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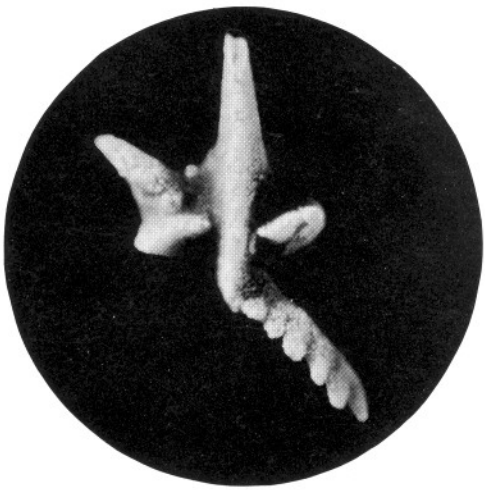
CONODONT ZONATION

OF LOWER OSAGEAN ROCKS (LOWER MISSISSIPPIAN) OF SOUTHWESTERN MISSOURI

BY THOMAS L. THOMPSON



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WILLIAM C. HAYES · STATE GEOLOGIST AND DIRECTOR

Conodont Zonation of Lower Osagean Rocks (Lower Mississippian) of Southwestern Missouri

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THOMAS L. THOMPSON

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STATE OF MISSOURI
Department of Business and Administration
Division of
GEOLOGICAL SURVEY AND WATER RESOURCES
WILLIAM C. HAYES, State Geologist
Rolla, Missouri

STATE OF MISSOURI
Warren E. Hearnes, Governor

DEPARTMENT OF BUSINESS AND ADMINISTRATION
Mrs. Ruby Jane Happy, Director

DIVISION OF GEOLOGICAL SURVEY AND WATER RESOURCES
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Wallace B. Howe*, Ph. D., Assistant State Geologist

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Thomas L. Thompson, Ph. D., Geologist
Marjorie Richards, Clerk Typist II

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*Certified Professional Geologist by the American Institute of Professional Geologists

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by

THOMAS L. THOMPSON

ABSTRACT

Six selected localities in southwestern Missouri were sampled in the attempt to establish biostratigraphic zones in lower Osagean rocks utilizing conodonts. The units studied were the Pierson, Reeds Spring, and Elsey Formations, and the basal portion of the Burlington Limestone.

The recovered conodont fauna contains 24 species of 10 genera, including three new species, and six problematical species of two genera. In addition, 10 genera of bar and bladelike conodonts were recovered, but not described or illustrated. Age of the recovered conodonts ranges from late Kinderhookian to late early Osagean.

Three conodont assemblage zones are established for the southwestern Missouri lower Osagean succession, the Gnathodus semiglaber - Polygnathus communis Assemblage Zone, the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone, and the Bactrognathus distorta - Gnathodus cuneiformis Assemblage Zone, in ascending order. The latter two assemblage zones are subdivided into two subzones, each characterized by a single representative species. These in ascending order, are the Pseudopolygnathus multistriata Subzone, the Doliognathus lata Subzone, the Bactrognathus distorta Subzone and the Gnathodus cuneiformis Subzone.

The youngest conodonts recovered in the present study are within the "Zone of Gnathodus bulbosus" (informal designation), characterized by a new species of Gnathodus. This zone was identified at only one locality.

Conodont correlation of lower Osagean rocks in southwestern Missouri indicates that the upper portion of the Pierson Formation, the entire Reeds Spring and Elsey Formations, and the basal portion of the Burlington Limestone become progressively younger southward and westward.

INTRODUCTION

Collinson and others (1962) established Devonian and Mississippian conodont biostratigraphic zones for the upper Mississippi Valley. Comparison of these conodont assemblage zones with the fauna recovered from lower Osagean rocks of southwestern Missouri described in the present study indicates that the same basic fauna is present in both regions. However, significant differences are present to facilitate the establishment of new conodont assemblage zones referable to the southwestern Missouri lower Osagean sequence.

The Pierson, Reeds Spring, and Elsey Formations, and the basal portion of the Burlington Limestone (Fig. 1) have been sampled at six selected localities in southwestern Missouri that allow spatial distribution for both north-south and east-west correlation. Future plans include more detailed stratigraphic and biostratigraphic studies encompassing Mississippian strata of the southwestern Missouri region.

Acknowledgments.-- Charles E. Robertson and Larry D. Fellows of the Missouri Geological Survey familiarized the author with Mississippian stratigraphy in southwestern Missouri, and assisted him in the collection of samples for the present study. Wallace B. Howe and John W. Koenig conferred with the author in numerous discussions which influenced the conclusions reached in this report. The author is indebted to the late M. G. Mehl, Missouri Geological Survey and Professor Emeritus of the University of Missouri at Columbia, for enthusiastic support and encouragement during initial phases of this study. Appreciation is extended to Carl B. Rexroad, Indiana Geological Survey, and Edwin D. Goebel, Kansas Geological Survey, for their comments and criticisms during review of this manuscript.

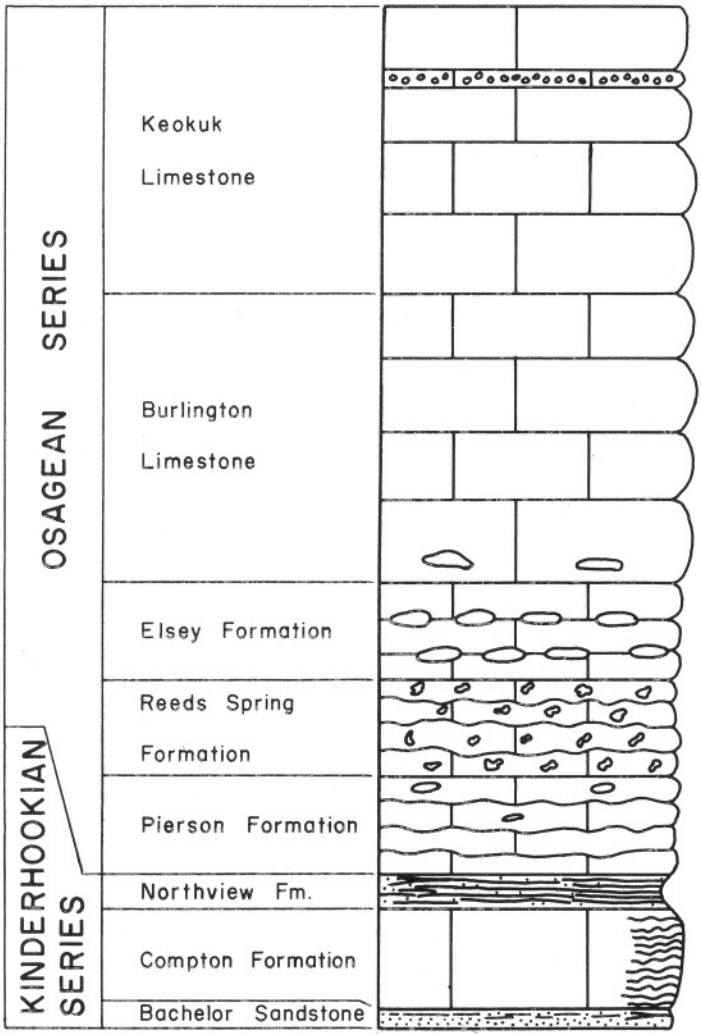

FIG. 1. Lower Mississippian formations in southwestern Missouri.

MATERIAL STUDIED

Study of Mississippian biostratigraphy of southwestern Missouri is initiated with a comparison and zonation of conodonts recovered from six selected localities of lower Osagean rocks (Fig. 2):

A. Dry Sac Creek section; roadcut west side U. S. Highway 65, 1.5 mile north of Interstate 44 interchange; SW¼ SE¼ SE¼, sec. 32, T. 30 N., R. 21 W., Greene County, Missouri; Ebenezer 7½-minute quadrangle.

B. Turner's Station; type section Pierson Formation, roadcut on Greene County road D; NW¼ SW¼ SW¼, sec. 29, T. 29 N., R. 20 W., Greene County, Missouri; Galloway 7½-minute quadrangle.

C. Dry Creek; type section Elsey Formation, roadcut on Missouri Highway 148; Center sec. 5, T. 24 N., R. 24 W., Stone County, Missouri; Aurora 15-minute quadrangle.

D. Type section Reeds Spring Formation, Missouri Pacific Railroad cut, southeast of Reeds Spring; SW¼ NW¼, sec. 31, T. 24 N., R. 22 W., Stone County, Missouri; Garber 7½-minute quadrangle.

E. Baird Mountain quarry, Table Rock Dam; SW¼ NW¼, sec. 26, T. 22 N., R. 22 W., Taney County, Missouri; Table Rock Dam 7½-minute quadrangle.

F. Roaring River State Park, south entrance, roadcut Missouri Highway 112; NE¼, sec. 34, T. 22 N., R. 27 W., Barry County, Missouri; Cassville 15-minute quadrangle.

From these six sections, 130 samples, averaging seven pounds each, were collected from Pierson, Reeds Spring, Elsey, and basal Burlington strata. Sample numbers referred to on Tables 1 through 6 correspond to described unit-numbers, discussed in detail in the appendix.

STRATIGRAPHIC SUMMARY

Pre-Burlington Mississippian units in southwestern Missouri are in ascending order: Bachelor Sandstone, Compton Formation, Northview Formation, Pierson Formation, Reeds Spring Formation, and Elsey Formation

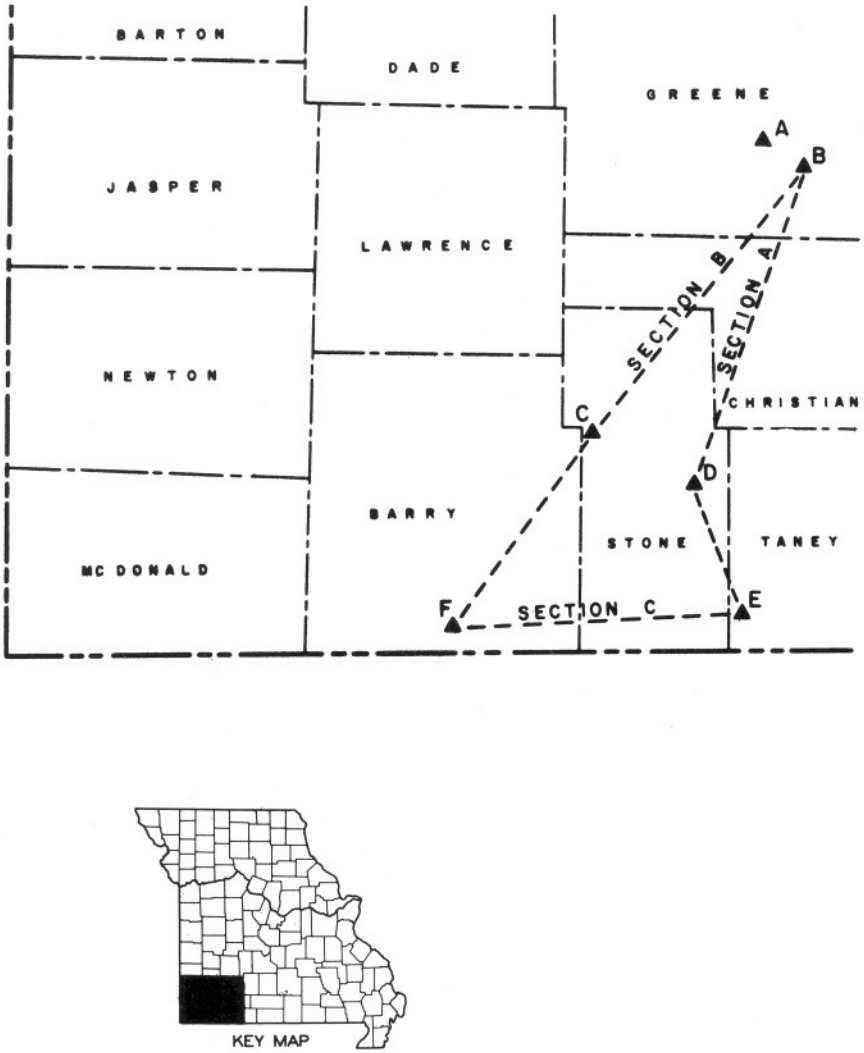

FIG. 2. Map of Missouri showing locations of localities sampled. Dashed lines refer to cross-sections, Figure 4.

(Fig. 1). In southwestern Missouri, the Kinderhookian-Osagean Series boundary has been placed at the Northview-Pierson contact (Beveridge and Clark, 1952, p. 77). Following this concept, the present study includes those units above the Northview and below the Burlington Limestone.

Weller (1901) named the Pierson Formation from outcrops along Pearson Creek (correct spelling, originally misspelled by Shepard, 1898) east of Springfield in Greene County, Missouri. At the type section (Turner's Station, section B, appendix), subsequently designated by Beveridge and Clark (1952), the Pierson strata are brown, dolomitic limestones or calcareous dolomites with numerous beds and nodules of white to brown chert. At Turner's Station, the Pierson is directly overlain by the Elsey Formation.

South and west from the type section, the Pierson beds are generally less dolomitic, and commonly chert free in the lower part. They range from greenish-gray, medium- to coarse-grained limestone (section D, appendix), to dark red, semicrinoidal, argillaceous limestone (sections E and F, appendix). Chert content in the upper part increases toward the south and west. Because of similarity to chert of the Reeds Spring, there is some difficulty in distinguishing with certainty upper Pierson from Reeds Spring which overlies the Pierson south of Greene County. In the extreme southern tier of counties (Taney, Stone, and Barry Counties), the Pierson-Reeds Spring sequence strongly resembles the Fern Glen Formation of eastern Missouri (Weller, 1906; Beveridge and Clark, 1952).

The Reeds Spring Formation, named by Moore (1928) from outcrops along the Missouri Pacific Railroad southeast of Reeds Spring, Stone County, Missouri (section D, appendix), consists of interbedded dark gray, fine-grained limestone and bluish-black and brown chert. Typical Reeds Spring chert occurs as very irregular intergrowths within thin limestone beds. Generally, chert constitutes over 50 percent of the unit.

The Reeds Spring is absent in northern Greene County and thickens southward from Christian County to over 100 feet in southern Stone County. The Reeds Spring lithology remains relatively consistent throughout its outcrop belt, but often it is difficult to determine the Pierson-Reeds Spring contact where the upper Pierson is very cherty. Commonly, a transition zone is present that contains both the evenly bedded Pierson

chert and the irregular nodules of Reeds Spring chert.

The Elsey Formation (Robertson, 1967) (type section, section C, appendix) is a dark gray, fine-grained, nodular limestone, usually containing scattered crinoid remains. The limestone is interbedded with large nodules of white, spicular, and fossiliferous chert. The bedding of the Elsey is characteristically thicker than that of the Reeds Spring, and the chert is in the form of large smooth, laterally connected nodules between nodular limestone beds.

The Elsey is not recognized in Polk County, Missouri, and thickens southward, averaging about 30 feet in thickness. It directly overlies the Pierson in Greene County, and rests on the Reeds Spring south of Christian County.

Overlying the Elsey Formation in southwestern Missouri is the Burlington Limestone, a crinoidal, light gray to white limestone, cherty in its lower portion. Although chert beds in the lower Burlington resemble those of the Elsey, the coarse crinoidal nature of the Burlington limestone serves to distinguish it from the Elsey.

THE CONODONT FAUNA

From the conodont fauna of 5,937 specimens, 4,180 platform-types have been identified, representing 24 species of 10 genera, and six problematical species of two genera. The remaining 1,757 bar and blade forms have not been identified to species but are recognized to represent 10 genera. These genera with the number of specimens recovered are:

Geniculatus	(4)	Metalonchodina	(65)
Hibbardella	(163)	Neoprioniodus	(251)
Hindeodella	(185)	Ozarkodina	(418)
Ligonodina	(210)	Roundya	(29)
Lonchodina	(331)	Synprioniodina	(101)

Of the platform-types, the 10 genera recovered arranged in the order of their abundance are:

Gnathodus	(1449)	Siphonodella	(95)
Polygnathus	(1289)	Doliognathus	(62)
Spathognathodus	(803)	Scaliognathus	(11)
Bactrognathus	(266)	Elictognathus	(3)
Pseudopolygnathus	(161)	Staurognathus	(1)

Tables 1 through 6 depict the distribution of the recovered conodont species for each locality.

Collinson and others (1962) indicated that Gnathodus semiglaber (Bischoff) and G. typicus Cooper first appear abundantly together in earliest Osagean time in the Mississippi Valley. In southwestern Missouri, G. semiglaber appears first, and G. typicus increases in abundance as G. semiglaber declines, and is the dominant gnathodid when G. semiglaber has disappeared from the fauna.

In the Mississippi Valley, again from the work of Collinson and others (1962), the next important gnathodids are G. antetexanus Rexroad and Scott and G. cuneiformis Mehl and Thomas, appearing together as the dominant gnathodids following the decline of G. semiglaber and G. typicus. In southwestern Missouri, G. antetexanus appears during the decline of G. typicus, whereas G. cuneiformis is not abundant until after the decline of G. antetexanus.

Thus, in southwestern Missouri, the succession of gnathodids is from G. semiglaber, to G. typicus, to G. antetexanus, to G. cuneiformis, and finally to G. bulbosus n. sp. (Roaring River south, locality F, Table 6)

Pseudopolygnathus multistriata Mehl and Thomas, occurring with G. semiglaber in the Mississippi Valley (Collinson and others, 1962), first appears in southwestern Missouri with G. typicus, and declines at approximately the same time as G. typicus. Bactrognathus, occurring after the zone of abundant P. multistriata in the Mississippi Valley region, appears at approximately the beginning of the zone of abundant P. multistriata in southwestern Missouri.

Gnathodus punctatus (Cooper) is unreported from the Mississippi Valley (Rexroad and Scott, 1964, p. 41), but is common in upper Kinderhookian rocks in southwestern Missouri. Doliognathus, Scaliognathus, and Stuarognathus,

not reported from the Mississippi Valley, are important elements in the southwestern Missouri lower Osagean fauna.

Of importance to Osagean biostratigraphy in southwestern Missouri is the recovery of Polygnathus mehli n. sp., a polygnathid younger than P. communis Branson and Mehl. P. mehli occurs with Bactrognathus distorta Branson and Mehl and Gnathodus cuneiformis Mehl and Thomas.

CONODONT ZONATION

Mississippian conodont assemblage zones have been utilized in the upper Mississippi Valley region by Collinson and others (1962) (Fig. 3). Late Kinderhookian conodonts are present in basal Pierson rocks at the Baird Mountain and Roaring River south localities (Tables 5 and 6). The specimens recovered are interpreted to represent the upper portion of the Siphonodella isosticha - S. cooperi Assemblage Zone of Collinson and others (1962, p. 21). Characteristic species include Elictognathus costata (E. R. Branson), Gnathodus delicatus Branson and Mehl, G. punctatus, Polygnathus communis, Siphonodella cooperi Hass, and S. obsoleta Hass. G. punctatus has not been recovered in the Mississippi Valley but is more abundant than G. delicatus in southwestern Missouri.

