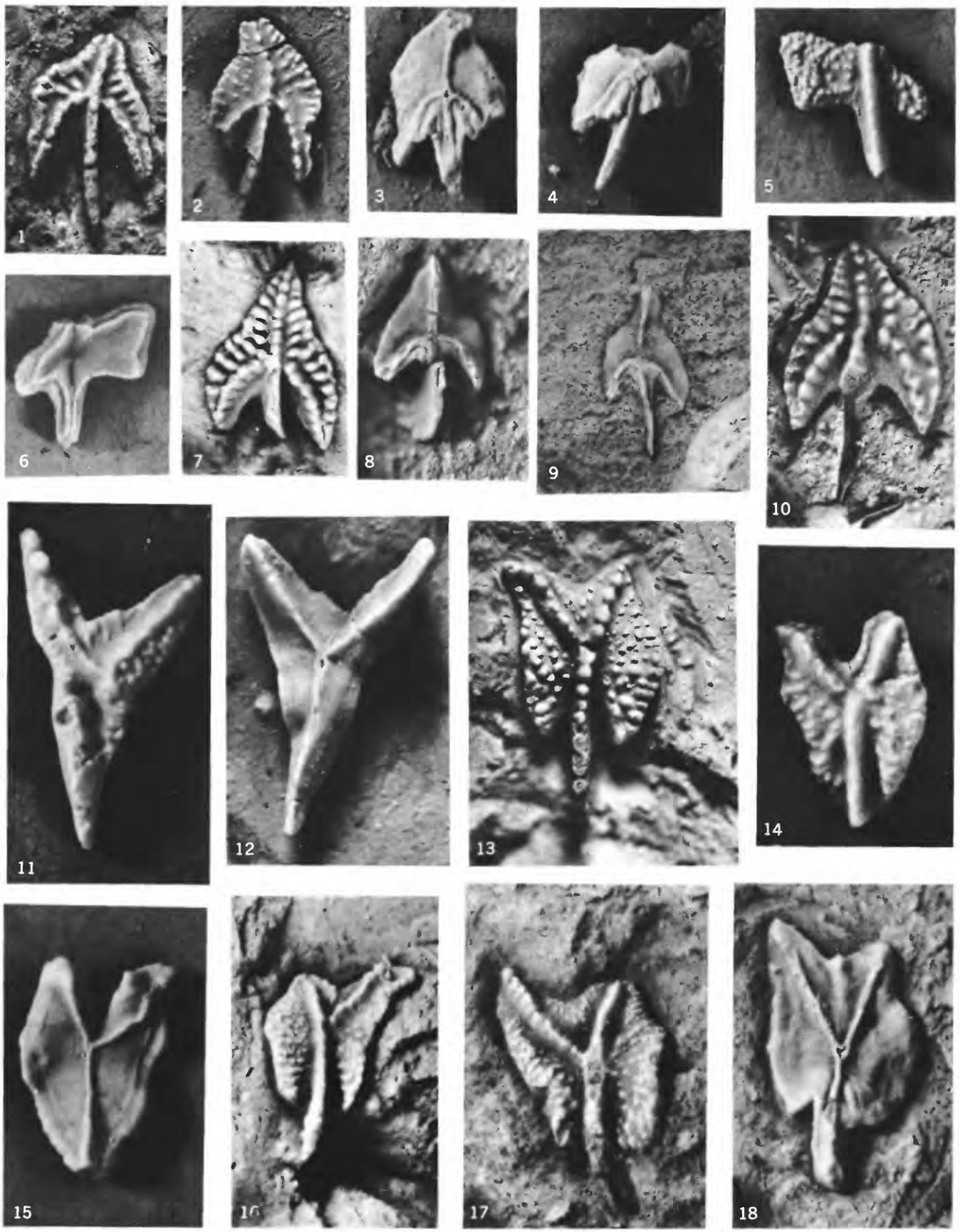
1. Oral view, holotype, *Ancyrodella hamata* Ulrich and Bassler, 1926, pl. 7, fig. 7=USNM 11011 VP.
2, 3. Oral and aboral views, holotype, *Ancyrodella symmetrica* Ulrich and Bassler, 1926, pl. 8, fig. 1=USNM 11008 VP.
4. Aboral view, *Ancyrodella malleus* Ulrich and Bassler, 1926, pl. 7, fig. 2=USNM 145873 IP.
7. Oral view, lectotype, *Ancyrodella nodosa* Ulrich and Bassler, 1926, pl. 1, fig. 10=USNM 11303 VP.
8. Aboral view, paralectotype, *Ancyrodella nodosa* Ulrich and Bassler, 1926, pl. 1, fig. 11=USNM 145870 IP.
9. Aboral view, paralectotype, *Ancyrodella nodosa* Ulrich and Bassler, 1926, pl. 1, fig. 13=USNM 145872 IP.
10. Oral view, paralectotype, *Ancyrodella nodosa* Ulrich and Bassler, 1926, pl. 1, fig. 12=USNM 145871 IP.

