R. LANGENHEIM

STATE OF ILLINOIS

William G. Stratton, Governor

DEPARTMENT OF REGISTRATION AND EDUCATION

Vera M. Binks, Director

1958

**CONODONTS from the
GLEN DEAN FORMATION
(CHESTER) of the ILLINOIS BASIN**

Carl B. Rexroad

REPORT OF INVESTIGATIONS 209

ILLINOIS STATE GEOLOGICAL SURVEY

JOHN C. FRYE, *Chief*

URBANA, ILLINOIS

**CONODONTS from the
GLEN DEAN FORMATION
(CHESTER) of the ILLINOIS BASIN**

Carl B. Rexroad

Illinois State Geological Survey Report of Investigations 209
Urbana, Illinois

June 1958

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

STATE OF ILLINOIS

HON. WILLIAM G. STRATTON, *Governor*

DEPARTMENT OF REGISTRATION AND EDUCATION

HON. VERA M. BINKS, *Director*

BOARD OF NATURAL RESOURCES AND CONSERVATION

HON. VERA M. BINKS, *Chairman*

W. H. NEWHOUSE, PH.D., *Geology*

ROGER ADAMS, PH.D., D.Sc., LL.D., *Chemistry*

ROBERT H. ANDERSON, B.S., *Engineering*

A. E. EMERSON, PH.D., *Biology*

LEWIS H. TIFFANY, PH.D., PD.D., *Forestry*

DEAN W. L. EVERITT, E.E., PH.D.,

University of Illinois

PRESIDENT DELYTE W. MORRIS, PH.D.,

Southern Illinois University

GEOLOGICAL SURVEY DIVISION

JOHN C. FRYE, PH.D., D.Sc., *Chief*

STATE GEOLOGICAL SURVEY DIVISION

Urbana, Illinois.

FULL TIME STAFF

JOHN C. FRYE, PH.D., D.Sc., *Chief*

M. M. LEIGHTON, PH.D., D.Sc., *Chief Emeritus*

ENID TOWNLEY, M.S., *Geologist
and Assistant to the Chief*

HELEN E. McMORRIS, *Secretary
to the Chief*

VELDA A. MILLARD, *Junior
Assistant to the Chief*

GEOLOGICAL GROUP

M. L. THOMPSON, PH.D., *Principal Geologist*

ARTHUR BEVAN, PH.D., D.Sc., *Principal Geologist, Emeritus*

FRANCES H. ALSTERLUND, A.B., *Research Assistant*

COAL

JACK A. SIMON, M.S., *Geologist and Head*

G. H. CADY, PH.D., *Senior Geologist and Head,
Emeritus*

ROBERT M. KOSANKE, PH.D., *Geologist*

JOHN A. HARRISON, M.S., *Associate Geologist*

PAUL EDWIN POTTER, PH.D., *Associate Geologist
(on leave)*

WILLIAM H. SMITH, M.S., *Associate Geologist*

KENNETH E. CLEGG, M.S., *Assistant Geologist*

MARGARET A. PARKER, M.S., *Assistant Geologist*

DAVID L. REINERTSEN, A.M., *Assistant Geologist*

OIL AND GAS

A. H. BELL, PH.D., *Geologist and Head*

VIRGINIA KLINE, PH.D., *Associate Geologist*

LESTER L. WHITING, B.A., *Associate Geologist*

WAYNE F. MEENTS, *Associate Geological Engineer*

MARGARET O. OROS, B.A., *Assistant Geologist*

THOMAS W. SMOOT, M.S., *Assistant Geologist*

JACOB VAN DEN BERG, M.S., *Assistant Geologist*

RONALD A. YOUNKER, B.S., *Research Assistant*

JUTTA I. ANDERSON, *Technical Assistant*

PETROLEUM ENGINEERING

CARL W. SHERMAN, M.S., *Petroleum Engineer and
Head*

INDUSTRIAL MINERALS

J. E. LAMAR, B.S., *Geologist and Head*

DONALD L. GRAF, PH.D., *Geologist*

JAMES C. BRADBURY, A.M., *Associate Geologist*

JAMES W. BAXTER, M.S., *Assistant Geologist*

MEREDITH E. OSTROM, M.S., *Assistant Geologist*

PHYSICS

R. J. PIERSOL, PH.D., *Physicist, Emeritus*

CHEMICAL GROUP

GRACE C. FINGER, B.S., *Research Assistant*

COAL CHEMISTRY

G. R. YOHE, PH.D., *Chemist and Head*

THOMAS P. MAHER, B.S., *Special Associate Chemist*

JOSEPH M. HARRIS, B.A., *Research Assistant*

PHYSICAL CHEMISTRY

J. S. MACHIN, PH.D., *Chemist and Head*

JOSE M. SERRATOSA, DR.SC., *Special Associate
Chemist*

NEIL F. SHIMP, PH.D., *Associate Chemist*

DANIEL L. DEADMORE, M.S., *Assistant Chemist*

JUANITA WITTERS, M.S., *Assistant Physicist*

FLUORINE CHEMISTRY

G. C. FINGER, PH.D., *Chemist and Head*

LAURENCE D. STARR, PH.D., *Associate Chemist*

DONALD R. DICKERSON, B.S., *Special Assistant
Chemist*

RICHARD H. SHILEY, B.S., *Research Assistant*

RAYMOND H. WHITE, B.S., *Special Research Assistant*

X-RAY

W. F. BRADLEY, PH.D., *Chemist and Head*

CLAY RESOURCES AND CLAY MINERAL TECHNOLOGY

RALPH E. GRIM, PH.D., *Consulting Clay Mineralogist*

W. ARTHUR WHITE, PH.D., *Geologist*

HERBERT D. GLASS, PH.D., *Associate Geologist*

WALTER E. PARHAM, M.S., *Assistant Geologist*

GROUNDWATER GEOLOGY AND GEOPHYSI- CAL EXPLORATION

GEORGE B. MAXEY, PH.D., *Geologist and Head*

MERLYN B. BUHLE, M.S., *Geologist*

ROBERT E. BERGSTROM, PH.D., *Associate Geologist*

JAMES E. HACKETT, M.S., *Associate Geologist*

JOHN P. KEMPTON, M.A., *Assistant Geologist*

WAYNE A. PRYOR, M.S., *Assistant Geologist*

LIDIA SELKREGG, D.NAT.SCI., *Assistant Geologist*

GROVER H. EMRICH, M.S., *Research Assistant*

LOWELL A. REED, B.S., *Research Assistant*

MARGARET J. CASTLE, *Assistant Geologic Draftsman
(on leave)*

ENGINEERING GEOLOGY AND TOPOGRAPHIC MAPPING

GEORGE E. EKBLAW, PH.D., *Geologist and Head*

WILLIAM C. SMITH, M.A., *Assistant Geologist*

STRATIGRAPHY AND AREAL GEOLOGY

H. B. WILLMAN, PH.D., *Geologist and Head*

ELWOOD ATHERTON, PH.D., *Geologist*

DAVID H. SWANN, PH.D., *Geologist*

CHARLES W. COLLINSON, PH.D., *Associate Geologist*

JOHN A. BROPHY, M.S., *Assistant Geologist*

T. C. BUSCHBACH, M.S., *Assistant Geologist*

F. L. DOYLE, M.S., *Assistant Geologist*

ALAN J. SCOTT, B.S., *Research Assistant*

ROBERT W. FRAME, *Supervisory Technical Assistant*

ROMAYNE S. ZIROLI, *Technical Assistant*

JOSEPH F. HOWARD, *Assistant*

CHEMICAL ENGINEERING

H. W. JACKMAN, M.S.E., *Chemical Engineer and Head*

R. J. HELFINSTINE, M.S., *Mechanical and Adminis-
trative Engineer*

B. J. GREENWOOD, B.S., *Mechanical Engineer*

ROBERT L. EISSLER, M.S., *Assistant Chemical
Engineer*

JAMES C. McCULLOUGH, *Research Associate (on leave)*

WALTER E. COOPER, *Technical Assistant*

EDWARD A. SCHAEDE, *Technical Assistant*

ANALYTICAL CHEMISTRY

O. W. REES, PH.D., *Chemist and Head*

L. D. McVICKER, B.S., *Chemist*

EMILE D. PIERRON, M.S., *Associate Chemist*

WILLIAM J. ARMON, M.S., *Assistant Chemist*

FRANCIS A. COOLICAN, B.S., *Assistant Chemist*

EFFIE E. HETISHEE, B.S., *Research Assistant*

MARY ANN MILLER, B.S., *Research Assistant*

LOUISE J. PORTER, A.B., *Research Assistant*

ISTVAN PUSZTASZERI, *Research Assistant*

GEORGE R. JAMES, *Technical Assistant*

BENJAMIN F. MANLEY, *Technical Assistant*

MINERAL ECONOMICS GROUP

W. H. VOSKUIL, Ph.D., *Principal Mineral Economist*

HUBERT E. RISSER, Ph.D., *Mineral Economist*

W. L. BUSCH, A.B., *Associate Mineral Economist*

ADMINISTRATIVE GROUP

EDUCATIONAL EXTENSION

GEORGE M. WILSON, M.S., *Geologist and Head*
IRA E. ODOM, B.A., *Research Assistant*
SHIRLEY TRUEBLOOD, B.S., *Research Assistant*

GENERAL SCIENTIFIC INFORMATION

ARLENE GREEN, *Technical Assistant*
DEL MARIE ROGERS, B.A., *Technical Assistant*

PUBLICATIONS

DOROTHY E. ROSE, B.S., *Technical Editor*
MEREDITH M. CALKINS, *Geologic Draftsman*
BETTY M. LYNCH, B.ED., *Assistant Technical Editor*
DONNA R. WILSON, *Assistant Geologic Draftsman*

MINERAL RESOURCE RECORDS

VIVIAN GORDON, *Head*
BETTY J. HANAGAN, M.S., *Technical Assistant*
HANNAH FISHER, *Technical Assistant*
ROSALIE PRITCHARD, *Technical Assistant*
HELEN ROSS, B.A., *Technical Assistant*
YVONNE M. SATHER, *Technical Assistant*
BARBARA L. SCOTT, B.A., *Technical Assistant*
ELIZABETH SPEER, *Technical Assistant*
CAROLYN VERRET, *Technical Assistant*

