

CONTRIBUTIONS  
FROM THE  
CUSHMAN FOUNDATION  
FOR  
FORAMINIFERAL RESEARCH

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VOLUME XIV, Part 3

July, 1963

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VOLUME XIV, PART 3, JULY, 1963

262. ANNOTATED BIBLIOGRAPHY  
OF PALEOZOIC NONFUSULINID FORAMINIFERA, ADDENDUM 1

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ABSTRACT

This addendum includes 109 annotated references pertaining to Paleozoic nonfusulinid Foraminifera and can be considered reasonably complete through the year 1961. As in previous bibliographies (Toomey, 1959, 1961),<sup>1</sup> the aims are essentially unchanged: (1) to summarize briefly the pertinent data contained in each article, (2) to list all new genera and species described therein, and (3) to denote, by brackets, all taxonomic changes noted from subsequent publications, thus making the bibliography a more useful working tool. In addition, an attempt is made to evaluate the literature to date and possibly to delineate certain trends.

INTRODUCTION

In a continuing effort to annotate all Paleozoic nonfusulinid foraminiferal references systematically, it is necessary to issue addenda at periodic intervals. In this manner, the bibliography can be kept up-to-date and will be a more useful working tool for workers on the Foraminifera. For uniformity and convenience, two sections have been prepared: (A) Precarboniferous Foraminifera, and (B) Late Paleozoic Foraminifera. This system will be adhered to in future addenda.

This annotated bibliography consists of 50 references containing original descriptions of genera and species, and taxonomic nomenclature of Paleozoic nonfusulinid Foraminifera. An additional 59 references with mention of foraminiferal names, incidental occurrences, and corrections of earlier errors are included for completeness.

The 109 references have been annotated by the compiler, except for the most recent publications in which the authors included comprehensive abstracts. In such cases the author's abstract has served as a nucleus, and additions and deletions have been made. The annotations include geologic age, geographic locality, type of illustrations, original language, new forms described, and comments in brackets on taxonomic changes noted from subsequent publications.

The bibliography may be considered reasonably complete through 1961, with the exception of the Soviet references which, owing to their general unavailability to most American workers, may be assumed to be only partially complete.

It will be greatly appreciated if any omissions in this bibliography are brought to the attention of the compiler.

ARTICLE EVALUATION AND TRENDS

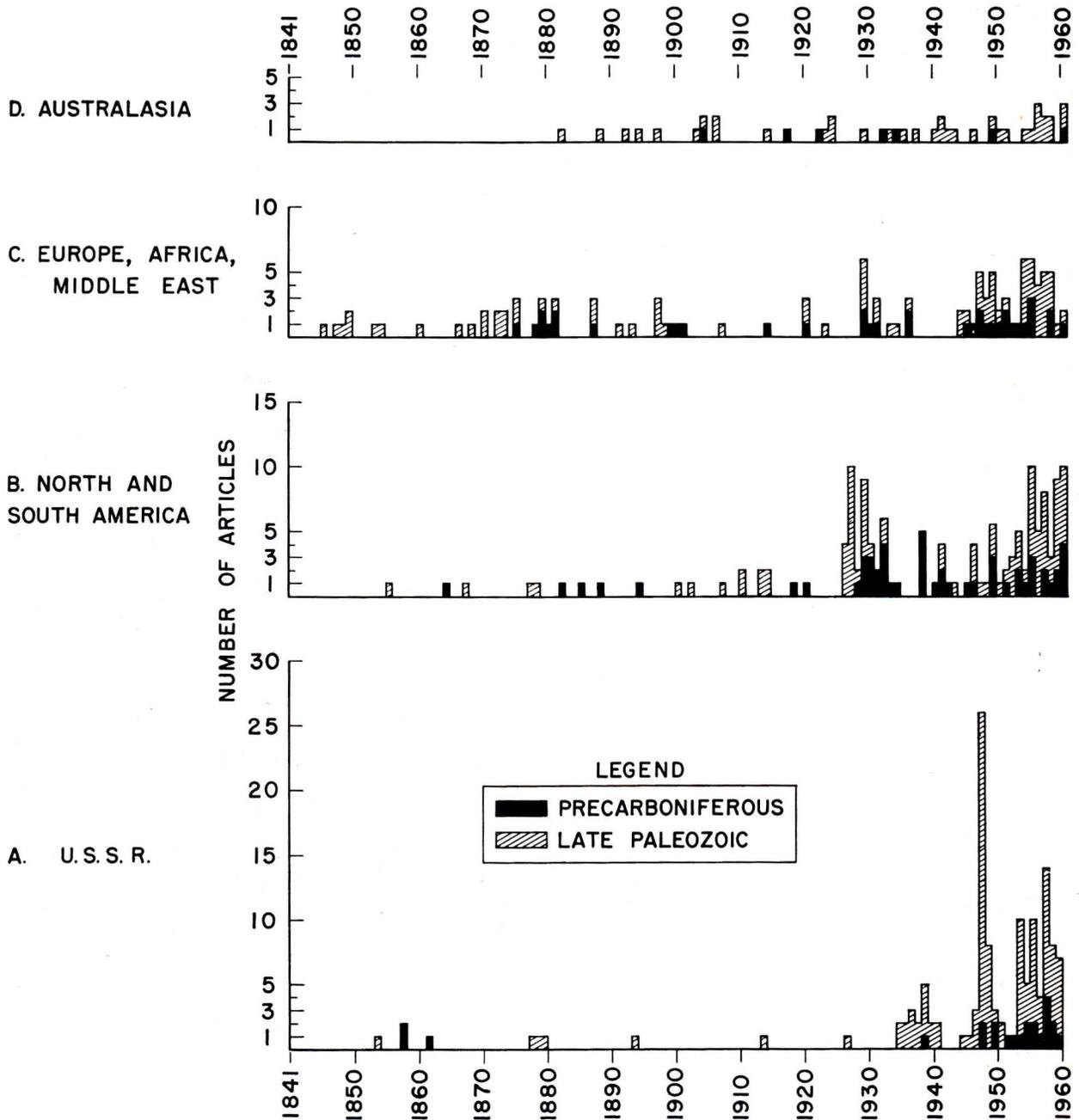
As previously noted (Toomey, 1959, 1961), the literature pertaining to Paleozoic nonfusulinid Forami-

nifera has become enriched with systematic studies only during the last three decades. Text figure 1 is an attempt to show chronologically the distribution of articles relating to Paleozoic Foraminifera according to designated geographic regions. This distribution is fairly obvious: (A) a few sporadic papers in the 19th century, commencing in the 1840's and continuing through the first quarter of the 20th century; renewed interest in the late 1920's with a reciprocal increase in article output that has continued to grow and shows healthy signs of moving forward in a like manner in the coming years (North and South America, Europe, Africa, and the Middle East); (B) awakening Soviet interest in the late 1930's, which was untimely cut off by the war, and a fantastic burst of literature output since then, which still appears to be in a dynamic state of expansion; (C) no trend established in Australasia because so little has been accomplished, compared to the vast potentiality.

In Text Figure 2 the foraminiferal literature output has been plotted according to geological age. The plot shows a general increase in numbers of articles from oldest (Precambrian records not substantiated) to an apex on Mississippian Foraminifera, then a substantial decrease in articles on Pennsylvanian and Permian foraminiferal faunas. This distribution can be explained most readily. The Mississippian apex is mute testimony to the confident use to which endothyroid faunas have been put in stratigraphically subdividing the Mississippian system all over the world. In post-Mississippian faunas the Fusulinidae have usurped the previously dominant position of the endothyroids, with a resultant decrease in effort applied to post-Mississippian nonfusulinid Foraminifera. The only reason for the relatively large number of post-Mississippian foraminiferal articles is their obviously abundant occurrence, compared to Precarboniferous foraminiferal faunas, in the geological section.

During the last decade Soviet paleontologists have paid increasing attention to Late Devonian foraminiferal faunas and have successfully utilized their stratigraphic potentiality. In North America most workers are still obsessed with obtaining specimens by the dilute acid insoluble residue method, and the study of forms found in early and middle Paleozoic carbonate thin sections is entirely neglected.

In the process of gathering articles and preparing this bibliography it has become increasingly evident to



TEXT FIGURE 1

Geographic distribution of Paleozoic foraminiferal literature

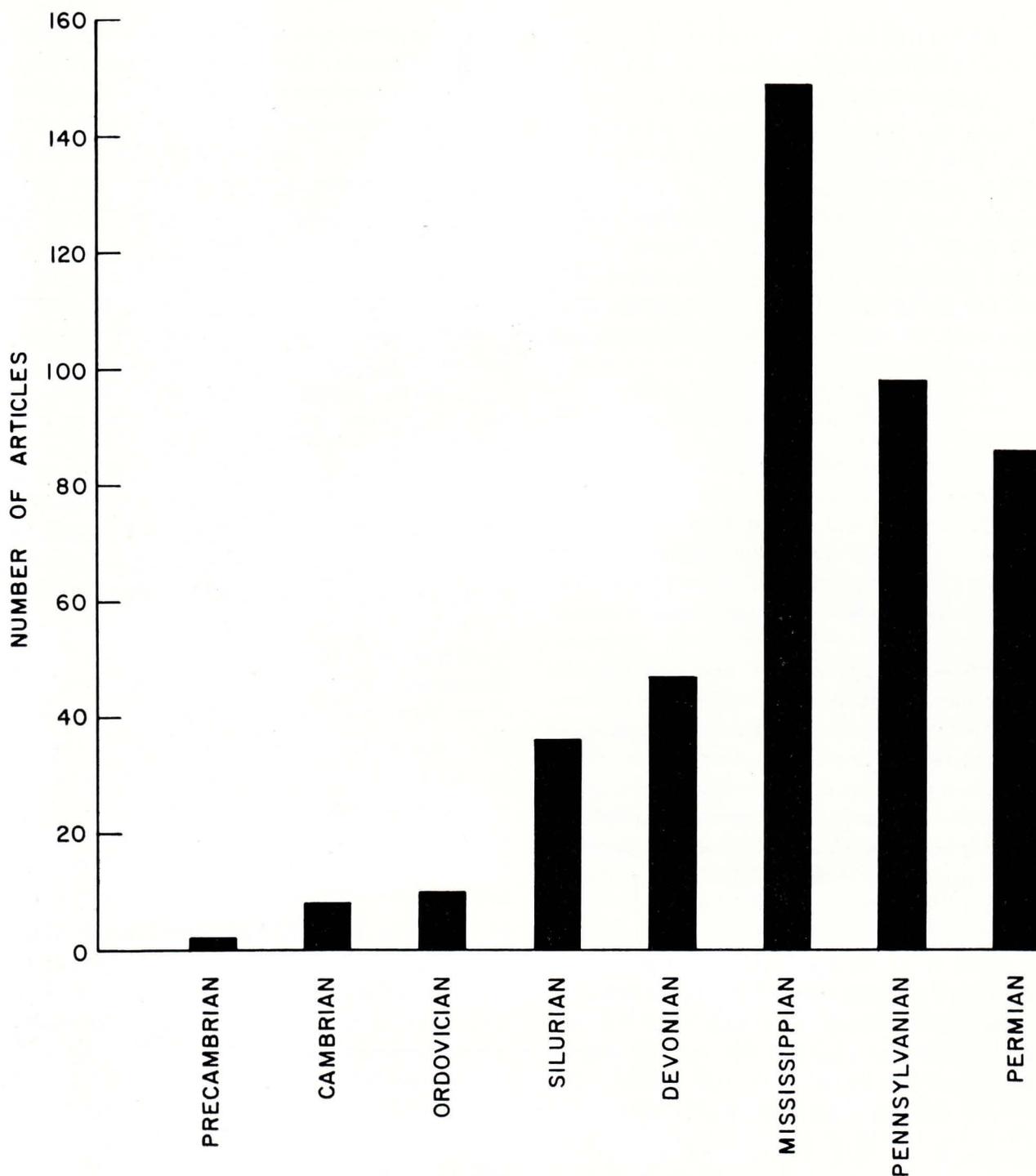
the compiler that most North American workers persistently ignore Soviet literature. Admittedly, papers by Soviet micropaleontologists are somewhat difficult to obtain, but there appears to be no excuse for specialists to be unacquainted with Soviet works completed over a decade ago. The results of an extreme case in point are offered by Malakhova's (1959)<sup>1</sup> comments on an American worker's endothyroid paper; more cases could be cited.

A foible that may be inherent to all paleontologists, and one that can justly be called to attention, is the ambiguous use of that small but potent word, ecology. Many times it is difficult to comprehend what the writer means by it. In many cases organism distribution is discussed and is regarded as synonymous with ecology. It is granted that organism distribution is

important in attempting to unravel the ecology of a particular fauna, but is only the beginning. From this point we must build and expand our story into a logical, realistic sequence. It would be perhaps wiser to restrain our ecological proclamations and to realize more fully the formidable array of variables that confront us (some of which are insoluble from the geologic standpoint) than to try to reduce a vastly complex situation into what we believe to be a simple statement of fact.

In dealing with foraminiferal faunas of structurally simple agglutinated tests the creation of species on the basis of a limited number of species is indeed hazardous. Yet many workers describing new genera and species of agglutinated Paleozoic Foraminifera, mainly derived from insoluble residues, have failed to take into consideration the most important attribute of a species—its natural inherent morphological variability.

<sup>1</sup> References in the text can be found either here or in the two earlier bibliographies.



TEXT FIGURE 2  
Geological distribution of Paleozoic foraminiferal literature

Hattin (1960) has called attention to this important fact and has lucidly pointed out that "meaningful evaluation of early Paleozoic foraminiferal populations demands study of large numbers of individuals from each fossiliferous facies at any locality." Only in this way can we be more objective in erecting new forms and ultimately reducing useless proliferation of taxa. Towards this goal many statistical approaches have been attempted. One method, which appears to have great potential, is that employed by Wolanska (1959), in which large numbers of specimens were isolated and studied statistically (analyzing the arithmetical mean of their indices regarded as their features) in order to determine the variability of the species. Further study will undoubtedly be more rewarding and will materially aid in clarifying a chronic problem.

The problem of the importance of the microstructure of the foraminiferal test wall in relationship to the classification scheme still remains unsolved. However, some progress can be noted. Henbest (1960) has made a significant contribution in his short summary of petrologic criteria to aid in distinguishing agglutinated tubiform Foraminifera from the secreted forms, where the shell material has been recrystallized. A much longer paper on the test-wall microstructure of Paleozoic encrusting Foraminifera is now in press by Henbest (personal communication).<sup>1</sup>

<sup>1</sup> Since going to press, this paper has appeared: Henbest, L. G., 1963, Biology, mineralogy, and diagenesis of some typical late Paleozoic sedentary Foraminifera: Cushman Found. Foram. Research, Special Pub. 6, p. 1-44, 7 pls.

## ANNOTATED BIBLIOGRAPHY

## A. PRECARBONIFEROUS FORAMINIFERA

1. BECKMANN, H., 1952, Foraminiferen aus dem Unterdevon des Rheinlandes: Neues Jahrb. Geol. Min., v. 8, p. 364-370, 11 text-fig., [in German].  
First reported occurrence of Lower Devonian Foraminifera from middle Europe (German Rhineland) is given. A form resembling *Psammosphaera micrograna* previously described by Eisenack (1932) from the Silurian of the Baltic region is fully described and illustrated by thin-section and whole-specimen photomicrographs.
2. BLUMENSTENGEL, H., 1961, Foraminiferen aus dem Thüringer Oberdevon: Geologie, v. 10, no. 3, p. 316-335, 3 pl., 1 text-fig., [in German].  
A fauna of 23 species of Upper Devonian Foraminifera, of which 6 are new, is described from the Gattendorffian Stage of the East Thuringian State Mountains (East Germany). The microfauna is illustrated by whole-specimen and thin-section photomicrographs.  
The fauna is agglutinated and was obtained from monochloroacetic acid insoluble residues.  
A brief discussion of the agglutinated wall structure is also given.  
The new forms are *Parathurammina micropapillata*, *Lagenammina thuringica*, *Hyperammina kahleitenensis*, *H. supergracilis*, *H. stabilis*, and *Tolypammina irregularis* [probably should be referred to *Serpulopsis*; see Henbest, 1960].  
Seven species of the microfauna have previously been reported from the Upper Devonian and Lower Carboniferous (Mississippian) of North America.  
The following taxonomic change is also included: *Pseudastrorhiza?* sp. Lipina, 1955, and *P. delicata* Gutschick and Treckman, 1959, are placed under *Thurammina delicata* (Gutschick and Treckman).
3. BYKOVA, E. V., 1953, Foraminifera of the Devonian deposits of the Russian Platform and the Volga-Ural Region: "Devon Russkoi Platformy," Sbornik Dokladov. Vses. Neft. Nauchno-Issledov. Geol. Razved. Inst., p. 274-279, [in Russian].  
Reviews the work done on the Upper Devonian Foraminifera from the Russian Platform and the Volga-Ural and demonstrates that the two areas were characterized by two different foraminiferal assemblages during Frasnian time. The transition to rocks of Fammenian Age is marked by the disappearance of the Lagenidae throughout and is so abrupt that this interval is used as a key horizon in comparing sections far removed from each other.
4. CONKIN, J. E., 1961, Mississippian smaller Foraminifera of Kentucky, southern Indiana, northern Tennessee, and southcentral Ohio: Bull. Am. Paleontology, v. 43, no. 196, p. 223, chart 22-23.  
A brief discussion of Upper Devonian Foraminifera obtained from limited sampling of shales in the region. In essence, a more complete restatement of a previous abstract (Conkin and Conkin, 1960). Two range charts in which Late Devonian Foraminifera are recorded are also given.
5. CONKIN, J. E., and CONKIN, B. M., 1960, Arenaceous Foraminifera in the Silurian and Devonian of Kentucky (abstract): Geol. Soc. America, Bull., v. 71, no. 12, p. 2014-2015.  
The writers demonstrate the fairly wide occurrence of agglutinated Foraminifera in the Silurian and Devonian sequence on all three sides of the Cincinnati Arch in Kentucky.  
Seven genera of Foraminifera (*Hyperammina*, *Involutina* [now referred to *Ammodiscus*; see Loeblich and Tappan, 1961], *Lituotuba*, *Proteonina*, *Psammosphaera*, *Thurammina*, and *Thuramminoides*) are reported from the Silurian formations: the Waldron Shale, Osgood Shale, and Estill Shale. Eight genera (*Glomospira*, *Hyperammina*, *Involutina*, *Proteonina*, *Rhabdammina*, *Thurammina*, and *Tolypammina*) are reported from the Devonian formations: the New Albany Shale, Portwood Formation, Boyle, Beechwood Limestone, Bone bed of Sellersburg age, and the Silver Creek Member of the Sellersburg.
6. CRESPI, I., 1950, Foraminifera in Australian stratigraphy: 18th. Internat. Geol. Cong., Gt. Britain, 1948, pt. 15, p. 65-69, 1 text-fig.  
Paper briefly mentions the recent discovery of Devonian Foraminifera from northern Australia. The genera included are *Lagenammina* and *Psammosphaera*.
7. CRESPI, I., 1961, Upper Devonian Foraminifera from Western Australia: Palaeontology, v. 3, pt. 4, p. 397-409, pl. 64-67.  
Ten species of agglutinated Foraminifera, of which 8 are new, are described from the Upper Devonian of the Pillara Range and Bugle Gap Areas, Fitzroy Basin, Western Australia; this is the first record of authentic Devonian Foraminifera in Australia. The microfauna is illustrated by line drawings and consists of the following new species: *Rhabdammina virgata*, *Saccammina glenisteri*, *Sorosphaera adhaerens*, *Lagenammina ampullacea*, *Colonammina imparilis*, *Hyperammina devoniana*, *Tolypammina helina*, *T. nexuosa* [probably should be referred to *Serpulopsis*; see Henbest, 1960], and *Marsipella* sp., and *Proteonina* sp.
8. CRONEIS, C., and GRUBBS, D. M., 1939, Silurian sea balls: Jour. Geology, v. 47, p. 598-612, 6 text-fig.  
A few possibly lagenoid types of Foraminifera and abundant rodlike forms, perhaps *Astrorhizidae*, occurring as insolubles from Niagaran "sea balls" are briefly mentioned.
9. CUSHMAN, J. A., 1930, Notes on some early Paleozoic Foraminifera: Contr. Cushman Lab. Foramin. Research, v. 6, pt. 2, p. 43-44, pl. 6.  
Discusses the potential value of Moreman's (1930) work on the Ordovician and Silurian Foraminifera.

nifera of Oklahoma and cites other works on early Paleozoic Foraminifera which can now definitely be discredited. A few of Moreman's topotypes are redrawn to show details of the wall not clearly shown in the original figures.

10. CUSHMAN, J. A., 1930, A résumé of new genera of the Foraminifera erected since early 1928: Contr. Cushman Lab. Foram. Research, v. 6, pt. 4, p. 73-94, pl. 10-12.

Briefly discusses and illustrates 3 Precarboniferous foraminiferal genera described since Cushman's first edition of "Foraminifera, Their Classification and Economic Use." The genera discussed are: *Stegnammina*, *Raibosammina*, and *Colonommina*.

11. DAWSON, J. W., 1889, *Saccammina eriana*: Am. Jour. Sci., v. 137, 3rd ser., p. 318.

This paper briefly asserts that the form *Saccammina eriana* is indeed a foraminifer and further suggests its affinity to the Lagenidae. [See Dawson, 1883, and Ulrich, 1886, for additional comments.].

12. DUNN, P. H., 1931, The Foraminifera of the Bainbridge (abstract): Ohio Jour. Sci., v. 31, no. 4, p. 279.

The Foraminifera obtained from the Bainbridge Formation are reported to be similar to those discovered by Moreman (1930) from the Arbuckle Mountains; hence there is a strong possibility of foraminiferal correlation of the Bainbridge with the Silurian formations of the southwest.

13. DUNN, P. H., 1933, Foraminiferal correlation of the Osgood Formation (abstract): Geol. Soc. America, Bull., v. 44, p. 209.

The writer reports that agglutinated Foraminifera have proved to be very useful in correlating the Silurian Osgood Formation (lower Niagaran) in Tennessee, Missouri, Kentucky, Indiana, and Illinois.

14. DUNN, P. H., 1950, Arenaceous Foraminifera found weathered free from the Silurian of Missouri (abstract): Geol. Soc. America, Bull., v. 61, no. 12, p. 1454-1455.

Screenings of weathered material from the *Pisocrinus* zone at the base of the Silurian Bainbridge Formation of Ste. Genevieve County, Missouri, have yielded a large number of agglutinated Foraminifera. Specimens of *Lithotubia* (sic *Lituotuba*) and *Ammodiscus* were especially abundant. Many of the specimens show distortion. This would seem to indicate that the original cementing material was flexible and was therefore more likely chitin and not silica or calcium carbonate. If this is true, the writer believes that some of the species previously erected by the senior author and other writers on the basis of shape alone may not be valid.

15. EVITT, W. R., 1954, Foraminifera from the Devonian of New York (abstract): Geol. Soc. America, Bull., v. 65, no. 12, p. 1249-1250.

The limestones and shales of the Middle Devonian Hamilton Group of western New York have yielded abundant specimens of two new and unusual Foraminifera.

A new species of the reophacid genus *Nodosinella* from the Centerfield Limestone is noteworthy because of the optical properties of the test wall.

From several Ludlowville and Moscow horizons a new genus and species of attached, perforate, multi-ocular, finely agglutinated Foraminifera is provisionally referred to the Placopsilinae. This form is notable for its method of chamber addition; when a new chamber is to be formed, the wall of the last chamber is mechanically ruptured.

16. HATTIN, D. E., 1960, Waldron (Niagaran) Foraminifera in Indiana (abstract): Geol. Soc. America, Bull., v. 71, no. 12, pt. 2, p. 2016.

From the Silurian Waldron Shale of Indiana 37 species of Foraminifera are assigned to the following genera, arranged in order of decreasing abundance of specimens: *Sorosphaera*, *Psammospaera*, *Rhabdammina*, *Thurammina*, *Webbinella*, *Hyperammina*, *Raibosammina*, *Thekammina*, *Marsipella*, *Lagenammina*, *Stegnammina*, *Amphitremonidea*, *Saccammina*, *Colonommina*, *Aschemonella*, *Tholosina*, *Psammophax*, and *Bathysiphon*.

Ontogeny from single-chambered to multichambered stages can be demonstrated for three species of *Sorosphaera* and for one species each of *Webbinella*, *Thurammina*, and a new genus related to *Sorosphaera*. Failure to recognize ontogenetic series can result in useless proliferation of taxa if specimens differing only in number of chambers are assigned to separate species. From detailed study of two small bioherms at Vernon, Indiana, the writer concludes that foraminiferal distribution was controlled closely by local environment; some lithologic units within the bioherms contain abundant specimens, whereas adjacent units are virtually barren. Meaningful evaluation of early Paleozoic foraminiferal populations demands study of large numbers of individuals from each fossiliferous facies at any locality.

17. KJELLESVIG, E. N., 1934, Trenton Foraminifera from New York (abstract): Geol. Soc. America, Proc. 1933, p. 340.

The Upper Ordovician Trenton Limestone at Trenton Falls, New York, has yielded a foraminiferal suite of 16 genera and 29 species. The forms reported belong to the families Astrorhizinae, Ammodiscidae, and Reophacidae. Some of the species are identical with those described by Moreman (1930) from the Viola and Chimneyhill limestones of Oklahoma.