5, 6. *Ancyrodella? malleus* Ulrich and Bassler (p. 6).
Oral and aboral views of the holotype, Ulrich and Bassler, 1926, pl. 7, fig. 1=USNM 11006 VP.

11, 12. *Ancyrognathus asymmetrica* (Ulrich and Bassler) (p. 7).
Oral and aboral views of the holotype, *Palmatolepis asymmetrica* Ulrich and Bassler, 1926, pl. 7, fig. 18=USNM 11000 VP.

13–18. *Ancyrognathus bifurcata* (Ulrich and Bassler) (p. 7).

13. Oral view, lectotype, *Palmatolepis bifurcata* Ulrich and Bassler, 1926, pl. 7, fig. 17=USNM 11010 VP.
14, 15. Oral and aboral views, paralectotype, Ulrich and Bassler, 1926, pl. 7, fig. 16=USNM 145874 IP.
16. Oral view, lectotype, *Palmatolepis inequalis* Holmes, 1928, pl. 11, fig. 8=USNM 11458 VP.
17. Oral view, paralectotype, *Palmatolepis inequalis* Holmes, 1928, pl. 11, fig. 9=USNM 145875 IP.
18. Aboral view, paralectotype, *Palmatolepis inequalis* Holmes, 1928, pl. 11, fig. 10=USNM 145876 IP.



ANCYRODELLA, ANCYRODELLA?, AND *ANCYROGNATHUS*

PLATE 14

[All figures × 30. Figs.1 and 3 retouched. Figs. 1–8, 15–17, 19, 20, 22–30 from "Hardin sandstone," Tennessee. Figs. 18, 21, 31 from the Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 9–14 from the Gassaway Member of the Chattanooga Shale, Alabama]

FIGURE 1. *Palmatolepis folia* (Ulrich and Bassler) (p. 29).
Aboral view of holotype, Ulrich and Bassler, 1926, pl. 7, fig. 5=USNM 11012 VP.

2–16. *Palmatolepis glabra* Ulrich and Bassler (p. 29).
2. Oral view, lectotype, Ulrich and Bassler, 1926, pl. 9, fig. 20=USNM 11043 VP.
3. Oral view, previously unfigured paratype, USNM 145961 IP.
4. Oral view, previously unfigured paratype, USNM 145962 IP.
5. Oral view, previously unfigured paratype, USNM 145964 IP.
6. Aboral view, previously unfigured paratype, USNM 145963 IP.
7. Oblique oral view, paralectotype, *Palmatolepis glabra* Ulrich and Bassler, 1926, pl. 9, fig. 18=USNM 145974 IP.
8. Oblique oral view, paralectotype, *Palmatolepis glabra* Ulrich and Bassler, 1926, pl. 9, fig. 19=USNM 145975 IP.
9. Oral view, previously unfigured paratype, *Palmatolepis elongata* Holmes =USNM 145965 IP.
10. Oral view, holotype, *Palmatolepis elongata* Holmes, 1928, pl. 11, fig. 13 =USNM 11460 VP.
11. Oral view, previously unfigured paratype, *Palmatolepis elongata* Holmes =USNM 145966 IP.
12. Aboral view, previously unfigured paratype, *Palmatolepis elongata* Holmes =USNM 145967 IP.
13. Oral view, previously unfigured paratype, *Palmatolepis elongata* Holmes =USNM 145968 IP.
14. Oral view, previously unfigured paratype, *Palmatolepis elongata* Holmes =USNM 145933 IP.
15. Lateral view, paralectotype, *Panderodella truncata* Ulrich and Bassler, 1926, pl. 9, fig. 16=USNM 145976 IP.
16. Lateral view, paralectotype, *Panderodella truncata* Ulrich and Bassler, 1926, pl. 9, fig. 17=USNM 145977 IP.

