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OCCURRENCE AND STRATIGRAPHIC DISTRIBUTION OF
PALEOZOIC OSTRACODES

BY
CHALMER L. COOPER

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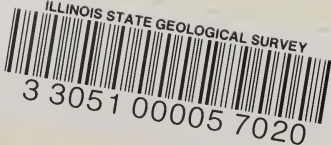
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Topographic Mapping in Cooperation with the United States Geological Survey.

This Report is a Contribution of the Division of Stratigraphy and Paleontology.

August 1, 1942

OCCURRENCE AND STRATIGRAPHIC DISTRIBUTION OF PALEOZOIC OSTRACODES¹

CHALMER L. COOPER²

ABSTRACT.—Although the Ostracoda constitute one of the most persistent orders of microfossils (Lower Ordovician to Recent) they are, considered in detail, quite diversified in character. While many genera are extremely long lived, careful study of formational materials reveals many species that are of value as index fossils. Ostracodes have been found in all types of marine sediments throughout most of the Paleozoic. The differentiation of fresh water forms becomes marked with the initiation of sedimentary conditions which resulted in the rapid alteration of fresh water and marine beds in the sedimentary cycles of the Pennsylvanian and Permian.

INTRODUCTION

SINCE THE segregation of the crustacean "Ostrachoda" as an order by Latreille (1801), these forms have become, next to the Foraminifera, the best known group of microfossils. Study of these fossils during the last 140 years has given us almost 3400 species from the Paleozoic, classified into about 300 genera. The ostracode literature would form a good sized library of about 800 titles. However, more than 50 years were required to produce the first 50 titles, after which a rather steady production of about 10 papers per year was maintained (see fig. 1).

Little progress was made until Jones and his associates Kirkby and Brady began their intensive studies in Great Britain about the middle of the nineteenth century. Their work stimulated others, particularly on the Continent and in North America. Ulrich in 1890, 1891, and 1900 published papers on the "New and little known Paleozoic Ostracoda," and Ulrich and Bassler published their "New American Paleozoic Ostracoda" in 1906 and 1908. In 1923 their "Morphology, Classification and Occurrence" together with the systematic treatment of the Clinton ostracodes of Maryland appeared. This was the most careful and comprehensive stratigraphic treatment based on the ostracodes yet to appear, and it will probably long remain preeminent in this field. Nine zones, each characterized by the prolific and persistent occurrence of an ostracode spe-

cies, were recognized in this Niagaran formation of western Maryland and adjacent parts of Pennsylvania. Work on ostracodes received further stimulation in this country during the last two decades due to the increasing importance of micropaleontology in petroleum geology. The excellent bibliography of Bassler and Kellett (1934) is indispensable to any worker in Paleozoic ostracodes. Since the publication of this very comprehensive work 167 genera and about 900 species have been proposed in 91 papers (Agnew, 1942).

The systematics of the order has in no manner kept pace with the number of new forms described. Since Latreille divided the Crustacea into two subclasses and included the Ostracoda under the Entomostraca a number of writers have dealt with the classification of these fossils. In 1850 Baird gave a general description which has served to distinguish the order until today. Dana, in the various editions of his "Manual of Geology" gave a general classification which was rather commonly followed from 1863 to near the end of the century. In 1889, Brady and Norman gave a detailed classification. Bassler (1913) in Zittel's "Textbook of Paleontology" divided the Eucrustacea into five superorders, and the Ostracoda (the third) into nine families. Later Ulrich and Bassler (1923) divided the Ostracoda into 3 superfamilies, 19 families, and 130 genera, several of which are not represented in the Paleozoic. In 1934 (Bassler and Kellett) this number had grown to 18 families and 198 genera for the Paleozoic only, and in the latest compilation the figures show, not counting those eliminated by synonymy, 30 families and 310 genera. Those who have made recent contributions to the classification are

¹ Presented at the conference of the Research Committee on Sedimentation, at the 27th Annual Meeting of the Am. Assoc. Petroleum Geologists, Denver, April 21, 1942.

² Illinois State Geological Survey. Published with permission of the Chief.