The Gnathodus semiglaber - Pseudopolygnathus multistriata Assemblage Zone (Fig. 3) was defined (Collinson and others, 1962, p. 22) as the zone of abundant G. semiglaber and P. multistriata and also contained G. typicus Cooper and Polygnathus communis. However, in southwestern Missouri, G. typicus appears later than in the Mississippi Valley region, and is common with P. multistriata, above the range of abundant G. semiglaber. Bactrognathus, first appearing in the Bactrognathus - P. communis Assemblage Zone in the Mississippi Valley (Collinson and others, 1962, p. 22), above the range of abundant Pseudopolygnathus multistriata, first appears near the middle of the range of abundant P. multistriata in southwestern Missouri. Therefore, these two assemblage zones overlap in the region of the present study.

The Bactrognathus - Polygnathus communis Assemblage Zone was reported to contain abundant Pseudopolygnathus triangula Voges, a form represented by only one specimen in southwestern Missouri. Gnathodus antetexanus and G. cuneiformis, appearing abundantly at the base of this assemblage zone in

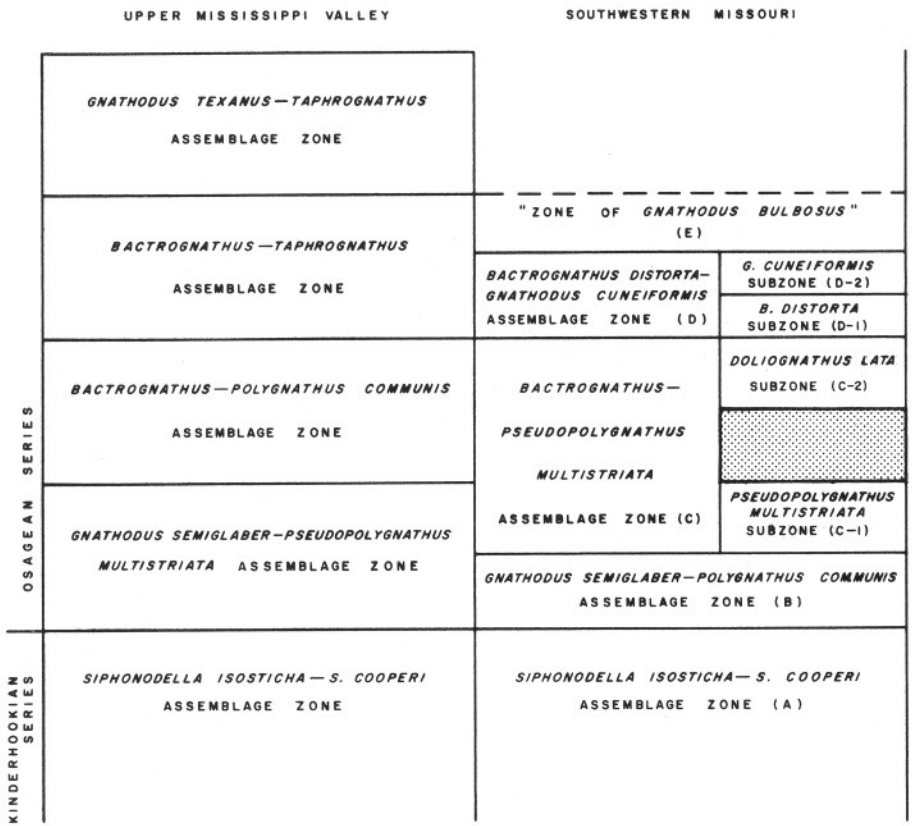

FIG. 3. Comparison of lower Osagean conodont assemblage zones from Upper Mississippi Valley (Collinson and others, 1962) with those from southwestern Missouri.

the Mississippi Valley, first appear in the upper portion of this zone in southwestern Missouri.

From the standpoint of usefulness to the study of southwestern Missouri and allied regions, new assemblage zones are hereby recognized (Fig. 3). These in no way invalidate those established for use in the Mississippi Valley, but are more meaningful to the present study than are those of Collinson and others (1962).

Gnathodus semiglaber - Polygnathus communis Assemblage Zone

This assemblage zone coincides with the range of abundant G. semiglaber, and includes in its lower portion the only occurrence of P. communis carina Hass.

The lower limit of this assemblage zone is placed at the last occurrence of Siphonodella, Elictognathus, Gnathodus delicatus, and G. punctatus. The upper limit is placed at the last abundant occurrence of G. semiglaber, the first abundant occurrence of G. typicus and Pseudopolygnathus multistriata, and the first occurrence of specimens of Bactrognathus.

Characteristic species of this assemblage zone include G. semiglaber and P. communis carina, with a few G. typicus and P. multistriata near the top. P. communis communis is common throughout this zone.

This assemblage zone corresponds in age to the lower portion of the G. semiglaber - Pseudopolygnathus multistriata Assemblage Zone from the upper Mississippi Valley (Collinson and others, 1962, p. 22), but does not contain P. multistriata in any significant numbers. G. typicus, abundant in the Mississippi Valley region assemblage zone, is not common in southwestern Missouri until the next younger zone. This zone is correlative with the lower portion of the "Sedalia" of Illinois (Collinson and others, 1962).

Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone

This assemblage zone coincides with the association of species of Bactrognathus with Polygnathus communis communis.

The base of this assemblage zone is at the first occurrence of species of Bactrognathus and abundant Gnathodus typicus and Pseudopolygnathus

multistriata. The top is at the last occurrence of P. communis and the first appearance of B. distorta Branson and Mehl.

Characteristic species of this assemblage zone include B. excavata Branson and Mehl, B. hamata Branson and Mehl, B. minuta n. sp., Doliognathus lata Branson and Mehl, Gnathodus antetexanus, G. typicus, Polygnathus communis communis, Pseudopolygnathus multistriata, Scaliognathus anchoralis Branson and Mehl, and Staurognathus cruciformis Branson and Mehl.

The Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone can be further subdivided into two subzones:

A) Pseudopolygnathus multistriata Subzone.-- The lower subzone contains species of Bactrognathus, G. typicus, P. communis communis, and P. multistriata. This subzone corresponds approximately to the upper portion of the G. semiglaber - P. multistriata Assemblage Zone from the upper Mississippi Valley, and is correlative with the upper "Sedalia" of Illinois.

B) Doliognathus lata Subzone.-- The upper subzone contains species of Bactrognathus, Doliognathus lata, G. antetexanus, G. cuneiformis, G. n. sp. B, P. communis communis, and Scaliognathus anchoralis. P. multistriata is absent from this subzone.

The D. lata Subzone appears to correspond to the upper portion of the Bactrognathus - P. communis Assemblage Zone of Collinson and others (1962, p. 22), and is correlative with the lower Burlington of Illinois. The lower portion of this Mississippi Valley assemblage zone overlaps the upper portion of the G. semiglaber - P. multistriata Assemblage Zone in southwestern Missouri (Fig. 3).

Bactrognathus distorta - Gnathodus cuneiformis Assemblage Zone

This zone corresponds to the combined ranges of Bactrognathus distorta and abundant Gnathodus cuneiformis.

The lower limit is placed at the last occurrence of Polygnathus communis, and at the first appearance of B. distorta. The upper limit is at the last occurrence of Gnathodus cuneiformis and Polygnathus mehli n. sp.

Characteristic species of this assemblage zone include B. distorta, B. excavata, B. hamata, B. minuta, Doliognathus lata, Gnathodus antetexanus,

G. cuneiformis, P. mehli, Scaliognathus anchoralis Branson and Mehl, and Spathognathodus pulcher (Branson and Mehl).

The Bactrognathus distorta - Gnathodus cuneiformis Assemblage Zone contains two recognizable subzones:

A) Bactrognathus distorta Subzone.-- The lower subzone is characterized by B. distorta, B. excavata, B. hamata, B. minuta, D. lata, G. antetexanus, and Scaliognathus anchoralis.

B) Gnathodus cuneiformis Subzone.-- The upper subzone is characterized by G. antetexanus, G. cuneiformis, and P. mehli, with only rare specimens of Bactrognathus.

This assemblage zone corresponds to the lower portion of the Bactrognathus - Taphrognathus Assemblage Zone from the upper Mississippi Valley (Collinson and others, 1962, p. 23) and is correlative with the lower portion of the upper Burlington of Illinois and Iowa.

"Zone of Gnathodus bulbosus"

Above the B. distorta - G. cuneiformis Assemblage Zone at Roaring River south (section F, Table 6) is the "Zone of Gnathodus bulbosus". All that can be said of this zone at present is that it is younger than the B. distorta - G. cuneiformis fauna, and is most likely older than the G. texanus Roundy fauna typical of the late Osagean and early Meramecian (Rexroad and Collinson, 1965), although this latter relationship is at present highly speculative. The age of the "Zone of G. bulbosus" is here considered to be latest early Osagean. There is at present no equivalent to this zone from the Mississippi Valley region.

IMPLICATIONS OF CONODONT FAUNA AND CONCLUSIONS

Construction of cross sections, utilizing the conodont assemblage zones described above and illustrated in Tables 1 through 6, produces the results seen on Figure 4. From north to south (cross-section A), northeast to southwest (cross-section B), and from east to west (cross-section C), except for the Gnathodus semiglaber - Polygnathus communis Assemblage Zone, the assemblage zones appear progressively lower in the stratigraphic section. If these zones are to be considered time-synchronous, all evidence points toward the conclusion that the upper Pierson, Reeds Spring,

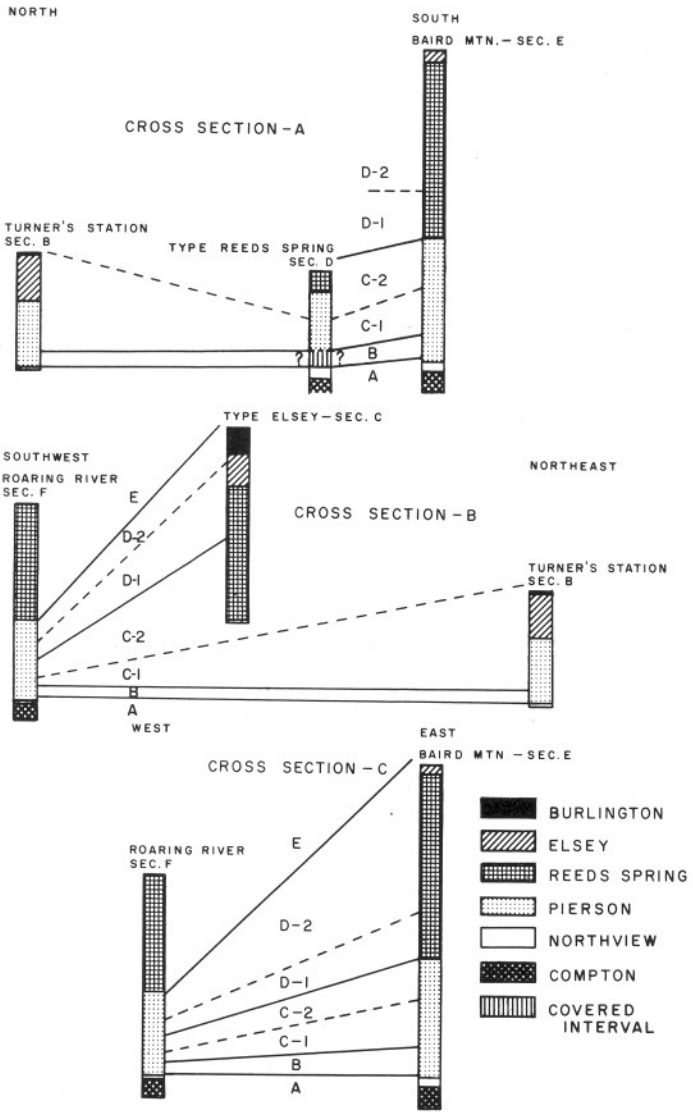

FIG. 4. Three cross-sections of lower Osagean formations in southwestern Missouri, and conodont assemblage zones. See Figure 2 for locations of cross-sections; Figure 3 for assemblage zones.

Elsey, and lower Burlington succession becomes progressively younger both southward and southwestward within the region of study. Furthermore, the vertical thickness of rocks contained in each assemblage zone decreases southward and southwestward, suggesting progressively slower deposition in those directions.

Figure 5 is a series of geologic maps drawn at the top of each assemblage zone and subzone. At the beginning of Osagean time, the lower Pierson underwent a short period of northward migration (maps A and B, Fig. 5), that culminated during the time of the Gnathodus semiglaber - Polygnathus communis Assemblage Zone, the only lower Osagean assemblage zone that appears in the same stratigraphic position in all sections recovered (Tables 2, 4, 5, and 6). At the beginning of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone, and continuing to the upper portion of the "Zone of Gnathodus bulbosus", the facies of the middle and upper Pierson, Reeds Spring, Elsey, and lower Burlington become progressively younger southward and southwestward. This is illustrated on maps C, D, E, and F (Fig. 5). Figure 6 is a time-stratigraphic section drawn through Turner's Station (locality B), type Elsey (locality C), and Roaring River south (locality F). Utilizing time (assemblage zones and subzones) as the vertical component, the southwestward progression of the Pierson, Reeds Spring, Elsey, and lower Burlington facies can readily be seen.

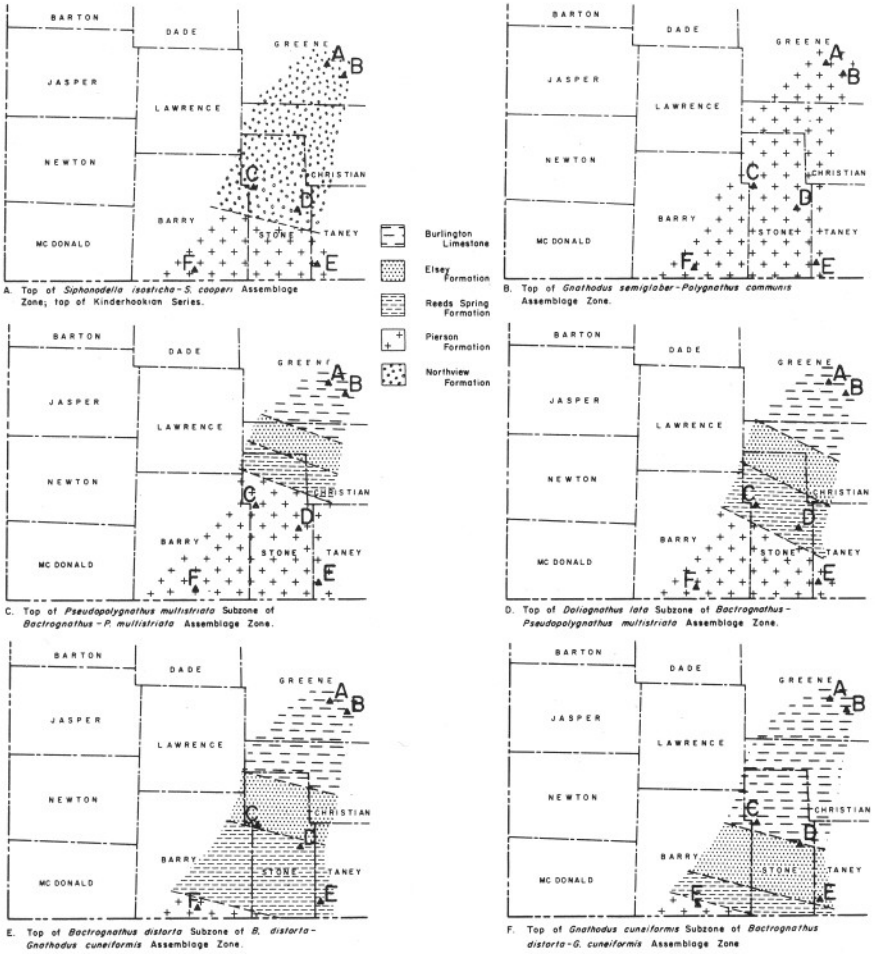

FIG. 5. Preliminary lower Osagean geologic maps of southwestern Missouri; datum at tops of conodont assemblage zones and subzones.

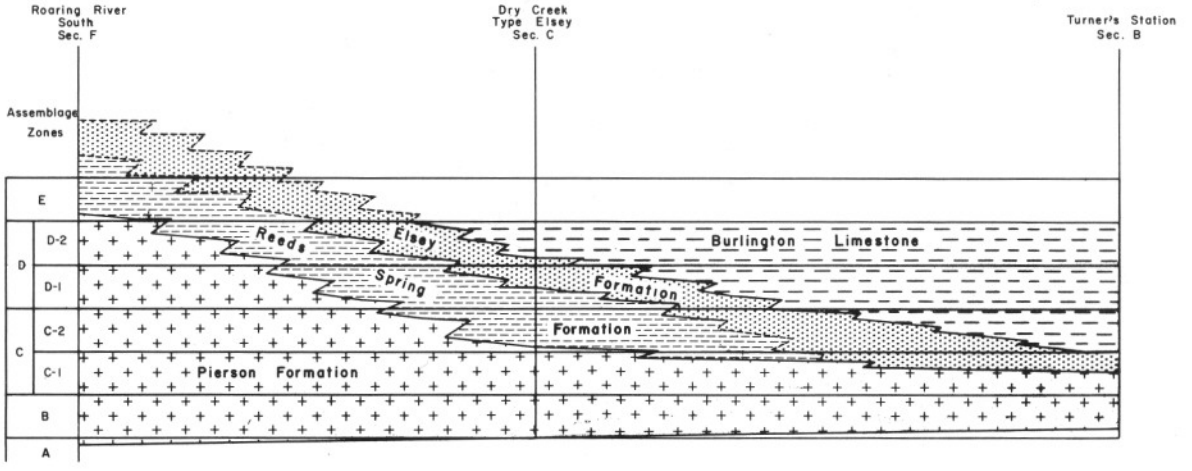

FIG. 6. Cross-section from Turner's Station (locality B) to Roaring River State Park (locality F) showing distribution of early Osagean formations in time. See Figure 3 for assemblage zone names.