17. *Panderodella maxillaris* Ulrich and Bassler (p. 35).
Lateral view, holotype, Ulrich and Bassler, 1926, pl. 9, fig. 21=USNM 11041 VP.

18, 19, 21, 31. *Polygnathus pennata* Hinde (p. 39).
18. Lateral view of *Gnathodus*? sp. Ulrich and Bassler, 1926, pl. 1, fig. 5 =USNM 140112 IP.
19. Lateral view, paralectotype, *Polygnathus pennatula* Ulrich and Bassler, 1926, pl. 9, fig. 25=USNM 145936 IP.
21. Oral view, paralectotype, *Polygnathus rimulatus* Ulrich and Bassler, 1926, pl. 1, fig. 9=USNM 145934 IP.
31. Oral view, lectotype. *Polygnathus rimulatus* Ulrich and Bassler, 1926, pl. 1, fig. 8=USNM 11302 VP.

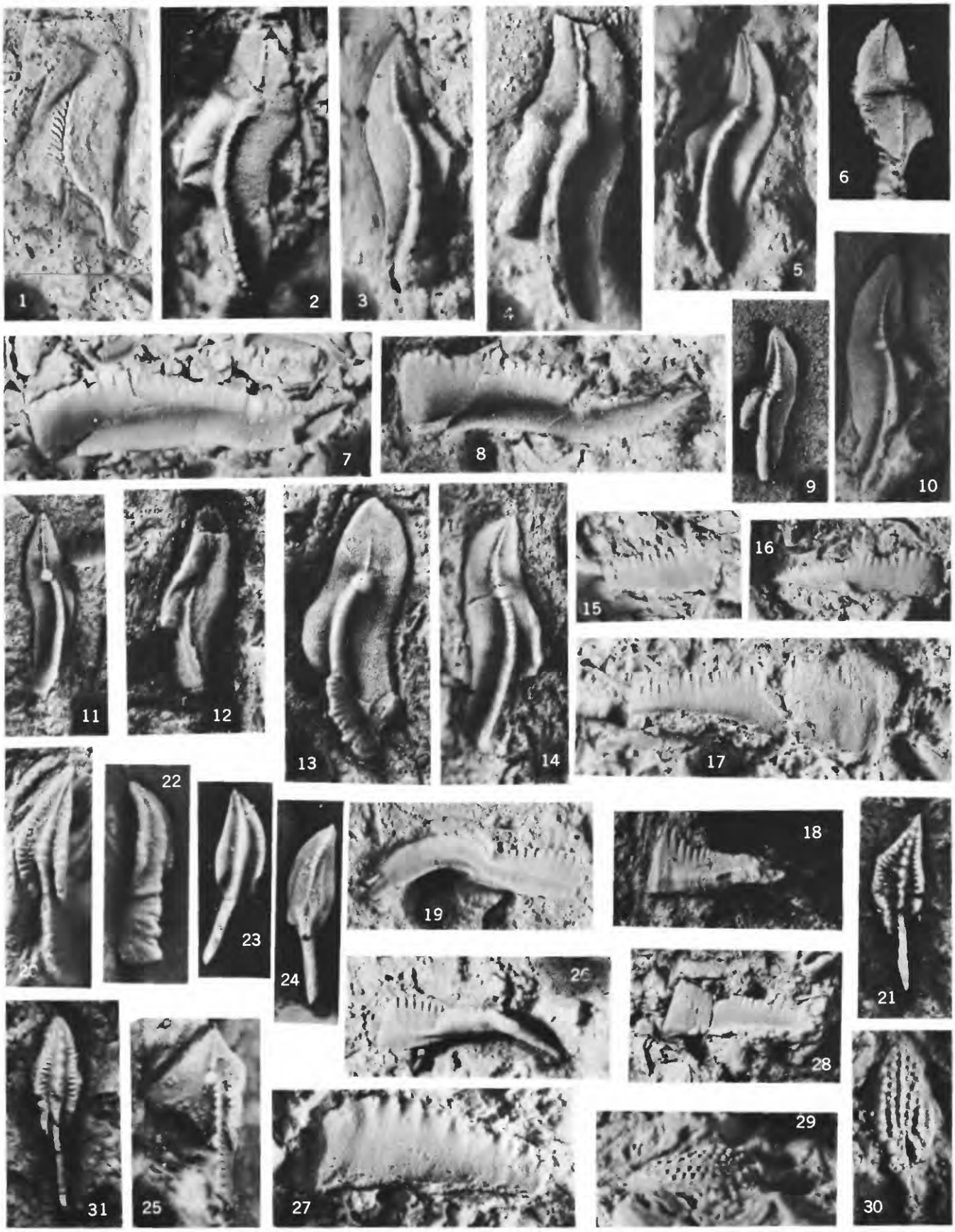
20, 22–24. *Polygnathus delicatula* Ulrich and Bassler (p. 38).
20. Oblique oral view, paralectotype, *Polygnathus delicatulus* Ulrich and Bassler, 1926, pl. 7, fig. 10=USNM 145932 IP.
22–24. Oblique oral, oral, and aboral views, lectotype, *Polygnathus delicatulus* Ulrich and Bassler, 1926, pl. 7, fig. 9=USNM 10994 VP.

