Contributions from the Cushman Foundation for Foraminiferal Research

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The numerous students and paleontologists who have worked at the Cushman Laboratory for Foraminiferal Research, Sharon, Massachusetts, will be saddened to learn of the death of Mrs. Frieda Billings Cushman. Mrs. Cushman published no papers as an author, but she made numerous indirect and important contributions to the study of Foraminifera. As the wife of the late Joseph Augustine Cushman, the founder and director of the Cushman Laboratory, her unusual vitality was devoted daily to maintaining a schedule and to performing routine and odd duties that would have dissipated the energy of the Director.

Frieda Gerlach Billings was born in Roxbury, Massachusetts, the second and only living child of Frank S. Billings and Harriet M. (Roulstone) Billings. A son born earlier had died in infancy while Frieda's father was studying in Germany. In 1913 Frieda came as a bride to a new home in Sharon, and there she assumed the care of the three young children of Joseph A. Cushman—Robert Wilson, Alice Eleanor, and Ruth Allerton. For more than 50 years she lived in the house at 76 Brook Road and was the last to leave it after making generous dispositions of the various paintings, antiques, books and other personal treasures it contained. After a brief illness, she died in the adjoining town of Norwood.

In the home on Brook Road, Mrs. Cushman created an atmosphere of hospitality and maintained a schedule of her own numerous family and community activities as well as those of the Cushman Laboratory. Her extraordinary organizational ability facilitated two trips to Europe—in 1927 and 1932—for visits to scientific colleagues and to museums. Annual summertime schedules included moving both the family and much of the laboratory work to a summer place on Cape Cod in the early years and to a cottage in Randolph Valley north of the Presidential Range in New Hampshire in the later years.

At various times Mrs. Cushman and her cousin, Miss Susan Minns, donated considerable funds to bear the costs of monographic studies and publication. After Dr. Cushman's death, a large gift was instrumental in launching the Cushman Foundation for Foraminiferal Research whose Contributions series is now in its 17th volume and whose Special Publications series numbers seven, with others in process.

All paleontologists who use the extraordinary volume of publications that came from Sharon or have been published by the Cushman Foundation are in some way indebted to this splendid lady. Those who had the good fortune to study at the laboratory will recall with pleasure Mrs. Cushman's outgoing personality, her warm hospitality, and her interesting guided tours to New England's places of historic and literary significance.

Lloyd G. Henbest
Ruth Todd
INTRODUCTION

The universally accepted opinion contained in the pertinent literature is that bentonic foraminifera live only on the surface of the sea floor and can survive only slight burial in bottom sediments. According to Myers (1943), a foraminifer buried in sandy sediments at a depth not exceeding five to seven times its own diameter can return to the surface of the sediments, and such larger forms as *Elphidium crispum* (Linné) can successfully emerge from a depth of one centimeter. If deeper burial occurs, they may survive for a short period (up to two or three months for *E. crispum*), but succumb with more prolonged burial. Myers further noted that after heavy storms as much as 80 per cent of the bentonic foraminifera in the vicinity of Plymouth, England, are buried and perish, being unable to exhume themselves. He considers the formation of pyrite within the shell to be an indication of death resulting from burial in oxygen-deficient sediments, conclusions reached by other workers as well.

Some observations made during recent years indicate the need for further critical examination of the problem. Richter (1961), for example, noted that *Nonion depressulus* (Walker and Jacob) can live buried under 4 centimeters of sediment, and in a more recent paper (1964) he recounted the discovery of the same species, as well as *Elphidium adesseynense* (Heron-Allen and Earland), alive at a depth of 6 centimeters. Green (1960), in a core from the Arctic Sea, found specimens containing protoplasm at a depth 20 centimeters beneath the sediment surface, but, in the light of Myers' observations, rejected the possibility of the organisms being alive and suggested that the staining method (Walton's Rose Bengal) was at fault.

The usual explanation of the inability of foraminifera to live buried under a relatively great thickness of sediment is the lack of available oxygen, but the scarcity of food and the probable presence of toxic substances produced by bacteria must also play an inhibitory role.

In spite of conflicting conclusions in the literature, my studies on the foraminiferan fauna of Chile have led me to the conclusion (1963b) that the oxygen requirements of the foraminifera are not limiting factors for several bentonic species that happen to be so buried. *Bolivina*, for example, is one genus of which this is particularly true. These initial observations prompted me to examine further the role played by oxygen during the burial that so frequently befalls foraminifera in life.

MATERIALS AND METHODS

Deseado Creek, running into the South Atlantic at latitude 47° 45' S., longitude 65° 55' W., was chosen for the study because (1) of the convenient proximity of essential research facilities at the Puerto Deseado Marine Biological Station; (2) of my familiarity with the foraminiferan fauna in the area (Boltovskoy, 1963a); and (3) the area, being several kilometers from the open coast, is relatively sheltered and experiences no heavy surf action, even during the most violent storms, although fairly strong tidal currents are developed there. The study was conducted during the month of February in 1964 and 1965, during the Chilean summer, when storms are unusual in the area. These circumstances gave reasonable assurance that important movement of the sediments and attendant burial of the foraminifera would not occur during the course of the experiment.

The study is based upon 53 cores ranging to 27 centimeters in length, the majority, however, between 12 and 15 centimeters. The upper part of the sublittoral zone (first 1 to 2 meters below the level of the lowest ebb tide) was sampled, centering around the Ipas pier, Quinta island and the area between Zar inlet and Los Conejos island. The first two are 4 kilometers from the seacoast, the last 12. Other cores were taken at the outlet of the Paraguay gorge, near Roca Foca and — 60 kilometers farther north — Cabo Blanco. The cores were obtained by means of a device designed by Lankford (Boltovskoy, 1965) that permits the recovery of undisturbed sediment cores having a diameter of 3.4 centimeters.

Immediately after collection, the core was returned to the laboratory, divided into segments 1

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1 Contribution No. 25 of the Puerto Deseado Marine Biological Station.
2 Carrera del Investigador Científico, Consejo Nacional de las Investigaciones Científicas y Técnicas, Argentina.
to 3 centimeters in length, fixed in 5 to 10 per cent formalin, washed through a no. 250 screen (69-micron openings), treated with rose Bengal and washed to remove excess dye. The samples were then dried and all specimens of foraminifera bearing protoplasm were picked, identified, counted and their density per cubic centimeter calculated for the different depths. In some cases, time permitted the removal and treatment of only the top and bottom fractions of a core.

Throughout the study, every precaution was taken to eliminate contamination. A 2-millimeter thickness was scraped from the outside of some of the cores and discarded in an effort to avoid contamination by vertical displacement of specimens within the coring device, and only those specimens were considered alive that clearly revealed the presence of protoplasm in the inside or near the opening of the shell. It is of some interest to note that shells having pyrite within them were practically nonexistent in the samples.

RESULTS AND CONCLUSIONS

The maximum depth at which specimens containing protoplasm were found was 16 centimeters. A specimen of Elphidium macellum (Fichtel and Moll) was found at this depth in one core, while a specimen of Epistominella exigua (Brady) and one of Elphidium magellanicum Heron-Allen and Earland were found in a second.

Both the number of cores containing such specimens and the number of species encountered increased at a depth of 15 centimeters, where specimens of the following were found: Buccella frigida (Cushman), Cibicides akenarianus (d’Orbigny), Elphidium articulatum (d’Orbigny), Trochammina inflata (Montagu) and Bolivina pseudoplicata Heron-Allen and Earland.

Elphidium gunteri Cole, Buliminella elegantissima (d’Orbigny), and Trochammina ex gr. squamosa Jones and Parker were new additions at 14 centimeters and Rotalia beccarii (Linné) at 13.

With further decrease in depth, the number of species and individuals increases. The progression was slow in the interval from 12 to 14 centimeters and from 8 to 10 centimeters, during which the number of specimens was restricted and only Bulimina patagonica d’Orbigny and Trochammina ochracea (Williamson) were added, but the number of species encountered between 4 and 6 centimeters was almost twice that between 12 and 14.

The values obtained are summarized in the following tabulation:

<table>
<thead>
<tr>
<th>Depth in Centimeters</th>
<th>Number of Species</th>
<th>Specimens per cc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>28</td>
<td>1.06</td>
</tr>
<tr>
<td>4-6</td>
<td>22</td>
<td>0.36</td>
</tr>
<tr>
<td>8-10</td>
<td>14</td>
<td>0.26</td>
</tr>
<tr>
<td>12-14</td>
<td>12</td>
<td>0.23</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Of the three principal collecting areas, specimens containing protoplasm occurred at greatest depth (16 centimeters) near Quinta island. In the Zar inlet and Los Conejos island areas, maximum penetration was about 11 centimeters, while near Ipas pier only a few specimens (Elphidium) penetrated as far as 7 to 8 centimeters. Such a pattern seems to be related to sediment size, to which, in turn, available oxygen is, of course, related. According to Mr. J. Remiro (Museo Argentino de Ciencias Naturales “B. Rivadavia”) a granulometric analysis of the samples, based on the Wentworth scale, has shown the following:

1. Near Quinta island, the sediment is a medium-coarse sand, most particles between 250 and 1000 microns. Isolated fragments of gravel size (greater than 1 centimeter) occur.

2. Between Zar inlet and Los Conejos island, the sediment is a fine-medium sand, most particles between 125 and 500 microns. Some isolated fragments of gravel size occur.

3. Near Ipas pier, the sediment is a clayey silt, most particles from colloidal size to 62 microns. Approximately 10 percent sand and gravel occurs.