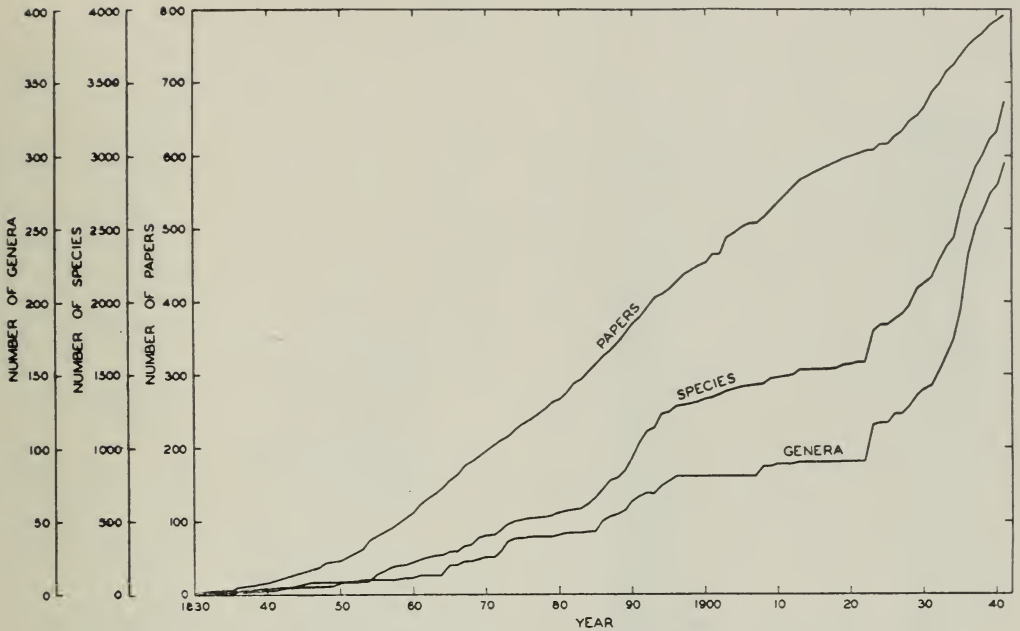


FIG. 1.—Cumulative curves showing rate of production of new genera, species, and papers on Paleozoic ostracodes.

Bouček (1936), Kellett (1936), Swartz (1936), and Teichert (1937).

As in other groups of fossils, we find both "splitters" and "lumpers" among the micropaleontologists and the species concept seems to be just as clouded with differences of opinion as with the zoologists. I do not quite agree with Arkell and Moy-Thomas (1940) that "the question 'what constitutes a species?' hardly concerns the paleontologist." The paleontological classification should be practical in the sense that the "International Rules" should be adhered to meticulously and every new species should conform as nearly as possible to a uniform scale of values. Perfection lies somewhere between the demands of the specialist who endeavors to describe every minute deviation from the norm and the requirements of the teacher or field geologist who must have a simple classification which is easy to use. Although the paleontologist cannot possibly apply the species concept of the biologist to any group of fossils because of the lack of the complete remains of the fossil animal or plant, it is upon species, or even upon the more minute subdivisions as now used by paleontologists that the stratigraphic pale-

ontologist must rely for correlation. If "a species is what a competent systematist considers to be a species" (Croneis, 1939) and that seems to be what a fossil species is today, then it cannot be too strongly urged that the system of classification and of nomenclature be kept as practical and thereby as useful as possible. "The most important question for a worker to ask himself, when erecting genera and species, is why he is doing so. He must remember that he is catering for the specialist and general geologist alike, and that any new addition should aim at clarifying the existing condition, and not obscuring it." (Arkell and Moy-Thomas, 1940). There have been considerable differences of opinion of late regarding the familial affinity of a number of Paleozoic ostracode genera, and the need for a comprehensive study of the superorder as a whole is great.

Sherborn (1897) early recognized the need for the careful collecting necessary for good stratigraphic work when he said "What is really wanted is careful collecting from some well-known section, or series of sections, of any geological formation, and this would be of greater importance than the casual description of various species taken at random

