STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION

SIX CHARTS SHOWING BIOSTRATIGRAPHIC ZONES, AND CORRELATIONS BASED ON CONODONTS FROM THE DEVONIAN AND MISSISSIPPIAN ROCKS OF THE UPPER MISSISSIPPI VALLEY

Charles Collinson
Alan J. Scott
Carl B. Rexroad

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ADDENDUM

Chart 1 - Studies completed after this report had gone to press have extended the range of *Bactrognathus* downward to the base of the "Sedalia" Formation.

ERRATA

Page 3, paragraph 1, line 5 - "no. 3" should read "no. 4".
Page 12, paragraph 9, lines 4 and 5 - "*Polygnathus rhenana*, and *Polygnathus triangularis*" should read "*Palmatolepis rhenana*, and *Palmatolepis triangularis*."
Page 32, line 22 - "wightiger" should reach "wichtiger".

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ABSTRACT

Six charts are presented and are titled: (1) Preliminary Chart, Ranges of important Devonian and Mississippian conodont genera in the Mississippi Valley; (2) Ranges of important species of Siphonodella; (3) Preliminary Chart, Ranges of important species of Gnathodus; (4) Ranges of conodont species from the Chesterian Series; (5) Correlation of European goniatite zones with Upper Devonian and Mississippian sections in the Mississippi Valley; and (6) Upper Devonian and Mississippian conodont assemblage zones in the Mississippi Valley.

Each chart uses revised ranges of important conodont genera, and three charts incorporate new ranges for species of Gnathodus and Siphonodella. Altogether 22 new conodont assemblage zones are delimited in the Upper Devonian, Kinderhookian, Valmeyeran, and Chesterian Series and their correlation to equivalent zones in western Europe is shown. No new genera or species are named, although several are described briefly or illustrated diagrammatically.

INTRODUCTION

Conodonts are ubiquitous and abundant in Upper Devonian and Mississippian rocks of the Upper Mississippi Valley and are considered to be among the most useful fossils for correlation of strata. For these reasons, the Illinois State Geological Survey, in cooperation with The University of Texas, The State

University of Iowa, Texas Technological College, the University of Houston, and the Indiana Geological Survey, has for some years conducted a program of research on conodonts in this region. Data from these projects have accumulated at a rate much greater than that at which they can be readied for publication and the present report has been prepared so that gross results of this continuing research will be available for use in stratigraphic correlation. Detailed reports on various aspects of conodont study covered by these six charts will be published later.

The six charts included here are modifications of those presented at the November 1961 annual meeting of the Geological Society of America (Collinson, Scott, & Rexroad, 1961). They are based mainly on original work by the authors and their students (Burton, 1959; Clarke, 1959; Collinson, 1961a, 1961b; Collinson, Rexroad, & Scott, 1959; Collinson, Scott, & Rexroad, 1961; Collinson & Swann, 1958; Jarrell, 1961; Liebe, 1959; Rexroad, 1957, 1958a, 1958b; Rexroad & Burton, 1961; Rexroad & Clarke, 1960; Rexroad & Jarrell, 1961; Rexroad & Liebe, in press; Scott, 1957, 1961; Scott & Collinson, 1959, 1961) but the work of German authors (Ziegler, 1959, 1960, 1962a, 1962b; Bischoff, 1956, 1957; Voges, 1959, 1960; and Helms, 1961) is relied on heavily for correlation of the Mississippi Valley section to western Europe, as well as for verification of conodont ranges and identifications. Especially valuable in confirming ranges and phylogenetic relationships of conodont species were lengthy discussions with Dr. Willi Ziegler of the Geologische Landesamt Nordrhein-Westfalen. His help is gratefully acknowledged.

Deserving special mention for assistance in preparing this report are May Defandorf (1960) for making possible detailed correlation to the Barnett and Chappel Formations of Texas, Gilbert Klapper for discussions concerning the Kinderhookian and Upper Devonian faunal sequences, and John Huddle for photographs of the Ulrich & Bassler (1926) type specimens. The final critical reading of the manuscript was done by H. B. Willman, who made numerous contributions.

Information from the following unpublished manuscripts, which will be submitted to journals in 1962, is incorporated in the charts:

1. "Conodonts of the St. Louis Formation (Valmeyeran) of the Illinois Basin" by Rexroad & Collinson.

2. "Conodonts of the Valmeyeran Series in the Illinois Basin" by Rexroad & Collinson.

3. "Systematics and phylogenetic development of the conodont genus Gnathodus in the Mississippi Valley" by Alan J. Scott.

4. "New conodont genera and species from the Saverton Formation (Upper Devonian) of the Mississippi Valley" by Alan J. Scott.

In the following discussion, as well as on the charts themselves, numerous references are made to the abundant, common, uncommon, or rare occurrence of conodont species. In such references, the following approximate limits per kilogram of sample apply: abundant >3, common 1-3, uncommon 1, rare <1.

Copies of all six charts, approximately 20 by 30 inches, are available from the Illinois State Geological Survey, Urbana, for 30 cents each.

CHART 1
PRELIMINARY CHART
RANGES OF IMPORTANT DEVONIAN AND MISSISSIPPIAN CONODONT GENERA IN THE MISSISSIPPI VALLEY

Chart 1 brings up to date the stratigraphic ranges of 25 of the most important Upper Devonian-Mississippian conodont genera. Ranges of 11 of the genera are based on unpublished information and represent new stratigraphic limits for the genera. Two genera, n.gen.A and n.gen.B, soon are to be published (see p. 2, list of unpublished manuscripts, no. 3).

Among the genera for which ranges have been revised, four, Icriodus, Ancyrognathus, Polylophodonta, and Ancyrodella, are closely related stratigraphically. All have been reported (Branson, 1938) to occur as high as the Louisiana Limestone in the Mississippi Valley, but Scott & Collinson (1961) have indicated that the beds from which the "Louisiana" collection was made should be referred to the Saverton Formation. Recent discussions with W. Ziegler (personal communication, 1961) and comparisons of first appearances of forms occurring with these genera in carefully determined zones in Germany (Ziegler, 1962a; Helms, 1961) lead the authors to consider Icriodus, Ancyrognathus, Polylophodonta, and Ancyrodella as reworked where they occur above the Sylamore Sandstone.

Pelekysgnathus has not been recorded previously from above the middle of the Saverton Formation, but the authors have examined specimens from the "Glen Park" that appear referable to the genus. They may, however, represent an unusual form of Spathognathodus.

Although Youngquist, Miller, & Downs (1950) reported Polygnathus? from the upper part of the Burlington Formation, it seems very likely that their specimen should be referred to Pseudopolygnathus. Our own collections indicate that Polygnathus is found only as high as the middle of the Burlington.

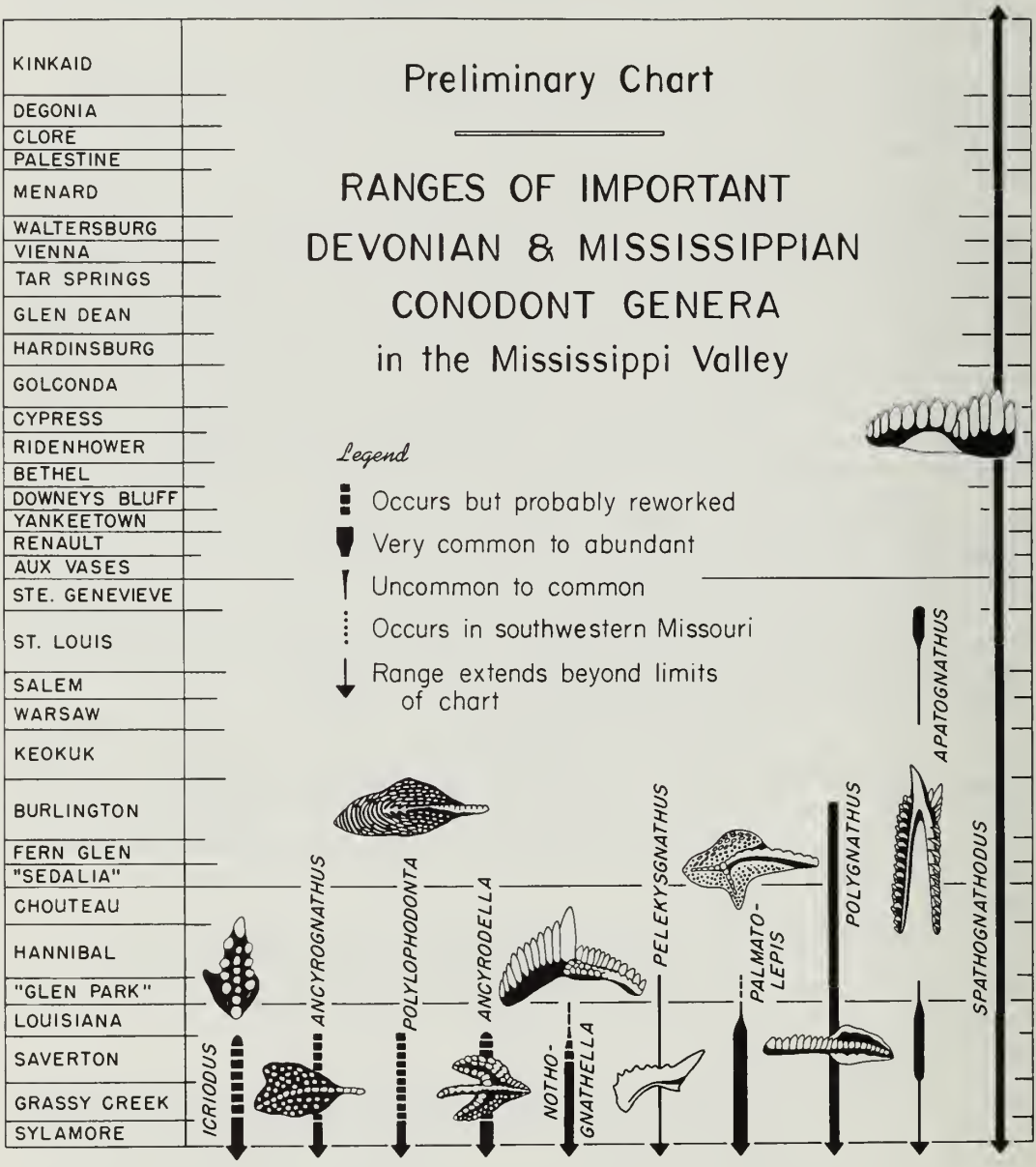
The discontinuous range of Apatognathus reinforces our belief that the apatognathids from the upper part of the Valmeyeran Series represent homeomorphs of early Mississippian forms. The homeomorphs presumably arose from Synprioniodina and are not related closely to Kinderhookian forms of Apatognathus.