TECHNICAL RECORDS

BERENICE REED, *Supervisory Technical Assistant*
JUDITH FLACH, *Technical Assistant*
MIRIAM HATCH, *Technical Assistant*

LIBRARY

OLIVE B. RUEHE, B.S., *Geological Librarian*
BEVERLY ANN OHREN, B.S., *Technical Assistant*

FINANCIAL RECORDS

VELDA A. MILLARD, *In Charge*
ELEANOR A. DRABIK, B.A., *Clerk IV*
VIRGINIA C. SANDERSON, B.S., *Clerk-Typist III*
CAROLYN S. TOPPE, *Clerk-Typist II*
PATRICIA A. NORTHRUP, *Clerk-Typist I*

* Divided time

Topographic mapping in cooperation with the
United States Geological Survey

March 1, 1958

SPECIAL TECHNICAL SERVICES

WILLIAM DALE FARRIS, *Research Associate*
BEULAH M. UNFER, *Technical Assistant*
A. W. GOTSTEIN, *Research Associate*
GLENN G. POOR, *Research Associate**
GILBERT L. TINBERG, *Technical Assistant*
WAYNE W. NOFFTZ, *Supervisory Technical Assistant*
DONOVON M. WATKINS, *Technical Assistant*
MARY CECIL, *Supervisory Technical Assistant*
RUBY D. FRISON, *Technical Assistant*

CLERICAL SERVICES

MARY M. SULLIVAN, *Clerk-Stenographer III*
RITA J. NORTRUP, *Clerk-Stenographer II*
LILLIAN W. POWERS, *Clerk-Stenographer II*
MARILYN BEVILL, *Clerk-Stenographer I*
BARBARA A. CARLING, *Clerk-Stenographer I*
MARILYN SCOTT, *Clerk-Stenographer I*
EDNA M. YEARGIN, *Clerk-Stenographer I*
LAUREL F. GRIFFIN, *Clerk-Typist I*
ANN VRINER, *Clerk-Typist I*
WILLIAM L. MATHIS, *Messenger-Clerk II*
JOSEPH R. EVANS, *Messenger-Clerk I*

AUTOMOTIVE SERVICE

GLENN G. POOR, *In Charge**
ROBERT O. ELLIS, *Automotive Shop Foreman*
DAVID B. COOLEY, *Automotive Mechanic*
EVERETTE EDWARDS, *Automotive Mechanic*

RESEARCH AFFILIATES

J HARLEN BRETZ, Ph.D., *University of Chicago*
STANLEY E. HARRIS, JR., Ph.D., *Southern Illinois University*
M. M. LEIGHTON, Ph.D., D.Sc., *Research Professional Scientist, State Geological Survey*
A. BYRON LEONARD, Ph.D., *University of Kansas*
CARL B. REXROAD, Ph.D., *Texas Technological College*
WALTER D. ROSE, B.S., *University of Illinois*
PAUL R. SHAFFER, Ph.D., *University of Illinois*
HAROLD R. WANLESS, Ph.D., *University of Illinois*
PAUL A. WITHERSPOON, Ph.D., *University of California*

CONSULTANTS

GEORGE W. WHITE, Ph.D., *University of Illinois*
RALPH E. GRIM, Ph.D., *University of Illinois*

CONTENTS

	PAGE
Introduction	7
Purpose and scope	7
Methods of study	7
Acknowledgments	8
Stratigraphic summary	8
Conodont fauna	9
Abundance of the fauna	11
Stratigraphic implications of the fauna	11
Uniformity of the Glen Dean fauna	12
Southern faunal province	14
Conclusions	15
Systematic descriptions	15
Genus <i>Cavusgnathus</i>	16
<i>Cavusgnathus convexa</i> Rexroad.	16
<i>Cavusgnathus cristata</i> Branson and Mehl.	16
<i>Cavusgnathus unicornis</i> Youngquist and Miller	17
Genus <i>Gnathodus</i>	17
<i>Gnathodus modocensis</i> Rexroad	17
<i>Gnathodus</i> ? sp.	18
Genus <i>Hibbardella</i>	18
<i>Hibbardella milleri</i> Rexroad, n. sp.	18
<i>Hibbardella ortha</i> Rexroad, n. sp.	18
Genus <i>Hindeodella</i>	19
<i>Hindeodella</i> spp.	19
Genus <i>Kladognathus</i>	19
<i>Kladognathus mehli</i> (Rexroad).	19
<i>Kladognathus prima</i> (Rexroad)	19
Genus <i>Lambdagnathus</i>	19
<i>Lambdagnathus fragilidens</i> Rexroad, n. sp.	20
Genus <i>Ligonodina</i>	21
<i>Ligonodina hamata</i> Rexroad	21
<i>Ligonodina obunca</i> Rexroad	21
<i>Ligonodina roundyi</i> Hass	21
Genus <i>Lonchodina</i>	22
<i>Lonchodina furnishi</i> Rexroad, n. sp.	22
<i>Lonchodina paraclaviger</i> Rexroad, n. sp.	22
<i>Lonchodina</i> cf. <i>L. paraclarki</i> Hass.	22
Genus <i>Neoprioniodus</i>	23
<i>Neoprioniodus camurus</i> Rexroad	23
<i>Neoprioniodus loxus</i> Rexroad	23
<i>Neoprioniodus scitulus</i> (Branson and Mehl)	23
<i>Neoprioniodus varians</i> (Branson and Mehl)	24
Genus <i>Ozarkodina</i>	24
<i>Ozarkodina compressa</i> Rexroad	24
<i>Ozarkodina curvata</i> Rexroad, n. sp.	24
Genus <i>Spathognathodus</i>	25
<i>Spathognathodus campbelli</i> Rexroad	25
<i>Spathognathodus cristula</i> Youngquist and Miller	25
<i>Spathognathodus spiculus</i> Youngquist and Miller	25
<i>Spathognathodus</i> cf. <i>S. commutatus</i> Branson and Mehl.	26

Genus <i>Roundya</i>	26
<i>Roundya costata</i> Rexroad, n. sp.	26
Genus <i>Trichonodella</i>	26
<i>Trichonodella imperfecta</i> Rexroad	26
Genus Indeterminate	26
References	27

ILLUSTRATIONS

TEXT FIGURES	PAGE
1. Localities from which conodonts were collected	8
2. Reily Lake North, locality 1	8
3. Coles Mill, locality 2	9
4. Grassy Knob, locality 3.	9
5. Vienna South, locality 4	11
6. Harris Creek, locality 5.	11
7. Walches Cut, locality 6	12
8. Gary Brothers Quarry, locality 8	13
9. Brownsville Southeast, locality 9	13
10. Type Glen Dean, locality 10	14
11. Lutgring and Sons Quarry, locality 11	14
12. Mulzer Brothers Quarry, locality 12	15
13. Gerkin Quarry, locality 13	16
14. Diagrammatic reconstruction of a mature representative of <i>Lambdagnathus</i> Rexroad, n. gen.	20

PLATES	FACING PAGE
1. Glen Dean conodonts.	12
2. Glen Dean conodonts.	13
3. Glen Dean conodonts.	14
4. Glen Dean conodonts.	15
5. Glen Dean conodonts.	16
6. Glen Dean conodonts.	17

CONODONTS FROM THE GLEN DEAN FORMATION (CHESTER) OF THE ILLINOIS BASIN

CARL B. REXROAD

ABSTRACT

The conodont fauna of the Glen Dean Formation in its outcrop area around the margin of the Illinois Basin is described. Samples were collected from thirteen uniformly spaced sections in southern Illinois, Indiana, and Kentucky, including the type section, and virtually every sample from limestone and many from shale yielded conodonts.

Twenty-seven species, seven new, were recognized and are referable to thirteen genera: *Cavusgnathus*, *Gnathodus*, *Hibbardella*, *Hindeodella*, *Kladognathus* (new name for *Cladognathus*), *Ligonodina*, *Lonchodina*, *Neoprioniodus*, *Ozarkodina*, *Roundya*, *Spathognathodus*, *Trichonodella*, and one new genus *Lambdaognathus*.

The fauna is unaffected by lithologic variations and is remarkably uniform geographically, although a southern faunal province based on abundance of certain species is recognized.

Six species appear restricted to the formation but their ranges cannot be considered fixed because the remainder of the Chester Series has not been sampled in comparable detail.

INTRODUCTION

PURPOSE AND SCOPE

Studies of conodonts from the Chester Series in the type area of southwestern Illinois (Rexroad, 1957) showed a diversified fauna from eight formations and indicated that conodonts will be useful in stratigraphic investigations of Chester strata. Although the earlier study established the Chester conodont fauna as a whole, that study was confined to one area and mainly to the shale beds. Thus it did not allow evaluation of limestone faunas, effects of facies changes, nor faunal variations within a single formation over a broad area. Such details, along with the more precise delimiting of stratigraphic ranges within the series, were the objectives of the present study.

The Glen Dean Formation was chosen for study because: (1) it contains relatively abundant conodonts in the type area of the Chester Series; (2) it is well exposed around the margin of the Illinois Basin; (3) in much of its outcrop area it consists of a lower massive limestone unit and an upper unit of mixed lithology, dominantly shale, which would be desirable for facies analysis;

and (4) its position in the middle Chester might show whether several species, which in the initial study appeared to have a range limited to the lower or to the upper part of the series, are truly restricted.

Thirteen sections from Illinois, Indiana, and western Kentucky, including the type section of the formation, were sampled. Only sections where stratigraphic positions are well established were chosen as collecting localities and these were spaced as uniformly as was consistent with the choice of complete or nearly complete Glen Dean sections.

METHODS OF STUDY

From each exposure, channel samples of all lithologies except sandstone were collected. The thickness represented by each sample was commonly one or two feet but depended upon the thickness of the lithologic units. Initial samples averaged about 700 grams. The samples were processed, then bulk samples were collected from each zone that contained abundant conodonts. In addition, a sample of approximately 150 pounds of crushed rock was collected from the lower massive limestone unit in the Mulzer Brothers quarry, location 12.