25, 26. *Palmatolepis marginata clarki*? Ziegler (p. 31).
Oral and lateral views, paralectotype, *Polygnathus pennatulus* Ulrich and Bassler, 1926, pl. 9, fig. 24=USNM 145935 IP.

27. *Palmatolepis subcrassa* (Ulrich and Bassler) (p. 34).
Lateral view of the holotype, Ulrich and Bassler, 1926, pl. 9, fig. 14=USNM 11042 VP.

28. *Panderodella truncata* Bassler (p. 35).
Lateral view of the lectotype, Ulrich and Bassler, 1926, pl. 9, fig. 15=USNM 11040 VP.

29, 30. *Polygnathus germana* Ulrich and Bassler (p. 38).
Oblique lateral and oral views, holotype, Ulrich and Bassler, 1926, pl. 7, figs. 11, 12=USNM 10997 VP.



PALMATOLEPIS, PANDERODELLA, AND *POLYGNATHUS*

PLATE 15

[Fig. 1 × 20; all others × 30. Figs. 7 and 13 retouched. Figs. 1–4, 6, 7, 12–17 from "Hardin sandstone," Tennessee. Figs. 5, 8–11 from Gassaway Member of the Chattanooga Shale, Alabama]

FIGURES 1–10. *Palmatolepis perlobata* Ulrich and Bassler (p. 32).