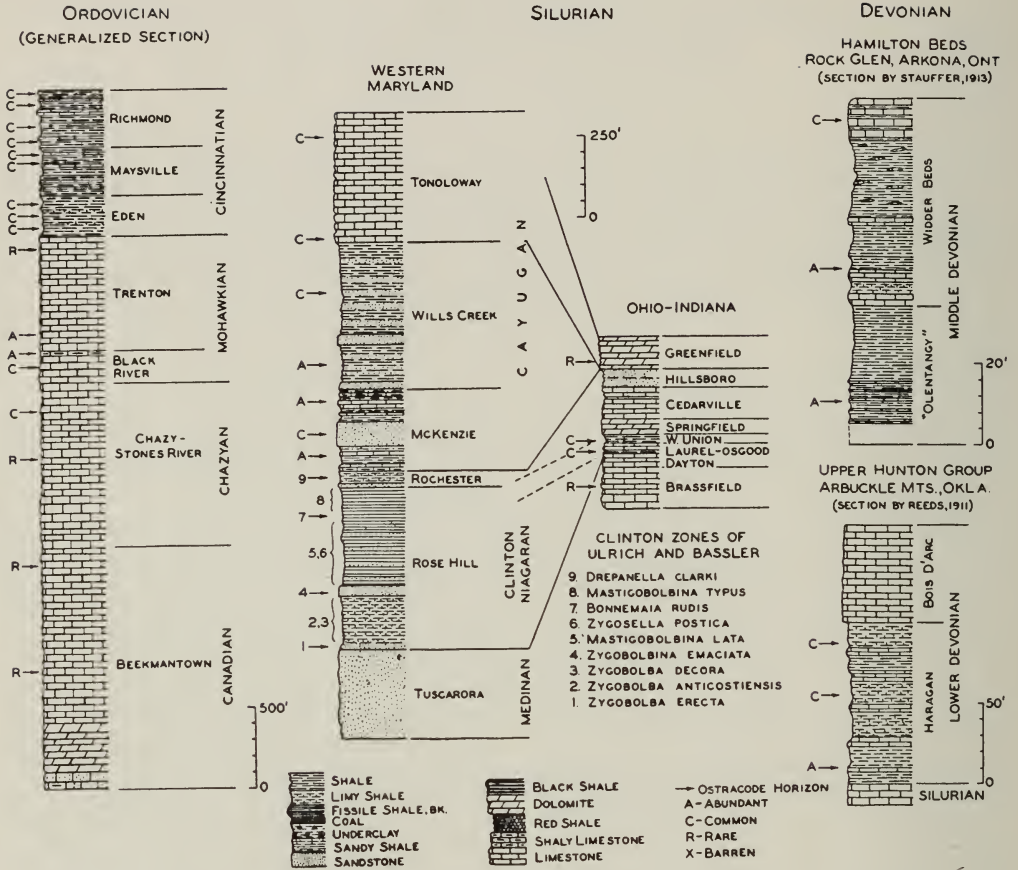


FIG. 2.—Graphic sections of the rock series of the Ordovician, Silurian, and Devonian periods showing the stratigraphic distribution of ostracodes.

from many localities, though the latter is, of course, a very necessary work." This still seems to be a good admonition, and I add my own strong appeal for additional stratigraphic work on some of our less perfectly known horizons, the correlation of which are important to the petroleum geologist. These horizons are found in the Lower Silurian, the Upper Devonian, the Lower and Middle Mississippian, and the uppermost Mississippian (Mauch Chunk). The latter may yield information on the confusing problem of the age of the Stanley-Jackfork series of Oklahoma and Arkansas.

OSTRACODE ENVIRONMENTS

The study of living ostracodes shows their

distribution to be world wide and that they seem to be able to thrive under more adverse conditions and are probably less sensitive to rapid changes in environment than most invertebrates. The poor swimmers live in the bottom oozes, some exist in the foul waters of sewers and others in sulphur water and in hot springs. They are also known to be almost unlimited in the depths at which they may exist. Yet ostracodes react to environmental influences, as do other organisms, but, due to their free swimming habit, and due to the scattering action of waves and currents, their carapaces may be found in rocks formed under conditions adverse to the existence of the animal.

Therefore it is not surprising that fossil

ostracodes have been found in a great variety of types of sedimentary rocks, both of fresh water and marine origin.

In the Paleozoic the preponderance of marine over fresh-water species is very great, largely because of the paucity of continental sediments in the stratigraphic column until near the end of the era. There are fewer than a half-dozen Paleozoic fresh-water genera known to me, of which only one genus, from the Dunkard of Pennsylvania and West Virginia, has been published. A number of unpublished new species have been found in the fresh-water members of a few of the Pennsylvanian sedimentary cycles in Illinois.

In marine beds the ostracodes are most easily obtained from the calcareous shales adjacent to, and in the thin shale breaks within limestones, where they occur abundantly. They are usually associated with bryozoans, crinoid fragments, brachiopods, and, in some cases, with conodonts and Foraminifera. Rarely some scolecodonts are found in the washed samples.

Although they are probably as abundant in some limestones as in the adjacent shales, they are very much more difficult to extract and prepare for study. However, thin slabs of limestones often contain great numbers of excellently preserved specimens on their weathered surfaces. This is particularly true of many of those described from the Ordovician and Silurian formations. In many instances the only specimens available must be laboriously prepared from the matrix of the massive limestone but in some cases good specimens can be obtained by careful crushing (not grinding) the limestone in an iron mortar, with frequent sieving. Silicified forms can, of course, be segregated by the use of dilute hydrochloric acid to dissolve the matrix.

Sandstones and sandy or siliceous shales furnish the leanest source of ostracodes. In these rocks the specimens usually occur widely scattered throughout the matrix, and often are found only as moulds or casts, which, except in rare instances, fail to preserve the delicate and intricate surface features which are necessary for accurate identification. These rocks are usually too hard to be broken down by boiling, and the moulds cannot be removed by any known means of

separation, except reproduction by one of several methods of artificial casts or squeezes.

STRATIGRAPHIC DISTRIBUTION

True ostracodes are found in rocks of all ages from Lower Ordovician to Recent. Species first described as ostracodes from the Cambrian were later found to belong to the Branchiopoda. The oldest known ostracode species came from the Beekmantown and Chazy rocks of Tennessee, Missouri, Arkansas, Oklahoma and New York.

