

Conodonts of the Barnett Formation of Texas

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By WILBERT H. HASS

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CONODONTS OF THE BARNETT FORMATION OF TEXAS

BY WILBERT H. HASS

ABSTRACT

The Barnett formation (Mississippian) of the Llano region, Texas, contains two conodont faunal zones. The upper of these two zones is believed to be restricted to that portion of the formation which herein is regarded as being of Meramec and possibly also partly of Chester age; and the lower faunal zone, to that portion of the formation which herein is regarded as being of Osage (Keokuk) age.

Rocks assigned to the upper faunal zone are present in all quadrants of the Llano region. In the eastern part of the area, these rocks consist chiefly of olive-gray to yellowish-brown shales that are interbedded with a few thin argillaceous limestones; westward, the above-mentioned rocks merge into limestones, some of which are extremely crinoidal. Conodonts are numerous in most collections, but the faunal assemblage is small as only 10 genera and 18 species have been recognized in 65 collections. Some of these conodonts are present in the lower part of the Stanley shale of Oklahoma and Arkansas, as well as in the Caney shale of Oklahoma. Two new generic names, *Geniculatus* and *Roundya* are proposed. P. V. Roundy's conodonts from the Barnett formation have been studied and all of his type specimens have been refigured.

Rocks assigned to the lower faunal zone of the Barnett formation are known to be present only in the southwest quadrant of the Llano region. The fauna of this zone has been recognized in 20 collections but has not been described as it is poorly preserved.

INTRODUCTION

The Barnett formation of Mississippian age crops out in the Llano region of Texas. It contains two conodont faunal zones: the upper faunal zone is restricted to that part of the formation which in this report is regarded as being definitely of Meramec and possibly also partly of Chester age; and the lower faunal zone, to that part of the formation which in this report is regarded as being of Osage (Keokuk) age. The conclusions of this paper are based on a study of specimens in 85 collections, most of which were made by the writer; of these collections, 65 are from the upper faunal zone, and 20 are from the lower. Figure 4 indicates the localities, C-1 to C-17, at which these collections were made, and table 1 records the species present in each collection from the upper faunal zone. Conodonts collected by P. V. Roundy (1926)—including those he described and figured—have been studied, and all of his type specimens have been refigured. The known fauna of the upper zone is well preserved and consists of 10 genera and 18 species.

That of the lower zone is poorly preserved, and, therefore, is not described.

Field work was done on four occasions. The first collections were made during the summer of 1938 while the writer was assisting Josiah Bridge with his studies of the lower Paleozoic rocks of the Llano region. As an examination of these collections indicated that conodonts are abundant in the upper faunal zone of the Barnett formation, additional collections were made in August 1942, June and July 1945, and July 1950. During the 1945 field season, the writer spent 2 days with V. E. Barnes of the Texas Bureau of Economic Geology making collections from measured section in Blanco and Burnet Counties; and 8 days with P. E. Cloud, Jr., of the United States Geological Survey making similar collections from sections located elsewhere in the Llano region. N. W. Shupe photographed the fossils used to illustrate the paper.

AGE OF THE BARNETT FORMATION

The name, Barnett shale, was proposed by Moore and Plummer (1922, pp. 25, 26) for all of the limestone and shale beds between the Marble Falls limestone of Pennsylvanian age and the Ellenburger group of Early Ordovician age. They (Plummer and Moore, 1922, pp. 23, 24) regarded the Barnett as the exact equivalent of the "lower Bend shale"—the lowermost of the three units into which Dumble's (1890, p. 65) Bend series was divided—and designated the exposure at Barnett Springs, "about 5 miles east of San Saba," as the type locality. Girty (1926, p. 3), however, has stated that the Barnett is not the exact equivalent of the "lower Bend shale" but that it also contains beds originally assigned to the overlying Marble Falls limestone.

For the most part, the base of the Barnett formation is easily recognized, though it is now known that, at many localities, a thin sequence of Mississippian and Devonian beds is present between that formation and the Ellenburger group. Opinions differ, however, as to where the base of the Barnett should be drawn in the southwest quadrant of the region, as beds occur there which some stratigraphers place in the Chappel limestone but which others place in the Barnett formation. (See Weller, and others, 1948, pp. 143, 144, and

pl. 2, column 54; Cloud and Barnes, 1949, pp. 52-59; Plummer, 1950, pp. 26, 28.)

Several opinions have been held concerning the age of the Barnett formation. One view, based on the work of Girty (1912, p. 8; 1919, pp. 71-81; 1926, pp. 3, 4; and Girty and Moore, 1919, pp. 418-420), held that the Barnett is a correlative of the Mississippian Caney shale; a formation that Girty (1926, p. 4) suggested might possibly be the equivalent of the entire interval from the base of the Moorefield formation to the top of the Fayetteville shale of Arkansas. Another view, based chiefly on the work of Moore, was that the Barnett is of early Pennsylvanian age. (See Moore, 1919, pp. 217-241; and Girty and Moore, 1919, pp. 418-420). Later (Plummer and Moore, 1922, pp. 23, 24) the age of these Carboniferous beds was considered to be uncertain and still more recently Plummer and Moore (1938, p. 104) have classified the Barnett as being definitely of Mississippian age. They also divided the formation into three units; the lowermost unit was correlated with the Moorefield shale (Moorefield formation and Ruddell shale of present usage) and the uppermost unit, with the Fayetteville shale.

Miller and Youngquist (1948) have described some cephalopods from the Barnett formation. Most of their fossils were collected by Cloud, Barnes, and G. A. Cooper and came from localities C-1, C-10, C-12, and C-14 of this report. (See fig. 4.) Miller and Youngquist's (1948, p. 651) views on the age and correlatives of the Barnett are given in the following statement:

The collections now available for study indicate that there is only one [cephalopod] faunal zone in the Barnett, but we are not able to ascertain with certainty whether the fauna is upper Viséan or lower Namurian (or both) in age. Furthermore, the cephalopods do not indicate the correlative of the Barnett in the classical Mississippian section of the middle Mississippi Valley, for the beds there have yielded too few ammonoids. However, from a study of the cephalopods alone, we can conclude that the Barnett is of approximately the same age as the Caney of Oklahoma, the Moorefield, Ruddell, Batesville, and/or lower Fayetteville of Arkansas, the "Meramec" of Kentucky, the Helms of west Texas, the White Pine of Nevada and southeastern California, and the goniatite-bearing portions of the Floyd of Georgia.

A recent opinion on the age of the Barnett formation is that of Cloud and Barnes (1949, p. 59) who wrote:

The lower limit of its age is virtually fixed as Keokuk, but the upper limit might be as high as Ste. Genevieve. The present authors [Cloud and Barnes] consider it extremely unlikely that any part of the Barnett formation is as young as Chester in age, and it is their opinion that it is actually entirely pre-St. Louis if not pre-Spergen. The greater number of species from the middle Mississippi Valley region that compare closely with Barnett species are either restricted to the Keokuk limestone or are known to occur in it. It is possible, therefore, that the Barnett formation and its correlatives, although provisionally referred to Keokuk plus Warsaw, are wholly of Keokuk age.

Plummer and Scott (1937) were of the opinion that the Barnett formation is upper Mississippian. Their work was based on a study of cephalopods. In his final publication, Plummer (1950, p. 43) correlated the Barnett with the Moorefield shale (Moorefield formation and Ruddell shale of present usage) and placed both formations in the Chester. His opinion was that:

The Barnett faunas correlate with the Moorefield of Arkansas and not with the Fayetteville or Pitkin. The Barnett faunas probably also are the time equivalent of the lower part (Okaw and older beds) of the Chester of Illinois and the Helms of west Texas * * * All four faunas [Barnett, Moorefield, lower Chester, and Helms] may represent more or less equivalent time space in the Upper Mississippian period. Clearly they all belong in the Chester series.

It should be pointed out in this connection that Cloud and Barnes (1949) included in the lower part of the Barnett formation, beds that Plummer (1950) placed in the Chappel limestone as the White's Crossing coquina member. Plummer considered these beds to be of Burlington age, whereas Cloud and Barnes considered them to be of Keokuk age.

Weller, and others (1948, p. 144) have summarized the prevailing opinions as follows:

The Barnett shale is similar lithologically and faunally to the lower part of the Caney shale of Oklahoma. Generally, it has been correlated with the Chesterian * * * but its relations to the Ruddell shale of Arkansas seem to be much closer. Cloud believes that no strata younger than Warsaw occur in outcrop and correlates most of the formation with the Keokuk, but Plummer assigned at least part of it to a considerably higher position in the section * * * It is doubtful, however, that any strata of Chesterian age outcrop.

CONODONT FAUNAL ZONES

The United States Geological Survey at present recognizes the classification of the Barnett formation proposed by Cloud and Barnes (1949). According to these authors, the Barnett may range from Keokuk to Ste. Genevieve in age. But they were inclined to believe that the top is not so high as St. Louis, or possibly Spergen, in age and even suggested that the entire formation could be of Keokuk age. These authors also regarded the Barnett of the Llano region as containing two interfingering lithologic facies; a predominantly dark shaly facies in the eastern part of the area and a predominantly limestone facies in the western.

The lowermost beds of the Barnett formation in the southwest quadrant of the Llano region have been found to contain conodonts distinct from those present in the immediately overlying beds of the formation. It is the writer's opinion that these lower beds do not interfinger with the predominantly shaly beds of the Barnett and, also, that the formation contains two distinct conodont faunal zones: (1) a lower zone of Osage

(Keokuk) age which is confined to the basal part of the Barnett formation in the southwest quadrant of the Llano region, and which contains poorly preserved conodonts as well as the megafossil, *Spirifer logani*; and (2) an upper zone of Meramec, and possibly partly of Chester, age which is present in the predominantly limestone sequence exposed in the western part of the Llano region—i. e. the beds above those containing the conodonts of the lower faunal zone—as well as in the predominantly shaly beds exposed in the eastern part of the area. Conodonts of this second zone are associated with megafossils, some of which are also present in the Caney shale of Oklahoma, as well as in the interval from the base of the Moorefield formation to the top of the Fayetteville shale of Arkansas. (See Girty, 1919, pp. 71-78; 1926, pp. 3, 4; Plummer and Scott, 1937; and Miller and Youngquist, 1948.)

LOWER CONODONT FAUNAL ZONE

Exposures of this faunal zone are found in the southwest quadrant of the uplift and, for the most part, consist of light-gray, fine-, medium-, and coarse-grained, crinoidal limestones. The known conodont fauna consists of only a few small poorly preserved fossils and is not described. The genera *Gnathodus*, *Hibbardella*, *Hindeodella*, *Ligonodina*, *Prioniodus*, *Roundya*, and *Subbryantodus* are present, but *Taphrognathus*, which according to Branson and Mehl (1941d, p. 180) is characteristic of the Keokuk limestone of St. Louis County, Mo., has not been recognized. Some of the gnathodids resemble the Keokuk species, *Gnathodus linguiformis* Branson and Mehl. Rocks of this faunal zone include those that Plummer (1950, pp. 26, 28) placed in the White's Crossing coquina member of the Chappel limestone. He considered such rocks to be of Burlington age.

UPPER CONODONT FAUNAL ZONE

Rocks of this zone crop out in all quadrants of the Llano region. In the eastern part of the area, these rocks consist chiefly of olive-gray to yellowish-brown shales that are interbedded with a few thin argillaceous limestones, but in the western part of the area, they consist chiefly of light-gray to yellowish-gray limestones, some of which are extremely crinoidal. Conodonts are numerous and well-preserved in the upper faunal zone; however, the variety is limited, as only 10 genera and 18 species have been recognized in 65 collections. *Gnathodus texanus*, *Gnathodus inornatus*, *Gnathodus bilineatus*, *Geniculatus claviger*, *Cavusgnathus cristata*, *Ligonodina roundyi*, *Lonchodina paraclarki*, and *Roundya barnettana* are the common species. All 18 species range throughout the entire faunal zone with the exception of *Gnathodus texanus* and *Prioniodus singularis*; the

former seems to be absent from the topmost beds of the zone, whereas the latter is apparently restricted to the topmost beds.

The conodonts of the Barnett formation, that Roundy described in 1926 (pp. 8-17) are from the upper faunal zone. His work was based, for the most part, on an examination of a limited amount of material and, except for the holotype of *Gnathodus texanus*, all of his figured specimens are fragments. It is the writer's opinion that two of Roundy's species, *Polygnathus* sp. A and *Polygnathus taffi*, were founded on reworked specimens. The first of these, *Polygnathus* sp. A, is based on a single fragmentary specimen which herein is identified as *Palmatolepis glabra*, a species whose normal stratigraphic range is considered by the writer to be restricted to a faunal zone in the Upper Devonian; and the other, *Polygnathus taffi*—also based upon a single specimen—belongs to a genus not known elsewhere to range above the Mississippian, Osage group. Roundy also included *Lonchodus? lineatus* (Pander) and *Lonchodus simplex* (Pander) in his Barnett fauna. For reasons given in the descriptive portion of the paper, it is believed that these two categories have no stratigraphic value.

Below are listed the generic and specific names used by Roundy (1926) and the corresponding names used in this report:

Names used in this report.	Names used by Roundy, 1926
<i>Geniculatus claviger</i> (Roundy).	{ <i>Polygnathus? claviger</i> Roundy. <i>Prioniodus healdi</i> Roundy. <i>Prioniodus</i> sp. D, pl. 4, figs. 13a, b (not fig. 12).
<i>Gnathodus bilineatus</i> (Roundy).	{ <i>Polygnathus bilineata</i> Roundy. <i>Polygnathus texana</i> Roundy.
<i>Gnathodus texanus</i> Roundy.	{ <i>Gnathodus texanus</i> Roundy. <i>Gnathodus texanus</i> var. <i>biruspidus</i> Roundy.
<i>Hindeodella ensis</i> Hass.	<i>Ctenognathus</i> sp. A.
<i>Ligonodina roundyi</i> Hass.	{ <i>Prioniodus</i> sp. A. <i>Prioniodus</i> sp. C.
<i>Lonchodus lineatus</i> (Pander).	<i>Lonchodus? lineatus</i> (Pander).
<i>Lonchodus simplex</i> (Pander).	<i>Lonchodus simplex</i> (Pander).
<i>Palmatolepis glabra</i> Ulrich and Bassler.	<i>Polygnathus</i> sp. A.
<i>Polygnathus taffi</i> Roundy.	<i>Polygnathus taffi</i> Roundy.
<i>Prioniodus inclinatus</i> Hass.	<i>Prioniodus</i> sp. D, pl. 4, fig. 12, (not figs. 13 a, b).
<i>Prioniodus ligo</i> Hass.	<i>Prioniodus peracutus</i> Hinde.
<i>Prioniodus roundyi</i> Hass.	<i>Prioniodus</i> sp. B.
<i>Subbryantodus roundyi</i> Hass.	<i>Ctenognathus</i> sp. B.

Four small collections cited by Roundy (1926) have not been seen by the writer and are presumed to be lost. Roundy identified the following species in these lots:

- Collection 2610b. North side of road to Bend post office about 6 miles from San Saba * * * about 30 to 40 feet below the top of the Barnett shale.
- Prioniodus* sp. (fragments)

Collection 2610c. Same locality as collection 2610b.

Ctenognathus sp. A
Lonchodus simplex (Pander)
Polygnathus? claviger Roundy
Prioniodus sp. (fragments)

Collection 7011a (green). Four miles southwest of Chappel on road to Cherokee, San Saba County. From 25 to 30 feet above base of Barnett shale.

Prioniodus sp. D?

Collection 7687 (green). Probably the same locality as 7011a (green).

Prioniodus sp. D

Conodonts, similar to those present in the upper

faunal zone of the Barnett formation, have been reported from the Caney shale of Oklahoma (Branson and Mehl, 1941a, pp. 167-178) and the lower part of the Stanley shale of Oklahoma and Arkansas (Hass, 1950). As a consequence of this similarity of conodont faunas, the writer (Hass, 1950) has suggested a partial correlation of the above-mentioned formations. The species on which this correlation is based are listed below, as some of the fossil names used in the present report differ from those previously used by the writer (Hass, 1950), as well as by Branson and Mehl (1941a) and Roundy (1926).