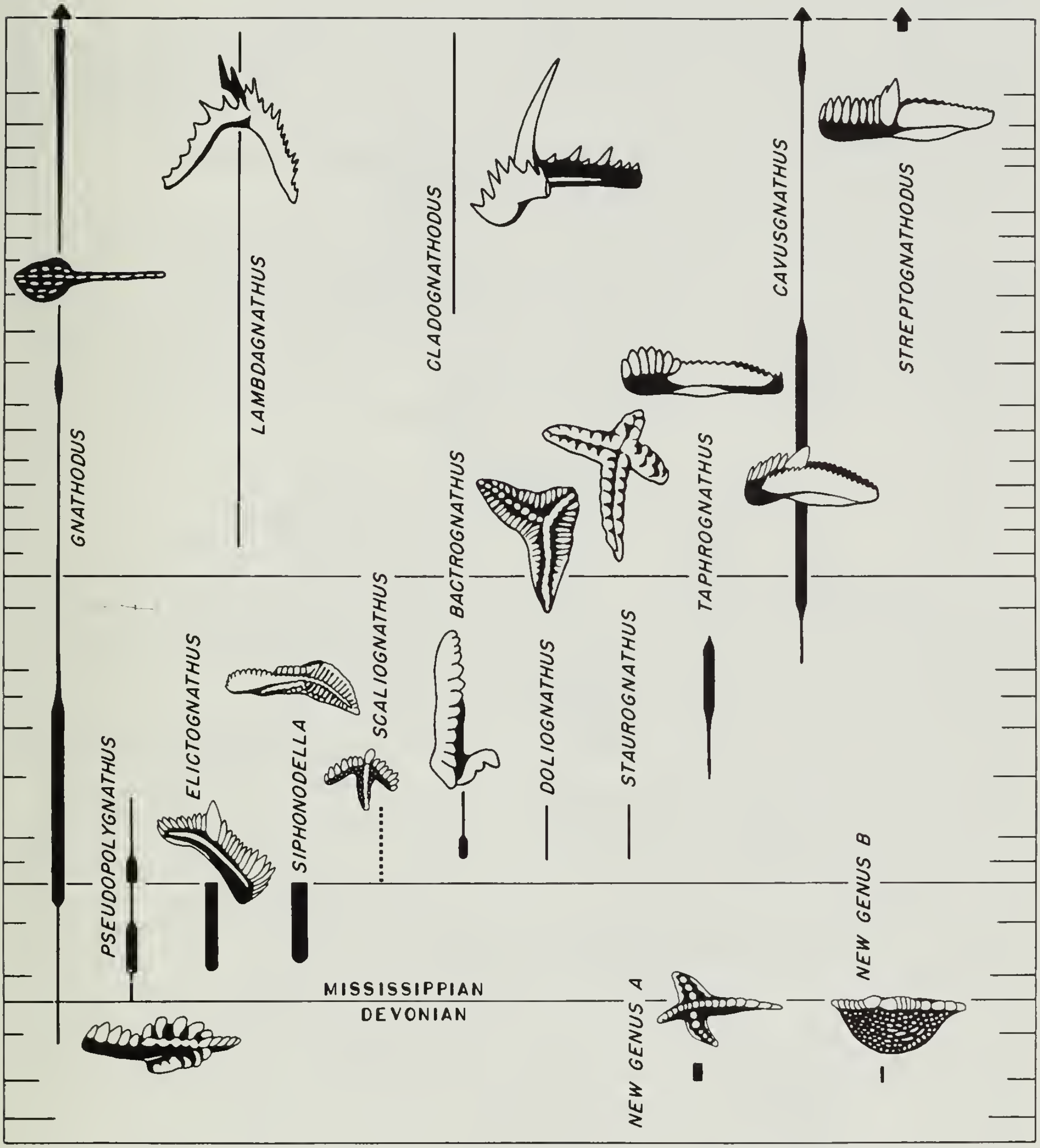
Elictognathus is restricted in range to the Chouteau-Hannibal sequence, as is Siphonodella, although the latter does not occur in the oldest parts of the Hannibal Formation (Chart 2).

Scaliognathus has not been found in the Mississippi Valley although it was originally described from the Pierson Formation ("Sedalia" equivalent) of southwestern Missouri. Because the fauna with which Scaliognathus is generally associated is found in the Mississippi Valley, the range published here is inferred from the Missouri occurrence.

To date, Bactrognathus has been found to occur only as high as the upper part of the Burlington Formation. Especially useful to the stratigrapher is a zone in which the genus occurs abundantly in the Fern Glen Formation and in the lowermost part of the Burlington Formation.

Taphrognathus is common to abundant throughout most of its range and therefore marks an easily recognized zone. Forms transitional between Taphrognathus


KINKAID
DEGONIA
CLORE
PALESTINE
MENARD
WALTERSBURG
VIENNA
TAR SPRINGS
GLEN DEAN
HARDINSBURG
GOLCONDA
CYPRESS
RIDENHOWER
BETHEL
DOWNEYS BLUFF
YANKEETOWN
RENAULT
AUX VASES
STE. GENEVIEVE
ST. LOUIS
SALEM
WARSAW
KEOKUK
BURLINGTON
FERN GLEN
"SEDALIA"
CHOUTEAU
HANNIBAL
"GLEN PARK"
LOUISIANA
SAVERTON
GRASSY CREEK
SYLAMORE
Preliminary Chart
RANGES OF IMPORTANT DEVONIAN & MISSISSIPPIAN CONODONT GENERA
in the Mississippi Valley
Legend
Occurs but probably reworked
Very common to abundant
Uncommon to common
Occurs in southwestern Missouri
Range extends beyond limits of chart
ICRIODUS
ANCYROGNATHUS
POLYLOPHODONTA
ANCYRODELLA
NOTHO-GNATHELLA
PELEKYSGNATHUS
PALMATO-LEPIS
POLYGNATHUS
APATOGNATHUS
SPATHOGNATHODUS


GNATHODUS
LAMBDAGNATHUS
CLADOGNATHODUS
CAVUSGNATHUS
STREPTOGNATHODUS
BACTROGNATHUS
TAPHROGNATHUS
SCALIOGNATHUS
ELICTOGNATHUS
DOLIOGNATHUS
STAUROGNATHUS
PSEUDOPOLYGNATHUS
SIPHONODELLA
NEW GENUS B
NEW GENUS A
MISSISSIPPIAN
DEVONIAN

and Cavusgnathus are found in the lower part of the St. Louis Formation but Taphrognathus is not found above the middle of the St. Louis. In the upper part of the St. Louis, Cavusgnathus becomes abundant and the zone of abundance extends upward to the base of the Glen Dean Formation.

The zones of abundant occurrence shown on Chart 1 are very useful for correlation. The lower zone of abundant occurrence of Pseudopolygnathus, which is widespread and distinctive in the central United States, is an excellent example. Similarly the abundance of Gnathodus serves as a guide to stratigraphic position in the Kinderhookian Series (Chart 3). Also notable are the two abundance zones of Apatognathus that respectively mark the upper part of the Valmeyeran St. Louis Formation and the Kinderhookian Louisiana Formation.

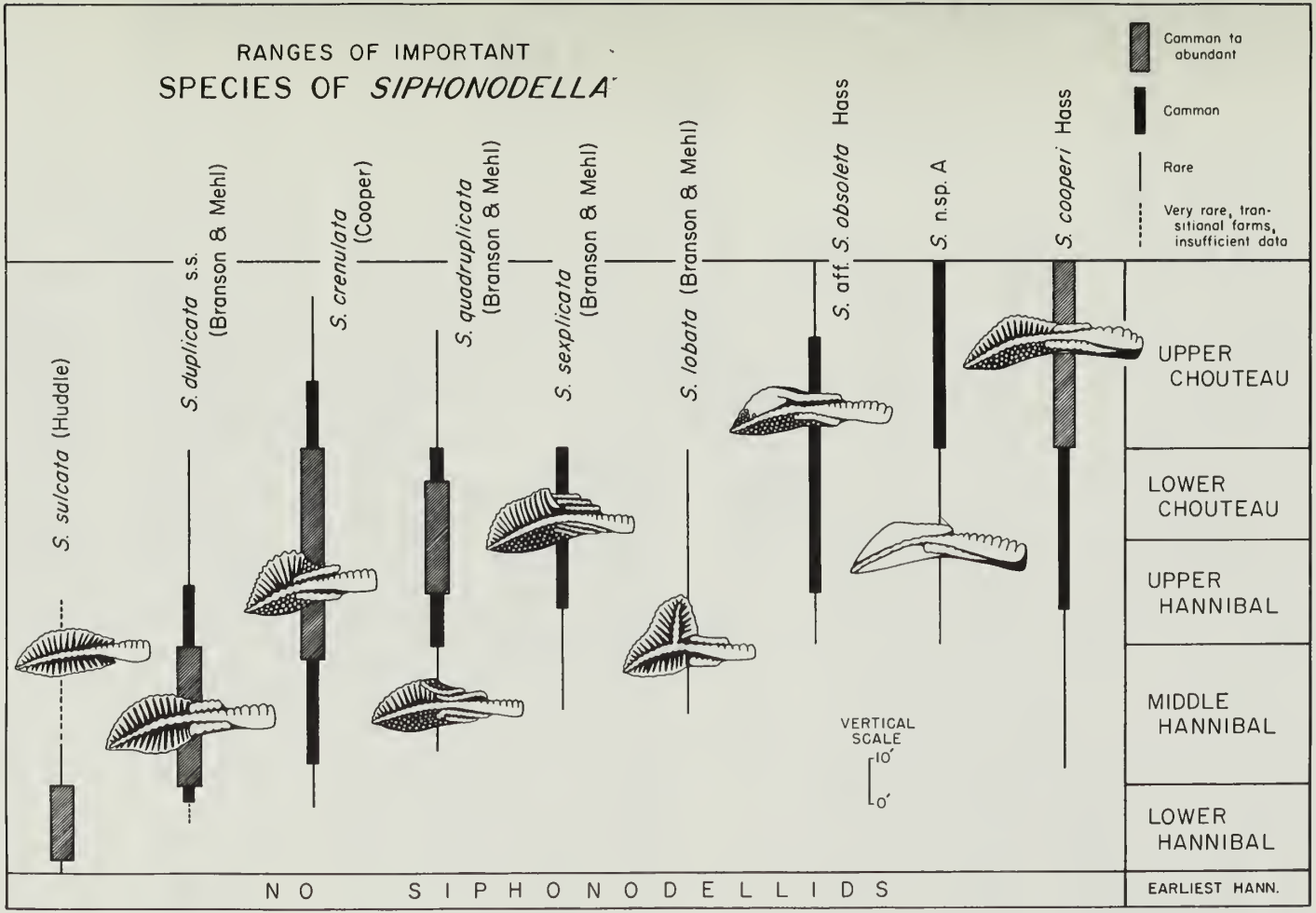
Two new genera with ranges restricted to the lower part of the Saverton Formation are shown on Chart 1. "New genus A" previously has been referred to Ancyrognathus by Branson & Mehl (1934a) but it clearly does not belong in that genus (Müller & Müller, 1957, p. 1094). Accordingly, Scott (see p. 2, list of unpublished manuscripts, no. 4) has proposed a new name for the taxon. In the same report "new genus B" is described and named likewise. Both genera are common to abundant and are restricted in range.

CHART 2
RANGES OF IMPORTANT SPECIES OF SIPHONODELLA

Siphonodella is one of the most useful of all guide fossils in the Kinderhookian Series. Members of the genus are distinctive, short ranging, and of world-wide occurrence. The sequence of ranges shown in Chart 2 is repeated both in western United States (Klapper, 1961, personal communication) and in western Europe (Ziegler, 1961, personal communication).

As used here, Siphonodella is differentiated from Polygnathus, from which it evolved, by the presence of well developed rostral ridges that parallel the median carina on the upper surface. In addition, the lower surface of Siphonodella has at the posterior tip of the unit a low keel that increases in width near the center of the platform. The basal cavity is minute and elongate. The lower surface in Polygnathus typically has a subcircular basal cavity and a narrow median keel. Actually, the two genera grade into each other and the most primitive siphonodellid species, S. sulcata, lacks well developed rostral ridges but does have a low keel with a wide flared medial groove on the lower side. Juvenile representatives of other Siphonodella species closely resemble S. sulcata.

In the Mississippi Valley the stratigraphic span of Siphonodella nearly coincides with the interval of the Hannibal and Chouteau Formations. Lowermost Hannibal, however, is much younger in some places than in others because of overlap onto pre-Hannibal structural features and, where oldest Hannibal beds are present (for example, near Champ Clark Bridge at Louisiana, Missouri), Siphonodella does not occur in the lowermost part of the formation. These oldest Hannibal beds do, however, contain Gnathodus n.sp.A, G. n.sp.B (Chart 3), G. kockeli, Polygnathus longipostica, P. communis, Spathognathodus costatus, S. aculeatus, and Pseudopolygnathus dentilineata. Such a fauna clearly places these beds in the Gnathodus kockeli—Pseudopolygnathus dentilineata Zone of Voges (1960).


RANGES OF IMPORTANT
SPECIES OF SIPHONODELLA
Common to abundant
Common
Rare
Very rare, transitional forms, insufficient data
S. sulcata (Huddle)
S. duplicata s.s. (Branson & Mehl)
S. crenulata (Cooper)
S. quadruplicata (Branson & Mehl)
S. sexplicata (Branson & Mehl)
S. lobata (Branson & Mehl)
S. aff. S. obsoleta Hass
S. n.sp. A
S. cooperi Hass
VERTICAL SCALE
10'
0'
UPPER CHOUTEAU
LOWER CHOUTEAU
UPPER HANNIBAL
MIDDLE HANNIBAL
LOWER HANNIBAL
NO SIPHONODELLIDS
EARLIEST HANN.

Immediately above the nonoccurrence zone of Siphonodella, the primitive species, S. sulcata, is abundant and marks an easily recognized zone.