In the laboratory the limestone samples were crushed to less than $\frac{5}{8}$ -inch size and dissolved in 10 percent acetic acid. Shales were dissociated by boiling and by the use of the Campbell microfossil washing machine. Residues were screened and the portion retained between the 20- and 100-mesh screens was concentrated by gravity separation in tetrabromoethane. Specimens picked from the heavy residues were grouped, first by sample and location number, then regrouped by genus and species.

ACKNOWLEDGMENTS

The project was directed by C. W. Collinson. D. H. Swann selected sections to be sampled in Illinois and gave helpful advice on the stratigraphic aspects of the study. Discussions of taxonomy with A. J. Scott proved most helpful. Valuable criticism of the manuscript was given by C. W. Collinson, D. H. Swann, and H. B. Willman. Marie Litterer prepared the text figures.

Edmund Nosow of the Kentucky Geological Survey collected samples from two sections in Kentucky (localities 7 and 8) and provided information about them. Ned Smith of the Indiana Geological Survey aided in the selection of suitable outcrops in Indiana. A manuscript by T. G. Perry

FIG. 1.—Localities from which conodonts were collected. See outcrop diagrams (figs. 2–13) for detailed descriptions.

FIG. 2.—Reily Lake North, locality 1. Small quarry in Mississippi Valley bluff about 1.1 miles northwest of Reily Lake, SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24 (extended), T. 6 S., R. 8 W., Chester quadrangle, Randolph County, Illinois.

and Ned Smith gave additional information about the Glen Dean Formation in Indiana. A. K. Miller loaned Pella Beds material from the State University of Iowa repository, P. E. Cloud and W. H. Hass loaned Barnett Formation type specimens from the U. S. National Museum, and M. G. Mehl of the University of Missouri made available figured specimens from the Caney Shale.

STRATIGRAPHIC SUMMARY

The Glen Dean Formation, although highly variable in lithology, is a well defined unit in its extensive outcrop area around the southwestern, southern, and southeastern margin of the Illinois basin and in the subsurface within the basin. It overlies the Hardinsburg Formation with apparent conformity and is overlain by the Tar Springs Sandstone, unconformably in

FIG. 3.—Coles Mill, locality 2. Just above mouth of ravine, east of flour mill at south edge of Chester, W. line NW¼ sec. 30, T. 7 S., R. 6 W., Chester quadrangle, Randolph County, Illinois.

some areas but apparently conformably in others. Although the Glen Dean is the uppermost formation of the middle Chester, it is nearly in the middle of the series, as eight of the sixteen formations of the standard sequence overlie it.

The lithologic sequence of twelve of the thirteen sections sampled is shown in text figures 2-13. Samples which contain conodonts are shown in solid black. The sections selected over-emphasize the amount of limestone in the formation because the dominantly limestone sections tend to be better exposed than those composed largely of shale. Generally in Indiana and Kentucky a "lower massive limestone" is recognized and above that a unit of mixed lithology in which shales predominate but in which limestones and sandstones are present. This twofold division does not persist in the Illinois outcrop belt, however, and there are places where shale predominates in the lower part and limestone in the upper.

The lower massive limestone, although persistent over much of the outcrop, varies in lithology and may be crinoidal, oolitic, dolomitic, or siliceous. Generally it occurs in beds one to two feet thick and is medium to dark gray, medium- to coarse-grained, argillaceous limestone with crystallinity that

FIG. 4.—Grassy Knob, locality 3. Stream bed in picnic area NE¼ SE¼ sec. 27, T. 10 S., R. 3 W., Alto Pass quadrangle, Jackson County, Illinois.

is caused in large part by abundant fossil fragments. The upper unit of the formation in Indiana and Kentucky is highly variable and contains shales, limestones, and sandstones. Some of the upper beds vary several feet in thickness, and may even thin out, within a single quarry.

CONODONT FAUNA

Conodonts in considerable variety are present in all of the thirteen Glen Dean sections sampled (table 1). Twenty-seven species belonging in twelve genera, one new, were identified, and specimens of a thirteenth genus, *Hindeodella*, are abundant. Also present are numerous fragments which apparently represent a new genus but which are not sufficiently well preserved to warrant detailed description. Of the twenty-seven species, seven are new.

TABLE 1.—GEOGRAPHIC OCCURRENCE OF CONODONT SPECIES

Locality numbers refer to outcrops shown in text-figure 1 and described in detail by text-figures 2-13. U and L refer to upper Glen Dean and lower Glen Dean, respectively.

LOCALITY	1	2	3	4	5	6L	6U	7L	8U	9L	9U	10L	11L	11U	12L	12U	13L
Cavusgnathus.	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—
C. convexa	x	x	x	x	x	—	—	x	—	—	—	x	x	—	x	x	x
C. cristata.	x	x	x	x	x	—	—	x	x	x	—	x	x	x	x	x	x
C. unicornis	x	x	x	x	x	x	x	x	x	x	—	x	x	x	x	x	x
Gnathodus																	
G. modocensis	x	—	x	—	x	x	—	x	x	x	—	x	x	—	x	—	x
G. ? sp.	—	—	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—
Hibbardella																	
H. milleri	x	x	x	x	x	x	—	x	x	x	—	x	x	x	x	—	x
H. ortha	x	x	x	—	x	—	—	—	x	—	—	x	—	—	x	x	x
Hindeodella	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kladognathus.	—	—	—	x	—	—	—	—	—	x	—	x	x	x	—	—	x
K. prima	x	x	x	—	x	—	—	—	—	x	—	—	—	—	—	—	—
K. mehli	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lambdagnathus	—	—	x	—	—	—	—	x	x	x	—	—	x	x	—	—	—
L. fragilidens	x	x	—	—	x	—	—	—	—	—	—	x	—	—	x	—	x
Ligonodina																	
L. hamata	x	x	x	x	x	x	—	x	x	x	—	x	x	x	x	x	x
L. obunca	x	x	x	x	x	—	—	x	x	x	—	x	x	x	x	x	x
L. roundyi.	x	—	x	—	—	x	—	x	—	—	—	—	x	—	x	—	x
Lonchodina	—	—	—	—	—	—	—	x	—	—	—	—	—	x	—	—	—
L. furnishi.	x	—	x	—	x	—	—	—	x	—	—	—	—	—	x	—	x
L. paraclaviger	—	—	x	—	—	—	—	—	—	—	—	—	x	—	x	—	x
L. cf. paraclarki	—	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—	x
Neoprioniodus																	
N. camurus	x	x	—	—	—	—	x	—	—	x	—	x	x	—	x	x	x
N. loxus	x	x	x	—	—	—	—	—	x	—	—	x	x	—	x	—	x
N. scitulus.	x	x	x	x	x	x	x	x	x	x	—	x	x	x	x	x	x
N. varians.	x	x	x	—	x	—	—	—	x	x	—	x	x	x	x	x	x
Ozarkodina																	
O. compressa	x	x	x	x	x	x	—	x	x	x	x	x	x	x	x	x	x
O. curvata.	x	x	—	—	—	—	—	—	—	x	—	—	x	—	x	—	x
Roundya																	
R. costata	x	—	—	—	—	—	—	x	—	x	—	—	x	—	x	x	x
Spathognathodus.																	
S. campbelli	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. cf. commutatus	—	—	—	—	x	—	—	x	x	—	—	x	—	—	—	—	—
S. cristula	x	x	—	x	—	—	—	—	—	x	x	x	x	x	x	x	x
S. spiculus.	x	x	—	x	—	—	—	—	—	—	—	x	—	x	—	—	—
Trichonodella																	
T. imperfecta	—	x	—	—	—	—	—	—	—	—	—	—	x	—	x	—	x
Genus indet.	x	x	x	x	x	—	—	x	x	x	—	x	x	x	x	x	x

FIG. 5.—Vienna South, locality 4. Abandoned quarry, west side of Highway 45, about 1.4 miles south of junction of Highways 45 and 165 in Vienna, SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 8, T. 13 S., R. 3 E., Vienna quadrangle, Johnson County, Illinois.

These are *Hibbardella milleri*, *H. ortha*, *Lambdagnathus fragilidens*, *Lonchodina furnishi*, *L. paraclaviger*, *Roundya costata*, and *Ozarkodina curvata*.

ABUNDANCE OF THE FAUNA

Conodonts are found in at least moderate abundance at all the outcrops sampled (50 to 150 specimens per 1000 grams of raw sample is considered abundant). Altogether more than 4000 specimens were examined and hundreds of representatives of many species were studied. Conodonts were found to be much more abundant in limestone than in shale.

The most abundant species encountered were *Neoprioniodus scitulus* and *Cavusgnathus unicornis* but they were closely followed in numbers by *Ligonodina obunca* and *Spathognathodus cristula*. Among those also considered abundant are *Cavusgnathus convexa*, *Ozarkodina compressa*, and *Spathognathodus spiculus*.

With the exception of eight rare species, all others listed in table 1 occur commonly, but *Cavusgnathus cristata*, *Gnathodus modocensis*, *Hibbardella milleri*, *Ligonodina hamata*, and *Neoprioniodus varians* were found in slightly larger numbers than the others. *Kladognathus prima*, *Lambdagnathus fragilidens*, and *Lonchodina paraclavi-*

FIG. 6.—Harris Creek, locality 5. Hillside above and below abandoned section of road, NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 15, T. 11 S., R. 9 E., Shawneetown quadrangle, Hardin County, Illinois.

ger are very uncommon in the Glen Dean; *Gnathodus* ? sp., *Kladognathus mehli*, *Lonchodina furnishi*, *L. cf. L. paraclarki*, *Roundya costata*, *Spathognathodus campbelli*, *S. cf. S. commutatus*, and *Trichonodella imperfecta* are considered rare.

STRATIGRAPHIC IMPLICATIONS OF THE FAUNA

Although the 1957 report established the general nature of the conodont fauna of the Chester Series, only one complete sequence was studied and the stratigraphic ranges for species were not well established. Consequently, a project to determine precisely the ranges of species in the Chester Series is now in progress.