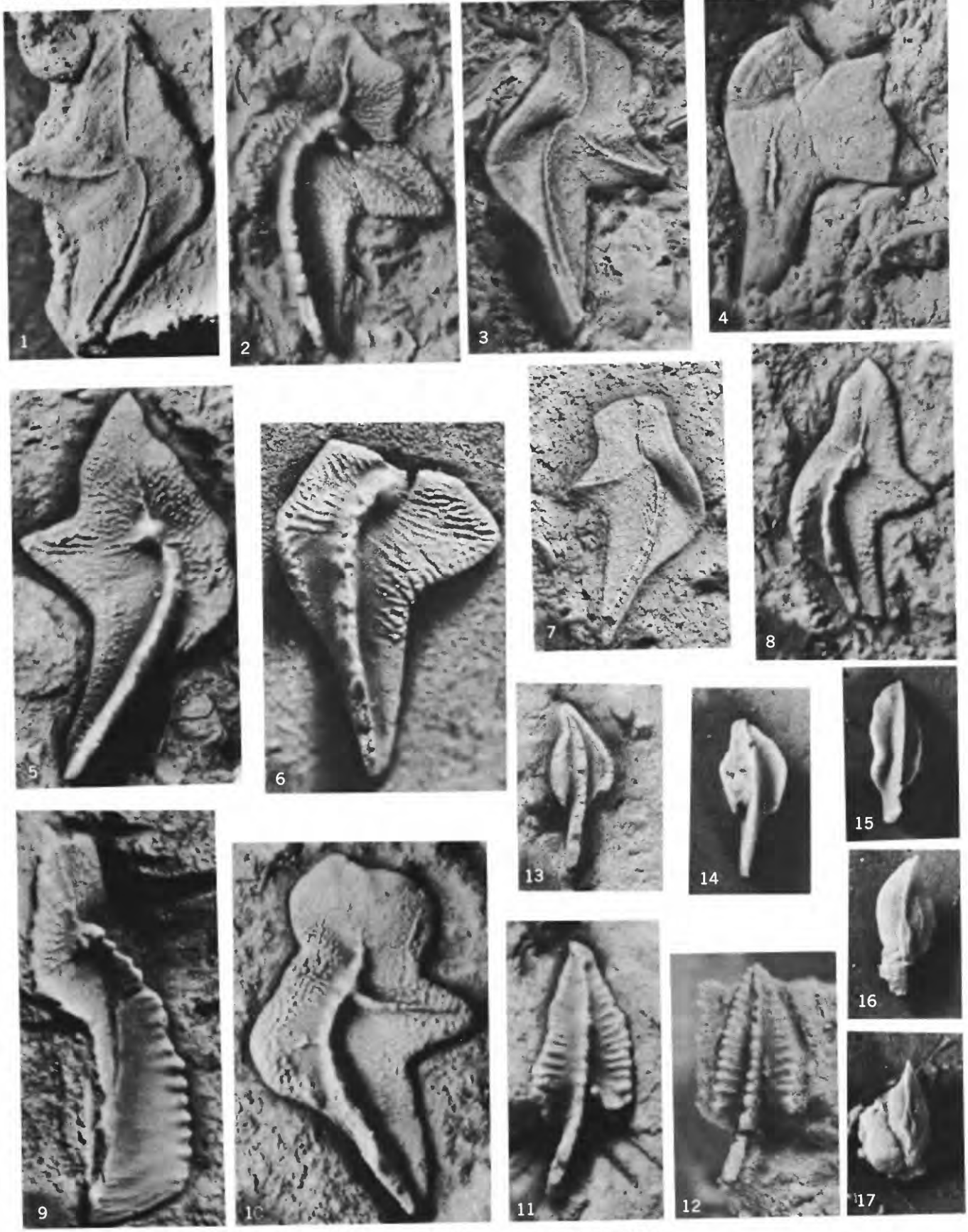
1. Aboral view, paralectotype, *Palmatolepis perlobata* Ulrich and Bassler, 1926, pl. 7, fig. 19=USNM 145922 IP.
2. Oral view, lectotype, *Palmatolepis perlobata* Ulrich and Bassler, 1926, pl. 7, fig. 22=USNM 10995 VP.
3. Aboral view, paralectotpye, *Palmatolepis perlobata* Ulrich and Bassler, 1926, pl. 7, fig. 21=USNM 145924 IP.
4. Aboral view, holotype, *Palmatolepis extralobata* Ulrich and Bassler, 1926, pl. 8, fig. 3=USNM 11007 VP.
5. Oral view, hypotype, *Palmatolepis perlobatus* Holmes, 1928, pl. 11, fig. 17=USNM 145978 IP.
6. Oral view, paralectotype, *Palmatolepis peculiaris* Ulrich and Bassler, 1926, pl. 8, fig. 12=USNM 145981 IP.
7. Aboral view, lectotype, *Palmatolepis lobatula* Ulrich and Bassler, 1926, pl. 7, fig. 3=USNM 11005 VP.
8. Oral view, hypotype, *Palmatolepis perlobatus* Holmes, 1928, pl. 11, fig. 18=USNM 145979 IP.
9. Oblique oral view, hypotype, *Palmatolepis perlobatus* Holmes, 1928, pl. 11, fig. 19=USNM 145980 IP.
10. Oral view, specimen studied by Holmes, 1928, USNM 153101 IP.

11, 12. *Polygnathus pennatula* Ulrich and Bassler (p. 40).

11. Oral view, specimen figured by Holmes, 1928, pl. 11, fig. 15 =USNM 11462 VP.
12. Oral view, lectotype, *Polygnathus pennatulus* Ulrich and Bassler, 1926, pl. 7, fig. 8=USNM 10996 VP.

13–17. *Polygnathus glabra* Ulrich and Bassler (p. 39).

13. Oral view, holotype, Ulrich and Bassler, 1926, pl. 7, fig. 13 =USNM 11004 VP.
14, 15. Oral views of topotype specimens, USNM 145971 IP and 145969 IP.
16. Aboral view of a topotype specimen, USNM 145970 IP.
17. Aboral view of an unfigured paratype, USNM 145972 IP.



PALMATOLEPIS AND *POLYGNATHUS*

PLATE 16

[All figures × 30. Fig. 7 retouched. Figs. 1–3 from the Rhinestreet Shale Member of the West Falls Formation, New York. Figs. 4–19 from the "Hardin sandstone," Tennessee]

FIGURES 1–3. *Palmatolepis punctata* (Hinde) (p. 33).