Occurring in the middle part of the Hannibal is the zone of abundance of Siphonodella duplicata s.s. (Chart 2). S. duplicata evolved directly from S. sulcata and is differentiated from it by two prominent rostral ridges at the anterior of the platform; the posterior portion of the platform is ornamented by transverse ridges. The species is an excellent marker for the middle part of the Hannibal Formation. From S. duplicata addition of ridges gave rise successively to S. quadruplicata and S. sexplicata. A trend toward loss of ornamentation gave rise to S. aff. S. obsoleta and S. n.sp.A.

The "Siphonodella zone" of Mehl (1960, p. 96-98) corresponds to the combined ranges of S. duplicata s.s. and S. crenulata and is found in the middle and upper parts of the Hannibal Formation where the oldest parts of the unit are present. Mehl (1960, p. 98; 1961, p. 91) interpreted the zone to represent the oldest Mississippian in North America.

Two siphonodellids occur commonly in the upper part of the Chouteau Formation in western Illinois. These forms, S. cooperi and S. aff. S. obsoleta, are excellent markers for the interval.

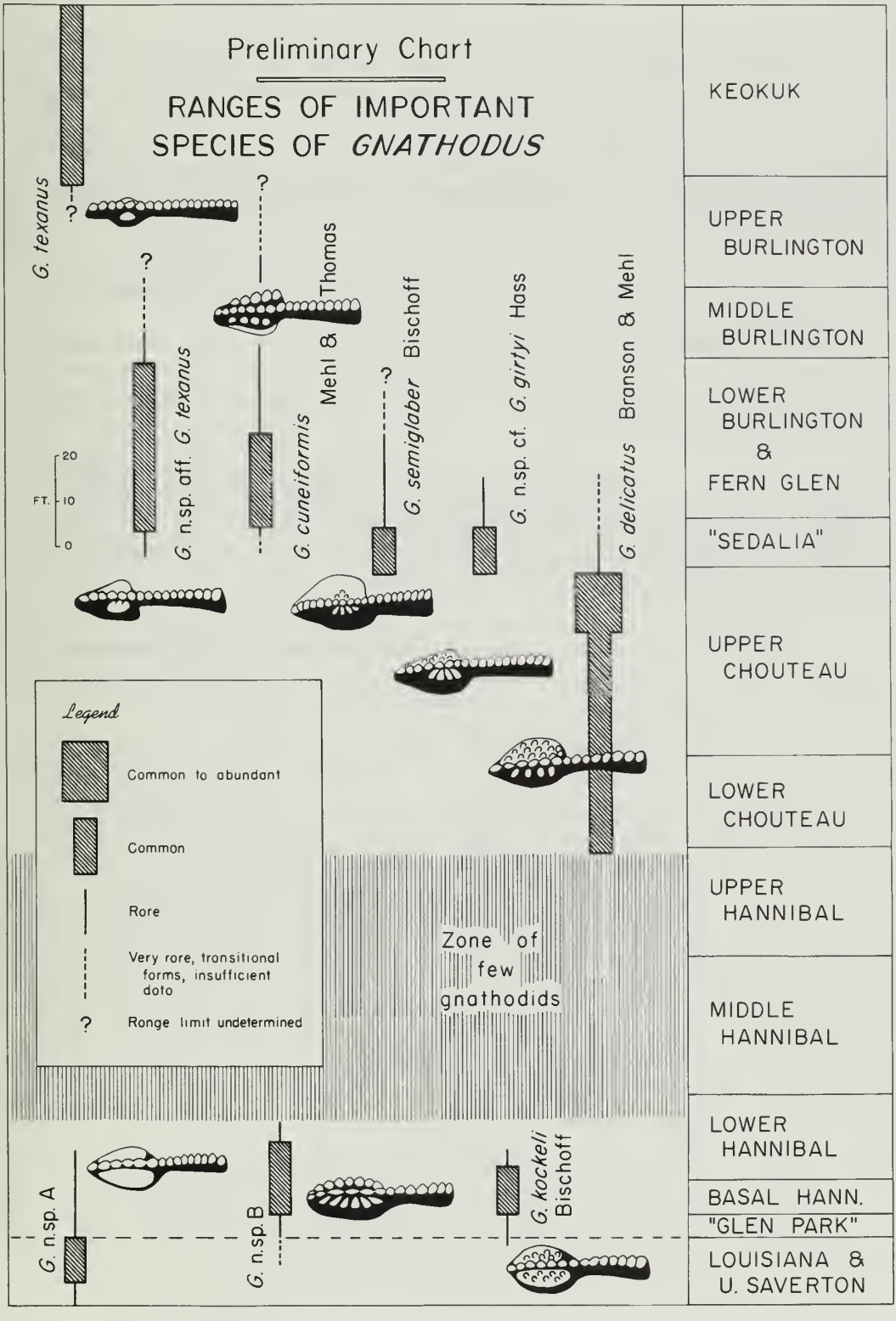
CHART 3
PRELIMINARY CHART
RANGES OF IMPORTANT SPECIES OF GNATHODUS

Chart 3 shows the stratigraphic distribution of important Upper Devonian, Kinderhookian, and Valmeyeran gnathodids in the Upper Mississippi Valley. It is based entirely on collections made and studied by the authors.

Ranges of previously described species have been modified and important unnamed forms are shown. A detailed study discussing the systematics and phylogenetic relationships of Gnathodus (see p. 2, list of unpublished manuscripts, no. 3) is scheduled to be published during the coming year. In it the various unnamed forms shown on Chart 3 will be described and named.

Gnathodids are especially useful for relative age determinations. The genus is represented by a relatively few, distinctive species, which have restricted stratigraphic ranges and occur in sufficient numbers to be useful. Representatives of the genus are especially abundant and useful in the Kinderhookian and Valmeyeran Series.

Until recently the early history of Gnathodus was not well known. Scott & Collinson (1961, p. 115) reported the occurrence of Gnathodus kockeli Bischoff and G. cf. G. commutatus (Branson & Mehl) in the Louisiana Limestone in western Illinois and northwestern Missouri. The latter species, here referred to as Gnathodus n.sp.A, is the oldest and most primitive gnathodid. Transitional specimens indicate that the species evolved from Spathognathodus stabilis (Branson & Mehl) by shifting the basal cavity from a subcentral position to the posterior end of the unit. Gnathodus n.sp.A is a heterochronic homeomorph and is not closely related to G. commutatus s.s. Although G. n.sp.A ranges somewhat higher in the section, it is a useful marker fossil for the Louisiana Limestone and its lateral equivalent, the upper part of the Saverton Shale. These units are considered late Devonian (toVI) in age by Scott & Collinson (1961).


Preliminary Chart
RANGES OF IMPORTANT SPECIES OF GNATHODUS
G. texanus
G. n.sp. aff. G. texanus
G. cuneiformis Mehl & Thomas
G. semiglaber Bischoff
G. n.sp. cf. G. girtyi Hass
G. delicatus Branson & Mehl
FT. 20 10 0
Legend
Common to abundant
Common
Rare
Very rare, transitional forms, insufficient data
? Range limit undetermined
Zone of few gnathodids
G. n.sp. A
G. n.sp. B
G. kockeli Bischoff
KEOKUK
UPPER BURLINGTON
MIDDLE BURLINGTON
LOWER BURLINGTON & FERN GLEN
"SEDALIA"
UPPER CHOUTEAU
LOWER CHOUTEAU
UPPER HANNIBAL
MIDDLE HANNIBAL
LOWER HANNIBAL
BASAL HANN.
"GLEN PARK"
LOUISIANA & U. SAVERTON

Gnathodus kockeli Bischoff is the oldest gnathodid reported from Europe. Bischoff (1957) and Voges (1960) consider this species an important marker for the lower part of the Gattendorfia Stufe (cuI) in western Germany. In the Mississippi Valley, Gnathodus kockeli first appears, and is rare, in the Louisiana Limestone and in the uppermost part of the Saverton Shale. It is present in the fauna of the "Glen Park" Formation and is common in samples from the oldest beds of the Hannibal Formation. This species and a closely related but distinct form, G. n.sp.B, are important index fossils for the oldest conodont fauna of the Hannibal Formation. The writers believe that this zone, the Gnathodus kockeli—G. n.sp.B Zone, is roughly a time equivalent to the Gnathodus kockeli—Pseudopolygnathus dentilineata Zone of Voges (1960) although it probably includes some material slightly older than does the European zone.

Both Gnathodus kockeli and G. n.sp.B range upward stratigraphically and are found associated with Siphonodella sulcata (Huddle), the oldest representative of that genus, and S. duplicata s.s. (Branson & Mehl). Above beds containing S. duplicata s.s., Gnathodus kockeli, and G. n.sp.B, there is a marked change in the conodont fauna. The interval is shown on Chart 3 as "zone of few gnathodids." Siphonodella is the dominant platform element in this fauna and is represented by several species and great numbers of individuals. Ziegler (personal communication, 1961) states that a similar zone, lacking or containing only a few gnathodids, is widespread in western Germany. This zone has led workers to the erroneous conclusion that Gnathodus was introduced into the North American Kinderhookian faunas after the first appearance of Siphonodella.

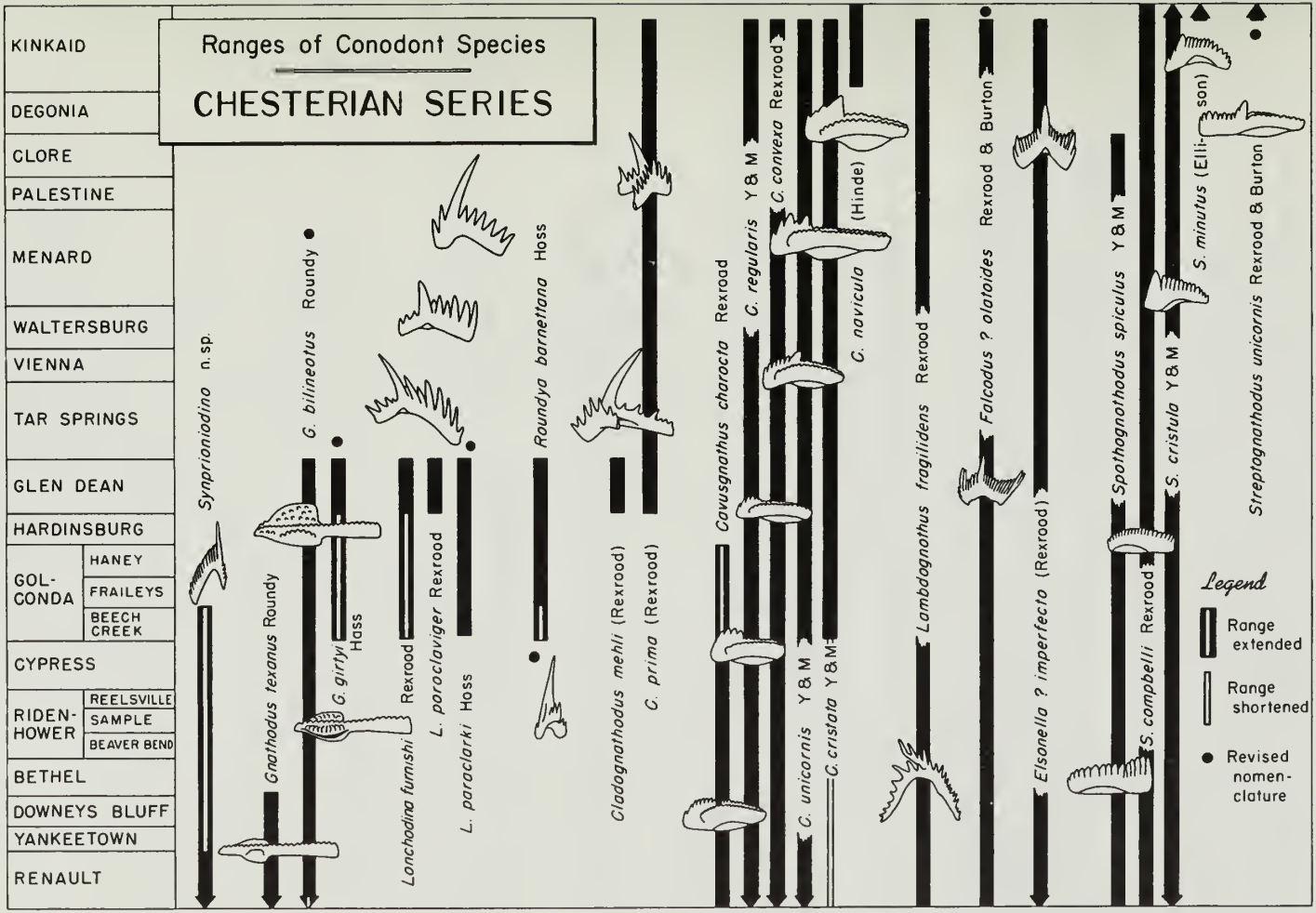
Gnathodus again became numerically important during the deposition of the lower part of the Chouteau Limestone and at the same time there was a corresponding decline in the diversity of the siphonodellids (Chart 2). Gnathodids became increasingly common in the upper part of the Chouteau, with G. delicatus (Branson & Mehl) the most important species.