18. KONOLIPINA, O. R., 1956, The microfauna of the Upper Devonian deposits of the Oleske Area (western Ukraine): Dopovidj Akad. Nauk Ukrain. R. S. R., no. 5, p. 454-456, [in Russian].

The subdivision of the Upper Devonian Fras-

nian and Fammenian stages is discussed on the basis of previously described Foraminifera in areas of the Russian western Ukraine.

19. LOEBLICH, A. R., JR., and TAPPAN, H., 1961, The status of the foraminiferal genera *Ammodiscus* Reuss, and *Involutina* Terquem: *Micropaleontology*, v. 7, no. 2, p. 189-192.

The status of the genera *Ammodiscus* Reuss, 1862, and *Involutina* Terquem, 1862 is discussed on the basis of their revision by Bornemann, 1874, and by Loeblich and Tappan, 1954. *Ammodiscus* Reuss is retained for agglutinated planispiral evolute species similar to the type species *Ammodiscus infimus* Bornemann, 1874 (not Strickland, 1846) = *Ammodiscus siliceus* (Terquem), 1862. *Involutina* Terquem is restricted to those planispiral calcareous species, with lateral umbilical filling, similar to the type species *Involutina jonesi* Terquem and Piette (1862) = *Involutina liasina* (Jones), 1853.

20. LOEBLICH, A. R., JR. and TAPPAN, H., 1961, Suprageneric classification of the Rhizopodea: *Jour. Paleontology*, v. 35, no. 2, p. 245-330.

*Umbellina* Loeblich and Tappan, *nom. nov.* is herein proposed for *Umbella* Maslov, 1955 (in Bykova and Polenova, 1955), not *Umbella* d'Orbigny, 1841, Mollusca. Type species, *Umbellina bella* (Maslov) = *Umbella bella* Maslov, 1955.

The subfamily was defined by Fursenko to include also *Cochleatina* and *Illigata* Bykova, 1955. *Cochleatina* is a bryozoan and is synonymous with the genus *Corynotrypa* Bassler, 1911; *Illigata* may also be a bryozoan. These two genera are attached and are thin-walled perforated forms which are quite distinct from the flask-shaped thick, radially fibrous walled *Umbellina* with large round terminal aperture. Originally considered as a subfamily of the Lagenidae (= Nodosariidae), the Umbellininae are here removed to the Nodosinellidae because of the fibrous structure of the thick walls.

21. MOORE, W. E., 1952, Preliminary report on the occurrence of Ordovician Foraminifera near Catawba, Virginia (abstract): *Virginia Jour. Sci.*, v. 3, no. 4, p. 334.

The occurrence of Ordovician (middle Trenton) Foraminifera obtained from dilute acid residues from limestones exposed near the base of Catawba Mountain along highway 311, near Catawba, Virginia, is briefly reported.

22. MOUND, M. D., 1961, Arenaceous Foraminifera from the Brassfield Limestone (Albion) of southeastern Indiana: *Indiana Geol. Survey, Bull. No. 23*, 38 p., 3 pl., 5 text-fig., 3 tables.

A large fauna of agglutinated Foraminifera from the Silurian Brassfield Limestone from four counties in southeastern Indiana is described in detail and illustrated by whole-specimen photomicrographs. The fauna was derived from dilute hydrochloric acid-insol-

uble residues and consists of 14 genera and 26 species, of which 2 genera and 3 species are new. The new forms are *Stomasphaera brassfieldensis*, *Amphicervicis elliptica*, and *A. hemisphaerica*.

The ammodiscids are particularly characteristic of the Brassfield fauna. The writer suggests that in future studies of Silurian Foraminifera where there are abundant specimens, it may be possible to show whether relative abundances of certain species are stratigraphically significant or not, even though the ranges of the given species may not be a critical factor.

The following taxonomic changes are incorporated: *Glomospira disca* Cooper, 1947. *G. diversa* (pars) Cushman and Waters, 1930, *G. simplex* Harton, 1928, Ireland, 1956, and *Glomospirella umbilicata* Ireland, 1958, are placed under *Glomospira gordialis* (Jones and Parker). *Glomospira diversa* (pars) Cushman and Waters, 1930, and *G. pusilla* Ireland, 1956, are placed under *G. articulosa* Plummer. *Thurammina parvituba* Dunn, 1942, is placed under *T. elliptica* Moreman. *Stegnammina triangularis* Moreman, 1930, *S. elongata* Ireland, 1939, and *S. cylindrica brevis* Dunn, 1942, are placed under *S. cylindrica* Moreman. *Psammosphaera angularis* Ireland, 1939, *P. gracilis* Ireland, 1939, *P. arcuata* Dunn, 1942, *P. conjunctiva* Dunn, 1942, *P. excerpta* Dunn, 1942, and *P. minuta* Dunn, 1942, are all placed under *P. cava* Moreman. *Psammosphaera gigantea* Dunn, 1942, and *P. pusilla* Parr, 1942, are placed under *P. laevigata* White. *Sorosphaera columbiense* Stewart and Lampe, 1947, and Summerson, 1958, and *S. bicelloidea* Stewart and Lampe, 1947, and Summerson, 1958, are placed under *S. bicella* Dunn. *Sorosphaera irregularis* Grubbs, 1939, is placed under *S. tricella* Moreman. *Sorosphaera multicella* Dunn, 1942, *S. subconfusa* Dunn, 1942, *Sorosphaeroidea polygonia* Stewart and Lampe, 1947, and Summerson, 1958, and *S. pentochora* Summerson, 1958, are placed under *Sorosphaera osgoodensis* Stewart and Priddy. *Bathysiphon curvus* Moreman, 1930, Ireland, 1939, Dunn, 1942, *Hyperammina sublaevigata* Dunn, 1942, *H. elegantissima* (sic) Plummer, 1945, and *H. compacta* Gutschick and Treckman, 1959, are all placed under *H. curva* (Moreman). *Bathysiphon curvus* var. *gracilis* Ireland, 1939, *B. rugosus* Ireland, 1939, and *B. parallelus* Dunn, 1942, are placed under *B. exiguus* Moreman.

Since Loeblich and Tappan have reversed their 1954 decision and have retained the genus *Ammodiscus* for the agglutinated planispiral evolute species the following taxonomic changes can also be incorporated in Mound's paper: *Ammodiscus minutus* Dunn, 1942, and *A. annularis* Ireland, 1956, should be placed under *Ammodiscus incertus* (D'Orbigny). *Ammodiscus brevitubus* Dunn, 1942, and *Involutina exserta* Gutschick and Treckmann, 1959, are placed under *Ammodiscus exsertus* Cushman.

23. NICHOLSON, H. A., and ETHERIDGE, R., JR., 1880. A monograph of the Silurian fossils of the Girvan

district in Ayrshire: v. 1, p. 21-23, pl. 9, fig. 23, W. Blackwood and Sons, Edinburgh and London.

A foraminifer identified as *Saccamina carteri* Brady, by Brady, is reported and described from the Craighead Limestone (Ordovician, Ardmillan Series, Carodocian) at Tramitchell, about 3 miles southeast of Girvan in the Lake district of Scotland. This form is illustrated by a thin-section drawing. [Specimen should probably be referred to *Saccaminopsis fusuliniformis*; see Chapman, 1898, Sollas, 1921, and Pringle, 1948.]

24. PRIDY, R. R., 1939, A petrographic study of Niagara rocks of southwestern Ohio and southeastern Indiana: Jour. Geology, v. 47, p. 489-502, 3 text-fig., 4 tables.

Agglutinated foraminiferal species are listed from the Silurian Dayton Limestone, Osgood Formation, Laurel Limestone, Massie Shale, and Springfield Dolomite of the southwestern Ohio and southeastern Indiana region. Genera listed are *Ammodiscus*, *Lituotuba*, *Sorosphaera*, *Bathysiphon*, *Thuramina*, and *Psammonyx* [later changed to *Marsipella? torta*; see Stewart and Priddy, 1941, p. 370].

25. PRINGLE, J., 1948, British regional geology: The South of Scotland; Dept. of Scientific and Industrial Research, Geol. Survey and Mus., 2nd. ed., 87 p., 7 pl., 14 text-fig.

This paper reports abundant *Saccaminopsis* sp. from the Stinchar Limestone Group (Ordovician, Barr Series, upper Llandeile) and the Craighead Limestone (Ordovician, Ardmillan Series, Carodocian) of the south of Scotland.

26. SULTANAYEV, A. A., 1960, Recent data on the vertical distribution of foraminifers in contiguous strata of the Devonian and Carboniferous in the southern Urals: Akad. Nauk S.S.S.R., Doklady, v. 133, no. 4, p. 921-924, 1 text-fig., [in Russian].

Many previously described species of Foraminifera formerly considered late Tournaisian in age but now definitely established in rocks of Late Devonian age (Famnenian) are reported from the southern Ural Mountains of the Soviet Union.

27. ULRICH, E. O., 1886, Descriptions of new Silurian and Devonian fossils: Contr. Am. Paleontology, v. 1, p. 34-35, pl. 3, fig. 8a-8e.

A new genus and species of a supposed foraminifer, *Moellerina greenii*, from the Middle Devonian rocks at the Falls of the Ohio is described and illustrated by line drawings. [This form should be re-studied; superficially it closely resembles a charophyte and, in all probability, should be referred to this grouping.]

#### B. LATE PALEOZOIC FORAMINIFERA

28. ALSENVERG, D. E., 1960, Carboniferous stratigraphy of the Donetz Basin: Quatrième Congrès pour L'Avancement des Études de Stratigraphie

et de Géologie du Carbonifère, Heerlen, Sept. 15-20, 1958, C. R., v. 1, p. 1-12, 1 text-fig.

This excellent summary of Carboniferous stratigraphy of the Russian Donetz Basin lists characteristic Foraminifera for each of the zones. Comparison is made with the Carboniferous section of western Europe.

29. ALEXANDROWICZ, S., 1959, Carboniferous foraminifers from Kozłowa Góra near Bytom (Upper Silesia): Poland Inst. Geol. Kwartalnik Geol. Warsaw, no. 4, v. 3, p. 869-881, 3 pl., 2 text-fig., [in Polish with English summary].

From the Namurian marly shales in the northeastern part of the Upper Silesian Basin of Poland, a microfauna of seven previously described species of Foraminifera representing the genera *Hyperamina*, *Thuraminoides*, *Ammodiscus*, and *Hemigordius* is described and illustrated by line drawings.

In the Upper Carboniferous sediments of the Upper Silesian Basin, Foraminifera appeared sparingly and are concentrated in intercalations containing a marine fauna. These species suggest correlation with the marine horizons of the Ostrava beds (Vasicek and Ruzicka, 1957).

30. BARTENSTEIN, H., 1960, Micropalaeontological research in European Upper Carboniferous stratigraphy: Geol. Mag., v. 87, p. 253-260, pl. 12, 2 text-fig.

This paper gives a report on the most recent developments in obtaining microfossils (Foraminifera, Ostracoda, and spores) from rocks of Late Carboniferous age (Namurian C-Westphalian C) of Westphalia, Germany. The microfauna is very monotonous being poor in both genera and species; of the Foraminifera only agglutinated genera are known, i.e., *Ammodiscus*, *Glomospira*, *Glomospirella*, *Hyperamina*, and *Thuraminoides*. Study has demonstrated that Late Carboniferous marine invasions were more frequent in Westphalian A than had been previously recognized. It is anticipated that further study of the microfauna will facilitate correlation between the Upper Carboniferous of England and Germany. One plate illustrating representative whole specimens of *Ammodiscus* and *Hyperamina* is included.

31. BELFORD, D. J., 1961, *Spiropecta pellicula*, n. gen., n. sp., from the Upper Cretaceous and *Giraliarella triloba*, n. sp., from the Permian of Western Australia: Contr. Cushman Found. For. Research, v. 12, pt. 3, p. 81-82, pl. 3.

A new species of agglutinated Foraminifera, *Giraliarella triloba*, is described from the subsurface Permian beds in the Carnovan Basin of Western Australia. This new form is illustrated by whole specimen photomicrographs and is characterized by the trilobate outline of the test in end view.

32. BERQUIST, H. R., 1960, Occurrence of Foraminifera and conodonts in upper Paleozoic and Triassic

rocks, northern Alaska: Jour. Paleontology, v. 34, no. 3, p. 596-601.

From the upper Paleozoic Siksikuk Formation (Permian?) in northern Alaska, an agglutinated fauna is reported. The fauna was found in red and green shales and consists of the following forms: *Hyperammmina*, *Thurammmina*, *Reophax?*, *Ammodiscus*, *Glomospira*, *Ammobaculites*, *Spiroplectammmina* or possibly *Mooreinella*, and *Trochammmina*. A Permian age is suggested by the presence of diagnostic corals and brachiopods; also found in association with the megafossils and Foraminifera were a few discoidal Radiolaria and platform conodonts. This marks the first reported occurrence of late Paleozoic Foraminifera found in Alaska.

33. BHATIA, S. B., 1959, Additional microfossils from the Umaria marine bed, central India: Geol. Soc. India, Jour., v. 1, p. 116-125, 12 test-fig., 1 chart.

The Permo-Carboniferous marine bed at Umaria in central India has yielded one additional foraminifer, *Nodosinella?* sp., previously not reported by Bhatia and Saxena (1957). The foraminifer is briefly described and accompanied by three line drawings.

34. BHATIA, S. R., and SINGH, S. K., 1959, Carboniferous (Uralian) Foraminifera from Manendragarh, central India: Micropaleontology, v. 5, no. 1, p. 127-134, 2 pl.

The first-known occurrence of Foraminifera in the Upper Carboniferous marine bed near Manendragarh, central India, is reported. Nine previously described species are recorded; one new species, *Trochammmina hasdoensis*, is described in detail; all forms are illustrated by line drawings. The fauna is characterized by the exclusive occurrence of agglutinated forms, which show affinity with faunas from the Pennsylvanian of North America. Paleoecologic observations are also given.

35. BOND, G., 1950, The Lower Carboniferous reef limestones of northern England: Jour. Geology, v. 58, no. 4, p. 313-329, pl. 1-2, 3 text-fig., 7 tables.

This paper briefly mentions that in the reef fauna from the Lower Carboniferous of northern England, thin sections of granular limestone show abundant Foraminifera; *Endothyra* and *Archaediscus* are the commonest forms.

36. BRAZNIKOVA, N. E., 1951, Changes in the foraminiferal fauna at the boundary between the Lower and Middle Carboniferous of the Donbas: Geol. Zhur., Akad. Nauk Ukrain. R.S.R., 11, no. 3, p. 29-40, [in Russian].

This paper deals primarily with Early and Middle Carboniferous stratigraphy of the Donbas Region of Russia on the basis of previously described foraminiferal species.

37. BRAZNIKOVA, N. E., et al., 1956, Fauna and flora of the Carboniferous beds of the Galitzi-Volyn

Basin: Akad. Nauk S.S.R. Ukraine, Proc. Inst. Geol. Nauk, Strat.-Paleont. ser., v. 10, p. 16-103, 17 pl., [in Russian].

From the Lower Carboniferous beds of the Galitzi-Volyn Basin of the U.S.S.R., a fauna of 39 species, of which 15 species, 3 subspecies, and 4 varieties are new, is described and illustrated by thin-section photomicrographs. The following new forms are included: *Saccamminopsis carteri* (Brady) *ukrainica* n. subsp., *Ammodiscus buskensis*, *A. diadema*, *Trepeilopsis granularis*, *T. extensus*, *Forschiella grandis*, *Haplophragmella?* *minima*, *Nanicella ammonoides* (Brady) *paraammonoides* n. subsp., *Quasiendothyra ukrainica* var. *confusa*, *Endothyra omphalota* Rauser and Reitlinger *volynica* n. subsp., *E. omphalota* Rauser and Reitlinger *involuta* n. var., *Palaeotextularia convexa*, *Tetrataxis quasiconica*, *T. submedia*, *T. regularis*, *T. gigas*, *Monotaxis gibba* (Möller) *longa* n. var. [genus *Monotaxis* regarded as a synonym of *Howchinia*; see Reitlinger, 1954], *M. exilis* Vissarionova *compressa* n. var., *Valvulinella angulata*, and *Archaediscus paraspirillinoides*. One taxonomic change is incorporated: *Endothyra?* *gracilis* Rauser, 1948, is placed under *Haplophragmella gracilis* (Rauser).

38. БЫКОВА, Е. В., et al., 1958, New genera and species of Foraminifera: Microfauna of the U.S.S.R., Sbornik 9, Vses. Neft. Nauchno-Issledov. Geol.-Razved. Inst., Trudy, v. 115, 81 p., 12 pl., 1 text-fig., [in Russian].

From a symposium on new genera and species of Foraminifera described from different regions of the Soviet Union, a late Paleozoic fauna of 12 new species and 1 new variety, embracing 1 new genus and family, is described in detail and illustrated by both thin-section photomicrographs and line drawings. The new forms are *Glomospira infracarbonica*, *Glomospirilla kugultinskensis*, *Ammodiscus obscurus*, *A. subcarbonicus*, *Hemidiscus kalmiussi*, *Trepeilopsis grandis* Cushman and Waters var. *minima*, *Loeblichia translucens*, *Chernyshinella disputabilis*, Mesoendothyridae n. fam., *Mesoendothyra izjumiana* n. gen., *Valvulinella latebrosa*, *Polytaxis limata*, *Orthovertella?* *issatchkensis*, and *Archaediscus?* *namuriensis*.

39. CONKIN, J. E., 1956, "*Nodosinella* Brady, 1876, and associated Upper Palaeozoic genera" — a comment: Micropaleontology, v. 2, no. 2, p. 193.

Conkin briefly corrects Cummings' misinterpretation of his definition of *Hyperammmina* and *Hyperamminoides*.

40. CONKIN, J. E., 1957, Mississippian smaller Foraminifera of east-central United States (abstract): Geol. Soc. America, Bull., v. 68, no. 12, p. 1889.

The occurrence in the east-central United States of Mississippian smaller Foraminifera in beds thought to be unfossiliferous or to bear only megafossils is reported. Foraminifera were found in the Greenbrier

Limestone (Chesterian part) of West Virginia, the Chesterian Paint Creek and Kincaid limestones (shales) of western Kentucky, the Kinderhookian Bedford Shale of Ohio, and the Osagian Cuyahoga Formation of Ohio, and the New Providence Formation of Kentucky.

Ecologically, the Mississippian smaller Foraminifera, which were overwhelmingly agglutinated, were mostly confined to silty, calcareous to highly argillaceous shales and were unsuited for life in high-calcium carbonate waters; however, the *Endothyra-Plectogyra* suite flourished in high-calcium carbonate waters and occupied the shoal and reef environments which were later inhabited by miliolid Foraminifera of Early Cretaceous and early Tertiary age.

41. CONKIN, J. E., 1961, Mississippian Foraminifera of Kentucky, southern Indiana, northern Tennessee, and southcentral Ohio: *Bull. Am. Paleontology*, v. 43, no. 196, p. 129-368, pl. 17-27, 43 text-fig., 22 chart.

Mississippian collections made from 89 geographic localities in southern Indiana, Kentucky, northern Tennessee, and south-central Ohio have yielded a microfauna of 18 genera and 38 species, of which 18 species are new; most of the forms are agglutinated. The microfauna is monographically treated and is illustrated by both thin-section and whole specimen photomicrographs. The new forms are *Crithionina palaeozoica*, *Proteonina cumberlandiae*, *P. wallingfordensis*, *Hyperammina casteri*, *Earlandia consternatio*, *Reophax kunklerensis*, *R. mcdonaldi*, *Lituotuba semiplana*, *Tolypammina jacobschapelensis*, *T. laocoon* [both forms should probably be referred to *Serpulopsis*; see Henbest, 1960], *Ammobaculites gutschicki*, *Climacammina mississippiana*, *Agathammina mississippiana*, *Hemigordius morillensis*, *Trochammina ohioensis*, *Stacheia cicatrix*, *S. neopupoides*, and *S. trepeilopsisiformis*. One genus, *Thuramminoides*, is removed from the family Saccamminidae and placed in the family Astrorhizidae. Two generic revisions are included — *Hyperammina* and *Thuramminoides* — and a proposal is introduced to formalize the emendation of *Hyperammina* made by Conkin in 1954. *Thuramminoides teichertii* (Parr), Crespin, 1958, is placed under *T. spaeroidalis* Plummer, 1945. The genus *Lugzonina* Cummings, 1955, is placed under the genus *Reophax* owing to doubtful generic status.

A classification of the foraminiferal test wall microstructure based on and modified after Brady, 1876, Plummer, 1930, and Cummings, 1955, is presented and discussed, but it is never fully developed or exploited.

42. CUMMINGS, R. H., 1960, Recent advances in micropalaeontology: Liverpool and Manchester Geol. Jour., v. 2, pt. 3, p. 288-310, 3 text-fig.

Current opinions of the status of micropalaeontology are reviewed against its historical development in an attempt to form a realistic concept, and signifi-

cant developments in the paleontology of the various biological groups which lie within the scope of this technological activity are summarized for the postwar period.

One of the main features of foraminiferal research in the last ten years has been the awakening interest in Paleozoic forms and their use in stratigraphy. Largely prompted by the dictates of petroleum exploration, an exhaustive study of these forms is being made in the Soviet Union. Similar schemes are now being developed in Britain and in the United States.

43. CUSHMAN, J. A., 1930, A résumé of new genera of the Foraminifera erected since early 1928: *Contr. Cushman Lab. Foram. Research*, v. 6, pt. 4, p. 73-94, pl. 10-12.

This paper briefly discusses and illustrates 16 late Paleozoic foraminiferal genera described since Cushman's first edition of "Foraminifera, Their Classification and Economic Use." The genera discussed are *Hyperamminoides*, *Earlandia*, *Trepeilopsis*, *Endothyranella*, *Deckerella*, *Spandelina*, *Spandelinoides*, *Orthoverrella*, *Calcitornella*, *Calcivertella*, *Apterrinella*, *Plummerinella*, *Mooreinella*, *Polytaxis*, *Gyphostomella*, and *Tuberitina*.

44. DEMANET, F., 1949, Contribution a l'étude de la microfauna marine du Westphalien de la Campine: *Roy. Inst. Sci. Nat. Belgique, Bull.* 25, no. 37, p. 1-16, 2 pl., [in French].

From marine zones in the Coal Measures of Belgium, the genera *Endothyra* and *Agathammina* are briefly described and illustrated by whole-specimen photomicrographs.

45. DORLODOT, J. DE, and DELEPINE, G., 1930, Faune Marine du Terrain Houiller de la Belgique: *Mém. Inst. Geol. Univ. Louvain*, v. 6, pt. 1, 112 p., 10 pl., [in French].

Foraminifera assigned to the genus *Endothyra* are briefly described and illustrated from the rocks of the Belgian Coal Measures. [Edwards and Stubblefield (1948) report the fossiliferous horizon as a high Millstone Grit zone associated with *Gastrioceras* aff. *G. cumbriense* Bistat.]

46. DUBINSKY, A. Y., 1960, Lower Permian carbonaceous deposits of east Ciscaucasia: *Akad. Nauk S.S.S.R., Doklady*, v. 133, no. 6, p. 1400-1411, 1 text-fig., [in Russian].

This paper presents the first reported occurrence of definite Lower Permian (Sakmarian) strata in the Ciscaucasia Region of the Soviet Union. Age determinations based upon previously described species of *Nodosaria*.

47. DURIF, P., 1959, Observations micropaléontologiques (Foraminifères) sur le Carbonifère marin du bassin de Fort-Polignac (Sahara oriental): *Géol. Soc. France, Bull.*, 7th sér., v. 1, no. 2, p. 163-165, [in French].

The Carboniferous of the Ft. Polignac Basin (eastern Sahara) contains some strata (Tournaisian?-Visean) which are poor in foraminiferal material; with the deposition of *Collenia* banks there is an increase in the microfauna, particularly *Archaeodiscus* in the lower part (Namurian) and *Profusulinella* in the upper part (Muscovian).

48. DURKINA, A. V., 1959, Foraminifera of the Lower Carboniferous deposits of the Timan-Pechora Province: Microfauna of the S.S.S.R., Sbornik 10, Vses. Neft. Nauchno-Issledov. Geol.-Razved. Inst., Trudy, v. 136, p. 132-335, 27 pl., text-fig., [in Russian].

From the Lower Carboniferous rocks of the Timan-Pechora Province of the U.S.S.R., a microfauna of 85 species of smaller Foraminifera, of which 56 species and 4 varieties are new, is described and illustrated by thin-section photomicrographs. Many new fusulinids are also described. The new forms are *Glomospira vytychegda*, *Brunsia obtusa*, *B. parva*, *B. ezhwadorica*, *B.?* *attenta*, *Glomospiranella?* *opulenta*, *Septatournayella potensa*, *S. lacera*, *S. njumylga*, *Forschiella gigantea*, *Lituotubella glomospiroides* Rauser var. *solncevi*, *Quasiendothyra kobeitunsana* (Rauser) var. *delicata*, *Q. kamenkaensis*, *Q. petchorica*, *Q. conferta*, *Q. nibelis*, *Q.?* *rudis*, *Q. kedrovica*, *Chernyshinnella gelida*, *C. vica*, *C. curta*, *Endothyra sazonomi*, *E. turbida*, *E. absoluta*, *E. dentata*, *E. orbiculata*, *E. demini*, *E. mykivica*, *E. latispiralis* Lipina var. *lecta*, *E. agilis*, *E. komi*, *E. tuberiformis*, *E. decliva*, *E. advena*, *E. polita*, *E. silva*, *E. karasikae*, *E. longa*, *E. rigida*, *E. rauserae*, *E. omraensis*, *E. tantula*, *E. alviterna*, *E. resida*, *E. cara*, *E. timanica*, *E. perculiaria*, *E. angusta*, *E. uchtovenski*, *E. elegantula*, *E. arguta*, *E. crassa* Brady var. *substricta*, *Mikhailovella uchtovica*, *M. popleformis*, *Cribrostomum fortis*, *C. juditchevi*, *Climacammina ignobilis*, *Spiroplectammina albita*, *Tetartaxis acutus*, and *T. izhmica*.

