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Mississippian Conodonts in Iowa

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SYNOPSIS: The literature on Mississippian conodonts in Iowa is reviewed. Conodont occurrences are noted from the McCraney, Prospect Hill, Hampton, Gilmore City, Burlington, Keokuk, War-

saw, Spergen, St. Louis and Ste. Genevieve formations. These conodont occurrences are related to the standard Mississippian conodont zones of the Mississippi Valley Region.

INDEX DESCRIPTORS: Conodont, Iowa conodonts, Mississippian conodonts.

The earliest reported occurrence of Mississippian conodonts in Iowa was Branson and Mehl's 1941 report describing conodonts from the Keokuk Formation in Iowa and Missouri. Later, in the late 1940's and early 1950's Walter Youngquist and his associates published descriptions of Mississippian conodonts from units such as, the Prospect Hill "Sandstone," the "Pella Beds," the Burlington Limestone and the Wassonville Dolomite. Collinson and his associates at the Illinois Geological Survey published reports of Mississippian conodonts from several localities in Iowa and Illinois during the late 1950's and early 1960's. This work culminated with a 1962 publication that proposed a zonal classification of the Mississippian of the Mississippi Valley consisting of 17 conodont assemblage zones. These zones were correlated to other North American conodont faunas and to the faunas from the standard Lower Carboniferous reference sections of Europe.

A description of the current understanding of Mississippian conodont zonation in North America is available in Collinson, Rexroad and Thompson's 1971 paper in the *Geological Society of America Memoir 127*. Table 1 lists these Mississippian conodont zones and indicates which are recognized in Iowa. The sections that follow are summarized primarily from Collinson and others (1971).

Nomenclature of Mississippian Units in Iowa

The column of Mississippian Units as recognized by the Iowa Geological Survey is shown in Figure 1. The discussion will start with the lowermost unit, the McCraney, and work up the column to progressively younger units. A brief section has been included on the English River Siltstone because it has been considered to be both Devonian and/or Mississippian in age.

English River Formation

The type locality of the English River Siltstone is in Washington County. At the type locality the English River does not contain any conodonts that are definitely restricted to the Mississippian (Klapper, personal communication in Dorheim and others, 1969, p. 25).

House (1962) dated an exposure of the English River at Burlington in southeast Iowa as Devonian because of the presence of late Devonian ammonoids. Collinson (1961) and Collinson and others (1967, p. 968) reported Upper Devonian conodonts from this locality.

The Iowa Geological Survey places the Devonian-Mississippian boundary at the top of the English River and below the North Hill Group "for mapping, subsurface logging and other utilitarian purposes." (Dorheim and others, 1969, p. 27.)

		CENTRAL	SOUTHEAST
Meramec		Ste. Genevieve	Ste. Genevieve
		St. Louis	St. Louis Spergen
Osage		Warsaw	Warsaw
		Keokuk	Keokuk
		Burlington	Burlington Fm. Cedar Fork Mbr. Haight Creek Mbr. Dolbee Creek Mbr.
Kinderhook		Gilmore City Hampton Fm. Iowa Falls Mbr. Eagle City Mbr. Maynes Creek Mbr.	Hampton Fm. Wassonville Mbr.
	North Hill Group	Chapin Prospect Hill McCraney	Starrs Cave Prospect Hill McCraney

Figure 1. Nomenclature of Mississippian units in Iowa.

KINDERHOOK SERIES

The North Hill Group

The North Hill Group is recognized as the lowermost Mississippian unit in Iowa. The divisions of the North Hill Group as recognized by the Iowa Geological Survey are shown below:

(Central Iowa)	(Southeast Iowa)
Chapin Fm.	Starrs Cave Fm.
Prospect Hill Fm.	Prospect Hill Fm.
McCraney Fm.	McCraney Fm.

McCraney Fm.: Conodonts are not abundant in the McCraney Formation. Scott and Collinson (1961) reported that they processed over 90 pounds of limestone to recover 33 conodont specimens. They reported *Siphonodella cooperi*, *Siphonodella duplicata*, *Polygnathus communis*, *Elictognathus laceratus*, and *Dinodus fragosus* from the McCraney Formation at Burlington, Iowa. They noted that the conodont fauna of the McCraney was similar to faunas found in the Prospect Hill and Wassonville formations.