The penetration of sediments by the foraminifera is greatest in the coarser sediments, found near Quinta island. One can then conclude that the vertical penetration is related to, and probably dependent in large part upon, aeration; but at the same time it should be emphasized that the oxygen requirements might actually be less than generally believed. The observations at Deseado Creek suggest that protoplasm-containing foraminifera might well be encountered at still greater depths in sediment, that the presence of such noted at a depth of 20 centimeters by Green (op. cit.), for example, might well be valid and not an indication of a technical failure.

Some further light on oxygen requirements might be shed by the observation that I have kept a small vial (35 mm. high, 23 mm. in diameter) of Allocromia laticollaris Arnold closed for a period of 21 days during the course of travels between San Francisco and Buenos Aires and that upon arrival in Argentina all specimens were alive and well preserved, this in spite of admonitions to open the vial periodically in order to improve the aeration of the sample.

The limited scope of this and previous studies permits no conclusions concerning survival rates for
species in different sediment types, but extensive studies in this direction should prove instructive.

REFERENCES CITED


GREEN, K. E., 1960, Ecology of some Arctic Foraminifera: Micropaleontology, v. 6, no. 1, p. 57-78, textfigs. 1-9, tab. 1-6, pl. 1.


CONTRIBUTIONS FROM THE CUSHMAN FOUNDATION FOR FORAMINIFERAL RESEARCH

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315. ANNOTATED BIBLIOGRAPHY OF PALEOZOIC NONFUSULINID FORAMINIFERA, ADDENDUM 3

DONALD FRANCIS TOOMEY

Pan American Petroleum Corporation Research Center, Tulsa, Oklahoma

ABSTRACT

This addendum includes 115 annotated references pertaining to Paleozoic nonfusulinid Foraminifera and can be considered reasonably complete through the year 1963. As in previous bibliographies, the aims of this addendum are 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. An attempt is also made to evaluate the literature to date and possibly to delineate trends.

INTRODUCTION

This annotated bibliography consists of 24 references containing original descriptions of genera and species, and taxonomic nomenclature of Paleozoic nonfusulinid Foraminifera. An additional 91 references contains references that utilized smaller foraminifers in stratigraphic subdivision, and that mention incidental occurrences, are also included for completeness.

The 115 references have been annotated by this compiler. These 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.

This bibliography may be considered to be reasonably complete through 1963, with the exception of Soviet references which, owing to their general unavailability to most American workers, may be assumed to be only partially complete.

Including this addendum, the total number of annotated Paleozoic nonfusulinid foraminiferal references has reached 665. This compiler would appreciate the effort and cooperation of all Paleozoic foraminiferal workers in keeping him up to date on all new works that appear by sending pertinent reprints and separates when available.

LITERATURE EVALUATION AND APPARENT TRENDS

Text Figure 1 is an attempt to show chronologically the distribution of articles relating to Paleozoic nonfusulinid Foraminifera according to designated geographic provinces. The inclusion of the present 115 references points out a potential trend not shown in previous plots. This is the pronounced increase of foraminiferal literature from Europe, Africa, and the Middle East (Column C). This trend is significant in that it demonstrates a growing interest there in the potential value of Paleozoic smaller foraminiferal studies.

In Text Figure 2 the foraminiferal literature output has been plotted according to geologic age. Similarly, as noted in earlier bibliographies, the overall trend remains essentially unchanged.

Of special note is the somewhat alarming trend in the reduction of articles containing original descriptions of genera and species of Paleozoic nonfusulinid Foraminifera. Addendum 1 carries 50 references containing original descriptions of genera and species, addendum 2 contains 40, and this present bibliography contains only 24. Perhaps, this trend can be best explained by the fact that most of the recent literature is related to the usage of foraminiferal data for stratigraphic age determinations utilizing previously described foraminiferous species. This trend may be good for the science. However, it should be borne in mind that the foundation of the science is the description of new genera and species, and from this we must continue to expand and develop.

ANNOTATED BIBLIOGRAPHY

A. PRECARBONIFEROUS FORAMINIFERA


Metasedimentary phylloid algae collected in the Urup River Basin (northern Caucasus) and formerly assigned to a Lower Devonian age, have, on the basis of fossils and absolute-age dating, been shown to be of Middle Devonian age. Present in the metasediments are a number of foraminifers whose skeletons have been largely recrystallized and replaced by minute tourmaline prisms, with the central portion filled by quartz. Identifiable foraminiferous genera include: *Eolvolutina, Archaesphaera, Parathurammina, Irregularina, Paralagelina,* and *Vincinesphaera*. Thin-section photomicrographs of representative forms are included.

The stratigraphic significance of Lower, Middle, and Upper Devonian foraminiferal genera (mostly agglutinated) from central Europe is briefly discussed (p. 40-41), and evaluated in terms of present knowledge. Excellent whole-specimen photomicrographs of representative German Devonian forms are given on pl. 1.


A study of the smaller Foraminifera and brachiopods of the Transvolga Beds, in Tataria, U.S.S.R., shows them to contain a mixed Devonian to Carboniferous assemblage of previously described species; hence there is no clear zonation. Therefore, since the Devonian-Carboniferous boundary cannot be drawn through the Transvolga Beds, as is customary in nearby areas, in Tataria the boundary must be placed either at the top or bottom of these beds.


A fauna of three previously described species of agglutinated Foraminifera is described, along with silicified ostracodes and condonts, from the Silurian Ochre Limestone of Thuringer, East Ger-
many. The described Foraminifera are: Psammosphaera gracilis Ireland, 1939 [now referred to P. cava Moreman, 1930; see Mound, 1961], Lagenammina distorta Ireland, 1939, and Hyperammina sp. cf. H. harrisii Ireland, 1939. All forms are illustrated by whole-specimen photomicrographs.


A large and diverse microfauna of agglutinated Foraminifera is described and illustrated by whole-specimen photomicrographs, from the Silurian (Niagaran) Osgood Formation exposed in the Southeastern Materials Corporation Quarry in Ripley County, Indiana. The microfauna consists of 24 genera and 63 species of which 1 genus and 12 species are new. The microfauna is represented by the following families: Astrorhizidae, Saccamminidae, Ammodiscidae, Hyperamminidae, and Trochamminidae. The microfauna comes from shale beds.

Of the Paleozoic foraminiferal studies made to date, the Chimneyhill Limestone (Lower Silurian) of Oklahoma has the most species in common
with this microfauna. The Brassfield Limestone (Lower Silurian) of Indiana is next.

The Osgood microfauna is associated with an abundant and varied macrofauna. All major phyla except Poriifera are represented.

The new forms are: *Rhabdaminia bifurcata*, *Ammodiscus biconvexus*, *A. compressus*, *A. moundi*, *Psammonyx campbelli*, *Lituotuba gallowayi*, *L. laticervis*, *Proteolina perryi*, *Tholosina acinaciforma*, *T. acuta*, *T. corniculata*, *T. rostrata*, and *Metamorphina n. gen. with Webbinella tholus* (Moreman) as the type species.

Taxonomic changes include the following: *Psammosphaera gigantea* Dunn, 1942, is placed under *P. cava* Moreman [Mound, 1961, p. 27, placed *gigantea* under *P. laevigata* White]. *Webbinella gibbosa* Ireland 1939, is now placed under *Metamorphina gibbosa* (Ireland); *Sorosphaera geometrica* Eisenack, 1954, *Webbinella quadripartita* Moreman, 1933, and *W. tholus* Moreman, 1933, are all placed under *Metamorphina tholus* (Moreman); *Hyperammina casteri* Conkin, 1961, is placed under *H. conica* Gutschick, Weiner, and Young, 1961; and *Bathyisphon deminutiosis* Moreman, 1930, and Stewart and Priddy, 1941, are placed under *Hyperammina deminutiosis* (Moreman).


The facies distribution of Late Devonian (Frasnian) sediments of the Chusovaya Basin from the Volga-Ural Region and the western slope of the Urals, U.S.S.R., is briefly reviewed. Mega- and microfaunal characteristics for each facies, based upon previously described species, are given. The facies consist of the following: (1) amphiporoid-stromatoporoid bioherms and biostromes, (2) branching-algal bioherms, and (3) beds deposited in relatively deep-water basins and depressions. Foraminifera showed a definite correlation with distinct lithologic variation. They are divided into planktonic and benthonic forms, the latter subdivided into attached, free, and passive mobile. The latter category includes Foraminifera possessing tests of a regular spherical or oval form and with a thick wall that excludes them from a planktonic mode of life; they also have no visible means of attachment. Their movement along the bottom was accomplished by movements of the aqueous environment. The group of attached forms includes those possessing distinct organs of attachment, or an irregular large, thick-walled shell. The planktonic forms include Foraminifera with relatively symmetrical thin-walled tests. Employing such a subdivision, some representatives of one genus fall into several categories. Thus, the genus *Parathu-rammina* includes planktonic and benthonic forms; among the latter are attached, free, and passive-mobile forms.

The facies distribution of Foraminifera leading different modes of life show that the sessile and passive-mobile forms are most numerous in shallow-water facies.

The overwhelming majority of Foraminifera settled on sandy and locally hard, rocky bottoms. They are most abundant and diversified in calcareous sands and organic-detrital limestones. Environments in which fine carbonate muds accumulated were unfavorable for both Foraminifera and algae.

For convenience in analyzing distribution features of Foraminifera and algae in the different facies, the writer has classified these organisms according to their mode of life and illustrated them schematically in text-figure 2.