The "Sedalia" of western Illinois, which is differentiated from the Sedalia of Missouri (Collinson, Swann, & Willman, 1954), is characterized by large numbers of Gnathodus semiglaber (Bischoff), and G. n.sp. cf. G. girtyi Hass. Bischoff (1957) reports Gnathodus semiglaber occurring as low as the upper part of the Siphonodella Subzone (cuIIα/β) and Voges (1959, p. 268) reports it from the upper half of the upper Siphonodella crenulata Zone (Pericyclus Stufe, cuIα).

Mehl & Thomas (1947) have reported the occurrence of Gnathodus texanus Roundy and G. cuneiformis (Mehl & Thomas) from the Fern Glen Formation of eastern Missouri. Our collections from the Fern Glen contain many specimens similar to G. texanus but differing from Roundy's type material in having a larger posterior platform. On Chart 3 these specimens are referred to G. n.sp. aff. G. texanus. G. texanus s.s., which has a small narrow posterior platform, has not been found by us below the uppermost beds of the Burlington but our study of that part of the section is only of a reconnaissance nature.

CHART 4
RANGES OF CONODONT SPECIES FROM THE CHESTERIAN SERIES

Chart 4 is a revision of Plate 1 of Rexroad & Collinson (1961) incorporating results of several studies completed after the work of Rexroad & Collinson and including only the more useful species from the earlier plate.


Ranges of Conodont Species
CHESTERIAN SERIES
KINKAID
DEGONIA
CLORE
PALESTINE
MENARD
WALTERSBURG
VIENNA
TAR SPRINGS
GLEN DEAN
HARDINSBURG
GOLCONDA
HANEY
FRAILEYS
BEECH CREEK
CYPRESS
RIDENHOWER
REELSVILLE
SAMPLE
BEAVER BEND
BETHEL
DOWNEYS BLUFF
YANKEETOWN
RENAULT
Synprioniodina n.sp.
Gnathodus texanus Roundy
G. bilineatus Roundy
G. girtyi Hass
Lonchodina furnishi Rexrood
L. paroclaviger Rexrood
L. paraclarki Hass
Roundya barnettana Hass
Cladognathodus mehli (Rexrood)
C. prima (Rexrood)
Cavusgnathus charocta Rexrood
C. regularis Y & M
C. convexa Rexrood
C. navicula (Hinde)
C. unicornis Y & M
C. cristata Y & M
Lambdognathus fragilidens Rexrood
Falcodus ? olatoides Rexrood & Burton
Elsonella ? imperfecta (Rexrood)
Spathognathodus spiculus Y & M
S. campbelli Rexrood
S. cristula Y & M
S. minutus (Ellison)
Streptognathodus unicornis Rexrood & Burton
Legend
Range extended
Range shortened
Revised nomenclature

Most of the chart revisions result from a detailed study by Rexroad & Jarrell (1961) of conodonts from the Golconda Group throughout the Illinois Basin. Stratigraphically, the authors extended the ranges of five important species. The ranges of Gnathodus girtyi (G. n.sp. of Rexroad & Collinson, 1961), Lonchodina furnishi, and Roundya barnettana (R. costata of Rexroad & Collinson, 1961) were all extended downward to the base of the Golconda. The ranges of Synprioniodina n.sp. and Cavusgnathus characta were extended upward into the Golconda. Nomenclaturally, Rexroad & Jarrell made one major change, that of recognizing Gnathodus n.sp. of the Rexroad & Collinson chart as belonging to the stratigraphically important species, G. girtyi.

Rexroad & Burton (1961) introduced two of the new species names shown on Chart 4. Falcodus? n.sp. of Rexroad & Collinson was named F.? alatoides Rexroad & Burton and Streptognathodus n.sp., of the Rexroad & Collinson chart, was named S. unicornis Rexroad & Burton.

Rexroad & Clarke (1960) first recognized the synonomy of Roundya costata Rexroad and R. barnettana Hass and the species is included here under the latter name.

Rexroad & Liebe (in press) are responsible for restriction of Cavusgnathus cristata to beds younger than the Renault.

Two changes incorporated in Chart 4, not published previously, are the recognition of Gnathodus modocensis Rexroad as a geographic subspecies of G. bilineatus Roundy and the extension of its range downward into the Ste. Genevieve Formation.

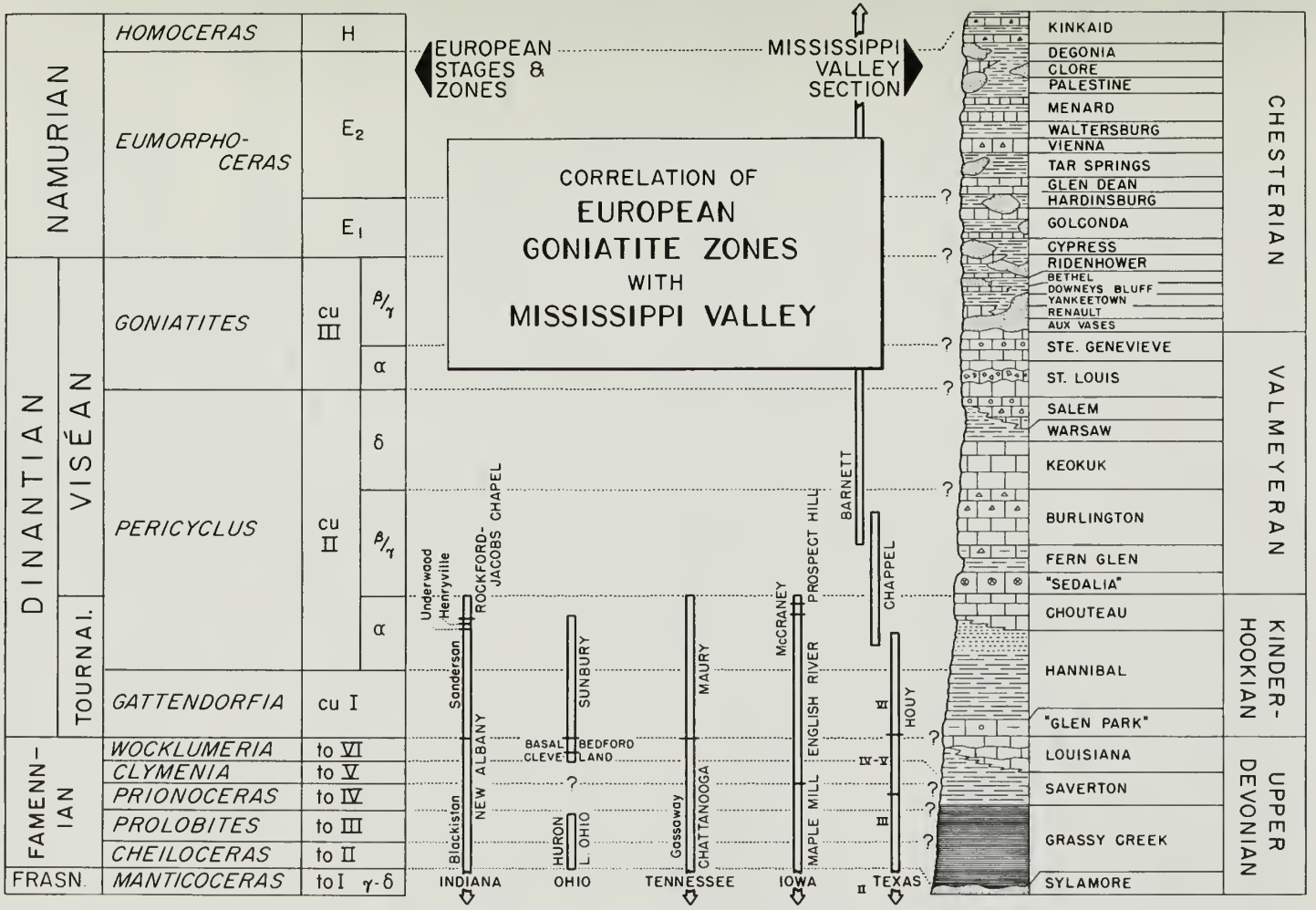
CHART 5
CORRELATION OF EUROPEAN GONIATITE ZONES WITH UPPER DEVONIAN AND MISSISSIPPIAN SECTIONS IN THE MISSISSIPPI VALLEY

Chart 5 summarizes correlations of Upper Devonian and Mississippian sections of the Mississippi Valley with corresponding standard stages and goniatite zones in western Europe. The correlations are based on comparison of American conodont faunas with conodont faunas found in the goniatite zones of Germany and England.

Fundamentally the chart is based on a few zones that can be correlated to Europe with confidence; the remaining zones have been correlated by interpolation.

The best understood portion of the column is the Upper Devonian Series. In Europe, it has been studied intensively by Sannemann (1955a, 1955b), Bischoff (1956, 1957), Bischoff & Ziegler (1956), Müller (1956), Ziegler (1960), and Helms (1959, 1961) and zoned in great detail by Ziegler (1962a). In the Mississippi Valley, the Upper Devonian has been the subject of studies by Branson (1938, 1944), Branson & Mehl (1934a, 1934b), Miller & Youngquist (1947), Youngquist & Miller (1948), Thomas (1949), Scott & Collinson (1961), and Scott (1961).

The oldest formation in the Mississippi Valley Upper Devonian that can be correlated to Europe with confidence is the Sylamore Sandstone which contains the conodont species Ancyrognathus triangularis and Palmatolepis triangularis. These species indicate a correlation with the Ancyrognathus triangularis, Polygnathus rhenana, and Polygnathus triangularis Zones of Ziegler (1962a) which characterize the to$I\gamma/\delta$ Zones of the Famennian Stage in Germany.


CORRELATION OF
EUROPEAN
GONIATITE ZONES
WITH
MISSISSIPPI VALLEY
EUROPEAN STAGES & ZONES
MISSISSIPPI VALLEY SECTION
NAMURIAN
DINANTIAN
VISÉAN
TOURNAI.
FAMENN-IAN
FRASN.
HOMOCERAS
EUMORPHO-CERAS
GONIATITES
PERICYCLUS
GATTENDORFIA
WOCKLUMERIA
CLYMENIA
PRIONOCERAS
PROLOBITES
CHEILOCERAS
MANTICOCERAS
H
E2
E1
cu III
cu II
cu I
to VI
to V
to IV
to III
to II
to I γ-δ
β/γ
α
δ
KINKAID
DEGONIA
CLORE
PALESTINE
MENARD
WALTERSBURG
VIENNA
TAR SPRINGS
GLEN DEAN
HARDINSBURG
GOLCONDA
CYPRESS
RIDENHOWER
BETHEL
DOWNEYS BLUFF
YANKEETOWN
RENAULT
AUX VASES
STE. GENEVIEVE
ST. LOUIS
SALEM
WARSAW
KEOKUK
BURLINGTON
FERN GLEN
"SEDALIA"
CHOUTEAU
HANNIBAL
"GLEN PARK"
LOUISIANA
SAVERTON
GRASSY CREEK
SYLAMORE
CHESTERIAN
VALMEYERAN
KINDER-HOOKIAN
UPPER DEVONIAN
Underwood
Henryville
Sonderson
Blackiston
ROCKFORD-JACOBS CHAPEL
NEW ALBANY
SUNBURY
BASAL CLEVELAND
BEDFORD
HURON
L. OHIO
MAURY
Gassoway
CHATTANOOGA
BARNETT
McCRANEY
PROSPECT HILL
ENGLISH RIVER
MAPLE MILL
CHAPPEL
HOUY
INDIANA
OHIO
TENNESSEE
IOWA
TEXAS

The next younger zone that can be correlated confidently is found in the lowermost part of the Saverton Formation which carries the earliest occurrences of Spathognathodus jugosus along with numerous representatives of Palmatolepis rugosa. S. jugosus in Europe is limited to the upper part of Ziegler's Polygnathus styriaca Zone and the lower part of his Spathognathodus costatus Zone. Palmatolepis rugosa is very common in the latter zone. These forms indicate a general assignment to the Famennian toV and perhaps part of the toIV Zone.