	Bactrognathus—Pseudopolygnathus multistriata Assemblage Zone					
	Pseudopolygnathus multistriata Subzone					
	Elsey Formation			Burlington Limestone		
SAMPLES COLLECTED	1	2	3	4	5	TOTAL
Bactrognathus hamata					1	1
Gnathodus antetexanus				5		5
G. n. sp. A			2		2	4
G. n. sp. D			2			2
Polygnathus communis communis			5		4	9
Spathognathodus pulcher	1		1	1		3
S. regularis		2	1			3
TOTAL	1	2	11	6	7	27

TABLE 1. Distribution by sample of conodont species recovered from Dry Sac Creek locality. (Sec. A)

	Gnathodus semiglaber–Polygnathus communis Assemblage Zone		*Bactrognathus – Pseudopolygnathus multistriata* Assemblage Zone															
			Pseudopolygnathus multistriata Subzone															Burlington Limestone
	Pierson Formation												Elsey Formation					
SAMPLES COLLECTED	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	21	TOTAL
Bactrognathus excavata										1									1
B. hamata										1	2								3
Gnathodus antetexanus														2		3		1	6
G. sp. cf. *G. bilineatus*							2		3										5
G. cuneiformis											2						5		7
G. semiglaber	2			6			6	2											16
G. typicus			8	24	2	27	14	5	4	1									85
G. n. sp. A															1				1
G. n. sp. D												8	3					8	19
Polygnathus communis carina	19																		19
P. communis communis			7	7	2	25	10	7	16	6	8	24	34	8	30	18	6		208
Pseudopolygnathus multistriata			1	3	1			1	1	2	5	8	10	10	6	2			50
Spathognathodus elongatus													1	1					2
S. regularis																	1		1
TOTAL	21	0	16	40	5	52	32	15	21	14	17	41	48	20	37	23	12	9	423

TABLE 2. Distribution by sample of conodont species recovered from Turner's Station (type Pierson) locality. (Sec. B)

	Bactrognathus — Pseudopolygnathus multistriata Assemblage Zone												Bactrognathus distorta — Gnathodus cuneiformis Assemblage Zone													
Pierson Formation	Doliognathus lata Subzone												Bactrognathus distorta Subzone								Gnathodus cuneiformis Subzone					
	Reeds Spring Formation												Elsey Formation								Burlington Limestone					
SAMPLES COLLECTED	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	TOTAL
Bactrognathus distorta													1	4			1	2		1	2							11
B. excavata			1	1	1											1					1	1						6
B. hamata					1					1			1															3
B. minuta					1	1															2	2						6
Doliognathus lata				1	2					5														1				9
Gnathodus antetexanus	2						1					1											10	3				17
G. cuneiformis																							2		8	3	2	15
G. n. sp. B					1				2			1																4
Polygnathus mehli							1	1																	2			4
Spathognathodus sp. cf. *S. crassidentatus*			1		1						1					1				1	3							8
S. elongatus																						2		1				3
S. pulcher	3	2	6	5	6	3	6	5	5	7	2	7	1		6	1	1	9	18	4	38	12	2	1	3			153
S. regularis																	1		2		1	1	3					8
TOTAL	5	2	8	7	13	4	8	6	7	13	3	9	3	4	6	3	3	11	20	6	47	18	17	6	13	3	2	247

TABLE 3. Distribution by sample of conodont species recovered from Dry Creek (type Elsey) locality. (Sec. C)

	Bactrognathus – Pseudopolygnathus multistriata Assemblage Zone																		
	Pseudopolygnathus multistriata Subzone							*Doliognathus lata* Subzone											
	Pierson Formation														Reeds Spring Formation				
SAMPLES COLLECTED	8	9	10	11	12	13	14	16	17	18	19	20	21	22	23	24	25	26	TOTAL
Bactrognathus excavata							4		2		1								7
B. hamata		2			2	3	1	4	3	1		2	1	2					21
B. minuta							3		1	1							1		6
Doliognathus dubia								1		1									2
D. lata		1							2		2	3	2			2	5	1	18
Gnathodus antetexanus											1	37	10	6	10	5	3		72
G. sp. cf. *G. bilineatus*	1												1						2
G. cuneiformis												4							4
G. semiglaber	12	4	8																24
G. typicus		2			50	48	38	16	13	13									180
G. n. sp. B											2	1							3
G. n. sp. D			5	4															9
Polygnathus communis communis	8	61	49	74	12	54	4	11		1			5						279
Pseudopolygnathus multistriata	3	8	9	4	1														25
Spathognathodus elongatus		1	1																2
S. pulcher			1		1	1	1	2		1			1	1	4	1	1	3	18
S. regularis		1																	1
Staurognathus cruciformis								1											1
TOTAL	24	80	73	82	66	106	51	35	21	18	6	47	20	9	14	8	10	4	674

TABLE 4. Distribution by sample of conodont species recovered from type Reeds Spring locality. (Sec. D)

	Kinderhookian Series				Osagean Series																																
	Siphonodella isosticha — S. cooperi Assemblage Zone				*Gnathodus semiglaber–Polygnathus communis* Assemblage Zone			*Bactrognathus — Pseudopolygnathus multistriata* Assemblage Zone												*Bactrognathus distorta — Gnathodus cuneiformis* Assemblage Zone																	
								Pseudopolygnathus multistriata Subzone							*Doliognathus lata* Subzone					*Bactrognathus distorta* Subzone					*Gnathodus cuneiformis* Subzone											
	Pierson Formation																			Reeds Spring Formation																Elsey Formation	
SAMPLES COLLECTED	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	41	42	44	TOTAL
Bactrognathus distorta																							2		1	3	2	2									10
B. excavata									7	3		1		2			3	2	2	1	1	2	1	1						1							27
B. hamata												4	1	5		1	1	15	1	1	2	1	2	1	2	3		2									42
B. minuta											1	1	1	5	4	8	13	6	2				5					2		6							54
Doliognathus dubia																		1																			1
D. lata																		4	7	7	3	4			1												26
Elictognathus costata	1		2																																		3
Gnathodus antetexanus								1						20		71	35	51	52	14			4	3	2						8	7		4			272
G. sp. cf. *G. bilineatus*						1	1						16	4				2	2	1																	27
G. cuneiformis													17	4			2	3	1									28	17	13	12	4				101
G. delicatus	1	1	1	1																																	4
G. punctatus	2		4	4																																	10
G. semiglaber	1				7	9	27	10	1	3																											58
G. typicus					4	6	4	28	19	17	26	17			48		1																				170
G. n. sp. B																		2		3	8	8															21
G. n. sp. C	5	1	1																																		7
G. n. sp. D														14																							14
Polygnathus communis carina						12																															12
P. communis communis	4	1	2		9	80	9	24	36	100	119	61	39	4	25	14	8		3		2																540
P. mehli																									1				1		1			1	1		5
Pseudopolygnathus multistriata								7	7	56	1		1	1																							73
P. triangula																		1																			1
Scaliognathus anchoralis																			1		5																6
Siphonodella cooperi	44	10	20																																		74
S. obsoleta	3																																				3
Spathognathodus sp. cf. *S. crassidentatus*																			1		1			2	1	3		15					4	2			29
S. elongatus									1		3		1																								5
S. pulcher															1	19	11	4	6	1	16	41	46	36	12	21	31	37	1	5	3	7	17	16	74	27	432
S. regularis																							2														2
TOTAL	61	13	30	5	20	108	41	70	71	179	150	84	76	59	78	113	74	91	78	28	32	62	62	43	20	30	33	58	30	29	17	27	32	19	79	27	2029

TABLE 5. Distribution by sample of conodont species recovered from Baird Mountain locality. (Sec. E)

	Kinderhookian Series	Osagean Series																							
1. *Siphonodella isosticha — S. cooperi* Assemblage Zone		*Gnathodus semiglaber — Polygnathus communis* Assemblage Zone			*Bactrognathus — Pseudopolygnathus multistriata* Assemblage Zone				*Bactrognathus distorta — Gnathodus cuneiformis* Assemblage Zone						"Zone of *Gnathodus bulbosus*"										
2. *Pseudopolygnathus multistriata* Subzone	1				2		*Doliognathus lata* Subzone		*B. distorta* Subzone		*Gnathodus cuneiformis* Subzone														
	Pierson Formation														Reeds Spring Formation										
SAMPLES COLLECTED	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	28	29	31	32	33	34	TOTAL
Bactrognathus distorta					2				2	3																7
B. excavata					3	2	2	2	3	1																13
B. hamata							3		9	1	2															15
B. minuta					6	11		1	7	7																32
Doliognathus lata							6	1	1																	8
Gnathodus antetexanus								3	5		5				5											18
G. sp. cf. *G. bilineatus*					4	20	16																			40
G. bulbosus																9	21	11	9	8	9	8	5	14	1	95
G. cuneiformis											2	2		3		4										11
G. delicatus	7																									7
G. punctatus	7																									7
G. semiglaber		2	10	16																						28
G. typicus				7	31	58	23																			119
G. n. sp. B								1																		1
Polygnathus communis carina		10	18																							28
P. communis communis	2	6	75	12	24	55																				174
P. mehli													9	2												11
Pseudopolygnathus multistriata					7	5																				12
Scaliognathus anchoralis							1			4																5
Siphonodella cooperi	16																									16
S. obsoleta	2																									2
Spathognathodus sp. cf. *S. crassidentatus*										5	2	3	3	1		1										15
S. pulcher						5	2		2	12		19	8	5	1	3										57
TOTAL	34	18	103	42	75	152	52	8	33	29	11	24	20	11	6	17	21	11	9	8	9	8	5	14	1	721

TABLE 6. Distribution by sample of conodont species recovered from Roaring River State Park locality. (Sec. F)

SYSTEMATIC PALEONTOLOGY

Genera and species are discussed alphabetically. All forms described are listed by formation recovered on Tables 1 through 6. All figured specimens are reposited with the Department of Geology, University of Missouri, Columbia, Missouri.

Genus BACTROGNATHUS Branson and Mehl, 1941

Bactrognathus BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 98.

TYPE SPECIES.-- Bactrognathus hamata Branson & Mehl, 1941c, by original designation.

DIAGNOSIS.-- Barlike anterior unit with inward flexed posterior lateral process. Subcircular basal cavity at juncture of main unit and lateral process. Oral surface unornamented to strongly nodose. Dentition of unit generally coarse and even, generally longest denticles over point of flexure.

REMARKS.-- Bactrognathus is important to the zonation of lower Osagean rocks, and probably arose from flexed barlike spathognathodids in early Osagean time.

Species are based on the size and ornamentation of the oral surface of the basal cavity, and on the size and degree of flexure of the lateral process.

BACTROGNATHUS DISTORTA Branson and Mehl

Pl. 1, fig. 12, 13, 17, 18.

Bactrognathus distorta BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 99, pl. 15, fig. 10, 11; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 22, pl. 3, fig. 9, 10.

Bactrognathodus distorta (Branson & Mehl), BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.

DIAGNOSIS.-- Straight anterior bar with prominent denticle at flexure; lateral process flexed sharply back toward anterior, curved strongly toward posterior at distal end. Basal cavity broad, often ornamented by nodes on outer oral surface.

REMARKS.-- Well developed specimens of Bactrognathus distorta Branson and Mehl are z-shaped in oral view. The denticles are large and partially fused, except for the prominent hornlike denticle jutting from the point of flexure. This denticle is not readily apparent on immature specimens.

MATERIAL STUDIED.-- 28 specimens; limited, except for two specimens, in southwestern Missouri to the B. distorta Subzone of the B. distorta - Gnathodus cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-992-14; UMC-992-15 (figured specimens).

BACTROGNATHUS EXCAVATA Branson and Mehl

Pl. 1, fig. 19-23; Pl. 6, fig. 4, 5.

Bactrognathus excavata BRANSON & MEHL, 1941c, Jour. Paleontology, v. 14, p. 99, pl. 19, fig. 12, 13; _____, 1944, in Shimer & Shrock, Index Fossils of North America, p. 243, pl. 94, fig. 13, 14; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 23, pl. 3, fig. 14.
Bactrognathus communis HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 380, pl. 46, fig. 20, 25-27, 30, 31.
Bactrognathodus communis Hass, BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.

DIAGNOSIS.-- Straight anterior bar with thin, slightly flexed lateral process angled 40 to 45 degrees inward. Basal cavity large, circular, strongly flared outward, weakly flared inward, bearing one to several large nodes on oral surface.

REMARKS.-- The large nodes on the oral surface of the highly flared basal cavity, and the large cavity itself, distinguish Bactrognathus excavata Branson and Mehl from other slightly flexed species, such as B. hamata Branson and Mehl. The cavity is more circular and shallower than that of B. minuta n. sp.

MATERIAL STUDIED.-- 54 specimens; ranges in southwestern Missouri from near the base of the Pseudopolygnathus multistriata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone to the top of the B. distorta Subzone of the B. distorta - Gnathodus cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-992-16; UMC-992-17; UMC-992-18 (figured specimens).

BACTROGNATHUS HAMATA Branson and Mehl

Pl. 1, fig. 11, 14.

Bactrognathus hamata BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 98, pl. 19, fig. 5-8; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 23, pl. 3, fig. 15-17.
Bactrognathus penehamata HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 381, pl. 46, fig. 22, 23, 29.
Bactrognathodus penehamata Hass, BURTON, 1964, New Mexico Geol. Soc. Guidebook 15th Field Conf., chart.

DIAGNOSIS.-- Long, straight, slender anterior bar with slightly flexed, thin lateral process. Basal cavity narrow, with little lateral flare; unornamented on oral surface. Denticles irregular in length, commonly longer over basal cavity.

REMARKS.-- The small, narrow basal cavity, unornamented orally, distinguishes Bactrognathus hamata Branson and Mehl from B. excavata Branson and Mehl, and the straight aboral outline distinguishes it from B. recta Mehl and Thomas, a form deflected downward at the basal cavity.

MATERIAL STUDIED.-- 85 specimens; ranges in southwestern Missouri from the middle of the Pseudopolygnathus multistriata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone into the basal portion of the Gnathodus cuneiformis Subzone of the B. distorta - G. cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-992-19 (figured specimen).

BACTROGNATHUS MINUTA Thompson, n. sp.

Pl. 1, fig. 5-10.

DIAGNOSIS.-- Small, thin unit with flared circular, unornamented basal cavity. Denticles discrete, pointed, commonly longest over point of flexure.

DESCRIPTION.-- Unit small, with anterior bar long and thin; lateral process thin, flexed inward about 45 degrees. Elongate basal cavity broad and deep, flared equally on both sides, unornamented on oral surface. Lateral edges of cavity uneven. Cavity pointed at anterior end, extending beneath anterior bar as narrow groove. Denticles discrete, unfused, short, sharply pointed, nearly equal in length except for slight lengthening over cavity. Seen laterally, oral outline nearly straight; aboral outline straight, except for slight upturn at posterior end.

REMARKS.-- Specimens of Bactrognathus minuta n. sp. are smaller than most other bactrognathids. The cavity is too wide to represent immature B. hamata Branson and Mehl, and is deep and elongate, unlike the shallow subcircular cavity of B. excavata Branson and Mehl. The straight aboral outline differs from B. recta Mehl and Thomas. The denticles are more discrete than on other forms of Bactrognathus. Bactrognathus minuta is the most abundant bactrognathid found in the present study, and is usually

less than half the size of other species.

HOLOTYPE.-- UMC-990-18.

MATERIAL STUDIED.-- 99 specimens; ranges in southwestern Missouri from the middle of the Pseudopolygnathus multistriata Subzone of the Bactrognathus - P. multistriata Assemblage Zone into the basal portion of the Gnathodus cuneiformis Subzone of the B. distorta - G. cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-992-20; UMC-993-1 (figured specimens).

Genus DOLIOGNATHUS Branson and Mehl, 1941

Doliognathus BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 100.

TYPE SPECIES.-- Doliognathus lata Branson and Mehl, 1941c, by original designation.

DIAGNOSIS.-- Platelike unit with long, broad main axis. Smaller outer-lateral process begins short of posterior end of main axis. Basal cavity triangular, pointed toward anterior, posterior, and lateral process. Oral surface with carina on main axis, and secondary carina on lateral process. Large specimens nodose along outer margins of broad plate, with smooth surface adjacent to carina.

REMARKS.-- Doliognathus is similar to Scaliognathus, except that the latter is symmetrical through the main axis, whereas the former is strongly asymmetrical. This genus is important to the zonation of early Osagean time.

Speciation is based on the width of the platelike surface, and the size and shape of the lateral process.

DOLIOGNATHUS DUBIA Branson and Mehl

Pl. 2, fig. 18, 21; Pl. 6, fig. 1, 3.

Doliognathus dubia BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 101, pl. 19, fig. 16, 17.

DIAGNOSIS.-- Unit straight, with small posterior projection beyond position of outer-lateral process. Lateral process short, blunt, projecting from position just short of posterior end.

REMARKS.-- Doliognathus dubia Branson and Mehl closely resembles forms of Bactrognathus, but the position of the lateral process anterior to the

posterior end of the main axis and the triangular basal cavity distinguish this form from bactrognathids.

MATERIAL STUDIED.-- Three specimens; located in southwestern Missouri in the middle portion of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone.

REPOSITORY.-- UMC-993-2; UMC-993-3 (figured specimens).

DOLIOGNATHUS LATA Branson and Mehl

Pl. 2, fig. 11, 14, 17, 19, 20, 22.

Doliognathus lata BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 100, pl. 19, fig. 22-26; _____, 1944, in Shimer and Shrock, Index Fossils of North America, p. 244, pl. 94, fig. 50, 51; VOGES, 1959, Paläont. Zeit., Bd. 33, no. 4, p. 273, pl. 33, fig. 3, 4; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.

Doliognathus excavata BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 101, pl. 19, fig. 20, 21; HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 388, pl. 46, fig. 28, 32.

DIAGNOSIS.-- Main anterior axis straight, curved outward about 15 degrees posterior of juncture of lateral process. Carina extends entire length of main axis; secondary carina on lateral process joins main carina. Basal cavity triangular, located beneath juncture of carinae. Mature forms have nodose edges on broad platelike oral surface, separated from carinae by smooth surface.

REMARKS.-- Immature specimens of Doliognathus lata Branson and Mehl are thin limbed with a very large basal cavity. As maturing progresses, the bars become broader, and the platelike oral surface develops on either side of the carina. The basal cavity remains the same size, except for some thickening of the lips. Immature specimens have been called D. excavata Branson and Mehl, mature forms D. lata.

It is the opinion of the author that D. excavata represents immature specimens of D. lata, and thus, D. lata is retained, as it is the type species of the genus.

MATERIAL STUDIED.-- 59 specimens; range in southwestern Missouri from the Doliognathus lata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone into the Bactrognathus distorta - Gnathodus cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-993-4; UMC-993-5; UMC-993-6 (figured specimens).

Genus ELICTOGNATHUS Cooper, 1939

Solenognathus BRANSON & MEHL, 1934, Missouri Univ. Studies, v. 8, p. 270, (non Aggassiz, 1846; Bleeker, 1856-57; Picet & Humbert, 1866)
Elictognathus COOPER, 1939, Jour. Paleontology, v. 13, p. 386.
Solenodella BRANSON & MEHL, 1944, in Shimer & Shrock, Index Fossils of North America, p. 244; _____, 1948, Jour. Paleontology, v. 22, p. 257.

TYPE SPECIES.-- Solenognathus bialata Branson & Mehl, 1934, by original designation.

DIAGNOSIS.-- Highly compressed, arched unit, with lateral ridges on either side near lower edge; outer lateral ridge usually poorly developed, inner lateral ridge often forms wide shelf with oral ornamentation. Basal cavity small, located in middle to posterior one-third of unit, at apex of arch. Highest part of oral outline above basal cavity.

REMARKS.-- Elictognathus is important to the zonation of late Kinderhookian time, but does not occur in rocks of early Osagean age. Speciation is based on the size and ornamentation of the inner lateral ridge, and on the oral outline of the denticles.