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Table 1: North American Conodont Zones (Mississippian)
(from Collinson and others 1971)

CONODONT ZONES OF THE CHESTERIAN SERIES	Main Occurrence
<i>Gnathodus girtyi simplex</i> Zone (Webster, 1969)	Ill. Basin
<i>Streptognathodus unicornis</i> Zone (Collinson, Scott and Rexroad, 1962)	Ill. Basin
<i>Kladognathus-Cavusgnathus naviculus</i> Zone (Collinson, Scott and Rexroad, 1962; Rexroad and Nicoll, 1965)	Ill. Basin
<i>Kladognathus primus</i> Zone (Collinson, Scott and Rexroad, 1962; Rexroad and Nicoll, 1965)	Ill. Basin
<i>Gnathodus bilineatus-Kladognathus mehli</i> Zone (Collinson, Scott and Rexroad, 1962)	Ill. Basin
<i>Gnathodus bilineatus-Cavusgnathus altus</i> Zone (Collinson, Scott and Rexroad, 1962)	Ill. Basin
<i>Gnathodus bilineatus-Cavusgnathus charactus</i> Zone (Collinson, Scott and Rexroad, 1962)	Ill. Basin; * Pella Beds
CONODONT ZONES OF THE VALMEYERAN SERIES	
<i>Apatognathus scalenus-Cavusgnathus</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *?St. Louis
<i>Taphrognathus varians-Apatognathus</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *Warsaw, *Spargen, *St. Louis
<i>Gnathodus texanus-Taphrognathus</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *Keokuk
<i>Gnathodus bulbosus</i> Zone (Thompson, 1967)	SW Mo.
<i>Bactrognathus distortus-Gnathodus cuneiformis</i> (Thompson, 1967)	SW Mo.
<i>Bactrognathus-Taphrognathus</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *Burlington
<i>Bactrognathus-Polygnathus communis</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *Burlington
<i>Bactrognathus-Pseudopolygnathus multistriatus</i> Zone (Thompson, 1967)	SW Mo.
<i>Gnathodus semiglaber-Pseudopolygnathus multistriatus</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S. *?reworked in Burlington
<i>Gnathodus semiglaber-Polygnathus communis carinus</i> Zone (Thompson, 1967; Thompson and Fellows, 1970)	SW Mo.
CONODONT ZONES OF THE KINDERHOOKIAN SERIES	
<i>Siphonodella cooperi hassi-Gnathodus punctatus</i> Zone (Thompson and Fellows, 1970)	SW Mo.
<i>Siphonodella isoticha-S. cooperi</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *Prospect Hill; *Wassonville; *Hampton, *?Gilmore City
<i>Gnathodus delicatus-Siphonodella cooperi cooperi</i> Zone (Thompson and Fellows, 1970)	SW Mo.
<i>Siphonodella quadruplicata-S. crenulata</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; *?Prospect Hill; *?Hampton
<i>Siphonodella lobata-Siphonodella crenulata</i> Zone (Thompson and Fellows, 1970)	SW Mo.; Montana; Wyoming
Lower <i>Siphonodella crenulata</i> Zone (Voges, 1959; Sandberg and Klapper, 1967)	
<i>Siphonodella duplicata</i> Zone (Collinson, Scott and Rexroad, 1962)	*McCraney; *Prospect Hill; Central U.S.
<i>Siphonodella sandbergi-Siphonodella duplicata</i> Zone (Sandberg and Klapper, 1967)	Montana, Wyoming
<i>Siphonodella sulcata</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.
<i>Protognathodus kuehni-P. Kockeli</i> Zone (Collinson, Scott and Rexroad, 1962)	Central U.S.; Utah * if recognized in Iowa Strata

Straka (1968) reported that conodonts he recovered from the McCraney Formation in Washington County resembled those described by Scott and Collinson (1961) from the McCraney at Burlington. The Washington County fauna was characterized by the presence of *Siphonodella cooperi*, *Siphonodella quadruplicata*, and *Polygnathus communis*.

Prospect Hill Siltstone: The Prospect Hill conodont fauna is well known. Thomas (1949) recovered conodonts from the Prospect Hill Siltstone in Des Moines, Louisa and Washington counties. Conodonts that Thomas listed as coming from the "English River" in Washington County apparently came from the Prospect Hill Siltstone.

Youngquist and Patterson (1949) also described conodonts from the Prospect Hill "sandstone" from Des Moines, Louisa and Washington counties.

Collinson (1961, p. 107) stated that the Prospect Hill Formation contains an abundant conodont fauna closely similar to that of the upper Chouteau.