The agglutinated Foraminifera derived from the insoluble residues of the Louisiana Limestone of northeastern Missouri and western Illinois is described and illustrated by whole-specimen photomicrographs. From this uppermost Devonian (Frasnian) horizon, nine genera and eighteen species (of which six are new) are represented in the microfauna. The new forms are: *Crititonia psammosphaeraformis*, *Amphitreomoida eisenacki*, *A. hufmani*, *Thurammina adamsii*, *T. strickleri*, and *Aschemonella louisiana*.

Taxonomic assignments include the following: *Oxinoxis Gutschick*, 1962, *O. ligula* of Gutschick, Weiner, and Young, 1961, and *Tolyammina bulbo* of Gutschick and Treckman, 1959, are emended. One species, *Saccammina ligula* Gutschick, Weiner and Young, 1961, is reassigned as the type species of the genus *Oxinoxis* Gutschick, 1962. Two species are placed in synonymy: *Tolyammina sperma* Gutschick, Weiner, and Young, 1961, is a junior subjective synonym of *T. jacobeshapelensis* Conkin, 1961; *Tolyammina continua* Gutschick, 1962, is a junior subjective synonym of *T. bulbo* Gutschick and Treckman, 1959. *Hyperammina sappingtonensis* Gutschick, 1962, is probably a junior subjective synonym of *H. Kahileitensis* Blumenstengel, 1961, but the synonymy is not formalized. *Amphicervicis* Mound, 1961, is probably congeneric with *Amphitreomoida* Eisenack, 1937.

Pertinent paleoecologic observations as to the environment of deposition are also given.

8. Johnson, J. H., 1964, Lower Devonian algae and encrusting Foraminifera from New South

The writer reports the occurrence of an encrusting foraminifer, associated with the algae Girvanella and Rothpletzella, from the Lower to Middle Devonian Nubrigyn Formation of New South Wales, Australia. It is noted that these forms are similar to those reported by Wood (1948) who referred them under the foraminiferan genus Wethereedella. Two thin-section photomicrographs are included on plate 28.


Questionable fossil remains assigned to the Foraminifera have been reported from undifferentiated Proterozoic (Precambrian) sediments of the Imadra-Varguza Formation, exposed on the Kola Peninsula of northern Russia. The un-named supposed foraminifer is illustrated by one rather poor, non-descriptive, thin-section photomicrograph.


A new foraminiferal genus and species, Ivdelina elongata, is described from the Lower Devonian rocks of the Ural Mountains and illustrated by thin-section photomicrographs. This new calcareous encrusting foraminifer is morphologically similar to the younger foraminiferal genus Tubertina Galloway and Harlton, described from the Pennsylvanian of Oklahoma.


The writer reports the presence of rare smaller Foraminifera from the Upper Devonian (Frasnian) rocks of Cop-Choux (Loire-Inférieure) of the Massif Amoricain. The Devonian foraminifers are not formally named, but one form morphologically resembles the genus Rotalia, and another form with a thick fibrous wall is reminiscent of the Permian foraminifers Lingulina szechynii and L. nankingensis described by Lörenthey from China. The writer further notes that these lingulinds are similar to the nodosarids reported from the Carboniferous of western Europe. Blue-green alga of the genus Girvanella are also present in this foraminifer-bearing interval.


A microfauna of 82 agglutinated species is reported from 5 deep-well cores in northern Indiana. The microfauna represents the families Ammodiscidae, Astrorhizidae, Saccamminidae, and Aschomennellidae.

Foraminiferal species subdivide the section into 3 biostratigraphic zones: (1) the lower characterized by Turrilabella and variably restricted to the Grassfield Limestone and/or the basal 20 feet of overlying lower Niagaran rocks in the area; (2) a middle zone characterized by Ammodiscus and Thurammina, which generally includes the remainder of pre-Waldron rocks; and (3) an uppermost zone characterized by Ammodiscus and Litutubia and including the Louisville Limestone Mississinewa Shale, and Liston Creek Limestone. The Kokomo Limestone and associated rocks contain few foraminifers and are hence not zoned faunally.

Silurian foraminifers of northern Indiana are most abundant in granular, relatively pure, biofragmental carbonate rock, lithologically reflecting optimum ecological conditions for growth of marine invertebrates in shallow water.


The Middle and Upper Silurian rocks of the Ufa Amphitheatre, U.S.S.R., have yielded a foraminiferal microfauna of 14 species, of which 2 genera and 5 species are new. The new forms are described and illustrated by thin-section photomicrographs; they are: Parthurammina polygona, Serginella scabrum n. gen., Cribrusphaeroides (Cribrusphaera Reitlinger, 1954) enormis, Arakaevella arakaica n. gen., and Archaeagela rotunda.


The Silurian Lower Llandovery rocks (Vargas Peña Shales) of eastern Paraguay, South America, have yielded an agglutinated assemblage of four distinctive foraminifers. The Foraminifera, listed only, consist of: Reophax sp., Hyperammina sp., Pelosina? sp., and Thurammina sp.; foraminiferal identifications are by Hiltermann.


Microscopic forms previously referred under
“calcisphere de forme A” of Lombard and Monteyne (1952), and now thought to be foraminifers of the genus *Umbellina* (Maslov), are described from the subsurface Upper Devonian Duperow Formation of western North Dakota. The foraminifers are illustrated by random-cut thin-section photomicrographs. This marks the first published occurrence of this distinctive foraminifer from the Upper Devonian of North America. [See the following articles for previously reported foreign occurrences of Middle and Upper Devonian *Umbellina*: Maslov (1950), Lipina (1950), Reitlinger (1954), Bykova and Polenova (1955), Konolipina (1959), Illyina (1961), Menner (1961), Miklukh-Maklay (1961), Shevchenko (1961), and Ozonkova (1962)].


Briefly describes a method for recovering delicate agglutinated foraminifers from hydrochloric acid insoluble residues of lower and middle Paleozoic limestones.


Recent drilling data show that the carbonate section of Devonian age of the Kama-Kinel Basin, U.S.S.R. (Tataria) comprises the Frasnian and Fammenian Stages. Previously described foraminiferal species of the genera *Quasiendothyra*, *Klubovella*, and *Parathurammina*, characterize the Fammenian Stage.


The writer reports individual nodosarid foraminifers from the Devonian, (Fammenian) Wabamun Group, in the subsurface of northeastern Alberta, Canada. The foraminifers occur in the muds adjacent to stromatoporid mounds and are associated with dasyclad alga of the genus “Mizizia.”


Calcareaous Foraminifera found in well cores that penetrated the Upper Devonian (Frasnian) Lower Manhattan Member of the Woodbend Formation in the Redwater and South Sturgeon Lake reefs, Alberta, Canada, have been studied from randomly oriented thin-sections. Tikhinellid foraminifers (*Paratikhinella* and *Tikhinella*) dominate the assemblage. However, distribution patterns of the tikhinellids and specimens described under the genus *Parathurammina* show an interesting relationship of biota to lithology in the Redwater Reef. The tikhinellids are restricted to the reef margin, where the characteristic rock type is grainstone. Conversely, the parathuramminids are distributed centerward two miles or more from the reef margin, in association with calcispheres, where pelletoidal wackestone is the dominant rock type. Rare occurrence of other foraminifers is noted; all forms are fully described and illustrated by thin-section photomicrographs. Foraminifera are rare from the South Sturgeon Lake cores, primarily due to dolomitization, hence no meaningful distribution pattern could be ascertained. No agglutinated foraminifers were present in the formic acid-insoluble residues from the entire interval.

A brief discussion of all known Devonian foraminifera horizons in North America is given, and future stratigraphic and ecologic potentiality of Devonian Foraminifera is briefly discussed.


From the basin of the Lesser Pechora River, west of the Urals in northern Russia, the transitional boundary beds from the Upper Devonian to Lower Carboniferous have yielded a distinctive microfauna. The Devonian portion contains the following new forms: *Parathurammina brevirodiosa*, *P. paraclushmani petschorica* n. subsp., *P. praetuber-culata ramosa* n. subsp., *Petchorina schezhimovensis* n. gen. (all Frasian), *Eolvutina (?) mirabilis* (Frasian and Fammenian), and *Caligella multispetata* (Fammenian). Excellent thin-section photomicrographs of all forms are included.


The writer reports the presence of the encrusting foraminifer *Wetherella* in the Tolga Calcarenite and Red Hill Limestone of the Lower Devonian algal reef complex of western Australia (New South Wales). [See Johnson 1964, for a formal description of *Wetherella* from the overlying Nubrigyn Formation.]

B. LATE PALEOZOIC FORAMINIFERA

22. Anderson, F. W., 1964, *Aschersonella longicaudata* sp. nov. from the Permian of Derby-
Core samples from the Lower Permian Grey Marls of the Lowpit Lane Borehole, Derbyshire, included numerous examples of a new species of the genus *Aschemonella* at two stratigraphic horizons (107 ft., and 124 ft. 10 in.). This new agglutinated foraminifer is described as *A. longicaudata*, and is illustrated by camera lucida drawings.

The writer notes that at the 107 ft. level associated Foraminifera included: *Agathammina pusilla* (Geinitz) (dominant) - accompanied by *Ammodiscus roesslerii* (Schmid), *Dentalina perminana* King, *Nodosaria jonesi* Richter, *Stucheia pytrematoides* Brady *non* Schwellwien, and *Textularia multilocularis* Reuss, together with numerous examples of a small undescribed species of *Aschemonella*. At the lower level (124 ft. 10 in.) the microfauna consisted almost entirely of *Ammodiscus roesslerii* and the new species.

The writer suggests that it is possible that in *Aschemonella* species the chambers were in life joined together in a linear series. Text fig. 1 shows a possible growth form of *A. longicaudata* in which three individuals are serially connected.