ELICTOGNATHUS COSTATA (E. R. Branson)

Pl. 2, fig. 8, 9.

Solenognathus costata E. R. BRANSON, 1934, Missouri Univ. Studies, v. 8, p. 332, pl. 27, fig. 7; COOPER, 1939, Jour. Paleontology, v. 13, p. 410, pl. 44, fig. 33-35; BEACH, 1961, Brigham Young Univ. Geology Studies, v. 8, pl. 5, fig. 1.
Solenodella costata (E. R. Branson), BISCHOFF & ZIEGLER, 1956, Hess. Landesamt. Bodenf., Notizbl., v. 84, p. 166, pl. 12, fig. 18, 19; BISCHOFF, 1957, Hess. Landesamt. Bodenf., Abh., v. 19, p. 55, pl. 6, fig. 15; BEACH, 1961, Brigham Young Univ. Geology Studies, v. 8, p. 51.
Bryantodus microdens HUDDLE, 1934, Bull. Am. Paleontology, v. 21, no. 72, p. 69, pl. 21, fig. 10, 11.
Pinacognathus? deflecta YOUNGQUIST & PATTERSON, 1949, Jour. Paleontology, v. 23, p. 60, pl. 15, fig. 5.
Elictognathus costata (E. R. Branson), REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 25, pl. 3, fig. 24.

DIAGNOSIS.-- Slightly arched, compressed unit, with narrow lateral ridges. Highest point of oral outline near one-third distance from posterior end; sharply sloping toward posterior end. Anterior oral outline high, nearly even from highest point over basal cavity, curved slightly downward at anterior end.

REMARKS.-- Elictognathus costata (E. R. Branson) can be distinguished

from E. lacerata (Branson and Mehl) by the narrow lateral ridges, and by the even oral outline from the major denticle over the pit to the anterior end. E. lacerata has a wide inner lateral ridge, and forms an oral saddle over the anterior two-thirds of the unit.

MATERIAL STUDIED.-- Three specimens; in southwestern Missouri restricted to the Siphonodella isosticha - S. cooperi Assemblage Zone.

REPOSITORY.-- UMC-993-7; UMC-993-8 (figured specimens).

Genus GNATHODUS Pander, 1856

Gnathodus PANDER, 1856, K. Akad. Wiss. St. Petersburg, p. 33 (non Fieber, 1866).
Dryphenotus COOPER, 1939, Jour. Paleontology, v. 13, p. 386.

TYPE SPECIES.-- Gnathodus mosquensis Pander, 1856, by monotypy.

DIAGNOSIS.-- Compound unit with long anterior free blade and expanded posterior platform. Basal cavity usually broad and deep, subcircular, located beneath platform; outer side usually flared wider than inner side. Oral surface usually ornamented by nodes and parapets.

REMARKS.-- Gnathodus is characterized by the extreme posterior position of the basal cavity, distinguishing it from Spathognathodus, the ancestral form.

Speciation is based on the surface ornamentation of the platform, and on the size and shape of the platform and corresponding basal cavity.

GNATHODUS ANTETEXANUS Rexroad and Scott

Pl. 5, fig. 1, 5-7

Gnathodus texanus (Roundy), MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 10, pl. 1, fig. 3.
Gnathodus texanus Roundy, BISCHOFF (part), 1957, Hess. Landesamt. Bodenf., Abh., v. 19, p. 25, pl. 3, fig. 22 only; VOGES (part), 1959, Paläont. Zeitschr., v. 33, p. 284, pl. 33, fig. 40, 42 only; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.
Gnathodus n. sp. aff. G. texanus Roundy, COLLINSON, SCOTT & REXROAD, 1962, Illinois Geol. Survey, Circ. 328, chart 3.
Gnathodus antetexanus REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 28, pl. 2, fig. 7-10.

DIAGNOSIS.-- Platform arrow-shaped, widest near anterior end, pointed at posterior end. Inner side of platform narrow, ornamented by single row of nodes often fused into parapet paralleling central carina. Wider outer

side unornamented or with few scattered nodes.

REMARKS.-- Gnathodus antetexanus Rexroad and Scott is similar to G. typicus Cooper in surface ornamentation, but differs in the parallelism of the central carina and inner row of nodes. The inner row of nodes on G. typicus is angled toward the carina in a posterior direction.

MATERIAL STUDIED.-- 390 specimens; ranges in southwestern Missouri from the upper portion of the Pseudopolygnathus multistriata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone through the Gnathodus cuneiformis Subzone of the Bactrognathus distorta - G. cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-993-9; UMC-993-10 (figured specimens).

GNATHODUS sp. cf. G. BILINEATUS (Roundy)

Pl. 3, fig. 8, 10, 12, 17.

DIAGNOSIS.-- Narrow inner platform ornamented with single row of nodes subparallel to central carina. Broad outer platform with small nodes in concentric rows paralleling outer margin; approaching rectangular outline in large forms.

REMARKS.-- Forms referred to Gnathodus sp. cf. G. bilineatus (Roundy) generally have gently rounded outer margins on the platform. However, a few are rectangular in outline. The major hinderance in identification of this form with G. bilineatus is one of a stratigraphic position. G. bilineatus is best known from strata within the late Meramecian and Chesterian Series. Forms recovered in the present study are all of early Osagean age. This could represent a case of homeomorphy, a situation that would by no means be unique in conodont morphology, or may represent ancestral forms to G. bilineatus.

MATERIAL STUDIED.-- 74 specimens; recovered in southwestern Missouri within the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone, with a few found in the older Gnathodus semiglaber - P. communis Assemblage Zone.

REPOSITORY.-- UMC-993-11; UMC-993-12; UMC-993-13 (figured specimens).

GNATHODUS BULBOSUS Thompson, n. sp.

Pl. 3, fig. 7, 11, 14, 15, 18-21; Pl. 6, fig. 2, 7.

DIAGNOSIS.-- Large, broad platform with bulbous posterior end protruding beyond end of platform. Oral ornamentation consists of large

circular node on narrow inner side and elongate node perpendicular to carina on broad outer side.

DESCRIPTION.-- Platform broad, rounded, high, subsymmetrical; inner side extends slightly more toward anterior. Platform ends short of posterior end of unit. Both sides near equal in width.

Inner side of platform ornamented near center of length by one large, elongate to circular node or parapet, extending approximately halfway to inner edge of platform. Outer side ornamented by small single node or row of small nodes angled 90 degrees to carina. Nodes of platform opposite each other across carina.

Posterior end of carina broadens to bulbous protrusion extending beyond end of platform; protrusion one-third to one-fourth as long as platform on large specimens. Basal cavity very broad and deep, sharply pointed toward posterior beneath protruding carina.

REMARKS.-- A fully mature specimen of Gnathodus bulbosus n. sp. possesses a broad, rounded platfrom with large nodes extending away from the carina near the mid-length of the platform on the outer side, and one large round node nearly covering the entire inner side. The extreme large size, coarse, nodose ornamentation of the platfrom, and the bulbous protrusion of the posterior end of the carina serve to distinguish this form from other species of Gnathodus.

G. bulbosus is much larger than other contemporary gnathodids, and in shape and size more closely resembles Kinderhookian forms such as G. punctatus (Cooper), or early Osagean representatives of G. semiglaber (Bischoff). G. bulbosus differs from G. semiglaber by the transverse node on the outer side of the platform, and by the triangular basal cavity. The name is derived from the bulbous protrusion of the posterior portion of the platform.

HOLOTYPE.-- UMC-993-20.

MATERIAL STUDIED.-- 95 specimens; restricted in southwestern Missouri to the "Zone of G. bulbosus."

REPOSITORY.-- UMC-993-20; UMC-994-1; UMC-994-2; UMC-994-3 (figured specimens).

GNATHODUS CUNEIFORMIS Mehl and Thomas

Pl. 3, fig. 13, 16; Pl. 5, fig. 17, 20.

Gnathodus cuneiformis MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 10, pl. 1, fig. 2; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 29.
Gnathodus mosquensis Pander , COOPER (part), 1939, Jour. Paleontology, v. 13, p. 388, pl. 41, fig. 23-25 only; pl. 42, fig. 75, 76.
Gnathodus stinus COOPER, 1939, Jour. Paleontology, v. 13, p. 388, pl. 41, fig. 40, 41.

DIAGNOSIS.-- Arrow-shaped platform with single row of nodes on either side of central carina, often fused to form parapets. Platform drops steeply to margins outside of parapets.

REMARKS.-- Gnathodus cuneiformis Mehl and Thomas probably belongs in the lineage of G. antetexanus Rexroad and Scott, through the addition of a second row of nodes on the outside portion of the platform. The inner row of nodes often is fused into a parapet that can be very high at its anterior end. The specimen illustrated on figure 17 and 20, Plate 5, has an unusually broad platform for this species, and may be a form between G. cuneiformis and G. sp. cf. G. bilineatus.

MATERIAL STUDIED.-- 138 specimens; in southwestern Missouri, G. cuneiformis sporadically occurs in small numbers in the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone, and dominates the G. cuneiformis Subzone of the B. distorta - G. cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-993-17; UMC-993-18 (figured specimens).

GNATHODUS DELICATUS Branson and Mehl

Pl. 3, fig. 1, 6.

Gnathodus delicatus BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, pt. 2, p. 145, pl. 34, fig. 25-27; HASS, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, pl. 1, fig. 4; _____, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 394, pl. 46, fig. 3-7; pl. 48, fig. 1-5; VOGES,1959, Paläont. Zeitschr., v. 33, p. 283, pl. 33, fig. 31-33; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 29, pl. 2, fig. 4-6.
Gnathodus perplexus BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, pt. 2, p. 145, pl. 34, fig. 24.
Gnathodus texanus Roundy , COOPER, 1939, Jour. Paleontology, v. 13, p. 388, pl. 41, fig. 26, 27.

DIAGNOSIS.-- Low, broad platform with single row of nodes on narrow inner side and several rows of small nodes roughly parallel to carina on broader outer side.

REMARKS.-- The platform of Gnathodus delicatus Branson and Mehl is more rounded laterally than that of G. typicus Cooper and G. antetexanus Rexroad and Scott. The latter two forms are more sharply arrow-shaped. G. delicatus is diagnostic of late Kinderhookian age.

MATERIAL STUDIED.-- 11 specimens; restricted in southwestern Missouri to the Siphonodella isosticha - S. cooperi Assemblage Zone.

REPOSITORY.-- UMC-993-19 (figured specimen).

GNATHODUS PUNCTATUS (Cooper)

Pl. 5, fig. 12-15.

Dryphenotus punctatus COOPER, 1939, Jour. Paleontology, v. 13, p. 386, pl. 41, fig. 42, 43; pl. 42, fig. 10, 11.
Dryphenotus litus COOPER, 1939, Jour. Paleontology, v. 13, p. 386, pl. 42, fig. 34, 35.
Dryphenotus oxys COOPER, 1939, Jour. Paleontology, v. 13, p. 386, pl. 42, fig. 12, 13.
Gnathodus (Dryphenotus) macrolobatus Cooper, BRANSON & MEHL, 1944, in Shimer and Shrock, Index Fossils of North America, p. 245, pl. 94, fig. 69.
Gnathodus punctatus (Cooper), HASS, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, p. 2539, pl. 1, fig. 2; _____, 1956a, U. S. Geol. Survey Prof. Paper 286, pl. 2, fig. 20; _____, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 395, pl. 47, fig. 11-18; VOGES, 1959, Paläont. Zeitschr., v. 33, p. 283, pl. 33, fig. 34-37; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.

DIAGNOSIS.-- Broad platform ornamented on inner side by three or four discrete high nodes forming row strongly convex toward carina; nodes located near inner margin. Outer side very wide, ornamented by two or three rows of nodes radiating from carina toward outer margin. Platform pointed at posterior end; inner side ends short of posterior end on mature forms.

REMARKS.-- Gnathodus punctatus (Cooper) is a very large form of this genus. The basal cavity is very large and deep, and the three or four prominent nodes on the inner oral surface of the platform are quite distinctive. G. punctatus has not been recovered from faunas studied in the Mississippi Valley and Indiana regions (Rexroad and Scott, 1964, p. 41).

Cooper (1939) did not state whether or not G. punctatus was found in the same horizon with Siphonodella. Hass (1959, p. 395) defines the range G. punctatus from the upper portion of abundant Siphonodella cooperi to the lower portion of the range of Bactrognathus. Within this range he described (p. 369) Polygnathus communis carina Hass and Gnathodus delicatus

Branson and Mehl. Of significance was his total lack of Gnathodus semiglaber (Bischoff). Hass placed his "Gnathodus punctatus zone" as uppermost Kinderhookian on the basis of Chouteau megafossils collected from the same horizon by Cloud and Barns (1948, p. 50). Some doubt exists within the present study as to this Kinderhookian assignment of G. punctatus, but sufficient data are not available at this time to either prove or disprove this concept.

MATERIAL STUDIED.-- 17 specimens; restricted in southwestern Missouri to the upper portion of the Siphonodella isosticha - S. cooperi Assemblage Zone.

REPOSITORY.-- UMC-994-4; UMC-994-5 (figured specimens).

GNATHODUS SEMIGLABER (Bischoff)

Pl. 4, fig. 11-14.

Gnathodus bilineatus semiglaber BISCHOFF, 1957, Hess. Landesamt. Bodenf. Abh., v. 19, p. 22, pl. 3, fig. 1a, b, 2-10, 12, 14.
Gnathodus perplexus Branson & Mehl, MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 10, pl. 1, fig. 4.
Gnathodus semiglaber (Bischoff), VOGES, 1959, Paläont. Zeitschr., v. 33, p. 285, pl. 33, fig. 38, 39; MÜLLER, 1962, Jour. Paleontology, v. 36, p. 1388, fig. 1; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull., p. 30, pl. 2, fig. 1, 2.

DIAGNOSIS.-- Platform broad and low, with low, broad parapet on narrow inner side, scattered nodes on anterior portion of wide outer side. Platform asymmetric, broadest on outer side. Carina broadens at posterior end two to three times normal width in mature specimens.

REMARKS.-- The broadened posterior portion of the carina and the indistinct but coarse ornamentation of the platform distinguishes Gnathodus semiglaber (Bischoff) from other gnathodids. This form is considered to indicate earliest Osagean age (Collinson and others, 1962).

MATERIAL STUDIED.-- 126 specimens; ranges in southwestern Missouri from a few specimens in the Siphonodella isosticha - S. cooperi Assemblage Zone to the lower portion of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone.

REPOSITORY.-- UMC-994-6; UMC-994-7 (figured specimens).

GNATHODUS TYPICUS Cooper

Pl. 4, fig. 5, 7, 8, 10.

Gnathodus typicus COOPER, 1939, Jour. Paleontology, v. 13, p. 388, pl. 42, fig. 77, 78; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 31, pl. 2, fig. 3.

Gnathodus texanus Roundy , VOGES (part), 1959, Paläont. Zeitschr., v. 33, p. 284, pl. 33, fig. 41, 43 only.

Gnathodus n. sp. cf. G. girtyi Hass , COLLINSON, SCOTT, & REXROAD, 1962, Illinois Geol. Survey, Circ. 328, Chart 3.

DIAGNOSIS.-- Sharply pointed, arrow-shaped platform ornamented by single large node or row of nodes, largest at anterior end, on narrow inner side; row of nodes or single node angled toward carina in posterior direction 30 to 45 degrees. Broad outer side of platform ornamented by small scattered nodes. Inner side terminates short of posterior end of carina, giving lobate appearance.

REMARKS.-- The inward angle of the row of nodes on the inner side of the platform distinguishes Gnathodus typicus Cooper from G. antetexanus Rexroad and Scott, and from G. sp. cf. G. bilineatus (Roundy), both with subparallel inner parapets and carinae.

MATERIAL STUDIED.-- 554 specimens; ranges in southwestern Missouri from the upper half of the Gnathodus semiglaber - Polygnathus communis Assemblage Zone to the lower portion of the Doliognathus lata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone.

REPOSITORY.-- UMC-994-8; UMC-994-9 (figured specimens).

GNATHODUS n. sp. A

Pl. 5, fig. 10, 11.

DESCRIPTION.-- Posterior platform bluntly arrow-shaped. Inner side highly ornamented by row or parapet of irregularly shaped nodes angled in toward carina, and joining carina at extreme posterior end; inner-lateral surface drops steeply to margin from top of parapet. Outer side narrow, ornamented by low parapet or row of nodes paralleling central carina, and by secondary row of nodes outside of first parapet, near outer margin of platform. Carina thin and nodose, becoming broader at extreme posterior end where parapets join carina.

Basal cavity deep, asymmetric, extending toward anterior on inner side. Inner margin joins carina short of posterior end on inner side, forming

lobelike platform.

REMARKS.-- The oral ornamentation of Gnathodus n. sp. A appears as sinuous ridges rather than distinct nodes. Some resemblance to G. semiglaber is suggested but the ornamentation of the former is more distinct and covers more of the platform than common to G. semiglaber.

MATERIAL STUDIED.-- Five specimens; restricted in southwestern Missouri to the Pseudopolygnathus multistriata Subzone of the Bactrognathus - P. multistriata Assemblage Zone.

REPOSITORY.-- UMC-994-10 (figured specimen).

GNATHODUS n. sp. B

Pl. 4, fig. 1-4.

DESCRIPTION.-- Platform strongly arrow-shaped, widest at extreme anterior end, tapering to sharp point. Unit nearly symmetrical, inner side slightly narrower and extending slightly more toward anterior. Extreme anterior end of inner side of platform bends back toward posterior at juncture with free blade on some specimens.

Ornamentation of inner side of platform by two rows of nodes; inner row nearly parallel to carina, consisting of four to six high discrete nodes. Outer row, near anterior inner margin of platform, of two or three nodes parallel to inner row. Outer side of platform ornamented by discrete row of nodes parallel to outer margin on anterior portion, and scattered nodes on posterior portion. Some specimens nearly unornamented on outer surface, but with three or four nodes forming row near posterior end of outer side, near and parallel to carina. Basal cavity wide and deep.

REMARKS.-- This form may include two different species, one highly ornamented, the other less so. The two rows of nodes on the inner side are consistent, as is the distinct arrow-shape, widest at the extreme anterior end.

MATERIAL STUDIED.-- 29 specimens; restricted in southwestern Missouri to the Doliognathus lata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone.

REPOSITORY.-- UMC-994-11; UMC-994-12 (figured specimens).

GNATHODUS n. sp. C

Pl. 3, fig. 2, 3, 9.

DESCRIPTION.-- Subcircular, near symmetrical posterior platform unornamented except for few small nodes on either side of central carina. Inner side of platform extends further to anterior than outer side. Outer margin of platform circular, reflecting circular basal cavity.

REMARKS.-- This form is restricted to rocks of late Kinderhookian age, and is associated with G. delicatus Branson and Mehl and G. punctatus (Cooper). It may represent an ancestral form of G. semiglaber (Bischoff).