Ulrich and Bassler (1923) have concisely traced the early history of the class and their conclusions, except for minor details, are still generally accepted in the light of our present knowledge. It is reasonably certain the Ostracoda originated in southern seas during the Early Ordovician by the development of the Leperditiiidae from the Cambrian branchiopods. In Middle and Late Ordovician most of the Paleozoic families were introduced, accompanied by a decided shifting to northern seas. This caused a decided change of type, the Leperditiiidae, Aparchitidae, and Eurychilinae giving place to the primitive types of the Beyrichiacea of Europe and northern North America. All types, except the Leperditellidae and the widespread genus *Eurychilina*, are rare in the Trenton formations of the Mississippi and Appalachian valleys, and they are almost absent from the succeeding Cincinnati series. The latter does contain a large number of species similar to those from the late Black River from America north of Missouri and in the Baltic of Europe.

The brood pouches of the females, rarely developed in the Ordovician, become generally developed in the Silurian. Commonly the Beyrichiidae and the Zygobolbidae, all Eurychilinae, and a few Primitiidae, notably *Bolbibollia*, possess brood pouches. The common presence of this feature is a reasonably positive index of Silurian age. Such a pouch is retained in only a few Devonian forms, such as *Treposella* and *Tetrasacculus*.

The Devonian shows marked changes brought about by the almost complete disappearance of the Leperditiiidae and by the appearance of new genera of the Beyrichiidae. The new genera *Kirkbya*, *Octonaria*, *Thlipsura*, *Paraparchites*, *Tetrasacculus*,

H. FORESTER NO. 1
SEC. 5, T. 6 S., R. 1 W.
PERRY COUNTY, ILL.
(CORE STUDY BY C. L. COOPER)

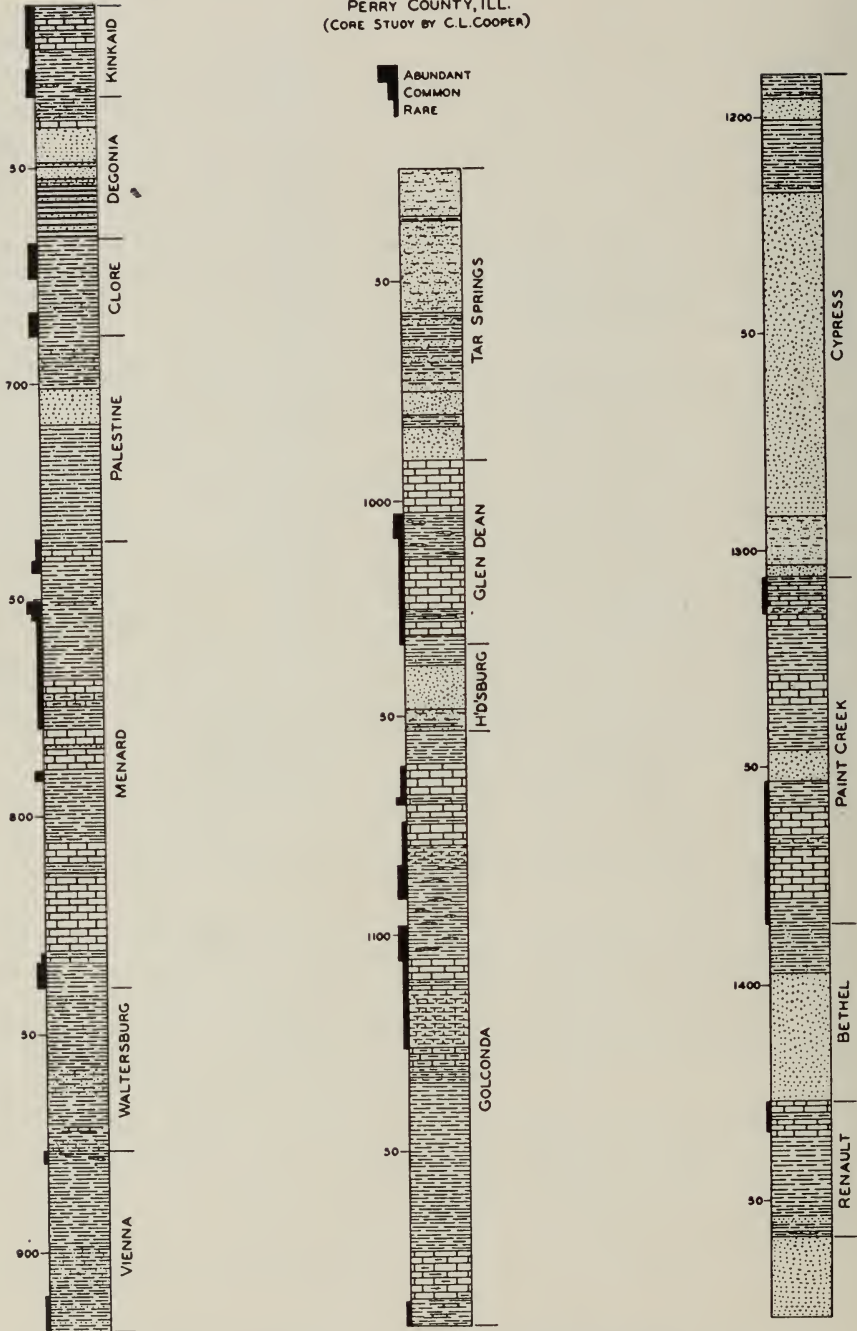


FIG. 3.—Graphic log of a core showing the distribution of ostracodes in the Chester series of Illinois.