49. DUSZYNSKA, S., 1958, Carboniferous Foraminifera from marginal beds in Upper Silesia: Polish Inst. Geol., Bull. 121, No. 3, p. 5-16, 5 text-fig., [Polish with Russian and English summaries].

From the Upper Carboniferous beds in the Upper Silesian Basin of Poland, a fauna of 3 previously described species is discussed and illustrated by line drawings. The fauna is rather monotonous, of simple construction and agglutinated, and is grouped under the Hyperamminidae and Ammodiscidae. This marks the first reported occurrence of Foraminifera in the Polish Coal Measures. The described forms are *Hyperammina compressa* Paalow, *Ammodiscus bradynus* (Spandel), and *Glomospira diversa* Cushman and Waters.

50. DUTRO, J. T., JR., and DOUGLASS, R. C., 1961, Pennsylvanian rocks in southeastern Alaska: U. S. Geol. Survey Prof. Paper 424-B, p. 239-241, 1 text-fig.

This paper lists a few species of previously described smaller Foraminifera and Fusulinidae from rocks near the head of Saginaw Bay, northern Kuiu Island, southeastern Alaska, which indicate a Middle Pennsylvanian age. Previously, these rocks had been thought to be of Late Mississippian age.

51. EDWARDS, W., and STUBBLEFIELD, C. J., 1948, Marine bands and other faunal marker-horizons in relation to the sedimentary cycles of the middle Coal Measures of Nottinghamshire and Derbyshire: Quart. Jour., Geol. Soc. London, v. 103, p. 209-260, pl. 13.

Three previously described genera from marine zones in the British middle Coal Measures are reported and illustrated with photomicrographs. The position of the marine phase generally, though not invariably, succeeds the coal. Described forms include *Agathammina*, *Anomonema*, and *Rectocornuspira*.

52. ELLIOTT, G. F., 1958, Fossil microproblematica from the Middle East: Micropaleontology, v. 4, no. 4, p. 419-428, pl. 1-3.

From the Permian of the Middle East, one new genus and species (*Pseudovermiporella sodalica*) of a problematical form thought to be an alga is fully described and illustrated by numerous excellent thin-section photomicrographs. [Later work (Henbest, 1960) indicates that this form should be placed under the cornuspirid Foraminifera.]

53. FLOWERS, R. R., 1956, A subsurface study of the Greenbrier Limestone in West Virginia: West Virginia Geol. and Econ. Survey, Rept. of Invest. No. 15, 17 p., 5 text-fig.

The first reported occurrence of *Climacammina?* sp. from the Mississippian System of North America is presented. It is identified by L. G. Henbest from the Greenbrier Limestone (top of the Reynolds Limestone) of West Virginia. [Conkin (1961, p. 327) also reports *Climacammina* along with *Tolypammina* spp. and dasycladacean algae in the pisolitic portions of the upper Greenbrier near White Sulphur Springs, West Virginia.]

54. FOMINA, E. V., 1958, The problem of the structure of the test wall of some Visean Foraminifera of the Moscow Basin: Voprosy Mikropaleontologii, Akad. Nauk S.S.S.R., Otdel. Geol.-Geograf. Nauk, Geol. Inst., no. 2, p. 121-123, 2 text-fig., [in Russian].

From the Lower Carboniferous rocks of the southwestern part of the Moscow Basin, numerous tests of *Quasiendothyra miranda* Rauser-Chernousova were isolated, and their wall structures were studied in great detail. The conclusion arrived at from this study is that since the form *Q. miranda* Rauser-Chernousova possesses a one-layered wall and shows either poor development or total absence of supplementary deposits, it is more closely allied to the genus *Loeblichia* Cummings, 1955, and is herewith assigned

to this genus. Whole-specimen drawings and thin-section photomicrographs are also included.

55. FOMINA, E. V., 1960, Correlation of upper and lower Tula foraminiferal complexes with various carbonate facies of the Tula horizon of the Moscow Basin: Voprosy Mikropaleontologii, Akad. Nauk S.S.S.R., Otdel. Geol.-Geograf. Nauk, Geol. Inst., no. 3, p. 72-82, 2 pl., [in Russian].

From the Lower Carboniferous foraminiferal complex of the Moscow Basin, a fauna of 7 species, of which 3 species and 1 variety are new, is described and illustrated by line drawings and thin-section photomicrographs. The new forms are *Rectocornuspira submosquensis*, *Tolypammmina incertae* [probably should be referred to *Serpulopsis*; see Henbest, 1960], *Lugtonia concinna* (Brady) var. *minima*, and *Moravammmina carbonica*.

56. FURSENKO, A. V., 1958, The chief stages in foraminiferal evolution, the geologic past: Akad. Nauk Belorussia S.S.R., Inst. Geol. Nauk, no. 1, Minsk, p. 10-29, [in Russian].

The author presents a very general résumé of foraminiferal evolution in the U.S.S.R. from Ordovician to Quaternary time. [See Rauser-Chernousova and Reitlinger (1957) for a more thorough treatment of the evolution of Paleozoic Foraminifera.]

57. GLOWACKI, E., JURKIEWICZ, N., and KARNKOWSKI, P., 1958, Occurrence of the Carboniferous in the borehole at Bratkowice: Przegląd Geologiczny, Warsaw, v. 6, no. 10, p. 437-442, 1 pl., 8 text-fig., [in Polish].

From a borehole which penetrated the Lower Carboniferous rocks in southeastern Poland, a fauna of 19 previously described species, of which 6 are fusulinids, is briefly described and illustrated by thin-section photomicrographs. The fauna consists primarily of endothyrids, quasiendothyrids, ammodiscids, and primitive fusulinids.

58. GOLUBTZOV, V. K., 1957, Stratigraphy and Foraminifera of the Visean Series of the Pripyat Arch: Akad. Nauk Belorussia S.S.R., Inst. Geol. Nauk, No. 2, Minsk, p. 41-191, 9 pl., [in Russian].

From rocks of the Lower Carboniferous Visean Stage of the Pripyat Arch in White Russia a fauna of 82 species, of which 9 species, 10 varieties, and 1 name are new, is described and illustrated by rather poor thin-section photomicrographs. The new forms are *Hyperammmina elegans* Rauser and Reitlinger var. *brazhnikovae* nom. n., *Archaelagena rauserae*, *Tuberitina grandis*, *T. porifera*, *T. rotunda*, *Ammodiscus diadema* Brazhnikova var. *irregularis*, *Bradyina rotula* (Eichwald) var. *minima*, *Palaeotextularia conobrinaeformis*, *Tetrataxis eominima* Rauser var. *lata*, *T. quasiconica* Brazhnikova var. *plana*, *T. submedia* Brazhnikova var. *quasidentata*, *T. pusillus*, *Monotaxis gibba* (Moeller) var. *turris* [genus *Monotaxis* regarded as a synonym of *Howchinia*; see Reitlinger, 1954],

*Archaediscus krestovnikovi* Rauser var. *multicava*, *A. granum*, *A. perlucidus* var. *maxima*, *A. spirillinoides* Rauser var. *faceta*, and *A. spirillinoides* Rauser var. *grandis*.

59. GROZDILOVA, L. P., and LEBEDVA, N. S., 1954, Foraminifera of the Lower Carboniferous and Bashkirian Stage of the Middle Carboniferous of the Kolva-Visherka Area: Microfauna of the S.S.S.R., Sbornik 7, vses. Neft. Nauchno-Issledov. Geol.-Razved. Inst., Trudy, v. 81, 203 p., 15 pl., [in Russian].

From the Lower and Middle Carboniferous rocks of the Kolva-Visherka area of east-central European Russia, a fauna of 109 species of smaller Foraminifera, of which 1 family, 30 species, and 1 variety are new, is described and illustrated by thin-section photomicrographs. The new forms are *Parathurammmina stellaeformis*, *Tournayella discoidea* Dain var. *uralica*, *Glomospiranella lipinae*, *G. finitima*, *Forschiidae* n. fam., *Haplophragmella sussaiensis*, *Archaediscus maximus*, *A. varsanofievae*, *A. akchimensis*, *A. ninae*, *A. pustulus*, *A. incertus*, *A. monstratus*, *Permodiscus uniensis*, *Tetrataxis immatura*, *T. digna*, *Valvulinella tchotchchii*, *V. pozhiensis*, *V. lata*, *Spiroplectammmina ? nana*, *S. ? gloriosa*, *Endothyra oldae*, *E. paucicamerata*, *E. kosvensis*, *E. paraukrainica*, *E. costifera*, *E. paracostifera*, *E. latispiralis*, *E. magna*, *E. antoninae*, *E. arcuata*, and *E. inconstans*. Numerous species of Fusulinidae are also described.

60. GROZDOLOVA, L. P., and LEBEDVA, N. S., 1960, Foraminifera from the Carboniferous deposits of the western slope of the Urals and Timan: Trudy Vses. Neft. Nauchno-Issledov. Geol. Razved. Inst. (VNIGRI), no. 150, 264 p., 33 pl., 47 text-fig., [in Russian].

A foraminiferal fauna of 67 species, of which 4 species are new, is described from the Carboniferous rocks of the western slope of the Urals and Timan, U.S.S.R. Many fusulinids are also described. The fauna is illustrated by thin-section photomicrographs of all the described species and by line drawings of all of the genera. In essence, this is an atlas of the most characteristic Carboniferous foraminiferal species from this region. Range charts are also included. The new species are *Archaelagena petchorica*, *Mstinia zigagnensis*, *Tetrataxis barkhatovae*, and *T. volongaensis*.

61. GUTSCHICK, R. C., 1960, Photography of Paleozoic arenaceous Foraminifera: Jour. Paleontology, v. 34, no. 4, p. 756-762, 2 text-fig.

A method employed in photographing Paleozoic agglutinated Foraminifera is briefly discussed. It is relatively simple and has yielded very satisfactory results, which the author hopes will encourage greater use of photographic reproduction for illustrating Paleozoic agglutinated Foraminifera.

62. GUTSCHICK, R. C., 1960, Early Mississippian (lower Carboniferous-Tournaisian) micropaleon-

tology in the United States: Int. Geol. Congress, 21st Session, Norden, 1960, Pt. 6, Pre-Quaternary Micropaleontology, p. 114-134, 2 text-fig.

Gutschick gives a comprehensive documented survey of the status of micropaleontology of Early Mississippian rocks in the United States. The study reveals the potential value of micropaleontology in rocks of Early Mississippian age and points to the lack of documentation of recognized faunas for correlation, phylogenetic, and environmental studies.

63. GUTSCHICK, R. C., 1960, Early Mississippian Foraminifera of the United States (abstract): Program 1960 Annual Meeting Geol. Soc. America, Denver, Colorado, p. 108-109.

The writer presents a brief résumé of the occurrence of Early Mississippian agglutinated and calcareous Foraminifera in the Kinderhookian-Osagian rocks in the United States. He concludes that the close relationship that exists between foraminiferal faunas and associated lithologies reflects environmental control. Environmental studies indicate that Early Mississippian Foraminifera are associated with shoal algal banks, the shoal open-marine edge of barrier banks, cool shallow aerated waters of the open-marine shelf, and the transitional basin-edge environment beyond the open marine shelf extending into the basin.

64. GUTSCHICK, R. C., and TRECKMAN, J., 1957, Arenaceous Foraminifera from the Rockford Limestone of northern Indiana (abstract): Geol. Soc. America, Bull., v. 68, no. 12, p. 1892.

Preliminary note reporting the occurrence of large numbers of agglutinated Foraminifera derived from dilute acid-insoluble residues of the Kinderhookian Rockford Limestone at two localities in northern Indiana [see Gutschick and Treckman, 1959, for a complete description of this microfauna].

65. GUTSCHICK, R. C., and TRECKMAN, J. F., 1959, Arenaceous Foraminifera from the Rockford Limestone of northern Indiana: Jour. Paleontology, v. 33, no. 2, p. 229-250, pl. 33-37, 3 text-fig.

From insoluble residues of the Lower Mississippian (Kinderhook) Rockford Limestone of northern Indiana, an agglutinated fauna of 33 species, of which 22 are new, is described and illustrated by excellent whole-specimen photomicrographs. This marks the first systematic study of Lower Mississippian agglutinated Foraminifera from North America. New forms are *Pseudastrorhiza delicata* [Blumenstengel (1961, p. 319) now places this form under *Thurammina delicata* (Gutschick and Treckman)], *Sorosphaera papilla*, *Thurammina furcata*, *T. triradiata*, *Hyperammina compacta*, *H. constricta*, *H. gracilentata*, *H. nitida*, *H. rockfordensis*, *Reophax buccina*, *R. lachrymosa*, *Involutina longexsertus* [now placed under the genus *Ammodiscus*; see Loeblich and Tappan, 1961], *Tolypammina botonumcus*, *T. cyclops*, *T. rotula* [probably should be referred to *Serpulopsis*; see Henbest, 1960], *Ammover-*

*tella bulbosa*, *Trepeilopsis glomospiroides*, *T. prodigalis*, *T. recurvidens*, *T. spiralis*, *Ammobaculites leptos*, and *A. pyriformis*.

66. GUTSCHICK, R. C., WEINER, J. L., and YOUNG, L., 1961, Lower Mississippian arenaceous Foraminifera from Oklahoma, Texas, and Montana: Jour. Paleontology, v. 35, no. 6, p. 1193-1221, pl. 147-150, 5 text-fig.

Early Mississippian agglutinated Foraminifera from the Welden Limestone of Oklahoma, the Chappel Limestone of central Texas, and the Lodgepole Limestone of southwestern Montana are compared with a previously described fauna from the Rockford Limestone of northern Indiana. Eleven genera and 33 species, of which 12 are new, are described and illustrated by both excellent line drawings and whole-specimen photomicrographs. The fauna has been derived from dilute acid-insoluble residues.

A summary is given of species in Early Mississippian strata in the United States (total of 16 genera and 49 species).

The new forms are *Pseudastrorhiza baccula*, *P. conica*, *P. digitata*, *P. lanceola*, *Saccammina ligula*, *Thurammina arenacorna*, *T. congesta*, *T. pustulosa*, *Hyperammina conica*, *Reophax calathus*, *Tolypammina sperma* [probably should be referred to *Serpulopsis*; see Henbest, 1960], and *Ammobaculites chappelensis*.

The following taxonomic changes are included: *Thuramminoides?* sp. Gutschick and Treckman, 1959, is now placed under *Pseudastrorhiza conica*, and *Ammobaculites?* sp. Gutschick and Treckman, 1959, is now placed under *Ammobaculites chappelensis*.

67. HANZAWA, S., 1961, Facies and micro-organisms of the Paleozoic, Mesozoic and Cenozoic sediments of Japan and her adjacent islands: Inter. Sed. Petrography Ser., v. 5, text 117 p., [plates containing late Paleozoic, smaller Foraminifera: 8-72], map stratigraphic columns.

Numerous plates illustrate and briefly describe late Paleozoic Foraminifera found in rocks from Japan and the surrounding island groups.

68. HENBEST, L. G., 1960, Reclassification, living habits, and shell mineralogy of certain late Paleozoic sedentary Foraminifera (abstract): Annual Meeting A.A.P.G.-S.E.P.M., Atlantic City, New Jersey, April 25-28, Program p. 82.

The confusion that has arisen from classifying late Paleozoic sedentary Foraminifera on the basis of shell composition is briefly discussed. Several lines of evidence are offered to show that the magnesium content of calcium carbonate in foraminifer shells is primarily related to the role of symbiosis with chlorophyll-bearing algae in the internal economy of the animal.

*Serpulopsis* Girty, 1911, originally described as a tubicolid worm and long overlooked as a foraminifer, probably includes most Paleozoic species identified as

*Tolypammina* Rhumbler, 1895, and some species identified as *Ammovertella* Cushman, 1928. *Pseudovermiporella* Elliot, 1958, originally classed as an alga, is shown to be a cornuspirid foraminifer. *Osagia* and *Otonosia* Twenhofel, 1919, are emended to clarify the nomenclatorial status of the Cornuspirinae. *Apterrinella* Cushman and Waters, 1928, is redescribed and subdivided.

69. HENBEST, L. G., 1960, Paleontologic significance of shell composition and diagenesis of certain late Paleozoic sedentary Foraminifera: U. S. Geol. Survey Prof. Paper 400-B, p. 386-387.

This paper is a short summary of petrologic criteria to aid in distinguishing agglutinated tubiform Foraminifera from the secreted forms in which the shell material has been recrystallized.

70. IRELAND, H. A., 1960, Emendations to Upper Pennsylvanian arenaceous Foraminifera from Kansas: Jour. Paleontology, v. 34, no. 6, p. 1217-1218.

The following emendations to Ireland's 1956 paper on Upper Pennsylvanian agglutinated Foraminifera from Kansas are made: *Bigenerina elongata* Ireland, 1956, is a species preoccupied by *B. elongata* Gauger, 1953; *B. perkinsi* Ireland is the new name to be applied to this species. *Saccamminoides* Ireland, 1956, is a generic name preoccupied by *Saccamminoides* Geroch, 1955. The new generic name, *Saccamminis*, is proposed and the type species should be referred to *Saccamminis multicella* (Ireland). Additional corrections to be incorporated in the range chart also are included.

71. KASHIRTSEV, A. S., 1959, Field atlas of the Permian fauna of the northeastern part of the U.S.S.R.: Leningrad Acad. Sci., 85 p., 44 pl., [in Russian].

This paper mainly describes the Permian megafauna from this portion of the Soviet Union. Ten previously described Foraminifera, representing the genera *Nodosaria*, *Rectoglandulina*, and *Frondicularia*, are illustrated with thin-section photomicrographs and are briefly diagnosed.

72. KONISHI, K., 1952, Permian microfossils in the Dodo Conglomerate of the Yasuba-type: Trans. Proc. Palaeont. Soc. Japan, n. s., no. 5, p. 155-165, pl. 14.

The Dodo Conglomerate in Okayama Prefecture, Japan, has yielded Permian algae and Fusulinidae along with a few previously described smaller Foraminifera. The smaller Foraminifera are not illustrated or systematically described but are listed. These include *Pachyphloia multiseptata* Lange, *P. sp.*, *Glomospira* spp., and "*Nodosaria radiculara* (Linné)." The writer concludes that the assemblage is of Permian age and probably corresponds to the age of Thompson's "Zone of Yabeina."

73. KREMP, G., and JOHST, W., 1952, Einige Mikrofossilien des Oberkarbons und Verfahren zur Ge-

winnung von Schliffen solcher oft sehr harten Objekte: Geol. Jahrb. f. 1950, v. 66, p. 151-161, 3 pl., [in German].

This paper deals mainly with microfossil preparation methods. Both whole-specimen and thin-section photomicrographs of a number of late Paleozoic Foraminifera are used as illustrative material.

74. LEBEDEVA, N. A., 1954, Lower Carboniferous Foraminifera of the Kuznetsk Basin: Microfauna of the S.S.S.R., Sbornik 7, Vses. Neft. Nauchno-Issledov. Geol.-Razved. Inst., Trudy, v. 81, p. 237-295, 12 pl., [in Russian].

From the Lower Carboniferous rocks of the Kuznetsk Basin in the south-central Asiatic portion of the U.S.S.R., a microfauna of 46 species, of which 27 species and 3 varieties are new, is described and illustrated by thin-section photomicrographs. The new forms are *Tournayella pigmea*, *Septatournayella pseudocamerata*, *S. recta*, *Spiroplectammina* (?) *sibirica*, *S. (?) nana*, *Endothyra* (?) *delecta*, *E. paraukrainica*, *E. paucicamerata*, *E. latispiralis*, *E. kosvensis*, *E. tenuiseptata*, *E. inflata*, *E. perfida* var. *creba*, *E. (?) evoluta*, *E. arcuata* Grozdilova and Lebedeva var. *evoluta* [name preoccupied; see Thalmann, 1959], *E. tomiliensis*, *E. nevskiensis*, *E. (?) mediocriformis*, *E. rotayi*, *E. barzassiensis*, *Quasiendothyra arta*, *Q. grata*, *Q. grozdilovae*, *Q. diserta*, and *Q. parachomatica*. One taxonomic change is also included: *Brunsiina krainica* Dain, 1951 = *Endothyra* (?) *krainica* Lipina, 1948.

75. LIBROVITCH, L., (ED.), 1941, The atlas of the guide forms of the fossil faunas of the U.S.S.R.: Committee For Geol. at the Sovnarkom of the U.S.S.R., v. 4, Lower Carboniferous, p. 44-50, pl. 1, text-fig. 1-4, [in Russian].

The fossils and faunas of the U.S.S.R. are briefly described and illustrated with thin-section and whole-specimen photomicrographs of previously described Lower Carboniferous Foraminifera from different parts of the Soviet Union.

76. LIPINA, O. A., 1959, Some data on the ontogeny of the Tournayellidae (Foraminifera): Géol. Soc. France, Bull., 7 sér., v. 1, no. 7, p. 649-650, 2 text-fig., [in French].

Lipina briefly discusses the ontogeny of this family of Lower Carboniferous Foraminifera and claims that the development of the Tournayellidae takes place via superposition of stages, with the appearance of new characteristics during the development of the individual. Almost all the genera of the Tournayellidae pass successively through the ammodiscid stage (a tube without septation) and the tournayellid stage (with constrictions of the wall). In the last whorls of the representatives of some genera, a certain interruption of the wall growth is visible, each new segment of this wall beginning to grow not at the edge of the preceding segment but a little behind it (*Septatournayella* stage). False septa then develop.

77. LIPINA, O. A., 1960, Stratigraphy of the Tournaisian Stage and the Devonian and Carboniferous boundary beds of the eastern part of the Russian Platform and western slopes of the Urals: Akad. Nauk, S.S.S.R. Trudy, Geol. Inst., no. 14, 128 p., 2 pl., 15 text-fig., [in Russian].

From the Lower Carboniferous rocks of the Russian Platform and western slopes of the Urals, a microfauna of 9 species, of which 5 species and 1 variety are new, is described and illustrated by thin-section photomicrographs. The new forms are *Plectogyra chernyshinelliformis*, *P. antiqua* (Raus.) var. *concavacamerala*, *P. brevivoluta*, *P. volgensis*, *P. pi'uginensis*, and *Ammobaculites? multicameratus*.

78. LIPINA, O. A., 1960, Beds at the Devonian-Carboniferous boundary and lower Tournaisian formations of the middle Urals (Vilva, Kosva, and Levikha Rivers): Akad. Nauk S.S.S.R., Doklady, v. 133, no. 5, p. 1161-1164, [in Russian].

The microfaunal sequence from the Fammenian to the Tournaisian stages of the middle Urals of the Soviet Union is discussed; these sections are compared and contrasted with those of the southern Urals. Stratigraphy is mainly based upon previously described foraminiferal species.

79. LOEBLICH, A. R., JR., and TAPPAN, H., 1961, The status of the foraminiferal genera *Ammodiscus* Reuss, and *Involutina* Terquem: Micropaleontology, v. 7, no. 2, p. 189-192.

The status of the genera *Ammodiscus* Reuss, 1862, and *Involutina* Terquem, 1862, is discussed on the basis of their revision by Bornemann, 1874, and Loeblich and Tappan, 1954. *Ammodiscus* Reuss is retained for agglutinated planispiral evolute species, similar to the type species *Ammodiscus infimus* Bornemann, 1874, (not Strickland, 1846) = *Ammodiscus siliceus* (Terquem), 1862. *Involutina* Terquem is restricted to those planispiral calcareous species, with lateral umbilical filling, similar to the type species *Involutina jonesi* Terquem and Piette (1862) = *Involutina liasina* (Jones), 1853.

80. LUDBROOK, N. H., 1957, Some Permian Foraminifera in South Australia: Australian Jour. Sci., v. 19, no. 4, p. 161-162.

A fauna of 9 previously described species, principally agglutinated, is reported from a Permian bore in South Australia. The Foraminifera provide positive evidence of the Permian age of the glacial deposits on Yorke Peninsula. It is suggested that deposition took place under low-temperature conditions in a deltaic environment. [This marks the first reported occurrence of Permian Foraminifera from South Australia; see Crespin (1958) for a more complete treatment of the Australian faunal sequence.]

81. MALAKHOVA, N. P., 1959, The Tournaisian Stage of the northern and central Urals: Akad. Nauk

S.S.S.R., Trudy, Bull. 38, 104 p., 14 pl., [in Russian].

From the Lower Carboniferous Tournaisian Stage rocks of the northern and central Ural Mountains, U.S.S.R., a microfauna of 22 foraminiferal species, of which 5 are new, is described and illustrated by rather poor thin-section photomicrographs. The new forms are *Archaeosphaera gigantea*, *Hyperammima? flexuosa*, *H. lingulata*, *Endothyra radiosa*, and *E. lytvensis*.

82. MALAKHOVA, N. P., 1959, E. J. Zeller's paper "Mississippian endothyoid Foraminifera from the Cordilleran geosyncline:" Akad. Nauk S.S.S.R., Izvest. Geol. Ser. No. 9, pp. 92-95, [in English translation by Amer. Geol. Inst., Feb., 1961].