Barnett formation, names used in present report	Stanley shale, names used by Hass (1950)	Caney shale, including names used by Branson and Mehl (1941)	Barnett formation, names used by Roundy (1926)
<i>Gemiculatus claviger</i> (Roundy).	<i>Bactrognathus claviger</i> (Roundy).	<i>Euprioniodina?</i> sp. (pl. 5, figs. 17, 18). <i>Metalonchodina?</i> sp. (pl. 5, fig. 15).	<i>Polygnathus? claviger</i> Roundy. <i>Prioniodus healdi</i> Roundy. <i>Prioniodus</i> sp. D (pl. 4, figs. 13a, b; not fig. 12).
<i>Cavusgnathus cristata</i> Branson and Mehl.	<i>Cavusgnathus</i> cf. <i>C. cristata</i> Branson and Mehl.	<i>Cavusgnathus cristata</i> Branson and Mehl.	Not mentioned by Roundy.
<i>Gnathodus bilineatus</i> (Roundy).	<i>Gnathodus bilineatus</i> (Roundy).	<i>Gnathodus pustulosus</i> Branson and Mehl.	<i>Polygnathus bilineata</i> Roundy. <i>Polygnathus texana</i> Roundy.
<i>Gnathodus inornatus</i> Hass.	<i>Gnathodus commutatus</i> (Branson and Mehl).	<i>Spathognathodus commutatus</i> Branson and Mehl.	Not mentioned by Roundy.
<i>Gnathodus texanus</i> Roundy.	<i>Gnathodus texanus</i> Roundy.	<i>Gnathodus texanus</i> Roundy.	<i>Gnathodus texanus</i> Roundy. <i>Gnathodus texanus</i> var. <i>bicuspidus</i> Roundy.
<i>Roundya barnettana</i> Hass.	<i>Hibbardella</i> sp. A.	Present in Caney shale but not mentioned by Branson and Mehl.	Not mentioned by Roundy.
<i>Hindeodella undata</i> Branson and Mehl.	<i>Hindeodella undata</i> Branson and Mehl.	<i>Hindeodella undata</i> Branson and Mehl. <i>Hindeodella</i> sp. (pl. 5, fig. 9).	Not mentioned by Roundy.
<i>Hindeodella ensis</i> Hass.	<i>Hindeodella</i> sp. A.	<i>Hindeodella</i> sp. (pl. 5, fig. 1).	<i>Ctenognathus</i> sp. A.
<i>Ligonodina roundyi</i> Hass.	<i>Ligonodina</i> sp.	Genus present.	<i>Prioniodus</i> sp. A. <i>Prioniodus</i> sp. C.
<i>Metalonchodina</i> sp. A.	<i>Metalonchodina</i> sp.	Genus present.	Not mentioned by Roundy.
<i>Prioniodus inclinatus</i> Hass.	<i>Prioniodus</i> sp. A.	Genus present.	<i>Prioniodus</i> sp. D (pl. 4, fig. 12; not figs. 13a, b).
<i>Subbryantodus roundyi</i> Hass.	<i>Subbryantodus</i> sp.	Genus present.	<i>Ctenognathus</i> sp. B.

MEMORANDUM FOR THE RECORD

DATE: 10/15/54
SUBJECT: [Illegible]

[The body of the memorandum contains several paragraphs of text that are extremely faint and illegible due to the quality of the scan. The text appears to be a standard memorandum format with a header, a subject line, and several paragraphs of body text.]

MEASURED SECTIONS

The faunal zonation of the Barnett is based on a study of the conodonts present in 85 collections (see fig. 4 and locality register pp. 76-77). Of these collections, 63 are serials that come from the six localities described below. At these localities, the fauna of the lower zone was recognized in 20 collections and that of the upper zone in 43; information on the thickness of the Barnett formation was obtained from P. E. Cloud, Jr.

Locality C-1, Type locality of the Chappel limestone: Cut on road from San Saba to Chappel near top of hill; 2.4 miles southeast of courthouse at San Saba, San Saba County.

Marble Falls limestone.

Barnett formation:

Upper conodont faunal zone: Shale, olive-gray where freshly exposed but yellowish-gray and yellowish-brown where weathered, fetid. A few thin limestone beds are present, mostly near top of formation. Basal 6 inches locally contains glauconite... 50

Collection no.	Height above base
9331	42 feet
9026	34 feet
8649	24 feet
9006	24 feet
8651	19 feet
9007	19 feet
9330	19 feet
9329	8 feet
9030	8 feet to 8 feet 6 inches
2613h	8 feet 5 inches to 10 feet 5 inches
2618	5 feet to 10 feet
2613g	5 feet 1 inch to 8 feet 5 inches
2613e	2 feet 9 inches to 5 feet 1 inch
2613d	9 inches to 2 feet 9 inches
2613c	0 to 9 inches
9028	0 to 6 inches

Chappel limestone.

Ives breccia.

Honeycut formation.

Locality C-12, Zesch Ranch section: About 5,000 feet N. 60° W. of point at which Honey Creek crosses the road from Mason to White's Crossing over the Llano River in Mason County.

Marble Falls limestone.

Barnett formation:

Upper conodont faunal zone: Limestone, yellowish-gray, medium- to coarse-grained, argillaceous, fetid; partly covered... 60

Collection no.	Height above base, in feet
9309	84
9322	75
9321	70
9320	65
9319	60
9318	53
9317	42

Barnett formation—Continued

Feet

Lower conodont faunal zone: Limestone, predominantly very nearly white, medium- to coarse-grained, crinoidal. Some beds are yellowish gray and pinkish gray; some are fine-grained. (Two unnumbered collections were made from the rocks of this zone; one collection came from the basal foot and the other from the top foot)..... 30

Total..... 90

Chappel limestone.

Gorman formation.

Locality C-13, White's Crossing over the Llano River: Approximately 8.3 miles (airline) southwest of the courthouse at Mason, Mason County.

Barnett formation:

Feet

Lower conodont faunal zone:
Limestone, very nearly white to light-gray, fine-grained to sublithographic..... 2
Limesand, very light gray to yellowish-gray where freshly exposed but moderate reddish-orange and moderate reddish-brown where weathered; very coarse grained except for a few sublithographic beds..... 11

Total..... 13

Chappel limestone.

Collections were made on two occasions. The first collection (9312), made by the writer in July 1945, came from fragments of a slab of rock from which P. E. Cloud obtained some megafossils, including *Spirifer logani*. The recognizable conodonts of this collection belong to the upper conodont faunal zone. Late in 1945, at the request of the writer, Cloud and Barnes made seven serial collections from the lower 13 feet of the Barnett at White's Crossing; six of these collections were examined, and all were found to contain the conodonts of the lower faunal zone. It is a writer's opinion that the specimens of collection 9312 are contaminants, and that their association with *Spirifer logani* is the result of a stratigraphic leak. Support for this view is found in the fact that a collection of conodonts from the basal beds of the Stribling formation at its type locality near Johnson City, Blanco County, Tex., contains conodonts of the upper faunal zone of the Barnett formation. These conodonts were found filling a crack that is only one-quarter of an inch wide. The presence of Mississippian conodonts in the Stribling (Early or Middle Devonian age) formation must be explained as being the result of a stratigraphic leak; and, by analogy, the presence of collection 9312 in rocks which subsequently have yielded only the species of the lower faunal zone can be interpreted in a like manner.

Locality C-14, Barton Ranch section 1: About 3,200 feet S. 14° W. of the southwest bank of the Llano River at White's Crossing, Mason County.

Marble Falls limestone. Feet
 Barnett formation:
 Upper conodont faunal zone:
 Covered, probably Barnett formation..... 10
 Limestone, nearly white where freshly exposed but gray where weathered; coarse-grained except for a few, fine-grained and sublithographic beds; partly covered..... 115

Collection no.	Height above base, in feet
9339.....	135
9338.....	118
9337.....	108
9336.....	80
9335.....	63
9334.....	50
9332.....	40
9333.....	39
9313.....	34

Lower conodont faunal zone: Limestone, similar to that of the upper conodont faunal zone. (Four unnumbered collections were made from the rocks of this zone. They came from the basal 2 inches; 18 inches above the base; 10 to 11 feet above the base; and 18 feet above the base)..... 20

Total..... 145

Chappel limestone.
 Gorman formation.

Locality C-15, Barton Ranch section 2: About 2,500 feet N. 88° W. of the southwest bank of the Llano River at White's Crossing, Mason County.

Marble Falls limestone. Feet
 Barnett formation:
 Upper conodont faunal zone:
 Covered, probably shale..... 15
 Limestone, principally white, coarse-grained, crinoidal..... 50
 Limestone, dark-gray, medium-grained, fetid... 5
 Covered, probably shale..... 15
 Limestone, brownish-gray, granular, a coquina of megafossils, in part splits along greenish shale partings..... 5

Collection no.	Height above base, in feet
9311.....	125
9316.....	102
9315.....	90
9310.....	55

Barnett formation—Continued Feet

Lower conodont faunal zone: Limestone, light-gray to white, coarse-grained, crinoidal; interbedded with fine-grained to sublithographic limestone. Speckled, granular, crinoidal chert concretions near middle of this interval. (Two unnumbered collections were made from the rocks of this lower conodont faunal zone. One collection was obtained 5 feet above the base and the other, 15 feet above the base.)..... 50

Total..... 140

Chappel limestone.
 Gorman formation.

Locality C-16, Barnett Trench section: About 2,100 feet due west of point at which Honey Creek intersects the road from Mason to White's Crossing over the Llano River in Mason County. Feet

Marble Falls limestone.
 Barnett formation:

Upper conodont faunal zone: Mostly covered. Limestone, yellowish-gray; fine-, medium-, and coarse-grained. Some very light gray limestone near the top of the section. Approximately 20 feet of the interval consists of exposed ledges of rock, remaining 88 feet is covered by caliche and may represent shaly beds..... 108

Collection no.	Height above base, in feet
9328.....	115
9327.....	90
9326.....	72
9325.....	67
9324.....	42
9323.....	24

Lower conodont faunal zone:
 Limestone, very nearly white to very light gray, fine-grained..... 1.5
 Limestone, very nearly white to very light gray, coarse-grained..... 9.5
 Limestone, very nearly white, very fine grained to sublithographic..... 1.0
 Limestone, very nearly white to very light gray, fine-grained..... 10.0

Total..... 130.0

Six collections, all unnumbered, came from the following intervals:

- Height above base
- 16 feet to 17 feet.
- 12 feet to 15 feet.
- 10 feet to 10 feet 6 inches.
- 10 inches to 16 inches.
- 5 inches to 10 inches.
- 4 inches to 5 inches.

Chappel limestone.
 Gorman formation.

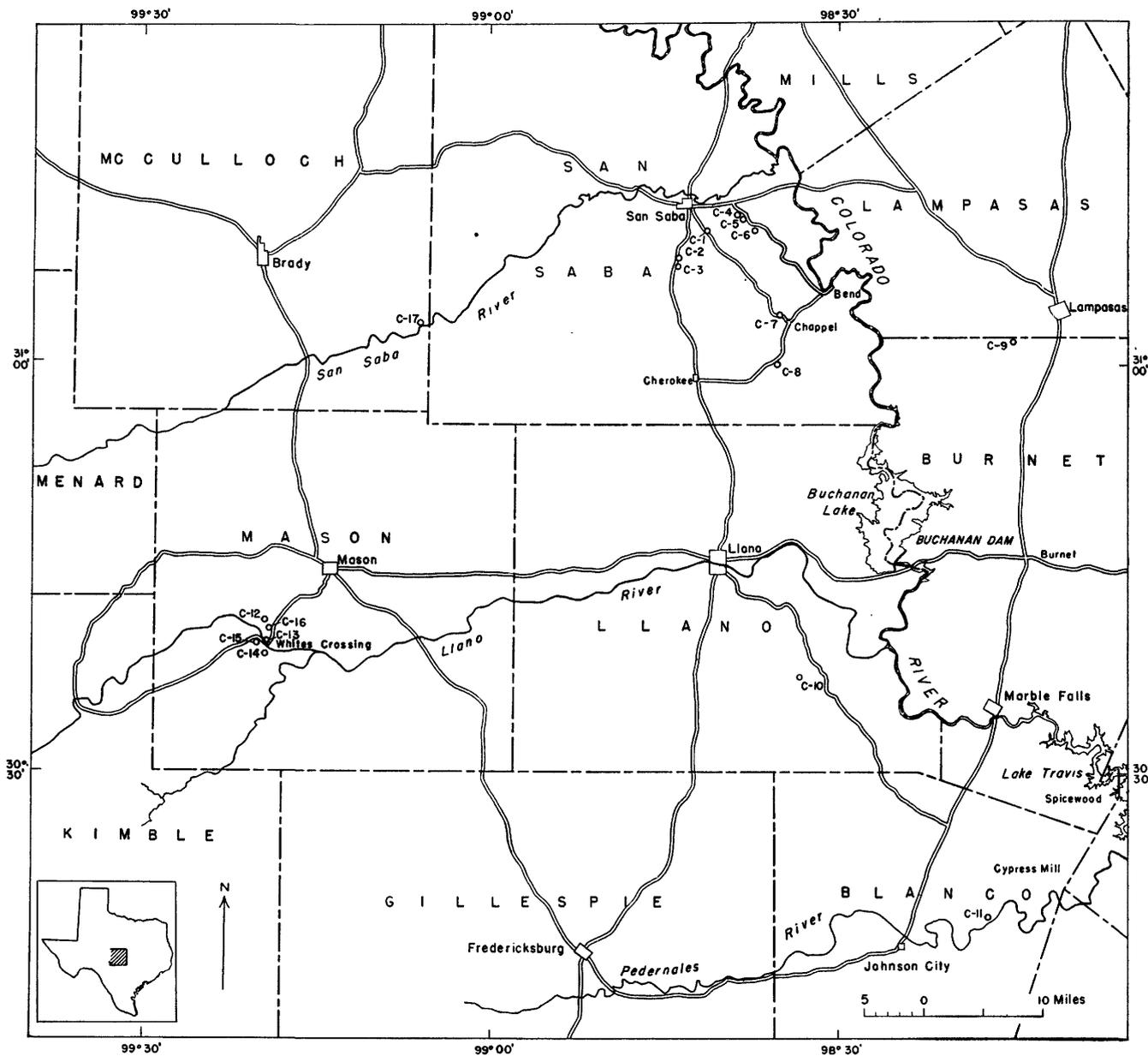


FIGURE 4.—Map showing localities at which conodonts of the Barnett formation were collected.

This section is a composite one. Beds of the lower faunal zone of the Barnett formation were measured and sampled at an exposure located approximately 500 feet northeast of the one at which beds of the upper zone were measured and sampled.

LOCALITY REGISTER

Listed below are individual localities from which conodonts were collected:

Conodont localities, upper faunal zone, Barnett formation

Number on fig. 4	Collection number	Collector, year of collection, description of locality
C-6	2609	P. V. Roundy, 1919. South side of road to Bend post office, about 6½ miles from San Saba, San Saba County, Tex.
C-6	2610b	P. V. Roundy, 1919. Along the Bend-San Saba road, at north end of a small hill. About 5 miles east and 1¼ miles south of the courthouse at San Saba, San Saba County, Tex. Collection not listed on table 1.
C-6	2610c	P. V. Roundy, 1919. Same locality as 2610b. Collection not listed on table 1.
C-1	2613c	P. V. Roundy, 1919. At type locality of the Chappel limestone. Cut on road from San Saba to Chappel, well up on side of hill; 2.4 miles southeast of courthouse at San Saba, San Saba County, Tex. From basal 9 inches of formation.
C-1	2613d	P. V. Roundy, 1919. Same locality as 2613c. From a 2-foot interval, 9 inches to 2 feet 9 inches above the base of the formation.
C-1	2613e	P. V. Roundy, 1919. Same locality as 2613c. From a 2-foot 4-inch interval, 2 feet 9 inches to 5 feet 1 inch above the base of the formation.
C-1	2613g	P. V. Roundy, 1919. Same locality as 2613c. From a 3-foot 4-inch interval, 5 feet 1 inch to 8 feet 5 inches above the base of the formation.
C-1	2613h	P. V. Roundy, 1919. Same locality as 2613c. From a 2-foot interval, 8 feet 5 inches to 10 feet 5 inches above the base of the formation.
C-1	2618	P. V. Roundy, 1919. Same general locality as 2613c but about 1,000 feet to east. From a 5-foot interval, 5 to 10 feet above the base of the formation.
C-5	2688	K. C. Heald, 1919. Along road 4.9 miles east and 0.9 mile south of the courthouse at San Saba, San Saba County, Tex.
C-8	7011a (green)	E. O. Ulrich and J. W. Beede, date of collection not known. About 4 miles southwest of Chappel on the road to Cherokee, San Saba County, Tex. About 25 to 30 feet above the base of the formation. Collection not listed on table 1.
C-9	7016 (green)	E. O. Ulrich and J. A. Taff, 1903(?). On road from Sulphur Creek to Llano, 5¼ miles west of Lampasas, northern Burnet County, Tex.
C-8	7687 (green)	G. H. Girty, 1910. About 4 miles southwest of Chappel on the road to Cherokee, on small hill just east of creek that flows into Cherokee Creek and about 1 mile southeast of point at which road crosses the creek. Probably same locality as collection 7011a (green). Not listed on table 1.
C-1	8649	W. H. Hass, 1942. Same locality as 2613c. From roadside ditch, about 24 feet above base of formation.
C-6	8650	W. H. Hass, 1938. Southeast of San Saba. Roadside ditch along the San Saba-Bend road. About 6½ miles from San Saba, San Saba County, Tex.
C-1	8651	W. H. Hass, 1938. Same locality as 2613c. From roadside ditch, about 19 feet above the base of the formation.
C-7	8652	W. H. Hass, 1938. Same locality as 9059. From between two conspicuous layers of concretions.
C-1	9006	W. H. Hass, 1942. Same locality as 2613c. From roadside ditch, about 24 feet above the base of the formation.
C-1	9007	W. H. Hass, 1942. Same locality as 2613c. From roadside ditch, about 19 feet above the base of the formation.
C-2	9020	W. H. Hass, 1942. South of San Saba. Roadcut on State Route 16, at top of hill, about 4.6 miles (by road) south of courthouse at San Saba, San Saba County, Tex. From a 6-inch interval, 6 to 12 inches above the base of the formation.
C-2	9021	W. H. Hass, 1942. Same locality as 9020. From a 3-inch-thick indurated bed, top of which is 4 feet above the base of the formation.
C-4	9025	W. H. Hass, 1942. Southeast of San Saba. In roadside ditch, at sharp turn on the San Saba-Bend road, about one mile from the junction with United States Highway 190. About 4.4 miles from the courthouse at San Saba, San Saba County, Tex.
C-1	9026	W. H. Hass, 1942. Same locality as 2613c. From roadcut, about 34 feet above base of the formation.