The present study was designed to determine the constancy of a conodont fauna in differing lithologies and over wide distances. However, it has developed important information about stratigraphic ranges. The lower Chester (Renault and Paint Creek) collections studied in 1957 by Rexroad were large enough (200 or more specimens) to be considered truly representative. Comparison of these faunas with those of the middle Chester Glen Dean indicates that several forms, *Cavusgnathus characta*, *Ozarkodina recta*, *O. ? bella*, and *Neopri-*

FIG. 7.—Walches Cut, locality 6. Illinois Central Railroad cut about 1.9 miles E-NE of Scottsburg. Section illustrated begins about 50 yards east of overpass bridge, Carter coordinates 23-H-21, 4000 feet N. of S. line, 1035 feet E. of W. line of quadrangle H-21, Princeton East quadrangle, Caldwell County, Kentucky.

oniodus erectus, appear to be restricted to the lower Chester. Representatives of the genera *Polygnathus* and *Synprioniodina* are also restricted to pre-Glen Dean rocks in the type Chester area but must be evaluated further.

Six species have been recorded from only the Glen Dean. Three, *Kladognathus mehli*, *Lonchodina furnishi* and *Roundya costata*, are uncommon; but the remaining three, *Hibbardella ortha*, *Lambdagnathus fragilidens*, and *Lonchodina paraclaviger*, are sufficiently abundant to appear stratigraphically significant.

UNIFORMITY OF THE GLEN DEAN FAUNA

The over-all uniformity of the conodont fauna is impressive from three standpoints: first, uniformity in differing lithologies; second, uniformity between the lower and upper parts of the formation; and third, geographic uniformity. One important exception to this pattern will be noted later.

No differences were found in the species represented in collections from differing types of limestone—oolitic, crinoidal, dolomitic, and others—nor between various kinds of shale. Conodonts were found to be more abundant and better preserved in

EXPLANATION OF PLATE 1

All figures $\times 40$

Numbers in parentheses after explanations refer to locality and sample numbers, for example (7-4) refers to locality 7, sample 4.

FIGURE

- 1, 2 *Gnathodus modocensis* Rexroad; 1, outer lateral view (7-4); 2, oral view (7-14).
 3-5 *Gnathodus?* sp.; 3, inner lateral view (8-7); 4, 5, oral views (8-2 and 8-7).
 6-11 *Cavusgnathus unicornis* Youngquist and Miller; 6, 7, inner and outer lateral views of mature specimens (1-43 and 9-30); 8, 9, oral and inner lateral views of young specimens (both 2-6); 10, 11, oral and inner lateral views of an old specimen (1-26).
 12-14 *Cavusgnathus convexa* Rexroad; 12, inner lateral view of mature specimen (1-43); 13, inner lateral view of old specimen (1-61); 14, outer lateral view of mature specimen (1-47).
 15-17 *Cavusgnathus cristata* Branson and Mehl; 15, inner lateral view (11-18); 16, aboral view (3-2); 17, outer lateral view (9-14).

REXROAD — GLEN DEAN CONODONTS

REXROAD — GLEN DEAN CONODONTS

FIG. 8.—Gary Brothers Quarry, locality 8. Quarry 2000 feet east of Highway 231, Carter coordinates 14-H-35, 1200 feet N. of S. line, 6300 feet E. of W. line of quadrangle H-35, Sugar Grove quadrangle, Butler County, Kentucky.

FIG. 9.—Brownsville Southeast, locality 9. Mc-Iellan Stone Quarry No. 4, just southwest of Highway 65 approximately 3.6 miles from Green River bridge in Brownsville, Carter coordinates line between 24-I-40 and 4-H-40, 5450 feet E. of W. line of quadrangle, Rhoda quadrangle, Edmonson County, Kentucky.

limestone than in shale, but twenty-one of the twenty-seven Glen Dean species are common to both limestone and shale. *Kladognathus mehli* and *Spathognathodus campbelli*, the two species limited to shale, were each represented in this study by less than four specimens, these from a single locality. The four species found only in limestone probably reflect the method of sampling rather than environmental factors. Zones particularly productive of conodonts were resampled in quantity, and, because of the greater abundance of conodonts in limestone than in shale, a disproportionately high percentage of specimens are

from limestone. *Ligonodina roundyi* and *Lonchodina paraclarki* have both been recorded from shale according to Hass's distribution chart (1953, table 1), but in this study *Ligonodina roundyi* and *Lonchodina* cf. *L. paraclarki* were found only in limestone.

A comparison between the lower Glen Dean massive limestone and the upper Glen Dean zone of mixed lithology shows that twenty-three species are common to both the lower and upper Glen Dean. The two species limited to the upper part are rare, and the two limited to the lower part are

EXPLANATION OF PLATE 2

All figures $\times 40$

Numbers in parentheses after explanations refer to locality and sample numbers, for example (12-3) refers to locality 12, sample 3.

FIGURE

- 1-4 *Hindeodella* spp., lateral views (12-3, 11-15, 2-42 and 11-14 respectively).
 5-8 *Roundya costata* Rexroad, n.sp.; 5, posterior view of holotype (12-4); 6, lateral view of a paratype (12-11); 7, posterior view of a paratype (13-17); 8, lateral view of a paratype, a young specimen (1-61).
 9-12 *Hibbardella ortha* Rexroad, n.sp.; 9, lateral view of a paratype, a young specimen (13-3); 10, posterior view of holotype (13-1); 11, posterior view of a paratype, a variant (8-7); 12, posterior view of a paratype, a young specimen (13-3).
 13-16 *Hibbardella milleri* Rexroad, n.sp.; 13, oblique posterior view of holotype (1-61); 14, lateral view of a paratype, a young specimen (7-16); 15, anterior view of a paratype (10-4); 16, lateral view of a paratype (13-15).

FIG. 10.—Type Glen Dean, locality 10. Cut on east side of road (abandoned railroad) about 0.8 mile N. of post office in Glen Dean, Carter coordinates 2-N-36, 1850 feet S. of N. line, 9025 feet W. of E. line of quadrangle N-36, Glen Dean quadrangle, Breckenridge County, Kentucky.

by no means common. For practical purposes the groups of conodonts from the two units are indistinguishable.

Conodonts from the Illinois and Indiana sections are nearly identical, both as to species present and the relative abundance of the species. *Kladognathus* is less common in Indiana; *Spathognathodus campbelli* was found in only one section, locality 2, in southwestern Illinois; *Lonchodina* cf. *L. paraclarki* was found only in the three Indiana sections. Otherwise the species coincide.

SOUTHERN FAUNAL PROVINCE

In the south part of the area studied there is a noticeable change in the fauna, as shown by comparing species collected at localities 7 and 8 in Christian and Butler counties, Kentucky, with those from the

FIG. 11.—Lutgring and Sons Quarry, locality 11. Abandoned quarry about 0.6 mile E. of Branchville, NW¼ NW¼ sec. 18, T. 4 S., R. 1 W., Perry County, Indiana.

other sections (table 1). Two differences are not shown by table 1. First, *Cavusgnathus cristata* is of slight importance in the northern sections but is the most common species of *Cavusgnathus* to the south, and second, *Neoprioniodus varians* is an important element in the fauna only at locality 8 where it is more abundant than *N. scitulus*.

EXPLANATION OF PLATE 3

All figures × 40

Numbers in parentheses after explanations refer to locality and sample numbers, for example (12-7) refers to locality 12, sample 7.

FIGURE

- 1-4 *Ligonodina roundyi* Hass; 1, posterior view (12-7); 2, inner lateral view (6-1); 3, anterior view (12-20); 4, posterior view (12-4).
- 5 *Kladognathus mehli* (Rexroad); inner lateral view (2-10).
- 6 *Kladognathus prima* (Rexroad); inner lateral view (3-6).
- 7, 8 *Ligonodina obunca* Rexroad; 7, inner lateral view of a young specimen (12-2); 8, outer lateral view (12-21).
- 9-14 *Ligonodina hamata* Rexroad; 9, anterior view (11-23); 10, 11, inner lateral and outer lateral views of young specimens (12-2 and 12-3); 12-14, inner lateral, outer lateral, and inner lateral views of mature specimens (1-61, 1-60 and 1-61 respectively).

REXROAD — GLEN DEAN CONODONTS

REXROAD — GLEN DEAN CONODONTS

The latter, next to *Cavusgnathus unicornis*, is the most abundant species in the Glen Dean Formation. The megafossils show a similar change in the southern area (Nossow, Swann, personal communications). In many aspects, the conodont faunas of these two southern localities resemble those of the upper conodont zone of the Barnett Formation of Texas and the Delaware Creek Member of the Caney Shale of Oklahoma.

CONCLUSIONS

The following conclusions are indicated:

(1) The conodonts in the Glen Dean Formation are virtually unaffected by changes in lithology and therefore will be useful for correlation between facies; (2) the abundance and variety of conodonts in limestone opens an avenue of stratigraphic investigation in many dominantly carbonate sections which have received little attention from conodont workers; (3) conodont faunas are relatively uniform within the Chester Series over broad geographic areas.

SYSTEMATIC DESCRIPTIONS

The type and figured specimens described and illustrated in this paper have been deposited at the Illinois State Geological Survey. Under the subheading *Distribution* in the discussion of each species, the formations in which it occurs are listed. For detailed information about stratigraphic and geographic distribution of each species see table 1.

FIG. 12.—Mulzer Brothers Quarry, locality 12. Approximately 2.1 miles N. of junction of Indiana highways 145 and 64, 1,500 feet E. of Highway 145, SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 10, T. 2 S., R. 2 W., Taswell quadrangle, Crawford County, Indiana.

EXPLANATION OF PLATE 4

All figures $\times 40$

Numbers in parentheses after explanations refer to locality and sample numbers, for example (12-4) refers to locality 12, sample 4.