A critical review is presented of Zeller's (1957) paper on the endothyroids of the Cordilleran geosyncline. The reviewer claims that she cannot agree with the assigning of one species to Zeller's form *Plectogyra tumula*. Unquestionably this form includes representatives not only of different species but also of different genera. Certain forms are very much like *Cheryshinella*, and others closely resemble the genus *Tournayella*. Furthermore, she believes that Zeller's form *Granuliferella granulosa* has been assigned forms differing from each other in the form of their test, the structure of coiling, and the wall structure. She also claims that Zeller does not list other smaller Foraminifera accompanying the endothyroids and that it is not clear whether such an omission is due to the absence of these Foraminifera or to their inadequate study. She believes that familiarity with Soviet monographs on Lower Carboniferous Foraminifera described from various parts of the Soviet Union could have provided Zeller with a better understanding of typical features of his foraminiferal assemblages.

A very generalized correlation chart for the Lower Carboniferous of the U.S.S.R. and the U.S.A., based on endothyroid Foraminifera, is also presented. She concludes that the similarity in morphologic features and the general character of evolution of the entire endothyroid fauna and its individual representatives allows a more certain correlation of Lower Carboniferous sections from these two distant provinces.

83. MANUKALOVA-GREBENYUK, M. F., 1959, Stratigraphic differentiation of the Donbas Lower Carboniferous, by microfauna: Akad. Nauk S.S.S.R., Izvest. Geol. Ser. No. 1, January, p. 91-93, [English Translation published by the American Geological Institute].

This paper presents a stratigraphic subdivision of the Lower Carboniferous of the Donbas, U.S.S.R., into 32 local members based upon previously described foraminiferal species.

84. MIKLUKHO-MAKLAI, A. D., 1947, New data on the foraminiferal fauna from the Permian deposits of the Caucasus: Akad. Nauk S.S.S.R., Doklady, v. 58, no. 2, p. 269-271, [in Russian].

This paper deals primarily with Permian stratigraphy of the Caucasus on the basis of previously described foraminiferal material. [For a more complete treatment of this area, see Miklukho-Maklai, 1954].

85. MIKLUKHO-MAKLAI, A. D., 1958, The phylogeny and stratigraphic significance of Paleozoic Lagenidae: Akad. Nauk S.S.S.R., Doklady, v. 122, no. 3, p. 481-484, 1 text-fig., [in Russian].

The phylogenetic development of the Paleozoic Lagenidae from Ordovician through Permian time from the Siberian faunal region is briefly outlined. The author also briefly discusses their stratigraphic implications. One phylogenetic diagram is included.

86. MIKLUKHO-MAKLAI, A. D., 1958, A new family of Foraminifera-Tuberitinae M. Maclay Fam. Nov.: Voprosy Mikropaleontologii, Akad. Nauk S.S.S.R., Otdel. Geol.-Geograf. Nauk, Geol. Inst., No. 2, p. 130-135 1 text-fig., [in Russian].

The morphology and the phylogeny of the new family Tuberitinae are discussed. Under this family the following genera are included: *Eotuberitina* n. gen., *Tuberitina* Galloway and Harlton, 1928, *Capidulina* Maslov, 1935, and *Neotuberitina* n. gen. Ecologically, the tuberitinae were not indifferent to temperature conditions, although they probably endured considerable fluctuations in the salinity of marine waters. The following taxonomic modifications are included: *Tuberitina maljavkini* Reitlinger, 1950 = *Eotuberitina reitlingerae*, new name; the type species of the new genus *Neotuberitina* is *Tuberitina maljavkini* Mikhailov, 1939.

87. MIKLUKHO-MAKLAI, A. D., and RUSAKOV, I. M., 1958, An assemblage of Foraminifera from the Paleozoic rocks of the Koryak Range: Proc. Acad. Sci. U.S.S.R., Geol. Sci. Sect., v. 118, p. 151-153, issues 1-6 in English translation.

This paper deals primarily with the stratigraphy of the Koryak Range in far-eastern Asiatic Russia, whose oldest rocks were considered to be of Cretaceous age. New data, based upon previously described foraminiferal material, indicate that the range contains rock formations ranging in age from Visean (Early Carboniferous) through the Artinskian-Kungurian (Late Permian).

89. OKIMURA, Y., 1958, Biostratigraphical and paleontological studies on the endothyroid Foraminifera from the Atetsu Limestone Plateau, Okayama Prefecture, Japan: Jour. Sci. Hiroshima Univ., ser. C, v. 2, no. 3, p. 235-264, pl. 32-36.

From the Lower Carboniferous, the first-reported endothyroid foraminiferal fauna from Japan is described and illustrated by thin-section photomicrographs. Eleven species are recorded, of which 1 genus and 4 species are new. The new forms are *Paraplectogya masanae*, n. gen., *P. longiseptata*, *P. gigantea*, and *Granuliferella pauciseptata*. Five faunal zones are

recognized and are correlated with the endothyroid zones of the North American Cordilleran region, as recognized by Zeller (1957). [See St. Jean, 1957, for pertinent comments as to the validity of the genus *Plectogya*.]

89. ORLOVA, I. N., 1958, Foraminifera of the Carboniferous horizons of the region of the Saratogan disturbances: Akad. Nauk S.S.S.R., Problems in Micropaleontology no. 2, p. 124-129, pl. 1, 5 text-fig., [in Russian].

From the Carboniferous rocks of Russia, in the mountain ranges where the Saratogan disturbance is well shown, a fauna of 4 species, of which 3 species are new, is described and illustrated by thin-section photomicrographs and whole-specimen drawings. The new forms are *Hemidiscus contractus*, *Quasiendothyra vera*, and *Endothyra altilis*.

90. PASTIELS, A., 1956, Contribution a l'étude des Foraminifères du Namurien et du Westphalien de la Belgique: Pub. Assoc. Étud. Paléon. Strat. Houill., No. 27, 32 p., 3 pl., [in French].

From a study of the Foraminifera found in the Namurian and Westphalian rocks of Belgium, the author relates certain paleoecologic observations regarding the cyclic distribution of these forms. In the Belgian sequence agglutinated forms such as *Thuramina*, *Hyperammia*, *Ammidiscus*, *Trochammia* and *Glomospirella* are found in those positions within the cyclothem that either precede or succeed a fresh-water period. The calcareous forms *Endothyra* and *Agathammina* are associated with the more definite marine element of the cyclothem. Whole-specimen photomicrographs and a schematic chart illustrating the successions of the component parts of thanatocoenoses in the regression phase of sedimentation, with relative positions of the Foraminifera, are also given.

91. PIERCE, G. R., et al., 1961, Fossiliferous Paleozoic localities in Mérida Andes, Venezuela: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 3, p. 342-375, 17 text-fig.

Late Paleozoic Foraminifera are reported from the Palmarito Formation from the Mérida Andes of western Venezuela. The forms *Geinitzina postcarbonica* Spandel, *Spandelina excavata* Cushman and Waters, and *Cribrogenerina* sp. would tend to suggest either a Late Pennsylvanian or Early Permian age for this formation. The writers also report *Hemigordius* sp. and *Trochammia* sp. from this formation.

92. POTIEVSKA, P. A., 1958, Foraminifera of the upper Bashkir deposits of the western part of the Donets Basin: Akad. Nauk R.S.R., Trudy, Inst. Geol. Ser. Strat. and Paleont. No. 31, 73 p., 7 pl., [in Russian].

From the upper Bashkir deposits of the western part of the Donets Basin, U.S.S.R., a fauna of 19 species of smaller Foraminifera, of which 8 species and 6 varieties are new, is described and illustrated by

thin-section photomicrographs. Twenty species of fusulinids, of which 5 are new, are also described. The new forms include *Ammodiscus compactus* Brazhnikova and Potievskaya var. *maxima*, *A. curvus*, *A. diadema* Brazhnikova var. *umbonata*. *Endothyra bradyi* Mikhailov var. *eminens*, *E. devexa* Rauser var. *parva*, *E. donetziana*, *Bradyina nana*, *Tetrataxis lata* [this species is a synonym; see Spandel, 1901], *T. acutiformis*, *Archaediscus longus*, *A. postmoelleri*, *A. reliquus*, *A. angulatus* Sosnina var. *compacta*, and *A. rectus* Kireeva var. *pressus*.

93. POTIEVSKA, P. D., and IARTSEVA, M. V., 1958, The nature of the rocks in the Bashkirian Series in the western extension of the Donets Basin, according to Foraminifera: Akad. Nauk S.S.S.R., Doklady, v. 120, Geol., in English Translation, p. 469-472.

A discussion of a layer-by-layer study of the Foraminifera (all previously described species) in the Bashkirian deposits confirms the presence of an incomplete section of the Bashkirian Series in the western extension of the Donets Basin. This section does not have certain correlatives present in the Donets Basin, and there is a marked thinning of this series from 6000 feet in the Donets Basin to 1050 feet in the region of Petrikovka.

94. PRINGLE, J., 1948, British Regional Geology: The South of Scotland; Dept. of Scientific and Industrial Research, Geol. Survey and Mus., 2nd ed., 87 p., 7 pl., 14 text-fig.

From rocks of the Lower Carboniferous limestone series in the south of Scotland (in the area traversed by the Esk and Liddel), the foraminifer *Saccamminopsis fusulinaformis* [sic] is reported. In the area south of Dunbar the middle Skateraw Limestone of the Lower Carboniferous limestone series is crowded with *Saccamminopsis* (*Saccammina*) *fusulinaformis* [sic]. From the same area but stratigraphically higher, the sandy Chapel Point Limestone contains small lenticles of chert with *Saccamminopsis fusulinaformis* [sic] and *Endothyra*; see Chapman, 1898, and Sollas, 1921.

95. RAUSER-CERNOUSOVA, D. M., 1953, The experience and form of the collective work in the field of investigation on the upper Paleozoic Foraminifera: Paleontological Data of the Committee for the Paleozoic, Akad. Nauk S.S.S.R., Paleont. Inst. and Inst. Geol. Nauk, p. 71-80, text-fig. 30-32, [in Russian].

This paper briefly discusses the procedure and goal of work on the upper Paleozoic Foraminifera in the U.S.S.R. One new species, *Glyphostomella insignis* [St. Jean, 1957, p. 34 considers the genus *Glyphostomella* a synonym of *Bradyina*], is formally described and illustrated by whole-specimen photomicrographs and line drawings of the test interior.

96. RAUSER-CERNOUSOVA, D. M., and REITLINGER, E. A., 1954, Biostratigraphic distribution of the

Foraminifera of the Middle Carboniferous beds of the southern limb of the Moscow Geosyncline: Akad. Nauk S.S.S.R., Regional Strat. of the U.S.S.R., v. 2, p. 7-120, 21 pl., [in Russian].

From the Middle Carboniferous rocks of the Moscow geosyncline, 8 species of smaller Foraminifera, of which 6 species and 1 variety are new, are briefly noted in the text and illustrated by thin-section photomicrographs. The new forms are *Tolypammina elegans*, *T. agrestis* [probably should be referred under *Serpulopsis*; see Henbest, 1960], *Ammovertella? plana*, *Textularia znensis*, *Textularia vulgaris* var. *grandis*, *Climacammina postprocera*, and *Nodosinella gigas*.

97. RAUSER-CERNOUSOVA, D. M., and REITLINGER, E. A., 1957, Development of Foraminifera during the Paleozoic and their stratigraphical importance: Akad. Nauk S.S.S.R., Izvest., Geol., Ser. No. 11, p. 103-124, 3 text-fig., [in Russian].

This lucidly written concise essay pertaining to the phylogeny of Paleozoic Foraminifera is based upon a complete survey of the world literature. Three excellent phylogenetic diagrams are also included.

98. REITLINGER, E. A., 1956, Le développement phylogénétique des Foraminifères comme base de la biostratigraphie du Carbonifère Inférieur (abstract): 20th. Int. Geol. Congress, Mexico City, Resúmenes de los Trabajos Presentados, p. 184, [in French].

A short résumé is presented of the phylogenetic development of the Lower Carboniferous smaller Foraminifera of the Soviet Union on the basis of biostratigraphy.

99. REITLINGER, E. A., 1958, The problem of the systematization and phylogeny of the superfamily Endothyridea: Voprosy Mikropaleontologii, Akad. Nauk S.S.S.R., Otdel. Geol.-Geograf. Nauk, Geol. Inst., no. 2, p. 53-73, 4 text-fig., [in Russian].

The phylogeny of the superfamily Endothyridea, which is herein interpreted to include two families — the Endothyridae and the Bradyinidae — is lucidly discussed. The article is mainly based on material dealing with the development of the Endothyridae in the Lower and Middle Carboniferous rocks of the Russian Platform. An excellent phylogenetic diagram is also included.

100. REITLINGER, E. A., and BALASHOVA, N. N., 1954, Stratigraphy of the Middle Carboniferous beds of the Volga Valley: Akad. Nauk S.S.S.R., Regional Strat. of the U.S.S.R., v. 2, p. 121-200, 15 pl., [in Russian].

From the Middle Carboniferous rocks of the Volga Valley of Russia, a fauna of 8 species, of which 4 species and 1 variety are new, is noted briefly in the text and is illustrated by thin-section photomicrographs. The new forms are *Glomospirella parva*, *Glomospira mutabilis*, *G. tolpinensis*, *Brunsiella densa* Reitlinger var. *angulata*, and *Climacammina eomoelleri*.

101. REYNOLDS, M. A., 1956, The identification of the boundary between coal measures and marine beds, Singleton-Muswellbrook district, New South Wales: Commonwealth of Australia, Dept. Nat. Dev., Bur. Mine Res., Geol. and Geophys., 35 p., 4 text-fig., 2 tables.

Thirty previously described species of Foraminifera (11 calcareous, 19 agglutinated) have been recognized in the Permian "Upper Marine Series" of New South Wales, Australia. The upper units are transitional and represent the final stage of marine deposition and the early stages of fresh-water deposition (Mulbring Stage). The change is readily identified by the presence or absence of *Ammodiscus multinctus*. Calcareous Foraminifera, mainly species of *Nodosaria* and *Frondicularia*, and Ostracoda previously thought to be restricted to the Branxton Stage have been found in the upper beds of the Mulbring Stage in the Singleton-Muswellbrook district.

The postulated depositional environment for the upper part of the "Upper Marine Series" was one of cold, shallow-water conditions. There appears to have been little movement of the water, and the environment was either neutral or alkaline.

102. SAID, R., and ANDRAWIS, S. F., 1961, Lower Carboniferous microfossils from the subsurface rocks of the western desert of Egypt: Contr. Cushman Found. Foram. Research, v. 12, pt. 1, p. 22-25, 10 text-fig.

A core from an exploratory well in the northern Western Desert of Egypt has yielded a fauna of 12 previously described foraminiferal species. Representative specimens are illustrated by line drawings. The age of the fauna is thought to be Visean. This is the first reported occurrence of authenticated late Paleozoic Foraminifera from this region. The fauna includes *Earlandia pulchra* Cummings, *Earlandinella* cf. *E. cylindrica* (Brady), *Nodosinella* sp., *Glomospira simplex* Harlton, *Ammobaculites* sp., *Palaeotextularia davisella* Cummings, *Bigenerina?* sp., *Climacammina ferra* Cummings, *Tetrataxis conica* Ehrenberg, *Valvulinella youngi* (Brady), *Endothyranopsis crassa* (Brady), and *Ramulina* cf. *R. ornata* Cushman.

103. SHLYKOVA, T. I., 1951, Foraminifera of the Visean and Namurian stages of the Lower Carboniferous of the western slope of the Moscow Basin: Vses. Neft. Nauchno-Issledov. Geol.-Rasved. Inst., Trudy, Leningrad, no. 56, n.s., p. 109-178, 6 pl., [in Russian].

From Lower Carboniferous rocks of the western slope of the Moscow Basin, a fauna of 28 species (5 fusulinids), of which 13 species and 7 varieties are new, is described and illustrated by excellent thin-section photomicrographs. The new forms are *Endothyra omphalota* Rauser and Reitlinger var. *infrequens*, *E. tantilla*, *E. irenae*, *E. glomeraris*, *E. similis* Rauser and Reitlinger var. *amplis*, *E. pannusaeformis*,

*E. parapriscas*, *Archaediscus pauxillus*, *A. embolicus*, *A. mellitus*, *A. grandiculus*, *A. itinerarius* var. *suppressa*, *A. moelleri* Rauser var. *ventrosa*, *A. inflatus*, *A. krestovnikovi* Rauser var. *magna*, *A. krestovnikovi* Rauser var. *enormis*, *A. infantis*, and *A. operosus*.

104. SKIPP, B. A. L., 1961, Stratigraphic distribution of endothyrid Foraminifera in Carboniferous rocks of the Mackay quadrangle, Idaho: U. S. Geol. Survey Prof. Paper 424-C, art. 236, p. C-239-C-244, 3 text-fig.

The writer shows that generic and specific divisions of endothyroid Foraminifera in the Carboniferous rocks of the Mackay region are recognizable in sufficient detail to show that they have limited stratigraphic range and are useful for age determination. She notes that in describing endothyroid faunas, size differences have been emphasized in the past, although the size varies with environment and with megaspheric and microspheric forms of the same species. The coiling habit has not been described fully for most species. The degree of rotational distortion is useful as a basis for classification, although in some specimens it changes from volution to volution and has never been properly calibrated more precisely than by the individual worker's own estimate. The same holds true for rate of coiling.

Representative endothyroid Foraminifera from the Mackay quadrangle are illustrated by a number of excellent drawings.

105. THALMANN, H. E., 1959, Foraminiferal homonyms: Contr. Cushman Found. Foram. Research, v. 10, pt. 4, p. 127-129.

*Climacammina simplex* Rauser-Chernousova, 1948, preoccupied by *C. simplex* Meunier 1888. *Endothyra arcuata* Grozdilova and Lebedeva var. *evoluta* Lebedeva, 1954, preoccupied by *E. spirilliniformis* Brazhnikova and Potievskaya, 1948, var. *evoluta* Reitlinger, 1950. *Saccamminoidea* Ireland, 1956, preoccupied by *Saccamminoides* Geroch, 1955, Ann. Soc. Geol. Pologne, v. 32, p. 54, Eocene, Czechoslovakia.

106. THOMPSON, M. L., and MELLETT, F. F., 1949, Foraminifera in the Black Warrior Basin of Mississippi and Alabama: Mississippi Geol. Soc., Guidebook 7th. Field Trip, p. 44-54, 3 pl.

From the Upper Mississippian rocks of the Black Warrior Basin of Mississippi and Alabama, a fauna consisting primarily of millerellid fusulinids and both large and small endothyrid Foraminifera is described. One plate of thin-section photomicrographs is also included.

107. TOOMEY, D. F., 1961, *Endothyra scitula*, new name for *E. symmetrica* Zeller, preoccupied: Contr. Cushman Found. Foram. Research, v. 12, pt. 1, p. 26.

The new name *Endothyra scitula* is proposed for *E. symmetrica* Zeller which is preoccupied [see Morozova, 1959, p. 247-248].

108. WHITE, C. A., 1879, Note on *Endothyra ornata*: U. S. Natl. Mus., Proc., v. 2, p. 291.

On the basis of a determination by H. B. Brady, the writer reports the occurrence of *Endothyra ornata* from the region of the Teton Mountains. This marks the first reported occurrence of this form from the "far west."

109. WOLANSKA, H., 1959, *Agathammina pusilla* (Geinitz) from the lower Zechstein in the Sudeten and Holy Cross Mountains: Acta Palaeont. Polonica, v. 4, no. 1, p. 27-59, 3 pl., 4 text-fig., [in Polish with English and Russian summary].

Approximately 460 specimens of the late Paleozoic foraminifer *Agathammina pusilla* (Geinitz) from the lower Zechstein Formation of the Sudeten and Holy Cross Mountains in Poland were isolated and studied statistically (analysing the arithmetical mean of their indices regarded as their features) in order to determine the variability of the species.

Detailed study of the composition and structure of the shell wall and morphology of the test has led to the emendation of the genus and suggests that *A. pusilla* (Geinitz) should be included with the superfamily Miliolidea Glaessner, 1945. However, the assignment of this species to the family Miliolidae, according to Cushman's conception, is still open to question. It is thought that the observed variability is individual and that the microspheric form is single-chambered and the megalospheric two-chambered. Spandel's (1898) "species" (*involutus*, *gordiformis*, and *geinitzi*) are considered to represent certain

growth stages. Microspheric forms have been described by Brady (1876) as *Trochaminna robertsoni*. Megalospheric forms have been described as *T. annularis* by Brady (1876) and as *Cornuspira spandela* by Paalzow (1936).

The paper is well documented by numerous whole-specimen and thin-section line drawings.

#### DISTRIBUTION OF ARTICLES ACCORDING TO GEOLOGIC AGE AND CATEGORY

##### ORDOVICIAN

9, 10, 17, 21, 23, 25

##### SILURIAN

5, 8, 9, 12, 13, 14, 16, 22, 24

##### DEVONIAN

1, 2, 3, 4, 5, 6, 7, 11, 15, 18, 26, 27

##### MISSISSIPPIAN

28, 35, 36, 37, 38, 40, 41, 45, 47, 48, 53, 54, 55, 57, 58, 59, 60, 62, 63, 64, 65, 66, 68, 74, 75, 76, 77, 78, 81, 82, 83, 87, 88, 89, 92, 93, 94, 98, 99, 102, 103, 104, 106, 108

##### PENNSYLVANIAN

28, 29, 30, 33, 34, 44, 47, 49, 50, 51, 59, 60, 68, 87, 90, 91, 95, 96, 100

##### PERMIAN

31, 32, 33, 46, 52, 68, 71, 72, 80, 84, 87, 91, 101, 109

##### GENERAL

10, 11, 19, 20, 39, 42, 43, 54, 56, 61, 67, 68, 69, 70, 73, 76, 79, 82, 85, 86, 95, 97, 99, 105, 107

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VOLUME XIV, PART 3, JULY, 1963

263. STRUCTURE OF *ASTEROCYCLINA ALTICOSTATA* (NUTTALL)

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ABSTRACT

The only species of multirayed discocyclinids known from the Indian middle Eocene is recognized as an *Asterocyclina*. The internal morphology is described in detail.

INTRODUCTION

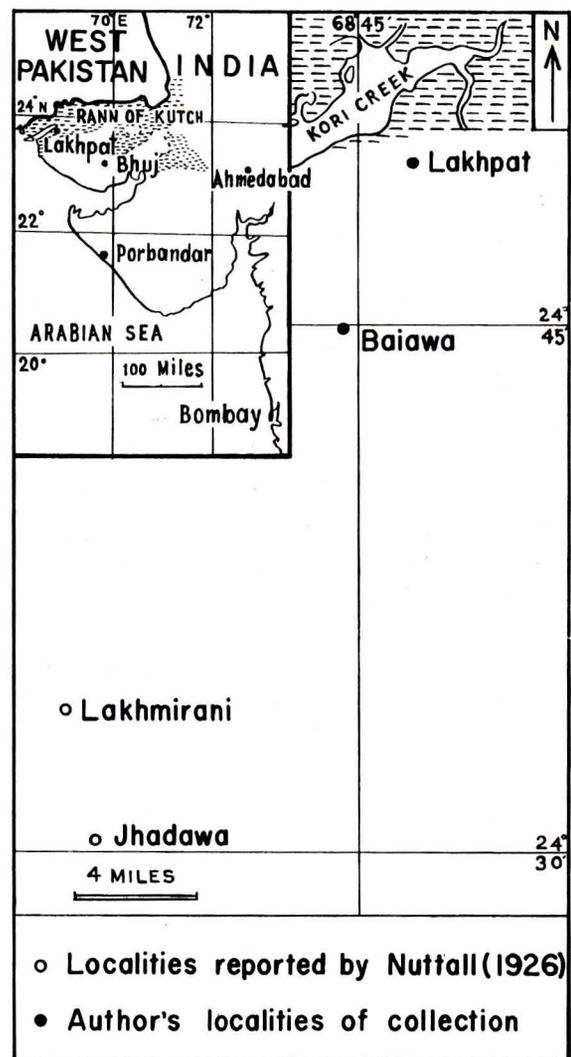
On the basis of 12 specimens from the "Middle Kirthar (B)" strata of northwestern Kutch (western India), Nuttall (1926, p. 151) described a new discocyclinid as *Actinocyclina alticostata*. This later became accepted as the only definitely identified Indian species of *Discocyclina* (*Actinocyclina*). Even though the species is indeed rare, as Nuttall remarked (*loc. cit.*), the present author has been able to collect numerous specimens from Lakhpat and a few from Baiawa. Both these places are within 25 miles of Lakhmirani and Jhadawa (= Shadwan), which are the localities from which Nuttall had obtained his holotype and paratypes (*see* text figure 1). These specimens were in an excellent state of preservation, although most of them were inseparable, or separable with difficulty, from the calcareous matrix in which they occurred. The internal structure of this important discocyclinid has been studied from a number of oriented thin sections, and it is clearly seen that the form is an *Asterocyclina*. The details are presented here in an attempt to facilitate future identification of the species, which now becomes the only definite *Asterocyclina* from India. Because of the paucity of specimens in Nuttall's original collection, his descriptions of the internal characters are necessarily inadequate, especially when many of these characters show considerable variation.

ACKNOWLEDGMENTS

The author is indebted to Professor T. C. Bagchi and to the authorities of the Indian Institute of Technology, Kharagpur, for providing field grants and laboratory facilities. He was privileged to work with Professor W. Storrs Cole as an International Cooperation Administration participant at Cornell University, and the discussions he had with Professor Cole on the structure of discocyclinids have been useful in the preparation of this paper.