Conodont localities, upper faunal zone, Barnett formation—Con.

Number on fig. 4	Collection number	Collector, year of collection, description of locality
C-7	9027	W. H. Hass, 1942. Same locality as 9059. About 5 to 6 feet stratigraphically below collection 9059.
C-1	9028	W. H. Hass, 1942. Same locality as 2613c. From the basal 6 inches of the formation.
C-8	9029	W. H. Hass, 1942. Near Chappel. About 4.1 miles from the schoolhouse at Chappel on the Cherokee-Chappel road, San Saba County, Tex. From borrow pit on north side of road.
C-1	9030	W. H. Hass, 1942. Same locality as 2613c. From a 6-inch interval, immediately beneath a 6-inch limestone bed, 8 feet to 8 feet 6 inches above the base of the formation.
C-7	9059	W. H. Hass, 1942. Near Chappel. Cut on the San Saba-Chappel road, about 1.2 miles from the schoolhouse at Chappel, San Saba County, Tex. Collection from zone between two conspicuous layers of concretions.
C-12	9309	W. H. Hass, 1945. Zesch Ranch section. About 5,000 feet N. 60° W. of point at which Honey Creek crosses the road from Mason to White's Crossing over the Llano River. Along the southeast side of a prominent hill at the head of a draw that enters Honey Creek from the west side, about 0.6 mile upstream from the above-mentioned road crossing on Honey Creek, Mason County, Tex. About 84 feet above the base of the formation.
C-15	9310	W. H. Hass, 1945. Barton Ranch section 2. About 2,500 feet N. 88° W. of the southwest bank of the Llano River at White's Crossing. At the axis of a prominent northeast draining draw, Mason County, Tex. About 55 feet above the base of the formation.
C-15	9311	W. H. Hass, 1945. Same locality as 9310. About 125 feet above the base of the formation.
C-13	9312	W. H. Hass and P. E. Cloud, 1945. White's Crossing. About 8.3 miles (airline) southwest of the courthouse at Mason, Mason County, Tex., and immediately north of White's Crossing on east bank of the Llano River.
C-14	9313	W. H. Hass, 1945. Barton Ranch section 1. About 3,200 feet S. 14° W. of the southwest bank of the Llano River at White's Crossing. Near southern end of the northwest slope of an elongate hill to the south of Bee Branch, Mason County, Tex. About 34 feet above the base of the formation.
C-15	9315	W. H. Hass, 1945. Same locality as 9310. About 90 feet above the base of the formation.
C-15	9316	W. H. Hass, 1945. Same locality as 9310. About 102 feet above the base of the formation.
C-12	9317	W. H. Hass, 1945. Same locality as 9309. About 42 feet above the base of the formation.
C-12	9318	W. H. Hass, 1945. Same locality as 9309. About 53 feet above the base of the formation.
C-12	9319	W. H. Hass, 1945. Same locality as 9309. About 60 feet above the base of the formation.
C-12	9320	W. H. Hass, 1945. Same locality as 9309. About 65 feet above the base of the formation.
C-12	9321	W. H. Hass, 1945. Same locality as 9309. About 70 feet above the base of the formation.
C-12	9322	W. H. Hass, 1945. Same locality as 9309. About 75 feet above the base of the formation.
C-16	9323	W. H. Hass, 1945. Barnett Trench section. About 2,100 feet due west of point at which Honey Creek crosses the road from Mason to White's Crossing over the Llano River. The locality is about 1,400 feet up from the mouth of an east-north-east draining draw that enters Honey Creek from the southwest about 1,000 feet upstream from the above-mentioned road crossing, Mason County, Tex. About 24 feet above the base of the formation.
C-16	9324	W. H. Hass, 1945. Same locality as 9323. About 42 feet above the base of the formation.
C-16	9325	W. H. Hass, 1945. Same locality as 9323. About 67 feet above the base of the formation.
C-16	9326	W. H. Hass, 1945. Same locality as 9323. About 72 feet above the base of the formation.
C-16	9327	W. H. Hass, 1945. Same locality as 9323. About 90 feet above the base of the formation.
C-16	9328	W. H. Hass, 1945. Same locality as 9323. About 115 feet above the base of the formation.
C-1	9329	P. E. Cloud and V. E. Barnes, 1945. Same locality as 2613c. About 8 feet above the base of the formation.
C-1	9330	P. E. Cloud and V. E. Barnes, 1945. Same locality as 2613c. From roadside ditch, about 19 feet above the base of the formation.
C-1	9331	P. E. Cloud and V. E. Barnes, 1945. Same locality as 2613c. From a limestone bed located about 8 feet below the top of the formation.
C-14	9332	W. H. Hass, 1945. Same locality as 9313. About 40 feet above the base of the formation.
C-14	9333	W. H. Hass, 1945. Same locality as 9313. About 39 feet above the base of the formation.
C-14	9334	W. H. Hass, 1945. Same locality as 9313. About 50 feet above the base of the formation. Collection not listed on table 1.
C-14	9335	W. H. Hass, 1945. Same locality as 9313. About 63 feet above the base of the formation.
C-14	9336	W. H. Hass, 1945. Same locality as 9313. About 80 feet above the base of the formation.

Conodont localities, upper faunal zone, Barnett formation—Con.

Number on fig. 4	Collection number	Collector, year of collection, description of locality
C-14.....	9337	W. H. Hass, 1945. Same locality as 9313. About 108 feet above the base of the formation.
C-14.....	9338	W. H. Hass, 1945. Same locality as 9313. About 118 feet above the base of the formation.
C-14.....	9339	W. H. Hass, 1945. Same locality as 9313. About 135 feet above the base of the formation.
C-17.....	9340	P. E. Cloud and V. E. Barnes, 1945. Lost Creek area. About 1.7 miles N. 60° E. of the mouth of Lost Creek which empties into the San Saba River just east of the slab-crossing of the San Saba River on the Voca to Long Valley road and about 600 feet southwest of the mouth of Jim Davis Hollow, southeastern McCulloch County, Tex. From highest exposed ledge of limestone.
C-17.....	9341	P. E. Cloud and V. E. Barnes, 1945. Same locality as 9340. From lowest exposed ledge of limestone.
C-3.....	9342	P. E. Cloud and V. E. Barnes, 1945. South of San Saba. Cut on State Route 16, 5 miles (by road) south of the courthouse at San Saba; the locality is north of Elm Branch and south of a bridge over Simpson Creek, San Saba County, Tex. From a fossiliferous limestone, several inches thick, whose top surface is 9 inches below the top of the formation.
C-3.....	9343	P. E. Cloud and V. E. Barnes, 1945. Same locality as 9342. From topmost 9 inches of the formation, immediately above collection 9342 and below a 6-inch bed of glauconitic rock.
C-10.....	9344	P. E. Cloud and V. E. Barnes, 1945. Moore Hollow area of the Riley Mountains. About 1,900 feet due west of a point on the Llano-Click road, approximately 1.9 miles south of the crossing on Honey Creek, Llano County, Tex.
C-11.....	9345	V. E. Barnes, 1945. Elm Pool area. About 5.3 miles south-southwest of Cypress Mill, approximately 2 miles southwest of the Cage Ranch headquarters, 4,000 feet north of the mouth of Miller Creek, Blanco County, Tex. From the basal 6 inches of the formation.
C-11.....	9346	V. E. Barnes, 1945. Same locality as 9345. From a 6-inch interval, 3 feet to 3 feet 6 inches above the base of the formation.

SYSTEMATIC DESCRIPTIONS

In the descriptions that follow, the blade and carina of a platelike conodont together comprise the axis of the fossil. The blade is defined as the portion of the axis which is anterior to the apex of the pulp cavity and the carina as the portion which is posterior to the same structure. The specimens described and illustrated in this paper have been deposited in the U. S. National Museum.

Genus *CAVUSGNATHUS* Harris and Hollingsworth, 1933

- 1933. *Cavusgnathus* Harris and Hollingsworth, Am. Jour. Sci., 5th ser., vol. 25, pp. 200, 201.
- 1933. *Cavusgnathus* Harris and Hollingsworth. Gunnell, Jour. Paleontology, vol. 7, p. 286.
- 1941. *Cavusgnathus* Harris and Hollingsworth. Ellison, Jour. Paleontology, vol. 15, pp. 125, 126.
- 1944. *Cavusgnathus* Harris and Hollingsworth. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 245.

Genotype, by original designation and by monotypy, *Cavusgnathus alta* Harris and Hollingsworth, 1933.

Cavusgnathus cristata Branson and Mehl

Plate 14, figures 12-14

- 1941. *Cavusgnathus* sp. Hass, Jour. Paleontology, vol. 15, pl. 14, fig. 6.
- 1941. *Cavusgnathus cristata* Branson and Mehl, Denison Univ.,

Sci. Lab., Bull., vol. 35, p. 177, pl. 5, figs. 26-31. (Date of imprint, 1940.)

Hypotypes: U.S.N.M. 115087, 115088, 115089.

Oral view.—An elongate unit with perpendicular sides, narrow platforms, a median trough, and a blade that is continuous with the outer platform. Carina may be evident at pointed posterior end of plate. Blade shorter than portion of fossil which is posterior to the pulp cavity; it is high, abruptly set off from oral surface of outer platform, and extends a short distance to anterior of inner platform. Denticles of blade large, even on inner side, expanded on outer side; each is fused nearly to its pointed sharp-edged tip. Surface of platforms ridged transversely; these platforms pitch steeply and together form a smooth, narrow, faintly sinuous trough that increases in depth toward the anterior end of fossil, where it is open.

Lateral view.—With reference to the aboral side of the plate, the blade is angled downward slightly. Summit line of inner and outer platforms minutely dentate, level or slightly arched; that of blade dentate and cristiform. Anterior end of inner platform truncate.

Aboral view.—Blade sharp-edged to a point near its posterior end, where it is split and merges into the cup (i. e. expanded pulp cavity). Pulp cavity lanceolate in outline; its sides pitch toward grooved midline of plate. Apex of pulp cavity located near anterior end of concavity.

Cavusgnathus cristata may be a synonym of *Cavusgnathus alta* Harris and Hollingsworth (1933). The writer's specimens have been compared with the holotype of *C. alta*, and although no important differences were noted, the author is reluctant to make a positive identification, as Harris and Hollingsworth's type specimen is quite fragmentary.

Distribution: Barnett formation; upper faunal zone.

Genus *GENICULATUS* Hass, n. gen.

Genotype, here designated, *Polygnathus? claviger* Roundy, 1926

A geniculate, asymmetric, massive, barlike unit which tapers from the vertex toward the anterior and posterior extremities. Unit slightly arched, denticulated. Main cusp at vertex. Aboral side grooved along midline; pulp cavity located beneath main cusp. An immature specimen consists of a distinct posterior bar, a main cusp, and a distinct anterior bar which is joined to inner side of the main cusp. A large geniculate unit was built about this framework through the accretion of numerous lamellae.

Geniculatus claviger (Roundy)

Plate 15, figures 10-19

- 1926. *Polygnathus? claviger* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 14, pl. 4, figs. 1a-c; 2a, b.

1926. *Prioniodus healdi* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 10, pl. 4, figs. 5a, b.
1926. *Prioniodus* sp. D Roundy [part], U. S. Geol. Survey Prof. Paper 146, p. 11, pl. 4, figs. 13a, b [not fig. 12=*Prioniodus inclinatus*].
1941. *Euprioniodina?* sp. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 171, pl. 5, figs. 17, 18. (Date of imprint, 1940.)
1941. *Metalonchodina?* sp. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 172, pl. 5, fig. 15. (Date of imprint, 1940.)
1941. *Bactrognathus claviger* (Roundy). Branson and Mehl, Jour. Paleontology, vol. 15, p. 99.
1941. *Bactrognathus inornata* Branson and Mehl, Jour. Paleontology, vol. 15, p. 100, pl. 19, figs. 14, 15.

Holotype: By original designation, the specimen shown by Roundy, 1926, as figures 1a-c on plate 4, U.S.N.M. 115066 [=U.S.G.S. Carb. cat. 4015a].

Paratype: The specimen shown by Roundy, 1926, as figures 2a, b on plate 4, U.S.N.M. 115068 [=U.S.G.S. Carb. cat. 4016a].

Hypotypes: The holotype of *Prioniodus healdi* Roundy, U.S.N.M. 115073 [=U.S.G.S. Carb. cat. 4034a]; the specimen of *Prioniodus* sp. D figured by Roundy, 1926, as figures 13a, b on plate 4, U.S.N.M. 115067 [=U.S.G.S. Carb. cat. 4036a]; also U.S.N.M. 115069, 115070, 115071, 115072, 115074, 115075.

Type locality: C-6, road to Bend post office, about 6½ miles from San Saba, San Saba County, Tex.; collection 2609.

Oral view.—A young specimen consists of a denticulated posterior bar that supports the main cusp, and a shorter, denticulated anterior bar that is joined to the inner side of the main cusp. During ontogeny, through the accretion of lamellae, the posterior and anterior bars gradually evolved into a massive, geniculate, bar-like unit. This unit is asymmetric, broadest at the vertex, and tapered toward the extremities; its denticles are slightly curved and are generally located nearer the outer than the inner side of the fossil. Other characteristics are more variable. Denticles may range from short to long, straight to curved, discrete to appressed, and peglike to toothlike. The main cusp also varies in size and shape. Sharp edges generally divide the cusp into a smaller, even, inner side and a larger, expanded outer side. In transverse section, the anterior and posterior bars of a young specimen are higher than wide and their convex sides are broadest at or below midheight; the bars of a more mature specimen are completely merged to form a geniculate unit which, at the vertex, is several times wider than high.

Lateral view.—Aboral side of unit slightly arched. Summit line of unit dentate, incised, and irregular.

Aboral view.—Aboral side of unit tends to be set off from remainder of fossil by a continuous ridge; area thus enclosed may be excavated. Pulp cavity tends to be large, and triangular to elliptical in outline.

Geniculatus claviger is a common species in the upper faunal zone of the Barnett formation. Most specimens are fragments but a sufficient number has been examined to indicate that during its ontogeny a member

of this species changed from a fragile barlike conodont into a massive geniculate one. Branson and Mehl (1941c, p. 99) would place *Polygnathus? claviger* Roundy in the genus *Bactrognathus* but the writer of this report believes that no such relationship exists. This opinion is held because the genotype of *Bactrognathus*, *B. hamata*, appears to have been derived from a blade-like conodont, similar to *Spathognathodus*, whereas *Geniculatus claviger* seems to have evolved out of a barlike conodont, similar to *Lonchodina*.

Bactrognathus inornata Branson and Mehl is believed to be a synonym of *Geniculatus claviger* (Roundy). Branson and Mehl's species (1941c, p. 97) comes from the "Sycamore of Pontotoc County, Oklahoma," a formation which some geologists place in the lower part of the Caney shale and which Branson and Mehl do not attempt to correlate with the type locality of the Sycamore limestone. The presence of *G. claviger* would suggest that the age of the "Sycamore of Pontotoc County" is approximately the same as that of the Caney shale. It should be pointed out, however, that Branson and Mehl (1941c, pp. 99, 101-103) have also described *Bactrognathus angularis*, *B. distorta*, *B. excavata*, *Doliognathus dubia*, and *Staurognathus cruciformis* from the same beds. It is the writer's opinion that an association of the last-named species with *Geniculatus claviger* is indicative of a mixed fauna. This interpretation is based on the fact that in the Llano region, *Geniculatus* has been found only in the upper faunal zone of the Barnett formation (Meramec and possibly in part Chester) whereas *Doliognathus*, *Staurognathus*, and *Bactrognathus* have been found only in the topmost beds of the Chappel limestone of Chouteau age.

Distribution: Barnett formation; upper faunal zone.

Genus GNATHODUS Pander, 1856

1856. *Gnathodus* Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, pp. 33, 34.
1921. *Gnathodus* Pander. Bryant, Buffalo Soc. Nat. Sci. Bull., vol. 13, no. 2, p. 22.
1926. *Gnathodus* Pander. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, p. 54.
1926. *Gnathodus* Pander. Roundy, U. S. Geol. Survey Prof. Paper 146, p. 12.
1938. *Gnathodus* Pander. Branson and Mehl, Missouri Univ. Studies, vol. 13, no. 4, pp. 136, 144.
1939. *Dryphenotus* Cooper, Jour. Paleontology, vol. 13, p. 386.
1944. *Gnathodus* Pander. Branson and Mehl, in Shirner and Shrock, Index fossils of North America, p. 245.
- Genotype, by monotypy, *Gnathodus mosquensis* Pander, 1856.