Straka (1968) described the Prospect Hill conodont fauna from Washington County and stated that "the conodont fauna from the upper Prospect Hill and the entire Wassonville Formation closely resembles that of the *Siphonodella isoticha* - *S. cooperi*" Zone of Collinson and others (1962).

Anderson (1969, p. 919) listed conodonts from the Prospect Hill from several locations in northern Iowa. This fauna is similar to that described by Straka (1968).

Starrs Cave and Chapin: The Starrs Cave (southeast Iowa) and the Chapin (north-central Iowa) are shown as the uppermost members of the North Hill Group by the Iowa Geological Survey.

To my knowledge no conodonts have been reported from the Starrs Cave Formation (see also Collinson 1961, p. 108). Anderson (1964) processed the Chapin for conodonts and reported that unit was barren.

Hampton Formation: The Iowa Geological Survey recognizes the following members as composing the Hampton Formation:

(Central)	(Southeast)
Iowa Falls Member	Hampton Formation
Eagle City Member	
Maynes Creek Member	Wassonville Formation

Maynes Creek Member and Wassonville Formation: Anderson (1969, p. 919) reported *Elictognathus laceratus*, *Polygnathus*, *Siphonodella obsoleta*, and *Siphonodella quadruplicata* from the Maynes Creek Member in northern Iowa.

Youngquist and Downs (1951) reported a sparse conodont fauna from the Wassonville Dolomite in southeastern Iowa. Their fauna contained specimens of *Siphonodella*. Straka, however, (1968, p. 16) reported that these specimens were apparently recovered from strata which are now recognized as the Prospect Hill Formation.

Straka (1968, p. 10) reported the following conodonts from the Wassonville Formation in Washington County: *Polygnathus marginata*, *Elictognathus laceratus*, *Polygnathus longipostica*, *Polygnathus inornata*, *Polygnathus communis* and *Siphonodella cooperi*. The Wassonville is overlain disconformably by the Burlington Formation in Washington County. Therefore, the Kinderhookian is incomplete in those areas.

Eagle City-Iowa Falls Member: Anderson (1969, Table 1, p. 919) reported small faunas consisting of species of *Polygnathus* and *Siphonodella* from the Eagle City and Iowa Falls members of the Hampton Formation from three localities in northern Iowa. Following the reasoning of Thomas

(1960) he considered the Eagle City-Iowa Falls as facies and treated them as one unit. The presence of *Siphonodella obsoleta* in the Iowa Falls lithology was noted as indicating a correlation of the Eagle City-Iowa Falls member with the upper Hannibal-Chouteau of the standard Mississippi Valley sequence. Collinson and others (1971, fig. 2) recognize three distinct conodont zones within the upper Hannibal-Chouteau interval.

Gilmore City Formation: Little is known regarding conodonts in the Gilmore City Formation. In a brief paper given at the 1969 Academy of Science Meeting in Cedar Falls, Davis and Anderson reported a small conodont fauna from the Gilmore City Formation in Pocahontas and Hardin counties. The fauna included species of *Spathognathodus*, *Siphonodella*, *Polygnathus*, *Neoprioniodus* and *Patrognathus*.

No specific identifications were made but the presence of *Siphonodella* was taken as evidence for a Kinderhookian age for the conodont fauna. The specimens of *Siphonodella* recovered were poorly preserved juvenile forms. Some of these specimens have since been lost.

Anderson (1969, Table 1, p. 919) had previously listed *Neoprioniodus scitulus* and a species of *Patrognathus* from the Gilmore City Formation. These forms were not considered to be diagnostic for correlation purposes but since then Klapper (1971) reported the association of *Patrognathus* with late Kinderhookian species of *Siphonodella* from the subsurface of Kansas and Nebraska. Klapper's study demonstrated that a species of *Patrognathus* (*P. andersoni*) occurs with Kinderhookian species of *Siphonodella* at localities in Kansas and Montana. He concluded that the association of *Patrognathus andersoni* with species of *Siphonodella* indicated that "*P. andersoni* is of late Kinderhookian age."

Patrognathus andersoni occurs in the Gilmore City Formation at its type locality in Pocahontas County, Iowa (Anderson, 1969, p. 919). This would appear to suggest a late Kinderhookian age for the Gilmore City formation.