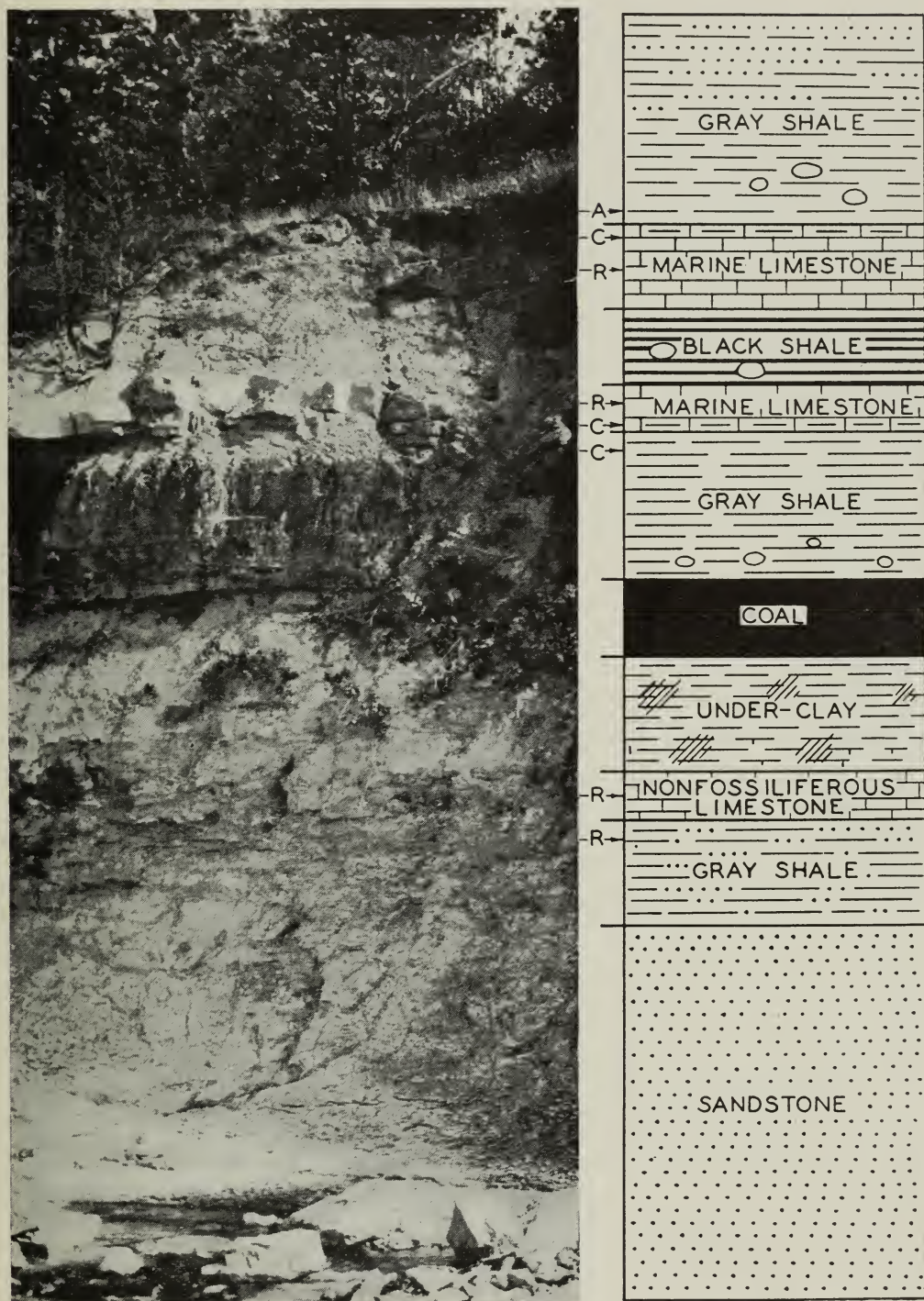


FIG. 4.—Outcrop and diagram of a cyclothem in the McLeansboro of eastern Illinois, illustrating the typical occurrence of ostracodes in the Pennsylvanian.

Cavellina, *Amphissites*, and possibly *Bairdia*, many of which later make important contributions to Carboniferous faunas, make their appearances.