Gnathodus bilineatus (Roundy)

Plate 14, figures 25-29

1926. *Polygnathus bilineata* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 13, pl. 3, figs. 10a-c.

- 1926. *Polygnathus texana* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 14, pl. 3, figs. 13a, b.
- 1939. *Gnathodus bilineatus* Roundy [sic]. Cooper, Jour. Paleontology, vol. 13, p. 388 [not pl. 42, figs. 59, 60].
- 1939. *Gnathodus texanus* (Roundy). Cooper, Jour. Paleontology, vol. 13, p. 388 [not pl. 41, figs. 26, 27].
- 1941. *Gnathodus pustulosus* Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 172, pl. 5, figs. 32-39. (Date of imprint, 1940.)

Holotype: By original designation, the specimen shown by Roundy, 1926, as figures 10a-c on plate 3, U.S.N.M. 115101 [=U. S. G. S. Carb. cat. 4021a].

Hypotypes: The holotype of *Polygnathus texana* Roundy U.S.N.M. 115103 [=U. S. G. S. Carb. cat. 4013a]; also, U.S. N.M. 115100, 115102, 115104.

Type locality: C-6, road to Bend post office, about 6½ miles from San Saba, San Saba County, Tex.; collection 2609.

Oral view.—Axis straight to slightly angled inward at junction of blade and carina. Carina broader than oral portion of blade; it rises higher above the cup of a young specimen than of a mature one. Generally, the carina is curved downward at the posterior end of the cup, though on some specimens it is high and ridgelike throughout its entire length. Denticles of carina fused nearly to their tips; they are largest over posterior two-thirds of cup, where, commonly, the tips are chevron-shaped or even modified into transverse ridges through their fusion with adjacent nodes. The cup of a young specimen is elongated antero-posteriorly; that of a mature one is more transverse. All cups are asymmetrical, widest anteriorly, and pointed posteriorly. Outer side of cup of a young specimen is narrow, thin, and arched; that of a mature one is expanded laterally in its anterior two-thirds. The expansion thus formed is semicircular to subrectangular in outline. Oral surface of this expansion may be slightly concave or slightly convex, and posteriorly, adjacent to the carina, it may be marked by a smooth narrow depression. This expansion bears nodes, or nodes and ridges, that differ from each other in size and shape; generally, they are arranged in concentric rows about the apex of the pulp cavity. Inner side of cup is higher, slightly longer, and much narrower than outer side. The anterior third of the inner side rises as high as the adjacent portions of the blade and carina and

with them forms a narrow trough; the middle third tends to be wider and lower than the anterior third; the posterior third is quite narrow and merges into the carina. Anterior portion of inner side ornamented with transverse ridges; posterior portion ornamented with ridges and nodes. Blade as much as 1½ times longer than carina, massive adjacent to pulp cavity, thickest near aboral side. Denticles of blade gradually increase in size anteriorly; each denticle is thickest along its midline and has a sharp-edged tip.

Lateral view.—With reference to the aboral side, fossil increases in height anteriorly. Summit line of carina irregular; that of blade dentate. Profile of aboral side of cup is slightly concave.

Aboral view.—Blade split toward its posterior end where it merges into sides of expanded pulp cavity (i. e. cup). Pulp cavity grooved along midline, deeply concave in young specimens and broadly so in mature ones. Apex of pulp cavity located near anterior end of the concavity.

The following species, described by Roundy in 1926, are gnathodids: *Gnathodus texanus*, *Gnathodus texanus* var. *bicuspidus*, *Polygnathus texana*, and *Polygnathus bilineata*. Subsequent work has resulted in some of the above species being misnamed. Cooper (1939, p. 416), who evidently accepted Branson and Mehl's (1938, p. 136) suggestion that *Gnathodus texanus* and *Gnathodus texanus* var. *bicuspidus* are probably "peculiarly modified spathodids," placed *Gnathodus texanus* Roundy in the genus *Spathodus* Branson and Mehl, 1933 (= *Nodognathus* Cooper, 1939; and *Spathognathodus* Branson and Mehl, 1941). Cooper (1939, p. 388) also placed *Polygnathus texana* Roundy and *P. bilineata* Roundy in the genus *Gnathodus*, but, as indicated above, so far as *Polygnathus texana* is concerned, Roundy had previously used the name *Gnathodus texanus* for another species of *Gnathodus*. In the present paper Roundy's *Polygnathus bilineata* is considered to be conspecific with his *Polygnathus texana*, and, as the specific name *bilineata* is available, the correct name of this species is regarded as being *Gnathodus bilineatus* (Roundy). The nomenclatorial changes that Roundy's species have undergone are listed below:

Original name, Roundy, 1926	Changes by Cooper, 1939	Names used in present paper
<i>Gnathodus texanus</i> Roundy-----	<i>Spathodus texanus</i> (Roundy)-----	} <i>Gnathodus texanus</i> Roundy.
<i>Gnathodus texanus</i> var. <i>bicuspidus</i> Roundy-----	-----	
<i>Polygnathus texana</i> Roundy-----	<i>Gnathodus texanus</i> (Roundy)-----	} <i>Gnathodus bilineatus</i> (Roundy).
<i>Polygnathus bilineata</i> Roundy-----	<i>Gnathodus bilineatus</i> (Roundy)-----	

Although Cooper (1939, pp. 388, 419) has stated that *Gnathodus bilineatus* (Roundy) [= *Polygnathus bilineata* Roundy, 1926] and *Gnathodus texanus* (Roundy) [= *Polygnathus texana* Roundy, 1926] are present in the lower Mississippian of Oklahoma, his citations are not included in the synonymy of *G. bilineatus* (Roundy)

because Roundy's species possesses many characteristics not recorded by Cooper. *Polygnathus bilineata* Roundy is based on a single fragmentary specimen which lacks the posterior end of the cup as well as the anterior end of the blade; *Polygnathus texana* Roundy is also based on a single fragmentary specimen which

lacks most of the blade and has a fracture that parallels the carina on the outer side of the cup. Specimens of *Gnathodus bilineatus* (Roundy) are very common in the upper faunal zone of the Barnett formation where they are found associated with specimens of *Gnathodus texanus*. These two species are easily identified through the ornamentation of the cup.

Distribution: Barnett formation; upper faunal zone.

Gnathodus girtyi Hass, n. sp.

Plate 14, figures 22-24

Holotype: U.S.N.M. 115097.

Paratypes: U.S.N.M. 115098, 115099.

Type locality: C-15, about 2,500 feet N. 88° W. of southwest bank of Llano River at White's Crossing, Mason County, Tex.; collection 9310.

Oral view.—Axis straight to slightly curved inward. Denticles of anterior portion of carina are fused into a sharp-edged ridge; but those of the posterior portion are fused into a broad noded ridge or even modified, through fusion with adjacent nodes, into a series of transverse ridges. Cup elongate, asymmetrical, widest anteriorly and pointed posteriorly. Outer side of cup wider than inner; its oral surface smooth except adjacent to the carina, where, anteriorly, it bears a row of nodes that are entirely fused into a transversely ridged platform. Posterior to this platform the outer side may be without nodes; if present, these nodes are separated from each other although each one may be fused to an adjacent portion of the carina. Inner side of cup longer and narrower, but in other respects similar to outer side. Blade approximately twice as long as carina, massive adjacent to cup. Denticles of blade increase in size to near the anterior end, compressed, with one side nearly even on some specimens. Each denticle has a sharp-edged tip.

Lateral view.—With reference to the straight aboral side of the blade, the profile of the aboral side of the cup is concave and trends downward slightly. Summit line of blade dentate except adjacent to cup, where it may be even; that of carina somewhat irregular and curved downward toward truncated posterior end of fossil.

Aboral view.—Blade sharp-edged, to a point near expanded pulp cavity (i. e., cup), where it is split; its sides merge into those of expanded pulp cavity. Pulp cavity grooved along midline, its apex located near anterior end of concavity.

Gnathodus girtyi resembles *G. texanus*, but the two species can be identified by the ornamentation of the cup. The aboral side of *G. girtyi* is not figured as it is similar to that of *G. texanus*.

Distribution: Barnett formation; upper faunal zone.

Gnathodus inornatus Hass, n. sp.

Plate 14, figures 9-11

1941. *Spathognathodus commutatus* Branson and Mehl. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 172, pl. 5, figs. 19-22. (Date of imprint, 1940.)

Holotype: U.S.N.M. 115084.

Paratypes: U.S.N.M. 115085, 115086.

Type locality: C-12, about 5,000 feet N. 60° W. of point at which Honey Creek crosses road from Mason to White's Crossing over Llano River, Mason County, Tex.; collection 9309.

Oral view.—Axis straight to slightly curved laterally; it is widest near posterior end of fossil and tapers anteriorly. Carina rises high above inner and outer sides of cup. Denticles of carina tend to be fused; their tips are subcircular to elliptical in transverse section. Cup low, unornamented, and circular to subcircular in outline; generally it extends beyond the posterior end of the carina. Blade may be as much as four times longer than carina, thickest at or below the midline of its lateral sides. Denticles of blade compressed, except at the posterior end, where they resemble those of carina. Each denticle has a sharp-edged tip.

Lateral view.—Outline of fossil is nearly rectangular, the rectangularity being modified by the extension of the cup.

Aboral view.—Blade sharp-edged except posteriorly, where it is split; its sides merge into those of expanded pulp cavity (i. e., cup). Pulp cavity funnel-shaped, located beneath carina and posterior portion of blade, grooved along midline.

Gnathodus inornatus resembles the syntypes of *G. commutatus* (Branson and Mehl) from the Pitkin limestone of Oklahoma. These two species, however, can be identified by the shape of the cup. The cup of *G. inornatus*, in oral view, is circular to subcircular in outline and generally extends posteriorly beyond the remainder of the fossil, whereas the cup of *G. commutatus* is elongate and pointed posteriorly.

Distribution: Barnett formation; upper faunal zone.

Gnathodus texanus Roundy

Plate 14, figures 15-21

1926. *Gnathodus texanus* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 12, pl. 2, figs. 7a, b, 8a, b.

1926. *Gnathodus texanus* var. *bicuspidus* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 12, pl. 2, figs. 9a, b.

1939. *Spathodus texanus* (Roundy). Cooper, Jour. Paleontology, vol. 13, p. 416 [not pl. 42, figs. 63, 64].

1939. [Not] *Gnathodus texanus* (Roundy). Cooper, Jour. Paleontology, vol. 13, p. 388, pl. 41, figs. 26, 27.

1941. *Gnathodus texanus* Roundy. Hass, Jour. Paleontology, vol. 15, pl. 15, fig. 4.

1941. *Gnathodus texanus* Roundy. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 173, pl. 5, figs. 23-25. (Date of imprint, 1940.)

1941. [Not] *Gnathodus texanus* Roundy. Ellison and Graves, Missouri School Mines and Metallurgy, Bull., vol. 14, no. 3, p. 2, pl. 2, figs. 8-10, 12.

1947. [Not] *Gnathodus texanus* (Roundy) [sic]. Mehl and Thomas, Denison Univ., Sci. Lab., Bull., vol. 47, p. 10, pl. 1, fig. 3.

Holotype: By original designation, the specimen shown by Roundy, 1926, as figures 8a, b, on plate 2, U.S.N.M. 115090 [=U.S.G.S. Carb. cat. 4018a].

Paratypes: The specimen shown by Roundy, 1926, as figures 7a, b on plate 2, U.S.N.M. 115092 [=U.S.G.S. Carb. cat. 4017a] and the holotype of *Gnathodus texanus* var. *bicuspidus* Roundy, U.S.N.M. 115091 [=U.S.G.S. Carb. cat. 4019a].

Hypotypes: U.S.N.M. 115093, 115094, 115095, 115096.

Type locality: C-5, along road, 4.9 miles east and 0.9 miles south of the courthouse at San Saba, San Saba County, Tex.; collection 2688.

Oral view.—Axis essentially straight. Carina broader than oral portion of blade; it rises high above oral surface of cup. Denticles of carina fused nearly to their tips; generally these tips are slightly chevron-shaped. Cup asymmetric, widest anteriorly, and pointed posteriorly. Outer side of cup larger than inner; its oral surface smooth or ornamented with a few nodes which tend to lie near the carina. These nodes, which vary in size, may be discrete or fused to form a ridge. Inner side of cup slightly longer than outer. Anteriorly, it supports a large pillarlike process which varies in size and shape; generally, it is as high as the carina, smooth, laterally constricted at the tip, and joined to the carina by a low ridge. Blade approximately twice as long as carina, most massive adjacent to cup, thickest near the aboral side. Denticles of blade increase in size anteriorly.

Lateral view.—With reference to straight aboral side of blade, profile of aboral side of cup is curved downward. Fossil increases in height anteriorly; summit line of carina irregular, that of the blade dentate.

Aboral view.—Aboral side of blade sharp-edged to near pulp cavity, where it is split; its sides merge into those of expanded pulp cavity (i. e., cup). Pulp cavity grooved along midline, its apex located near the anterior end of the concavity.

The pillarlike process of the inner side of the cup is the distinguishing feature of *G. texanus*. Roundy described a variety of this species, as *G. texanus* var. *bicuspidus*. This variety, which is based upon a single specimen, was described as differing from *G. texanus* s. s. by having a nodelike process on the outer side of the cup as well as on the inner; this difference, however, is unimportant, as any large suite of specimens will show a gradation of the individuals from those entirely devoid of nodes to those bearing nodes of various sizes, shapes, and numbers on the outer side of the cup. Even the holotype of *G. texanus* possesses such a node. *G. texanus* var. *bicuspidus* is therefore regarded as being

within the range of variation of *G. texanus*. The species is associated with *G. bilineatus*, from which it can be distinguished by the ornamentation of the cup.

The name *Gnathodus texanus* (Roundy) was used by Cooper (1939, p. 388) when he transferred *Polygnathus texana* Roundy to the genus *Gnathodus*, but, as stated on page 79 of this paper, the correct name for *P. texana* is believed to be *G. bilineatus*. Ellison and Graves (1941) have reported *G. texanus* Roundy from the Dimple limestone of the Marathon region of Texas, but their figured specimens do not resemble the holotype of Roundy's species. Mehl and Thomas (1947, p. 10) have stated that *G. texanus* (Roundy) [sic] is represented by an abundance of specimens in the Fern Glen limestone of Missouri. They do not describe the species, and their figured specimen does not clearly record the characteristics of Roundy's species.

Distribution: Barnett formation; upper faunal zone.

Genus HINDEODELLA Bassler, 1925

1925. *Hindeodella* Bassler, Geol. Soc. America Proc., vol. 36, p. 219.

1926. *Hindeodella* Bassler. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, pp. 17, 38.

1932. *Hindeodella* Bassler. Stauffer and Plummer, Texas Univ. Bull. 3201, pp. 32, 33.

1934. *Hindeodella* Bassler. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 3, pp. 194, 195. (Date of imprint, 1933.)

1941. *Hindeodella* Bassler. Ellison, Jour. Paleontology, vol. 15, p. 117.

1944. *Hindeodella* Bassler. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 241.

Genotype, by original designation, *Hindeodella subtilis* Bassler, 1925.

Hindeodella ensis Hass, n. sp.

Plate 16, figures 19-21

1926. *Ctenognathus* sp. A Roundy, U. S. Geol. Survey Prof. Paper 146, p. 16, pl. 2, fig. 3.

1941. *Hindeodella* sp. Hass, Jour. Paleontology, vol. 15, p. 1, figs. 2, 3; pl. 16, fig. 6.

1941. *Hindeodella* sp. Branson and Mehl, Denison Univ. Sci. Lab., Bull., vol. 35, p. 170, pl. 5, fig. 1. (Date of imprint, 1940.)

Holotype: U.S.N.M. 115191.

Paratypes: U.S.N.M. 115192; also, the figured specimen of *Ctenognathus* sp. A figured by Roundy, 1926, U.S.N.M. 115190 [=U.S.G.S. Carb. cat. 4029a].

Type locality: C-12, about 5,000 feet N. 60° W. of point at which Honey Creek crosses the road from Mason to White's Crossing over the Llano River, Mason County, Tex.; collection 9309.

Unit is long, thin, and bladelike. Posterior bar slightly arched, curved inward, especially at the distal end; bar thickest near midheight, below which it is beveled and faintly lined by free edges of lamellae composing fossil. Bar denticles are of two sizes,

closely set, directed posteriorly, and curved inward slightly. Larger-sized denticles sharp-edged, biconvex in transverse section with inner side slightly larger than outer. Two or three smaller-sized, needlelike denticles generally separate adjacent larger-sized ones. Main cusp compressed at base, longer, broader, and thicker than bar denticles; in other respects main cusp is similar to larger-sized denticles. Anterior bar short, flexed inward, angled downward; its other characteristics similar to those of posterior bar. Aboral side sharp-edged except adjacent to main cusp, where it is grooved along the midline. Pulp cavity small.

Distribution: Barnett formation; upper faunal zone.

***Hindeodella undata* Branson and Mehl**

Plate 16, figures 5-7

1941. *Hindeodella undata* Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 169, pl. 5, fig. 3. (Date of imprint, 1940.)

1941. *Hindeodella* sp. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 170, pl. 5, fig. 9. (Date of imprint, 1940.)