OSAGE SERIES

The Iowa Geological Survey recognizes the following formations in the Osage Series:

- Warsaw Formation (youngest)
- Keokuk Formation
- Burlington Formation (oldest)

Workers in other states often include the Warsaw Formation in the overlying Meramec Series. The Illinois Geological Survey uses the term "Valmeyeran Series" for rocks assigned to the Osage and Meramec series.

Burlington Formation: Youngquist, Miller and Downs (1950) published a description of conodonts from a shale bed in upper portion of the Burlington Formation of southeastern Iowa (Louisa County). This fauna was small, consisting of 30 specimens.

Straka (1968, p. 17) reported a sparse conodont fauna from the Burlington Limestone in Washington County, Iowa. He noted that "a basal glauconitic layer of the Burlington contained an admixed, as well as an indigenous fauna." Conodont elements, diagnostic of the *Gnathodus semiglaber*-*Pseudopolygnathus multistriata* and *Bactrognathus*-*Polygnathus communis* Assemblage Zones were recovered from the glauconite unit."

Straka also noted the presence of *Bactrognathus distortus* throughout the "remaining portion of the exposed Burlington

strata" in Washington County. This species is characteristic of the *Bactrognathus-Taphrognathus* Assemblage Zone.

Collinson, Rexroad, and Thompson, (1971, p. 378) reported the presence of the *Bactrognathus-Polygnathus communis* Zone in the Dolbee Creek Member and the lower portion of the Haight Creek Member of the Burlington Formation.

The *Bactrognathus-Taphrognathus* Zone was originally established by Collinson, Scott and Rexroad, (1962) but the zone is now known to be more complex (Collinson and others, 1971, p. 378). The zone includes "all but the lower few feet of the Haight Creek (middle) Member and all of the Cedar Fork (upper) Member of the Burlington Limestone in southeastern Iowa." The zone is bounded below by the earliest occurrence of *Bactrognathus distortus* and above by the earliest consistent occurrence of *Gnathodus texanus*. The zone can now be divided into three distinct parts (see Collinson and others, 1971, p. 378).

There is lithologic and faunal evidence for a nonsequence at the top of the Burlington Formation in the Mississippi Valley.

Keokuk Formation: According to Collinson and others (1971, p. 381) the *Gnathodus texanus-Taphrognathus* zone "essentially coincides with the Keokuk Formation in the type region." Collinson *et al.*, (1962, p. 23) listed the characteristic species of this zone as being *Gnathodus texanus* and *Taphrognathus varians*.

Rexroad and Collinson (1965) described conodonts from the Keokuk, Warsaw and Salem formation of Illinois. Three of their 16 collecting localities were in southeastern Iowa. Rexroad and Collinson noted that specimens described by Branson and Mehl (1941) as representative of the Keokuk Formation probably came from the Warsaw or Salem formations. According to Rexroad and Collinson "*Gnathodus texanus* dominates the Keokuk collection at 78 percent of the fauna. *Taphrognathus* is next at only 7 percent, and the remaining genera are minor."

Warsaw and Spergen (Salem) formations: These formations are considered together since they are characterized by only one significant conodont fauna (see Rexroad and Scott, 1965, p. 4). The *Taphrognathus varians-Apatognathus* Zone occurs in the Warsaw, Salem (Spergen) and lower part of the St. Louis formations in the Mississippi Valley. The zone is recognized by the lowest common occurrence of *Taphrognathus*.

The upper limit of the zone is distinguished by the earliest common occurrence of *Cavusgnathus*, the earliest abundance of *Apatognathus* and the latest common occurrence of *Taphrognathus*. *Gnathodus texanus* is common in the lower half of the zone and *Neoprioniodus loxus* is essentially limited to the zone (Collinson and others, 1971, p. 382).

Rexroad and Collinson (1965, p. 4) stated that "in the Warsaw, *Gnathodus* represented 44% of the specimens and *Taphrognathus* 20%; in the Salem (a Spergen equivalent) *Gnathodus* represents 3% and *Taphrognathus* 58%."

MERAMEC SERIES

The Iowa Geological Survey recognizes the following divisions of the Meramec Series:

Ste. Genevieve

St. Louis

Spergen

Spergen Formation: The Spergen (Salem) conodont fauna was discussed above because of its similarity with the Warsaw fauna.

St. Louis Formation: The *Taphrognathus varians-Apatognathus* zone occurs in the lower part of the St. Louis Formation (see Collinson *et al.*, 1971, p. 382).