After the Devonian, the whole aspect of the Lower Paleozoic Ostracoda changed so that few of the old familiar ones remain. The *Beyrichia*, *Ctenobolbina*, *Isochilina*, *Leperditia*, and most of the *Primitia* have disappeared. The place of dominance in the Carboniferous is occupied by such genera as *Hollinella*, *Sansabella*, *Jonesina*, *Seminolites*, *Healdia*, *Glyptopleura*, and *Cytherella* (?)³ in addition to those mentioned above. Many reach their culmination in the Upper Pennsylvanian and carry over into the Permian. A few, such as *Bairdia*, *Pontocypris*, *Bythocypris*, *Macrocypris* and *Cytherella* carry on into the Recent.

The geologic ranges of the Paleozoic ostracode genera are shown graphically in figures 8 and 9.

INDEX OSTRACODES

Ordovician.—As might be expected, the oldest known ostracode horizon, the Beekmantown, contains relatively few species. *Isochilina* dominates the list, with *Leperditia*, *Primitia*, and *Entomidella* following in order. They are rather common in the Stones River of Kentucky and Tennessee, and the Chazy of New York, and they become increasingly abundant throughout the Mohawkian in the Black River of Kentucky and Minnesota, and in the Trenton of Ohio, Kentucky, Tennessee, and New York. The upper Lowville has a fauna of ostracodes which extends from New York to Alabama, thence to the Mississippi Valley States and northward through Canada.⁴ The shale-limestone formations of the Cincinnati have furnished a large number of species, especially in the upper part of the series in the Richmond beds of Ohio and Indiana.

Some Middle Ordovician genera are *Apatochilina*, *Dicranella*, *Hallatia*, *Monoceratina*, *Parabolbina*, *Rayella*, *Sacclatata*, and *Winchellatia*.

³ The occurrence of this common post-Paleozoic genus in the Carboniferous is questioned because of the close similarity to *Cavellina*, which ranges from the Devonian to the Permian. Future work may show that the Paleozoic species of *Cytherella* should be classified with this genus.

⁴ Bassler, R. S., personal communication.

Cincinnati genera include *Barychilina*, *Biflabellum*, *Jonesella*, and *Milleratia*.

Silurian.—Many of the Ordovician genera continue into the Silurian, some of the persistent types increasing in range and others declining, becoming extinct by the end of the period. The various divisions of the Cayugan, as well as the Rochester shale and its equivalents, can be traced throughout the Appalachian Valley by their ostracode zones.⁴

The Lower Silurian is very poorly defined in ostracode faunas, but the Jupiter River beds of Anticosti are characterized by a number of species of *Zygodolba* in addition to a few species of *Apatobolbina*, *Chilobolbina* and *Leperditia*. Other localities yield numerous species of *Aparchites*, *Beyrichia*, *Bollia*, and *Bythocypris*. *Leperditia* and *Primitia* both showed marked decreases in the Lower Silurian.

The Middle Silurian, the Clinton of Maryland and Pennsylvania is one of the few formations that has been completely zoned by means of these fossils. Ulrich and Bassler (1923) have described nine zones, each characterized by the prolific occurrence of a different ostracode species as shown on figure 2. These zones have been recognized at a number of widely separated localities in New York, Tennessee, Ohio and Indiana.

The Upper Silurian (Cayugan series) contains many horizons with an abundance of ostracodes, particularly in the McKenzie and Wills Creek formations of Maryland and Pennsylvania. Few genera are restricted to the series, although several reach the culmination of their development, with very few species in formations above and below. Some of these are *Dizygopleura*, *Eukloedenella*, *Kloedenella*, and *Zygodbeyrichia*.

The development of *Bollia*, *Bythocypris*, *Entomis*, *Kloedenia*, and *Octonaria* continues more or less regularly into the Lower Devonian. *Beyrichia*, *Dizygopleura*, and *Eukloedenella* have few or no representatives after the end of the Silurian. *Leperditia* has reached its peak and declines rapidly in the Devonian.

Devonian.—The rapid decline of many of the characteristic stocks of the Lower Paleozoic at the end of the Silurian reaches completion in the Devonian. At the same time

the introduction of many new genera in the Devonian serves to change the faunal facies almost completely.

The Lower Devonian fauna is made up largely of genera from the Haragan (Helderbergian) of Oklahoma and the Shriver chert (Oriskanian) of West Virginia. Genera which are restricted to or reach their culmination in these formations are *Acanthoscapa*, *Condracypris*, *Kloedenia*, and *Thlipsurella*.

Ostracodes are almost entirely wanting in the Upper Devonian of North America. The complete record includes *Beyrichia dragon*, Geneseo, New York; *Entomis serratostratus* and *Primitia variostrata*, Naples, New York; and *Kloedenia simplex*, Kings Mill, Pennsylvania. A large number of Upper Devonian species are found in the Eifel, Hartz, Saurland, etc., of Europe and South Devon in Great Britain. Common genera are *En-*