G. n. sp. C, a Kinderhookian form, and G. n. sp. D, an Osagean form, are very similar in appearance, but do not form a complete sequence; they are separated in occurrence by as much as 11 samples where found in the same section (Table 5).

MATERIAL STUDIED.-- 7 specimens; restricted in southwestern Missouri to the Siphonodella isosticha - S. cooperi Assemblage Zone.

REPOSITORY.-- UMC-993-14; UMC-993-15 (figured specimens).

GNATHODUS n. sp. D

Pl. 3, fig. 4, 5.

DESCRIPTION.-- Asymmetrical, rounded platform, equally broad inward and outward; inner side extends more toward anterior. Oral surface of deep, broad basal cavity unornamented or with one very small indistinct node near central carina on inner side.

REMARKS.-- Gnathodus n. sp. D differs from G. n. sp. C in possessing at most only one small node on the inner side of the platform. The latter form has several small nodes on either side of the carina.

This form is found above the range of G. semiglaber (Bischoff), and may represent a separate lineage from the G. antetexanus Rexroad and Scott and G. texanus Roundy line. It may even represent an ancestral form to G. bulbosus Thompson, n. sp.

MATERIAL STUDIED.-- 44 specimens; restricted in southwestern Missouri to the Pseudopolygnathus multistriata Subzone of the Bactrognathus - P. multistriata Assemblage Zone.

REPOSITORY.-- UMC-993-16 (figured specimen).

Genus POLYGNATHUS Hinde, 1879

Polygnathus HINDE, 1879, Geol. Soc. London Quart. Jour., v. 35, p. 361.

TYPE SPECIES.-- Polygnathus dubia Hinde, 1879, by subsequent designation.

DIAGNOSIS.-- Compound unit with lanceolate-shaped posterior platform and anterior free blade. Aboral surface usually with central keel and small circular basal cavity. Oral ornamentation of platform variable, usually with central carina.

REMARKS.-- Species of Polygnathus range from Devonian into early Osagean time. Polygnathids are important to zonation of lower Osagean strata, but generally at the subspecific level.

Speciation is based on the shape of the platform, the surface ornamentation of the platform, and the size of the aboral keel and basal cavity.

POLYGNATHUS COMMUNIS Branson and Mehl

DIAGNOSIS.-- Platform lanceolate, pointed to rounded at posterior end; ornamented only by central nodose carina; a few with transverse ridges at anterior end of platform. Aboral surface with raised narrow keel and small circular basal bit.

REMARKS.-- Polygnathus communis Branson and Mehl ranges from late Devonian into early Osagean time. It has been subdivided into several useful subspecies; P. communis bifurcata Hass, P. communis carina Hass, and P. communis communis Branson and Mehl. The last subspecies spans the entire range of the species, but the other two have restricted ranges. P. communis bifurcata was not recovered in the present study.

POLYGNATHUS COMMUNIS CARINA Hass

Pl. 2, fig. 7, 10; Pl. 4, fig. 6, 9.

Polygnathus communis Branson & Mehl var. carina HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 391, pl. 47, fig. 8, 9.
Polygnathus cf. styriaca (Ziegler), VOGES (part), 1959, Paläont. Zeitschr., v. 33, p. 294, pl. 34, fig. 36-39 only.
Polygnathus communis carina Hass, REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 34, pl. 2, fig. 24, 25.

DIAGNOSIS.-- Anterior portion of platform ornamented by nodose transverse ridges, one on either side of nodose carina.

REMARKS.-- This subspecies is restricted to the lower portion of the

Gnathodus semiglaber - Pseudopolygnathus multistriata Assemblage Zone in the upper Mississippi Valley and Indiana (Rexroad and Scott, 1964, p. 34). It is a short-lived variation from the normal form Polygnathus communis communis Branson and Mehl.

MATERIAL STUDIED.-- 57 specimens; restricted in southwestern Missouri to the basal portion of the Gnathodus semiglaber - Polygnathus communis Assemblage Zone.

REPOSITORY.-- UMC-994-13; UMC-994-14 (figured specimens).

POLYGNATHUS COMMUNIS COMMUNIS Branson & Mehl

Pl. 2, fig. 12, 13, 15, 16.

Polygnathus communis BRANSON & MEHL, 1934, Missouri Univ. Studies, v. 8, p. 293, pl. 24, fig. 1-4; E. R. BRANSON, 1934, Missouri Univ. Studies, v. 8, p. 308, pl. 25, fig. 5, 6; BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, p. 145, pl. 34, fig. 39-41; COOPER, 1939, Jour. Paleontology, v. 13, p. 399, pl. 39, fig. 1, 2, 9, 10, 23, 24; MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 15, pl. 1, fig. 36; BRANSON & MEHL, 1944, in Shimer & Shrock, Index Fossils of North America, p. 245, pl. 94, fig. 21-31; YOUNGQUIST & PATTERSON, 1949, Jour. Paleontology, v. 23, p. 62, pl. 15, fig. 7, 8; THOMAS, 1949, Geol. Soc. America Bull., v. 60, pl. 3, fig. 37; YOUNGQUIST & DOWNS, 1951, Jour. Paleontology, v. 25, p. 787, pl. 111, fig. 4, 5, 19, 20; HASS, 1951, Am. Assoc. Petroleum Geologist Bull., v. 35, pl. 1, fig. 10; BISCHOFF & ZIEGLER, 1956, Hess. Landesamt. Bodenf., Notizbl., v. 84, p. 156, pl. 12, fig. 1-3; HASS, 1956, U. S. Geol. Survey Prof. Paper 286, pl. 2, fig. 2-5; BISCHOFF, 1957, Hess. Landesamt. Bodenf., Abh., v. 19, p. 42, pl. 2, fig. 23-27; FLÜGEL & ZIEGLER, 1957, Naturw. Ver. Steiermark, Mitt., v. 87, p. 46, pl. 2, fig. 15; HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 390, pl. 49, fig. 9-11, 13; VOGES, 1959, Paläont. Zeitschr., v. 33, p. 288, pl. 34, fig. 1-7; ZIEGLER, 1960, Fortschr. Geol. Rheinland u. Westfalen, v. 6, pl. 1, fig. 9; BEACH, 1961, Brigham Young Univ. Geology Studies, v. 8, p. 49, pl. 6, fig. 1-4; SCOTT & COLLINSON, 1961, Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook, p. 130, pl. 1, fig. 6-10; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart. ETHINGTON, 1965, Jour. Paleontology, v. 39, p. 581, pl. 67, fig. 7; KLAPPER, 1966, Univ. Kansas Paleontological Contrib., Paper 3, p. 21, pl. 6, fig. 6, 11.

Polygnathus adola COOPER, 1939, Jour. Paleontology, v. 13, p. 399, pl. 39, fig. 33-36.

Polygnathus marginata Branson & Mehl , COOPER, 1939, Jour. Paleontology, v. 13, p. 401, pl. 41, fig. 15, 16.

Polygnathus communis communis Branson & Mehl , REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 33, pl. 2, fig. 17, 18.

DIAGNOSIS.-- Oral surface of platform unornamented except for central nodose carina. Aboral surface with only narrow keel and small circular basal pit.

REMARKS.-- This subspecies is very long ranged, and constitutes the bulk of recovered Polygnathus communis. It is the typical form of the genus.

Forms of P. communis communis Branson and Mehl from late Kinderhookian rocks tend to be sharply pointed at the posterior end of the platform, and often the central carina extends slightly beyond the end of the platform. Modifications in early Osagean time include the gradual broadening of the posterior tip to a bluntly rounded form, and also the gradual obliteration of the central carina within the posterior one-fourth of the platform. However, both pointed and rounded forms appear together in lower Osagean samples, and thus there is only a suggestion to possible further subdivision of this species.

MATERIAL STUDIED.-- 1,210 specimens; ranges in southwestern Missouri from the Siphonodella isosticha - S. cooperi Assemblage Zone through the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone.

REPOSITORY.-- UMC-994-15; UMC-994-16 (figured specimens).

POLYGNATHUS MEHLI Thompson, n. sp.

Pl. 2, fig. 1-6

DIAGNOSIS.-- Narrow, elongate platform ornamented by distinct but low transverse ridges on either side of central carina. Basal cavity widely flared and elongate, located at anterior end of broad raised keel.

DESCRIPTION.-- Symmetrical platform lanceolate in shape, sharply pointed at posterior end, broadest in middle portion, decreasing anteriorly against both sides of posterior end of blade. Platform ornamented by low, weakly nodose, narrow carina, ending short of posterior end of platform, and by distinct, closely spaced transverse ridges that are separated from either side of carina by shallow trough.

Aboral surface with shallow, widely flared, elongate basal pit on broad, highly raised keel. Keel broadest at pit, tapers gradually to posterior end of unit. Basal pit extends to point as gradually tapering groove within keel to posterior end of unit, decreases rapidly to point beneath anterior end of platform.

Free anterior blade about equal in length to platform; oral outline gently convex. Denticles sharply pointed, fused two-thirds to apices.

REMARKS.-- The high broad keel, long basal pit, and transverse ridges of the platform all distinguish Polygnathus mehli n. sp. from P. communis Branson and Mehl, an unornamented form with very low keel and subcircular basal pit.

P. mehli is distinguished from P. marginata Branson and Mehl and P. longipostica Branson and Mehl by the small, narrow central carina ending short of the posterior end of the platform. The two latter species have protruding carinae at this posterior tip. P. mehli closely resembles P. delicatula Ulrich & Bassler in oral ornamentation, but the basal pit is more elongate and more widely flared in P. mehli. Although the basal pit is large for polygnathids, the lips are thin, differing from the thick-lipped pits common to forms of Pseudopolygnathus.

The recognition of this new species extends the upward range of Polygnathus above that of P. communis.

Polygnathus mehli n. sp. is named in honor of the late M. G. Mehl of Columbia, Missouri, in recognition of the important contributions he made toward the significant use of conodonts in biostratigraphy and for his personal interest in the work of the author.

HOLOTYPE.-- UMC-994-17.

MATERIAL STUDIED.-- 20 specimens; ranges in southwestern Missouri throughout the Bactrognathus distorta - Gnathodus cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-994-17; UMC-994-18; UMC-994-19 (figured specimens).

Genus PSEUDOPOLYGNATHUS Branson and Mehl, 1934

Pseudopolygnathus BRANSON & MEHL, 1934, Missouri Univ. Studies, v. 8, p. 297.
Macropolygnathus COOPER, 1939, Jour. Paleontology, v. 13, p. 392.

TYPE SPECIES.-- Pseudopolygnathus prima Branson & Mehl, 1934, by original designation.

DIAGNOSIS.-- Compound unit with elongate posterior platform ornamented by large nodose carina and usually by large transverse ridges or nodes. Aboral surface with large, thick-lipped, basal pit. Free anterior blade usually broad and short.

REMARKS.-- Species of Pseudopolygnathus are abundant in Kinderhookian and lower Osagean strata, and are useful throughout their ranges.

Speciation is based on the shape and ornamentation of the platform.

PSEUDOPOLYGNATHUS MULTISTRIATA Mehl and Thomas

Pl. 4, fig. 15, 16, 19, 20.

Pseudopolygnathus multistriata MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 16, pl. 1, fig. 36; BISCHOFF, 1957, Hess. Landesamt. Bodenf., Abh., v. 19, p. 51, pl. 4, fig. 33, 35; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 41, pl. 2, fig. 30; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.
Pseudopolygnathus attenuata MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 17, pl. 1, fig. 9.
Pseudopolygnathus rustica MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 17, pl. 1, fig. 8.
Pseudopolygnathus striata MEHL & THOMAS, 1947, Denison Univ. Bull., Jour. Sci. Labs., v. 40, p. 17, pl. 1, fig. 10; BISCHOFF & ZIEGLER, 1956, Hess. Landesamt. Bodenf., Notizbl., v. 84, p. 164, pl. 11, fig. 20; FREYER, 1961, Freiberger Forschungshefte, C. 95, p. 81.
Pseudopolygnathus lanceolata HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 391, pl. 47, fig. 19-26.

DIAGNOSIS.-- Elongate, nearly symmetrical, gently convex, doubly tapered platform with low nodose central carina and ornamented by coarse transverse nodes separated from carina. Anterior free blade short, one-third length of platform, with fused denticles. Large basal pit subcircular, thick-lipped, with short points posterior and anterior within narrow keel.

REMARKS.-- Immature specimens of Pseudopolygnathus multistriata Mehl and Thomas are bladelike, with lateral nodes near mid-length of platform. As maturity proceeds, the platform broadens by the coalescing of these lateral nodes.

MATERIAL STUDIED.-- 160 specimens; ranges in southwestern Missouri from the upper portion of the Gnathodus semiglaber - Polygnathus communis Assemblage Zone to the basal portion of the Doliognathus lata Subzone of the Bactrognathus - P. multistriata Assemblage Zone.

REPOSITORY.-- UMC-994-20; UMC-995-1 (figured specimens).

PSEUDOPOLYGNATHUS TRIANGULA Voges

Pl. 4, fig. 17, 18.

Pseudopolygnathus triangula, VOGES, 1959, Paläont. Zeitschr., v. 33, p. 301, pl. 34, fig. 51-66; pl. 35, fig. 1-13; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 42, pl. 2, fig. 28.

DIGANOSIS.-- Platform triangular, arrow-shaped, sharply pointed at

posterior end, broadest at anterior end. Central carina nodose, separated from parallel transverse ridges by low trough. Inner anterior margin of platform often extended laterally, distorting bilateral symmetry of unit. Aboral surface with small basal cavity. Free blade compressed, nearly equal to length of platform.

REMARKS.-- Pseudopolygnathus triangula Voges is rare in Indiana and southwestern Missouri. It is considered to be the youngest pseudopolygnathid so far identified. The single specimen recovered in the present study can be compared with P. triangula pinnata Voges

MATERIAL STUDIED.-- One specimen; recovered in southwestern Missouri from the Doliognathus lata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone.

REPOSITORY.-- UMC-995-2 (figured specimen).

Genus SCALIOGNATHUS Branson and Mehl, 1941

Scaliognathus BRANSON & MEHL, 1941, Jour. Paleontology, v. 15, p. 101,

TYPE SPECIES.-- Scaliognathus anchoralis Branson and Mehl, 1941c, by original designation.

DIAGNOSIS.-- Bilaterally symmetrical platelike compound unit with straight anterior limb and two (inner and outer) lateral lobes. Lateral lobes extend at greater than 90 degree angle from posterior end of main axis, and curve slightly back toward anterior. Oral surface ornamented by central nodose carina and two secondary carinae, one on each lateral lobe, and in large specimens, by transverse nodes along outer edge of plate. Aboral surface with small triangular basal pit beneath point of juncture of three carinae, and with keel or ridge along center line of main axis and two lateral processes.

REMARKS.-- The overall shape of Scaliognathus is like an anchor, and this gives the name to the only species, S. anchoralis Branson and Mehl. In southwestern Missouri this form is restricted in range to early Osagean time, and is important to the zonation of this segment of time.

This genus is presently monospecific.

SCALIOGNATHUS ANCHORALIS Branson and Mehl

Pl. 5, fig. 2-4, 8, 9.

Scaliognathus anchoralis BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15,

p. 102, pl. 19, fig. 29-32; _____, 1941d, Denison Univ. Bull., Jour. Sci. Labs., v. 25, pl. 7, fig. 22, 23; BISCHOFF & STOPPEL, 1957, Neues Jahrbuch Geol. & Paläont., Jahrg., p. 17, fig. 2; BISCHOFF, 1957; Hess. Landesamt. Bodenf., Abh., v. 19, p. 53, pl. 1, fig. 8-14; HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 392, pl. 46, fig. 18, 19; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field conf., chart.

DIAGNOSIS.-- Same as that for genus.

REMARKS.-- This short-ranged form has not been reported from the Mississippi Valley region. It is present in Texas, Germany, and southwestern Missouri, and is associated with Doliognathus and Bactrognathus.

MATERIAL STUDIED.-- 11 specimens; ranges in southwestern Missouri through the Doliognathus lata Subzone of the Bactrognathus - Pseudopolygnathus multistriata Assemblage Zone and the Bactrognathus distorta Subzone of the B. distorta - Gnathodus cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-995-3; UMC-995-4; UMC-995-5 (figured specimens).

Genus SIPHONODELLA BRANSON AND MEHL, 1944

Siphonognathus BRANSON & MEHL, 1934, Missouri Univ. Studies, v. 8, p. 295, (non Richardson, 1858).
Siphonodella BRANSON & MEHL, 1944, in Shimer & Shrock, Index Fossils of North America, p. 245; _____, 1948, Jour. Paleontology, v. 22, p. 528.

TYPE SPECIES.-- Siphonognathus duplicata Branson and Mehl, 1934, by original designation.

DIAGNOSIS.-- Compound unit with inwardly curved, broad, elongate posterior platform. Free blade short, compressed, extending into platform as central carina to near posterior end of platform. Platform ornamented commonly by two or more rostral ridges paralleling major carina at anterior end of platform. Transverse ridges may or may not be present, generally on outer side only; usually ornamented by scattered nodes on inner side of platform. Aboral surface bowed or arched, with very small basal pit just anterior to position of arch. Keel, if present, very small.

REMARKS.-- Siphonodella is restricted to Kinderhookian time, and is a good index to this time. It is reported to have evolved from Polygnathus (Rexroad and Scott, 1964, p. 42).

Speciation is based on the length and number of rostral ridges on the platform, and on the type of platform ornamentation; whether transverse ridges, nodes, both, or neither.

SIPHONODELLA COOPERI Hass

Pl. 5, fig. 17-19.

Siphonodella cooperi HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 392, pl. 48, fig. 35, 36; BEACH, 1961, Brigham Young Univ., Geology Studies, v. 8, p. 46, pl. 6, fig. 8, 10, 11; SCOTT & COLLINSON, 1961, Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook, p. 131, pl. 2, fig. 31, 33, 35; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 43, pl. 3, fig. 27-29; KLAPPER, 1966, Univ. Kansas Paleontological Contrib., Paper 3, p. 16, pl. 2, fig. 10, 11; pl. 3, fig. 1-4.

Siphonognathus duplicata BRANSON & MEHL (part), 1938, Missouri Univ. Studies, v. 13, p. 148, pl. 34, fig. 34 only.

Siphonodella duplicata (Branson & Mehl) , YOUNGQUIST & PATTERSON (part) 1949, Jour. Paleontology, v. 23, p. 69, pl. 16, fig. 7, only; THOMAS, (part), 1949, Geol. Soc. America Bull., v. 60, pl. 3, fig. 9 only; BISCHOFF & ZIEGLER (part), 1956, Hess. Landesamt. Bodenf., Notizbl., v. 84, p. 165, pl. 12, fig. 13 only; BISCHOFF, 1957, Hess. Landesamt. Bodenf., Abh., v. 19, p. 55, pl. 6, fig. 1, 2.

Siphonodella duplicata (Branson & Mehl) var. B, HASS, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, pl. 1, fig. 7.