The Grassy Creek Formation, which lies between the Saverton and Sylamore Formations, has yielded few conodonts, but numerous elements of faunas known to represent Zones toII and toIII reworked into the overlying Saverton suggest that Zones toII and toIII are represented in the Grassy Creek.

The fauna of the middle part of the Saverton Formation is one of the most useful for international correlation. It contains the earliest occurrences of Spathognathodus aculeatus, a species limited to Ziegler's (1962a) Spathognathodus costatus Zone, which marks the upper part of the toV and the lower part of the toVI Zones of the Frasnian Stage of western Europe.

The conodont fauna of the Louisiana Limestone and of its lateral equivalent, the upper part of the Saverton Formation, is exceedingly important because it locates the boundary between the Devonian and Mississippian Systems. In this connection, the occurrence in the Louisiana-upper Saverton fauna of a new species of Gnathodus, G. n.sp.A, along with such species as Polygnathus communis, Palmatolepis gracilis, Palmatodella delicatula, Scutula bipennata, and several distinctive species of Spathognathodus, is especially significant inasmuch as it immediately underlies the Gnathodus kockeli—Pseudopolygnathus dentilineata fauna of Voges (1960). The Voges fauna is considered to represent the oldest Carboniferous zone in Europe. The Louisiana-upper Saverton fauna has not been reported from Germany and Ziegler (1961, personal communication) has suggested that it may represent the time equivalent of the unfossiliferous portion of the Hangenberg-Schichten of the Rheinisch Schiefergebirge that lies between the highest occurrences of Wocklumeria and the lowest occurrences of Gattendorfia. Until the Louisiana-upper Saverton fauna is found in association with goniatites, correlation to the European goniatite zones will remain to some degree in doubt. However, the predominance of Devonian forms in the fauna seems to indicate that the zone is Upper Devonian in age (Scott & Collinson, 1961).

The "Glen Park" Formation (Collinson, 1961a, p. 104) and the lowermost part of the Hannibal Formation in the Mississippi Valley contain the Gnathodus kockeli—Pseudopolygnathus dentilineata fauna of Voges (1960) and are interpreted therefore as representing the lowermost part of the cuI Zone (Voges, 1960).

The upper limit of the cuI (Gattendorfia) Zone has been placed by Voges (1959) at the base of his Siphonodella crenulata Zone and occurs in the Mississippi Valley (Chart 2) near the middle of the Hannibal Formation.

Perhaps the most precise and definite correlation to Europe that can be made is that of the Viséan-Tournaisian boundary which, on the basis of the highest occurrence of the genus Siphonodella, is placed at the top of the Chouteau Formation. This limit coincides with the top of Voges' (1959) Siphonodella crenulata Zone, which also represents the top of the cuIIα Subzone of the Pericyclus Stufe.

The upper limit of the cuIIβ/γ Subzone in Germany is placed by Voges (1960) above Bischoff's (1957) Scaliognathus anchoralis Zone. Although S. anchoralis has not been found in the Mississippi Valley, several other species characteristic of the zone, such as Doliognathus lata and Pseudopolygnathus triangula pinnata,

are found in the middle part of the Burlington Formation. Thus, we have placed with question the upper cuIIβ/γ Subzone limit at the top of the Burlington, some distance above where we believe the Scaliognathus anchoralis Zone would occur.

The horizon of the top of the Pericyclus Stufe (cuIIδ) is very difficult to place in terms of the Mississippi Valley section. Bischoff (1957) placed the boundary at the top of his Scaliognathus anchoralis Zone but this calls for the occurrence of Goniatites s.s. as low as the middle part of the Burlington Formation, a correlation untenable to the present authors. Voges (1960), however, places the top of the Pericyclus Stufe with question some distance above the lowermost occurrence of Gnathodus bilineatus. G. bilineatus in the Mississippi Valley occurs as low as the upper part of the Ste. Genevieve Formation but, because the species is interpreted much more broadly by Voges than by the present authors, we are estimating that the upper limit of the Pericylus Stufe correlates to a horizon within the St. Louis Formation. If this correlation is in error, it is in placing the boundary too low, but the placement is in keeping with the stratigraphic occurrence of Goniatites in central United States (Gordon, 1944, p. 1631). The upper limit of cuIIIα is placed by interpolation.

The upper boundary of the Goniatites Stufe, which represents the Viséan-Namurian boundary, is correlated to the Mississippi Valley on the basis of a fauna from the Eumorphoceras aff. E. pseudobilingue marine band in Staffordshire, England (Higgins, 1961). The presence in the fauna of such species as Cavusgnathus unicornis, Gnathodus bilineatus, G. girtyi, and Lonchodina furnishi indicates a general correlation with the Golconda-Hardinsburg-Glen Dean interval of Illinois.

The boundary between the Homoceras Zone and the Eumorphoceras Zone is placed within the Kinkaid Formation on the basis of the lowest occurrence of the genus Streptognathodus.

Correlations of several of the best known Devonian-Mississippian conodont-bearing sections are shown in the middle part of Chart 5. Correlation of the Indiana section is based on the published work of Huddle (1934). The Ohio and Tennessee sections are correlated through the work of Hass (1947 and 1956, respectively). Correlation of the Houy and Chappel sections in Texas is based on reports by Cloud, Barnes, & Hass (1957) and Hass (1959). Correlation of the Barnett Formation of Texas is based on an unpublished University of Texas thesis by Defandorf (1960). The sections from Iowa are correlated through the work of Thomas (1949), Scott & Collinson (1961), House (1962), and unpublished studies by the authors.

CHART 6
UPPER DEVONIAN AND MISSISSIPPIAN CONODONT ASSEMBLAGE ZONES IN THE MISSISSIPPI VALLEY

Knowledge of the stratigraphic distribution of conodonts is much more advanced for the Upper Devonian, Kinderhookian, and Chesterian Series than for the Valmeyeran Series, but we can, nevertheless, zone the entire sequence in the Mississippi Valley.

In the following 22 zones, only genera or species that occur commonly to abundantly are used as name-givers. The name-giver is not necessarily limited to the zone but in most instances it is. In many cases zone limits coincide with generic range limits. All zones are recognizable over broad areas and generally

are well defined stratigraphically. Ranges of the genera used in constructing the assemblage zones are shown on the left side of the chart and those parts of the stratigraphic column where species of the genus are especially useful are marked by cross-hatched lines.

The limits and main characteristics of the zones are described below, beginning with the lowermost and continuing upward in the section.

Palmatolepis proversa—P. triangularis Assemblage Zone

This is the oldest Upper Devonian assemblage zone in the Mississippi Valley and appears to be confined to the Sylamore Sandstone. The unit is of early late Devonian age and correlates to the toIβ/γ Subzones of western Europe.

Limits

Limits are the same as ranges of the Palmatolepis proversa and P. triangularis name-givers.

Characteristic species

Palmatolepis proversa Ziegler, Ancyrodella curvata (Branson & Mehl), A. lobata Branson & Mehl, Ancyrognathus triangularis Youngquist, Polygnathus foliata Bryant, P. normalis Miller & Youngquist, Nothognathella bicristata Youngquist & Miller, and Palmatolepis triangularis Sannemann.

Remarks

The lower limit of this zone may be found in rocks older than the Sylamore but our investigations have been confined to Sylamore and younger formations.

Palmatolepis quadrantinodosa—P. glabra Assemblage Zone

This zone is found in the Grassy Creek Formation in the Mississippi Valley. Because very few conodonts have been found in the formation the limits are difficult to place precisely. The zone is considered to correlate with the Upper Devonian toIδ through toIIIα Zones of western Europe.

Limits

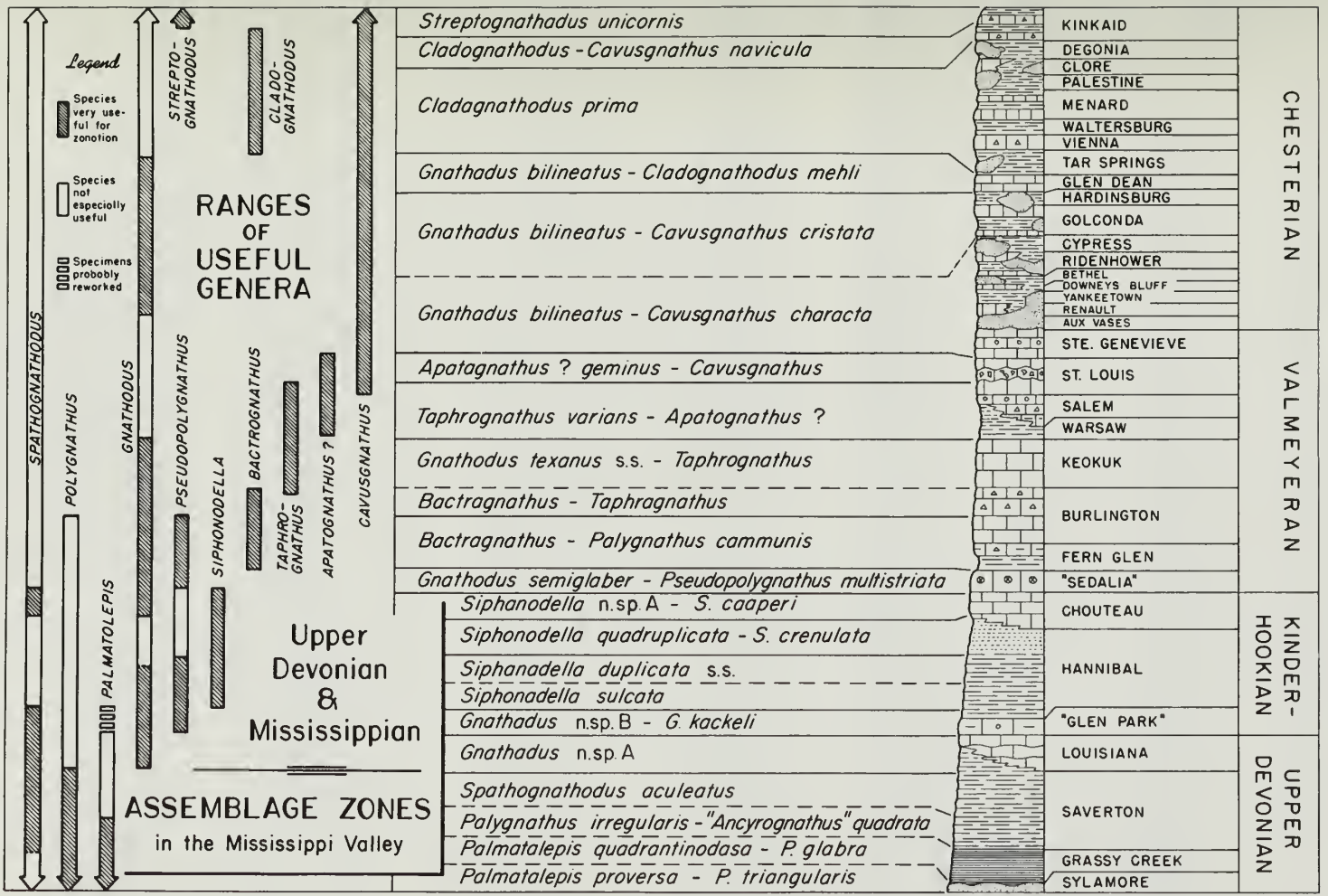
Same as ranges of the Palmatolepis quadrantinodosa—P. glabra name-givers.

Characteristic species

Palmatolepis glabra Ulrich & Bassler, P. quadrantinodosa Branson & Mehl, P. perlobata Ulrich & Bassler, P. rhomboidea Sannemann, and P. minuta Branson & Mehl.

Remarks

In the Mississippi Valley the characteristic species of this zone are commonly reworked into younger strata.