BIOSTRATIGRAPHY

At both Lakhpat and Baiawa, *Asterocyclina alticostata* (Nuttall) occurs in middle Eocene strata which are part of the Kirthar Series (*see* Khan, 1956, pp. 134-136, and Krishnan, 1960, pp. 505-508). These strata are particularly rich in *Discocyclina* (*Discocyclina*) *dispansa* (Sowerby) and *D. (D.) sowerbyi* Nuttall (*see* Sen Gupta, 1963). *Camerina exponens*



TEXT FIGURE 1

Map of localities. Inset: Map of a part of western India showing location of Lakhpat.

(Sowerby) is also present. At Lakhpat, where a scheme of local zones has been worked out, this assemblage is preceded and succeeded by other foraminiferal associations typical of the Indian Kirthar (Sen Gupta, 1959).

SAMPLE LOCATIONS

1. About 0.69 mile southwest of the main gate of the walled village of Lakhpat ( $23^{\circ} 50' N.$ ;  $68^{\circ} 47' E.$ ). A band two feet thick is exceptionally rich in *Asterocyclina*. This band is in the upper part of limestone strata characterized by the species of *Discocyclina* (*Discocyclina*) and *Camerina* mentioned earlier. Although nonpersistent, it is well exposed in a small gully, where the foraminiferal limestone occurs in sections 15-20 ft. thick.

2. About 0.13 mile south-southeast of the center of the small village of Baiawa ( $23^{\circ} 45' N.$ ;  $68^{\circ} 43' E.$ ),

on the east bank of the Panadro stream. Rare specimens of *Asterocyclina* have been found at the local top of a 25 foot section of limestone in which *Discocyclina* (*Discocyclina*) is abundant.

#### SYSTEMATIC DESCRIPTION

Family DISCOCYCLINIDAE

Genus *Asterocyclina* Gumbel, 1870

*Asterocyclina alticostata* (Nuttall)

Plate 8, figures 1-8; text figure 2

1926. *Actinocyclina alticostata* NUTTALL, India, Geol. Survey, Rec., v. 59, p. 151, pl. 8, figs. 6-8.

*Megalospheric generation*.—The test is of considerable size, generally about 8-11 mm. in diameter. The prominent central umbo is surrounded by a thin, wide brim, on which there are about 10-12 distinctly elevated rays. Of these, only about five are primary, that is, they start from the center of the test. Secondary rays bifurcate from these some distance away from the center. The surface, in particularly well-preserved specimens, is covered by minute papillae.

The bilocular embryonic chambers consist of an ovoid initial chamber which is only very slightly enclosed by

a reniform second chamber. The size of the initial chamber in equatorial view varies from 130  $\mu$  x 165  $\mu$  to 210  $\mu$  x 320  $\mu$ , and that of the second chamber from 115  $\mu$  x 230  $\mu$  to 155  $\mu$  x 380  $\mu$ . The distance across both the embryonic chambers is between 265 and 405  $\mu$ . The thickness of the outer embryonic wall is about 10  $\mu$ . There are generally 8 to 12 peri-embryonic chambers, which show a great variation in size. Their shape is irregular, but the majority are considerably elongated. Some overlap is seen in their arrangement.

Only the primary rays are distinctly visible in equatorial sections. At the rays, the equatorial chambers become considerably larger, and generally their tangential walls show a slight curvature. These chambers are radially elongated in both the rays and the interrays. Generally, the radial diameter is more than twice the tangential diameter. The maximum radial diameter of the equatorial chambers varies between 115 and 150  $\mu$  in the rays, and between 40 and 50  $\mu$  in the interrays. The annular stolon is proximal. Radial chamber walls are well developed and straight, and alternate in position in adjacent annuli. In any

TABLE 1  
Measurements of equatorial sections of *Asterocyclina alticostata* (Nuttall)

Specimen no.	1	2	3	4	5	6	7	8	9
Reference to illustration on Plate 8	Fig. 8	-	Figs. 5, 7,	-	-	Fig. 6	-	-	-
Diameter (mm.)	10.6	7.5+	8.5+	8.3+	-	8.8+	9.3+	-	-
Total number of rays	12	-	-	-	11	-	6	11	10
Embryonic chambers ( $\mu$ ):									
Diameters of initial chamber	130, 165	165, 215	125, 180	155, 265	150, 265	210, 320	155, 250	210, 275	240, 250
Diameters of second chamber	130, 215	115, 230	135, 265	165, 315	140, 330	155, 345	165, 330	130, 320	155, 380
Distance across both chambers	280	295	265	330	300	375	330	350	405
Thickness of outer wall	10	10	10	10	10	15	10	15	15
Equatorial chambers ( $\mu$ ):									
In rays:									
Radial diameter	65-130	65-115	35-130	40-130	50-115	50-150	35-115	30-130	35-130
Tangential diameter	30-50	25-50	25-50	30-50	25-40	25-50	25-50	25-50	20-50
In interrays:									
Radial diameter	30-100	30-85	30-70	30-70	25-65	30-100	30-85	30-100	35-100
Tangential diameter	15-35	20-35	25-40	25-40	15-40	15-40	25-35	25-50	30-40

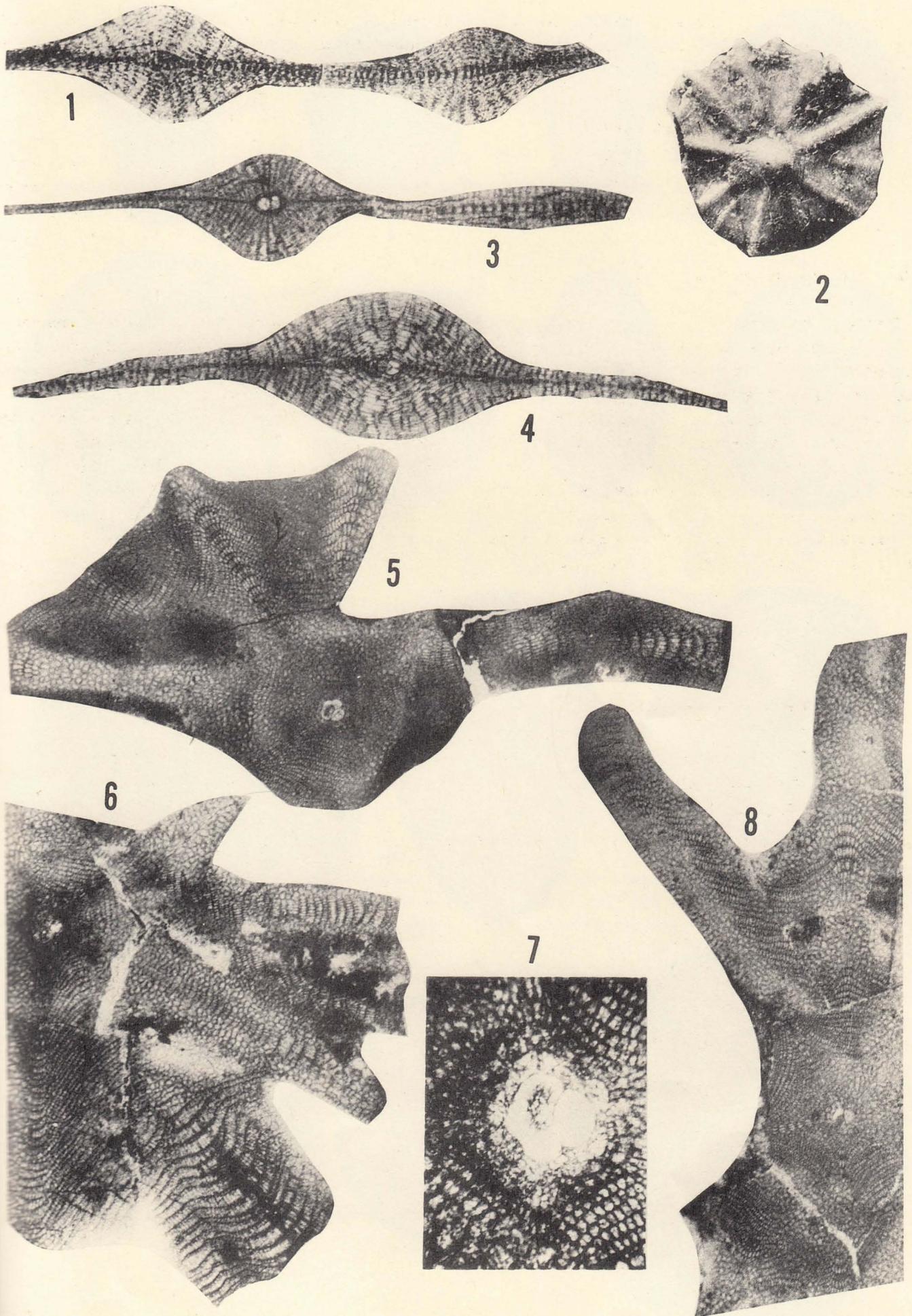
#### EXPLANATION OF PLATE 8

FIGS.

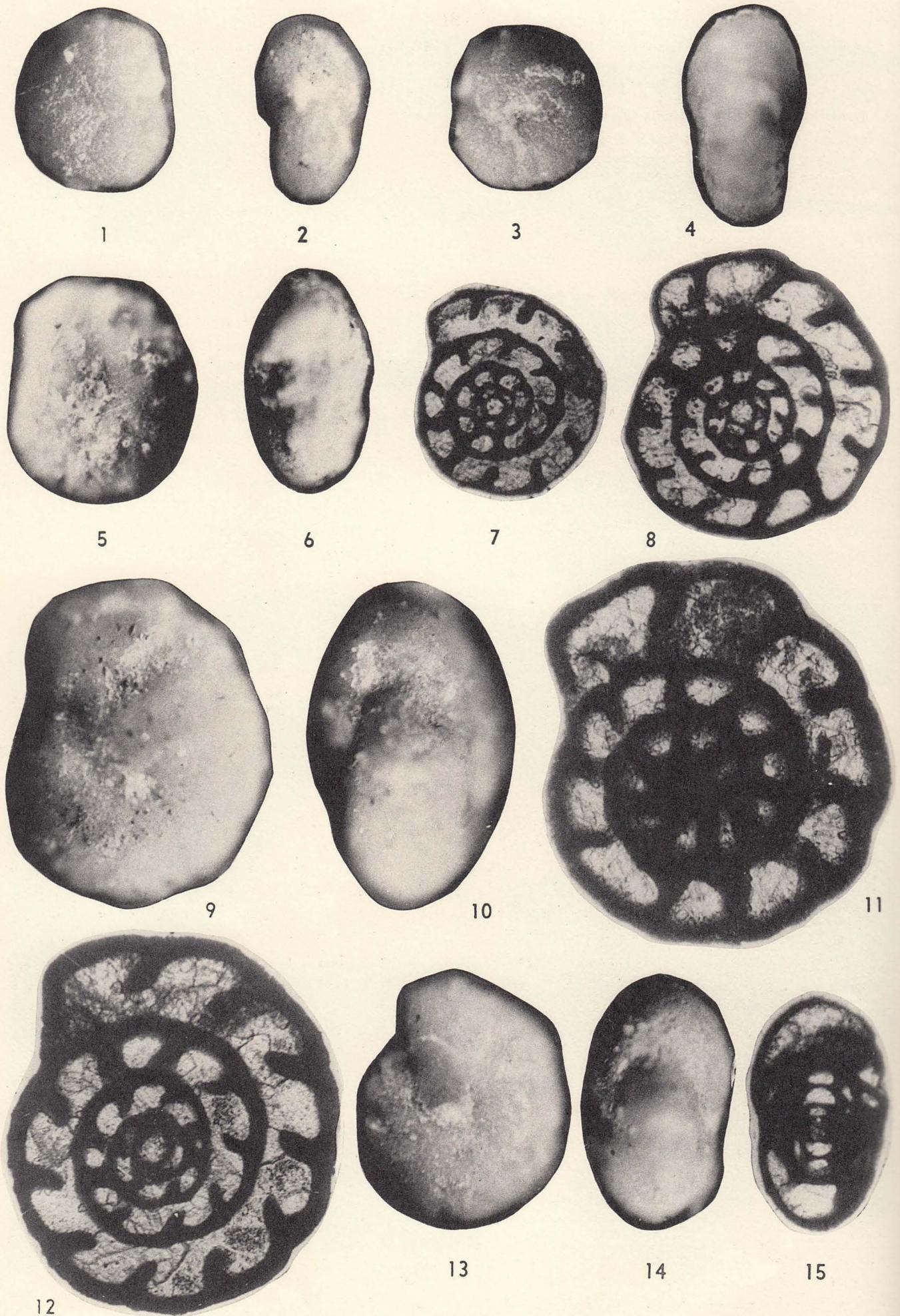
1-8. *Asterocyclina alticostata* (Nuttall) .....  
2,  $\times 3$ ; 3-6, 8,  $\times 12.5$ ; 1,  $\times 25$ ; 7,  $\times 50$ . 1, off-centered vertical section through two rays. 2, external view. 3, 4, vertical sections. 5-8, parts of equatorial sections (7, enlarged central part of specimen illustrated as fig. 5).

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Sen Gupta: *Asterocyclina alticostata* (Nuttall)



Anisgard and Campau: *Paramillerella thompsoni*, n. sp.

TABLE 2

Measurements of vertical sections of *Asterocyclina alticostata* (Nuttall)

Specimen no.	10	11	12	13	14	15	16
Reference to illustration on Plate 8	-	Fig. 3	Fig. 4	-	-	-	-
Diameter (mm.)	8.5	11.0	8.8	7.1+	3.0	8.3	6.5
Diameter of umbo (mm.)	3.15	2.00	3.15	3.40	1.15	2.75	2.75
Thickness at center (mm.)	1.65	1.40	1.80	1.90	0.70	2.00	1.35
Thickness of flange (mm.):							
Near umbo—	0.45	0.25	0.40	0.50	0.20	0.50	0.40
Near periphery—	0.20	0.15	0.15	0.25	0.05	0.25	0.20
Embryonic chambers ( $\mu$ ):							
Length	400	300	270	385	315	300	330
Height	150	165	150	245	200	230	200
Thickness of outer wall	10	10	10	15	10	15	15
Height of equatorial layer ( $\mu$ ):							
At center—	50	50	65	65	50	65	50
At periphery—	50	35	50	40	35	50	35
Lateral chambers:							
Number on each side of initial chamber	22	26	20	20	10	24	18
Length ( $\mu$ )	80- 230	35- 100	65- 300	65- 230	35- 70	80- 330	50- 265
Height ( $\mu$ )	25- 65	15- 35	25- 65	20- 65	15- 35	20- 85	25- 65
Thickness of floors and roofs ( $\mu$ )	10- 20	10- 15	10- 25	10- 15	10	10- 25	10- 15
Surface diameter of pillars ( $\mu$ )	35- 130	35- 85	35- 130	25- 230	30- 115	30- 130	35- 100

radial direction, the thickness of the equatorial chamber layer decreases only slightly from the center to the periphery. This layer, however, is appreciably thicker in the rays than in the interrays.

Lateral chambers are arranged in irregular tiers, and, commonly, there are about 20-25 such chambers on either side of the embryonic chambers. There is a considerable variation in the size of the lateral chambers, which are generally high and long. The thickness of their floors and roofs is between 10 and 25  $\mu$ . There is a remarkable increase in the number of lateral chamber layers at the rays.

The pillars are usually thin, but some of them show a considerable thickening very near the surface. Rare cases of strong pillars have also been noted. Compared to the interrays, the rays show a sharp increase in the number and thickness of pillars.

Measurements of the equatorial and vertical sections are given in tables 1 and 2.

The microspheric generation of *Asterocyclina alticostata* (Nuttall) has not yet been found.

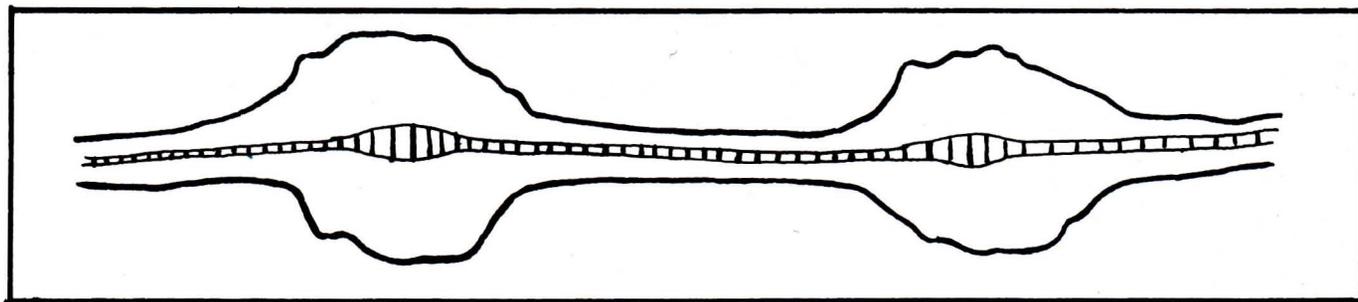
*Discussion.*—That the species is not a *Discocyclina* (*Aktinocyclina*), but an *Asterocyclina*, is proved by the perceptible increase in the thickness of the equatorial layer at the rays (text fig. 2; pl. 8, fig. 1), and by the difference in size and form between the equatorial chambers of the interrays and those of the rays (pl. 8, figs. 5, 6, 8) (Brönnimann, 1945 a, b; Vaughan and Cole, 1948). The second feature is also observed in Nuttall's single illustration of the equatorial view (Nuttall, 1926, pl. 8, fig. 6). The structure of the stellate test is primarily determined by the small increments in the thickness of the equatorial layer at

## EXPLANATION OF PLATE 9

*Paramillerella thompsoni*, n. sp. (see p. 102)All figures  $\times 37$  unless otherwise noted

Figs.

1-3, Lateral and peripheral views, U. S. N. M. Cat. No. 139,892a. 4, Peripheral view of Mus. Pal., Univ. Mich., Cat. No. 44,273 showing narrow, crescentic aperture filled with secondary material. 5-7, Lateral and peripheral views and sagittal section, U. S. N. M. Cat. No. 139,891a. Note probable aperture at base of last septum and changes in direction of curvature of septa. Fig. 7 is the holotype. 8-10, Sagittal section, lateral and peripheral views, Mus. Pal., Univ. Mich., Cat. No. 44,275. Hook present in last chamber, curving forward gently. 11-12, Sagittal sections ( $\times 74$ ) of U. S. N. M. Cat. Nos. 139,893a and 139,893b respectively, showing hooks and varying attitudes of septa. Fig. 11 with aperture. 13-15, Lateral and peripheral views and axial section, U. S. N. M. Cat. No. 139,891b. Individual essentially planispiral, tunnel and chomata well developed.



TEXT FIGURE 2

*Asterocyclina alticostata* (Nuttall).  $\times 40$ . Off-centered vertical section through two rays to show the thickening of the equatorial chamber layer at these regions. The lateral chamber layers and the pillars are not shown. See pl. 8, fig. 1, for the illustration of a similar section through another specimen.

nearly regular intervals. The disposition of the lateral chamber layers simply conforms to this arrangement (Brönnimann, 1945 a, p. 575), even though the increase in the number of the lateral layers (and in the number and thickness of pillars) is particularly impressive in off-centered vertical sections. Nuttall (1926, p. 151) noted the similarity of this Kutch species with a number of other forms, especially with *Orthophragmina colcanapi* R. Douvillé (1906, p. 67, pl. 1, figs. 4, 5) presumably on the basis of external appearance. He (*loc. cit.*) commented that his new species "belongs to the group of *Actinocyclina radians* (d'Archiac)." The structure of this subgenotype of *Discocyclina* (*Actinocyclina*), however, is wholly different (see Schlumberger, 1904; Brönnimann, 1945 a; Neumann, 1958).

*Asterocyclina alticostata* has many more rays than the common forms of *Asterocyclina*, but, as remarked earlier, only about five of these start from the outer boundary of the periembryonic ring. Other rays are produced because of subsequent bifurcation of the primary rays, and it is only rarely that they show up distinctly in the equatorial sections.

*Asterocyclina* has not so far been reported from the Indian subcontinent, although it is probable that Carter's (1861, pp. 78-79) *Orbitoides asterifera*, a middle Eocene 6-8 rayed species from Baluchistan (West Pakistan), may belong to this genus. The only other stellate discocyclinid known from this region is a *Discocyclina* (*Actinocyclina*) described by Tewari (1949, p. 401) from the upper Eocene *Pellatispira* bed of the Surat-Broach area in western India. This horizon is higher than that in which *Asterocyclina alticostata* occurs in Kutch. The species has been recognized as "very close to, if not identical with," *Discocyclina* (*Actinocyclina*) *crassicostata* H. Douvillé (1922, p. 99, pl. 5, fig. 8).

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VOLUME XIV, PART 3, JULY, 1963

264. *PARAMILLERELLA THOMPSONI*, N. SP.,  
FROM MICHIGAN AND A REDEFINITION OF *PARAMILLERELLA*

H. W. ANISGARD and D. E. CAMPAU

Humble Oil and Refining Co., New Orleans, La., and American Stratigraphic Co., Billings, Mont.

ABSTRACT

*Paramillerella* is a primitive involute fusulinid with a 3-layered calcareous wall structure and an essentially planispiral coil. Occasionally the juvenarium is asymmetrical, and an aperture is present infrequently. Several species of *Millerella* and *Eostaffella* are grouped under *Paramillerella*. *Eostaffella* Rauser-Chernousova, 1948, is a subjective synonym of *Millerella* Thompson, 1942. *Paramillerella thompsoni*, n. sp., from the Bayport Limestone Formation of Michigan is larger than other species of the genus. *Paramillerella* characterizes Middle Mississippian to Lower Pennsylvanian rocks, although its range may be slightly longer.

INTRODUCTION

The present study of the primitive fusulinids in the Bayport Limestone indicates that the provisional identification of *Orobias* and *Plectogyra* made by Campau (in Crane and Kelly, 1956) is in error. All of the specimens examined are now considered referable to the genus *Paramillerella*. The fusulinids are found associated with ostracods in 6 inches of gray shaly limestone (clayey fossiliferous micrite in Folk's classification) near the base of the Bayport (text fig. 1). This fossiliferous unit is further identified as part of bed 4 of Crane and Kelly (p. 870).

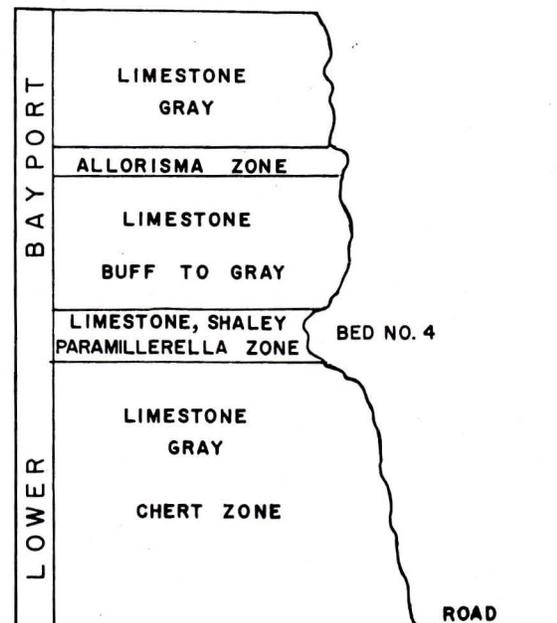
Crane and Kelly have described the ostracods from this formation, and suggest that the Bayport may be the time equivalent of the Salem Formation of Illinois. Both the megafossils and lithology indicate a slightly younger age and possible correlation with the St. Louis Limestone.

ACKNOWLEDGEMENTS

Jack D. Burgess, of Humble Oil and Refining Co., and Cecille Anisgard reviewed and corrected the manuscript. Sally M. Burghardt, Jana Adams, Mona McClain, and Georgia Simmons, of the same company, have been kind enough to type the paper. It is a pleasure to express our thanks to them. Humble Oil and Refining Co. generously provided many of the laboratory facilities to study the Foraminifera. I. A. Mamontov, of Sun Oil Co., and Stephan Zirko, of Eastern Montana College of Education, translated the part of Rauser-Chernousova's publication pertinent to our paper, and the editors of the Cushman Foundation for Foraminiferal Research provided an English translation of Reitlinger's paper. Without their generous help it would not have been possible to do justice to the present article.

DISCUSSION

The original purpose of this paper was a simple description and an age interpretation of the fusulinids of



TEXT FIGURE 1

Stratigraphic position of limestone with *Paramillerella* (section not to scale).

the Bayport Limestone. Although the fusulinids occur in abundance, all are believed to be assignable to a single species of *Paramillerella*. The principal character of the genus as expressed by the population of more than 100 forms is a tightly coiled, slightly umbilicate, and nearly completely planispiral shell with just over three whorls. The test has a rounded periphery, a triple-layered calcareous wall structure in at least its older portion, and a tunnel bordered by chomata. About two-thirds of the sagittal sections of the individuals show a hook (*hamulus* of Woodland, 1958, p. 795) rising from the floor of the last chamber. Approximately one-third of both the whole specimens and sagittal sections shows the presence of a crescent-shaped aperture at the base of the last septum. Only 25 percent of the axial sections reveals a change in the angle of the plane of coiling of the first volution. The number of forms exhibiting such asymmetry in the later whorls decreases sharply to less than 10 percent of the population. The combination of the structures just described is essentially characteristic of a primitive fusulinid.