Siphonodella duplicata (Branson & Mehl) var. A, CLOUD, BARNES & HASS, 1957, Geol. Soc. America Bull., v. 68, pl. 5, fig. 8.

Siphonognathus quadruplicata Branson & Mehl , COOPER, 1939, Jour. Paleontology, v. 13, p. 409, pl. 41, fig. 44, 45.

DIAGNOSIS.-- Elongate, narrow platform, with two rostral ridges confined to anterior portion of platform. Prominent nodose carina separates outer platform with prominent transverse ridges from inner platform with low random nodes.

REMARKS.-- The two short rostral ridges on the anterior portion of the platform and the nodose inner side of the platform distinguish Siphonodella cooperi Hass from other species. S. obsoleta Hass possesses the same platform ornamentation; however, the outer rostral ridge is very long, extending nearly half the length of the platform.

MATERIAL STUDIED.-- 90 specimens; restricted in southwestern Missouri to the Siphonodella isosticha - S. cooperi Assemblage Zone.

REPOSITORY.-- UMC-995-6; UMC-995-7; UMC-995-8 (figured specimens).

SIPHONODELLA OBSOLETA Hass

Siphonodella obsoleta HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 392, pl. 47, fig. 1, 2; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 45, pl. 3, fig. 25; KLAPPER, 1966, Univ. Kansas Paleontological Contrib., Paper 3, p. 17, pl. 2, fig. 9, 12; pl. 4, fig. 17, 19.

Siphonodella aff. S. obsoleta Hass , COLLINSON, SCOTT & REXROAD, 1962, Illinois Geol. Survey, Circ. 328, p. 7, chart 2.

DIAGNOSIS.-- Broad platform with two rostral ridges, outer rostral ridge exceptionally long, curving away from carina to outer edge of platform; inner rostral ridge short. Ornamentation of outer portion of platform lacking, or reduced transverse ridges; inner platform nodose.

REMARKS.-- The very long outer rostral ridge distinguishes Siphonodella obsoleta Hass from S. cooperi Hass.

MATERIAL STUDIED.-- Five specimens; restricted in southwestern Missouri to the S. isosticha - S. cooperi Assemblage Zone.

Genus SPATHOGNATHODUS Branson and Mehl, 1941

Ctenognathus PANDER, 1856, K. Akad, Wiss. St. Petersburg, p. 32, (non Fairmair, 1843).
Spathodus BRANSON & MEHL, 1933, Missouri Univ. Studies, v. 8, p. 46, (non Boulenger, 1900).
Spathognathodus BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 98.
Mehlina YOUNGQUIST, 1945, Jour. Paleontology, v. 19, p. 363.
Branmehla HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 381.
Ctenognathodus FAY, 1959, Jour. Paleontology, v. 33, p. 195.
Spathognathodus (Bispathodus) MÜLLER, 1962, Paläont. Zeitschr., v. 36, p. 114.

TYPE SPECIES.-- Ctenognathus murchisoni Pander, 1856, by subsequent designation.

DIAGNOSIS.-- Elongate bladelike unit with basal cavity near middle one-third of unit; commonly extending to posterior tip. Cavity ranges from long and narrow to short and expanded, subcircular. Main axis straight to flexed; aboral surface straight to slightly arched; oral outline variable.

REMARKS.-- The oral outline, size and shape of the basal cavity, and possession or lack of flexure or arch all have been used as specific determinates. These are all variable, particularly the oral outline, which may vary considerably within one species.

SPATHOGNATHODUS sp. cf. S. CRASSIDENTATUS (Branson and Mehl)

Pl. 1, fig. 2, 3.

Spathodus crassidentatus BRANSON & MEHL, 1934, Missouri Univ. Studies, v. 8, p. 276, pl. 22, fig. 17, 18.

DIAGNOSIS.-- Straight unit with centrally located, highly flared subcircular basal cavity. Anterior blade increases in height to very long anterior three or four denticles. Posterior oral outline from cavity straight, tapering rapidly to posterior end.

REMARKS.-- Spathognathodus sp. cf. S. crassidentatus (Branson and Mehl) is similar in all respects to S. crassidentatus (Branson and Mehl), except for its stratigraphic range. The latter has previously been restricted to Kinderhookian rocks. The form in the present study is common in lower Osagean rocks. If they are the same species, the range of S. crassidentatus must be extended upward into the Osagean Series.

MATERIAL STUDIED.-- 52 specimens; ranges in southwestern Missouri from the Bactrognathus - Pseudopolygnathus multistrata Assemblage Zone through the B. distorta - Gnathodus cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-995-9 (figured specimen).

SPATHOGNATHODUS ELONGATUS (Branson and Mehl)

Pl. 1, fig. 15.

Spathodus elongatus BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, p. 139, pl. 34, fig. 6, 9.

DIAGNOSIS.-- Subcentral, elongate basal cavity tapers to point at posterior end of long bladelike unit. Anterior blade composed of four or more subequal major denticles; posterior portion with smaller, sharply pointed denticles of even length to posterior end, sharply decreasing to end.

REMARKS.-- Rexroad and Scott (1964, p. 48) consider Spathognathodus elongatus (Branson and Mehl) to be a junior synonym of S. crassidentatus (Branson and Mehl). However, the basal cavity of S. elongatus is elongate, extending nearly to the posterior tip of the unit, while that of S. crassidentatus is flared, subcircular, and is more restricted to the central portion of the blade.

MATERIAL STUDIED.-- 12 specimens; restricted in southwestern Missouri to the Pseudopolygnathus multistriata Subzone of the Bactrognathus - P. multistriata Assemblage Zone, except for one specimen recovered in the Gnathodus cuneiformis Subzone of the B. distorta - G. cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-995-10 (figured specimen).

SPATHOGNATHODUS PULCHER (Branson and Mehl)

Pl. 1, fig. 1, 4.

Spathodus pulcher BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, p. 139, pl. 34, fig. 7, 8.

Spathognathodus sp. REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 50, pl. 3, fig. 12, 13.

DIAGNOSIS.-- Blade straight, thin; composed of two or more denticles, longest near center; basal cavity narrow, elongate, beneath posterior two-thirds of unit, pointed to posterior tip of unit, bluntly rounded at anterior end beneath posterior end of anterior blade.

REMARKS.-- Spathognathodus pulcher (Branson and Mehl) is here interpreted as variable in dentition of the anterior blade. This portion may consist of a single large denticle in smaller specimens, or of several large denticles, longest in the center, forming a convex oral outline. The forms with a single large denticle usually show a germ denticle at the anterior end of the specimen. Subsequent workers may be able to subdivide this form, but present knowledge does not warrant subdivision.

MATERIAL STUDIED.-- 663 specimens; ranging in southwestern Missouri from the upper portion of the Pseudopolygnathus multistriata Subzone of the Bactrognathus - P. multistriata Assemblage Zone through the Gnathodus cuneiformis Subzone of the B. distorta - G. cuneiformis Assemblage Zone.

REPOSITORY.-- UMC-995-11; UMC-995-12 (figured specimens).

SPATHOGNATHODUS REGULARIS (Branson and Mehl)

Pl. 1, fig. 16.

Spathodus regularis BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, p. 137, pl. 34, fig. 1-3, 10; _____, 1944, in Shimer and Shrock, Index Fossils of North America, p. 244, pl. 94, fig. 1.
Spathognathodus regularis (Branson & Mehl) , YOUNGQUIST & DOWNS, 1950, Jour. Paleontology, v. 24, p. 528, pl. 67, fig. 15; REXROAD & SCOTT, 1964, Indiana Geol. Survey, Bull. 30, p. 49, pl. 3, fig. 1, 2.

DIAGNOSIS.-- Straight unit with elongate basal cavity beneath posterior two-thirds of unit, pointed at posterior end. Anterior blade usually of two large discrete sharply pointed denticles of near equal length. Posterior portion over cavity with numerous blunt, wide denticles increasing in width toward posterior end.

REMARKS.-- Rexroad and Scott (1964, p. 49) place Spathognathodus pulcher (Branson and Mehl) in synonomy with S. regularis (Branson and Mehl). However, the posterior denticles over the cavity are long, narrow, and sharply pointed in S. pulcher, and decrease in size toward the posterior end; those of S. regularis are short, blunt, and wide, and increase in

width toward the posterior end. The anterior blade of S. pulcher usually has three or four denticles, longest in the center, forming a strong convex oral outline. S. regularis has two equal-length anterior denticles, and lacks smaller germ denticle at the anterior end.

MATERIAL STUDIED.-- 15 specimens; ranges in southwestern Missouri through the Bactrognathus - Pseudopolygnathus multistriata and Bactrognathus distorta - Gnathodus cuneiformis Assemblage Zones.

REPOSITORY.-- UMC-995-13 (figured specimen).

Genus STAUROGNATHUS Branson and Mehl, 1941

Staurognathus BRANSON & MEHL, 1941c, Jour. Paleontology, p. 102.

TYPE SPECIES.-- Staurognathus cruciformis Branson and Mehl, 1941c, by original designation.

DIAGNOSIS.-- Compound unit composed of slightly curved main axis and two lateral lobes projecting from position near one-third distance from posterior end of main axis.

REMARKS.-- Staurognathus is similar to Scaliognathus, but differs in the position of the lateral lobes. Those of Scaliognathus project just short of the posterior end of the main axis, those of Staurognathus project more toward the center of the main axis, leaving a relatively long free posterior portion of that axis. The angle of projection of the latter genus varies from near 90 degrees to 45 degrees toward the anterior.

Speciation is based on the degree of curvature of the main axis and on the angle of projection of the lateral lobes.

STAUROGNATHUS CRUCIFORMIS Branson and Mehl

Pl. 6, fig. 6, 8.

Staurognathus cruciformis BRANSON & MEHL, 1941c, Jour. Paleontology, v. 15, p. 102, pl. 19, fig. 25, 36; HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 393, pl. 46, fig. 24; BURTON, 1964, New Mexico Geol. Soc., Guidebook 15th Field Conf., chart.

DIAGNOSIS.-- Main axis slightly curved inward. Outer lateral lobe nearly perpendicular to main axis, long; inner lateral lobe short, angled toward anterior approximately 30 degrees. Basal cavity very large, located beneath juncture of lateral lobes, extending along aboral surface of all four limbs nearly to apices. Oral ornamentation coarse, as transverse ridges across all four limbs, and shallow groove down center of each limb

cutting transverse ridges into two portions.

REMARKS.-- Staurognathus, along with Doliognathus and Scaliognathus, occurs within the range of Bactrognathus. It has not been reported from the Mississippi Valley region, but has been recovered in Texas (Hass, 1959). These short-ranging genera are significant in their similarities to late Devonian forms, and in their distinction from contemporary forms.

MATERIAL STUDIED.-- One specimen; recovered in southwestern Missouri from the upper portion of the Pseudopolygnathus multistriata Subzone of the Bactrognathus - P. multistriata Assemblage Zone.

REPOSITORY.-- UMC-995-14 (figured specimen).

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PLATES

(All figures X 30)

Specimens are identified by University of Missouri at Columbia (UMC) collection numbers. (1283-30-6) refers to Missouri Geological Survey field notebook 1283, locality description beginning on page 30, described unit 6.

PLATE 1

Fig. 1, 4. Spathognathodus pulcher (Branson and Mehl). Lateral views; Reeds Spring Formation, Baird Mountain (sec. E): 1 UMC-995-12 (1283-30-42); 4 UMC-995-11 (1283-30-37) ..... p. 54

Fig. 2, 3. Spathognathodus sp. cf. S. crassidentatus (Branson and Mehl). 2 lateral view, 3 oral view; Reeds Spring Formation, Baird Mountain (sec. E): UMC-995-9 (1283-30-32) ..... p. 53

Fig. 5-10. Bactrognathus minuta Thompson n. sp. 5 aboral view of paratype, 6 outer-lateral view of paratype, 7 oral view of paratype; Pierson Formation, Roaring River south (sec. F); UMC-993-1 (1283-36-14). 8 aboral view of holotype, 9 outer-lateral view of holotype, 10 oral view of holotype; Pierson Formation, Baird Mountain (sec E): UMC-992-20 (1283-30-22) ..... p. 32

Fig. 11, 14. Bactrognathus hamata Branson and Mehl. 11 oral view, 14 aboral view; Pierson Formation, Baird Mountain (sec. E): UMC-992-19 (1283-30-18) ..... p. 31

Fig. 12, 13, 17, 18. Bactrognathus distorta Branson and Mehl. 12 oral view, 13 aboral view; Pierson Formation Roaring River south (sec. F): UMC-992-15 (1283-36-15). 17 oral view, 18 aboral view; Pierson Formation, Roaring River south: UMC-992-14 (1283-36-15) ..... p. 30

Fig. 15. Spathognathodus elongatus (Branson and Mehl). Lateral view; Pierson Formation, Baird Mountain (sec. E): UMC-995-10 (1283-30-16) ..... p. 54

Fig. 16. Spathognathodus regularis (Branson and Mehl). Lateral view; Reeds Spring Formation, Baird Mountain (sec. E): UMC-995-13 (1283-30-28) ..... p. 55

Fig. 19-23. Bactrognathus excavata Branson and Mehl. 19 oral view, 23 aboral view; Pierson Formation, Roaring River south (sec. F): UMC-992-16 (1283-36-10). 20 oral view, 21 outer-lateral view, 22 aboral view; Pierson Formation, Roaring River south: UMC-992-17 (1283-36-11) ..... p. 31

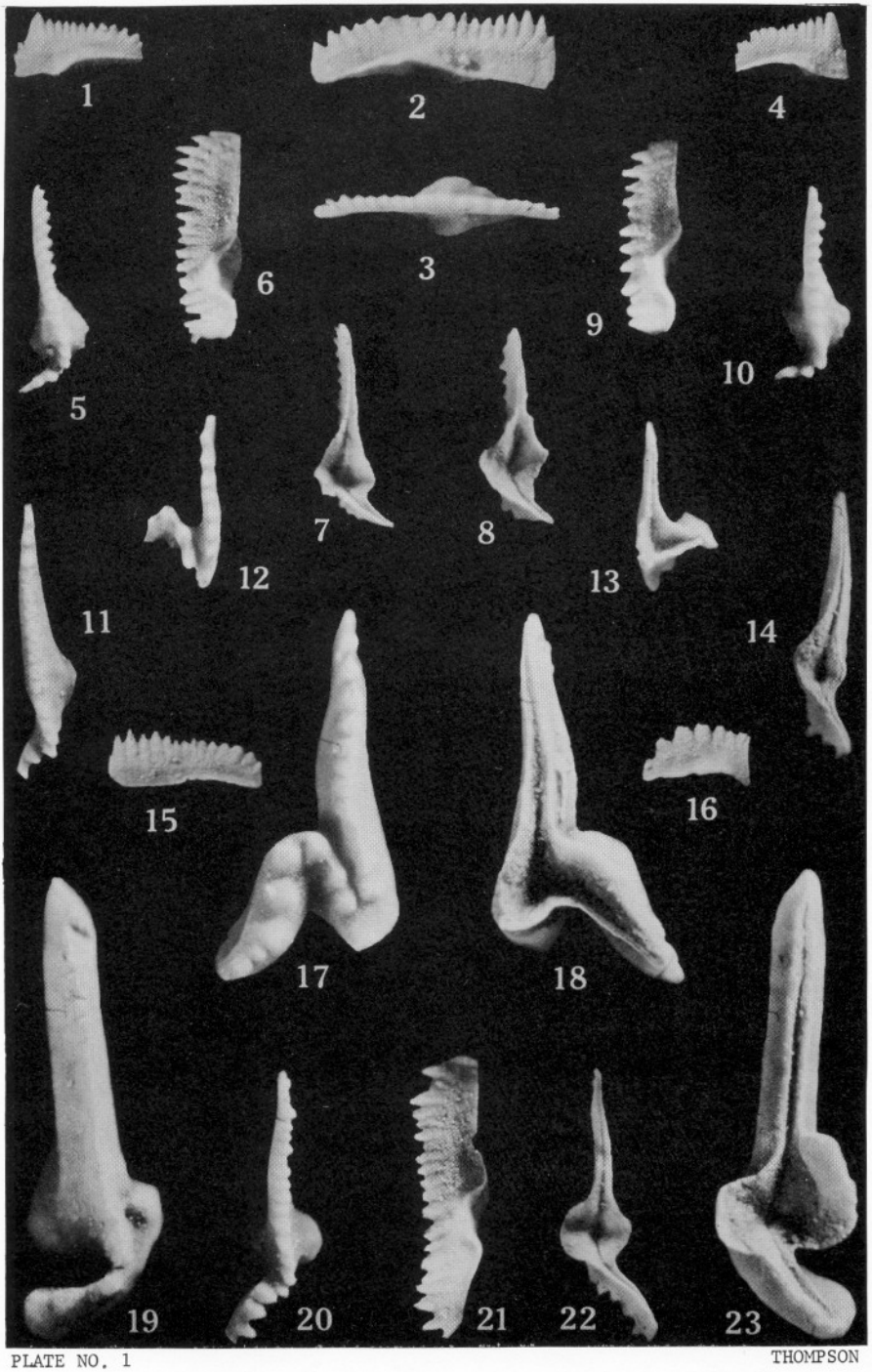

PLATE NO. 1

THOMPSON

PLATE 2

Fig. 1-6. Polygnathus mehli Thompson, n. sp. 1 oral view of holotype, 2 aboral view of holotype; Pierson Formation, Roaring River south (sec. F): UMC-994-17 (1283-36-19). 3 oral view of paratype, 4 aboral view of paratype; Pierson Formation, Roaring River south: UMC-994-18 (1283-36-19). 5 oral view of paratype, 6 aboral view of paratype; Reeds Spring Formation, Baird Mountain (sec. E): UMC-994-19 (1283-30-41) ..... p. 47

Fig. 7, 10. Polygnathus communis carina Hass. 7 oral view, 10 aboral view; Pierson Formation, Turner's Station (sec. B): UMC-994-13 (1283-27-2) ..... p. 45

Fig. 8, 9. Elictognathus costata (E. R. Branson). Inner-lateral views; Pierson Formation, Baird Mountain (sec. E): 8 UMC-993-7 (1283-30-8); 9 UMC-993-8 (1283-30-8) ..... p. 35

Fig. 11, 14, 17, 19, 20, 22. Doliognathus lata Branson and Mehl. 11 oral view, 14 aboral view; Pierson Formation, Baird Mountain (sec. E): UMC-993-4 (1283-30-24). 17 oral view, 19 aboral view; Pierson Formation, Baird Mountain: UMC-993-5 (1283-30-24) 20 oral view, 22 aboral view; Pierson Formation, Baird Mountain; UMC-993-6 (1283-30-27) ..... p. 34

Fig. 12, 13, 15, 16. Polygnathus communis communis Branson and Mehl. 12 oral view, 13 aboral view; Pierson Formation, Baird Mountain (sec. E): UMC-994-15 (1283-30-18). 15 oral view, 16 aboral view; Pierson Formation, Turner's Station (sec. B): UMC-994-16 (1283-27-13) ..... p. 46