In the southwestern section of Iran (southern Meyaneh Basin in Azarbayzan), from the Qazi Kand Locality, a 378 foot interval of dolomitic limestone, designated as Carboniferous in age, has yielded the following representative smaller foraminiferal genera: *Geinitzina, Palaeotextularia, Climacammina*, and *Cribrigerina*.


Six biostratigraphic horizons, based upon previously described Middle Carboniferous smaller foraminifers, have been delineated as a result of studying well cores taken on the south side of the Voronezh Massif, near Strel'tsovka and Markovka, U.S.S.R.


A study of 800 samples from the Upper Carboniferous (Nammrian C-Westphalian A) of the Ruhr District of West Germany, has allowed the writer to delineate a number of marine intervals containing foraminifers. Only agglutinated foraminifers have been found. It is suggested that if calcareous forms did occur they have been destroyed by groundwater solution. It is alternately suggested that perhaps the depositional environment may have been inhospitable to calcareous foraminifers (i.e. substrate with pronounced reducing conditions). Within the marine horizons foraminifers are relatively abundant, with ostracodes next in abundance. No generic or specific identifications are given, but line drawings of representative forms are included.


Briefly discusses the stratigraphic value of Permo-Carboniferous Foraminifera (mainly agglutinated forms) found in central Europe. Representative specimens are illustrated by excellent whole-specimen photomicrographs. Of especial interest are the specimens of *Textularia* sp. (pl. 3, fig. 1-7) from the Lower Carboniferous (Viséan) Erdbacher Kalk at the Iberg Quarry, Harz Mountains, West Germany.


Contains a list (table 2, p. 36) of previously described genera and species of common Lower Pennsylvanian Foraminifera from the Belden and Paradox Formations of the Glenwood Springs, Colorado area [Foraminifera identified by Henbest and Roberts].


Recent paleontological data show that the Sarayl strata in the lower Kama Area are transitional between Tournaisian and Viséan in age. Previously described foraminiferal species in association with spores and brachiopods have aided in dating this sequence.

29. BÖGER, H., 1964, Paläökologische Untersuchungen an Cyclothem en im Ruhrkarbon: Paläontol. Zeits., v. 38, no. 3-4, p. 142-157, 7 text-fig., [in German].

The distribution of the marine Schieferbank Zone of the Upper Namurian C (Upper Mississippian) and the marine Sarnsbank Zone of the basal Westphalian A (Lower Pennsylvanian) throughout...
the entire Ruhr Region of West Germany permits an analysis of the relationship between sediment cycles and faunal rhythms. This relationship allows an interpretation of the biofacies. The evidence discloses that the faunal rhythms indicate less the changes in salinity, and more the shift of infaunas, epifaunas, and the associated nektonic faunas of a dynamically changing habitat.

Significantly, it is postulated that the smaller Foraminifera, all agglutinated forms in this instance, are an integral constituent of the infaunal element that is associated with the Lebenspuren (Planolites ophthalmoides Jessen), and the inarticulate brachiopod Lingula. This association is characteristic of rhythm II of the biozones and thought to be indicative of relatively shallow near-shore waters.


Paleoclimatologic inferences relating to the west Siberian Depression are drawn from the inferred ecology of the Bashkir (Lower Pennsylvanian) Archaeodiscus foraminiferal complex. Abrupt changes in the foraminiferal assemblages on transition from the Urals-Tien-Shan Province to the west Siberian Depression and Taymir may be evidence of a former landmass which intensified the influence of climatic zones. All of the listed foraminifers have been previously described, and are from a well core taken in the central part of the west Siberian Depression near the village of Malo-Muromok. Significantly, it is noted that Rauzer-Chernousova's (1948) observation that the substitution of archaeodiscid foraminifers for a complex of other forms usually occurs on transition to a facies less favorable for the majority of Foraminifera. The present writers find that this overall change of the microfaunal aspect is accompanied by a reduction in the size and a pronounced increase in the numbers of the archaeodiscids.


The writer contends that Girty’s genus Ser
gulopsis is based upon a presently unrecognizable fossil from rocks of medial Desmoinesian age in western Indiana; that Girty’s Oklahoma specimens from the Wewoka are best classified, as Henbest (1963) did, as a new species, and that the Henbest name, Minammodytes, is actually a new genus (not merely a new name). It is further believed that Henbest intended only to place the identification of the Oklahoma specimens in synonymy, and that if types of Serpulopsis insita from Indiana be found, or should neotypes be described, and these prove to be like the Wewoka specimens, then the generic name Minammodytes would be a junior synonym, and if the Indiana form is specifically the same, M. girtyi would then be a junior specific synonym.

A list of some Pennsylvanian fossils from Oklahoma on which Minammodytes has been found is appended. [see Henbest (1963) and Loeblich and Tappan (1964) for additional comment.]


From Lausatia, East Germany, at the Camina-Berg, Lower Carboniferous (Viséan) rocks have been encountered by seven drillings during the geological mapping of the area. The Viséan rocks contained the following previously described Foraminifera: Cornuspira prisa (Rauzer), Glomospirella sp., Tetrataxis sp. cf. T. conica Ehrenberg, and Endothyra sp. cf. E. crassa Brady. In addition, fusulinids of the genus Parastaffella were also recorded. The microfauna is described and illustrated by drawings and thin-section photomicrographs.


The writer reports the smaller foraminifer Geinitzina sp. from the Permian (Wolfcampian-Lower Leonardian?) Plomosas Formation exposed at Cerro de Enmedio, Chihuahua, Mexico. The foraminifer is reported from the reef facies in association with fusulinids, sponges, and the problematical form Tubiphytes.


A study of the smaller Foraminifera from a series of Lower Carboniferous (Viséan) sections in the Namur and Dinant Basins of Belgium has demonstrated the feasibility of utilizing smaller foraminifers in subdividing a relatively thick carbonate section into a number of correlative basal zones. In general, the foraminiferal sequence present in the Belgian Viséan may be characterized as follows: V2b = Archaeodiscus krestovnikovi Rauzer; V3a = Archaeodiscus convexus Grozdilova and Lebedeva in association with Plectogyra omphalota minima
(Rauser and Reitlinger), P. exelika Conil and Lys, and P. foeda Conil and Lys; V3b = Howchinia sp., Archaediscus gigas Rauser, and A. molleri Rauser; V3bα = Planorarchaediscus spirillinoidea (Rauser); V3b = Cribrostomum molleri Conil and Lys, Neoarchaediscus incertus (Grozdilova and Lededeva), Archaediscus approximatus Ganelina, Globoendothyra magna (Grozdilova and Lededeva), Bradyina rotula (Eichwald), and “Saccammina carteri.”

All of the characteristic forms are illustrated by excellent thin-section photomicrographs.


The Mississippian Northview Formation of southwestern Missouri contains abundant agglutinated Foraminifera consisting of 15 identifiable species (6 new) and 3 unidentifiable species, belonging to 10 genera. The contained Foraminifera and the absence of the definitive Osagian species Hyperammina kentuckyensis (present in the overlying Pierson Formation) indicate a late Kinderhookian age for the Northview Formation.

The new species are: Reophax northviewensis, Tolypammina frizzelli, T. gersterensis [the toly- paminids should probably be referred under the genus Minammodytes; see Henbest, 1964], Ammonovertella pikei, Ammobaculites beveridgei, and Trochammina mehli.

Representative foraminiferal specimens are illustrated by whole-specimen photomicrographs.

It is suggested that the Northview and Hannibal Formations are largely contemporaneous shale-siltstone facies of the Compton-Sedalia-Chouteau Limestones.


A review of the North American occurrences of Pre-Pennsylvanian agglutinated foraminiferal faunas with emphasis upon stratigraphic occurrences, possibly exclusiveness, evolutionary lineages useful in age determination, regional zonation, and inter-regional correlation, indicates that the Mississippian agglutinated Foraminifera have the greatest potential of those of any Paleozoic System.

Studies to date show that 4 species range from Upper Devonian to Upper Osagian; 2 species are found only in the Upper Devonian and Kinderhookian; 8 species are restricted to the Kinderhookian and 11 species to the Kinderhookian and lowermost Osagian; and that 6 species are found only in the Osagean.

The writers believe that the rate of evolution in agglutinated Foraminifera is fast enough, and their geographic distribution cosmopolitan enough, to permit their use in regional zonation and inter-regional correlations.


From the Pennsylvanian upper Morrowan strata (Ely Limestone and Bird Spring Formation pars) of the Ely Basin, Nevada, the writer reports Climacocannina, Tetrataxis, and abundant ammovertellids. Abundant ammovertellid and paleotextularid foraminifers are also reported from the lower Derryan zone of Profusulinerella, and from the upper Derryan zone of Fussulinella paleotextularid foraminifers are also common.


A brief résumé noting the presence of significant Permian smaller foraminiferal horizons in Australia. It is further noted that the foraminiferal assemblages in the subsurface are characterized by numerous calcareous tests of the family Lagenidae, whereas agglutinated forms dominate most of the outcrop occurrences. Eight foraminiferal assemblages have been recognized in the Australian Permian; these should be useful in stratigraphic studies. [See Crespin, 1958, for systematic descriptions of the above microfauna.]