FIGURE

- 1-3 *Ozarkodina curvata* Rexroad, n.sp.; 1, inner lateral view of holotype (12-4); 2, outer lateral view of a paratype (12-4); 3, inner lateral view of a paratype (12-4).
 4, 5 *Lonchodina* cf. *L. paraclarki* Hass; 4, outer lateral view (12-15); 5, inner lateral view (12-composite).
 6 *Trichonodella imperfecta* Rexroad; posterior view (13-10).
 7-10 *Lonchodina paraclaviger* Rexroad, n.sp.; 7, inner lateral view of a paratype (12-7); 8, outer lateral view of holotype (12-4); 9, aboral view of a paratype (12-composite); 10, inner lateral view of a paratype (12-composite).
 11-13 *Lonchodina furnishi* Rexroad, n.sp.; 11, aboral view of a paratype (12-5); 12, inner lateral view of a paratype, a young specimen (13-3); 13, inner lateral view of holotype (12-3).

FIG. 13.—Gerkin Quarry, locality 13. Small abandoned quarry about 2.9 miles NW of Shoals, NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T. 3 N., R. 4 W., Shoals quadrangle, Martin County, Indiana.

Genus *CAVUSGNATHUS* Harris and Hollingsworth, 1933

Type species: *Cavusgnathus alta* Harris and Hollingsworth

CAVUSGNATHUS CONVEXA Rexroad

Plate I, figures 12-14

Cavusgnathus convexa REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 17, pl. 1, figs. 3-6.

The holotype and the two paratypes of this species are from the Glen Dean Formation in the type area of the Chester Series, and specimens from other Glen Dean locations conform closely to the type specimens. The large number of specimens examined in this study show clearly the changes which occurred during ontogeny. Young specimens tend to be narrow with nearly straight parapets. With growth they tend to broaden the platform without a proportional increase in length, increase the flare of the inner lip of the navel, and some gerontic individuals show additional denticles on the

anterior margin of the blade, increasing the number of blade denticles from the typical four, five, or six to as many as nine. Variants which in oral outline show blades less regularly convex than any previously known are also present in the Glen Dean collections.

Material studied.—201 specimens from this study, 35 from Rexroad 1957 study.

Distribution.—Renault, Golconda, Glen Dean, Menard, and Kinkaid Formations of Illinois; Glen Dean of Indiana and Kentucky.

Repository.—Illinois State Geological Survey, 3P1, 3P2, 3P3 (figured specimens).

CAVUSGNATHUS CRISTATA Branson and Mehl

Plate 1, figures 15-17

Cavusgnathus cristata BRANSON and MEHL, 1940, Denison University Bull., Jour. Sci. Labs., v. XXXV, p. 177, pl. V, figs. 26-31. HASS, 1953, U. S. Geol. Survey Prof. Paper 243-F, p. 77, pl. 14, figs. 12-14. COOPER, (part) 1947 Jour. Paleontology, v. 21, no. 2, p. 91, pl. 20, figs. 4-6 (not figs. 7-10). ELIAS, 1956, Petroleum Geology of southern Oklahoma: Am. Assoc. Petrol. Geol., v. 1, p. 115, pl. II, figs. 1-6. BISCHOFF, 1957, p. 19, pl. 2, figs. 7a, b.

Cavusgnathus cristata var. *grandis* ELIAS, 1956, Petroleum Geology of southern Oklahoma: Am. Assoc. Petrol. Geol., v. 1, p. 115, pl. II, figs. 12-14.

Some of the Glen Dean specimens conform quite closely to Branson and Mehl's holotype of *C. cristata*, but most have a more regular outline of the oral margin of the blade as viewed laterally, thus resembling *C. convexa*. There are a number of differences, however, between *C. convexa* and *C. cristata*. The navel of *C. convexa* extends to the posterior tip of the specimen and is very asymmetric with greater flare of the inner lip in contrast to the greater symmetry of the navel of *C. cristata* which ex-

EXPLANATION OF PLATE 5

All figures $\times 40$

Numbers in parentheses after explanations refer to locality and sample numbers, for example (12-3) refers to locality 12, sample 3.

FIGURE

- 1, 2 Genus indeterminate; posterior views (12-3 and 1-40).
- 3, 4 *Neoprioniodus varians* (Branson and Mehl); inner lateral views (11-20 and 8-4).
- 5, 6 *Neoprioniodus camurus* Rexroad; inner lateral views (12-2 and 12-4).
- 7-9 *Neoprioniodus loxus* Rexroad; 7, 8, inner lateral views (1-12 and 13-2); 9, outer lateral view (2-22).
- 10-14 *Neoprioniodus scitulus* (Branson and Mehl); 10, 11, inner lateral views of young specimens (12-29 and 1-38); 12-14, inner lateral views of mature specimens (1-41, 10-4, and 1-41 respectively).

REXROAD — GLEN DEAN CONODONTS

REXROAD — GLEN DEAN CONODONTS

tends only part way to the posterior, leaving the posterior fourth of the aboral margin sharp-edged. At the posterior end of the oral trough a median carina is typical in *C. cristata* but is present only rarely in *C. convexa* and then consists of only a few isolated nodes. The parapets of *C. convexa* are ornamented by sharper more regularly spaced transverse ridges than those of *C. cristata*.

There is a considerable range in the size of even the mature specimens of *C. cristata* and in the older specimens the transverse ridges of the parapets tend to become less sharp and in some cases remain only as a series of nodes. For these reasons, Elias' variety *C. cristata* var. *grandis* is not considered valid.

Material studied.—71 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky, Barnett Formation of Texas, and the Delaware Creek Member of the Caney Shale of Oklahoma.

CAVUSGNATHUS UNICORNIS Youngquist and Miller

Plate 1, figures 6-11

Cavusgnathus unicornis YOUNGQUIST and MILLER, 1949, Jour. Paleontology, v. 23, no. 6, p. 619, pl. 101, figs. 18-23. REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 17, pl. 1, fig. 7. *Cavusgnathus cristata* Branson and Mehl, COOPER (part), 1947, Jour. Paleontology, v. 21, no. 2, p. 91, figs. 7-10.

This easily recognizable species is an important element of the Glen Dean Forma-

tion at all locations studied. Except for changes during ontogeny, the species shows little variation. The young specimens tend to be narrow with parapets nearly straight or slightly concave toward the inner side. With growth the platform broadens without a proportional increase in length, there develops a pronounced convexity of the inner parapet near the posterior as viewed orally, an increase in the flare of the inner lip of the navel, and an increase in the number of small denticles on the blade anterior to the prominent posterior denticle.

Material studied.—524 specimens from this study, 170 from Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, Clore, and Kinkaid Formations of Illinois, Indiana, and Kentucky, and the Pella Beds of Iowa.

Repository.—Illinois State Geological Survey, 3P7, 3P8, 3P9, 3P10, 3P11 (figured specimens).

Genus GNATHODUS Pander, 1856

Type species: *Gnathodus mosquensis* Pander

GNATHODUS MODOCENSIS Rexroad

Plate 1, figures 1 and 2

Gnathodus modocensis REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 30, pl. 1, figs. 15-17.

Most specimens of *Gnathodus* that occur in the Glen Dean Formation are very uniform in appearance and may be readily identified as *G. modocensis*. As stated previously (Rexroad, 1957, p. 30), this species closely resembles *G. bilineatus* (Roundy).

EXPLANATION OF PLATE 6

All figures $\times 40$

Numbers in parentheses after explanations refer to locality and sample numbers, for example (8-7) refers to locality 8, sample 7.

FIGURE

- 1, 2 *Ozarkodina compressa* Rexroad; 1, inner lateral view (8-7); 2, outer lateral view (1-25).
- 3, 4 *Spathognathodus cristula* Youngquist and Miller; 3, inner lateral view of a mature specimen (2-31); 4, inner lateral view of a young specimen (12-7).
- 5-7 *Spathognathodus spiculus* Youngquist and Miller; lateral views (10-3, 10-3, and 1-43 respectively).
- 8 *Spathognathodus* cf. *S. commutatus* Branson and Mehl; inner lateral view (8-7).
- 9 *Spathognathodus campbelli* Rexroad; inner lateral view (12-14).
- 10-16 *Lambdagnathus fragilidens* Rexroad, n.gen., n.sp.; 10, 11, 13, two oblique views and an oral view of holotype (1-41); 12, outer lateral view of a paratype (1-49); 14, aboral view of a paratype (1-60); 15, 16, posterior views of two paratypes (12-composite and 12-2).

This is especially apparent when comparing the adult of the former with the young of the latter. This resemblance seems to indicate that the two are closely related although not conspecific because of the differences between adults. About five percent of the specimens of *Gnathodus* found in the Glen Dean bear an especially strong resemblance to *G. bilineatus* (Roundy). These specimens, nevertheless, are identified as *G. modocensis* and are considered variants toward the closely related species.

Material studied.—87 specimens.

Distribution.—Paint Creek and Glen Dean Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P12, 3P13 (figured specimens).

GNATHODUS ? sp.

Plate 1, figures 3-5

Four specimens from two localities are difficult to place generically because they are young and broken. From oral view a free blade continues as a slightly sinuous carina with nearly symmetrical parapet-like units on each side. On the aboral side of the platform is a navel which in the broken specimens gives the impression of being asymmetrical, the inner side being essentially limited to the under side of the inner parapet and the outer side perhaps extending outward as a platform beyond the outer parapet-like structure on its oral surface. This development is similar to that in several species of *Gnathodus* including *G. girtyi* Hass from the Barnett Formation of Texas.

Material studied.—4 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P14, 3P15, 3P16 (figured specimens).

Genus HIBBARDELLA Bassler, 1925

Type species: *Hibbardella angulata* Hinde

HIBBARDELLA MILLERI Rexroad, n.sp.

Plate 2, figures 13-16

Hibbardella n.sp. ? REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 31, pl. 1, fig. 19.

Anterior arch moderately deep, charac-

teristically with a small central denticle immediately anterior to main cusp, each lateral bar typically bearing four discrete round denticles bowed posteriorly and increasing in size distally, distal ends of bars spatulate; aboral edges of lateral bars thin, grooved, may be slightly sigmoidal as viewed from anterior and meeting at base of cusp in an acute angle, bars inclined 5° to 20° posteriorly; anterior faces convex and inclined posteriorly downward. Cusp large, recurved, elliptical in cross section, sharp edged fore and aft, but increasingly rounded toward tip. Posterior bar short, anterior end of bar stout in adults, longer and thinner in young, few denticles or nodes on oral surface in adults, marked attachment scars on anterior end of bar seen in lateral view; aboral margin wedge-shaped with longitudinal median groove.