Analysis of the features enumerated above indicates that the Bayport specimens have morphological criteria which are in part common to the genera *Endothyra*, *Paramillerella*, and *Eostaffella*. Unfortunately, a survey of the literature involving these genera reveals a

certain amount of confusion, inconsistency, and disagreement concerning the characters of the test. A precise definition of each of these three genera would unmistakably help to differentiate them from one another.

St. Jean (1957) and Henbest (1953) both have very convincingly argued the case of *Endothyra* Phillips vs. *Plectogyra* E. J. Zeller. We agree with both these authors that *Endothyra* Phillips should refer to skew-coiled forms only and is the name that should be retained. St. Jean (1957, p. 23) further describes *Endothyra* as possessing a calcareous wall composed of two layers, and states that the aperture is absent in the Mississippian specimens but present in the Pennsylvanian forms. However, Galloway (1933, p. 156), Cushman (1948, p. 107), and Glaessner (1948, p. 107), in their textbooks, each define *Endothyra* Phillips as having an aperture regardless of its geologic age. Cushman states that the wall is arenaceous with much cement. Adding to the differences of opinion in the recent generic definition, Scott, E. J. Zeller, and D. E. Zeller (1947, p. 558) claim a three-layered wall structure for *Endothyra*, based on a study of *E. baileyi* (Hall). Later, E. J. Zeller (1950), in splitting *Plectogyra* from *Endothyra*, interprets a triple-layered wall for the latter genus. The Russian micropaleontologist, Reitlinger, follows (1958) E. J. Zeller in his recognition of a planispiral *Endothyra* and a skew-coiled *Plectogyra*.

Because the Bayport fusulinids have the asymmetry of coiling restricted to the very early portion of growth of a few individuals and only a small change in the angle of coiling, we believe that their assignment to *Endothyra* is effectively eliminated. The rather sporadic occurrence of an aperture in the population we interpret as a vestigial character persisting in relatively few individuals. We concur with E. J. Zeller's statements regarding the importance of the aperture (1950, p. 5) in Foraminifera in distinguishing primitive fusulinids from endothyrids, when this feature is consistently present.

If the Michigan forms are not assignable to *Endothyra* because they are indeed primitive fusulinids, of what genus are they members? Both *Paramillerella* and *Eostaffella* have features in common with those of

the Bayport specimens, and, in determining which of the two genera they belong to, it is relevant to interpret their generic characters. *Millerella*, from which *Paramillerella* was later split off, was established by Thompson in 1942 as the most primitive of all fusulinids described until that time, with *M. marblensis* as the genotype. Thompson based his genus on specimens from the Marble Falls Limestone of Texas. These forms are characterized by completely planispiral, umbilicate tests with narrowly rounded peripheries, and consist of four to seven whorls, the inner three to four involute, the outer one or two evolute. The wall structure, as described by Thompson, consists of a thin middle layer between very thin upper and lower layers. However, the middle layer is the only one recognizable in all specimens. Thompson also placed *Staf-fella ciscoensis* Harlton 1927 from the Cisco of Texas in synonymy with his newly erected genus. He based his action on a study of Harlton's illustrations, although both the text (Harlton, 1928, p. 308) and the figure (pl. 52, fig. 9b) clearly indicate that Harlton's species has an aperture, a character presumably not present in the fusulinids.

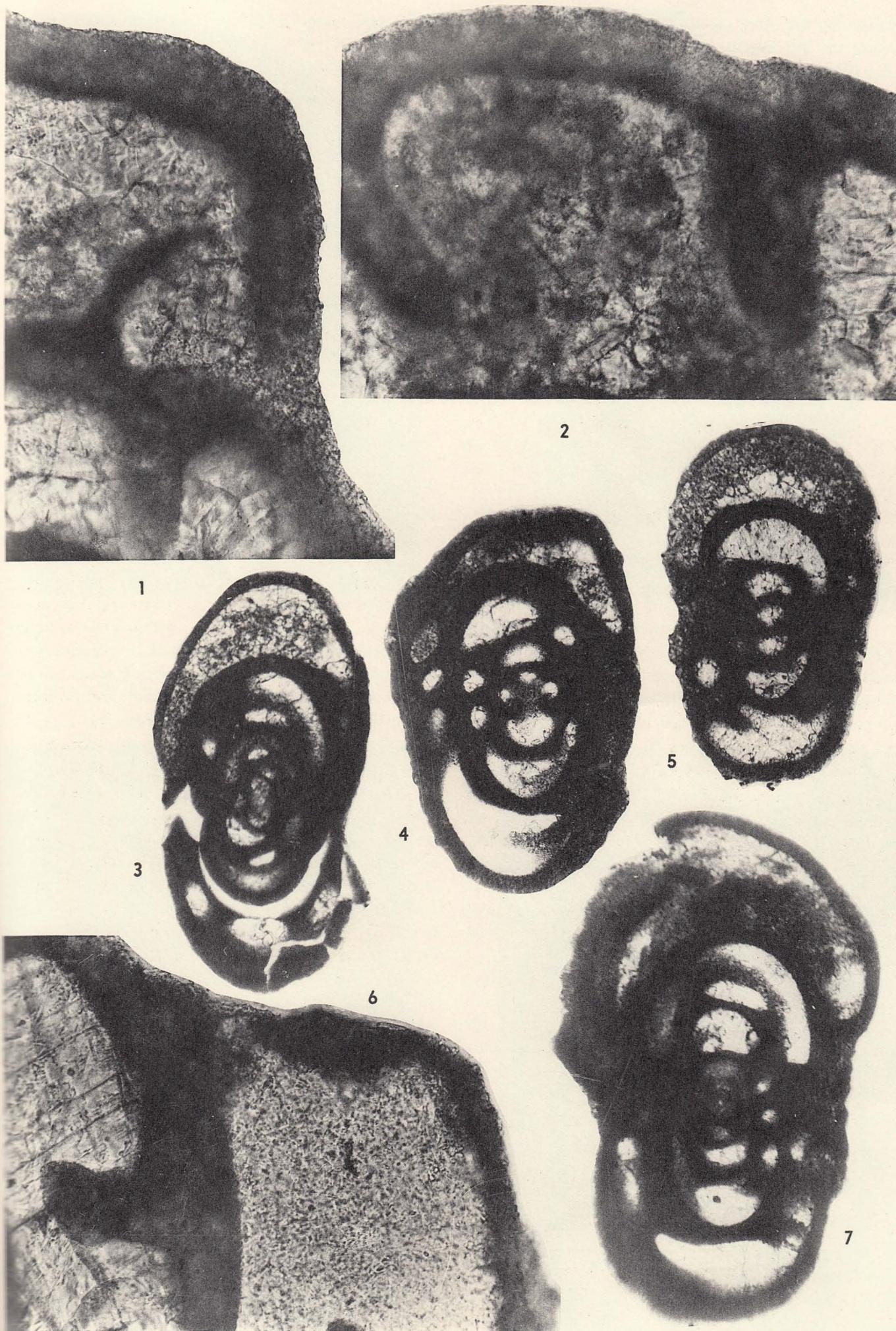
Thompson two years later (1944), studying Morrowan fusulinids from Kansas and Arkansas, recognized four additional species of *Millerella* (two questionably), and stated that the genus was more highly variable than he had previously believed. His new species include less evolute forms than those of the genotype, *M. marblensis*, (*M. pressa*, *M. pinguis*), forms with slightly asymmetrical first volutions (*M. advena*, *M. advena* var. *ampla*), and forms with rounded peripheries. Thompson interpreted the spirothecal structure of the Kansas individuals to be composed of a thin, dense central layer and indefinite thicker, less dense inner and outer layers. This was a departure from his previous interpretation of the Texas forms, in which the central layer was found to be the thickest of the three layers. Skinner and Wilde (1954) show a similar type of wall structure for the primitive profusulinellids. A study of Thompson's (1944) figure 13 of plate 1 and figure 19 of plate 2 suggests that some of his Kansas specimens of *Millerella* have apertures. Thompson also stated at this time that after further investigation *Millerella* probably

#### EXPLANATION OF PLATE 10

*Paramillerella thompsoni*, n. sp. (see p. 102)

#### FIGS.

1, Enlargement ( $\times 268$ ) of part of last chamber of Fig. 11, pl. 1, showing 3-layered wall, hook, and aperture. Note hook rising from node, both indicating they are secondary growths. 2, Above specimen with revolving wall over penultimate septum and chamber magnified ( $\times 268$ ), showing 3-layered structure. Note that outer layer (tectum) does not make flexure into septa. 3, Axial section ( $\times 64$ ), Mus. Pal., Univ. Mich. Cat. No. 44,277. First 2 whorls asymmetrical, tunnel well developed. 4, 5, Axial sections ( $\times 64$ ), U. S. N. M. Cat. Nos. 139,893c and 139,893d respectively. Juvenaria slightly asymmetrical, chomata and tunnels well developed. Section in fig. 5 probably has cut hook in last chamber. 6, Enlargement ( $\times 268$ ) of distal portion of fig. 7, pl. 9, showing aperture, 3-layered wall in penultimate whorl, 2-layered wall in last whorl. 7, Axial section, U. S. N. M., Cat. No. 139,893e ( $\times 64$ ). Juvenarium slightly asymmetrical, tunnel and chomata well developed, chomata on proloculus. Hook may be sectioned in last chamber.



Anisgard and Campau: *Paramillerella thompsoni*, n. sp.



1



2



3



4

would be found in rocks of Mississippian age. The following year Thompson (1945) added two new species from the Morrowan of Utah and Colorado to the *Millerella* group (*M. inflecta*, *M. circuli*, the latter with an evolute first volution). Again, Thompson suggested that these primitive fusulinids would eventually be noted in rocks older than the Morrowan.

Until this time (1945), then, all species of *Millerella* had been described from Pennsylvanian rocks. In 1946 Henbest reported *Millerella* from the Mississippian of Arkansas, and during the same year Cooper (1947) received a personal communication from E. J. Zeller mentioning the occurrence of the genus in what Zeller considered to be the Chester portion of the Amsden Formation of Wyoming. Cooper, in the same publication of 1947, described 3 new species of *Millerella* (*M. chesterensis*, *M. kinkaidensis*, *M. zelleri*) from the Chesteran Kinkaid Formation of southern Illinois. In doing so, Cooper disagreed with Thompson's opinion of these forms, for the latter had studied them and believed that they were more like his *Millerella inflecta* from Utah and Colorado than any other species of the genus (Cooper, 1947, p. 83). All three of Cooper's new species of *Millerella* have rounded peripheries and endothyroid juvenaria. *M. chesterensis* has a partly evolute last whorl, but the other two species are completely involute.

Thompson and Mellen (1949), studying the Paleozoic in the subsurface in Alabama and Mississippi, identified *Millerella advena* Thompson in sections assigned to the Pennington Formation, upper Chesteran in age. This species, as noted above, originally was described by Thompson from Morrowan rocks of Kansas and Arkansas in 1944, but was questionably assigned to the genus by him at that time. Additional study also now convinced these authors that the inner one or two volutions of the species were evolute, and that the form, therefore, was not completely involute as stated by Thompson 5 years earlier. E. J. Zeller (1950) extended the range of *Millerella* downwards in the Chester to the Glen Dean Formation. He pointed out the similarity and possible synonymy of the genus to his restricted conception of *Endothyra*, but nevertheless indicated certain differences between the two.

It is apropos now to emphasize that Thompson's original interpretation of *Millerella* as completely planispiral forms with evolute whorls and narrowly rounded to angular peripheries had been changed in 7 years to include specimens with asymmetrical juvenaria that are entirely involute and have broadly rounded peripheries.

Thompson, possibly concerned with the expanding characters of *Millerella*, in 1951 erected the new genus *Paramillerella*, with *M.?* *advena* Thompson as the genotype. He separated the new genus from *Millerella* on the basis of its having a more tightly coiled and more spherical shell with more massive chomata. Its geologic range was from the Late Mississippian through the Pennsylvanian, but Thompson believed it to be most abundant and varied in the Morrowan and Aotakan. He listed and illustrated *P. advena*, *P. ampla*, *P. pinguis*, and *P. circuli*, species which he originally had classified as *Millerella*, indicating that they should be transferred to and included with *Paramillerella*. Although Thompson did not mention them, Cooper's *M. kinkaidensis* and *M. zelleri* from the Illinois Chester possess the characters of *Paramillerella* and should be classified with the new genus.

D. Zeller (1953), in her analysis of endothyroid and ancestral fusulinid Foraminifera from the type Chesteran of Illinois, described three new species of *Millerella* (*M. tortula*, *M. designata*, *M. cooperi*). In our opinion, *Millerella cooperi*, with its completely involute test, very slightly asymmetrical juvenarium, and very broadly rounded periphery, and possibly *Millerella tortula*, with a partly evolute last whorl but with the same type of juvenarium and periphery, should both be assigned to *Paramillerella*.

Very recently Easton (1962), in his thorough discussion of the Carboniferous formations and faunas of central Montana, described and figured two species of millerellids from the Big Snowy Group. His specimens of *Millerella* aff. *M. chesterensis* Cooper from the Otter Formation and those of *Millerella*, n. sp., from the Cameron Creek Formation are diagnosed by Easton as being completely involute and having evenly rounded peripheries. His rather complete bibliography does not list Thompson's 1951 publication. In view of Thompson's emendation of *Millerella* that year, both of Easton's species clearly are more correctly placed in *Paramillerella*.

At this point our conception of the Michigan specimens would have placed them in Thompson's *Paramillerella*. However, Coogan (1958) called attention to the erection of about 40 genera of fusulinids since 1948 by Russian micropaleontologists. Among the new forms Coogan lists *Eostaffella* Rauser-Chernousova, 1948, a subgenus of *Staffella* Ozawa, 1925, with type species *E. parastruvei*. Coogan's paraphrased description and remarks concerning *Eostaffella* suggested similarity of this form to *Paramillerella* Thompson, and,

#### EXPLANATION OF PLATE 11

*Paramillerella thompsoni*, n. sp. (see p. 102)

All figures  $\times 283$

FIGS.

1, 2. Enlargements of parts of figs. 7 and 3, pl. 10, respectively. Note 3 layers in wall structure of last whorls and secondary growths of chomata. 3, Fig. 7 of pl. 10, proloculus and juvenarium. Proloculus shows aperture and chomata. 4, Fig. 4 of pl. 10, proloculus and juvenarium enlarged. Aperture bounded by curving borders directed outward.

thus, to the Bayport individuals. Thompson (personal communication, May 23, 1960), because of difficulties in translating the Russian article, stated that he wished to examine Rauser-Chernousova's specimens before committing himself as to the disposition of her species. To check further on this matter so that we might correctly assign the Michigan forms, we obtained the microfilm of Rauser-Chernousova's 1948 paper (in Russian). Fortunately, we were able to get the text describing *Eostaffella* and its species (pp. 14-19) translated into English. The translation of Rauser-Chernousova's description of *Eostaffella* follows:

Test lenticular to ovoidal, laterally compressed. First volutions usually endothyroid, resulting occasionally in 90 degree changes in the direction of the axis of coiling. Size small to medium. Wall thin, undifferentiated, or composed of three layers: tectum, outer, and inner tectoria. Septa completely unfluted. Additional deposits present in the shape of terminal thickenings of the septa on either side of the aperture; they do not develop, however, as a rule into permanent septa.

Rauser-Chernousova thus made no mention of the degree of uncoiling in her original generic diagnosis of *Eostaffella*, although Coogan states that the genus is involute in his paraphrased description. Rauser-Chernousova included four species in her new genus (*E. parastruvei*, *E. prisca*, *E. prisca* var. *ovoidea*, and *E. kasakhstanica*), and described each as having an aperture and all but one as being involute. She chose the evolute form, *E. parastruvei*, as the type species. Based on her description (pp. 15, 16) and illustrations (pl. III, figs. 16-18) of the species, it is our opinion that *E. parastruvei* is more properly assigned to Thompson's *Millerella*. With the transfer and elimination of its type species, the subgenus *Eostaffella* Rauser-Chernousova is relegated to the status of a subjective synonym of *Millerella*. The description and figures of the three remaining species of Rauser-Chernousova's *Eostaffella* indicate to us that they can be readily assigned to *Paramillerella* Thompson. Harold J. Bissell (personal communication, May 9, 1960), after writing to Russian micropaleontologists, assumes that they believe *Eostaffella* and *Paramillerella* to be distinct genera. Obviously, we do not share this view. Bissell has continued to use the name *Paramillerella* (1960, 1961). More recently, McGugan (1961, p. 104), however, has used the name *Eostaffella* in discussing the fauna of the lower Middle Pennsylvanian Kananaskis Formation of the Banff area in Alberta, Canada.

Based on the literature which is available to us, the following species of primitive fusulinids are considered to be assignable to *Paramillerella*:

*Eostaffella kasakhstanica* Rauser-Chernousova  
*Eostaffella prisca* Rauser-Chernousova  
*Eostaffella prisca* var. *ovoidea* Rauser-Chernousova  
*Millerella cooperi* D. Zeller

*Millerella kinkaidensis* Cooper  
*Millerella tortula* Zeller?  
*Millerella zelleri* Cooper  
*Millerella* sp. A. Thompson, 1945

As has been pointed out earlier, we disagree with E. J. Zeller's conception of *Endothyra* and *Plectogyra*. Consequently, it is very likely that the species from the Mississippian of the central United States (Zeller 1950; Wray, 1952) and the Cordilleran geosyncline (Zeller, 1957; Woodland, 1958), if they possess the three-layered wall structure of primitive fusulinids, should be reclassified as *Paramillerella*. St. Jean (1957, p. 25) previously noted the possibility that E. J. Zeller's version of *Endothyra* actually may be "*Millerella*."

#### SYSTEMATIC PALEONTOLOGY

Order FORAMINIFERA d'Orbigny, 1826

Family FUSULINIDAE Moller, 1878

Subfamily OZAWAINELLINAE Thompson  
 and Foster, 1937

Genus *Paramillerella* Thompson, 1951, emend.

*Type species*.—*Paramillerella advena* Thompson, 1951. Fixed by original designation.

*Emended description*.—Test calcareous, lenticular, discoidal, or ovoidal; periphery subrounded to rounded; tightly coiled; biumbilicate; either completely planispiral, or with early whorls (juvenarium) slightly asymmetrical; essentially involute; wall structure fusulinid, consisting of three layers—inner and outer, thinner, denser layers sandwiching a thicker, less dense, central layer; chomata massive; hook often present in last chamber; aperture occurs infrequently, probably restricted to more primitive forms.

*Paramillerella thompsoni* Anisgard  
 and Campau, n. sp.

Plate 9, figures 1-15; plate 10, figures 1-7;  
 plate 11, figures 1-4

*Paramillerella thompsoni*, n. sp., differs from nearly all other species currently assigned to the genus in its larger size. Both the length and width of the test of *P. thompsoni* are markedly greater than those of all the other species but one. Only *Endothyra hamula* Woodland, from the Desert Formation (Meramecian) of central Utah, to which the Michigan species is similar in many other respects, is of about the same size. The Bayport species, however, can be distinguished from Woodland's form by its tighter coil and fewer septa in the first whorl.

*Paramillerella thompsoni*, n. sp., can be distinguished from Pennsylvanian species of the genus by its lower septal count per whorl, the near parallelism of its lateral slopes, fewer volutions, and by the frequent presence of a hook in the last chamber. Most Mississippian species of *Paramillerella*, besides being smaller than the Bayport individuals, also have smaller form ratios and a higher septal count per volution.

*Holotype*.—Pl. 9, fig. 7; U. S. National Museum Catalogue No. 139,891a. D. E. Campau collector.

*Paratypes*.—Pl. 9, figs. 1-3, 11, 12, 15; pl. 10, figs. 4, 5, 7; U. S. National Museum Catalogue Nos. 139,892a, 139,893a, 139,893b, 139,891b, 139,893c, 139,893d, and 139,893e respectively; also No. 139,892b not illustrated.

Pl. 9, figs. 4, 8; pl. 10, fig. 3; Museum of Paleontology, University of Michigan, Catalogue Nos. 44,273, 44,274, and 44,277 respectively. Nos. 44,275, 44,276, 44,278, and 44,279 not illustrated.

*Type Locality*.—Arenac Co. Michigan, Mason township, SE  $\frac{1}{4}$  sec. 34, T. 20 N., R. 5 E., near the east section-line road just north of the fire tower.

*Geologic Age*.—Meramecian, Upper Mississippian.

*Remarks*.—The new Michigan species is named in honor of Dr. M. L. Thompson, who has done so much valuable work on fusulinid Foraminifera.

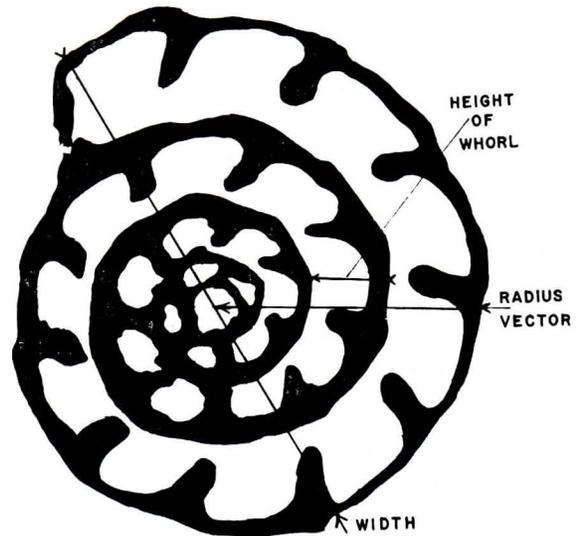
*External Features*.—Test coiled planispirally, calcareous, smooth, shiny; shape in side view subcircular to subovate, in edge view suboval; sides subparallel; outline smooth to slightly lobulate; biumbilicate, involute, last whorl embracing to just above umbilical area. Small, shallow depression marks umbilicus on each side of test. Periphery broad, evenly rounded. Septal sutures either flush with, or slightly depressed below, surface of test to form shallow, narrow grooves; last two or three sutures progressively more concave anteriorly, remaining sutures either straight and radial, or gently concave posteriorly. Aperture occasionally present, but probably filled with secondary calcite; some specimens show low, crescent-shaped filling occupying most of basal portion of septal face. Chambers moderately distinct and inflated, 9 to 13 in last whorl.

Many specimens with walls of chambers weathered and with outer portions of chambers of last volution collapsed. When compared with well-preserved forms, such specimens have more sharply rounded to angular and even keeled peripheries; these individuals have more lobulate outlines in side view and thickened septal sutures.

*Sagittal and Horizontal Sections*.—(text fig. 2).

#### General Features

The observations which follow are based on an examination of the thin sections of more than 40 specimens. The study shows forms that are apparently planispirally coiled in all volutions, with the chambers increasing gradually and regularly in size as added. Only rarely is the juvenarium (first whorl) slightly elongated in one direction, indicating asymmetry during the early part of growth. The periphery is smooth to slightly lobulate; the lobulation, when present, is caused by a combination of archings of the revolving wall over the chamber cavities and deflections inwardly at the junctions of the wall with the septa. The septa in different whorls and in different parts of the same whorl are gently curved with the convexity directed forward, are straight and radial, or



TEXT FIGURE 2

Sagittal section of *Paramillerella thompsoni*, n. sp., showing terms used in description of features. ( $\times 25$ )

are gently curved with the convexity directed posteriorly. These curvature differences thus indicate a slight septal fluting across the length of the shells.

#### Measurements and Statistics

The proloculus is spherical to subspherical in shape. Its minimum and maximum diameters are .025 mm. and .087 mm. The average minimum diameter for the population is .046 mm. and the maximum .054 mm. Other measurements are tabulated on page 104.

#### Wall Structure

Well-preserved sections of *Paramillerella thompsoni*, n. sp., (pl. 9, fig. 11; pl. 10, fig. 2) show a thin and apparently granular revolving wall. In the inner whorls three fairly distinct layers are evident—two thinner, darker, denser layers (the upper tectum and the lower tectoria) enclosing a thicker, lighter, less dense layer (diaphanotheca). The upper tectum forms a part of the revolving wall, extending from the proloculus to that chamber in the penultimate whorl directly below the last chamber of the test. In those specimens in which a hook is evident in the last chamber, the tectum disappears in the underlying chamber just below the node from which the hook emanates. This suggests both a relationship and communication between the outer part of the wall structure and the hook process. As a result, the wall of the outermost whorl usually consists of the lower tectoria and diaphanotheca. Occasionally, however, the diaphanotheca remains as the only element of the wall persisting in the last whorl.

Both the lower tectoria and the diaphanotheca bend inwardly at the septal junctions with the revolving wall to form a double-layered septal wall. The wall of the last septum has the tectoria present only on its proximal side. With the addition of a new chamber, the tectoria curves around the base, and extends up the anterior side of the now penultimate septum to meet the roof of the new chamber. Thus, the wall

(see p. 103)	Minimum	Maximum	Average
Number of volutions (41)*	2½	4¼	3.2
Radius vector (33)	.240 mm.	.625 mm.	.406 mm.
Width (36)	.512 mm.	1.06 mm.	.829 mm.
Total number of chambers (41) (excluding proloculus)	18	40	28

Whorl Number	Number of Septa		
	Minimum	Maximum	Average
1 (41)	4	7	5
2 (35)	7	11	8
3 (36)	8	13	10
4 (5)	11	14	12

\* Number in parentheses indicates number of specimens studied

Although some of the specimens have the distal part of the last whorl broken and missing, the maximum number of the total of 40 chambers noted probably will be rarely exceeded.