Hypotypes: U.S.N.M. 115176, 115177, 115178.

Posterior bar long, compressed at the distal end; in transverse section it is higher than wide with the inner side thicker than the outer. Aboral side may be either sharp-edged or rounded. Denticles of posterior bar are of two sizes, closely set, and normal to the bar. Larger-sized denticles curved inward, pointed, biconvex in section with inner side thicker than outer. Smaller-sized denticles similar to larger-sized ones; generally, a group of four to six smaller-sized denticles separate the adjacent larger-sized ones. Posterior bar is sinuous in oral view; it bulges inward at the base of the larger-sized denticles and outward at the base of each group of smaller-sized ones. Main cusp erect or directed slightly to the posterior, larger than bar denticles, pointed, biconvex in section, compressed, and beveled in basal portion. Anterior bar emerges from main cusp without offset; it is flexed inward more than 90° and is produced below remainder of fossil into a very short, pointed extremity. This bar supports four or five closely set, discrete, needlelike denticles. Each of these denticles curves inward slightly and may be as large as the larger-sized denticles of the posterior bar. Midline of aboral side is grooved; faintly so on specimens with a sharp-edged aboral side and more plainly so on specimens with a broadly rounded aboral side. Pulp cavity small, pitlike.

Distribution; Barnett formation; upper faunal zone.

Genus *LIGONODINA* Bassler, 1925

1925. *Ligonodina* Bassler, Geol. Soc. America Proc., vol. 36, p. 219.

1926. *Ligonodina* Bassler. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, pp. 8, 12.

1933. *Plagiodina* Cooper, Geol. Soc. America Bull., vol. 44, p. 210.

1933. *Ligonodina* Bassler. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 1, p. 48.

1933. *Idioproniodus* Gunnell, Jour. Paleontology, vol. 7, p. 265.

1934. *Ligonodina* Bassler. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 3, p. 198. (Date of imprint, 1933.)

1934. *Ligonodina* Bassler. Huddle, Bull. Am. Paleontology, vol. 21, no. 72, pp. 58-60.

1941. *Ligonodina* Bassler. Ellison, Jour. Paleontology, vol. 15, p. 114.

1944. *Ligonodina* Bassler. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 241.

Genotype, by original designation, *Ligonodina pectinata* Bassler, 1925.

***Ligonodina fragilis* Hass, n. sp.**

Plate 15, figure 1

Holotype: U.S.N.M. 115057.

Type locality: C-13, east bank of Llano River at White's Crossing, Mason County, Tex.; collection 9312.

Posterior bar straight, approximately three times higher than wide. Denticles of posterior bar discrete, either erect or directed posteriorly, pointed, biconvex in section, and, at the base, almost as wide as the bar; denticles tend to alternate in size. Main cusp pointed, biconvex in section, curved posteriorly, with greatest degree of curvature in basal portion; near the tip, main cusp may be twisted inward slightly. Basal portion of main cusp is located below level of posterior bar. Anticusp emerges from basal portion of anterior side of main cusp, is flexed inward, and twisted so that its pointed extremity is directed posteriorly. Anticusp supports four or five denticles; these denticles, which are discrete, pointed, posteriorly curved, and circular to elliptical in section, decrease in size toward distal extremity. Aboral side of fossil even or rounded, grooved along midline, expanded beneath main cusp. This side is entirely set off from remainder of fossil by a ridge that may be much enlarged on the inner side of the main cusp and the adjacent portion of the posterior bar; elsewhere, generally, this ridge is poorly developed. Pulp cavity small, pitlike.

Ligonodina fragilis resembles *L. tenuis* Branson and Mehl but differs in that it has a long posterior bar that supports well-developed denticles instead of a short bar with very small denticles.

Distribution: Barnett formation; upper faunal zone.

***Ligonodina roundyi* Hass, n. sp.**

Plate 15, figures 5-9

1926. *Prioniodus* sp. A Roundy, U. S. Geol. Survey Prof. Paper 146, p. 11, pl. 4, fig. 9.

1926. *Prioniodus* sp. C Roundy, U. S. Geol. Survey Prof. Paper 146, p. 11, pl. 4, fig. 11.

Holotype: U.S.N.M. 115065.

Paratypes: The specimen of *Prioniodus* sp. A figured by Roundy, 1926, U.S.N.M. 115061 [=U. S. G. S. Carb. cat. 4035a]; the specimen of *Prioniodus* sp. C figured by Roundy, 1926, U.S.N.M. 115062 [=U.S.G.S. Carb. cat. 4025a]; also U.S.N.M. 115063, 115064.

Type locality: C-13, east bank of Llano River at White's Crossing, Mason County, Tex.; collection 9312.

Unit consists of a massive main cusp, a well-formed anticusp, and a fragile posterior bar. Bar denticles minute, discrete, and, at the base, as wide as the oral side of the posterior bar. Main cusp long, stout, pointed, and curved posteriorly with greatest degree of curvature near the base. Near the tip, the main cusp is compressed and the anterior and posterior sides are sharp-edged; toward the base, the posterior edge becomes a faint median line in a shallow groove. The anterior edge of the main cusp trends inward gradually so as to form a sharp-edged ridge along the front inner side. This ridge continues downward along the midline of the anticusp. Basal outer side of main cusp expanded; inner side, posterior to above-mentioned ridge, slightly grooved. Anticusp emerges from main cusp without offset; it is short, directed downward, and flexed inward approximately 90°. Anticusp supports at least four denticles, which, in general, decrease in size toward the pointed distal extremity. Denticles of anticusp compressed, pointed, discrete, closely set, and directed upward and slightly backward. Aboral side of fossil grooved along midline. Aboral side of main cusp excavated, expanded more on outer side than on inner. Apex of pulp cavity located at junction of main cusp and anticusp.

This species closely resembles *Ligonodina typa* (Gunnell) but differs in that it has a larger main cusp and has discrete denticles on the anticusp, instead of partly fused ones.

Distribution: Barnett formation; upper faunal zone.

Genus LONCHODINA Bassler, 1925

1925. *Lonchodina* Bassler, Geol. Soc. America Proc., vol. 36, p. 219.
 1926. *Lonchodina* Bassler. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, pp. 30, 31.
 1933. *Lonchodina* Bassler. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 2, p. 136.
 1934. *Lonchodina* Bassler. Huddle, Bull. Am. Paleontology, vol. 21, no. 72, p. 81.
 1944. *Lonchodina* Bassler. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 243.

Genotype, by original designation, *Lonchodina typicalis* Bassler, 1925.

Lonchodina paraclarki Hass, n. sp.

Plate 16, figures 15, 16

Holotype: U.S.N.M. 115186.

Paratype: U.S.N.M. 115187.

Type locality: C-12, about 5,000 feet N. 60° W. of point at

which Honey Creek crosses road from Mason to White's Crossing over Llano River, Mason County, Tex.; collection 9307.

Main cusp long, pointed, and directed forward, with greatest degree of curvature near the base. Two sharp edges divide main cusp into a smaller inner side and a larger outer one. Inner side of cusp broadly convex throughout its entire length. Outer side convex, its basal portion expanded posteriorly. A groove, which may be faint, is located adjacent to the posterior sharp edge on the basal portion of the outer side of cusp. Anterior sharp edge of cusp continuous with midline of anterior bar. Anterior bar straight, shorter than main cusp, and, with reference to posterior bar, is directed downward. Anterior bar of young specimen fragile and compressed; that of a mature one is stout, higher than wide, and is tapered to a pointed distal extremity. In transverse section, this bar is broadest along aboral side; its lateral sides converge orally and merge into the denticles. Anterior bar supports two to four denticles which are discrete, closely set, curved posteriorly, pointed, compressed, and biconvex in section. Posterior bar is shorter than anterior bar; it supports two to three denticles, which, though normal to bar, curve toward outer side of fossil. Other characteristics of posterior bar and its denticles similar to those of denticulated anterior bar. Aboral side of fossil broadest beneath main cusp from where it tapers to pointed extremities. Midline of aboral side grooved. Pulp cavity occupies entire under side of main cusp and is located mainly on outer side of midline of fossil.

This species is distinguishable from *Ligonodina clarki* (Gunnell) in that it tends to be more massive, its anterior bar is broadest along the unbeveled aboral side, and the denticles of its anterior bar are discrete.

Distribution: Barnett formation; upper faunal zone.

Genus LONCHODUS Pander, 1856

1856. *Centrodus* Pander [not Giebel, 1848], Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 31.
 1856. *Lonchodus* Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 80.
 1926. *Lonchodus* Pander. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, p. 42.
 1926. *Lonchodus* Pander. Roundy, U. S. Geol. Survey Prof. Paper 146, p. 15.
 1932. *Lonchodus* Pander. Stauffer and Plummer, Texas Univ. Bull. 3201, p. 37.
 1935. *Lonchodus* Pander. Stauffer, Geol. Soc. America Bull., vol. 46, p. 144.
 1935. *Lonchodus* Pander. Stauffer, Jour. Paleontology, vol. 9, p. 607.
 1945. *Lonchodus* Pander. Youngquist, Jour. Paleontology, vol. 19, p. 362.

Genotype, by subsequent designation of Ulrich and Bassler, 1926, *Centrodus simplex* Pander, 1856.

In 1856, Pander (p. 31) erected the genus *Centroodus* for some conodont fragments that he thought might have "paleontologic" [stratigraphic] value. Upon learning that the name *Centroodus* was preoccupied, Pander (1856, p. 80) changed the name of the genus to *Lonchodus*. A free translation of Pander's description reads: *Lonchodus* "includes large, slender, pointed, lamellose teeth, alone or alternating with smaller ones of varying size and number, which rest upon a horizontal or convex base." Under *Lonchodus*, Pander described and figured four types of fragments, and with two of these, *Lonchodus simplex* and *Lonchodus lineatus*, Roundy (1926, p. 15) identified some fragments from the Barnett formation.

Lonchodus lineatus (Pander)

Plate 14, figures 1, 2

1856. *Centroodus lineatus* Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 31, pl. 2a, fig. 9.
1856. *Lonchodus lineatus* (Pander). Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 80.
1879. *Polygnathus dubia* Hinde [part], Geol. Soc. London Quart. Jour., vol. 35, pp. 362, 363, pl. 16, figs. 13, 14, [not figs. 6-12, 15-18].
1900. *Centroodus lineatus* Pander. Hinde, Nat. History Soc. Glasgow Trans., n. ser., vol. 5, p. 341, pl. 9, figs. 13, 14.
1926. *Lonchodus? lineatus* (Pander). Roundy, U. S. Geol. Survey Prof. Paper 146, p. 15, pl. 3, figs. 7, 8.
1928. *Hindeodella lineata* (Pander). Holmes, U. S. Nat. Mus. Proc., vol. 72, art. 5, p. 11.
1937. *Hindeodella* cf. *H. lineata* (Pander). Currie, Geol. Soc. Glasgow Trans., vol. 19, pt. 3, p. 432, pl. 3, fig. 3 [not figs. 2, 2a=*Hindeodella* sp.].
1938. *Hindeodella lineata* (Pander). Demanet, Mus. royal histoire nat. Belgique Mem., no. 84, p. 162, pl. 14, figs. 12, 13(?), 14.
1939. [Not] *Hindeodella lineata* (Pander). Cooper, Jour. Paleontology, vol. 13, p. 389, pl. 46, figs. 28, 31.

Hypotypes: The specimens figured by Roundy, 1926, as fig. 8, pl. 3, U.S.N.M. 115076 [=U.S.G.S. Carb. cat. 4031a] and as fig. 7, pl. 3, U.S.N.M. 115077 [=U.S.G.S. Carb. cat. 4030a].

Bar elongate, denticulated, slightly bowed inward, and subcircular in transverse section. Aboral third of bar beveled, faintly lined longitudinally. Bar denticles are of two sizes; three to six smaller-sized denticles separate adjacent larger-sized ones. All denticles closely set, posteriorly directed, curved inward, pointed, sharp-edged; in section, inner side of each denticle is thicker than outer side. Aboral side grooved.

Even though the fragments that Roundy identified as *Lonchodus? lineatus* are probably hindeodellids, no attempt has been made to identify them because there is nothing of stratigraphic or nomenclatorial value to be gained thereby. Pander (1856, p. 31) intended that *Lonchodus lineatus* contain only indeterminable frag-

ments. His description of the species is "a row of teeth, crowding one another, that rises from a linear base; of these teeth, generally every fourth one is larger than the remaining." However, one cannot assume, as Pander did, that *L. lineatus* might possibly have "paleontologic" [stratigraphic] value because his generalized description applies equally well to the bar fragments of so many species, that the total stratigraphic range is great enough to nullify any value the category might otherwise have.

Some workers have not followed Pander in regarding *L. lineatus* as a catch-all species as specimens less fragmentary than Pander's have been assigned to it. Hinde (1879, p. 362), for example, identified whole specimens as *Centroodus lineatus* (i. e., *L. lineatus*). Other students including Holmes (1928, p. 11) have transferred *L. lineatus* to the genus *Hindeodella*; their reason for favoring this change was due, no doubt, to the fact that Pander's fragmentary specimen closely resembles a hindeodellid bar. In the present paper, however, the view is held that inasmuch as the anterior and posterior extremities of the holotype of *L. lineatus* are not known, it is impossible to prove a relationship with *Hindeodella*, so *L. lineatus* rather than *Hindeodella lineata* is considered to be the correct name. Although Holmes effected a generic change from *Lonchodus* to *Hindeodella*, she probably did consider the category to be a catch-all, as witness her synonymy which contains only two citations; both of which refer to fragmentary specimens. These entries are: *Centroodus lineatus* Pander, Hinde, 1900 (two briefly described and poorly figured barlike fragments from the Carboniferous of western Scotland) and *Lonchodus? lineatus* (Pander), Roundy, 1926 (the two fragments redescribed in this paper). Recently, Cooper (1939, p. 389) described and figured some specimens from the lower Mississippian of Oklahoma as *Hindeodella lineata*. He, like Holmes, placed only Hinde's and Roundy's fragmentary specimens in his synonymy but inasmuch as the specimens he described and figured are much more complete than Pander's holotype, he appears to have assigned characteristics to *L. lineatus* that are not evident from either Pander's description or illustration. Currie (1937, p. 432), also, has attempted to assign characteristics to *L. lineatus*. She has stated in her paper on the fauna of the Carboniferous Skipsey's Marine Band of Scotland that *Hindeodella* cf. *H. lineata* is the most common conodont species; a species that she would have named *L. lineatus* had not one of the specimens possessed characteristics of generic significance.

It is very possible that they who have attempted to augment the characteristics of *L. lineatus* have studied specimens that are not closely related to Pander's fragmentary fossil, and it is therefore suggested that the

category be employed as Pander had intended, that is, as a catch-all. On the other hand, if *L. lineatus* is to be regarded as a category for specifically related specimens, it certainly follows that the additional characteristics of such a poorly known category can be established with reasonable certainty only by comparing Pander's specimen with better preserved material from the type locality at Tula, U. S. S. R. Until this is done, any specific identification with *L. lineatus*, as well as attendant correlations based on it, can be easily challenged. Therefore, in this paper, *L. lineatus* is regarded merely as a convenient but meaningless category for fragments that resemble the one Pander described and figured in 1856.

Distribution: Described specimens are from Barnett formation; upper faunal zone.

Lonchodus simplex (Pander)

Plate 14, figure 7

1856. *Centroodus simplex* Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 31, pl. 2a, figs. 2, 3, 5, 6.
1856. *Lonchodus simplex* (Pander). Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 80.
1879. *Polygnathus dubia* Hinde [part], Geol. Soc. London Quart. Jour. vol. 35, pp. 362, 363, pl. 16, figs. 10, 11 [not figs. 6-9, 12-18].
1926. *Lonchodus simplex* (Pander). Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, p. 42.
1926. *Lonchodus simplex* (Pander). Roundy, U. S. Geol. Survey Prof. Paper 146, p. 15, pl. 3, figs. 1-5.
1931. *Lonchodus simplex* (Pander). Gunnell, Jour. Paleontology vol. 5, p. 248, pl. 29, figs. 13, 14 [misprinted in text as pl. 1, figs. 10, 11].
1932. *Lonchodus simplex?* (Pander). Stauffer and Plummer, Texas Univ. Bull. 3201, p. 38, pl. 2, fig. 1.
1933. *Lonchodus simplex?* (Pander). Gunnell, Jour. Paleontology, vol. 7, p. 269, pl. 31, fig. 2 [misprinted in text as pl. 1, fig. 2].
1933. *Polygnathus dubia* Hinde. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 2, pl. 11, fig. 19; pl. 12, fig. 3.
1938. *Synprioniodina* cf. *S. simplex* (Pander). Demanet, Mus. royal histoire nat. Belgique Mém., no. 84, p. 162, pl. 14; figs. 8, 9 [not figs. 10, 11].
1939. *Lonchodus simplex* (Pander). Cooper, Jour. Paleontology, vol. 13, p. 392, pl. 46, figs. 34, 38.
1941. *Lonchodus simplex* (Pander). Ellison and Graves, Missouri School Mines and Metallurgy, Bull., vol. 14, no. 3, p. 3, pl. 1, fig. 21.