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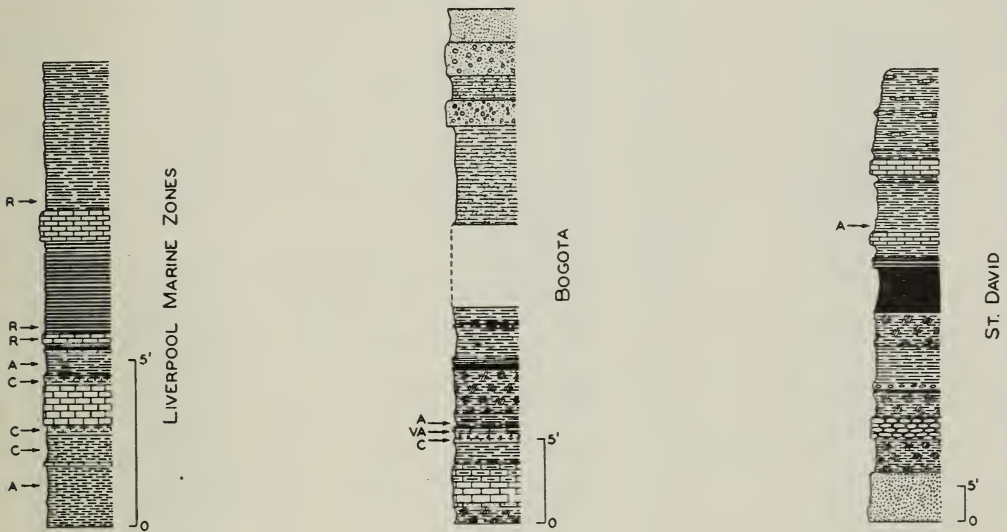


FIG. 5.—Graphic sections of the Liverpool, Bogota, and St. David cyclothem from the Pennsylvanian of Illinois, showing location of ostracode-bearing beds.

The Middle Devonian is best known because of the very excellently preserved material of the Hamilton at Arkona, Ontario, and from species described from the Silica shale of northern Ohio, and the Traverse beds of Michigan. Representative genera are *Barychilina*, *Bufina*, *Burlella*, *Euglyphella*, *Favulella*, *Hamiltonella*, *Hollina*, *Ponderodictya*, and *Quasillites*. Many "firsts" of genera of later importance are recorded, namely *Amphissites* (?),⁵ *Bairdia* (?), *Cavellina*, *Hollinella*, and *Kirkbya* (?).

⁵ The queries indicate that the genera may have an earlier existence in species of doubtful affinity.

tomis (*Richterina*), *Haploprimitia*, *Nehdentomis*, and *Polycope*.

Bollia, *Ctenobolbina*, *Halliella*, *Haploprimitia*, *Isochilina*, *Kloedenia*, *Leperditia*, *Ocotonaria*, *Primitia* (?), and *Ulrichia* (?) become extinct during this period.

Mississippian.—Several Devonian genera continue with little change into the Lower Mississippian, chiefly *Bairdia*, *Hollinella*, and *Tetrasacculus*. On the whole the Lower and Middle Mississippian have furnished little in the way of diagnostic ostracodes. Most of the common genera have either come over from the Devonian or are the early representatives of genera common in

the Chester series and the Pennsylvanian system. In the latter category are found *Bairdia*, *Cavellina*,⁶ *Glyptopleura*, *Graphidactyllis*, *Healdia*, and *Paraparchites*.

After a marked decrease in the number of species present in the Lower and Middle Mississippian, an increase is again noted in the Chester series. However, a few of the

represented. The Chester is characterized by a very great increase in the number of species of *Bairdia*, *Cavellina*, *Glyptopleura*, *Healdia*, and *Paraparchites*. Genera restricted to the series are *Bairdiolites*, *Chesterella*, *Deloia*, *Geffenina*, *Geffenites*, *Glyptopleuroides*, *Lochriella*, *Neokloedenella*, *Paracavellina*, *Perprimitia*, and *Tetratylus*.

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WEST VA. HWY. 21
(SECTION BY COOPER)