The species is named in honor of A. K. Miller of the State University of Iowa.

Material studied.—113 specimens from Glen Dean, 25 from Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, Clore, and Kinkaid Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P17 (holotype), 3P18, 3P19, 3P20 (paratypes).

HIBBARDELLA ORTHA Rexroad, n.sp.

Plate 2, figures 9-12

Anterior arch deep, anterior face coinciding with anterior face of main cusp; the two lateral limbs nearly in a common plane, anterior faces flat, each limb typically with five erect primary denticles fused about one-half way to apices, some specimens with germ denticles between; aboral edges of lateral limbs thin, meeting at base of cusp at a low obtuse angle. Cusp erect, thin, nearly straight, triangular in cross section with flat anterior face and a sharp edge posterior. Posterior bar moderately deep, thin, none complete, bears closely spaced, laterally compressed denticles; aboral margin with median longitudinal groove which extends anteriorly to tiny aboral pit near the anterior of base of cusp.

I do not believe that the partial fusion of the denticles of this species justified the erection of a genus distinct from similar species with discrete denticles.

Material studied.—31 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P21 (holotype), 3P22, 3P23, 3P24 (paratypes).

Genus HINDEODELLA Bassler, 1925

Type species: *Hindeodella subtilis* Ulrich and Bassler

HINDEODELLA spp.

Plate 2, figures 1-4

Hindeodella is represented by abundant fragmentary specimens but few complete specimens. Specific references do not seem justified on the basis of the several complete specimens and fragments representing only the termini or midsection of bars. Several representative specimens are figured to indicate the nature of the material.

Repository.—Illinois State Geological Survey, 3P25, 3P26, 3P27, 3P28 (figured specimens).

Genus KLADOGNATHUS

Rexroad, n. name

Type species: *Cladognathus prima* Rexroad

W. H. Hass has called to my attention the fact that the name *Cladognathus* Rexroad is preoccupied by *Cladognathus* Burmeister given to a genus of the Coleoptera (Burmeister, 1847, p. 364).

KLADOGNATHUS MEHLI (Rexroad)

Plate 3, figure 5

Cladognathus mehli REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 29, pl. 1, figs. 11, 12.

Only two additional specimens of this species were found in this study, both from the location from which the holotype was described. They show little variation from the type specimens.

Material studied.—8 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P29 (figured specimen).

KLADOGNATHUS PRIMA (Rexroad)

Plate 3, figure 6

Cladognathus prima REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 28, pl. 1, figs. 8-10.

The type and figured specimens show the amount of variation to be expected in this species, but its occurrence is not common enough to allow description of growth stages which probably would clarify the phylogenetic relations of *Kladognathus*. The chief variation in this species is in the number of denticles of the anterior process and hence in the length of the process. This suggests that the genus developed from *Ligonodina*.

Material studied.—20 specimens from this study, 10 from Rexroad 1957 study.

Distribution.—Glen Dean, Menard, Clore, and Kinkaid Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P30 (figured specimen).

Genus LAMBDAGNATHUS Rexroad, n.gen.

Type species: *Lambdagnathus fragilidens* REXROAD, n.sp.

New genus ?, REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 41, pl. 4, figs. 8-13.

Complex unit consisting of a posterior denticulate process and blade-like anterior and inner lateral denticulate processes with an apical denticle, usually triangular in shape, at the juncture of the three, and, aborally, a triangular shaped pit at their juncture (figure 14). The posterior bar is usually the shortest of the three branches, is thin, and aborally bears a median groove as do the other processes. The anterior process may continue nearly in line with the posterior bar or may incline somewhat outward and down, and it may be slightly sinuous. The denticles of the posterior bar and the anterior process are subequal in size and approximately equal to the apical denticle at the juncture of the three limbs.

Typically the inner lateral process is the longest and deepest of the three processes. It commonly branches from the posterior bar nearly at right angles but may be inclined posteriorly or slightly anteriorly and

FIG. 14.—Diagrammatic reconstruction of a mature representative of *Lambdagnathus* Rexroad, n. gen., showing outer lateral (A), aboral (B) and outer posterior (C) views, X35.

also is inclined sharply downward. Typically, it is arched, slightly bowed convexly anteriorly, is deepest near its midlength, and has denticles largest near its midsection and decreasing in size in either direction, the larger denticles being considerably

larger than the apical denticles. Attachment scars may be prominent on the faces of the inner lateral process, less so on the posterior bar and anterior process. Chief variations in the genus are expected to be in the proportions of the lengths of the three processes and their angular relations to each other, plus variations in the denticulation and depths of the processes, particularly the inner lateral one.

Relationships of this genus to other genera are problematical. The general form is most similar to that of *Centrognathodus* Branson and Mehl, but it differs particularly in the angular relations of the three processes, in the presence of a pronounced triangular subapical pit in *Lambdagnathus*, and in its triangular apical denticle.

LAMBDAGNATHUS FRAGILIDENS Rexroad,
n.sp.

Plate 6, figures 10-16

New Genus ? (Part), REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 41, pl. 4, fig. 10 only.

Posterior bar delicate, no thicker than the four posteriorly inclined laterally compressed denticles it typically bears. Anterior process curves outward at juncture of bars, then continues direction of posterior bar. Anterior process thin, of uniform depth, with about twelve denticles which are slightly smaller toward anterior end of process. Inner lateral process viewed orally appears nearly perpendicular to posterior bar, viewed anteriorly is inclined downward approximately 45° . Inner lateral process deepest about one-third distance from juncture of processes, with two largest denticles located here, denticles strongly compressed in plane of process, slightly recurved, and typically number from nine to eleven. Apical denticle larger than denticles of posterior bar, triangular in shape with sharp edge in line with each process, slightly recurved. Well defined triangular pit beneath apical denticle with grooves extending from it along the thin aboral margin of each of the processes.

Material studied.—19 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P31 (holotype), 3P32, 3P33, 3P34, 3P35, 3P36 (paratypes).

Genus LIGONODINA Bassler, 1925

Type species: *Ligonodina pectinata* Bassler

LIGONODINA HAMATA Rexroad

Plate 3, figures 9–14

Ligonodina hamata Rexroad, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 32, pl. 1, figs. 24, 25.

Ligonodina sp., *ibid.*, p. 33, pl. 1, figs. 20, 21.

Ligonodina sp., YOUNGQUIST and MILLER, 1949, Jour. Paleontology, v. 33, no. 6, pl. 101, fig. 11 (not figs. 12, 13).

Specimens of *Ligonodina* from the Glen Dean Formation show that the specimens designated by Rexroad (1957) as *Ligonodina* sp., although not typical of *L. hamata*, must be regarded as belonging to this species. It seems likely that *L. hamata* developed from *L. obunca* by the shift of the inner lateral process to the anterior margin of the terminal fang. This was followed by further development of the proximal portion of the inner lateral process. The specimens previously referred to as *L. sp.* by Rexroad represent the extreme development of this trend but as a variation from the norm. The additional material also shows that four discrete denticles are commonly present on the inner lateral process. After further study of specimens from both the Pella Beds and the Glen Dean Formation, the figured specimen designated above and referred to *L. sp.* by Youngquist and Miller (1949) is referred to *L. hamata*.

Material studied.—111 specimens from this study, 45 from Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, Clore, and Kinkaid Formations of Illinois, Indiana, and Kentucky, and the Pella Beds of Iowa.

Repository.—Illinois State Geological Survey, 3P37, 3P38, 3P39, 3P40, 3P41, 3P42, (figured specimens).

LIGONODINA OBUNCA Rexroad

Plate 3, figures 7 and 8

Ligonodina obunca REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 32, pl. 1, figs. 22, 23.

Ligonodina sp., YOUNGQUIST and MILLER, 1949,

Jour. Paleontology, v. 23, no. 6, p. 620, pl. 101, figs. 12, 13 (not fig. 11).

Study of many complete specimens shows that the inner lateral process of *L. obunca* typically bears four discrete denticles and that the presence of three or five denticles is less common. The original description of the species stated that the process bore three (or rarely four) denticles. It is partly for this reason that *Ligonodina* sp. of Youngquist and Miller as represented by two of their figured specimens is now placed with *L. obunca*. In young specimens of *L. obunca* the posterior bar is much thinner and the denticles on it more prominent than on adult specimens. Greatest thickening occurs along the anterior portion of the bar.

Material studied.—423 specimens from this study, 65 from Rexroad 1957 study.

Distribution.—Renault, Paint Creek, and Glen Dean Formation of Illinois, Indiana, and Kentucky, and the Pella Beds of Iowa.

Repository.—Illinois State Geological Survey, 3P43, 3P44 (figured specimens).

LIGONODINA ROUNDYI Hass

Plate 3, figures 1–4

Ligonodina roundyi HASS, 1953, U. S. Geol. Survey Prof. Paper 243-F, p. 82, pl. 15, figs. 5–9; ELIAS, 1956, Petroleum Geology of southern Oklahoma: Am. Assoc. Petrol. Geol., v. 1, p. 126, pl. V, figs. 10–14.

The Glen Dean specimens conform very closely to Hass's type specimens. The denticles of the inner lateral process of some Glen Dean specimens are not noticeably compressed. The amount and symmetry of the expansion of the base of the main cusp is variable, as is also true of Hass's type specimens.

Material studied.—32 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky, Barnett Formation of Texas.

Repository.—Illinois State Geological Survey, 3P45, 3P46, 3P47, 3P48 (figured specimens).

Genus LONCHODINA Bassler, 1925

Type species: *Lonchodina typicalis* Ulrich and Bassler

LONCHODINA FURNISHI Rexroad, n.sp.