	Number of Volutions	Length of Radius Vector	Width	Total Number of Chambers	Inside Diameters of Proloculus
				(excluding proloculus)	
pl. 9, fig. 12	3¾	.310 mm.	.750 mm.	30	.040 mm. x .060 mm.
pl. 9, fig. 7	3¼	.400 mm.	.800 mm.	27	.062 mm. x .062 mm.

Proloculus	Thickness of Spirotheca		Height of Whorl*		Septal Count	
	pl. 9, fig. 12	pl. 9, fig. 7	pl. 9, fig. 12	pl. 9, fig. 7	pl. 9, fig. 12	pl. 9, fig. 7
Whorl Number	.012 mm.	.015 mm.				
1	.020 mm.	.035 mm.	.120 mm.	.150 mm.	5	5
2	.025 mm.	.037 mm.	.185 mm.	.262 mm.	8	8
3	.037 mm.	.020 mm.	.310 mm.	.400 mm.	9	10

\* Includes thickness of spirotheca.

structures of all septa but the last simulate a three-layered arrangement. The upper tectum, however, does not curve downward to form a part of the septal wall, but is restricted in its extent to the plane of curvature of the revolving wall.

#### Tunnel, Aperture, and Hook

Well-oriented and well-preserved specimens of the population show a low tunnel or passageway at the base of the penultimate septa, which is continuous from the penultimate chamber backwards to the proloculus. The ratio of the height of the tunnel to the height of the whorl (between the revolving walls) is about 1:3. Usually the tunnel height is greatest at the base of the penultimate septum.

Infrequent (12 of 37) sections indicate the presence of an opening or aperture, (pl. 9, fig. 11; pl. 10, fig. 1) at the base of the last septum. The aperture is low and not as high as the tunnel. Those specimens possessing the aperture thus are afforded direct communication throughout the spire, from the proloculus along the tunnel and through the aperture to the exterior.

A hook (*hamulus* of Woodland) occurs in 24 of 35 sections of complete specimens of the assemblage. The hook is always in the last chamber behind the last septum, and is always directed forward (pl. 9, figs. 11, 12; pl. 10, fig. 1). Usually it is gently curved in this direction, but rare specimens have a straight hook. The hook arises from a mound or node (*tumulus* of Woodland 1958, p. 795), which forms a secondary deposit on the tectum of the revolving wall of the previous whorl. The hook extends forward and upward about half of the height of the chamber cavity, at times reaching close to but never actually making contact with the last septum. Its position, with regard to the length of the chamber cavity, varies from a central location to one either slightly anterior or slightly posterior to the center. Infrequently the hook originates from the lower posterior corner of the last chamber and extends in a forward direction transversely across the chamber. With respect to the septa of the penultimate coil, the hook often originates from a node between two septa, but occasionally it emanates from a mound-like growth directly opposite the junction of a

septum and the revolving wall. The hook is dense and noticeably thinner than either the spirotheca or any of the septa of the test. As stated previously, the older chambers have no hooks, but the last three or four frequently have spirothecal growths or nodes. Evidently, with the addition of a new chamber to the test, the hook in the now penultimate chamber is resorbed. During the growth of the test, the nodes persist for a longer time before being completely resorbed.

The position, extent, and consistent presence of the hook strongly suggest that it is a structure distinct from the septal face, and that it serves as a baffle-plate in the last chamber of the test. The hook thus produces a vestibule in the last chamber, as E. J. Zeller has indicated for his genus *Plectogyra* (1950, p. 195). Furthermore, inasmuch as the hook is present concomitantly with an aperture at the base of the last septal face, St. Jean's interpretation (1957, p. 26) of the hook as part of the septal face seems to be invalid, at least for *Paramillerella thompsoni*, n. sp.

*Axial and Vertical Sections.*—(text fig. 3).

#### General Features

Discussion of the vertical sections are based on a study of 31 specimens, although all of the features discussed below are not present in every specimen. The outline of the forms is most often subelliptical, but subtrapezoidal outlines occur rarely. As Thompson (1951, p. 115) has noted, the form ratio decreases with the approach of maturity. The sides of the tests are subparallel. The periphery is rounded in all whorls,

but more broadly in the earlier whorls. The umbilical area is reflected by a small, shallow depression centrally located on each side of the test. Generally, the sections show that the first whorl is almost entirely evolute, thus leaving most of the proloculus exposed during the early stage of growth, but the second, third, and fourth volutions, if developed, are involute, embracing nearly to the umbilical depression. Rare specimens are either completely involute, or have both the first and second whorls partly evolute.

#### Measurements and Statistics

The minimum number of coils observed is 2.5, the maximum 4.5, and the average for the population is 3.5. The proloculus, as in the sagittal and horizontal sections, is spherical to subspherical in shape. Its minimum diameter is .025 mm., its maximum .150 mm. The average value for the minimum diameters is .049 mm., and for the maximum .067 mm. As a general rule, the proloculi with the longer diameters are found in the larger-sized specimens, but this relationship is not absolute. No definite grouping into microspheric and megalospheric forms appears possible from the data and material on hand. Other pertinent measurements made for the vertical and axial sections are tabulated on page 106.

Some of the relationships indicated by these tabulations deserve further discussion. The average thickness of the spirotheca increases sharply from the first to the second whorl, but in the later coils the increase is almost imperceptible. The average tunnel angle widens rather slowly from the first to the fourth whorls. Both the ratio of the tunnel width to the whorl width and of the tunnel height to the whorl height in all coils are maintained at values slightly more than 1:0.30. Only a small number of specimens (8 of 31) show a change in the angle of the plane of coiling, and most often this change takes place between the first and second whorls. Very rarely is there a change in the angle of the plane of coiling of the volutions after the second whorl. *Paramillerella thompsoni*, n. sp., thus is basically planispirally coiled.

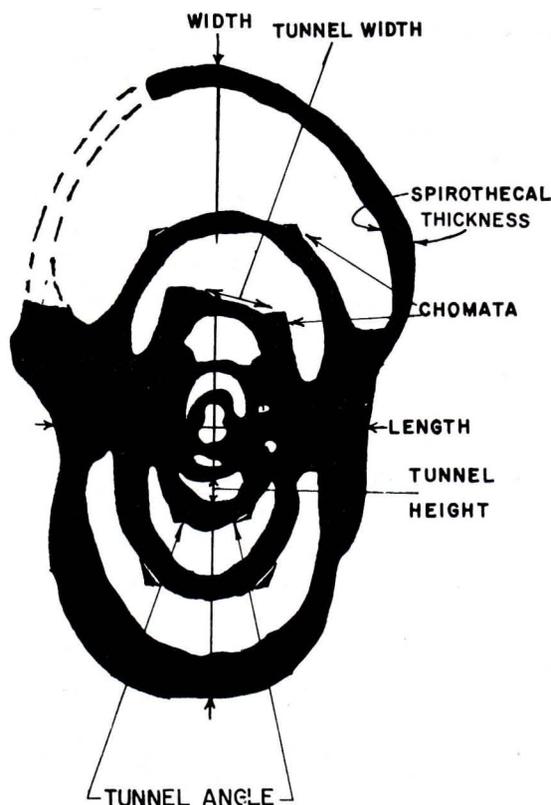
Dimensions of two typical specimens are shown on page 107.

#### Wall Structure

In well-preserved and centered sections, the wall in all but the final volutions has the same three-layered structure as revealed by the sagittal and horizontal sections—a central, thicker, and less dense diaphanotheca sandwiched between a thinner, denser upper tectum and a lower tectoria. In the outermost whorl usually the diaphanotheca and the tectoria comprise the wall, and the tectum is missing. More infrequently, the diaphanotheca remains as the only constituent of the wall in the last coil.

#### Tunnel and Chomata

All sections show the presence of the tunnel and chomata in at least one or more whorls. Rare speci-



TEXT FIGURE 3

Axial section of *Paramillerella thompsoni*, n. sp., showing terms used in description of features. ( $\times 25$ )

(see p. 105)	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Whorl Number		1 (31)			2 (31)			3 (30)			4 (12)	
Length in mm.	.082	.262	.144	.170	.475	.275	.240	.720	.420	.355	.652	.496
Width in mm.	.124	.362	.211	.237	.715	.416	.465	1.10	.708	.787	1.12	.909
Form Ratio	0.45	1.15	0.72	0.49	0.88	0.67	0.46	0.78	0.59	0.44	0.72	0.54
Thickness Spirotheca in mm.	.008	.037	.018	.012	.053	.031	.020	.050	.033	.022	.050	.034
Tunnel Angle		(13)			(25)			(18)			(8)	
	16°	55°	27°	16°	47°	30°	19°	66°	31°	16°	62°	32°
Ratio Width Tunnel to Width* Whorl		(6)			(23)			(21)			(8)	
	0.27	0.33	0.28	0.14	0.61	0.32	0.28	0.54	0.37	0.15	0.52	0.29
Ratio Height Tunnel to Height Whorl†		(3)			(16)			(18)			(5)	
	0.24	0.60	0.40	0.24	0.50	0.24	0.12	0.42	0.31	0.28	0.47	0.35
Change in Angle of Plane of Coiling	Between 1st & 2nd whorls (present only in 8 specimens)			Between 2nd & 3rd whorls (present in only 2 specimens)			Between 3rd & 4th whorls (present in only 2 specimens)					
Minimum	9°			5°			5°					
Maximum	29° 30"			30°			12°					
Average	18° 15"			17° 30"			8° 30"					

\* Width of whorl includes wall thicknesses

† Height of whorl limited to chamber cavity

Note: Numbers in parentheses refer to the number of specimens studied.

mens even indicate the development of faint chomata on the wall of the proloculus. The tunnel is centrally located at the base of the whorl and varies in outline from a crescent to a reniform shape. It is reasonable to assume that both the tunnel and the chomata probably are continuous throughout the length of the spire from the proloculus to the last chamber. Well-preserved and centered sections have chomata which are steep-sided towards the tunnel but slope gently to the outer edges of the whorls.

#### AGE AND STRATIGRAPHIC SIGNIFICANCE

The published records of the ages of the forms reclassified as *Paramillerella* in this paper indicate a range for the genus from the Mississippian Osagean to the Pennsylvanian lower Atokan. Its occurrence in the Lower Mississippian, however, is limited to two

species ("*Endothyra*" *taedia* and "*Endothyra*" *disca*, both E. J. Zeller), and only from the Meramecian upwards does *Paramillerella* occur with regularity and abundance.

E. J. Zeller (1950, pl. 6) and Woodland (1958, p. 807) have indicated that the phylogenetic trend of the planispiral forms (their *Endothyra*, our *Paramillerella*) during the Lower and Middle Mississippian was towards larger-sized individuals bearing secondary deposits, especially hooks. This development apparently reached a peak during the Meramecian, inasmuch as Chesteran and Lower Pennsylvanian species of *Paramillerella* show a reversal of these evolutionary lines. These later species are characterized by the return to a smaller size and the disappearance of the hooks. Furthermore, in the Late Mississippian and Early Pennsylvanian paramillerellas the presence of an aperture

(see p. 105)

Whorl No.	Length (in mm.)		Width (in mm.)		Form Ratio		Thickness Spirotheca (in mm.)	
	pl. 9 fig. 15	pl. 10 fig. 5	pl. 9 fig. 15	pl. 10 fig. 5	pl. 9 fig. 15	pl. 10 fig. 5	pl. 9 fig. 15	pl. 10 fig. 5
1	.112	.182	.150	.232	0.75	0.78	.011	.018
2	.175	.315	.295	.477	0.59	0.66	.013	.031
3	.345	.425	.522	.802	0.66	0.53	.030	.025
4	.490	.....	.900	.....	0.54	.....	.023	.....

Whorl No.	Tunnel Angle	Ratio		Width Tunnel to Width Whorl†
		Height Tunnel to Height Whorl*	Width Tunnel to Width Whorl†	
		pl. 9 fig. 15	pl. 10 fig. 5	
1	23°	0.25	0.40	
2	25°	0.29	0.49	0.40
3	29°	.....	.....	

Diameters of Proloculus (in mm.)	pl. 9 fig. 15	pl. 10 fig. 5
	.050 x .060	.050 x .060

\* Height of whorl limited to chamber cavity.  
 † Width of whorl includes wall thicknesses.

becomes sporadic and gradually disappears. The evidence also indicates that the Early Pennsylvanian species of *Paramillerella* tend towards either completely planispiral forms, or possess a very slight asymmetry restricted to the first one or two whorls.

Insofar as an age is indicated for the Bayport Limestone Formation, *Paramillerella thompsoni*, n. sp., because of its vestigial aperture, large size, and limited occurrence of a slightly endothyroid juvenarium, suggests that the Bayport is Meramecian in age, probably equivalent to the St. Louis, as interpreted previously from both megafossils and lithology.

ENVIRONMENT

As the only foraminifer present in bed 4 of the Bayport, *Paramillerella thompsoni*, n. sp., does not furnish much evidence regarding the environment in which deposition of the bed took place. The ostracodes listed by Crane and Kelly (1956, p. 870) merely indicate general marine conditions, while the lithology permits these conditions to be refined to quiet, turbid waters. The presence of many specimens of only a single foraminifer suggests either a delicately constituted marine environment, or a transporting or sorting mechanism of the water which allowed the concentrated accumulation of the primitive fusulinids.

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CONTRIBUTIONS FROM THE CUSHMAN FOUNDATION  
FOR FORAMINIFERAL RESEARCH  
VOLUME XIV, PART 3, JULY, 1963

265. NOMENCLATURE OF FORAMINIFERA<sup>1</sup>

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ABSTRACT

In the nomenclature of Foraminifera, examples of good and bad usage include new names proposed and long-abandoned ones resurrected. Good examples are given of changes made to clear up confusion or to facilitate the distinguishing of similar but unlike species. Bad examples are given of proposed changes that would result in the abandonment of well-known and long-established names. In the interest of stability of nomenclature and in accordance with the Principle of Conservation, changes representative of examples in the second category should be rejected.

DISCUSSION

Within recent months I have had the privilege of discussions with many people concerned with the study of Foraminifera. A recurrent problem in these discussions is the naming (as opposed to the identifying) of species, particularly well-known and widely recognized species about whose nomenclature opinions differ. In the individual solution of the problem of what to call a species there seems to be a serious state of confusion in recognizing the difference between what ought to be done and what must be done. Simply stated, this confusion manifests itself in such questions as "Am I required to follow the recently proposed nomenclature of Nussbaum?" or "Which name must I use for my species, *alpha* or *beta*?"

It seems to me that the best answer to such questions is that no one is obligated to follow any proposed nomenclature, recent or ancient, and that the question of which name to use ought to be answered in terms of the more fundamental question, "Which name will be more widely, clearly, and unequivocally understood?"

Within the last few years there has been a marked increase in the introduction of nomenclatural changes through the resurrection of old and long-unused names. These nomenclatural changes are invariably proposed either in the name of priority or to correct homonymy in conformity with the Rules of Zoological Nomenclature. But some are in apparent disregard of the basic object of the Code of Zoological Nomenclature as expressed in its Preamble: " \* \* \* to promote stability and universality in the scientific names of animals." (International Commission on Zoological Nomenclature, 1961, p. 3).

Many nomenclatural changes can be challenged on various grounds (Todd, 1961) within the framework of the Rules of Zoological Nomenclature, but it now appears that a general objection should be raised to wholesale nomenclatural changes, that is, to changes

made without good and reasonable causes. Efforts to distinguish between similar or closely related and formerly indistinguishable forms, or to clear up situations where historical usage of names has been variable and not uniform, would constitute valid reasons for nomenclatural changes.

The Preamble to the Code states that "Priority is the basic principle of zoological nomenclature." However, the Code continues, "Its application \* \* \* may be moderated to preserve a long-accepted name in its accustomed meaning." It further continues that "When stability of nomenclature is threatened in an individual case, the strict application of the Code may under specified conditions be suspended by the International Commission on Zoological Nomenclature" (International Commission on Zoological Nomenclature, 1961, p. 3).

Thus the framers of the Code recognized the hazard that the Code's own basic principle (priority) constitutes to its underlying object (stability). Moreover, it is surely clear to users of Foraminifera nomenclature that during a period of well over one hundred years (counting from d'Orbigny's *Tableau méthodique de la classe des Céphalopodes*, 1826) little stability of nomenclature has been achieved through strict application of the Rules of Zoological Nomenclature.

Therefore, I recommend that the principle of priority become in fact, as stated in the Preamble, "subservient to these ends [stability and universality], and none [of the Code's provisions, including the application of priority] restricts the freedom of taxonomic thought or action." (International Commission on Zoological Nomenclature, 1961, p. 3).

Briefly summarized, I urge that we let usage itself serve as a primary consideration over the principle of priority. The Principle of Conservation serves the cause of stability better than does the Principle of Priority.

In a brief note, J. Chester Bradley, President of the International Commission on Zoological Nomenclature (Bradley, 1962), has made a similar appeal for the adoption of already established family-group names without regard to their priority. Dr. Bradley describes an instance in which the Code caused a scientist reluctantly to give up the task of monographic studies because the task would have required excessive amounts of time in sterile search of literature and raised the possibility of abandonment of long-established names in favor of older, long-forgotten ones. In such a case the "Code not only fails to stimulate taxonomic work, but actually puts an end to it in its highest and most widely useful form" (Bradley, 1962, p. 178).

<sup>1</sup> Publication authorized by the Director, U. S. Geological Survey.

Bradley's recommendation to remedy this "shocking and intolerable situation" consists of proposed amendments to facilitate the adding of names of the family-group to the Official List of Family-Group Names in Zoology, whereby all names believed to be in undisputed use are to be added without regard to their priority.

In the spirit of Dr. Bradley's proposal, I recommend a similar proposal, applying it to scientific names of any rank—namely, that undisputed, long-established scientific names be accepted because of usage and because those who use them understand what they mean. Let priority or lack of it be disregarded in favor of continued use as a convenient means of communication.

#### EXAMPLES

Following are recent examples of good and bad usage in the nomenclature of Foraminifera.

A.—Genus *Rectoglandulina* Loeblich and Tappan, 1955, for *Pseudoglandulina* Cushman, 1929, suppressed

Through the technicality of the type species belonging to a different genus, the concept of the genus *Pseudoglandulina* was left nameless. In providing a name for the *Pseudoglandulina* concept, the authors (Loeblich and Tappan, 1955) clarified the existing confusion between, and misuse of, *Pseudoglandulina* and *Glandulina*. The erection of *Rectoglandulina* called attention to and clarified a situation that had become confused. Thus, the introduction of a new name tended to increase stability of nomenclature.

B.—Genus *Rosalina* d'Orbigny, 1826, for *Discorbis* (part) of authors

For many years after its original description, *Rosalina* was virtually ignored. Even among those who used it, there was no consistency in the generic concept it carried. Designation of a genotype for *Rosalina* in 1927 (Galloway and Wissler, 1927, p. 62) was the first step in making this genus of use. It was not until 1954, however, when Parker (1954, p. 523) began assigning species to the genus, that *Rosalina* came to find acceptance and general use. Now, together with several other genera whose species were formerly included under *Discorbis*, *Rosalina* serves a useful function. It provides a name for a fairly universally understood restricted generic concept within the formerly very broad and vague generic concept of *Discorbis*. Thus, the resurrection of this old genus has served a useful purpose in clearing up a confused and unstable state that resulted from an unclear generic concept that was being used as a dumping-ground for many similar, but not always related, species.

C.—*Sejunctella earlandi* Loeblich and Tappan, 1957, for *Spirillina lateseptata* Terquem of Cushman, 1931

In erecting a new genus to contain this and other species formerly placed in *Spirillina*—in which the whorls are separated from one another by a plate of granular calcite—the necessary taxonomic change

(Loeblich and Tappan, 1957, p. 228) calls attention to a significant morphologic difference between the two genera.

D.—*Hastigerina*<sup>2</sup> *adamsi* Banner and Blow, 1959, for *Globigerina digitata* Brady, 1884 (part)

In the erection of the new species, *H. adamsi*, Banner and Blow (1959, p. 13) made clear a generic distinction that had been overlooked and was being obscured by a superficial resemblance between two species originally given the same name, *Globigerina digitata* Brady.

E.—*Globigerinella siphonifera* (d'Orbigny) for *Globigerinella aequilateralis* (Brady)

This name change is based on Banner and Blow's (1960) discovery of a specimen said to be d'Orbigny's type specimen of *Globigerina siphonifera*. Banner and Blow, in their detailed description (1960, p. 22) of the minute particulars surrounding the specimen and the probable sequence of events leading up to its preservation in its present circumstances, make it clear that the specimen was one remounted by Terquem (or quite possibly by someone else) during restudy of d'Orbigny's original collection. This situation, combined with the fact that the specimen said to be "the type specimen of *Globigerina siphonifera*" differs from both d'Orbigny's original illustrations (1839, pl. 4, figs. 15-18) and his description (1839, p. 83-84), makes it clear that the presumed "type specimen" was designated and accepted in error.

It is impossible to reconcile d'Orbigny's description of his species, *Globigerina siphonifera*, with the specimen of *Globigerinella aequilateralis* that was accepted on such insecure grounds as the type specimen of *Globigerina siphonifera*. D'Orbigny's original description and figures (1839, p. 83, pl. 4, figs. 15-18) show a species clearly involute on one side and evolute on the other, with the aperture extending from the umbilicus only to the periphery and not over onto the opposite side. Incidentally, although it is generally accepted that small differences in number of chambers are not in themselves of specific importance, the number of chambers in the final whorl (3½ in d'Orbigny's illustrations and 4½ in the proposed lectotype) make it obvious that the specimen described by d'Orbigny and the presumed "type specimen" are not the same. This lectotype should therefore be rejected as not reasonably conforming with what the author described when he erected the species.

F.—Genus *Fursenkoina* Loeblich and Tappan, 1961, for *Virgulina* d'Orbigny, 1826

This generic name was proposed (Loeblich and Tappan, 1961a, p. 314) ill-advisedly when it was learned that the generic name *Virgulina* had been applied to a trematode by Bory de St. Vincent in 1823. In view of the long-continued and undisputed usage of the

<sup>2</sup> Discussion of the generic assignment of the species *H. adamsi* is not pertinent at this time; other publications (Parker, 1962, p. 228; Todd, in press) cover that question.

name *Virgulina* for the foraminifer, it would have been more reasonable to continue the infinitesimal risk of confusion between the foraminifer and the worm (which risk seems not to have bothered zoologists much in the past 135 years) than to introduce more confusion by having a new name. Here stability has been overthrown for the sake of eliminating a homonym. In the interest of stability, the generic name *Fursenkoina* should be rejected and the use of the generic name *Virgulina* continued.

#### G.—Order Foraminiferida for Order Foraminifera

In this instance an extra syllable has been added to the older name, simply for the sake of conformity (Jahn and Jahn, 1949, p. 128; Loeblich and Tappan, 1961a, p. 273). The extra syllable adds nothing to the etymological meaning of the word. Here stability has been overthrown for the sake of conformity. Yet the Code of Zoological Nomenclature does not even include conformity as something to be attained. The extra syllable, adding nothing to the etymological meaning of the word, should be eliminated.

#### H.—Genus *Involutina* Terquem, 1862, for *Ammodiscus* Reuss, 1862, subsequently reversed

The metamorphoses of generic concept in these two fairly well-known and widely reported genera is the ultimate example of taxonomic confusion. Even a casual inspection of the discussions relating to the taxonomy of these two genera (Loeblich and Tappan, 1954; 1961b) is the best object lesson illustrating the hazards of being guided by the principle of priority rather than by the principle of conservation. In addition, it emphasizes the sterility of this kind of research.

### SUMMARY

The prime consideration in nomenclatural problems of the kind discussed above is neither that the Rules be strictly adhered to nor that accepted morphologic relationships be mirrored by our nomenclature. Rather it is that we maintain clear communication amongst ourselves (including the past and the future) so that we reduce, insofar as possible, misunderstanding and oversights. In the interest of uniform usage of scientific names by those who have occasion to refer to fossils in connection with stratigraphic work, as well as by Foraminifera systematists, and in the further interest of stability and continuity of nomenclature extending from past years into the future, I propose that strict application of the Rules of Zoological Nomenclature may fail to serve this end and that a more liberal interpretation of the Rules is necessary. When conflicts arise between long-established usage and strict application of the Rules, let us act in the spirit of the Code of Zoological Nomenclature by permitting the Principle of Conservation to outweigh the Principle of Priority.

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CONTRIBUTIONS FROM THE CUSHMAN FOUNDATION  
FOR FORAMINIFERAL RESEARCH  
VOLUME XIV, PART 3, JULY, 1963

266. NOTES ON THE JURASSIC FORAMINIFERA  
OF NORTHEAST MEXICO

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ABSTRACT

Three biostratigraphic zones can be defined from beds of Late Jurassic age in northeast Mexico. Many of the species found are believed to be new.

INTRODUCTION

Extensive collections were made from the La Casita Group of the Grutas de Garcia anticline by Teodoro Diaz G. and the writer in 1960. It is the writer's intention to describe the Jurassic foraminifera from this group in the near future. The present paper is preliminary, being the first paper of a series.

Samples were collected on the west flank of the Grutas de Garcia anticline in a section measured previously by Dr. William E. Humphrey and Teodoro Diaz G. in 1956.