1. Oral view, specimen figured by Ulrich and Bassler, 1926, pl. 1, fig. 6=USNM 11309 VP.
2. Aboral view, specimen figured by Ulrich and Bassler, 1926, pl. 1, fig. 7=USNM 145927 IP.
3. Oral view, specimen figured by Ulrich and Bassler, 1926, pl. 1, fig. 6′=USNM 145926 IP.

4. *Palmatolepis perlobata*? Ulrich and Bassler (p. 33).
   Oral view, lectotype *Polygnathus*? *acaulis* Ulrich and Bassler, 1926, pl. 8, fig. 4=USNM 11003 VP.

5, 6. *Palmatolepis subrecta* Miller and Youngquist (p. 34).

5. Oral view, paralectotype, *Palmatolepis perlobata* Ulrich and Bassler, 1926, pl. 7, fig. 23=USNM 145928 IP.
6. Aboral view, paralectotype, *Palmatolepis lobatula* Ulrich and Bassler, 1926, pl. 7, fig. 4=USNM 145929 IP.

7. *Palmatolepis subrecta*? Miller and Youngquist (p. 34).
   Aboral view, *Polygnathus* sp. Ulrich and Bassler, 1926, pl. 9, fig. 23=USNM 10979 VP.

8, 9. *Palmatolepis perlobata* Ulrich and Bassler (p. 32).

8. Oral view, paralectotype, *Palmatolepis perlobata* Ulrich and Bassler, 1926, pl. 7, fig. 20=USNM 145923 IP.
9. Oral view, lectotype, *Palmatolepis peculiaris* Ulrich and Bassler, 1926, pl. 8, fig. 11=USNM 10999 VP.

10, 11, 14–18. *Polygnathus sublata* Ulrich and Bassler (p. 41).

10, 11. Aboral and oral views, holotype, Ulrich and Bassler, 1926, pl. 8, fig. 2=USNM 11009 VP.

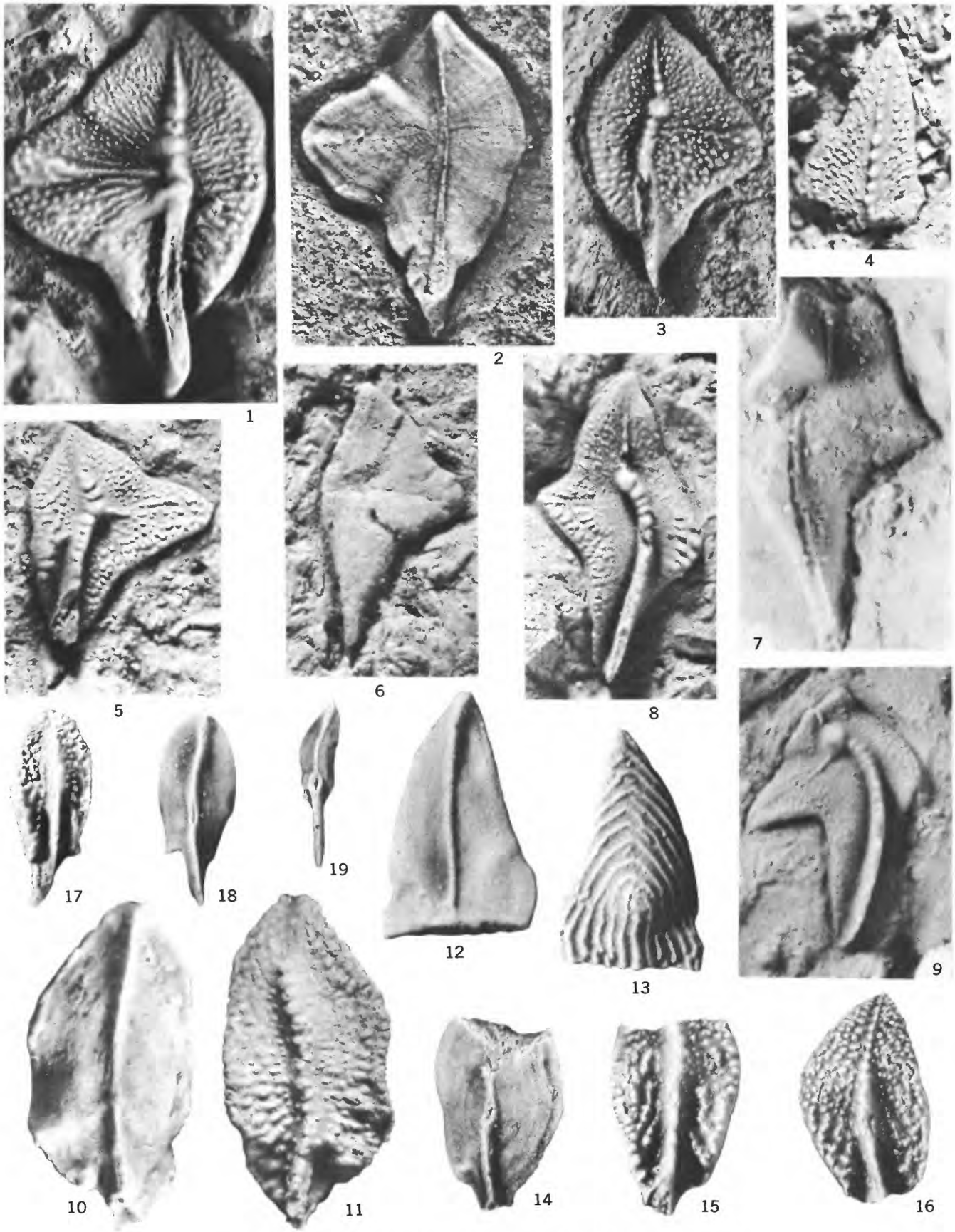
14, 15. Aboral and oral views of a topotype specimen collected by Huddle and Whitlatch, 1933, USGS loc. No. 22240 PC; USNM 153098 IP.