Legend
Species very useful for zonotion
Species not especially useful
Specimens probably reworked
SPATHOGNATHODUS
POLYGNATHUS
PALMATOLEPIS
GNATHODUS
PSEUDOPOLYGNATHUS
SIPHONODELLA
BACTROGNATHUS
TAPHRO-GNATHUS
APATOGNATHUS ?
CAVUSGNATHUS
STREPTO-GNATHODUS
CLADO-GNATHODUS
RANGES OF USEFUL GENERA
Upper Devonian & Mississippian
ASSEMBLAGE ZONES in the Mississippi Valley
Streptognathadus unicornis
Cladognathodus - Cavusgnathus navicula
Cladognathodus prima
Gnathadus bilineatus - Cladognathodus mehli
Gnathadus bilineatus - Cavusgnathus cristata
Gnathadus bilineatus - Cavusgnathus characta
Apatagnathus ? geminus - Cavusgnathus
Taphrognathus varians - Apatognathus ?
Gnathodus texanus s.s. - Taphrognathus
Bactragnathus - Taphragnathus
Bactragnathus - Palygnathus communis
Gnathodus semiglaber - Pseudopolygnathus multistriata
Siphanodella n.sp. A - S. caaperi
Siphonodella quadruplicata - S. crenulata
Siphanodella duplicata s.s.
Siphonadella sulcata
Gnathadus n.sp. B - G. kackeli
Gnathadus n.sp. A
Spathognathodus aculeatus
Palygnathus irregularis - "Ancyrognathus" quadrata
Palmatalepis quadrantinodasa - P. glabra
Palmatalepis proversa - P. triangularis
KINKAID
DEGONIA
CLORE
PALESTINE
MENARD
WALTERSBURG
VIENNA
TAR SPRINGS
GLEN DEAN
HARDINSBURG
GOLCONDA
CYPRESS
RIDENHOWER
BETHEL
DOWNEYS BLUFF
YANKEETOWN
RENAULT
AUX VASES
STE. GENEVIEVE
ST. LOUIS
SALEM
WARSAW
KEOKUK
BURLINGTON
FERN GLEN
"SEDALIA"
CHOUTEAU
HANNIBAL
"GLEN PARK"
LOUISIANA
SAVERTON
GRASSY CREEK
SYLAMORE
CHESTERIAN
VALMEYERAN
KINDER-HOOKIAN
UPPER DEVONIAN

Polygnathus irregularis—"Ancyrognathus" quadrata Assemblage Zone

This zone is known from the lower part of the Saverton Formation and possibly the upper part of the Grassy Creek Formation, Pike and Calhoun Counties, in western Illinois. The species characteristic of this zone occur in faunas described from the Upper Devonian toIV and toV Zones of western Europe (Ziegler, 1962a; Helms, 1961).

Limits

Same as ranges of the Polynathus irregularis—"Ancyrognathus" quadrata name-givers.

Characteristic species

Polygnathus irregularis Cooper, "Ancyrognathus" quadrata Branson & Mehl, Palmatolepis rugosa Branson & Mehl, and Spathognathodus jugosus (Branson & Mehl).

Remarks

The upper limit of the zone is well defined but the lower limit is imprecise because relatively few specimens have been collected from the Grassy Creek Formation. This zone generally yields great numbers of conodonts.

Spathognathodus aculeatus Assemblage Zone

This represents one of the most widespread and easily identified zones in the Mississippi Valley. It is confined to the middle part of the Saverton Formation and represents approximately the uppermost toV to lowermost toVI Zones of the Upper Devonian of western Europe.

Limits

Same as range of the Spathognathodus aculeatus name-giver.

Characteristic species

Spathognathodus aculeatus (Branson & Mehl), Polygnathus triangularis Branson & Mehl, and P. longipostica E. R. Branson.

Remarks

In the Mississippi Valley great numbers of reworked specimens from underlying strata are encountered in this zone. First occurrences of species must be used,therefore,with great care in evaluating the age of faunas from this part of the stratigraphic section.

Gnathodus n.sp.A Assemblage Zone

The Gnathodus n.sp.A Assemblage Zone coincides with the uppermost part of the Saverton Formation and its lateral equivalent, the Louisiana Formation. The

zone correlates with the upper part of the toVI Zone of the Upper Devonian of western Europe.

Limits

The upper boundary of the zone coincides with the uppermost occurrence of abundant Apatognathus varians as well as the uppermost indigenous occurrence of Palmatolepis.

The lower boundary represents the lowest occurrence of Gnathodus as well as Spathognathodus anteposicornis Scott and S. collinsoni Scott. The last two species occur commonly in the zone and are restricted to it.

Characteristic species

Gnathodus n.sp.A, Apatognathus varians Branson & Mehl, Spathognathodus anteposicornis Scott, S. culminidirectus Scott, S. collinsoni Scott, Gnathodus kockeli Bischoff, and Polygnathus communis Branson & Mehl.

Remarks

This zone represents an interval through which Devonian faunas are transitional to Mississippian faunas and the general aspect of the faunas is greatly complicated by significant numbers of reworked specimens from underlying strata.

The name-giver for this zone, Gnathodus n.sp.A, is a primitive gnathodid with a smooth, relatively large posterior platform (Chart 3). The species is common throughout the zone.

Gnathodus n.sp.B — G. kockeli Assemblage Zone

The "Glen Park" Formation (Collinson, 1961a, p. 104) and the oldest beds of the Hannibal Formation in western Illinois contain a distinctive fauna that marks this zone. The zone correlates with the lowest part of the Lower Carboniferous cuI Zone of western Europe.

Limits

The lower boundary is marked by the earliest occurrence of Gnathodus n.sp.B (Chart 3) as well as the first appearance in the Mississippi Valley of the genus Pseudopolygnathus. The upper limit is marked by the earliest common occurrence of Siphonodella sulcata (Huddle). The uppermost limit of the zone of abundant Gnathodus kockeli Bischoff occurs only a short distance above the upper limit of this assemblage zone.

Characteristic species

Gnathodus n.sp.B, Gnathodus kockeli Bischoff, Polygnathus communis Branson & Mehl, Polygnathus longipostica E. R. Branson, Spathognathodus costatus (E. R. Branson), Pseudopolygnathus dentilineata E. R. Branson, and Gnathodus n.sp.A.

Remarks

This zone represents the upper half of the general zone of transition between Devonian and Lower Carboniferous faunas. In some areas these oldest beds of the Mississippian are absent and the overlying Siphonodella sulcata Assemblage Zone represents oldest Mississippian. The zone includes beds referable to Voges' Gnathodus kockeli—Pseudopolygnathus dentilineata Zone (Voges, 1960).

Siphonodella sulcata Assemblage Zone

This zone is entirely confined to the Hannibal Formation and correlates with the middle part of the Lower Carboniferous cuI Zone of western Europe.

Limits

The assemblage zone coincides with the zone of abundant Siphonodella sulcata (Huddle). The upper boundary is also the lower limit of abundant Siphonodella duplicata s.s. (Branson & Mehl).

Characteristic species

Pseudopolygnathus prima Branson & Mehl, P. dentilineata E. R. Branson, Elictognathus spp., Gnathodus kockeli Bischoff, G. n.sp.A, and G. n.sp.B.

Remarks

The fauna of this zone is similar to that of the underlying Gnathodus n.sp. B—G. kockeli Assemblage Zone but the presence of Pseudopolygnathus prima Branson & Mehl and Elictognathus lacerata Branson & Mehl serves to distinguish it.

Siphonodella duplicata s.s. Assemblage Zone

This zone is restricted to the middle part of the Hannibal Formation and its correlatives. The unit correlates with the upper part of the European Lower Carboniferous cuI Zone and possibly the lowermost part of the cuII Zone.

Limits

The limits of the assemblage zone coincide with the limits of abundant Siphonodella duplicata s.s. (Branson & Mehl) (Chart 2).

Characteristic species

Siphonodella duplicata s.s. (Branson & Mehl), S. crenulata (Cooper), Pseudopolygnathus dentilineata E. R. Branson, and P. prima Branson & Mehl.

Remarks

The uppermost part of this zone is marked by the abundant occurrence of Siphonodella crenulata (Chart 2). The assemblage zone falls into a general zone of few gnathodids and abundant pseudopolygnathids.

Siphonodella quadruplicata—S. crenulata Assemblage Zone

This assemblage zone is widespread and easily identifiable in the Mississippi Valley. The zone occurs near the top of the Hannibal Formation and includes the lower part of the Chouteau Formation. The zone probably correlates with the lower part of the cuIIα Zone in the Lower Carboniferous of Europe.

Limits

The upper limit of the assemblage zone is marked by the uppermost abundance of Siphonodella crenulata and the uppermost common occurrence of S. quadruplicata. The bottom of the assemblage zone is marked by the lowermost common occurrence of S. quadruplicata and the uppermost abundant occurrence of S. duplicata s.s.

Characteristic species

Siphonodella quadruplicata (Branson & Mehl), S. crenulata (Cooper), S. aff. S. obsoleta Hass, S. sexplicata (Branson & Mehl), and S. lobata Branson & Mehl.

Remarks

This assemblage zone corresponds roughly to Mehl's (1960, p. 96) "Siphonodella Zone." The zone is characterized by great abundance and diversity among the siphonodellids and a dearth of gnathodids.

In some places around the Ozark Uplift in Missouri, this assemblage zone represents the oldest Mississippian present. The zone correlates with much of Voges' (1960) Siphonodella crenulata Zone.

Siphonodella n.sp.A—S. cooperi Assemblage Zone

This assemblage zone occupies the upper part of the Chouteau Formation and correlates with the upper part of the European Lower Carboniferous cuIIα Zone.

Limits

This zone coincides with the common occurrence of Siphonodella n.sp.A (Chart 2) and abundant occurrence of S. cooperi (Chart 2). The upper limit also coincides with that of abundant Gnathodus delicatus (Chart 3).

Characteristic species

Siphonodella n.sp.A, S. cooperi Hass, S. aff. S. obsoleta Hass, Gnathodus delicatus Branson & Mehl, Polygnathus communis Branson & Mehl, P. inornata E. R. Branson, Spathognathodus curvatus (Branson & Mehl), Elictognathus lacerata (Branson & Mehl).

Remarks

This assemblage zone is one in which gnathodids and siphonodellids are very abundant and Elictognathus is slightly less abundant. The upper

limit of the assemblage zone coincides with a major unconformity in the Mississippi Valley so it is a cut-off horizon for Siphonodella, Elictognathus, and Gnathodus delicatus.

Gnathodus semiglaber—Pseudopolygnathus multistriata Assemblage Zone

This assemblage zone coincides with the "Sedalia" Formation of the Mississippi Valley and correlates with the lowermost part of the cuIIα Zone of western Europe.

Limits

This zone coincides with the zone of abundant Gnathodus semiglaber, G. n.sp. cf. G. girtyi (Chart 3), and Pseudopolygnathus multistriata.

Characteristic species

Gnathodus semiglaber (Bischoff), G. n.sp. cf. G. girtyi Hass, Pseudopolygnathus multistriata Mehl & Thomas, Neoprioniodus oligus (Cooper), Polygnathus communis Branson & Mehl.

Remarks

This zone is distinctive and easily recognized because of the complete absence of siphonodellids and the abundance of pseudopolygnathids. In addition, representatives of Elictognathus, very abundant in the underlying zone, are absent.

Bactrognathus—Polygnathus communis Assemblage Zone

This assemblage zone extends from the base of the Fern Glen Formation to the top of the middle part of the Burlington. In western Europe it ranges from upper cuIIβ into lower cuIIγ.

Limits

The lower limit is marked by the earliest occurrences of Bactrognathus hamata and B. excavata as well as the earliest abundance of Gnathodus cuneiformis and G. n.sp. aff. G. texanus (Chart 3). The upper limit coincides with the youngest occurrence of Polygnathus communis.

Characteristic species

Bactrognathus hamata Branson & Mehl, B. excavata Branson & Mehl, Gnathodus cuneiformis Mehl & Thomas, G. n.sp. aff. G. texanus, Polygnathus communis Branson & Mehl, Pseudopolygnathus triangula pinnata Voges, Doliognathus lata Branson & Mehl, Staurognathus cruciformis Branson & Mehl, and Pseudopolygnathus multistriata.

Remarks

Polygnathus communis and representatives of Pseudopolygnathus are by far the most abundant in this zone. In the upper part of the zone Pseudopolygnathus

triangula pinnata is especially common and it may be possible to subdivide this assemblage zone with further study.

Bactrognathus—Taphrognathus Assemblage Zone

This unit is confined mainly to the upper part of the Burlington Formation and is approximately correlative to the upper part of the European cuIIβ/γ Zones.

Limits

The upper boundary is marked by the lowest abundant occurrence of Gnathodus texanus s.s., although the species is uncommon to rare slightly lower in the section. The lower limit is marked by the highest occurrence of Polygnathus communis.