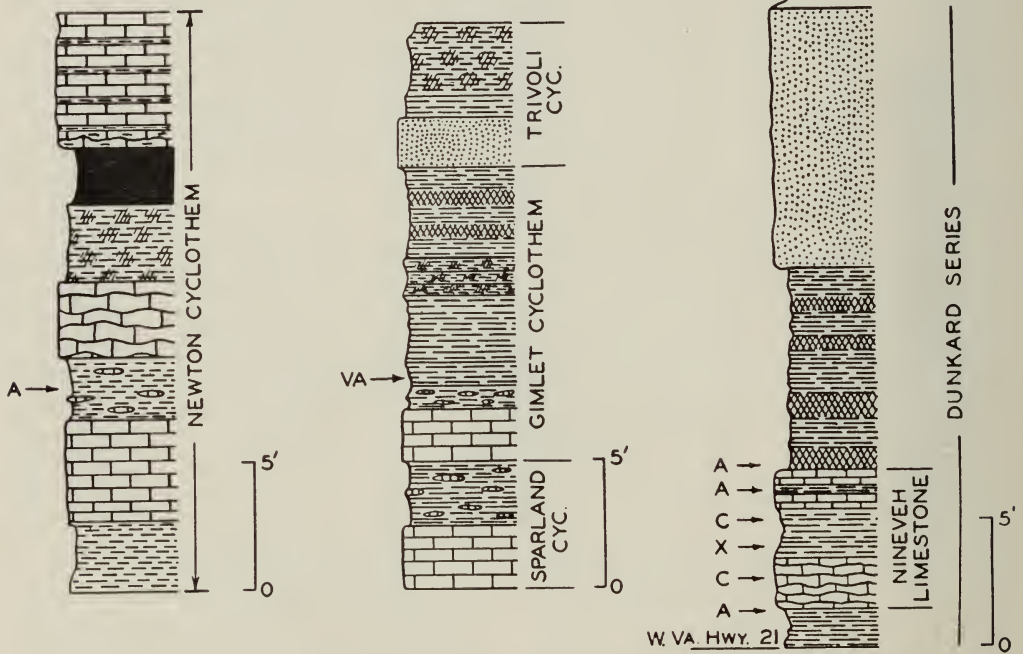


FIG. 6.—Graphic sections of the Newton and Gimlet cyclothem of Illinois and a part of the Permian section of West Virginia showing ostracode horizons.

holdover genera from earlier periods continue their decline, namely, *Beyrichia*, *Entomis*, and *Primitia*. *Amphissites*, *Bythocypris*, *Ectodemites*, *Kirkbya*, and *Paraparchites* continue into the Pennsylvanian with little or no change in the number of species

⁶ If the Paleozoic cytherellas are equivalent to *Cavellina*, the latter originated long before the Kinderhook, in the Middle Ordovician.

Pennsylvanian.—The most common ostracodes of this period came over from the Mississippian, and many genera, whose roots were started in the Chester series or earlier, reached culmination in the Middle or Upper Pennsylvanian. In this group we find *Bairdia*, *Healdia*, *Hollinella*, *Kirkbya*, *Knightina*, *Seminolites*, and *Waylandella*. The restricted genera, each represented by

only a few species are *Aechminella* (L, M),⁷ *Binodella* (M), *Burlella* (U), *Harlionella* (L), and *Kellettella* (U).

Permian.—Many genera originate in the Pennsylvanian and continue into the Permian, namely, *Bairdianella*, *Basslerella*, *Ellipsella*, *Kelletina*, *Knightina*, *Offa*, and *Roundyella*.⁸ Diagnostic Permian genera are *Haworthina*, *Suchonella*, *Suchonellina*, *Tommiella*, and *Whipplella*.⁹ All except the first and last are known only from Russia.

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⁷ L—Lower, M—Middle, U—Upper Pennsylvanian.

⁸ May have a Devonian species, but none is known from the Mississippian.

⁹ May be equivalent to *Basslerella*, common in the fresh water beds of the Pennsylvanian of Illinois and the Pennsylvanian and Permian of Kansas.

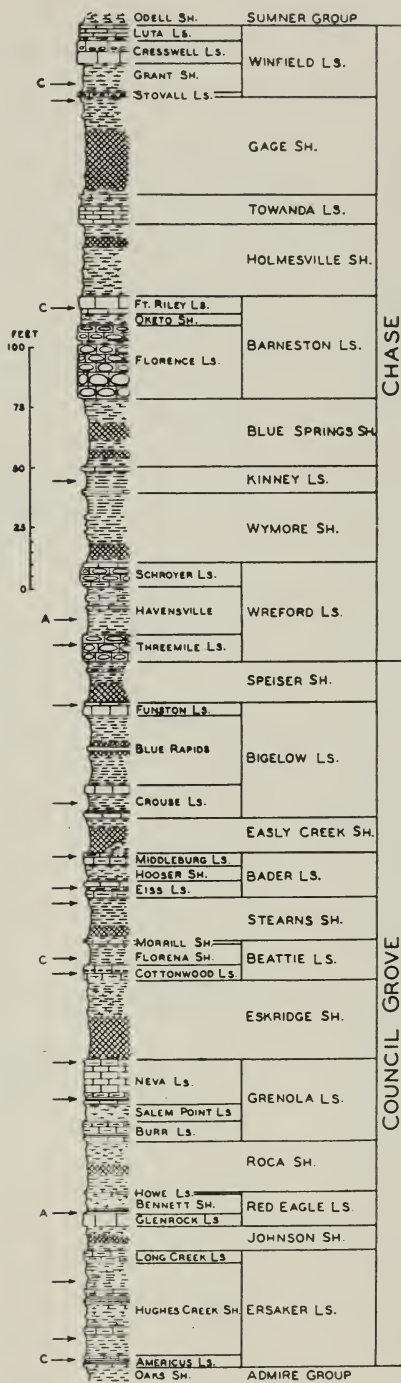


FIG. 7.—Section showing the ostracode horizons in the formations and members of the Chase and Council Grove groups of the Permian of Kansas (Section after Moore, 1936).

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