Hypotype: The specimen figured by Roundy, 1926, as fig. 5, pl. 3, U.S.N.M. 115082 [=U.S.G.S. Carb. cat. 4026a].

This description is based upon a single fragmentary specimen that lacks both the anterior and posterior extremities. The bar is straight and smooth. In transverse section, it is higher than wide, with the oral side roundly arched and with the lateral sides gradually converging toward the aboral edge where they flare

slightly. The aboral side is a wide, V-shaped groove. This fragment supports five denticles; the posterior two are long and pointed but the anterior three have been broken off adjacent to the bar. These denticles are discrete, sharp-edged, and directed posteriorly; their sides are convex, and, at the base, they are as wide as the bar.

Pander's description of *Lonchodus simplex* is translated as "long, sharp, pointed, straight or bent teeth that stand vertically on a common horizontal base." Pander believed his category might have "paleontologic" [stratigraphic] value, but today its worth is vitiated by the knowledge that *L. simplex* contains fragments whose ages differ greatly.

Distribution: Described specimen is from Barnett formation; upper faunal zone.

Genus METALONCHODINA Branson and Mehl, 1941

1941. *Metalonchodina* Branson and Mehl, Jour. Paleontology, vol. 15, pp. 105, 106.
1944. *Metalonchodina* Branson and Mehl. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 243.
- Genotype, by original designation of Branson and Mehl, 1941, *Prioniodus bidentatus* Gunnell, 1931.

Metalonchodina sp. A

Plate 16, figures 17, 18

Figured specimens: U.S.N.M. 115188, 115189.

The following description is based upon a suite of fragmentary specimens. In oral view the species tends to be flexed outward near the anterior extremity and inward near the posterior end. Anterior bar is short, thickest adjacent to the pulp cavity, compressed and pointed at the distal extremity; in lateral view this bar is straight or curved downward. Anterior bar supports one or more denticles which are directed slightly forward, curved inward, pointed, compressed, and bi-convex in transverse section. Posteriormost of these denticles is approximately twice as large as main cusp; its inner side, especially adjacent to the main cusp, is much larger than its outer side. Posterior bar fragile, approximately as high as wide, and, with reference to the anterior bar, is flexed downward about 90°. Denticles of posterior bar curved upward; other characteristics similar to those of anterior bar. Main cusp similar to bar denticles except that the inner side is enlarged especially in the basal portion. Aboral side of fossil with narrow groove along midline. Pulp cavity deep, coniform, and located chiefly on inner side of midline.

Distribution: Barnett formation; upper faunal zone.

Genus PALMATOLEPIS Ulrich and Bassler, 1926

1926. *Palmatolepis* Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, pp. 44, 49.

1934. *Palmatolepis* Ulrich and Bassler. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 3, p. 233. (Date of imprint, 1933.)
1934. *Palmatolepis* Ulrich and Bassler. Huddle, Bull. Am. Paleontology, vol. 21, no. 72, p. 106.
1944. *Palmatolepis* Ulrich and Bassler. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 245.

Genotype, by original designation, *Palmatolepis perlobata* Ulrich and Bassler, 1926.

***Palmatolepis glabra* Ulrich and Bassler**

Plate 15, figure 4

1926. *Palmatolepis glaber* Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, p. 51, pl. 9, figs. 18-20.
1926. *Polygnathus* sp. A Roundy, U. S. Geol. Survey Prof. Paper 146, p. 14, pl. 3, figs. 12a, b.
1928. *Palmatolepis elongata* Holmes, U. S. Nat. Mus. Proc., vol. 72, art. 5, p. 33, pl. 11, fig. 13.
1934. *Palmatolepis glabra* Ulrich and Bassler. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 3, pp. 233, 234, pl. 18, figs. 9, 22, 26. (Date of imprint, 1933.)
1934. *Palmatolepis elongata* Holmes. Huddle, Bull. Am. Paleontology, vol. 21, no. 72, p. 108, pl. 9, figs. 8-10.
1935. [?]*Palmatolepis elongata* Homes. Cooper, Jour. Paleontology, vol. 9, p. 314, pl. 27, fig. 40.
1941. [?]*Palmatolepis glabra?* Ulrich and Bassler. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 192, pl. 7, fig. 13. (Date of imprint, 1940.)
1941. [?]*Palmatolepis* cf. *P. glabra* Ulrich and Bassler. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, p. 192, pl. 7, figs. 15, 16. (Date of imprint, 1940.)
1943. [?]*Palmatolepis glabra* Ulrich and Bassler. Cooper, in Cooper and Sloss, Jour. Paleontology, vol. 17, pl. 29, figs. 5, 36.
1947. *Palmatolepis glabra* Ulrich and Bassler. Bond, Ohio Jour. Sci., vol. 47, no. 1, p. 33, pl. 2, fig. 25.
1949. *Palmatolepis glabra* Ulrich and Bassler. Thomas, Geol. Soc. America Bull., vol. 60, pl. 1, fig. 19.

Hypotype: The specimen of *Polygnathus* sp. A figured by Roundy, 1926, U.S.N.M. 115060 [=U.S.G.S. Carb. cat. 4014a].

The specimen that Roundy described and figured as *Polygnathus* sp. A is a fragment of *Palmatolepis glabra*. This species does not appear to range naturally above the Upper Devonian and its presence in the Barnett fauna is therefore regarded as having been the result of reworking. The following description is based upon a suite of well-preserved specimens from the Upper Devonian.

Oral view.—An elongate asymmetric unit. Plate upturned posterior to the large azygous node; margin of plate smooth. Carina straight or concave toward outer platform, composed of small fused denticles, some of which are nodelike; it may be indistinct at posterior end of plate. Blade approximately twice as long as carina, concave as well as inclined slightly toward inner side of fossil. Axis divides plate into platforms of unequal size that are ornamented with numerous reticulating rows of granules. Inner platform extends entire length of fossil; it is slightly broader than the outer

platform and has the sigmoid curvature of its free edge interrupted in some specimens by a small lobe near the azygous node. Outer platform terminates abruptly halfway between azygous node and the anterior end of the fossil. Anterior to the azygous node the outer platform is arched and its margin is upturned to form a ridge or parapet that is as high as the adjacent portions of the blade.

Lateral view.—With reference to the aboral side of the blade, the plate is upturned posterior to the azygous node. Summit line of axis dentate or irregular; in general, it increases in height anteriorly.

Aboral view.—Midline sigmoid, keeled except adjacent to the extremely small pulp cavity which is located beneath the azygous node.

Distribution: Figured specimen is considered to be a reworked Upper Devonian fossil.

Genus POLYGNATHUS Hinde, 1879

1879. *Polygnathus* Hinde, Geol. Soc. London Quart. Jour., vol. 35, p. 361.
1889. *Polygnathus* Hinde. Miller, N. Am. Geology and Paleontology, p. 520.
1921. *Polygnathus* Hinde. Bryant, Buffalo Soc. Nat. Sci. Bull., vol. 13, no. 2, pp. 22-24.
1926. *Polygnathus* Hinde. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, pp. 43-45.
1926. *Polygnathus* Hinde. Roundy, U. S. Geol. Survey Prof. Paper 146, p. 13.
1933. *Polygnathus* Hinde. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 2, p. 146.
1934. *Polygnathus* Hinde. Huddle, Bull. Am. Paleontology, vol. 21, no. 72, p. 94.
1939. *Macropolygnathus* Cooper, Jour. Paleontology, vol. 13, p. 329.
1944. *Polygnathus* Hinde. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 24E.

Genotype, by subsequent designation of Miller 1889, *Polygnathus dubia* Hinde, 1879. The type of *Polygnathus dubia* designated by Roundy, 1926, as fig. 17 on pl. 16 of Hinde's 1879 publication.

***Polygnathus taffi* Roundy**

Plate 14, figure 8

1926. *Polygnathus taffi* Roundy, U. S. Geol. Survey Prof. Paper 146, p. 13, pl. 3, figs. 11a, b.
- Holotype: The specimen shown by Roundy, 1926, as figs. 11a, b, pl. 3, U.S.N.M. 115083 [=U. S. G. S. Carb. cat. 4020a].

Type locality: C-9, 5¼ miles west of Lampasas, Burnet County, Tex.; collection 7016 (green).

Oral view.—This description is based upon a single fragmentary specimen that lacks both the anterior and posterior extremities. Plate elongate; its unbroken margin crenate. Denticles of carina compressed and fused nearly to their pointed sharp-edged tips. Outer platform slightly larger than inner; both platforms low at posterior end and upturned throughout most of their length so as to form smooth-bottomed troughs with

the carina. Troughs increase in depth anteriorly. Margin of inner platform nearly straight; that of outer, slightly convex. Oral surface of platforms minutely pitted and marked by faint transverse ridges.

Lateral view.—Summit line of carina dentate. Aboral side angled downward immediately posterior to pulp cavity. Oral edge of inner platform nearly straight and on level with summit line of carina; that of outer platform is arched above carina.

Aboral view.—Plate smooth; platforms pitch steeply from the midline. Pulp cavity large, elliptical, moderately deep, and set off from anterior portion of plate by a thick rounded margin. This margin merges posteriorly into the sharp-edged keel of the plate.

The holotype of *Polygnathus taffi* has been damaged since Roundy described it. A comparison of Roundy's figures of the type with the one in this paper shows that a portion of the anterior end has been broken away and lost. Because of its fragmentary nature *P. taffi* is not compared with any other species of *Polygnathus*. *P. taffi* moreover, has no stratigraphic value as it is based upon a single specimen that appears to have been reworked into the fauna of the Barnett formation. According to Ellison (1946, p. 94), the genus *Polygnathus* does not range above the Osage group of the Mississippian.

Distribution: Described specimen is considered to be a reworked fossil. Its stratigraphic position not known.

Genus PRIONIODUS Pander, 1856

1856. *Prioniodus* Pander, Monographie der fossilen Fische des silurischen Systems der russisch-baltischen Gouvernements, p. 29.
1889. *Prioniodus* Pander. Miller, N. Am. Geology and Paleontology, p. 520.
1926. *Prioniodus* Pander. Ulrich and Bassler, U. S. Nat. Mus. Proc., vol. 68, art. 12, pp. 8, 9.
1926. *Prioniodus* Pander. Roundy, U. S. Geol. Survey Prof. Paper 146, p. 10.
1933. *Prioniodus* Pander. Cooper, Geol. Soc. America Bull., vol. 44, p. 210.
1933. *Prioniodus* Pander. Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 2, pp. 129, 130.
1944. *Prioniodus* Pander. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 241.

Genotype, by subsequent designation of Miller, 1889, *Prioniodus elegans* Pander, 1856.

Prioniodus inclinatus Hass, n. sp.

Plate 16, figures 10-14

1926. *Prioniodus* sp. D Roundy [part], U. S. Geol. Survey Prof. Paper 146, p. 11, pl. 4, fig. 12 [not figs. 13a, b=*Geniculatus claviger* (Roundy)].

Holotype: U.S.N.M. 115182.

Paratypes: The specimen *Prioniodus* sp. D, shown by Roundy, 1926, as fig. 12 on pl. 4, U.S.N.M. 115183 [=U.S.G.S. Carb. cat. 4037a]; also U.S.N.M. 115181, 115184, 115185.

Type locality: C-15, about 2,500 feet N. 88° W. of southwest bank of Llano River at White's Crossing, Mason County, Tex.; collection 9310.

Posterior bar of unknown length—presumably as long as main cusp—straight to slightly curved inward. In transverse section posterior bar is approximately as high as wide, broadest at the aboral side; the inner side is thicker than the outer. Bar denticles directed forward, curved inward, pointed, and biconvex in section with the inner side thicker than the outer. These denticles may be discrete or fused, and, at the base, each one is as wide as the bar. Main cusp weakly joined to posterior bar, bowed inward at the base, directed forward, pointed, biconvex in section with inner side enlarged, especially adjacent to the posterior bar. The pointed basal projection of the main cusp is flexed outward slightly and may bear partly fused denticles along its anterior side. Midline of aboral side grooved. Pulp cavity a large, coniform concavity located beneath posterior portion of main cusp. Anterior to pulp cavity, basal projection of main cusp may be slightly excavated.

Distribution: Barnett formation; upper faunal zone.

Prioniodus ligo Hass, n. sp.

Plate 16, figures 1-3

1926. *Prioniodus peracutus* Hinde. Roundy [part], U. S. Geol. Survey Prof. Paper 146, p. 10, pl. 4, figs. 7, 8 [not fig. 6 = lectotype of *Prioniodus peracutus* Hinde].

Holotype: U.S.N.M. 115172.

Paratypes: The specimens shown by Roundy, 1926, as fig. 7, pl. 4, U.S.N.M. 115174 [=U.S.G.S. Carb. cat. 4023a] and as fig. 8, pl. 4, U.S.N.M. 115173 [=U.S.G.S. Carb. cat. 4022a].

Type locality: C-12, about 5,000 feet N. 60° W. of point at which Honey Creek crosses road from Mason to White's Crossing over Llano River, Mason County, Tex.; collection 9317.

Posterior bar curved inward; its aboral portion is beveled and finely lined by free edges of lamellae composing fossil. In transverse section, bar is higher than wide, with the inner side thicker than the outer. Denticles of bar closely set, normal to bar, curved inward slightly, pointed, and biconvex in section with the inner side thicker than the outer. In lateral view, the main cusp, together with the basal projection, forms a massive, triangularly shaped unit that is pointed at the extremities, broadest and thickest adjacent to the posterior bar, and bowed inward slightly. Anterior and posterior sides of cusp sharp-edged and nearly straight; aboral side of cusp slightly convex. Outer side of cusp evenly rounded; inner side, adjacent to the anterior edge is compressed, but posterior to this area the inner side is thicker. The beveled and striated characteristics of the aboral portion of the posterior bar continue to the tip of the anticusp. Aboral side of fossil grooved along midline. Pulp cavity small, pit-like, located at junction of posterior bar and cusp.

In gross features *Prioniodus ligo* closely resembles *P. scitulus* Branson and Mehl, but differs in that it is larger and has the aboral side of its main cusp grooved instead of excavated. *P. ligo* resembles the lectotype of *P. peracutus* Hinde but differs in having many constant characteristics that are not evident from either Hinde's description or figure.

Distribution: Barnett formation; upper faunal zone.

Prioniodus roundyi Hass, n. sp.

Plate 15, figures 2, 3

1926. *Prioniodus* sp. B Roundy, U. S. Geol. Survey Prof. Paper 146, p. 11, pl. 4, fig. 10.

Holotype: U.S.N.M. 115058.

Paratype: The specimen *Prioniodus* sp. B, shown by Roundy, 1926, as fig. 10, pl. 4, U.S.N.M. 115059 [=U.S.G.S. Carb. cat. 4024a].

Type locality: C-15, about 2,500 feet N. 88° W. of the southwest bank of the Llano River at White's Crossing, Mason County, Tex.; collection 9310.

Posterior bar fragile, slightly sinuous, compressed, and approximately as long as main cusp. In transverse section, posterior bar is widest immediately above the aboral side; inner side thicker than the outer. Bar denticles short, slender, appressed to near their pointed sharp-edged tips, normal to bar, and curved inward slightly. Main cusp is flexed inward slightly at its junction with the posterior bar; it is also directed forward, bowed inward, compressed near its pointed tip, and biconvex in section, with the inner side thicker than the outer. The basal projection of the cusp extends below level of posterior bar; its pointed extremity is flexed outward. Anterior side of cusp may be sharp-edged or rounded. In lateral view, anterior side is faintly sigmoid, with the basal projection curved backward; posterior side of cusp slightly convex; the aboral side is concave. Aboral side of fossil grooved. Pulp cavity a coniform pit located at junction of cusp and posterior bar; anterior to pulp cavity, the aboral side of the cusp is troughlike.

Prioniodus roundyi resembles *P. scitulus* Branson and Mehl; its main cusp, however, is directed forward and is flexed inward at its junction with the posterior bar whereas that of *P. scitulus* is erect and does not appear to be flexed inward. Cooper (1939, p. 405) has placed *Prioniodus* sp. B of Roundy, 1926 in synonymy with *P. oligus* Cooper. Roundy's fragmentary specimen is conspecific with the holotype of *P. roundyi* and differs from *P. oligus* as follows: the anterior side of the cusp of *P. roundyi* is faintly sigmoid in lateral view and its inner side is not greatly enlarged adjacent to the posterior bar, whereas the anterior side of the cusp of

P. oligus is convex in lateral view and its inner side is enlarged adjacent to the posterior bar.

Distribution: Barnett formation; upper faunal zone.

Prioniodus singularis Hass, n. sp.

Plate 16, figure 4

Holotype: U.S.N.M. 115175.