Plate 4, figures 11-13

Arched and slightly bowed unit, limbs thickest at apex and thinning distally. Posterior limb the shorter, about three-eighths the length of anterior limb, bowed slightly inward, bearing three or four small, discrete denticles strongly compressed laterally, larger denticles toward posterior tip of limb. Anterior limb the longer, typically inclined downward and only slightly outward, bearing seven laterally compressed, recurved, discrete denticles of subequal size. Apical denticle nearly twice as large as denticles of anterior limb, recurved, laterally compressed with sharp edges fore and aft, edges in midline of each limb, base of apical denticle expanded into flaring lips about the subapical pit, inner lip flaring in and posteriorly, outer lip flaring out and anteriorly, resulting in a pit which is nearly oval in outline with longest axis oblique to axis of posterior bar. Aborally, faint median groove extends from apical pit to extremities of limbs.

The species is named in honor of W. M. Furnish of the State University of Iowa.

Material studied.—13 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P49 (holotype), 3P50, 3P51 (paratypes).

LONCHODINA PARACLAVIGER Rexroad, n.sp.

Plate 4, figures 7-10

Anterior and posterior limbs thickened, bar-like, each nearly straight but together forming an arched and outwardly bowed unit. Considering the slight curvature of the denticles of some specimens, the shorter limb is designated the posterior limb in the orientation of this species. Posterior limb averages one-half length of anterior limb, is slightly bowed convexly inward, typically bears four small laterally compressed, dis-

crete denticles. Anterior limb inclines outward up to 35° from line of posterior bar, is very slightly bowed outward, and bears six, seven, or eight denticles which are laterally compressed, sharp-edged fore and aft, and in some specimens fused about a third of the distance up from the base. In a number of specimens the denticles toward the distal end of the bar are increasingly large. Apical denticle usually, although not always, the largest denticle, sharp-edged fore and aft, inner face the more convex, nearly straight, may incline slightly posteriorly and inward. Aboral margin of each limb rounded with a faint median groove extending the length of each limb from a subtriangular apical pit which has a straight outer margin and a sharply flaring inner lip.

The thickening of the limbs of this species results in a form approaching the genus *Geniculatus* Hass. However, the accretion of lamellae in building a heavier limbed form has not progressed to the point of building the geniculate unit characteristic of *Geniculatus*.

Material studied.—19 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P52 (holotype), 3P53, 3P54, 3P55 (paratypes).

LONCHODINA cf. L. PARACLARKI Hass

Plate 4, figures 4 and 5

Lonchodina paraclarki Hass, 1953, U. S. Geol. Survey Prof. Paper 243-F, p. 83, pl. 16, figs. 15, 16.

The specimens from the Glen Dean Formation are very similar to the holotype of *L. paraclarki* Hass. The apical denticles of some Glen Dean specimens are slightly broader and shorter than those of the holotype, but this may well come within the range of individual variation. One of the Glen Dean specimens has a complete posterior bar which bears six widely spaced denticles. This is contrary to the description of *L. paraclarki*, but in my opinion, based on examination of the type speci-

mens of *L. paraclarki*, the posterior bars of both the holotype and figured paratype are broken. In the Glen Dean specimens this bar is twisted so that the denticles on it, although normal to the bar, curve toward the outer side of the fossil. Apparently there is a typographical error in labeling of Hass's figures 15 and 16 of plate 16 as both views are labeled as showing the outer side. Actually the greater expansion of the base of the apical denticle is on the inner side.

Material studied.—8 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky, the Barnett Formation of Texas.

Repository.—Illinois State Geological Survey, 3P56, 3P57 (figured specimens).

Genus NEOPRIONIODUS Rhodes and Müller, 1956

Type species: *Prioniodus conjunctus* Gunnell

NEOPRIONIODUS CAMURUS Rexroad

Plate 5, figures 5 and 6

Neoprioniodus camurus REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 33, pl. 2, figs. 18–20.

Some of the Glen Dean specimens of *N. camurus* have as many as fifteen denticles on the posterior bar. Complete specimens show that the terminal fang is rather short, tapering uniformly to a point. None of the Glen Dean specimens have the relatively thick posterior bar which was noted in four specimens from the Renault and Paint Creek Formations.

Material studied.—44 specimens from this study, 20 from the Rexroad 1957 study.

Distribution.—Renault, Golconda, Glen Dean, Menard, and Kinkaid Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P58, 3P59 (figured specimens).

NEOPRIONIODUS LOXUS Rexroad

Plate 5, figures 7–9

Neoprioniodus loxus REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 34, pl. 2, figs. 8, 9, 14.

Neoprioniodus tenuis REXROAD, 1957, *ibid.*, p. 35, pl. 2, figs. 13, 16.

A number of specimens intermediate between *N. loxus* and *N. tenuis* were found in this study. The two extremes are readily distinguishable on the basis of differences in cross-section shape of the posterior bar. *N. tenuis* has a proportionately deeper and thinner bar. However, the presence of intermediate specimens gives a gradational series between the two extremes, and it seems best to place the two in synonymy.

Material studied.—49 specimens from this study, 35 from the Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, and Menard Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey 3P60, 3P61, 3P62 (figured specimens).

NEOPRIONIODUS SCITULUS (Branson and Mehl)

Plate 5, figures 10–14

Prioniodus scitulus BRANSON and MEHL, 1940, Denison Univ. Bull., Jour. Sci. Labs., v. XXXV, p. 173, pl. V, figs. 5, 6; COOPER, 1947, Jour. Paleontology, v. 21, no. 2, p. 92, pl. 20, figs. 1–3; ELIAS, 1956, Petroleum Geology of southern Oklahoma: Am. Assoc. Petrol. Geol., v. 1, p. 109, pl. II, figs. 9, 10.

Neoprioniodus scitulus (Branson and Mehl), REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 35, pl. 2, figs. 22, 26.

Neoprioniodus striatus REXROAD, 1957, *ibid.*, p. 35, pl. 2, figs. 11, 12.

This is an abundant and somewhat variable species in the Glen Dean Formation. The anterior margin of the fang, viewed laterally, may be straight or convex in the adult and is usually more convex in the young. The length of the aboral projection of the fang varies as does the outline of the aboral margin. The outline may be slightly convex posteriorly or straight, more convex in the young specimens which may have well developed, slightly flaring lateral lips, which disappear in the adult form. The base of the aboral projection is excavated in the young but fills in during growth leaving a tiny pit with a longitudinal median groove extending anteriorly and posteriorly from it. With growth lateral attachment scars may become prominent on the aboral projection of the fang. Other variations

are shown by slight differences in the height and thickness of the posterior bar.

The variations in shape and length of the aboral projection of the fang, as well as the convexity of the anterior margin of the fang, are reflected in the young. About two dozen young specimens were sufficiently distinctive that their relationship to the adult was not recognized in an earlier study (Rexroad, 1957). They were named as a new species, *N. striatus*. The additional specimens recovered from the Glen Dean Formation show the variations among the young and the gradation from the young to the mature stage, as well as adult specimens which still retain to some degree the aberrant youthful characteristics upon which *N. striatus* was based. Therefore, *N. striatus* is placed in synonymy with *N. scitulus*.

Material studied.—548 specimens from this study, 100 from the Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, Clore, and Kinkaid Formations of Illinois, Indiana, and Kentucky, and the Delaware Creek Member of the Caney Shale of Oklahoma.

Repository.—Illinois State Geological Survey, 3P63, 3P64, 3P65, 3P66, 3P67 (figured specimens).

NEOPRIONIODUS VARIANS (Branson and Mehl)

Plate 5, figures 3 and 4

Prioniodus varians BRANSON and MEHL, 1940, Denison Univ. Bull., Jour. Sci. Labs., v. XXXV, p. 174, pl. V, figs. 7, 8; ? BISCHOFF, 1957, p. 49, pl. 5, fig. 35; FLUGEL and ZIEGLER, 1957, p. 50. *Neoprioniodus varians* (Branson and Mehl), REXROAD, Illinois Geol. Survey Rept. Inv. 199, p. 35, pl. 2, fig. 10.

The Chester specimens, although variable, conform well to the Caney Shale forms. The species is similar to *N. loxus* but differs chiefly in the angle between the fang and posterior bar from lateral view. In *N. varians* it is about 100°, in *N. loxus* about 135°. Also, the inner lip on the aboral projection of *N. loxus* flares more markedly.

Material studied.—121 specimens from this study, 10 from the Rexroad 1957 study.

Distribution.—Paint Creek, Glen Dean, and Clore Formations of Illinois, Indiana, and Kentucky, also the Caney Shale of Oklahoma.

Repository.—Illinois State Geological Survey, 3P68, 3P69 (figured specimens).

Genus OZARKODINA Branson and Mehl, 1933

Type species: *Ozarkodina typica* Branson and Mehl

OZARKODINA COMPRESSA Rexroad

Plate 6, figures 1 and 2

Ozarkodina compressa REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 36, pl. 2, figs. 1, 2.

The majority of specimens of *O. compressa* found in the Glen Dean Formation correspond closely to the holotype and paratype of the species. A few specimens vary in being markedly more elongate than the average, and some specimens are slightly less arched than the remainder. Young specimens have fewer denticles, a proportionately larger subapical pit, and lack germ denticles.

Material studied.—243 specimens from this study, 25 from the Rexroad 1957 study.

Distribution.—Golconda, Glen Dean, Menard, and Kinkaid Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P70, 3P71 (figured specimens).

OZARKODINA CURVATA Rexroad, n.sp.

Plate 4, figures 1-3

Strongly arched and bowed, thin, blade-like unit with posterior limb less arched; the anterior limb typically has four or five laterally compressed denticles fused about two-thirds the distance to the apices; denticles decrease slightly in size anteriorly; denticles of the posterior limb number about nine to eleven and are laterally compressed, fused about one-half to two-thirds distance to the apices, and of somewhat varying sizes. Typically the denticles of the posterior limb are smaller than denticles of the anterior limb and suppressed germ denticles are commonly present. The apical denticle is twice the width of adjacent anterior denticles, is longer, tapers to a point, and is laterally compressed with

sharp edges fore and aft, inclined slightly posteriorly. The navel is very small, moderately deep, asymmetric in outline, with the inner margin nearly straight, the outer margin with slightly flaring lip, the posterior end pointed and continued as a faint groove along the aboral margin of the posterior bar. The anterior end of the navel is rounded.