STRATIGRAPHY

The Jurassic deposits of the Grutas de Garcia anticline, which are equivalent to the La Casita Group and La Caja Formation, were defined by Imlay (1936) as the uppermost Jurassic sediments in northeast Mexico as based on ammonite assemblages. In the Grutas de Garcia anticline, the La Casita Group overlies the Zuloaga Limestone (Zuloaga Group) and underlies the Taraises Formation (Durango Group). The age of the La Casita Group is Late Jurassic. The lower part is equivalent to the Kimmeridgian Stage, the middle part to the Portlandian Stage, and the upper part to the Tithonian Stage.

FORAMINIFERA

Foraminifera are very rare in the beds of the La Casita Group of the Grutas de Garcia anticline as compared to their occurrences in Cretaceous or Tertiary formations. Genera and species are few in number, and most of the specimens are small and poorly preserved, making it extremely difficult to find them in the washed samples.

After a preliminary analysis of the microfauna we found—a priori—three biostratigraphic zones, based on the foraminiferal generic ranges.

Zone I, restricted to the lower 413 feet, overlies the Zuloaga Formation which is part of the Upper Kimmeridgian according to its stratigraphic position. This zone, of which about 80% is covered, consists of gray, impure, thin-bedded, platy, considerably distorted and welded limestone; there are some interbeds of gray, red weathering, platy, calcareous and laminated shales. The microfauna is poorly represented by a few genera

and species. In the lowermost beds there is a faunule consisting of *Trocholina* cf. *T. elongata* (Leupold) associated with a few specimens of *Patellina* sp., *Coscinoconus* sp., *Patellinella* sp., *Textularia* cf. *T. jurasica* (Gümbel) and other foraminifera so poorly preserved that it is impossible to identify them even generically. None of these forms is present in zones II and III, and, therefore, they are index forms for Zone I.

Overlying Zone I, there is a tremendous section 1969 feet thick consisting essentially of shales with interbeds of limestone containing *Idoceras* sp. The upper 262 feet of Zone II are somewhat different to the lower 1707 feet, especially in color and faunal content. For this reason, the upper part of Zone II is considered to be a subzone with an *Epistomina-Haplophragmoides* complex. In this zone, all the species from Zone I have disappeared. The predominant foraminiferan throughout is *Epistomina* sp.

The uppermost 570 feet of Zone III consists of: a) a basal sandstone and medium- to thick-bedded brown limestone containing *Exogyra* cf. *E. potosina* Castillo and Aguilera, and b) black, carbonaceous shales containing earthy limestone concretions with fragmentary pyritized ammonites. The predominant species throughout the zone is *Spirocyclina* cf. *S. lusitanica* (Egger). Within the beds of Zone III, there are two subzones. The first subzone overlies the *Exogyra* limestone and is characterized by a *Tritaxia-Haplophragmium* complex. The second subzone corresponds to the uppermost 65 feet, consisting of *Lenticulina* sp., *Spirillina* sp. and *Spirocyclina* *S. lusitanica* (Egger). Thin sections of the earthy concretions show *Calpionella alpina* Lorenz, *C. elliptica* Cadish, and *Nannoconus steimanni* Kamptner. Within the concretions, Dr. W. E. Humphrey found *Berriasella* sp. and *Susteueroeras* sp.

Many species were found in the samples collected from the Grutas de Garcia anticline whose identities were unknown to the writer; it is believed that some of these species have not been described and should be investigated. Some samples have been sent to European paleontologists specializing on Jurassic faunas and they report that most of the species sent to them have not been described.

REFERENCES CITED

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267. *TROCHAMMINA PEIRSONAE*, NEW NAME FOR  
*T. CHITINOSA* UCHIO, PREOCCUPIED

TAKAYASU UCHIO

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The writer was recently informed by Mrs. Jean Peirson Hosmer that *Trochammina chitinos* Uchio (1960, Cushman Found. Foram. Research, Special Pub. no. 5, p. 58, pl. 3, figs. 22, 23), described from off San Diego, California, is preoccupied by *Trochammina*

*chitinos* Collins (1958, Great Barrier Reef Expedition, 1928-29, Sci. Repts., vol. 6, no. 6, p. 354, pl. 1, figs. 12a, b, c). The new name *Trochammina peirsonae* is proposed for the San Diego form.

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RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the Foraminifera that have come to hand.

- ACCORDI, B. Some data on the Pleistocene stratigraphy and related pigmy mammalian faunas of eastern Sicily.—*Quaternaria*, v. 6, 1962, p. 415-429, pls. 1, 2, text figs. 1-3 (map, geol. sections).—Foraminifera listed from two Quaternary formations.
- ALEXANDROWICZ, S. W. Microfauna and stratigraphical position of Miocene clays from Iwkowa and Zegocina (Western Carpathians).—*Bull. Acad. Polonaise Sci., ser. sci. geol. geogr.*, v. 10, No. 3, 1963, p. 161-166, photomicrograph, map, distrib. table.—Of early Tortonian age.
- ANDRUSOV, D., BYSTRICKA, H., and KÖHLER, E. Le niveau à Globigérines dans le Paléogène des Karpates Centrales (French summary of Czech text).—*Geol. Sbornik, Bratislava, roc. 13, cislo 2*, 1962, p. 179-182.
- ANIC, DRAGUTIN. Ein Beitrag zur Kenntnis der Jura und der Kreide des östlichen Teiles von Biokovo-Gebirges (German summary of Yugoslavian text).—*Geol. Vjesnik, Zagreb, sv. 15, broj 1*, 1961 (1962), p. 161-175, pls. 1-14, text fig. 1 (map).—Includes illustrations of Foraminifera in thin section.
- BANDY, ORVILLE L., and KOLPACK, RONALD L. Foraminiferal and sedimentological trends in the Tertiary section of Tecolote Tunnel, California.—*Micropaleontology*, v. 9, No. 2, April 1963, p. 117-170, text figs. 1-35 (map, columnar section, correl. charts, frequency distrib. diagrams, paleobathymetry diagram, geol. section, graphs, photomicrographs, range chart, foram drawings), tables 1-4.—Qualitative and quantitative study of some Tertiary parts of the faulted tunnel section. Age (middle Eocene to Miocene) and paleoecology (bathyal, alluvial fan, shallow-water, and deep-silled basin deposits) are based on evidence of the Foraminifera. Four planktonic Foraminifera zones are established, one in the Eocene and three in the Miocene. The appearance of *Orbulina universa* in the upper Saucesian is judged to be equivalent to the base of the Burdigalian.
- BANNER, F. T., and CLARKE, W. J. Type species of foraminiferal genera.—*Nature*, v. 196, No. 4861, Dec. 29, 1962, p. 1334-1335.—List of specimens selected and awaiting formal validation as lectotypes and neotypes of species that are type species of genera.
- BARNARD, TOM. Polymorphinidae from the Upper Cretaceous of England.—*Palaeontology*, v. 5, pt. 4, Feb. 1963, p. 712-726, text figs. 1-8.—Illustrations and descriptions of six species and one subspecies from the Chalk, none new. Fistulose forms are regarded as abortive offshoots, not true species.
- BELJAEVA, N. V. Raspredelenie Planktonnykh Foraminifer v Vodakh i Osadkakh Indijskogo Okeana.—*Akad. Nauk SSSR, Geol. Institut.*, 1962, p. 1-19 (reprint).
- BENDA, WILLIAM K., and PURI, HARBANS S. The distribution of Foraminifera and Ostracoda off the Gulf Coast of the Cape Romano area, Florida.—*Trans. Gulf Coast Assoc. Geol. Soc.*, v. 12, 1962, p. 303-341, pls. 1-5, text figs. 1-12 (maps), tables 1-8.—Quantitative analysis and illustration of species from four facies (marsh river, lagoonal, mangrove island, and open gulf).
- BORSETTI, ANNA MARIA. Foraminiferi planctonici di una serie Cretacea dei dintorni di Piobbico (Prov. di Pesaro).—*Giornale di Geol., Ann. Museo Geol. Bologna, ser. 2, v. 29*, 1960-61 (1962), p. 19-75, pls. 1-7, text figs. 1-245 (on 7 pls.), text figs. A-B (map, columnar section), tables 1, 2 (occurrence table, range chart).—From a series of 17 samples extending from Albian to Maestrichtian, 46 planktonic species and subspecies are described and illustrated. One subspecies is new and another is given a new name.
- BRAUSE, HERMANN, HIRSCHMANN, GOTTFRIED, and TRÖGER, KARL-ARMIN. Einige neue Ergebnisse aus dem Paläozoikum der Lausitz (Die Kartierungsbohrungen am Camina-Berg).—*Geologie, Berlin, Jahrg. 11, heft 7*, Aug. 1962, p. 792-817, pls. 1, 2, text figs. 1-4 (map, drawings, graphs, geol. section).—Foraminifera illustrated from the lower Carboniferous.
- BRÖNNIMANN, PAUL and WIRZ, ALBERT. New Maestrichtian Rotaliids from Iran and Libya.—*Eclogae Geol. Helvetiae*, v. 55, No. 2, Dec. 31, 1962, p. 519-528, text figs. 1-7 (diagram, drawings).—Two new genera of orbitoid-like rotaliids: *Sirtina* (genotype *S. orbitoidiformis* n. sp.) and *Vandenbergia* (genotype *V. trochoidea* n. sp.), probably from a middle to outer shelf environment.
- CEBULSKI, DONALD E. Foraminiferal populations and faunas in the barrier reef and lagoon of British Honduras (abstract).—*Trans. Gulf Coast Assoc. Geol. Soc.*, v. 12, 1962, p. 283, 284.—Species listed from reef, channel, and lagoon assemblages.
- CHARMATZ, RICHARD. On "*Hastigerina digitata* Rumbler, 1911".—*Micropaleontology*, v. 9, No. 2, April

- 1963, p. 228.—The type species of *Hastigerinella* should be *H. eocanica* Nuttall.
- COLACICCHI, R., and ROMEO, M. La sedimentazione miopliocenica nel territorio di Pachino.—Atti Accad. Gioenia Sci. Nat. Catania, ser. 6, v. 13, 1960, p. 1-38, pls. 1-3, text figs. 1-5 (geol. sections, graphs), map.—Includes lists of species, quantitative composition diagrams, and photographs of assemblages from the Tortonian, Messinian, and lower Pliocene.
- COLE, W. STORRS. Illustrations of conflicting interpretations of the biology and classification of certain larger Foraminifera.—Bull. Amer. Pal., v. 46, No. 205, Feb. 13, 1963, p. 1-63, pls. 1-14, text fig. 1 (graph).—Multilocular embryonic chambers are a result of irregularities in the reproductive cycle, hence cannot be used in generic definitions and are not stratigraphically significant.
- CONKIN, JAMES E., CONKIN, BARBARA M., and McDONALD, DONALD. Mississippian smaller Foraminifera from the southern peninsula of Michigan.—Micropaleontology, v. 9, No. 2, April 1963, p. 215-226, pl. 1, text figs. 1-5 (map, distrib. table, correl. charts, range chart), tables 1-13.—Nine species (one new and two indeterminate) from the Coldwater shale.
- CORDEY, WILLIAM GRIFFITH. Foraminifera from the Oxford Clay of Staffin Bay, Isle of Skye, Scotland.—Senckenbergiana lethaea, Band 43, No. 5, Nov. 15, 1962, p. 375-409, pls. 46-48, text figs. 1-62 (map, columnar section, drawings, graphs), tables 1, 2 (range and abundance charts).—Illustrated catalog of 42 species (two new and one given a new name) and one new subspecies and one variety.
- CUVILLIER, J. *Angotia aquitanica*, Foraminifère nouveau du Lutétien d'Aquitaine.—Revue de Micropaléontologie, v. 5, No. 4, March 1963, p. 223-225, pl. 1.—A low conical form, known only from thin section, possibly related to *Gypsina*.
- DABAGYAN, N. V. Foraminifers from Oligocene deposits in the environment of the village Uzhok (River Uzh), eastern Carpathians (English summary of Russian text).—Paleont. Sbornik, No. 1, Lvov. Geol. Obschsh., 1961, p. 97-104, 173, pls. 1-4.—Illustrations of a few species, one new.
- DAS, RUPENDRA MOHAN, and CHATTERJEE, BHASKAR PROSAD. Upper Cretaceous smaller Foraminifera from the gypseous clays of the 'Uttattur Beds' of the Uttattur Group, Trichinopoly District, Madras State.—Bull. Geol. Min. Metallurg. Soc. India, No. 28, Jan. 1963, p. 1-20, pl. 1, fig. 1 (map).—Illustrated systematic catalog of 46 species, tentatively indicating Senonian age.
- DECIMA, A. Osservazioni sulle argille ritenute plioceniche del versante meridionale delle Madonie (Sicilia centro-settentrionale).—Riv. Ital. Pal. Stratig., v. 68, No. 3, 1962, p. 389-428, pls. 29, 30, text figs. 1-3 (map, drawings), tables 1-3.—Quantitative analysis of 13 samples across a sequence, formerly interpreted as Pliocene tectonically emplaced beneath Messinian beds, reveals its late Tortonian age instead. A few species from the rich fauna are illustrated.
- DOUGLASS, RAYMOND C. Fusulinidae of the Brownville through Americus interval in Kansas, in Mudge, Melville R., and Yochelson, Ellis L., Stratigraphy and paleontology of the uppermost Pennsylvanian and lowermost Permian rocks in Kansas.—U. S. Geol. Survey Prof. Paper 323, 1962 (April 11, 1963), p. 55-64, 120-122, pls. 6-10, text fig. 28 (diagram), tables 2-4.—Nine species (two new) described and illustrated.
- DU BAR, JULES R., and TAYLOR, DONALD S. Paleogeology of the Choctawhatchee deposits, Jackson Bluff, Florida.—Trans. Gulf Coast Assoc. Geol. Soc., v. 12, 1962, p. 349-376, text figs. 1-11 (map, facies diagram, columnar sections, graphs), tables 1-6, check lists.—Interpretation based on comparison with extant foram and mollusk communities in the Gulf and other areas.
- DUPEUBLE, P. A. Aperçu sur la répartition des principales familles de Foraminifères dans trois faciès de la région de Roscoff (Finistère).—Revue de Micropaléontologie, v. 5, No. 4, March 1963, p. 277-279, text figs. 1-3 (pie diagrams).—Analyses at the family level show striking quantitative differences between facies in shell sand, in *Zostera* grass, and in debris of calcareous algae.
- EISENACK, ALFRED. Mikrofossilien aus dem Ordovizium des Baltikums. 2. Vaginatenskalk bis Lyckholmer Stufe.—Senckenbergiana lethaea, Band 43, No. 5, Nov. 15, 1962, p. 349-366, pl. 44, text figs. 1-7 (drawings), tables 1-3.—A few Foraminifera listed.
- EMILIANI, CESARE, GIANOTTI, AGOSTINO, and MAYEDA, TOSHIKO. Analisi isotopica dei foraminiferi Siciliani delle argille di Ficarazzi, Palermo.—Quaternaria, Roma, v. 5, 1958-61, p. 135-141, 1 graph.—Marked temperature oscillations between 19° and 28° C.
- ERICSON, DAVID B., EWING, MAURICE, and WOLLIN, GOESTA. Pliocene-Pleistocene boundary in deep-sea sediments.—Science, v. 139, No. 3556, Feb. 22, 1963, p. 727-737, text figs. 1-14 (map, graphs, photographs, photomicrographs).—Beginning of Pleistocene is interpreted as coinciding with extinction of discoasters and of *Globigerinoides sacculifer fistulosa*, abundant appearance of *Globorotalia truncatulinoides*, and changes in *Globorotalia menardii* complex (coiling direction, in-

crease in average size and decrease in abundance, and change from a complex to a single race). The boundary was found in seven deep-sea cores in the Atlantic and one in the southern Indian Ocean.

- FARINACCI, ANNA. Nuova genere di Verneuilinidae (Foraminifera) marker di zona del Senoniano inferiore (with English translation).—*Geologica Romana*, v. 1, 1962, p. 5-10, pls. 1-5, text fig. 1 (map).—*Accordiella* gen. nov. (type species *A. conica* sp. nov.), a direct offspring of *Dukhania*, found in association with lower Senonian rudistids.
- FORD, A., and HOUBOLT, J. J. H. C. The microfacies of the Cretaceous of western Venezuela.—*Internat. Sedimentary Petrographical Ser.*, Leiden, v. 6, 1963, p. 1-55, photomicrographs 1-109, text figs. 1-8 (maps, diagrams, graphs).—Book includes illustrations of thin sections of various formations, many showing Foraminifera.
- FUKUTA, OSAMU. Eocene Foraminifera from the Kyoragi beds in Shimo-shima, Amakusa Islands, Kumamoto Prefecture, Kyushu, Japan.—*Geol. Survey Japan, Rept. No. 194*, 1962, p. 1-31, pls. 1-8, text figs. 1-8 (map, outline drawings), tables 1, 2.—Illustrated systematic catalog of about 60 species (nine new), indicating late Ypresian to Lutetian age. Predominance of *Cyclammina*, other arenaceous genera, and representatives of the Nodosariidae, suggests deposition at bathyal depths.
- GARTNER, S., JR., and HAY, WILLIAM W. *Eclogae Geol. Helvetiae*, v. 55, No. 2, Dec. 31, 1962, p. 553-572, pls. 1, 2, table 1.—Eleven species of *Globorotalia* (one new) and six of *Globigerina* from the type locality of the Ilerdian stage, marine upper Paleocene.
- GASPARINI, MARIA GRAZIA. Le microfaune del Quaternario di Spinagallo (Siracusa) (with English summary).—*Geologica Romana*, v. 1, 1962, p. 237-254, pls. 1-3, text figs. 1-3 (graphs, pie diagrams), tables 1-5.—Qualitative and quantitative analysis of six samples from a section extending from the Sicilian into the overlying Milazzian. A few species are illustrated from the Milazzian part of the section.
- GOLEV, B. T. Representatives of the *Operculina* and *Neoperculinoides* from the Eocene deposits of the Bukovina-Pokutye Carpathians (English summary of Russian text).—*Paleont. Sbornik No. 1*, Lvov. Geol. Obschsh., 1961, p. 61-69, 172, pls. 1, 2.
- GRIGORJAN, S. M. Nummulyty iz Oligothenovykh Otlozhenij Erevanskogo Bassejna.—*Akad. Nauk Armjanskoj SSR, Erevan, Izvestija*, tom 13, Nos. 3-4, 1960, p. 3-18, pls. 1, 2.—Three species of *Nummulites*.
- GUILLAUME, SOLANGE. Les Trocholines du Crétacé du Jura.—*Revue de Micropaléontologie*, v. 5, No. 4, March 1963, p. 257-276, pls. 1-6.—An inventory of seven species (one new) from the Valanginian, one from the Hauterivian, and three (two indeterminate) from the Barremian.
- HAQUE, A. F. M. MOHSENUL. Some middle to late Eocene smaller Foraminifera from the Sor Range, Quetta District, West Pakistan.—*Mem. Geol. Survey Pakistan, Palaeontologia Pakistanica*, v. 2, pt. 2, 1959 (1960), p. 1-79, pls. 1-6, text figs. 1-12 (map, drawings), tables 1, 2.—Descriptions and illustrations of over 100 species, 35 new. The genera *Pseudopatellina* (type species *P. arthurcooperi* n. sp.) and *Soriella* (type species *S. schoechlei* n. sp.) are described as new in the Spirillinidae and Anomalinidae respectively.
- HAY, WILLIAM W., TOWE, KENNETH M., and WRIGHT, RAMIL C. Ultramicrostructure of some selected foraminiferal tests.—*Micropaleontology*, v. 9, No. 2, April 1963, p. 171-179, pls. 1-16.—The wall structures of ten identified species, representing eight different families, are studied at high magnifications by light microscopy and electron microscopy to correlate submicronic structures of test surfaces with features observed in thin sections.
- HEDLEY, R. H. *Gromia oviformis* (Rhizopodia) from New Zealand with comments on the fossil Chitinozoa.—*New Zealand Jour. Sci.*, v. 5, No. 2, June 1962, p. 121-136, text figs. 1-7 (photomicrographs, drawings).—Detailed description and high-magnification photographs of the living animal. In possessing non-granular and non-reticulate pseudopodia, they differ from Foraminifera.
- VON HILLEBRANDT, AXEL. Das Alttertiär im Becken von Reichenhall und Salzburg (Nordliche Kalkalpen).—*Zeitschr. Deutschen Geol. Gesell.*, Band 113, teil 2-3, Jahrg. 1961, June 1962, p. 339-358, text figs. 1-7 (range charts, correl. charts, columnar sections, map, geol. sections).—Occurrence of planktonic species shown in seven Paleocene and six Eocene zones, between Danian and Ledian, and the correlation of these zones with zones in the Caucasus and Trinidad.
- Das Alttertiär im Mont Perdu-Gebiet (Spanische Zentralpyrenäen).—*Eclogae Geol. Helvetiae*, v. 55, No. 2, Dec. 31, 1962, p. 295-315, pls. 1-6, text figs. 1-3 (map, columnar sections).—Thin section illustrations of Eocene Foraminifera.
- HOFKER, J. Mise au point concernant les genres *Pragoglobotruncana* Bermudez, 1952, *Abathomphalus* Bolli, Loeblich and Tappan, 1957, *Rugoglobigerina* Bronnimann, 1952, et quelques espèces de *Globorotalia*.—*Revue de Micropaléontologie*, v. 5, No. 4, March 1963, p. 280-288, pls. 1, 2.—The genera that have been established for the distinction of Cretaceous from Tertiary planktonic Foraminifera are artificial. Synonymity is suggested

between *Praeglobotruncana*, *Rugoglobigerina* and *Globigerina* and between *Abathomphalus* and *Globotruncana*.

- JARKE, JOACHIM. Beitrag zur Kenntnis der Foraminiferenfauna der Mittleren und Westlichen Barents-See.—Internat. Revue Gesamten Hydrobiol., Berlin, v. 45, heft 4, 1960, p. 581-654, pls. 1-13, text figs. 1-25 (maps, drawings), tables 1-4.—Quantitative analysis of 27 samples taken between depths of 58 and 480 meters. Illustrated systematic catalog includes about 55 species.
- KIPRIJANOVA, F. V. Stratigrafija Morskikh Melovykh Otlozhenij Vostochnogo Sklona Srednego Urala v Svete Izuchenija Foraminifer.—Akad. nauk SSSR, Ural. filial, Sverdlovsk, Gorno-geol. instit., Trudy, vyp. 61, 1961, p. 11-48, text figs. 1-15 (maps, columnar sections, photomicrographs), occur. and abund. table.—Typical assemblages from various parts of the Cretaceous section.
- KOCHANSKY-DEVIDÉ, VANDA, and MILANOVIC, MOMCILO. Unterpermische Fusuliniden und Kalkalgen des Tara-Gebiets in der Mittleren Crna Gora (Montenegro) (German summary of Yugoslavian text).—Geol. Vjesnik, Zagreb, sv. 15, broj 1, 1961 (1962), p. 195-227, pls. 1-8, text fig. 1 (map).—Three new species and a new subspecies of fusulinids are described.
- LOEBLICH, ALFRED R., JR., and TAPPAN, HELEN. *Discolithus* Fortis, 1802 (Foraminiferida), and its type species.—Jour. Paleontology, v. 37, No. 2, Mar. 1963, p. 488-490.—*Orbitolites complanata* Lamarck designated type species in order to make *Discolithus* a synonym of *Orbitolites*.
- LUDBROOK, N. H. Stratigraphy of the Murray Basin in South Australia.—Geol. Survey So. Australia, Bull. No. 36, p. 1-96, pls. 1-8, text figs. 1-36 (columnar sections, photographs, maps), tables 1-11.—Includes several micropaleontological logs and illustrations of Eocene, Oligocene, and Miocene smaller Foraminifera from several subsurface formations.
- MAGNÉ, J., and POLVECHE, J. Sur le niveau à *Actinocamax plenus* (Blainville) du Boulonnais.—Soc. Géol. du Nord, Lille, Ann., tome 81, livr. 1, 1961, p. 47-62, text figs. 1-8 (map, columnar sections, distrib. and abund. tables).—The age of the *Actinocamax plenus* beds is determined (by planktonic Foraminifera) as largely upper Cenomanian but with the top of the formation in the lower Turonian.
- MARTIN, BRUCE D. Rosedale Channel—evidence for late Miocene submarine erosion in Great Valley of California.—Bull. Amer. Assoc. Petr. Geol., v. 47, No. 3, March 1963, p. 441-456, text figs. 1-7 (maps, geol. sections), table 1.—Coarse sediments that fill a canyon eroded into shale are interpreted as a deep-water turbidity current deposit. Depth of deposition (more than 1,300 feet) of the channel fill is interpreted on the basis of Foraminifera.
- McGUGAN, ALAN. Upper Cretaceous foraminiferal zones, Vancouver Island, British Columbia.—Jour. Alberta Soc. Petr. Geol., v. 10, No. 11, Dec. 1962, p. 585-592, text figs. 1-4 (map, correl. diagram, distrib. and abund. charts).—Three zones, extending from Campanian to Maestrichtian, are recognized in two sedimentary basins.
- McKAY, W., and GREEN, R. Mississippian Foraminifera of the southern Canadian Rocky Mountains, Alberta.—Research Council of Alberta, Bull. 10, Feb. 1963, p. 1-77, pls. 1-12, text figs. 1-4 (map, correl. chart, occur. and abund. charts).—Several zones based on endothyrids are recognized and interpreted as late Kinderhookian to early Chesterian. Thirty-six species (eight new and one given a new name) are described and illustrated. *Granuliferelloides* n. gen. (type species *G. jasperensis* n. sp.) is erected.
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