According to Collinson (*et al.*, 1971, p. 382) the *Apatognathus scalenus-Cavusgnathus* zone is well defined and easily recognizable. It occurs in the upper part of the St. Louis Formation in the central United States.

Rexroad and Collinson (1963) illustrated conodont faunas from the St. Louis Formation of Illinois, Indiana and Missouri. They illustrated species typical of the *Apatognathus scalenus-Cavusgnathus* zone.

This zone is marked at the top of the youngest common occurrences of *Apatognathus* and *Spathognathodus scitulus*. The lower boundary coincides with the earliest common occurrence of *Cavusgnathus* and the youngest occurrence of *Taphrognathus*. Common species within the zone include *Apatognathus porcatus*, *A. scalenus*, *Ozarkodina laevipostica* and *Neoprioniodus tulensis*. The upper boundary of this zone represents a sharp conodont faunal break and is traceable over several states (Collinson *et al.*, 1971, p. 382).

Ste. Genevieve Formation: The "Pella Beds" of south central Iowa are considered to be equivalents of the Ste. Genevieve Formation. The Pella Beds yield an abundant conodont fauna which has been described by Rexroad and Furnish (1964). They described a conodont fauna consisting of 25 conodont species based on more than 5,000 total specimens.

Correlation of the Pella Formation with the Ste. Genevieve seems likely according to Rexroad and Furnish (1964, p. 669). They referred the Pella fauna to the *Gnathodus bilineatus-Cavusgnathus charactus* zone of the standard Mississippi Valley sequence and stated "because the *Gnathodus bilineatus-Cavusgnathus charactus* Assemblage zone straddles the Valmeyer-Chester boundary as it is currently conceived, discussion of Chester versus Valmeyer affinities is futile except for the statement that the Ste. Genevieve conodont fauna is sharply different from the underlying formations of the Valmeyer Series but is closely similar to, if not identical with, the conodonts of the overlying Chester Series."

This is the youngest Mississippian conodont fauna recognized in Iowa. Collinson and others (1971, p. 383) place the *Gnathodus bilineatus-Cavusgnathus charactus* Zone in the Chesterian Series.

Summary and Conclusions:

Six to eight distinct conodont faunas are present in the Mississippian rocks of Iowa. These faunas are related to the standard Mississippian conodont zones (see Table 1).

In the interval of time since the establishment of the standard conodont zonations, research has demonstrated that conodont distribution and occurrence is influenced more by environmental conditions than was previously recognized. Also the conodont taxonomy based on individual conodont specimens is slowly giving way to a taxonomy based on a "restoration" of discrete conodonts into conodont assemblages. Future conodont research in these two areas should prove to be fruitful.