Under the section on Foraminifera (p. 22-34), 17 Lower Permian foraminifers from Western Australia are listed as primary and secondary types that are deposited at the University of Western Australia. The types are: Ammobaculites woolnoughi Crespin and Parr, 1941; Parr, 1942; Crespin, 1958 (hypotype), Ammodiscus nitidus Parr, 1942; Crespin, 1958 (holotype), A. wandageeensis Parr, 1942; Crespin, 1958 (holotype), Calcitornella stephani (Howchin), 1894; (Chapman and Howchin) 1905; Chapman, Howchin, and Parr, 1934; Crespin, 1945; Crespin, 1958 (hypotype), Critithonia teicherti Parr, 1942 (holotype), Glomospira adhaerens Parr, 1942 (holotype), Hyperammina coleyi Parr, 1942; Crespin, 1958 (holotype), H. ? rudis Parr, 1943 (holotype), Hyperamminidae acicula Parr, 1942 (holotype), Psammosphaera pusilla Parr, 1942; Crespin, 1958 (holotype), Reophax tricameratus Parr, 1942; Crespin, 1958 (holotype), R. subasper Parr, 1942; Crespin, 1958 (holotype),
Streblospira australae Crespin and Belford, 1957; Crespin, 1958, Thurammina papillata Brady, 1879; Parr, 1942 (hypotyope), Tolypamina undulata Parr, 1942; Crespin, 1958 (holotype), Trepeolopsis australiensis Crespin, 1958 (paratype), and Trochammina subobtusa Parr, 1942; Crespin, 1958 (holotype).


Primarily a monograph on the stratigraphy and petrology of the Permian rocks of southwestern Montana. However, Figure 110 (p. 309) shows a thin-section photomicrograph of the cherty phosphorite lithology, common in the Phosphoria Formation, and containing abundant foraminiferal tests which form the nuclei of many of the phosphorite pellets. The illustrated phosphorite lithology is from the Madison Range. It is noted in the text that a few pellets contain silt inclusions arranged in loops and swirls that may be tests of agglutinated Foraminifera.


Primarily a paper dealing with Pennsylvanian (Virgilian) calcareous sponges from the Graham Formation of northcentral Texas. Paleozoological data based principally on a thorough study of the smaller foraminifers (calcareous forms observed in thin-section, agglutinated whole-specimens derived from formic acid residues, and agglutinated and calcareous whole-specimens derived from shale disintegration) has led the writers to postulate a relatively shallow-water depositional environment for the sponge-bearing shale, and the underlying and overlaying carbonate units. All of the smaller foraminifers have been previously described, and all are illustrated by either thin-section or whole-specimen photomicrographs. The suggestion is made that Globivalvulina was probably an early pelagic form, and that its occurrence within the sponge-horizon is due principally to movement and segregation by ocean currents, and may be illustrative of a pelagic death assemblage. In addition, the occurrence of the agglutinated foraminifer Textularia sensu stricto in the Pennsylvanian of North America is corroborated.


A study of the Foraminifera ( fusulinids and smaller foraminifers) from the Terbat Formation of West Sarawak, indicates that the forms are of the Wolfcampian Stage (Zone of Pseudoschwagerina), and hence of Lower Permian age. Foraminifers are rather scarce and in a poor state of preservation owing to a complex series of diagenetic effects, including compaction, recrystallization, brecciation, re-cementation, and silicification. All of the smaller foraminifers have been previously described from other regions and supply supporting evidence of and suggest local correlation with that of Sumatra and Malay. Three plates of foraminiferal thin-section photomicrographs are included.


The Carboniferous sequence present in test well 35 near Calarasi, Rumania, has a thickness of 1300 meters, and consists primarily of limestones. Microfossils (ostracodes and foraminifers) were recovered from cored intervals. The described foraminifers are: Ammodiscus planus, Hyperammina kentuckyensis, Endothyra excentrals, Endothyra-nella cracoviensis, Hemigordius harltoni, Tetraxis conica and Valvulinella youngi. The writer notes that the microfossils suggest that most of the samples belong to the Lower Carboniferous (Tournaisian-Viséan), in spite of the fact that some of the forms noted above have been previously reported from the Namurian and Westphalian (Upper Carboniferous).


The writer reports numerous smaller Foraminifera from the Lower Carboniferous rocks of the Bas-Boulonnais Region of northeastern France. The following forms are noted: Endothyra, Ammodiscus, Textilaridiae [Palaeotextularidiae], and Archae-discus. Excellent thin-section photomicrographs and drawings are included. A brief discussion of the microstructure of the test wall is also given.


From West Anatolia, Turkey, one new species, Lasiodiscus sellieri, is described from rocks of Middle Carboniferous age. Associated with this new species are the following previously described Foraminifera: Permodiscus rotundus Chernysheva, Tetraxis sp., Bradyina sp. cf. B. samarica Reitlinger, and Tuberitina bulbeca Galloway and Harlton. In addition, other species of Lasiodiscus and
Lasiotrochus from the Permian of this region are compared to previously described forms.

From the Ankara Region of Turkey three previously described species of Lasiodiscus are reported from the Middle Permian.

All forms are illustrated by both thin-section photomicrographs and drawings.


Three Upper Carboniferous suites, lithologically and paleontologically similar to the Carboniferous of the Donbas, are distinguished in the transitional province between the Donbas and the Donets Basin of the Soviet Union. Microfaunal data is principally furnished by the Fusulinidae, although a few previously described smaller foraminifers are mentioned. All faunal data is derived from well samples.


The writers report that north of Polleur, Belgium, a Lower Carboniferous (Tournaisian) structural block containing crinoidal limestones, has yielded an interesting smaller foraminifer assemblage consisting of: Bisphaera sp., Paracaligella antropovi Lipina, representative Tourmayellidae, and Quasiendothyra.


The writer briefly notes the occurrence of smaller foraminifers ("calcitornellids," paleotextularids, Bradyina, and fusulinids) from the middle member of the Pennsylvanian (Atokan), Marble Falls Formation, of central Texas.


A discussion of the internal structures of representative forms of the family Lagenidae from rocks of Permian-Jurassic age from the Soviet arctic provinces. Of especial note is the résumé on lagenid apertures, overall morphology, and test-wall microstructure. Line drawings of pertinent foraminiferal internal structures are included.


In the process of emending the Late Paleozoic nodosarid-like Foraminifera the writer has erected one new genus, Protonodosaria, with Nodosaria proceraformis Gerke, 1952, as the genotype. The form Nodosaria procera Rauser-Chernousova, 1949, is herein placed under Protonodosaria rauserae Gerke, and the form Nodosaria praecursor Rauser-Chernousova, 1949, is placed under Protonodosaria praecursor (Rauser). Drawings and thin-section photomicrographs are also included.


The writer reports the occurrence of the smaller foraminifers Pachyphloia sp. Geinitzina sp., nodosarids, and paleotextularids from the Upper Permian Nesen Formation of central Iran.


Three Moscovian (Middle Pennsylvanian) suites in the Pripyat Depression of the Soviet Union are described on the basis of their characteristic foraminiferal elements. The foraminiferal microfaunas, both fusulinids and smaller foraminifers, have all been previously described. The microfauna in the topmost suite suggests a link with the Moscow Basin in Moscovian times.


A concise compendium describing the thin-section methods employed in the study of Paleozoic Foraminifera (fusulinid and non-fusulinid Foraminifera). Drawings and thin-section photomicrographs of pertinent forms are given.


The writer notes that while it is true that foraminiferal wall structure is a character of taxonomic significance, it does not follow that it is not
an adaptive characteristic. Recent work on living Foraminifera suggests that algal symbiosis and radial hyaline wall structure may be related. Significantly, this provides a clue towards an understanding of the reasons for the rise of radial wall structure and perhaps, also the reasons for the striking modifications seen in the chamber shape and arrangement of some Foraminifera.

It is concluded that the varied types of Foraminiferal test wall structure suggest that evolution has sometimes followed curiously devious routes. This is to be expected if changes in wall structure are strongly adaptive and a feature of groups which adopted symbiotic life in shallow water at different times, to be replaced by others later. It is suggested that in a situation where rhythmic transgressions onto continental margins bring shallow water and lagoonal environments to a maximum, as may be postulated for the Late Paleozoic, these conditions would undoubtedly favor the evolution of Foraminifera with algal symbionts. The writer notes that granular genera, including the fusulinids and the first radial genera, Archaeodiscus and Rastidiscus, arose in the Lower Carboniferous, possibly under somewhat similar circumstances.


In a study of the Pennsylvanian pre-Mar mation (Desmoinesian) rocks exposed in southeastern Kansas, the writer notes the occurrence of the encrusting foraminifer Ptychocladia sp. undet. in the Mulky, Lagonda, Verdigris, Fleming, Seville, and Rowe Formations. Tetrataxis sp. undet. is reported from the Verdigris, Fleming, and Seville Formations. Other smaller Foraminifera (forms identified as Plectogyra, Cribrostoma (sic), Rectocorun spira, Ammodiscus, and Climacamina) occur in the Fleming and Seville Formations.


This paper marks the first reported occurrence of the agglutinated foraminifer Reophax from rocks of Namurian C (Lower Pennsylvanian) age in the Ruhr District of West Germany. The described form, Reophax cf. R. tumidulus Plummer, is illustrated by a series of whole-specimen photomicrographs and one thin-section photomicrograph. Associated with Reophax are silicified gastropods and pelecypods.

57. Knauff, W., 1963, Zur Mikrofauna im Oberkarbon der Bohrung Münsterland 1 und den Möglichkeiten ihrer stratigraphischen Auswer-
tung: Fortschr. Geol. Rheinld. u. Westf., v. 11, p. 113-122, 1 pl., 1 table, [in German].