16. Oral view topotype specimen collected by Hass, 1949, USGS loc. No. 22238 PC; USNM 153099 IP.

17, 18. Oral and aboral views of a topotype specimen collected by Huddle and Whitlatch, 1933, USGS loc. No. 22240 PC; USNM 153097 IP.

12, 13. *Polylophodonta pergyrata* (Holmes) (p. 42).
   Aboral and oral views, paralectotype, *Polygnathus*? *acaulis* Ulrich and Bassler, 1926, pl. 8, fig. 5=USNM 145982 IP.

19. *Polygnathus delicatula* Ulrich and Bassler (p. 38).
   Aboral view, topotype specimen collected by Hass, 1949, USGS loc. No. 22238 PC; USNM 153100 IP.



PALMATOLEPIS, POLYGNATHUS, AND *POLYLOPHODONTA*

PLATE 17

[All figures × 30. Figs. 1–4, 11 from "Hardin sandstone," Tennessee. Figs. 5–10, 12 from Gassaway Member of the Chattanooga Shale, Alabama]

FIGURES 1, 2, 8, 9, 11. *Polylophodonta confluens* (Ulrich and Bassler) (p. 42).

1. Oral view, lectotype, *Polygnathus confluens* Ulrich and Bassler, 1926, pl. 7, fig. 14=USNM 10998 VP.
2. Oral view, paralectotype, *Polygnathus confluens* Ulrich and Bassler, 1926, pl. 7, fig. 15=USNM 145937 IP.
8. Oral view, *Polygnathus rhomboideus* Ulrich and Bassler. Holmes, 1928, pl. 11, fig. 11=USNM 11456 VP.
9. Oral view, *Polygnathus rhomboideus* Ulrich and Bassler. Holmes, 1928, pl. 11, fig. 12=USNM 146509 IP.
11. Oral view, holotype, *Polygnathus rhomboideus* Ulrich and Bassler, 1926, pl. 7, fig. 6=USNM 11013 VP.

3–7, 10. *Polylophodonta concentrica* (Ulrich and Bassler) (p. 41).

3. Oral view, lectotype, *Polygnathus concentricus* Ulrich and Bassler, 1926, pl. 8, fig. 6=USNM 11002 VP.
4. Aboral view, paralectotype, *Polygnathus concentricus* Ulrich and Bassler, 1926, pl. 8, fig. 7=USNM 145938 IP.
5. Oral view, *Polygnathus concentricus* Ulrich and Bassler. Holmes, 1928, pl. 11, fig. 6=USNM 145983 IP.
6. Oral view, *Polygnathus concentricus* Ulrich and Bassler. Holmes, 1928, pl. 11, fig. 5=USNM 11457 VP.
7. Oral view, *Polygnathus concentricus* Ulrich and Bassler. Holmes, 1928, pl. 11, fig. 7=USNM 145984 IP.
10. Oral view, holotype, *Polygnathus trilobatus* Holmes, 1928, pl. 11, fig. 4=USNM 11456 VP.