Characteristic species

Bactrognathus n.sp., Taphrognathus n.sp., Gnathodus cuneiformis Mehl & Thomas, and G. texanus s.s.

Remarks

The lower part of this zone is readily distinguished by the presence of distinctive undescribed Z-shaped bactrognathids that have long lateral processes and a prominent hornlike denticle at the juncture of the lateral process and main blade. The upper part of the zone is marked by the presence of G. texanus and Taphrognathus.

Gnathodus texanus s.s.—Taphrognathus Assemblage Zone

This zone coincides with the Keokuk Formation and correlates approximately with the lower part of the cuIIδ Zone of western Europe.

Limits

The upper limit is marked by the lowest occurrence of Apatognathus? in the Valmeyeran Series and by the lower boundary of abundant occurrence of Taphrognathus varians. The lower boundary is marked by the lowermost limit of the zone of abundant occurrence of Gnathodus texanus s.s.

Characteristic species

Gnathodus texanus s.s. Roundy, Taphrognathus varians Branson & Mehl, Taphrognathus n.sp.

Remarks

This is a zone of relatively few species but great abundance of Gnathodus texanus and rare to common occurrence of Taphrognathus varians as well as a new species of Taphrognathus.

Taphrognathus varians—Apatognathus? Assemblage Zone

This zone includes the Warsaw, Salem, and lower part of the St. Louis Formation and probably correlates with the upper part of the cuIIIδ Zone of western Europe.

Limits

The lower limit is marked by the lowermost occurrence of Apatognathus? in the Valmeyeran Series plus the highest occurrence of common Taphrognathus varians. The upper limit is distinguished by the lowermost common occurrence of Cavusgnathus and the youngest occurrence of Taphrognathus as well as by the lower limit of the upper zone of abundant Apatognathus?.

Characteristic species

Gnathodus texanus Roundy, Taphrognathus varians Branson & Mehl, Apatognathus? n.sp., Neoprioniodus loxus Rexroad, N. tulensis (Pander), and Spathognathodus n.sp.

Remarks

This unit is a zone dominated by the genera Taphrognathus and Gnathodus although conodonts cannot be said to be abundant anywhere within the zone. Gnathodus dominates the Warsaw, Taphrognathus dominates the Salem, and Cavusgnathus occurs, although uncommonly, in the lower part of the St. Louis Formation. It therefore seems likely that the assemblage zone can be subdivided into subzones with further study.

Apatognathus? geminus—Cavusgnathus Assemblage Zone

This is a well defined zone that coincides with the upper part of the St. Louis Formation and appears to correlate with the lower part of the cuIIIα Zone of western Europe.

Limits

This unit represents the upper zone of common occurrence of Apatognathus? (Chart 1). The upper limit is marked by the youngest occurrence of the genus as well as that of Spathognathodus scitulus. The lower limit is marked by the earliest common occurrence of Cavusgnathus and the youngest occurrence of the genus Taphrognathus.

Characteristic species

Apatognathus? geminus (Hinde), A. porcatus (Hinde), Cavusgnathus characta Rexroad, C. unicornis Youngquist & Miller, Spathognathodus scitulus (Hinde), Neoprioniodus tulensis (Pander).

Remarks

This zone is easily distinguished by abundant Spathognathodus scitulus and Apatognathus?, the common occurrence of Cavusgnathus, and the absence of Taphrognathus. There is a definite faunal break at the top of the zone as witnessed by the fact that more than a third of the species in this zone do not continue into the overlying zone.

Gnathodus bilineatus—Cavusgnathus characta Assemblage Zone

This zone is the oldest to contain a fauna that is Chesterian in general aspect. The zone coincides with the interval extending from the base of the Ste. Genevieve Formation to the base of the Golconda Group, and is approximately equivalent to the interval spanned by the upper part of the cuIIIα, the cuIIIβ/γ and the lower part of the E_1 Zones.

Limits

The lower limit of the zone is marked by the highest occurrences of Apatognathus? and Spathognathodus scitulus. In addition, the lowermost occurrence of Gnathodus bilineatus probably coincides with the lower limit,but the range of the species is not known with complete confidence. The upper limit of the zone is marked by the oldest occurrences of Gnathodus girtyi, Lonchodina furnishi, L. paraclarki, Roundya barnettana, and Cavusgnathus cristata.

Characteristic species

Gnathodus bilineatus (Cooper), G. texanus Roundy, G. commutatus (Branson & Mehl), Cavusgnathus characta Rexroad, C. regularis Youngquist & Miller, C. convexa Rexroad, C. unicornis Youngquist & Miller, Spathognathodus cristula Youngquist & Miller, S. campbelli Rexroad.

Remarks

This is one of the least known of Mississippian assemblage zones due to the fact that the faunas of the Ste. Genevieve Formation have not been thoroughly studied. The upper limit of the zone is easy to recognize, but it may be revised downward after further study of the Ridenhower Formation. There is little doubt that the zone will be subdivided.

Gnathodus bilineatus—Cavusgnathus cristata Assemblage Zone

In the Mississippi Valley this zone extends from the base of the Golconda Group to the base of the Glen Dean Formation. This interval is believed to include approximately the middle and upper part of the west European E_1 Zone.

Limits

The assemblage zone is bounded at the base by the lowermost occurrences of Gnathodus girtyi, Lonchodina furnishi, L. paraclarki, Roundya barnettana, and

Cavusgnathus cristata. The upper limit of the zone is marked by the lowest occurrences of Cladognathodus mehli, Cavusgnathus prima, and Lonchodina paraclaviger. Cavusgnathus characta ranges up only to the top of the Golconda Group.

Characteristic species

Cavusgnathus cristata Branson & Mehl, Gnathodus bilineatus Roundy, Cavusgnathus characta Rexroad, C. unicornis Youngquist & Miller, Spathognathodus cristula Youngquist & Miller, S. spiculus Youngquist & Miller, Gnathodus girtyi Hass, G. commutatus (Branson & Mehl), Lonchodina furnishi Rexroad, and Roundya barnettana Hass.

Remarks

This zone is one of conodont abundance and diversity and contains several species of restricted range. Nevertheless, the upper limit is in a sense indefinite inasmuch as the Hardinsburg Formation represents a nonmarine environment and, therefore, an area of no knowledge as far as conodont ranges in geologic time are concerned.

Gnathodus bilineatus—Cladognathodus mehli Assemblage Zone

This zone coincides with the stratigraphic limits of the Glen Dean Formation in the Illinois Basin area. Correlated to western Europe the zone is approximately equivalent to the lowermost part of the Eumorphoceras E_2 Zone.

Limits

The upper boundary is marked by the highest occurrences of Cladognathodus mehli, Gnathodus bilineatus, G. girtyi, Lonchodina furnishi, L. paraclaviger, L. paraclarki, and Roundya barnettana. The lower limit corresponds to the lowest occurrences of Cladognathodus mehli, C. prima, and Lonchodina paraclaviger.

Characteristic species

Gnathodus bilineatus Roundy, Cavusgnathus unicornis Youngquist & Miller, C. convexa Rexroad, Neoprioniodus scitulus (Branson & Mehl), Cladognathodus prima Rexroad, and Lonchodina paraclaviger Rexroad.

Remarks

This zone is easily recognized because of diversity of species and abundance of specimens. The zone has been traced widely in central United States.

Cladognathodus prima Assemblage Zone

In the Mississippi Valley this zone ranges from the top of the Glen Dean Formation to the base of the Kinkaid Formation. In western Europe the zone appears to correlate to all but the lowermost part of the Eumorphoceras E_2 Zone.

Limits

The lower limit coincides with the uppermost occurrences of Cladognathodus mehli, Gnathodus bilineatus, G. girtyi, Lonchodina furnishi, L. paraclaviger, L.

cf. L. paraclarki, and Roundya barnettana. The upper limit is marked by the lowermost occurrence of Cavusgnathus navicula.

Characteristic species

Cladognathodus prima Rexroad, Neoprioniodus scitulus Branson & Mehl, Spathognathodus cristula Youngquist & Miller, Ligonodina hamata Rexroad, Cavusgnathus unicornis Youngquist & Miller, and C. convexa Rexroad.

Remarks

This is a gross assemblage zone and, with completion of detailed studies of the Menard Formation, it may be subdivided. Helpful in locating the upper boundary is the fact that Spathognathodus spiculus ranges only to the top of the Clore Formation.

Cladognathodus—Cavusgnathus navicula Assemblage Zone

This zone is entirely confined to the Kinkaid Formation in the Mississippi Valley region and appears to correlate to the uppermost part of the Eumorphoceras E_2 Zone of western Europe.

Limits

This assemblage zone is limited to the range overlap of Cladognathodus prima and Cavusgnathus navicula. The upper limit is also marked by the youngest occurrences of Cavusgnathus regularis, C. unicornis, C. convexa, and C. cristata.

Characteristic species

Cavusgnathus navicula (Hinde), Cavusgnathus unicornis Youngquist & Miller, C. cristata Branson & Mehl, C. regularis Youngquist & Miller, Ligonodina hamata Rexroad, Neoprioniodus scitulus Branson & Mehl, Spathognathodus cristula Youngquist & Miller, Cladognathodus prima Rexroad.

Remarks

This zone is easily distinguished by the presence of C. navicula, which is relatively common, and the absence of Streptognathodus, which is very abundant in the overlying zone.

Streptognathodus unicornis Assemblage Zone

This zone is restricted to the uppermost part of the Kinkaid Formation in the Mississippi Valley, Unit D of Rexroad & Burton (1961, p. 148). The zone correlates with the west European Homoceras Zone.

Limits

This zone coincides with the range limits of Streptognathodus unicornis. The lower limit is marked by the uppermost occurrences of Cavusgnathus regularis and C. unicornis, which are both common in the underlying zone.

Characteristic species

Streptognathodus unicornis Rexroad & Burton, Cavusgnathus navicula (Hinde), Neoprioniodus scitulus Branson & Mehl, Ligonodina n.sp.?, and Spathognathodus campbelli Rexroad.

Remarks

The fact that Streptognathodus composes more than a third of the fauna in this zone sharply differentiates it from the underlying zone which contains no streptognathodids. The zone of Streptognathodus unicornis probably is incompletely represented in the Mississippi Valley due to the fact that the Chesterian Series is truncated by an erosional unconformity.

REFERENCES

Bischoff, Günther, 1956, Oberdevonische Conodonten (to$I\delta$) aus dem Rheinischen Schiefergebirge: Notizbl. hess. L.-Amt. Bodenforsch., v. 84, p. 115-137, pls. 8-10.

Bischoff, Günther, 1957, Die Conodonten-Stratigraphie des rheno-herzynischen Unterkarbons mit Berucksichtigung der Wocklumeria-Stufe und der Devon/Karbon-Grenze: Abh. hess. L.-Amt. Bodenforsch., v. 19, 64 p., 6 pls.

Bischoff, Günther, and Ziegler, Willi, 1956, Das Alter der "Urfer" Schichten im Marburger Hinterland nach Conodonten: Notizbl. hess. L.-Amt. Bodenforsch., v. 84, p. 138-169, pls. 11-14.

Branson, E. B., 1938, Stratigraphy and paleontology of the Lower Mississippian of Missouri, Part II: Univ. Missouri Studies, v. 13, no. 4, p. 1-242.

Branson, E. B., 1944, The geology of Missouri: Univ. Missouri Studies, v. 19, no. 3, 535 p., pls. 1-49.

Branson, E. B., and Mehl, M. G., 1934a, Conodonts from the Grassy Creek Shale of Missouri: Univ. Missouri Studies, v. 8, no. 3, p. 171-259, pls. 13-21.

Branson, E. B., and Mehl, M. G., 1934b, Conodonts from the Bushberg Sandstone and equivalent formations of Missouri: Univ. Missouri Studies, v. 8, no. 4, p. 265-300, pls. 22-24.

Branson, E. B., and Mehl, M. G., 1941, New and little known Carboniferous conodont genera: Jour. Paleontology, v. 15, p. 97-106, pl. 19.

Branson, E. R., 1934, Conodonts from the Hannibal Formation of Missouri: Univ. Missouri Studies, v. 8, no. 4, p. 301-343, pls. 25-28.

Brinkmann, Roland, 1960, Geologic evolution of Europe: New York, Hafner Publishing Co., 161 p.

Burton, R. C., 1959, Conodonts from the Kinkaid Formation of the Illinois Basin: Texas Technological College [Lubbock] unpublished M. S. thesis.