The writer reports the occurrence of a suite of smaller Foraminifera from a borehole that penetrated the Upper Carboniferous rocks in the Ruhr District of West Germany. None of the foraminifers have been formally described, but the following genera have been designated: Ammodiscus, Glomospira, Glomospirella, Hyperammina, Reophax, and Agathammina. The associated ostracode microfauna and the small invertebrates and conodonts appear to demonstrate that the penetrated interval has facies representative of non-marine, brackish, and marine environments. The foraminifers are illustrated by whole-specimen photomicrographs, and one group of photomicrographs shows forms embedded in xylol to increase the transparency of the specimens.


Previously described Lower Carboniferous-type multilocular foraminifers appear in Late Devonian (Famennian) horizons on Chernyshev Ridge and in Chernov, Pay-Khor and Vaygach Island Uplifts earlier than in the western slope of the southern Urals and the eastern part of the Russian Platform; hence, the boundary problem in this region is complex. It is suggested that the boundary between the Devonian and Carboniferous sediments here should be drawn neither at the base of the Quasiendothyla kobeitusana (Raus.) Zone nor from the flood appearance of Q. communis (Raus.), but considerably higher up in the section. It is thought that wherever the Devonian-Carboniferous transitional beds are most fully represented the boundary should be placed at the base of the Bisphaera beds, which also carry the brachiopod Spirifer (Paulonia) cf. S. medius Leb.


Primarily a paper describing the Lower Permian fusulinid microfauna from Yugoslavia (Montenegro). The smaller foraminifers Climacamina sp. and Tetrataxis maxima Schellwien are reported from the fusulinid horizon.


Primarily a fusulinid paper which reports
the occurrence of the Permian (Leonardian Guadalupian) neoschwagerinid fauna from southern Montenegro (Yugoslavia). Described species of the following smaller foraminifer genera are reported from the fusulinid horizons: *Agathammina, Hemigordius, Pachyphylloia, Climacamina, Cribroglobularia, Padangia, Geinitzina, Textularia, Globivalvulina, Ammodiscus, Glomospira, Nodosinella, Hemigordiopsis*, *Tetrataxis, Lasiotrochus, Bradyina, Endothyra, Bigenerina*, and *Colaniella*.


The writer presents a series of faunal lists of microfossils (algae, smaller foraminifers, and fusulinids) found to date in the Permian rocks of Yugoslavia. The following smaller foraminifer genera are reported from Croatia, Slovenia, and Montenegro: *Endothyra, Bradyina, Tetrataxis, Palaeonubecularia* [probably a junior synonym of *Apterinella*; see Henbest, 1963, p. 31], *Climacamina, Globivalvulina, Geinitzina, Lasiodiscus, Pachyphylloia, Hemigordius, Glomospira, Lasiotrochus, Olympina, Valvulinella, Colaniella, Hemigordiopsis*, and *Frondicularia*.


The writer reports the occurrence of the encrusting foraminifera *Tetrataxis* emeshed between the laminae of pycnocystoma-type *Spongiostromata* (oncolites) from the Permian Nabeyama Formation of central Honshu, Japan. The form is illustrated by one thin-section photomicrograph.


The writer describes and illustrates (text-fig. 1) the stratigraphic horizons which carry agglutinated Foraminifera (*Ammodiscus, Glomospira, Glomospirella*, and *Hyperammina*) in the Upper Carboniferous (Namurian C to Westphalian C) of the Ruhr Valley region of West Germany.


In a brief outline of the salient features pertaining to the evolution of certain Triassic Foraminifera, mention is made of the ancestral Paleozoic generic stock, i.e., *Ammodiscus, Hemigordius, Archaeiscus, Permodiscus*, and *Cornuspira*. An idealized evolutionary and stratigraphic diagram (pl. 8) shows the development of the Archaediscidae, Trocholinidae, and Cornuspirinae from Silurian to Upper Cretaceous time.


This article presents new data on deep drilling and electric logging relating to the stratigraphy of the Lower Carboniferous (Tournaisian and Viséan Stages) in the Tatar A.S.S.R. (Soviet Union), mainly within the Kama-Kinel Basin. Fossil assemblages, including previously described foraminifer species, from which stratigraphic determinations have been made, are listed and the thicknesses of stratigraphic units given.


Shale samples were obtained at 1-foot intervals throughout a composite section of the Council Grove Group (Lower Permian) in northcentral Kansas. All samples were disaggregated and thoroughly searched for microfossils. All available microfossils were utilized. Eleven kinds of Foraminifera (calcareaous and agglutinated genera) and 21 genera of ostracodes, as well as conodonts, holo-thuran sclerites, fish remains, inarticulate brachiopods, and charophytes were identified and their abundance plotted. Distinct microfaunal assemblages were recognized which reflect cyclothemic position of the beds and show a regular alternation that is judged to have paleoecologic significance. Paleoecology of the microfossils is interpreted by comparisons with living representatives, fossil associations, and type of shale matrix. A salinity gradient is postulated from fresh water through brackish to marine water, each category being represented by a distinctive suite of microfossils. Within beds laid down under marine conditions, different assemblages of microfossils are judged to have been controlled either by depth of water, salinity, or other ecologic factors.

It is noted that among the microfossils that most likely represent brackish-water depositional environments the agglutinated form *Ammodiscus* is perhaps the most characteristic.


The stratigraphy of the Lower Carboniferous sequence of the Siberian Platform is described.
and classified by means of a correlation chart (Table 1). The Upper Tournaisian (Taydon Horizon or the Spirifer ussien isis Talm. Zone) is characterized by a number of previously described endothyroid foraminifers identified for this study by Ganelina and Lebedeva.

The writers report the occurrence of a typical Lower to Upper Permian fusulind sequence from the rocks of central Afghanistan. Associated with the fusulinids is a rich assemblage of smaller foraminifers, for the most part previously described species, of which the following genera are represented: Climacocammina, Glomospira, Globivalvula, Robuloides, Pachyphloia, Tetrataxis, Plectogyra, Spiroplectammina, Lunammina, Ammodiscus, Hemigordius, Tuberitina, and Capidulina. The alga Mizzia and Permocalculus are commonly found with the smaller foraminifers.

From a comparison with the Lower Carboniferous (Tournaisian) smaller foraminifers of the U.S.S.R., doubt is cast on the assumed Visean age of the Comblain-au-Pont beds at Hatentrat near Stolberg, West Germany. These limestones contain Foraminifera similar to those in the Cherepet Horizon (Tournaisian) of the Soviet Union. It is noted that the Lower Carboniferous and Etrenne Zone of western Europe have Foraminifera very similar to those of the eastern part of the Russian Platform and the western side of the Urals. It is believed that both parts of Europe formed a single zoogeographic province in the Early Carboniferous.

From a borehole at Chelm I in the regions of Krakow and Walbrycz, Poland, numerous Carboniferous (Upper Viséan to Lower Westphalian) foraminifers have been obtained and identified. The foraminiferous assemblages are stratigraphically comparable with those described from the Soviet Union and North America. Such types as Endothyranopsis and Loeblichia are characteristic of the Viséan Stage, and the fusulinids Staffella and Profusulinella at the Westphalian Stage. It is noted that the genera Paraendothyra or Quasiendothyra disappear at the end of the Tournaisian Stage and are replaced by the Endothyranopsis-Loeblichia assemblage; at the end of the Viséan Stage the genera Loeblichia, Forschiella, and numerous representatives of Plectogyra, Tetrataxis, and Valvulinella disappear. In the Westphalian Stage new types, mainly fusulinids (Ozawainella and Profusulinella) appear. The statement is made that only agglutinated foraminifers are found in the clastic rocks, whereas in some shales such forms as Loeblichia ammonoides and Tetrataxis conica appear in great numbers.

One plate contains rather crude line-drawings of some of the more abundant foraminifers.

The Tournaisian (Taydon Horizon) of the Soviet Union. It is believed that the Lower Carboniferous and Etrenne Zone of western Europe have Foraminifera very similar to those of the eastern part of the Russian Platform and the western side of the Urals. It is believed that both parts of Europe formed a single zoogeographic province in the Early Carboniferous.

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One plate contains rather crude line-drawings of some of the more abundant foraminifers.

(3) to place the following specific names on the Official List of Specific Names in Zoology:
- \textit{siliacea} Terquem, 1862, as published in the binomen \textit{Involutina siliacea} (senior synonym of \textit{Ammodiscus infimus}, type-species of \textit{Ammodiscus});
- \textit{arenacea} Williamson, 1858, as published in the binomen \textit{Spirillina arenacea}, subsequently referred to \textit{Ammodiscus} by Macfadyen, 1862, herein referred to \textit{Glomospirella} Plummer, 1945;
- \textit{iassicus} Jones, 1853, as published in the binomen \textit{Nummulites} \textit{iassicus} (senior synonym of \textit{Involutina Jonesi}, the type-species of \textit{Involutina});
- \textit{infimus} Strickland, 1846, as published in the binomen \textit{Orbis infimus}, and as defined by the lectotype selected for the species by Barnard, 1954, subsequently referred to the genus \textit{Spirillina} Ehrenberg, 1844.

(4) to place the following family-group names on the Official List of Family-Group Names in Zoology:

Additional comments supporting the Loeb-lich-Tappan point of view by H. C. Skinner, F. L. Parker, and D. L. Frizzell are included; one dissenting opinion, by J. Hofker, is also added.


In essence, the writers agree with the Henbest (1962) proposal to the Commission in which it was proposed that the type-species of \textit{Endothyra} should be retained in Brady's sense.

Of especial note is the statement by the writers that "the specific name lobata, Brady, 1870, would thus have priority over bradyi Mikhailov, 1939, if bowmani were not an available name." This in reality invalidates the Rosovskaya (1962) counter-proposal to Henbest's original petition.