Type locality: C-12, about 5,000 feet N. 60° W. of point at which Honey Creek crosses road from Mason to White's Crossing over the Llano River, Mason County, Tex.; collection 9309

Posterior bar compressed, shorter than main cusp, adjacent to which it is flexed inward between 45° and 90°. In lateral view bar is highest at the anterior end from where it tapers to a pointed distal extremity. Denticles of the bar gradually decrease in size posteriorly; they are closely set, erect or directed slightly forward, curved inward, pointed, and biconvex in section. With reference to the posterior bar the main cusp is directed forward; in lateral view it is an elongate, triangularly shaped unit which is pointed at the extremities, broadest and thickest adjacent to the posterior bar, and bowed inward slightly. The anterior and posterior sides of the cusp are sharp-edged and nearly straight; the aboral side is slightly convex. In transverse section the cusp is biconvex with the inner side thicker than the outer. Anterior-most one or two denticles of posterior bar may be almost entirely incorporated into the main cusp. Aboral side of fossil grooved along the midline. Pulp cavity very small, located near the posterior end of the main cusp. Aboral portion of lateral sides of fossil beveled and lined by free edges of lamellae of fossil. Above the pulp cavity, on the inner side, the above-mentioned beveled area is conspicuously arched.

Prioniodus singularis differs from *P. ligo* in that it is less massive, has a shorter basal projection, and has a main cusp which, with reference to the posterior bar, is directed forward instead of being erect. The stratigraphic range of *P. singularis* seems to be restricted, as it has been found only in collections from the top-most beds of the Barnett formation.

Distribution: Barnett formation; upper faunal zone.

Genus *ROUNDYA* Hass, n. gen.

Genotype, here designated, *Roundya barnettana* Hass.

A bilaterally symmetrical unit consisting of a denticulated anterior arch which is surmounted by a large main cusp, and a denticulated posterior bar which is joined to the basal posterior side of the main cusp. Denticles of posterior bar and anterior arch discrete. Main cusp erect or curved posteriorly. Pulp cavity large, located beneath main cusp.

Roundya is proposed for those species, formerly assigned to *Trichonodella*, that have a denticulated posterior bar. The reason for this emendation is given on page 90. In addition to the species described in this paper, the new genus includes the following: *Trichognathus laminata* Branson and Mehl, 1934; *Trichognathus separata* Branson and Mehl, 1934; *Trichognathus tumida* Branson and Mehl, 1934; *Idioprioniodus striatus* Gunnell, 1933; *Prioniodus missouriensis* Gunnell, 1931; *Prioniodus subacodus* Gunnell, 1931; *Trichonodella brassfieldensis* E. B. Branson and C. C. Branson (name valid as of July 1948); *Trichonodella? edentata* E. B. Branson and C. C. Branson (name valid as of July 1948); and *Trichonodella carinata* E. B. Branson and C. C. Branson (name valid as of July 1948). The new genus differs from *Hibbardella* in that it has a large, rather than a very small sized, pulp cavity.

Roundya barnettana Hass, n. sp.

Plate 16, figures 8, 9

Holotype: U.S.N.M. 115179.

Paratype: U.S.N.M. 115180.

Type locality: C-15, about 2,500 feet N. 88° W. of the southwest bank of the Llano River at White's Crossing, Mason County, Tex.; collection 9310.

Main cusp stout, pointed, curved posteriorly, with greatest curvature immediately above the enlarged base. Sharp-edged, lateral ridges divide main cusp into anterior and posterior portions; these ridges continue downward along each limb of anterior arch. In transverse section, anterior to the above-mentioned lateral ridges, cusp is broadly convex; posterior to these same ridges, it is also convex and, near the base, is expanded and extended posteriorly. Posterior side of main cusp has a groove adjacent to each of the above-mentioned lateral ridges; a groove may be present also along the basal portion of the posterior midline. Limbs of anterior arch about as long as main cusp from which they emerge without offset; each limb is flexed laterally immediately beneath the main cusp and is curved backward slightly throughout its length. In transverse section each limb of anterior arch is nearly circular adjacent to the main cusp but is slightly broader than high throughout most of its length; the greatest width is along the aboral side. Denticles of anterior arch well-formed, discrete, pointed, sharp-edged, and biconvex in transverse section with posterior side slightly thicker than anterior side. Each denticle tends to curve upward as well as backward. Length of posterior bar not known; adjacent to the main cusp it is broader than high with the lateral sides converging orally. Denticles of posterior bar erect, pointed, compressed, and biconvex in section. Aboral side of posterior bar is broadly grooved; that of each limb of anterior arch

is rounded and grooved along its midline. Aboral side of main cusp excavated, ovate in outline. Pulp cavity large, coniform.

Prioniodus subacodus Gunnell, a species that Ellison (1941, p. 118) placed in the genus *Hibbardella*, is assigned by the writer to *Roundya*. This species resembles *R. barnettana* but is less massive.

Distribution: Barnett formation; upper faunal zone.

Genus SUBBRYANTODUS Branson and Mehl, 1934

1934. *Subbryantodus* Branson and Mehl, Missouri Univ. Studies, vol. 8, no. 4, p. 285. (Date of imprint, 1933.)

1944. *Subbryantodus* Branson and Mehl. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 244.

Genotype, by original designation, *Subbryantodus arcuatus* Branson and Mehl, 1934.

Subbryantodus roundyi Hass, n. sp.

Plate 14, figures 3-6

1926. *Ctenognathus* sp. B Roundy, U. S. Geol. Survey Prof. Paper 146, p. 16, pl. 2, figs. 4, 5.

Holotype: U.S.N.M. 115079.

Paratypes: The specimens of *Ctenognathus* sp. B, figured by Roundy, 1926, as fig. 4, pl. 2, U.S.N.M. 115080 [=U.S.G.S. Carb. cat. 4032a]; fig. 5, pl. 2, U.S.N.M. 115081 [=U.S.G.S. Carb. cat. 4033a]; and U.S.N.M. 115078.

Type locality: C-15, about 2,500 feet N. 88° W. of the southwest bank of the Llano River at White's Crossing, Mason County, Tex.; collection 9310.

Oral view.—Unit compressed, bladelike, broadest at pulp cavity, from where it tapers toward the extremities; it may be straight but generally is bowed inward adjacent to the pulp cavity and outward near the distal extremities.

Lateral view.—Posterior blade may be only half as long as anterior blade. Its denticles are either erect or directed posteriorly and are closely set; each one has a pointed, sharp-edged tip and is biconvex in transverse section. Anterior blade, with reference to the posterior blade, may be angled downward more than 45°. Denticles of anterior blade directed upward; in other respects similar to denticles of posterior blade. Suppression and regeneration of denticles common. Apical denticle directed posteriorly; generally, it is larger but in other respects it is similar to blade denticles.

Aboral view.—Aboral side of fossil sharp-edged at the extremities but grooved along the midline adjacent to the pulp cavity. Pulp cavity elliptical in outline; its longer axis makes an acute angle with the inner posterior side of the fossil.

Distribution: Barnett formation; upper faunal zone.

Genus TRICHONODELLA Branson and Mehl, 1948, emend. Hass

1933. *Trichognathus* Branson and Mehl, Missouri Univ. Studies vol. 8, no. 1, p. 36.

1935. *Trichognathus* Branson and Mehl. Stauffer, Geol. Soc. America Bull., vol. 46, p. 155.
1941. *Trichognathus* Branson and Mehl. Branson and Mehl, Denison Univ., Sci. Lab., Bull., vol. 35, pp. 175, 176. (Date of imprint, 1940.)
1944. *Trichognathus* Branson and Mehl. Branson and Mehl, in Shimer and Shrock, Index fossils of North America, p. 241.
1948. *Trichonodella* Branson and Mehl, Jour. Paleontology, vol. 22, p. 527.

Genotype, by original designation and by monotypy, *Trichognathus prima* Branson and Mehl, 1933.

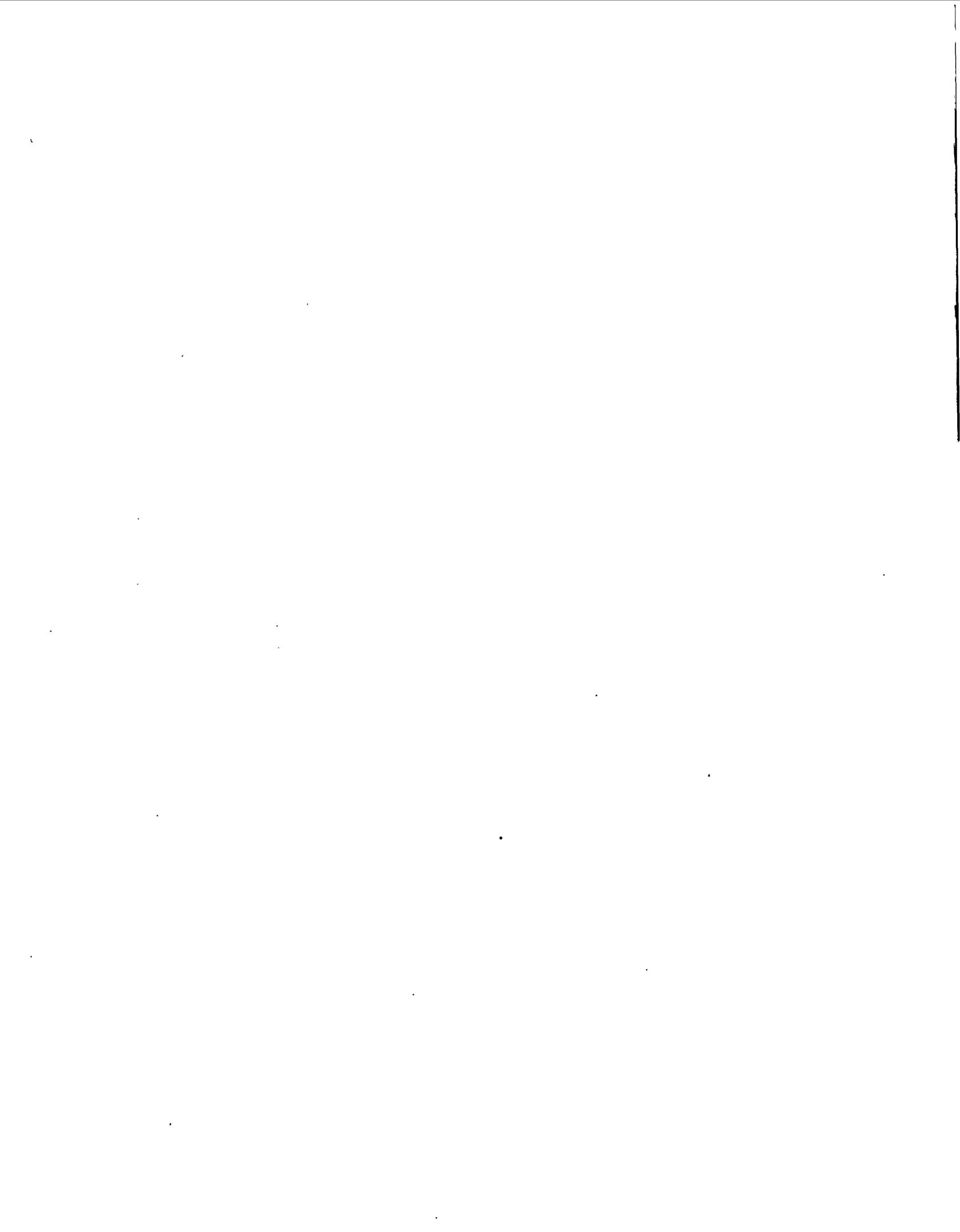
A bilaterally symmetrical unit, consisting of a denticulated arch that is surmounted by a posteriorly curved, main cusp. Pulp cavity located beneath main cusp. Basal portion of main cusp may be enlarged and extended posteriorly.

In "Index fossils of North America," Branson and Mehl (1944, p. 241) have cited *Trichognathus symmetrica* Branson and Mehl from the Bainbridge limestone (Silurian) of Missouri as the genotype of *Trichognathus* (= *Trichonodella* of present report); the genotype, as stated above, is *Trichognathus prima* Branson and Mehl, from the Harding sandstone (Ordovician) of Colorado. *T. prima* is based on a single fragmentary conodont that differs from most of the species previously assigned to the genus by lacking a denticulated posterior bar. The present writer regards the presence or absence of this bar as being of sufficient taxonomic importance to warrant the recognition of the following two generic categories: forms lacking a denticulated posterior bar that, because of the nature of *T. prima*, remain in *Trichonodella*; and forms possessing a denticulated posterior bar that are removed to *Roundya*. The species affected by this emendation are listed on page 89.

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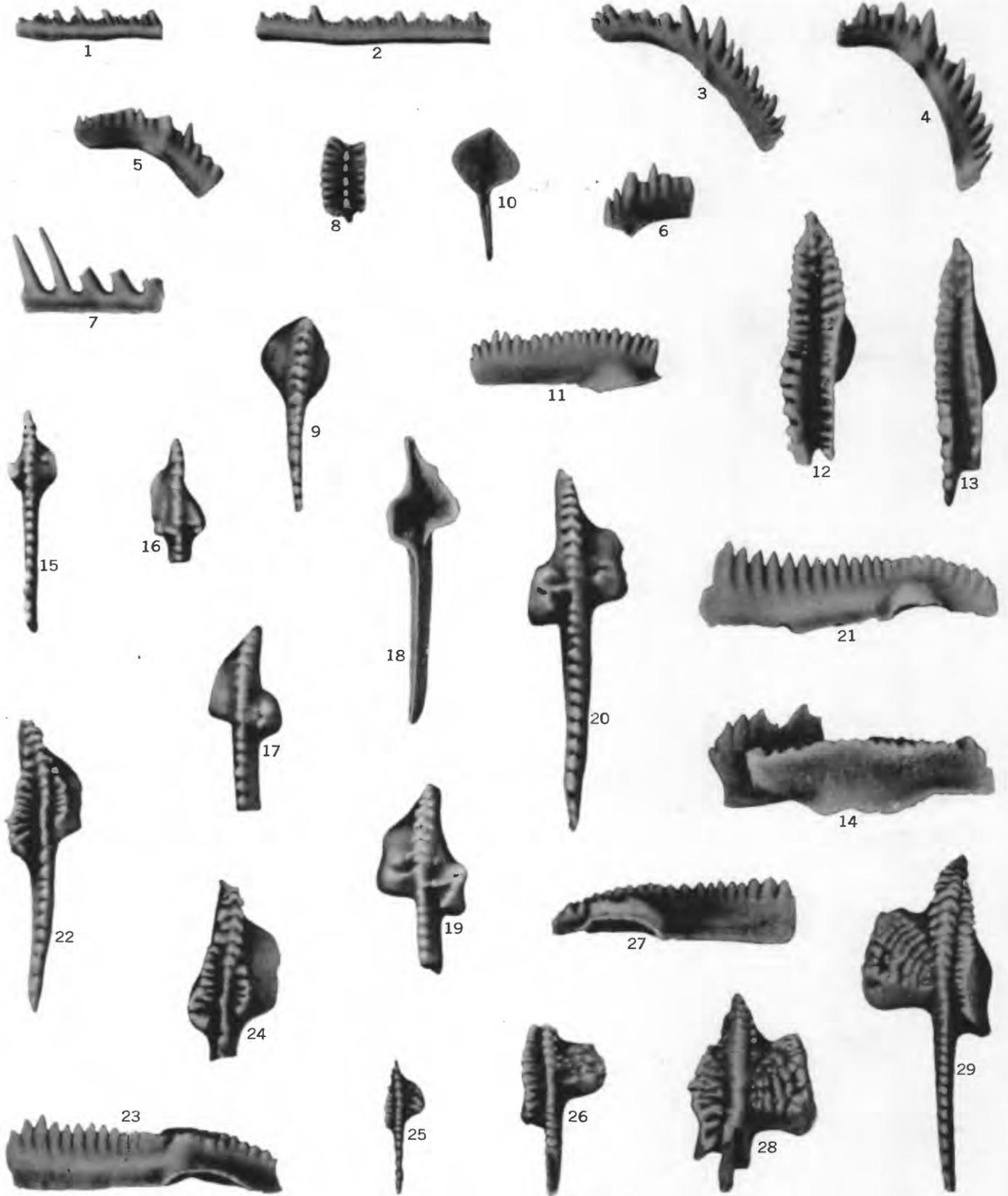
PLATE 14