Fig. 18, 21. Doliognathus dubia Branson and Mehl. 18 oral view, 21 aboral view; Pierson Formation, Baird Mountain (sec. E): UMC-993-2 (1283-30-23) ..... p. 33

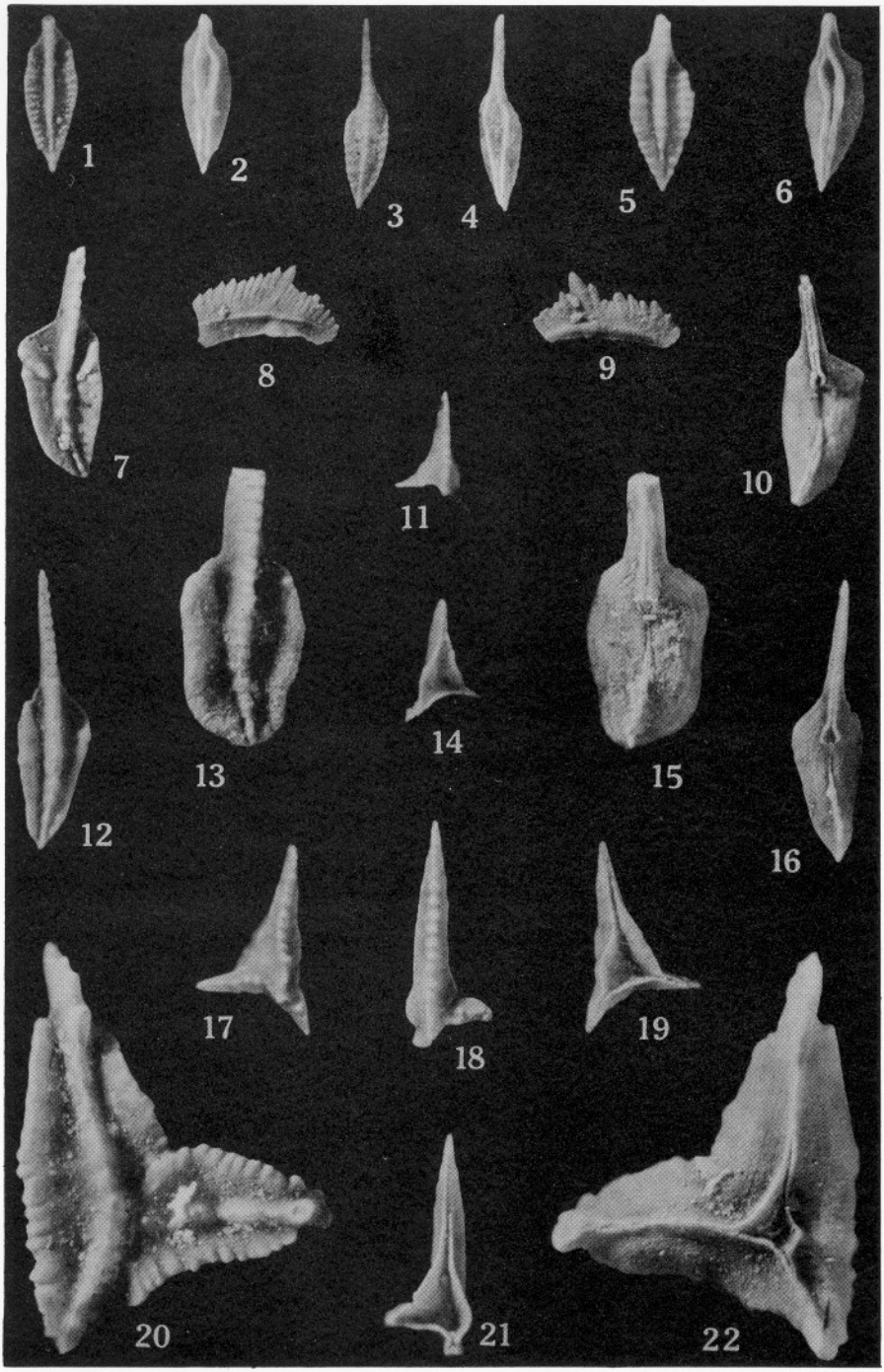

PLATE NO. 2

THOMPSON

PLATE 3

Fig. 1, 6. Gnathodus delicatus Branson and Mehl. 1 oral view, 6 aboral view; Pierson Formation, Baird Mountain (sec. E): UMC-993-19 (1283-30-6) ..... p. 39

Fig. 2, 3, 9. Gnathodus n. sp. C. 2 oral view, 3 aboral view; Pierson Formation, Baird Mountain (sec. E.): UMC-993-15 (1283-30-6). 9 oral view; Pierson Formation, Baird Mountain: UMC-993-14 (1283-30-8) ..... p. 44

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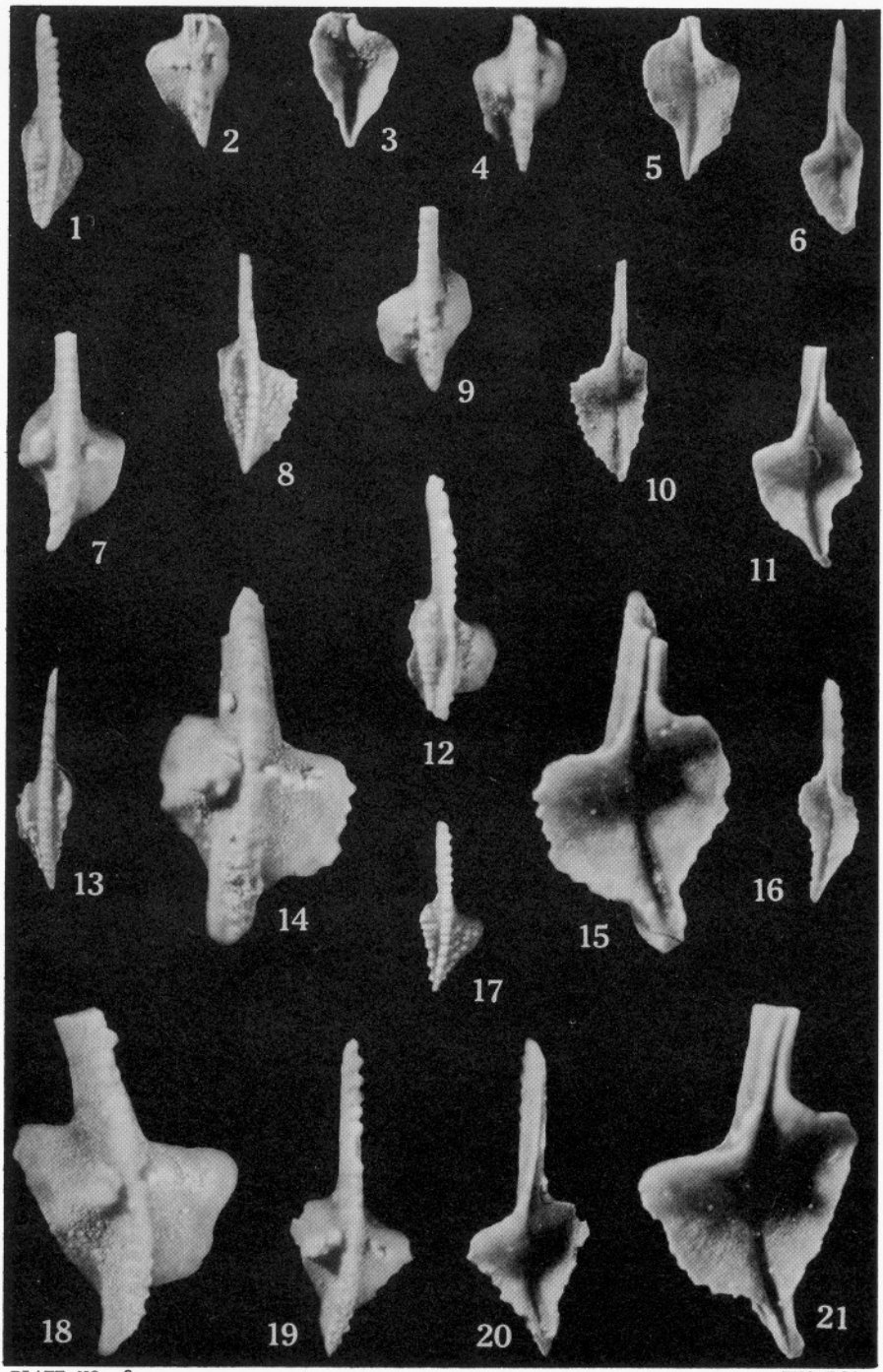

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PLATE 4

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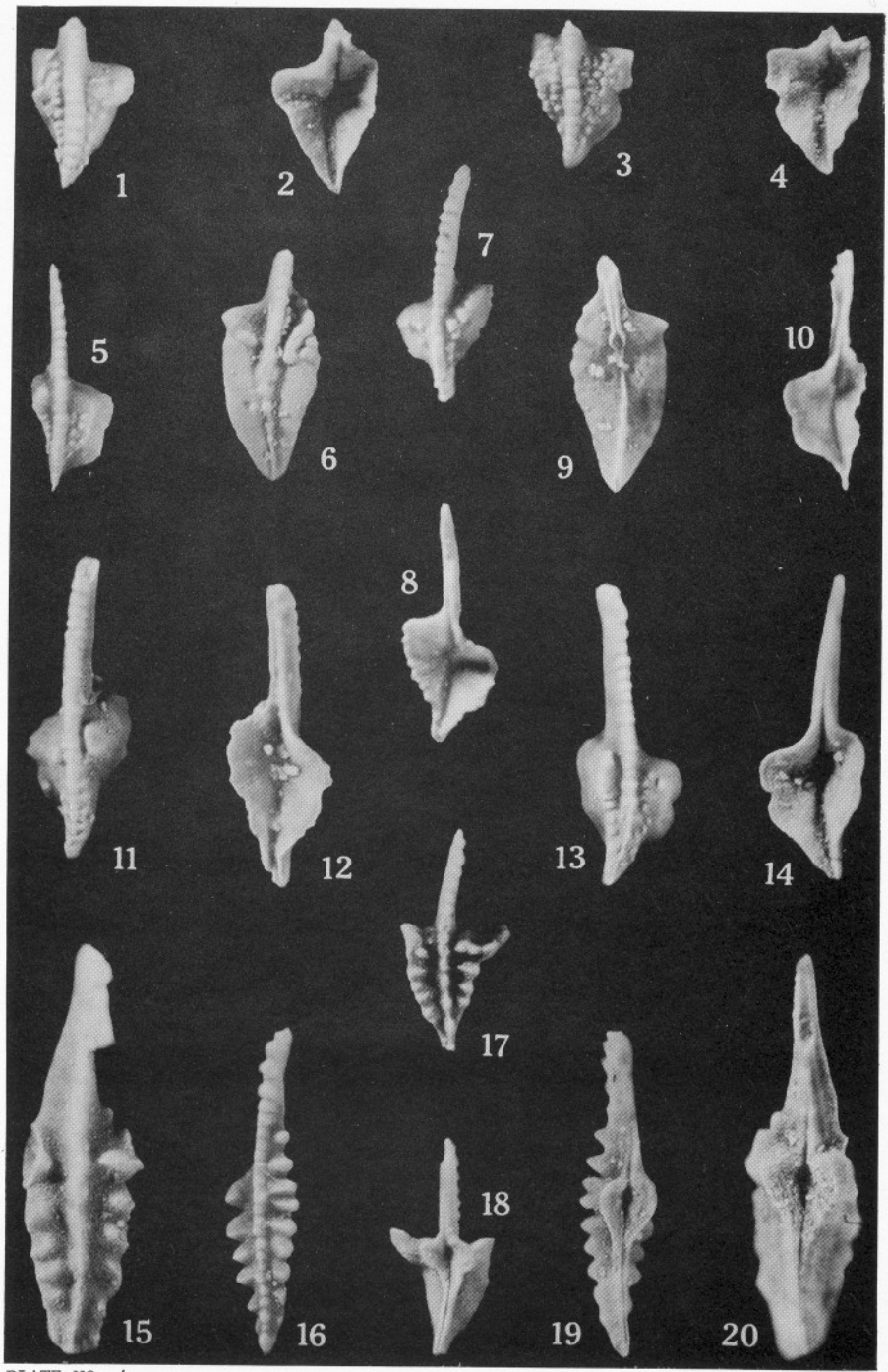

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PLATE 5

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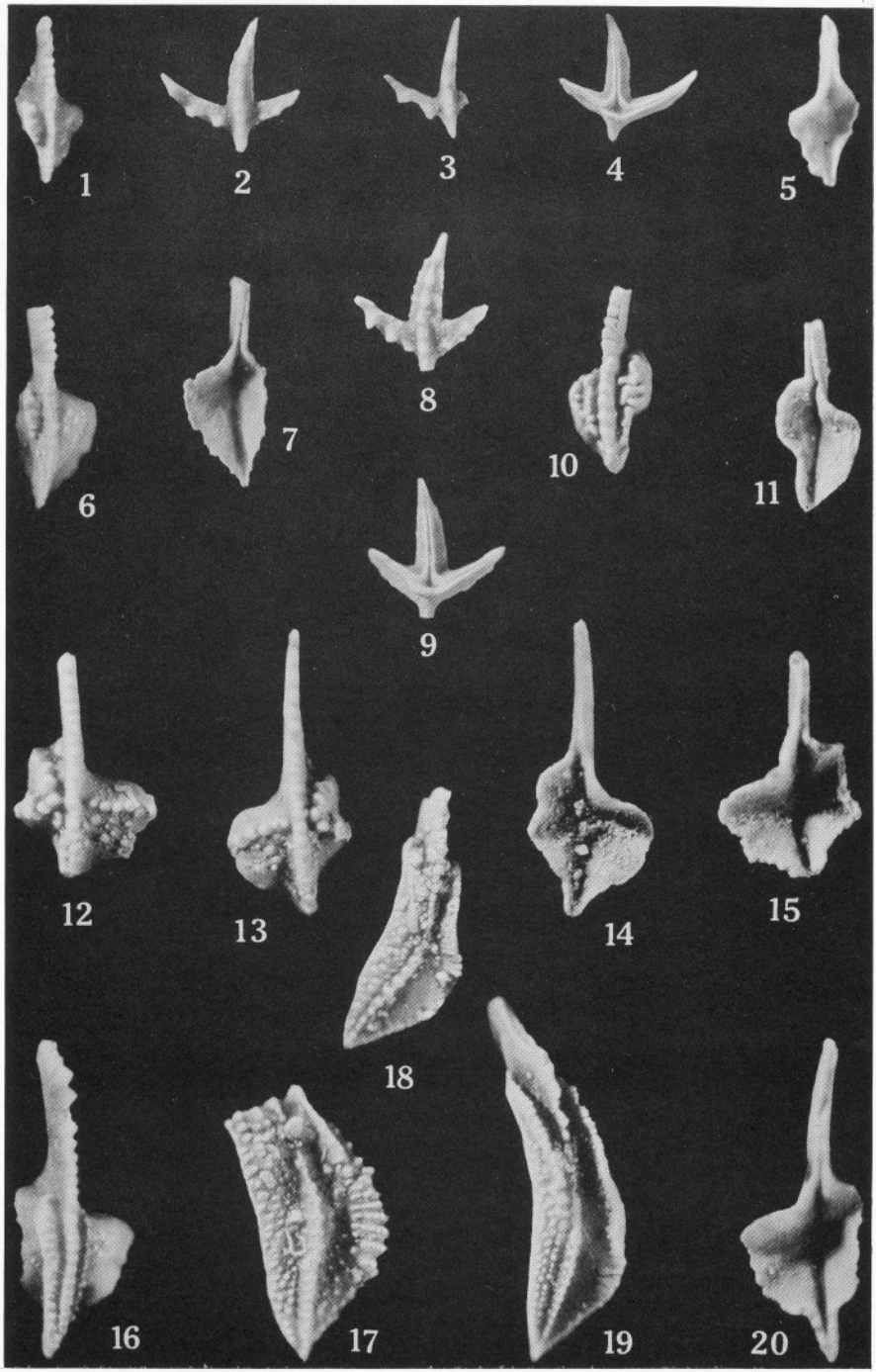

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PLATE 6

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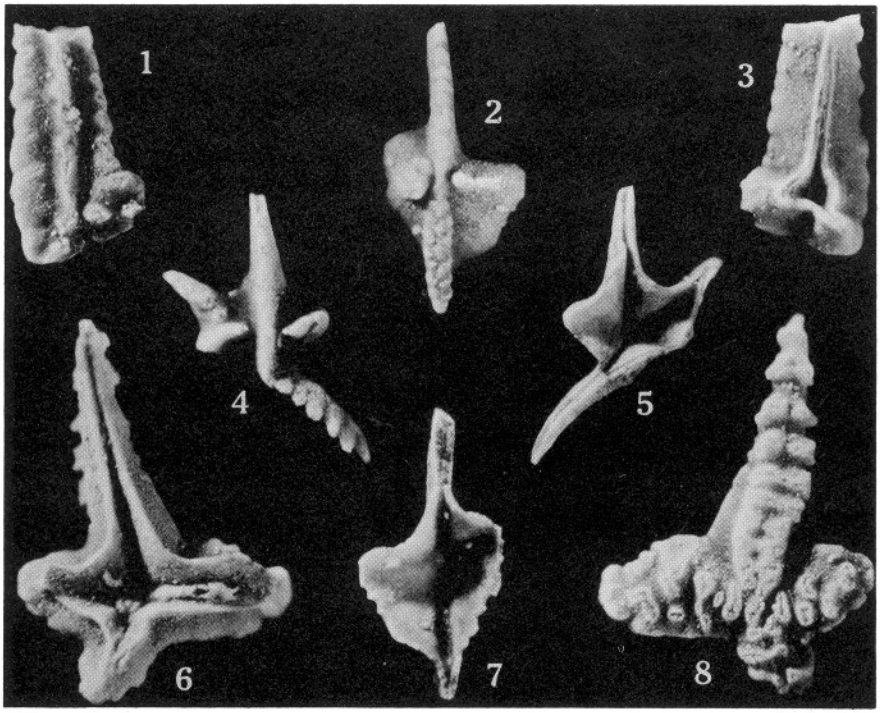
LOWER OSAGEAN CONODONTS OF SOUTHWESTERN MISSOURI



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APPENDIX

The following are detailed lithologic descriptions of the six localities sampled for the present study. The numbered units described correspond to numbered samples as found on Tables 1 through 6.

Section A

Dry Sac Creek Locality, roadcut west side U. S. Highway 65, 100 to 150 yards south of Dry Sac Creek Bridge, 1.5 miles north of Interstate 44 interchange; SW¼ SE¼ SE¼ sec. 32, T. 30 N., R. 21 W., Greene County, Missouri.