Comments are also given on the unfortunate choice of a neotype, plus the totally inadequate description, by D. N. Zeller (1963) in view of the fact that the writers had already chosen a neotype in conjunction with their work on the Treatise on Invert. Paleontol.

A brief comment by Malakhova, supporting the Rosovskaya proposal is also given.

Finally, a lucid statement pointing out some concrete flaws in the Rosovskaya proposal and favoring the Henbest proposal is presented by Betty Skipp.


From the Upper Permian Abriola Limestone, near Potenza in southern Italy, one new genus and species, \textit{Abriolina mediterranea}, (family Nodosariidae), is described and illustrated by rather poor thin-section photomicrographs. Associated smaller foraminifers are previously described species of the following genera: \textit{Pachyphloia}, \textit{Geinitzina}, \textit{Colaniella}, and \textit{Robuloides}.


In a paleoecologic and biostratigraphic study of the sediments of the Lower Permian (Wolfcampian) Red Eagle cyclothem of Kansas, Oklahoma, and Nebraska, 16 foraminifera genera are listed (\textit{Ammobaculites}, \textit{Ammodicella}, \textit{Ammodiscina}, \textit{Ammodiscus}, \textit{Ammovertella}, \textit{Bigenerina}, \textit{Corno­spira}, \textit{Globivalvulina}, \textit{Glomospira}, \textit{Glyphostomella}, \textit{Hyperammina}, \textit{Nodosinella}, \textit{Nummulostegina}, \textit{Tet­rataxis}, \textit{Tolypammina}, and \textit{Trochammina}); their stratigraphic range and abundance within the cyclo­them is shown on text-figure 4 (p. 38-39). It is noted that smaller Foraminifera are common in the Red Eagle Limestone, rare in the Johnson Shale, and extremely rare in the Roca Shale. The tolerance of the smaller foraminifers for a variety of marine conditions is suggested by their occurrence in lithologies ranging from nearly pure limestone to moderately calcareous shale and mudstone. Although \textit{Tetrataxis} and \textit{Ammodiscus} are present in various Red Eagle cyclothem lithologies, they occur most commonly in rocks containing less than 40% calcium carbonate. \textit{Glyphostomella} is found in lithologies containing about 75% clastic insoluble residue. Conversely, \textit{Ammovertella} and \textit{Tolypammina} seem to favor the calcareous environments represented by lithologies containing less than 10% insoluble residue.

Few definite opinions about the paleoecology of the smaller foraminifers are forthcoming from
the available evidence. The writer believes that the presence of these animals in a variety of lithologies suggests that they could tolerate a moderately wide range of environmental conditions and, thus, are of little use as environmental indicators in paleoecological interpretations.


Discovery of Foraminifera in the metasediments of the Baymak-Burebayekva suite, on the east side of the southern Urals, U.S.S.R., indicates that the Gay chalconpypite deposit is probably Permian in age, and not Silurian as hitherto supposed. It is noted that the foraminifers have lost the primary carbonate composition of their shells. Some of them have been replaced by quartz, chlorite, epidote, and feldspar, yet they retain enough of their morphology to be identifiable.


Lower to Upper Permian sedimentary rocks of marine and continental origin have been identified on the eastern slope of the Urals and have been dated by previously described species of smaller Foraminifera and a Permian flora and spore-pollen complex. Of especial interest is the reported occurrence of a form similar to the genus Streblospiza Crespin, previously known only from the Permian of Australia.


A new calcareous foraminiferal genus and species of the family Reophacidae, is described from the Lower Carboniferous (Viséan) rocks of the Ural Mountains. The new form is Darjella monilis, and is illustrated by thin-section photomicrographs.


The writer briefly describes the relationships of some Paleozoic Foraminifera to their Mesozoic counterparts. One range chart is included.


The writer briefly describes the salient features of 12 foraminiferal families which have Paleozoic representatives. Brief consideration is also given to Paleozoic foraminiferal evolutionary trends.


The writer presents a comprehensive review and analysis of the systematics and phylogeny of the Paleozoic Foraminifera (both smaller foraminifers and fusulinids). Of especial interest are the diagrams detailing phylogenetic lineages of the various major smaller foraminiferal groups (e. g., Archaeciscidae, Paleaeotextulariidae etc.) as shown on text-fig. 7-13. In addition, 8 colored maps showing the world-wide distribution of certain foraminiferal groups of limited stratigraphic range are also given.

The following pertinent taxonomic changes are included: (1) the establishment of the new subfamily Usloniinae to contain the genera Raibosamina Moreman, 1930; Thecammina Dunna, 1942; Ceratammina Ireland, 1939; Shiderella Dunn, 1942; and Uslonia Antropov, 1959; (2) the description of the new genus Bithurammina with Parathurammina? aff. dagnmarae Grozdilova and Lebedeva, 1954, as the type species; and (3) the establishment of the new subfamily Lituoobellinae to contain the genera Lituoobellula Rauser-Chernoussova, 1948, and Septammina Meunier, 1888.


The stratigraphy of the Khabarovsk section of Carboniferous and Permian age in the Soviet Union is discussed and revised in the light of new fossil finds. Abundant mention is made of previously described Late Paleozoic smaller Foraminifera.


In the chapter on Paleozoic rocks, Sutherland notes (p. 29) that specimens of Endothyra occur in all three members of the Mississippian Tererro Formation, southern Sangre de Cristo Mountains, New Mexico. The endothyroid assemblages were studied by Zimmerman (Sun Oil). He states that the endothyroids from all three members are definitely of Meramecian age, and he further notes that forms from both the Macho and Manuel-
Many changes are also included: "Monotaxinoides transitorius" Brazhnikova and Jarzeva, 1956, and "Eolasiodiscus galinae" Reitlinger, 1956 = "Eolasiodiscus transitorius" (Brazhnikova and Jarzeva); and "Monotaxinoides priscus" Brazhnikova and Jarzeva, 1956 = "Eolasiodiscus priscus" (Brazhnikova and Jarzeva).


Typical Lower Carboniferous smaller foraminiferal assemblages (containing previously described species) from the Magnitogorsk Synclinorium of the Soviet Union permit a stratigraphic subdivision between the Tournaisian and Viséan sequences.


A microfauna of 47 species of smaller Foraminifera, of which 9 species are new, is described from the Carboniferous Berezovo Series of the eastern slope of the southern Ural Mountains of the Soviet Union. All described forms are illustrated by thin-section photomicrographs. The new forms are: "Earlandia aspera", "Archaeospirà", "Parathurammina clivosa", "Brunsina dainae", "Tournayella immodica", "Endothyrina? separata", "Palaeo­textularia illinna", "Spiroplectaminna otoria", and "Per­modiscus? primaevus". Included in this paper are also newly described species of fusulindae, and one new species of "Calcisphaera". The following taxonomic modifications are also included: "Hyperam­mina vulgaris minor" Rauser 1948, and Lebedeva 1954 = "Earlandia vulgaris var. minor" (Raus.); "Hyperam­mina moderata Malakhova 1954 = "Earlandia moderata" (Malakhova); "Hyperam­mina elegans" Rauser and Reitlinger, 1937 and 1940 = "Earlandia elegans" (Raus. and Reitlinger); "Brunsellia ovalis" Malakhova 1956 = "Glomospirella ovalis" (Malakhova); Ammobaculites pygmaeus Malakhova 1954 = "Chernyshinellina pigrea" (Malakhova); "Brunsellia? pulchra" Reitlinger 1940, Rauser and Reitlinger 1948, Malakhova 1954, "Glomospirella pseudopulchra" Lipina 1955, and "Glomospirella pulchra" Malakhova 1956 = "Glomospirella pseudopulchra" (Lipina); and Spirillina irregularis Moeller 1886, "Brun­sia irregularis" Mikhailov 1939 and Malakhova 1954, "Glomospirella irregularis" Lipina 1955, and "Glomospirella irregularis" Malakhova, 1956 = "Glomospirella irregularis" (Moeller).

A lucid endorsement of the Loeblich-Tappan proposal concerning the type-species of Ammodiscus Reuss, 1862. Rauser-Chernousova et al. believe that Loeblich and Tappan (1961) conclusively proved that Involutina silicea Terquem, 1862, was the type-species of the genus Ammodiscus.


This paper is primarily concerned with post-Paleozoic taxonomic features of perforate Foraminifera; however, a number of pertinent genera (mainly Late Paleozoic) are discussed and analyzed in some detail.


Primarily a paper describing the fusulinid microfaunas of the Upper Carboniferous-Pерmian Cyathophyllum Limestones of central Vestspitsbergen: however, the writer notes that in many of the fossil collections smaller Foraminifera such as Tetraaxis, Globivalvulina, Geinitzina, Neogoenitzenia?, Bradyina, and Climacammina are common constituents.

93. Sacal, V., 1963, Microfaciès du Paléozoïque Saharien.—Notes et Mémoires, No. 6, Compagnie Française des Pétroles, Paris, 30 p., 100 photos, 4 text-fig., correlated columnar sections, map, [in French].

Primarily a collection of superb microfacies photomicrographs of representative rock types from the Paleozoic of the Sahara Region of north Africa. Photographs 91-96 contain assemblages of smaller Foraminifera from Namurian rocks; identified foraminifers include: Archaeodiscus, Tetraaxis, endothyrids, and palaetoexturalids. Photographs 97-100 illustrate smaller foraminiferal assemblages belonging to the Moscovian interval and containing: Climacammina, Bradyina, Globivalvulina, and Aemigordius.