Barnett formation; upper conodont faunal zone

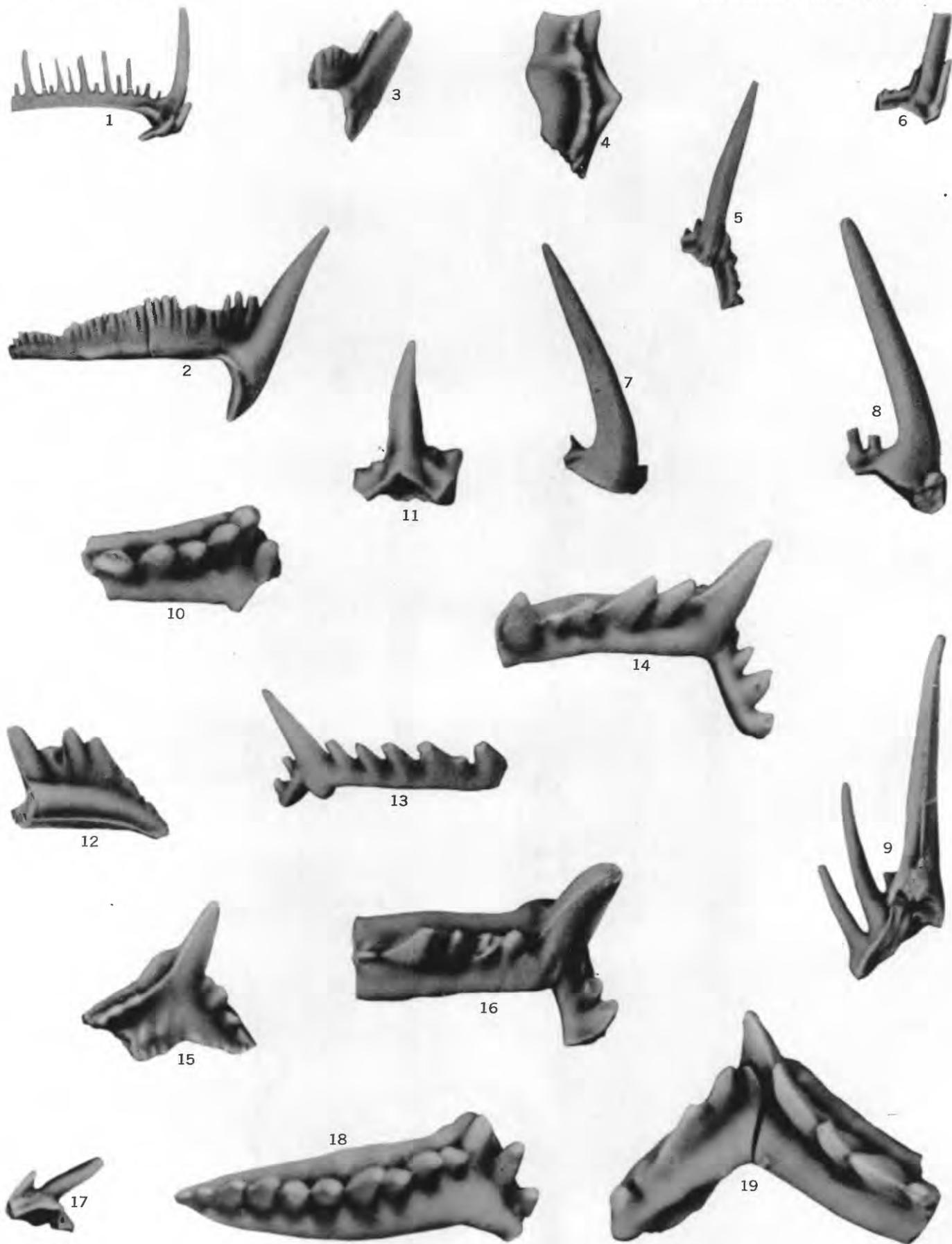
[Figures are 30 times natural size]

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- 1, Lateral view of conodont fragment, hypotype, U.S.N.M. 115076 [= *Lonchodus? lineatus* (Pander). Roundy, U.S.G.S. Prof. Paper 146, pl. 3, fig. 8; U.S.G.S. Carb. cat. 4031a], collection 2613e.
- 2, Lateral view of conodont fragment, hypotype, U.S.N.M. 115077 [= *Lonchodus? lineatus* (Pander). Roundy, U.S.G.S. Prof. Paper 146, pl. 3, fig. 7; U.S.G.S. Carb. cat. 4030a], collection 2609.
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 - 4, Holotype, U.S.N.M. 115079, collection 9310.
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 - 6, Paratype, U.S.N.M. 115081 [= *Ctenognathus* sp. B Roundy, U.S.G.S. Prof. Paper 146, pl. 2, fig. 5; U.S.G.S. Carb. cat. 4033a], collection 2613h.
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- 9-11. *Gnathodus inornatus* Hass, n. sp. (p. 80).
 - 9, Oral view, holotype, U.S.N.M. 115084, collection 9309.
 - 10, Aboral view, paratype, U.S.N.M. 115085, collection 9309.
 - 11, Lateral view, paratype, U.S.N.M. 115086, collection 9309.
- 12-14. *Cavusgnathus cristata* Branson and Mehl (p. 77).
 - 12, Oral view, hypotype, U.S.N.M. 115087, collection 9311.
 - 13, Oral view, hypotype, U.S.N.M. 115088, collection 9311.
 - 14, Lateral view of inner side, hypotype, U.S.N.M. 115089, collection 9311.
- 15-21. *Gnathodus texanus* Roundy (pp. 80, 81).
 - 15, Oral view, holotype, U.S.N.M. 115090 [= U.S.G.S. Prof. Paper 146, pl. 2, figs. 8a, 8b; U.S.G.S. Carb. cat. 4018a], collection 2688.
 - 16, Oral view, paratype, U.S.N.M. 115091 [= *Gnathodus texanus* var. *bicuspidus* Roundy. U.S.G.S. Prof. Paper 146, pl. 2, figs. 9a, 9b; U.S.G.S. Carb. cat. 4019a], collection 2613e.
 - 17, Oral view, paratype, U.S.N.M. 115092 [= U.S.G.S. Prof. Paper 146, pl. 2, figs. 7a, 7b; U.S.G.S. Carb. cat. 4017a], collection 2609.
 - 18, Aboral view, hypotype, U.S.N.M. 115093, collection 9310.
 - 19, Oral view, hypotype, U.S.N.M. 115094, collection 9310.
 - 20, Oral view, hypotype, U.S.N.M. 115095, collection 9310.
 - 21, Lateral view of outer side, hypotype, U.S.N.M. 115096, collection 9310.
- 22-24. *Gnathodus girtyi* Hass, n. sp. (p. 80).
 - 22, Oral view, holotype, U.S.N.M. 115097, collection 9310.
 - 23, Lateral view of outer side, paratype, U.S.N.M. 115098, collection 9310.
 - 24, Oral view, paratype, U.S.N.M. 115099, collection 9310.
- 25-29. *Gnathodus bilineatus* (Roundy) (pp. 78-80).
Oral views illustrating specific variation and the development of characteristics during ontogeny.
 - 25, Hypotype, U.S.N.M. 115100, collection 9309.
 - 26, Holotype, U.S.N.M. 115101 [= *Polygnathus bilineata* Roundy, U.S.G.S. Prof. Paper 146, pl. 3, figs. 10a-c; U.S.G.S. Carb. cat. 4021a], collection 2609.
 - 27, Lateral view of outer side, hypotype, U.S.N.M. 115102, collection 9309.
 - 28, Hypotype, U.S.N.M. 115103 [= *Polygnathus texana* Roundy, U.S.G.S. Prof. Paper 146, pl. 3, figs. 13a, 13b; U.S.G.S. Carb. cat. 4013a], collection 2618.
 - 29, Hypotype, U.S.N.M. 115104, collection 9309.



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PLATE 15

Barnett formation; upper conodont faunal zone

[Figures are 30 times natural size]

- FIGURE 1. *Ligonodina fragilis* Hass, n. sp. (p. 82).
Lateral view of inner side, holotype, U.S.N.M. 115057, collection 9312.
- 2, 3. *Prioniodus roundyi* Hass, n. sp. (p. 88).
Lateral views of the inner side.
2, Holotype, U.S.N.M. 115058, collection 9310.
3, Paratype, U.S.N.M. 115059 [= *Prioniodus* sp. B Roundy, U.S.G.S. Prof. Paper 146, pl. 4, fig. 10; U.S.G.S. Carb. cat. 4024a], collection 2609.
4. *Palmatolepis glabra* Ulrich and Bassler (p. 86).
Oral view of a fragmentary specimen regarded as reworked into the Barnett fauna. Hypotype, U.S.N.M. 115060 [= *Polygnathus* sp. A Roundy, U.S.G.S. Prof. Paper 146, pl. 3, figs. 12a, 12b; U.S.G.S. Carb. cat. 4014a], collection 2609.
- 5-9. *Ligonodina roundyi* Hass, n. sp. (pp. 82, 83).
5, Lateral view of outer side of immature fragmentary specimen, paratype, U.S.N.M. 115061 [= *Prioniodus* sp. A Roundy, U.S.G.S. Prof. Paper 146, pl. 4, fig. 9; U.S.G.S. Carb. cat. 4035a], collection 2609.
6, Lateral view of inner side of immature fragmentary specimen, paratype, U.S.N.M. 115062 [= *Prioniodus* sp. C Roundy, U.S.G.S. Prof. Paper 146, pl. 4, fig. 11; U.S.G.S. Carb. cat. 4025a], collection 2609.
7, Lateral view of outer side of main cusp, paratype, U.S.N.M. 115063, collection 9312.
8, Lateral view of inner side of main cusp, paratype, U.S.N.M. 115064, collection 9312.
9, View of posterior side of main cusp and anticusp, holotype, U.S.N.M. 115065, collection 9312.
- 10-19. *Geniculatus claviger* (Roundy) (pp. 77, 78).
10, Oral view, holotype, U. S. N. M. 115066 [= *Polygnathus?* *claviger* Roundy, U.S.G.S. Prof. Paper 146, pl. 4, figs. 1a-c; U.S.G.S. Carb. cat. 4015a], collection 2609.
11, View of outer side of main cusp, hypotype, U.S.N.M. 115067 [= *Prioniodus* sp. D Roundy, U. S. G. S. Prof. Paper 146, pl. 4, figs. 13a, 13b; U.S.G.S. Carb. cat. 4036a], collection 2609.
12, Lateral view of inner side of distal end of posterior bar, paratype, U.S.N.M. 115068 [= *Polygnathus?* *claviger* Roundy, U.S.G.S. Prof. Paper 146, pl. 4, figs. 2a, 2b; U.S.G.S. Carb. cat. 4016a], collection 2613e.
13, Lateral view of outer side, hypotype, U.S.N.M. 115069, collection 9310.
14, View of inner side, hypotype, U.S.N.M. 115070, collection 9312.
15, View of inner side, hypotype, U.S.N.M. 115071, collection 8651.
16, View of inner side, hypotype, U.S.N.M. 115072, collection 9312.
17, View of outer side of main cusp, hypotype, U.S.N.M. 115073 [= *Prioniodus healdi* Roundy, U.S.G.S. Prof. Paper 146, pl. 4, figs. 5a, 5b; U.S.G.S. Carb. cat. 4034a], collection 2688.
18, Oral view of specimen lacking distal end of anterior bar, hypotype, U.S.N.M. 115074, collection 9313.
19, Oral view of specimen lacking distal end of posterior bar, hypotype, U.S.N.M. 115075, collection 9313.

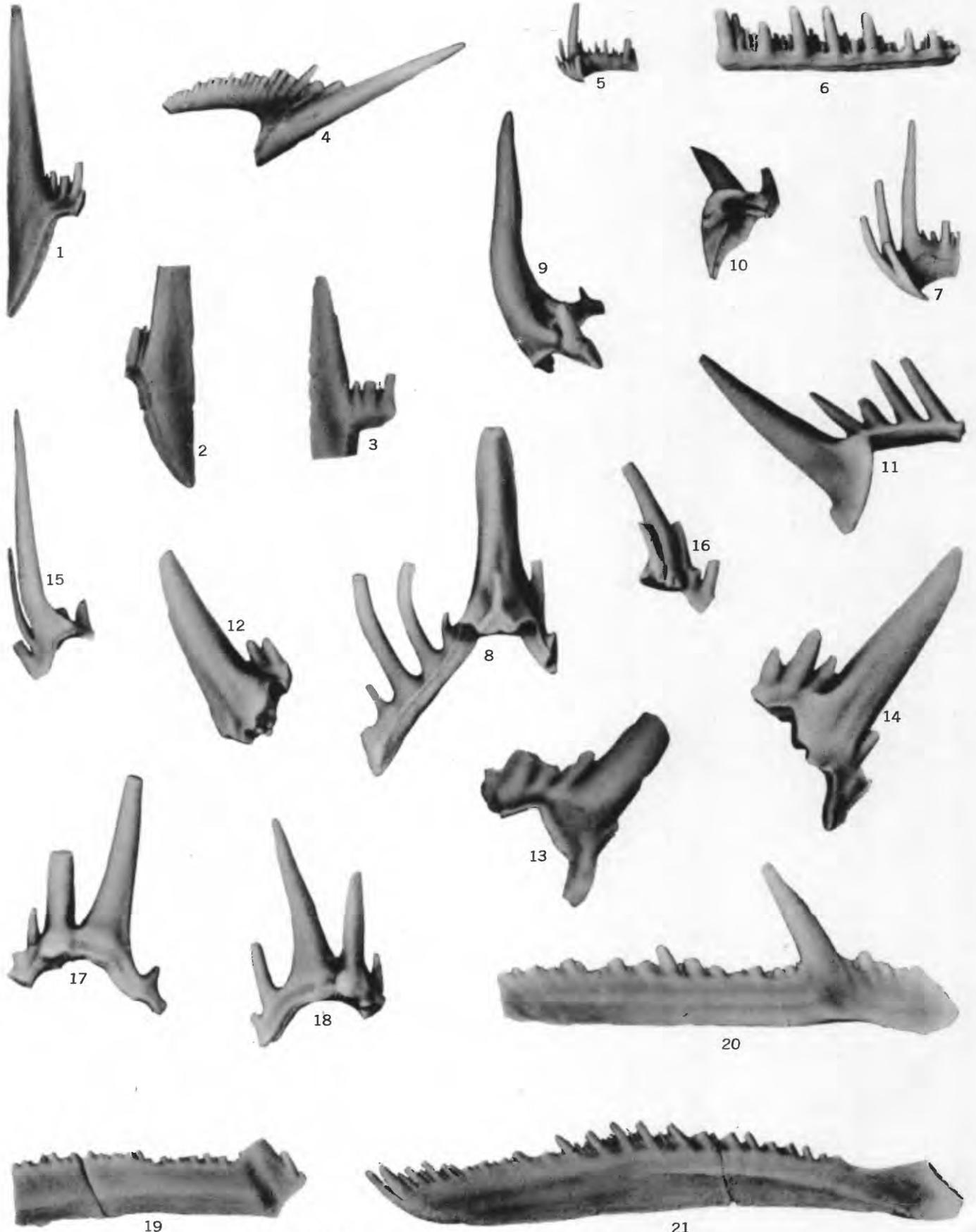
PLATE 16

Barnett formation; upper conodont faunal zone

[Figures are 30 times natural size]

- Figures 1-3. *Prioniodus ligo* Hass, n. sp. (pp. 87, 88).
 1, Lateral view of inner side, holotype, U.S.N.M. 115172, collection 9317.
 2, Lateral view of outer side, paratype, U.S.N.M. 115173 [= *Prioniodus peracutus* Hinde. Roundy, U. S. G. S. Prof. Paper 146, pl. 4, fig. 8, U. S. G. S. Carb. cat. 4022a], collection 2609.
 3, Lateral view of outer side, paratype, U.S.N.M. 115174 [= *Prioniodus peracutus* Hinde. Roundy, U. S. G. S. Prof. Paper 146, pl. 4, fig. 7; U. S. G. S. Carb. cat. 4023a], collection 2613g.
4. *Prioniodus singularis* Hass, n. sp. (p. 88).
 Lateral view of inner side, holotype, U.S.N.M. 115175, collection 9309.
- 5-7. *Hindeodella undata* Branson and Mehl (p. 82).
 5, Lateral view of inner side, hypotype, U.S.N.M. 115176, collection 9312.
 6, Lateral view of bar fragment, hypotype, U.S.N.M. 115177, collection 9312.
 7, Lateral view of inner side, hypotype, U.S.N.M. 115178, collection 9312.
- 8, 9. *Roundya barnettana* Hass, n. sp. (p. 89).
 8, Posterior view of anterior arch, holotype, U.S.N.M. 115179, collection 9310.
 9, Lateral view, paratype, U.S.N.M. 115180, collection 9312.
- 10-14. *Prioniodus inclinatus* Hass, n. sp. (p. 87).
 10, Aboral view of main cusp, paratype, U.S.N.M. 115181, collection 9310.
 11, Lateral view of inner side, holotype, U.S.N.M. 115182, collection 9310.
 12, Lateral view of inner side of main cusp, paratype, U.S.N.M. 115183 [= *Prioniodus* sp. D Roundy, U. S. G. S. Prof. Paper 146, pl. 4, fig. 12; U. S. G. S. Carb. cat. 4037a], collection 2613e.
 13, Lateral view of outer side, paratype, U.S.N.M. 115184, collection 9312.
 14, Lateral view of outer side, paratype, U.S.N.M. 115185, collection 9312.
- 15, 16. *Lonchodina paraclarki* Hass, n. sp. (p. 83).
 15, Lateral view of outer side, holotype, U.S.N.M. 115186, collection 9309.
 16, Lateral view of outer side, paratype, U.S.N.M. 115187, collection 9312.
- 17, 18. *Metalonchodina* sp. A (p. 85).
 17, Lateral view of inner side, figured specimen, U.S.N.M. 115188, collection 9313.
 18, Lateral view of inner side, figured specimen, U.S.N.M. 115189, collection 9310.
- 19-21. *Hindeodella ensis* Hass, n. sp. (pp. 81, 82).
 Lateral views of inner side.
 19, Paratype, U.S.N.M. 115190 [= *Ctenognathus* sp. A Roundy, U. S. G. S. Prof. Paper 146, pl. 2, fig. 3; U. S. G. S. Carb. cat. 4029a], collection 2609.
 20, Holotype, U.S.N.M. 115191, collection 9309.
 21, Paratype, U.S.N.M. 115192, collection 9312.





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