	Thickness Feet	Inches
Mississippian System		
Osagean Series		
Burlington Limestone (17 feet)		
6. Limestone, as No. 5, to top of cut.....	10±	
5. Limestone, light gray, crinoidal; single massive bed, weathers to several beds	5±	
4. Limestone, light gray, semicrinoidal to crinoidal; thick, massive beds; chert (10%) white, opaque, as large nodules and irregular beds, prominent chert bed 2 feet above base	2	6
Elsey Formation (8 feet)		
3. Limestone, light gray, fine grained, to semicrinoidal, dense, irregular and discontinuous nodular beds; chert (40%) white, opaque, some brown mottled, fossiliferous; as irregular continuous beds and large nodules	3	6
2. Same as No. 3; fine-grained	2	3
1. Same as No. 2	2	9

Section B

Section at Turner's Station, type section Pierson Formation, roadcut north side Greene County road D; NW¼ SW¼ SW¼ sec. 29, T. 29 N, R. 20 W., Greene County, Missouri.

	Thickness Feet	Inches
Mississippian System		
Osagean Series		
Burlington Limestone (?) (1 foot)		
21. Limestone, dolomitic, light tan, coarse grained, thin-bedded, slabby	0	6
20. Covered interval	3±	
Elsey Formation (27 feet)		
19. Limestone, light gray, fine-grained; chert white, mottled, large nodules	2	6
18. Covered interval	13±	
17. Limestone, grayish-brown, very fine-grained, scattered crinoidal debris, thick-bedded; chert (50%) white, gray-mottled, crinoidal debris; large nodules between nodular limestone beds	4±	
16. Same as 17; chert (40%)	3	8
15. Same as 17	2	2
14. Same as 17; slightly dolomitic	2±	
Pierson Formation (40 feet)		
13. Dolomite, dark to medium brown, fine-grained, chert, medium-bedded	2±	
12. Dolomite, dark brown, fine-grained, scattered crinoidal debris; few scattered chert nodules; one bed	5	6
11. Limestone, dolomitic, brown, fine-grained, shaly, slabby, cross-laminated, thick-bedded; chert brown with white rinds, spicular; as thin beds	2	8

		Thickness Feet	Inches
10.	Limestone, dolomitic, light brown, crinoidal debris, nodular; chert white and brown, mottled, rough exteriors, scattered nodules	8+	
9.	Same as 10	9+	
8.	Same as 10	2+	
7.	Same as 10; no chert, shaly top and bottom	0	5
6.	Limestone, dolomitic, fine-grained; chert brown, bedded	1	10
5.	Dolomite, brown, fine-grained; chert gray to tan, scattered nodules; one bed	3	4
4.	Dolomite, light tan, medium-grained, silty, thin, slabby, wavy beds	2	6
3.	Siltstone, dolomitic, yellowish-brown, gradational with unit 2	1+	
2.	Siltstone, dolomitic, light greenish-gray, laminated	2	6

Kinderhookian Series
Northview Formation (2 feet)

1.	Siltstone and shale, yellowish-brown	2+	

Section C

Dry Creek locality, type section Elsey Formation, roadcut north side Mo. Highway 148; Center sec. 5, T. 24 N., R. 24 W., Stone County, Missouri.

Mississippian System		Thickness Feet	Inches
Osagean Series			
Burlington Limestone (14 feet)			
27.	Limestone, light gray, coarse-grained crinoidal; cross-laminated; chert-white, as flat nodules	3	2
26.	Same as 27	3	1
25.	Same as 27	4	1

		Thickness Feet	Inches
24.	Same as 27; chert very large flat nodules, porous, tripolitic	3	8
Elsey Formation (19 feet)			
23.	Limestone, brown to gray, alternating fine-grained and crinoidal; chert white, glassy, mottled, flat nodules	1	0
22.	Same as 23	3	3
21.	Limestone, brown to gray, fine-grained to crinoidal, medium-bedded; chert, white, brown-mottled, crinoidal, beds and nodules	2	8
20.	Limestone and chert; limestone, light gray to brown, dolomitic, fine- to medium-grained, semicrinoidal, medium-bedded; chert, white to gray, mottled, opaque, long, flat nodules within limestone beds	2	0
19.	Same as 20; crinoidal lenses	3	0
18.	Same as 20; white chert with brown amoeboid mottling	5+	
17.	Same as 20; chert brown to gray	2	3
Reeds Spring Formation (79 feet)			
16.	Limestone and chert; limestone light gray to tan, fine-grained, crinoidal at top, nodular-bedded; chert (60%), dark bluish-black, brown, nodules and discontinuous beds, light brown rinds	4	3
15.	Same as 16; fine-grained	5	5
14.	Limestone and chert; limestone, light grayish-brown, fine-grained, nodular-bedded; chert (50%) gray, even beds, and blue nodules	4	0
13.	Same as 14; upper 3 feet very argillaceous	4+	
	Covered interval	10+	

		Thickness Feet	Inches
12.	Same as 14	4±	
	Covered interval	5	0
11.	Limestone and chert; limestone, light grayish-brown, fine-grained, thin, nodular-bedded; chert (50%) gray, mottled, smooth, opaque, some dark gray to light gray, blue and brown chert beds	5±	
10.	Same as 11	2	8
9.	Limestone and chert; limestone, dark gray, fine-grained, argillaceous, nodular, irregular beds, weathers laminated light gray; chert (30%) dark blusih-black, dull green rinds, nodules within limestone beds	2	10
8.	Same as 9; chert beds brown	2	6
7.	Same as 9	1	7
6.	Limestone and chert; limestone, gray to grayish-brown, fine-grained, dense as irregular nodules between chert nodules, and in chert nodules; chert (60-75%) dark bluish-black and brown, spicular, brown chert large nodules, bluish-black chert large and small nodules with white rinds	3	0
5.	Same as 6	3	0
4.	Same as 6	3	0
3.	Limestone and chert; limestone gray to dark gray, and brown, fine-grained, dense, slightly argillaceous, thin, nodular beds; chert (60%) bluish-black to brown, some pink, thin, discontinuous beds and irregular nodules and beds	3±	
2.	Same as 3	3	0

	Thickness Feet	Inches
Pierson Formation (1 foot)		
1. Limestone, argillaceous, grayish-green, weathers to thin, slabby beds; in road ditch at bottom of cut at road bend	0	8

Pierson exposed 1/4 mile north and west of section described.

Section D

Type section Reeds Springs Formation, Missouri Pacific Railroad cut, 100 yards to 1/2 mile southeast of tunnel, southeast of Reeds Spring; SW¼ sec. 31, T. 24 N., R. 22 W., Stone County, Missouri. Section begins on railroad cut, 1/2 mile south of tunnel.

	Thickness Feet	Inches
Mississippian System		
Osagean Series		
Reeds Spring Formation (17 feet)		
27. Chert, brown, limestone removed	4±	
26. Limestone and chert (75%); limestone dark gray, fine-grained, dense; chert light to medium gray and brown, opaque to transluscent, as irregular nodules and discontinuous beds	2	4
25. Same as No. 26	2	9
24. Same as No. 25	3	1
Pierson Formation (45 feet)		
23. Thin, alternating beds of calcareous shale, argillaceous limestone, and shale; thin lines of chert nodules; limestone and shale brown to dull green; chert dark gray, rough opaque	4	4
22. Limestone and chert (50%); limestone gray to brown, dense, fine-grained, argillaceous, nodular, thin-bedded; chert bluish-black, weathers reddish-brown, beds and scattered nodules	2	9
21. Same as No. 22	2	4

		Thickness Feet	Inches
20.	Limestone, greenish-gray, fine-grained, nodular, argillaceous, weathers thin, slabby; chert (10%) as small nodules and thin discontinuous beds; bluish-black, smooth, transluscent	2	6
19.	Same as No. 20	2	8
18.	Same as No. 19, three-inch shale at top	1	7
17.	Shale, calcareous, and argillaceous limestone; grayish-green, semicrinoidal, scattered brachiopods; thin; slabby-bedded	0	6
16.	Limestone, grayish-green, dense to fine-grained, scattered crinoid columnals, nodular bedding on weathered surface, massive on un-weathered surface; some reddish-brown limestone scattered as nodules	4	10
15.	Limestone, brown, semicrinoidal, dense matrix, some greenish-brown	1	1
14.	Same as No. 15, scattered dendrites	1	5

Section continued at south entrance to tunnel, headwaters Roark Creek, down east side track fill.

13.	Same as No. 14, stylolitic	1	3
12.	Limestone, brown, reddish shale films, nodular bedded, fine-grained, coarser grained at top	3	4
11.	Limestone, grayish-tan, medium-grained, massive, one single bed, nodular	1	4
10.	Same as No. 11, limestone brick red to grayish-tan, medium bedded (8-12 inches)	2	0
9.	Same as No. 10	2	2
8.	Same as No. 11, brick red and grayish tan	2	0

	Thickness Feet	Inches
Kinderhookian Series		
Northview Formation (7 feet)		
7. Covered	10+	
6. Shale, light green to gray, crinoidal at base, calcareous, limestone nodules in upper part	6+	
5. Limestone, tan, fine-grained, dense	0	8
4. Shale, green, clayey, blocky	0	4
Compton Formation (16 feet)		
3. Limestone, tan, fine- to medium-grained, semicrinoidal, medium-bedded	6+	
2. Same as No. 3, weathers thin, hackly	7+	
1. Same as No. 3	3+	
Ordovician System		
Jefferson City - Cotter Formation		

Section E

Baird Mountain quarry, above Table Rock Dam; SW¼ NW¼ sec. 26, T. 22 N., R. 22 W., Taney County, Missouri.

	Thickness Feet	Inches
Mississippian System		
Osagean Series		
Elsey Formation (5 feet)		
44. Chert and limestone (25%); chert white, gray to brown-mottled, large nodules; limestone dark gray to grayish-brown, fine-grained, cross-laminated, thin nodular beds between chert nodules; large float block at top of quarry face	5	6
Reeds Spring Formation (108 feet)		
43. Covered interval	33+	

		Thickness Feet	Inches
42.	Limestone, dark gray, dense, very irregular; chert light bluish-gray, mottled	4	2
41.	Limestone, dark grayish-brown, fine-grained, nodular; chert (50%) tan to white and gray	1	0
40.	Covered interval	16	6
39.	Limestone, gray to grayish-green, medium-grained, medium-bedded, nodular; chert brown, vuggy, weathers white, no sample taken	10+	
38.	Limestone, grayish-green, semicrinoidal to crinoidal, one bed; chert bluish-black, thin nodular beds	3	5
37.	Limestone, gray to tan, fine- to medium-grained, thin, nodular beds, thin gray shale partings, scattered crinoidal debris; chert (25%) gray and brown, mottled, thin beds and scattered nodules	1	11
36.	Limestone, grayish-green, crinoidal, cross-laminated and size-sorted crinoidal debris; chert brown, crinoidal, very irregular-bedded; biostromal	4	2
35.	Same as No. 37; chert (50%) opaque brown	3	0
34.	Same as No. 37	4	0
33.	Same as No. 37	10	6
32.	Limestone, grayish-tan, fine-grained, argillaceous, thin, slabby-bedded; chert (40%) bluish-black, thin beds and nodules	4	4
31.	Limestone, gray to grayish-green, streaks of red, medium-grained, argillaceous; chert dark blue, nodular, upper part green opaque and blue transluscent nodules	2	6

		Thickness Feet	Inches
30.	Limestone, gray to grayish-green, fine-grained, few scattered crinoid debris, thin, nodular-bedded; chert (40%) bluish-gray, tan and green, with brown rinds, scattered nodules and beds	3	1
29.	Same as No. 30; thin- to medium-bedded	3	7
28.	Same as No. 30; thin- to medium-nodular-bedded	3	0
	Pierson Formation (73 feet)		
27.	Shale, green and grayish-green, calcareous, fossiliferous; dark gray chert nodules	1	6
26.	Limestone, grayish-green to brown, fine-grained, thin- to medium-bedded, nodular; chert (60%) brown and bluish-gray, smooth, irregular nodules and beds, rough brown rinds	6	10
25.	Limestone, greenish-gray, fine-grained, argillaceous; chert grayish-black, beds and small nodules	6+	
24.	Limestone, greenish-gray, fine- to medium-grained, medium-bedded, nodular; chert dark gray and brown, nodules and beds, green rinds, inclusions of limestone nodules	2	5
23.	Limestone, greenish-gray, fine- to medium-grained, green shale partings, nodular; little or no chert	6	6
22.	Limestone, red, crinoidal, thin- to medium-bedded, nodular	5	5
21.	Limestone, brick-red, argillaceous, crinoidal, medium-bedded; chert red, crinoidal, brown rinds	3	9
20.	Limestone, brick-red, and green semicrinoidal; chert red- and green-mottled	5	5
19.	Same as No. 20	5	3

		Thickness Feet	Inches
18.	Same as 20; chert with white crinoidal debris, greenish-white rinds	4	0
17.	Shale, red and green, calcareous, crinoidal, platy to blocky	0	1
16.	Limestone, light gray, medium to semi-crinoidal, medium-bedded; chert red, white rinds at base, dark gray to bluish-gray at top, crinoidal debris	4	8
15.	Limestone, grayish-green, fine- to medium-grained, medium-bedded	1	2
14.	Limestone, red to gray, fine- to medium-grained, nodular-bedded, red shale films	3	6
13.	Limestone, red, fine- to medium grained, red shale partings, crinoidal debris, medium-bedded	3	0
12.	Limestone, red, fine-grained at base, semicrinoidal toward top, single bed, red shale partings; top of unit at floor or main quarry	2	10
11.	Limestone, green with thin red and green shale partings, crinoidal, slabby nodular-bedded	3	8
10.	Limestone, red, green shale partings, medium-grained, scattered crinoidal debris, argillaceous, one bed, shaly at top	4+	
9.	Shale, brick-red, calcareous, blocky	0	6
8.	Limestone, red and green, streaked, shaly, crinoidal	2	0
7.	Limestone, brick-red, green mottled, medium-grained, shaly at top	0	5
6.	Shale, dark brick-red, calcareous, blocky	0	6

	Thickness Feet	Inches
Kinderhookian Series		
Northview Formation (5 feet 4 inches)		
5. Limestone, green, argillaceous, crinoidal, dense toward base, shaly toward top, medium-bedded	5	4
Compton Formation (13 feet)		
4. Limestone, grayish-tan, fine-grained, medium-bedded, even-bedded	4	3
3. Limestone, greenish-gray, fine- to medium-grained, green shale films, wavy-bedded on weathered surface, massive on fresh surface	8±	
Bachelor Sandstone (1 foot)		
2. Shale, green, sand and clayey, blocky to platy	0	6
1. Sandstone, green, well-cemented, phosphatic nodules and Ordovician chert pebbles	0	6
Ordovician System		
Jefferson City - Cotter Formations	4±	

Section F

Section in Roaring River State Park, south entrance, roadcut on west side of Missouri Highway 112; NE¼ sec. 34, T. 22 N., R. 27 W., Barry County, Missouri.

	Thickness Feet	Inches
Mississippian System		
Osagean Series		
Reeds Spring Formation (67 feet)		
35. Limestone and chert (75%); limestone gray to brown, fine-grained, thin-bedded; chert dark gray to brown, mottled, thin- to medium-bedded	8	5

		Thickness Feet	Inches
34.	Limestone and chert (60%); limestone dark gray, fine-grained, thin irregular beds; chert bluish-black and gray, irregular nodules and thin discontinuous beds with serrated edges	2	4
33.	Limestone and chert (60%); limestone gray, fine-grained, nodular; chert gray to brown, smooth, mottled, nodular and bedded	3	10
32.	Chert and limestone; chert brown to gray, mottled, thick-bedded, smooth, calcite vugs; limestone brown, fine-grained, thin wavy beds	3	6
31.	Limestone and chert (50%); limestone gray, fine-grained, coarse crinoidal at top; chert gray to brown, mottled crinoidal; one single bed	3	3
30.	Limestone, cherty; gray, fine-grained argillaceous, thin-bedded, irregular and nodular; chert dark gray, thin beds and scattered nodules	18+	
29.	Limestone and chert; limestone tan, fine-grained, thick-bedded; chert gray and mottled brown	2	10
28.	Limestone and chert (40%); limestone dark gray, fine-grained, cross-laminated, argillaceous, weathers thin and slabby; chert gray to black, thin discontinuous beds and small nodules	2	4
27.	Limestone and chert (50%); limestone tan and gray, fine-grained, argillaceous, weathers to slabby beds; chert bluish-black and brown, irregular nodules and beds	4	6
26.	Same as No. 27	7	7
25.	Same as No. 27; gray chert, medium-bedded	5	6
24.	Same as No. 27; chert (65%), mainly nodules	2	7
23.	Same as No. 27; chert (55%), in upper half	2	6

		Thickness Feet	Inches
Pierson Formation (50 feet)			
22.	Shale, gray to grayish-green, fissile to blocky	0	8
21.	Limestone, cherty, gray to grayish-green, fine-grained, argillaceous, thin-nodular-bedding, weathered, crinoidal debris; chert bluish-black, discontinuous beds and nodules	3	2
20.	Same as No. 21	3	7
19.	Shale, light grayish-green, fissile	0	6
18.	Limestone and chert (50%); limestone gray to grayish-green, fine-grained, argillaceous, scattered crinoidal debris, thin, slabby-beds; chert bluish-black, brown rinds, bedded	3	7
17.	Limestone, cherty (25%), grayish-green, fine-grained, scattered crinoidal beds, very argillaceous, thin, uneven beds; chert dark gray, in lower half of unit, few poorly developed nodules upper half	3	7
16.	Limestone, brown to gray, fine-grained, argillaceous, thin, nodular-bedding when weathered	2	2
15.	Same as No. 16	5	0
14.	Same as No. 16	2	3
13.	Shale, lower part green, fissile, middle red, blocky, upper part green, fissile	2	0
12.	Limestone, grayish-green and red, medium-grained to semicrinoidal, argillaceous, thin shale films, nodular on weathered surface	6	4
11.	Limestone, lower portion gray, upper red, medium-grained, semicrinoidal, red shale films in red part	3	4

	Thickness Feet	Inches
10. Limestone, grayish-green, lower part, red upper half, medium-grained, weathers thin, hackly	5	0
9. Limestone, tan lower part, red in middle, tan top part, fine- to medium-grained, weathers thin, hackly	3	5
8. Limestone, tan, dense, scattered crinoidal debris, massive on fresh face, weathers to medium beds	1	9
7. Limestone, grayish-brown, fine-grained dendritic	2	10
6. Limestone, red to gray, fine- to medium-grained, argillaceous, thin-bedded	0	10
Northview Formation (1 foot)		
5. Shale, green, fissile, clayey	0	4
4. Limestone and shale; limestone gray, fine- to medium-grained, thin, slabby beds; shale green, interbedded with limestone	1	0
Compton Formation (12 feet)		
3. Limestone, light gray to tan, fine- to medium-grained, medium- to thick bedded, weathers thin and wavy, thin green shale films	7	8
2. Limestone, same as No. 3	4	3
Bachelor Sandstone (4 inches)		
1. Shale, sandy, green, clayey and blocky	0	4
Chattanooga Shale (1 foot)		
0. Shale, gray to brown, blocky, dark films	1+	
Ordovician System		