12. *Polylophodonta pergyrata* (Holmes) (p. 42).

Oral view, paralectotype of *Polylophodonta gyratilineata* Holmes, 1928, pl. 11, fig. 2=USNM 146510 IP.

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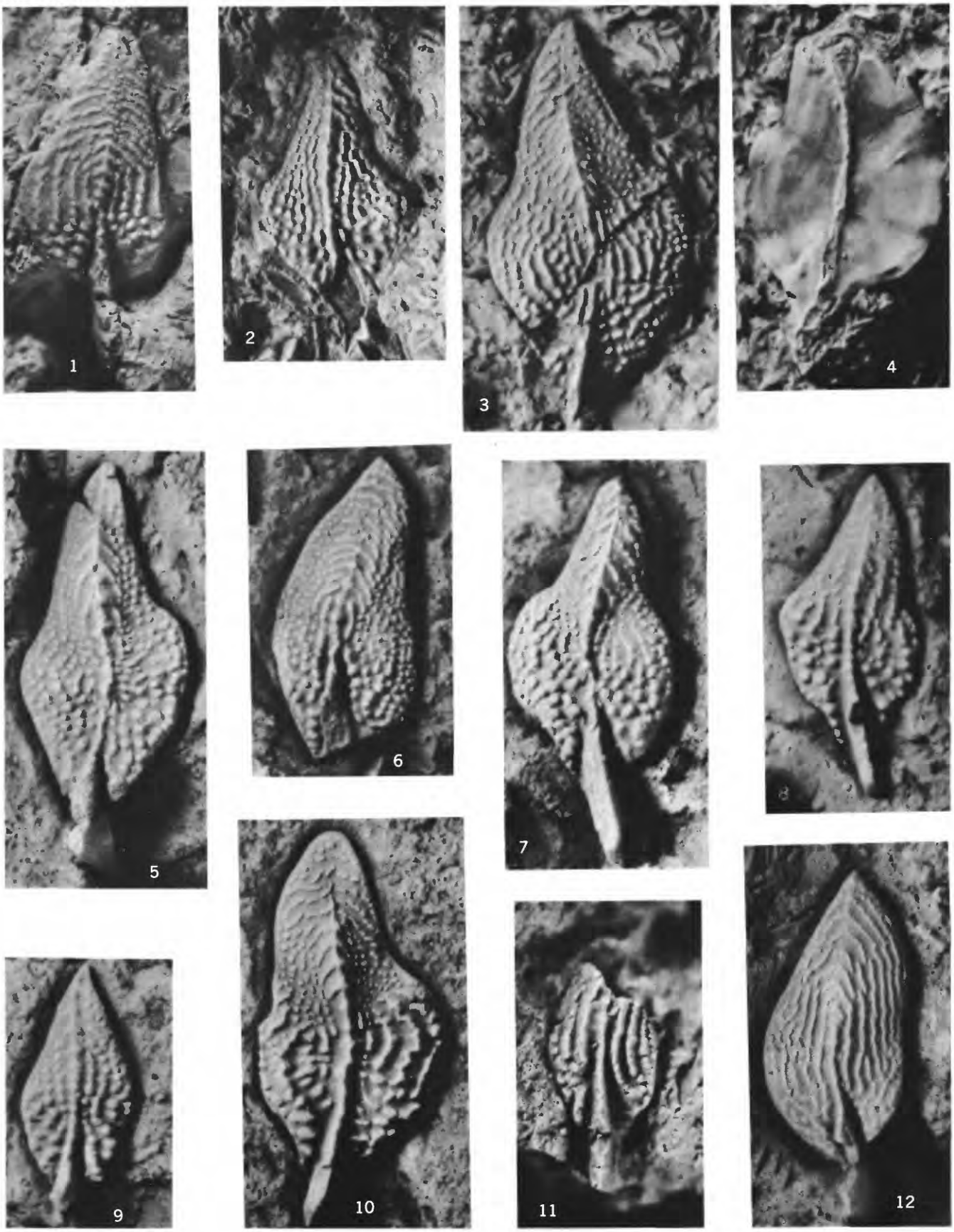

POLYLOPHODONTA