Campbell, Guy, 1946, New Albany Shale: Geol. Soc. America Bull., v. 57, p. 829-908, pls. 1-3.

Clarke, C. E., 1959, Conodonts from the Glen Dean Formation of Kentucky and equivalent formations of Virginia and West Virginia: Texas Technological College [Lubbock] unpublished M.S. thesis.

Clarke, W. J., 1960, Scottish Carboniferous conodonts: Edinburgh Geol. Soc. Trans., v. 18, pt. 1, p. 1-31, pls. 1-5.

Cloud, R. E., Jr., Barnes, V. E., and Hass, W. H., 1957, Devonian-Mississippian transition in central Texas: Geol. Soc. America Bull., v. 68, p. 807-816, pls. 1-5.

Collinson, Charles, 1955, Mississippian prolecanitid goniatites from Illinois and adjacent states: Jour. Paleontology, v. 29, p. 433-438, pl. 45.

Collinson, Charles, 1961a, The Kinderhookian Series in the Mississippi Valley: Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook, p. 100-109; Missouri Div. Geol. Survey and Water Resources Rept. Inv. 27.

Collinson, Charles, 1961b, Road log. Second day of field conference: Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook, p. 49-74; Missouri Div. Geol. Survey and Water Resources Rept. Inv. 27.

Collinson, Charles, Rexroad, C. B., and Scott, Alan J., 1959, Abundance and stratigraphic distribution of Devonian and Mississippian conodonts in the Upper Mississippi Valley: Jour. Paleontology, v. 33, p. 692-696.

Collinson, Charles, Scott, Alan J., and Rexroad, C. B., 1961, Biostratigraphic zonation of the Devonian and Mississippian in the Mississippi Valley [abs.]: Geol. Soc. America 74th Annual Meetings Program, p. 30A.

Collinson, Charles, Swann, D. H., and Willman, H. B., 1954, Guide to the structure and Paleozoic stratigraphy along the Lincoln Fold in western Illinois: Am. Assoc. Petroleum Geologists 39th Ann. Conv., Illinois Geol. Survey Field Conf. Guidebook, 75 p.

Collinson, Charles, and Swann, D. H., 1958, Field Trip No. 3, Mississippian rocks of western Illinois: Geol. Soc. America St. Louis Meeting Field Trip Guidebook, p. 21-52.

Defandorf, May, 1960, Paleontology and petrography of Carboniferous strata in the Sloan area, San Saba County, Texas: Univ. Texas [Austin] unpublished M. A. thesis.

Flügel, Helmut, and Ziegler, Willi, 1957, Die Gliederung des Oberdevons und Unterkarbons am Steinburg westlich von Graz mit Conodonten: Mitteilungen Naturw. Vereins f. Steiermark, v. 87, p. 25-60, pls. 1-5.

Gordon, Mackenzie, Jr., 1944, Moorefield Formation and Ruddell Shale, Batesville District, Arkansas: Am. Assoc. Petroleum Geologists, v. 28, p. 1626-1634.

Gordon, Mackenzie, Jr., 1957, Mississippian cephalopods of northern and eastern Alaska: U. S. Geol. Survey Prof. Paper 283, 61 p., 6 pls.

Hass, W. H., 1947, Conodont zones in Upper Devonian and Lower Mississippian formations of Ohio: Jour. Paleontology, v. 21, p. 131-141.

Hass, W. H., 1951, Age of Arkansas novaculite: Am. Assoc. Petroleum Geologists Bull., v. 35, p. 2526-2541, pl. 1.

Hass, W. H., 1956, Age and correlation of the Chattanooga Shale and the Maury Formation: U. S. Geol. Survey Prof. Paper 286, 47 p., pls. 2-5.

Hass, W. H., 1959, Conodonts from the Chappel Limestone of Texas: U. S. Geol. Survey Prof. Paper 294-J, p. 365-399, pls. 46-50.

Helms, Jochen, 1959, Conodonten aus dem Saalfelder Oberdevon (Thüringen): Geologie, Jahrg. 8, Heft 6, p. 634-677, pls. 1-6.

Helms, Jochen, 1961, Die "nodocostata-Gruppe" der Gattung Polygnathus: Geologie, Jahrg. 10, Heft 6, p. 674-711, pls. 1-4.

Higgins, A. C., 1961, Some Namurian conodonts from North Staffordshire: Geol. Mag. [Great Britain], v. 98, p. 210-224.

House, M. R., 1962, Observations on the ammonoid succession of the North American Devonian: Jour. Paleontology, v. 36, p. 247-284, pls. 43-48.

Huddle, J. W., 1934, Conodonts from the New Albany Shale of Indiana: Bull. Am. Paleontology, v. 21, no. 72, p. 1-136, pls. 1-13.

Jarrell, Mary K., 1961, Conodonts from the Golconda Group (Chester) of the Illinois Basin: Univ. Houston [Texas] unpublished M. S. thesis.

Liebe, Richard, 1959, Conodonts from the Renault Formation (Chester) of the Illinois Basin: Univ. Houston [Texas] unpublished M. S. thesis.

Mehl, M. G., 1960, The relationships of the base of the Mississippian System in Missouri: Denison Univ. Jour. Sci. Labs.,v. 45, art. 5, p. 57-107.

Mehl, M. G., 1961, Basal relationships of the Mississippian in northeastern Missouri: Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook, p. 89-94; Missouri Div. Geol. Survey and Water Resources Rept. Inv. 27.

Mehl, M. G., and Thomas, L. A., 1947, Conodonts from the Fern Glen of Missouri: Denison Univ. Jour. Sci. Labs., v. 40, art. 2, p. 3-19, pl. 1.

Miller, A. K., and Collinson, Charles, 1951, Lower Mississippian ammonoids of Missouri: Jour. Paleontology, v. 25, p. 454-487, pls. 68-71.

Miller, A. K., and Garner, H. F., 1955, Lower Mississippian cephalopods of Michigan, Part III—Ammonoids and summary: Univ. Michigan Mus. Paleontology Contrib., v. 12, p. 113-173, pls. 1-7.

Miller, A. K., and Youngquist, Walter, 1947, Conodonts from the type section of the Sweetland Creek Shale in Iowa: Jour. Paleontology, v. 21, p. 501-517, pls. 72-75.

Müller, K. J., 1956, Zur Kenntnis der Conodonten-Fauna des europäischen Devons, 1. Die Gattung Palmatolepis: Abh. senckenb. naturf. Gesell., v. 494, p. 1-45, pls. 1-11.

Müller, K. J., and Müller, E. M., 1957, Early Upper Devonian (Independence) conodonts from Iowa, Part I: Jour. Paleontology, v. 31, p. 1069-1108, pls. 135-142.

Rexroad, C. B., 1957, Conodonts from the Chester Series in the type area of southwestern Illinois: Illinois Geol. Survey Rept. Inv. 199, p. 1-43, pls. 1-4.

Rexroad, C. B., 1958a, Conodonts from the Glen Dean Formation (Chester) of the Illinois Basin: Illinois Geol. Survey Rept. Inv. 209, p. 1-27, pls. 1-6.

Rexroad, C. B., 1958b, The conodont homeomorphs Taphrognathus and Streptognathodus: Jour. Paleontology, v. 32, p. 1158-1159.

Rexroad, C. B., and Burton, R. C., 1961, Conodonts from the Kinkaid Formation (Chester) in Illinois: Jour. Paleontology, v. 35, p. 1143-1158, pls. 138-141.

Rexroad, C. B., and Clarke, C. E., 1960, Conodonts from the Glen Dean Formation of Kentucky and equivalent formations of Virginia and West Virginia: Jour. Paleontology, v. 34, p. 1202-1206.

Rexroad, C. B., and Collinson, Charles, 1961, Preliminary range chart of conodonts from the Chester Series (Mississippian) in the Illinois Basin: Illinois Geol. Survey Circ. 319, 11 p., 1 pl.

Rexroad, C. B., and Jarrell, Mary K., 1961, Correlation by conodonts of Golconda Group (Chesterian) in Illinois Basin: Am. Assoc. Petroleum Geologists Bull., v. 45, p. 2012-2024.

Rexroad, C. B., and Liebe, R. M., in press, Conodonts from the Paoli and equivalent formations in the Illinois Basin: Micropaleontology.

Sannemann, Dietrich, 1955a, Beitrag sur Untergliederung des Oberdevons nach Conodonten: Abh. N. Jb. Geol. Paläont., v. 100, p. 324-331, pl. 24.

Sannemann, Dietrich, 1955b, Oberdevonische Conodonten (toIIα): Senck. leth., v. 36, p. 123-156, 6 pls.

Scott, Alan J., 1957, Growth stages and specific variation in Devonian-Mississippian conodonts [abs.]: Geol. Soc. America 70th Annual Meetings Program, p. 124-125.

Scott, Alan J., 1961, Three new conodonts from the Louisiana Limestone (Upper Devonian) of western Illinois: Jour. Paleontology, v. 35, p. 1223-1227.

Scott, Alan J., and Collinson, Charles, 1959, Intraspecific variability in conodonts, Palmatolepis glabra Ulrich & Bassler: Jour. Paleontology, v. 33, p. 550-565, pls. 75-76.

Scott, Alan J., and Collinson, Charles, 1961, Conodont faunas from the Louisiana and McCraney Formations of Illinois, Iowa and Missouri: Kansas Geol. Soc. 26th Ann. Field Conf. Guidebook, p. 110-141, 2 pls.

Thomas, L. A., 1949, Devonian-Mississippian Formations of southeast Iowa: Geol. Soc. America Bull., v. 60, p. 403-438, pls. 1-4.

Ulrich, E. O., and Bassler, R. S., 1926, A classification of the toothlike fossils, conodonts, with descriptions of American Devonian and Mississippian species: U. S. Nat. Mus. Proc., v. 68, art. 12, p. 1-63, pls. 1-11.

Voges, Adolf, 1959, Conodonten aus dem Unterkarbon des Sauerlandes (Gattendorfia- und Pericyclus-Stufe): Paläont. Zeit., v. 33, no. 4, p. 266-314.

Voges, Adolf, 1960, Die Bedeutung der Conodonten für die Stratigraphie des Unterkarbons I und II (Gattendorfia- und Pericyclus-Stufe) im Sauerland: Fortschr. Geol. Rheinld. u. Westf., Bd. 3, pt. 1, p. 197-228.

Walliser, Otto, 1958, Zum Oberdevon und Unterkarbon von Erdbach-Langenaubach (S W Dillmulde, Rheinisches Schiefergebirge): Notizbl. hess. L.-Amt. Bodenforsch., v. 87, p. 120-132.

Weller, Stuart, 1906, Kinderhook faunal studies, IV; The fauna of the Glen Park Limestone: St. Louis Acad. Sci. Trans., v. 10, p. 435-471.

Youngquist, Walter, and Miller, A. K., 1948, Additional conodonts from the Sweetland Creek Shale of Iowa: Jour. Paleontology, v. 22, p. 440-450, pls. 67-68.

Youngquist, Walter, Miller, A. K., and Downs, H. R., 1950, Burlington conodonts from Iowa: Jour. Paleontology, v. 24, p. 525-530, pl. 67.

Ziegler, Willi, 1958, Conodontenfeinstratigraphische Untersuchungen an der Grenze Mitteldevon/Oberdevon und in der Adorf-Stufe: Notizbl. hess. L.-Amt. Bodenforsch., v. 87, p. 7-77.

Ziegler, Willi, 1959, Conodonten aus Devon und Karbon Südwesteuropas und Bemerkungen zur bretonischen Faltung: Mh. N. Jb. Geol. Paläont., v. 7, p. 289-309.

Ziegler, Willi, 1960, Die Conodonten aus den Gerollen des Zechsteinkonglomerates von Rossenray (Südwestlich Reinberg/Niederrhein): Fortschr. Geol. Rheinld. u. Westf., v. 6, 15 p. (preprint 1960).

Ziegler, Willi, 1962a, Taxionomie und Phylogenie oberdevonischer Conodonten und ihre stratigraphische Bedeutung: Abh. Hess. Landesamt f. Bodenforsch., v. 38, 14 pls., in press.

Ziegler, Willi, 1962b, Phylogenetische Entwicklung stratigraphisch wichtiger Conodonten-Gattungen in der Manticoceras-Stufe (Oberdevon, Deutschland): Abh. N. Jb. Geol. Paläont., v. 114, in press.

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