Chief variation in this species is in the size of the denticle on the posterior limb. Limbs of some specimens bear denticles of a single size, but on other specimens denticles are of varying sizes.

Because the posterior limb is longer than the anterior limb, is bowed but otherwise nearly straight, and because the denticles on it may vary in size, this species bears a resemblance to the group of *hindeodellids* in which the anterior process is sharply downturned in a "pick-like" manner.

Material studied.—38 specimens.

Distribution.—Renault and Glen Dean Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P72 (holotype), 3P73, 3P74 (paratypes).

Genus SPATHOGNATHODUS Branson and Mehl, 1941

(SPATHODUS Branson and Mehl, 1933)

Type species: *Spathodus primus* Branson and Mehl

SPATHOGNATHODUS CAMPBELLII REXROAD

Plate 6, figure 9

Spathognathodus campbelli REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 37, pl. 3, figs. 13–15.

The representatives of this species found in the Glen Dean closely resemble the previously described specimens.

Material studied.—12 specimens from this study, 65 from the Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, and Kinkaid Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P79 (figured specimen).

SPATHOGNATHODUS CRISTULA Youngquist and Miller

Plate 6, figures 3 and 4

Spathognathodus cristula YOUNGQUIST and MILLER, 1949, Jour. Paleontology, v. 23, no. 6, p. 621, pl. 101, figs. 1–3; REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 38, pl. 3, figs. 16, 17.

This is one of the least variable and most abundant Glen Dean species. All specimens are very similar to the holotype and paratypes.

Material studied.—367 specimens from this study, 50 from the Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard and Clore Formations of Illinois, Indiana, and Kentucky, and the Pella Beds of Iowa.

Repository.—Illinois State Geological Survey, 3P80, 3P81 (figured specimens).

SPATHOGNATHODUS SPICULUS Youngquist and Miller

Plate 6, figures 5–7

Spathognathodus spiculus YOUNGQUIST and MILLER, 1949, Jour. Paleontology, v. 23, no. 6, p. 622, pl. 101, fig. 4; REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 38, pl. 3, figs. 18–21.

Spathognathodus bidens YOUNGQUIST and MILLER, Jour. Paleontology, v. 23, no. 6, p. 621, pl. 101, fig. 5.

The Chester representatives of this species show a great amount of variation, particularly in the number and shape of the major anterior denticles. The large number of specimens available show a unity in this variable group and include specimens nearly identical to the holotype of *S. bidens* as well as of *S. spiculus* indicating that the two represent a single species. Because the great majority of specimens conform more closely to *S. spiculus*, that name is retained in preference to *S. bidens*.

Material studied.—175 specimens from this study, 90 from the Rexroad 1957 study.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, Clore, and Kinkaid Formations of Illinois, Indiana, and Kentucky, and the Pella Beds of Iowa.

Repository.—Illinois State Geological Survey, 3P82, 3P83, 3P84 (figured specimens).

SPATHOGNATHODUS cf. *S. COMMUTATUS*
Branson and Mehl

Plate 6, figure 8

Spathognathodus commutatus BRANSON and MEHL, 1941, Jour. Paleontology, v. 15, no. 2, p. 98, pl. 19, figs. 1-4.

Spathognathodus cf. *S. commutatus* Branson and Mehl, REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 38, pl. 3, figs. 23, 24.

Chester specimens have a thinner lipped, proportionately longer navel, and fewer denticles than do Branson and Mehl's syntypes from the Pitkin limestone, and it is still felt that the differences of the Chester specimens do not justify the erection of a new species.

Material studied.—8 specimens from this study, 10 from the Rexroad 1957 study.

Distribution.—Renault, Paint Creek, and Glen Dean Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P85 (figured specimen).

Genus *ROUNDYA* HASS, 1953

Type species: *Roundya barnettana* Hass

ROUNDYA COSTATA Rexroad, n.sp.

Plate 2, figures 5-8

Cusp large, recurved, sharpest curvature about one-third distance above base, sharp lateral edges, sharp edges expanding toward base into distinct ridges continuous with lateral bars, distal anterior and posterior faces of cusp convex, basally anterior face becomes nearly flat and posterior face develops sharp edge passing into slight ridge which merges into oral surface of posterior bar. Posterior bar widest anteriorly where it merges with expanded base of cusp, bar tapers sharply posteriorly and continues as very thin bar which is rarely preserved, bar bears a few discrete denticles. Lateral limbs thick, none complete, bear closely spaced, slightly compressed, discrete denticles; limbs inclined slightly backward and downward about 45° to 55°. Aboral margin marked by deep pit beneath cusp, triangular in outline with apex of triangle posterior, pit continued as faint median grooves along aboral margins of posterior bar and lateral limbs.

Material studied.—13 specimens.

Distribution.—Glen Dean Formation of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P75 (holotype), 3P76, 3P77, 3P78 (paratypes).

Genus *TRICHONODELLA* Branson and Mehl, 1948

(*TRICHOGNATHUS* Branson and Mehl, 1933)

Type species: *Trichognathus prima* Branson and Mehl

TRICHONODELLA IMPERFECTA Rexroad

Plate 4, figure 6

Trichonodella imperfecta REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 41, pl. 4, figs. 4, 5.

The few specimens recovered in this study are nearly identical with the previously described material from the Chester Series of southwestern Illinois.

Material studied.—6 from this study, 10 from the Rexroad 1957 study.

Distribution.—Renault, Glen Dean, and Kinkaid Formations of Illinois, Indiana, and Kentucky.

Repository.—Illinois State Geological Survey, 3P86 (figured specimen).

Genus *INDETERMINATE*

Plate 5, figures 1 and 2

Lonchodina sp. BRANSON and MEHL, 1940, Denison Univ. Bull., Jour. Sci. Labs. v. XXXV, p. 171, pl. V, figs. 10, 12.

Lonchodina? spp., YOUNGQUIST and MILLER, 1949, Jour. Paleontology, v. 23, no. 6, p. 620, pl. 101, figs. 7, 8.

Metalonchodina sp. B, ELIAS, 1956, Petroleum Geology of southern Oklahoma: Am. Assoc. Petrol. Geol., v. 1, p. 124, pl. V, fig. 2.

Metalonchodina? spp., ELIAS, 1956, *ibid.*, p. 124, pl. V, fig. 3.

Genus Indeterminate, REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 42, pl. 4, figs. 19-22.

Several hundred fragments fail to give an adequate picture of this group of conodonts upon which to base a generic determination because in no single specimen are both limbs completely preserved. Because one limb is fragile, it commonly is represented only by a fracture or by a very short stub. When a stub is present, a pit can be seen on its aboral margin near the juncture of the two main portions, but in a number of

specimens there is no main denticle or cusp above the pit, only small denticles. I would interpret the form as consisting of a bar with or without a small main cusp, a deep pit near the anterior end of bar, and, rising from the anterior end of the bar, an antero-lateral process directed downward and slightly backward, bowed convexly posteriorly, and bearing several stout discrete denticles, the antero-lateral process considerably larger than main bar. The specimens seem more closely related to

Ligonodina than to any other described genus.

Material studied.—140 specimens.

Distribution.—Renault, Paint Creek, Golconda, Glen Dean, Menard, Clore and Kinkaid Formations of Illinois, Indiana, and Kentucky, the Pella Beds of Iowa, and the Delaware Creek Member of the Caney Shale of Oklahoma.

Repository.—Illinois State Geological Survey, 3P87, 3P88 (figured specimens).

REFERENCES

- BISCHOFF, GUNTHER, 1957, Die Conodonten-Stratigraphie des rheno-herzynischen Unterkarbons: Hess. Landesamt. Bodenf., Abhl., Hf. 19, p. 1-64, pl. 1-6.
- BRANSON, E. B., and MEHL, M. G., 1940, Caney Conodonts of Upper Mississippian age: Denison Univ. Bull., Jour. Sci. Labs., v. XXXV, p. 167-178, pl. V.
- BRANSON, E. B., and MEHL, M. G., 1941, New and little known Carboniferous conodont genera: Jour. Paleontology, v. 15, no. 2, p. 97-106, pl. 19.
- BURMEISTER, H. C. C., 1847, Handbuch der Entomologie, v. 5, p. 364.
- COOPER, CHALMER L., 1947, Upper Kinkaid (Mississippian) microfauna from Johnson County, Illinois: Jour. Paleontology, v. 21, no. 2, p. 81-94, pls. 19-23; reprinted as Illinois Geol. Survey Rept. Inv. 122.
- ELIAS, MAXIM K., 1956, Upper Mississippian and Lower Pennsylvanian formations of south-central Oklahoma: Petroleum geology of southern Oklahoma: Am. Assoc. Petrol. Geol., v. 1, p. 56-134, pl. I-VI.
- FLUGEL, VON, HELMUT, and ZIEGLER, WILLI, 1957, Die Gliederung des Oberdevons und Unterkarbons am Steinberg westlich von Graz mit conodonten: Naturwissenschaft. vereines f. Steiermark, Mitteil. Bd. 87, p. 25-60, pl. 1-5.
- HASS, WILBERT H., 1950, Age of lower part of Stanley Shale: Am. Assoc. Petrol. Geol. Bull., v. 34, no. 7, p. 1578-1584.
- HASS, WILBERT H., 1953, Conodonts of the Barnett Formation of Texas: U. S. Geol. Survey Prof. Paper 243-F, p. 69-94; pl. 14-16.
- HASS, WILBERT H., 1954, Age of some black shales in cores from northeast Mississippi: Mississippi Geol. Soc. Guide Book, 11th Field Trip, p. 32-33.
- REXROAD, CARL B., 1957, Conodonts from the Chester Series in the type area of southwestern Illinois: Illinois Geol. Survey Rept. Inv. 199, p. 1-43, pl. 1-4.
- YOUNGQUIST, WALTER, and MILLER, A. K., 1949, Conodonts from the late Mississippian Pella Beds of south central Iowa: Jour. Paleontology, v. 23, no. 6, p. 617-622, pl. 101.