REFERENCES CITED

- ANDERSON, W. I. 1964. Upper Devonian and Lower Mississippian conodont faunas, north-central Iowa. *Proc. Iowa Acad. Sci.*, 71:320-334.
- _____. 1969. Lower Mississippian conodonts from Northern Iowa. *Jour. Paleontology*, 43:916-929, Pls. 107-109.
- BRANSON, E. B., and M. G. MEHL. 1941. Conodonts from the Keokuk formation. *Jour. Sci. Labs.*, Denison Univ., Granville, Ohio, 35:179-188.
- COLLINSON, C. 1961. The Kinderhookian Series in the Mississippi Valley. *Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook*, 100-109.
- _____. 1961. The Kinderhookian Series in the Mississippi Valley. *Missouri Div. Geol. Survey and Water Resources Rept. Inv.*, 27:100-109.
- _____. 1967. Devonian of the north-central region, United States, in International Symposium on the Devonian System. *Alberta Soc. Petroleum Geologists*, 1:933-971.
- _____, A. J. SCOTT, and C. B. REXROAD. 1962. Six charts showing biostratigraphic zones and correlations based on conodonts from the Devonian and Mississippian rocks of the upper Mississippi Valley. *Ill. Geol. Survey Circ.*, 328:32pp.
- _____, C. B. REXROAD, and T. L. THOMPSON. 1971. Conodont zonation of the North American Mississippian. *Geol. Soc. of Amer. Memoir*, 127:353-394.
- DAVIS, J. B., and W. I. ANDERSON. 1969. Conodonts from the Gilmore City Formation. Reported at the 1969 meeting of the Iowa Academy of Science, Cedar Falls, Iowa.
- DORHEIM, F. H., D. L. KOCH, and M. C. PARKER. 1969. The Yellow Spring Group of the Upper Devonian in Iowa. *Ia. Geol. Survey Report of Investigations*, No. 9:30 pp.
- HOUSE, M. R. 1962. Observations on the Ammonoid Succession of the North American Devonian. *Jour. Paleon.*, 36:247-284, pls. 43-48.
- KLAPPER, G. 1971. *Patrognathus* and *Siphonodella* (Conodonts) from the Kinderhookian (Lower Mississippian) of Western Kansas and Southwestern Nebraska. *Bull.* 202, Part 3, State Geol. Survey, Lawrence, Kans.
- REXROAD, C. B., and C. COLLINSON. 1961. Preliminary range chart of conodonts from the Chester Series (Mississippian) in the Illinois Basin. *Ill. Geol. Survey Circ.*, 319:1-11, Pl. 1.
- _____, and _____. 1963. Conodonts of the St. Louis Formation (Valmeyeran Series) of Illinois, Indiana, and Missouri. *Ill. Geol. Survey Circ.*, 355:1-28, Pls. 1, 2.
- _____, and _____. 1965. Conodonts from the Keokuk, Warsaw and Salem Formations (Mississippian) of Illinois. *Ill. Geol. Survey Circ.*, 388:1-26, Pl. 1.
- _____, and W. M. FURNISH. 1964. Conodonts from the Pella Formation (Mississippian) of south-central Iowa. *Jour. Paleon.*, 38:667-676.
- _____, and R. S. NICOLL. 1965. Conodonts from the Menard Formation (Chester Series) of the Illinois Basin. *Indiana Geol. Survey Bull.*, 35:1-28, Pls. 1, 2.
- SANDBERG, C. A., and G. KLAPPER. 1967. Stratigraphy, age, and paleotectonic significance of the Cottonwood Canyon Member of the Madison Limestone in Wyoming and Montana. *U.S. Geol. Survey Bull.*, 1251-B:1-70.
- SCOTT, A. J., and C. COLLINSON. 1961. Conodont faunas from the Louisiana and McCraney Formations of Illinois, Iowa, and Missouri. *Missouri Div. Geol. Survey and Water Resources Rept. Inv.*, 27:110-141, Pls. 1, 2.
- STRAKA, J. J. 1968. Conodont zonation of the Kinderhookian Series, Washington County, Iowa. *Iowa Univ. Studies in Nat. Hist.*, 21(2):1-71, Pls. 1-7.
- THOMAS, L. A. 1949. Devonian-Mississippian formations of south-east Iowa. *Geol. Soc. Amer. Bull.*, 60:403-438, Pls. 1-4.
- _____. 1960. Guidebook for the twenty-fourth annual Tri-State Geological Field Conference.
- THOMPSON, T. L. 1967. Conodont zonation of lower Osagean rocks (Lower Mississippian) of southwestern Missouri. *Missouri Div. Geol. Survey and Water Resources Rept. Inv.*, 39:88 pp., 6 pls.
- _____, and L. D. FELLOWS. 1970. Stratigraphy and conodont biostratigraphy of Kinderhookian and Osagean (Lower Mississippian) rocks of southwestern Missouri and the adjacent area. *Missouri Div. Geol. Survey and Water Resources Rept. Inv.* 45.
- VOGES, A. 1959. Conodonten aus dem Unterkarbon I und II (Gattendorfiaund Pericyclus-Stufe) des Sauerlandes. *Palaont. Zeitschr.*, 33(4):266-314, Pls. 33-35.
- WEBSTER, G. D. 1969. Chester through Derry conodonts and stratigraphy of northern Clark and southern Lincoln Counties, Nevada. *Calif. Univ. Pub. Geol. Sci.*, 79:121 pp., 8 pls.
- YOUNGQUIST, W., and H. R. DOWNS. 1951. Conodonts from the Lower Mississippian Wassonville Dolomite of Iowa. *Jour. Paleon.*, 25:785-792, Pl. 111.
- _____, and A. K. MILLER. 1949. Conodonts from the Late Mississippian Pella beds of south-central Iowa. *Jour. Paleon.*, 23:617-622, Pl. 101.
- YOUNGQUIST, W., A. K. MILLER, and H. R. DOWNS. 1950. Burlington conodonts from Iowa. *Jour. Paleon.*, 24:525-530, Pl. 67.
- _____, and S. H. PATTERSON. 1949. Conodonts from the Lower Mississippian Prospect Hill Sandstone of Iowa. *Jour. Paleon.*, 23:57-73, Pls. 15-17.