The writers state that fusulinid genera and species referable to the Zone of Fusulinella and Zone of Pro fusulinella are present in the Dimple Limestone and indicate a Pennsylvanian (Atokan) age for much of the formation. In addition, they noted that among the smaller Foraminifera are species of the genera Climacammina, Tetraaxis, Globivalvulina, Endothyra, Tubertitina, Ammodiscus, and Calticornella [the last named genus would now probably be placed under the genus Hedraites; see Henbest, 1963].


Of the three sequences of red beds that occur on the east side of the Urals, two (Middle Carboniferous and Lower Permian) occur together in the Bagaryak section. T. V. Pronina and N. P. Malakhova identified previously described Middle Carboniferous foraminiferal assemblages (including fusulinids) from the East Sugoyak Area.


Tournayellinae occur with endothyrid Foraminifera and, except for Brunsiina Lipina, 1953, are restricted in North America to Kinderhook, Osage, and Meramec rocks. They are common and zonally distinctive in most Cordilleran faunas studied but are rare in the Midcontinent. The remarkable similarity between the tournayellid and endothyrid faunas of the Cordillera and these of the western slope of the Urals suggests coeval development and like environments, possibly connecting seaways.


A detailed study of the smaller Foraminifera, corals and brachiopods (all previously described) from the Sin'yi Kamen' Series suggests that they may correspond to the lower part of the tennigenous coal measures overlying the Kizelovka horizon. Although geologists working on the west side of the central Urals have traditionally placed the Tournaisian-Viséan boundary at the base of the coal measures, the boundary actually crosses formations of diverse lithology.

98. Sosnina, M. I., 1960, Studies of the lagenids by the method of sequential grinding. IN: Results of the first seminar on the microfauna. N. N. Subbotina, Editor, Vses. Neft. Nauk-
Orthovertella; Sylvanian rocks exposed near McCoy, Colorado, probably lived in depths ranging from 20-50 meters, while the textulariid fauna (which also contains fusulinids) apparently lived in deeper water—perhaps 50-70 meters. The Lower Carboniferous (Upper Tournaisian-Lower Viséan) rocks of the Usuyla River section, on the west side of the southern Urals, U.S.S.R., have been subdivided by means of assemblages of previously described smaller Foraminifera and brachiopods into three stratigraphical and paleontological complexes.


In the Kazan Area of the Soviet Union, Early Kazanian (Late Permian) time was one of transgression by a shallow sea in which clayey carbonates, clays, and siltstone were deposited in three main cycles. The basin later silted up, became part of the coast, and was the site of deposition of continental clastics. The upper horizon contains a smaller foraminiferal assemblage of previously described species identified by N. A. Valeyeva.


New data indicate that the Lower Permian sulfate-carbonate deposits in the Volgograd Area of the Soviet Union consist partly of Skamarian and Artinskian deposits, which are described in detail. Numerous previously described foraminiferal species, both fusulinids and smaller foraminifers, are utilized in stratigraphically subdividing the sequence.


Add. 3
Methods used in the preparation of foraminiferal thin-sections are discussed with the aid of sections of the Permian (Zechstein) foraminifer *Agathammina pusilla* (Geinitz) as an example. From this study methods have been developed which allowed the writer to construct a model illustrating the coiling habits of this form. Whole-specimen photomicrographs, thin-section photomicrographs, and thin-section drawings are included.


A systematic study of 20 marine horizons between Namurian C and Westphalian C (Upper Carboniferous) of West Germany (Ruhr district) yielded 700 samples containing smaller foraminifers. From the marine horizons, 22 species, of which 4 species and 1 genus are new, are described in detail and illustrated by whole-specimen and thin-section photomicrographs. The new forms are: *Ammodiscus hiltermanni*, *A. ovalis*, *Glosso spirilla unangularis*, and *Agathamminoides gracilis* (new genus). The microfauna is composed entirely of agglutinated forms. Of especial interest is the table illustrating all previously described Permo-Carboniferous species of the genus *Hyperammina* with a brief diagnosis of their characteristics and stratigraphic potential. Comparison of the German section with that of the Belgian Carboniferous, as described by Pastiels (1956), is discussed in some detail. The following taxonomic changes are also included: *Ammodiscus semiconstrictus* Waters-Pastiels, 1956, and *A. cf. A. hiltermanni* Pastiels, 1956, are placed under *A. roesleri* (Schmid, 1887); *A. obscurscus Dain* (pars) Bykova, 1958, is placed under *A. hiltermanni*; *Glosso spirilla milioides* Paal-zow, 1935, and *Agathammina* sp. Pastiels, 1956, are placed under *Ammodiscus ovalis*; *Gloso spirilla areolata* Crespin, 1958, is placed under *G. umbilicata* (Cushman and Waters, 1927); *Ammodiscus labilis* Kremp and Johst, 1950, is placed under *Gloso spirilla unangularis*; *Trocchamminoides milioides* Jones, Parker, and Kirkby, 1869, and Brady, 1876, and *Agathammina milioides* (Jones, Parker, and Kirkby, 1869); *Agathammina mississippiiana* Conkin, 1961, is placed under *Agathamminoides cf. A. mississippiana* (Conkin, 1961); and *Hyperamminidelongata clavatula* Harlton, 1933, is placed under *H. gracilis* Waters, 1927.


From the basin of the Lesser Pechora River, west of the Urals in northern Russia, the transitional boundary beds from the Upper Devonian to Lower Carboniferous have yielded a distinctive microfauna. The Lower Carboniferous beds have yielded the following previously described forms: *Rectoseptaglo mospiranella* sp., *Septaglomospiranella* (S.) *primaeva* (Rauser), *Septatournayella lacera* Durkina, and *Quasiendothyra communis* (Rauser) var. *turbida* Durkina. All of the above are illustrated by thin-section photomicrographs and completely described.


A résumé of the Permian biostratigraphic sequence from the Syndasko Area (northwestern portion of the Soviet Union) utilizing previously described foraminiferal species.


The writer briefly mentions that the Pennsylvanian (Desmoinesian) Holdenville Shale carries a rich microfauna in which *Ammodiscus* is the most common genus, but *Tolympammina* [probably should be referred to *Minammodytes*; see Henbest, 1963] and *Ammobaculites* are also present.


The writer notes that the Lower Pennsylvania *Chaetetes* biostromes of central Texas, extend
for at least 10 miles across the middle part of a carbonate shelf. The biostromes consist of scattered clumps of *Chaetetes* heads separated by beds of matalga biolithite and fragmental biomicrites and biosparites containing fusulinids and smaller Foraminifera (*Bradyina* (sic), paleotextulariids (sic), and *Calcitornella* [probably should be referred to *Hedraites*; see Henbest, 1963]).


The writer reports the occurrence of *Tetrataxis* sp. from an early Permian formation of the Buttle Lake Area in central Vancouver Island, British Columbia.


The writers report the occurrence of the foraminifers *Endothyra crassa*, *E. globulus*, *E. bradyi* and *Bradyina sphérica* from a Lower Carboniferous sequence in a bore-hole drilled south of the Swiety Krzyz Mountains (foreland of the Middle Carpathians), Poland. Plate 4, fig. 2, and plate 5, fig. 2, carry unrecognizable thin-section photomicrographs of supposed *Bradyina* and *Endothyra*.


The writers express their objections to both Z. N. (S.) 768, Henbest, 1962, and the alternative proposal by Rosovskaya, 1962. They recommend strict application of the Law of Priority and feel that none of the evidence presented in either of these proposals is adequate to warrant the use of the plenary powers of the Commission. Hence, they believe that no action of the Commission is required in this case and that by refusing to act the Commission will uphold the Law of Priority and effectively reject the proposals. [See Loeblich and Tappan (1963, p. 286-290) for pertinent comments and criticisms].

DISTRIBUTION OF ARTICLES ACCORDING TO GEOLOGIC AGE AND CATEGORY

**Precambrian**

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**Silurian**

4, 5, 12, 13, 14, 82

**Devonian**

1, 2, 3, 6, 7, 8, 10, 11, 15, 17, 18, 19, 20, 21, 36, 58, 82

**Mississippian**

26, 28, 29, 32, 34, 35, 36, 43, 44, 47, 54, 58, 65, 67, 69, 70, 79, 82, 84, 85, 88, 89, 96, 97, 102, 103, 108, 114

**Pennsylvanian**

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**Permian**

22, 26, 33, 38, 39, 40, 42, 45, 49, 50, 51, 59, 60, 61, 62, 66, 68, 71, 75, 76, 77, 78, 82, 83, 92, 95, 100, 104, 105, 106, 109, 110, 113

**General**

16, 39, 40, 53, 54, 64, 72, 73, 74, 80, 81, 90, 91, 98, 106, 115
ON SOME RECENT FORAMINIFERA FROM THE FAEROE ISLANDS, DENMARK

DREW HAMAN

Geology Department, University of Wales, Aberystwyth, Wales, U. K.

ABSTRACT

Ten equal volume (10 ml. dry measure) littoral surface sediment samples from two small fjords in the Faeroe Islands were studied for foraminiferal content. Twelve species of foraminifera, one new, were obtained, and two environmental areas are provisionally delimited.

INTRODUCTION

During the summer of 1963 ten surface sediment samples were collected from the fjord between the islands of Strömo and Österö and from a small fjord on the South coast of the adjacent island of Vaagø, in the Faeroe Islands (text fig. 1). A 10 ml. dry standard measure of each sample was sieved at 500, 250, 152 and 75 microns, (corresponding to the sand size fractions of the Wentworth scale of sediments), and studied for foraminiferal content and associated fauna content. Six samples were found to be barren of foraminifera whilst varying numbers of twelve species of foraminifera were retrieved from the remaining samples. The samples were collected as part of the U.C.W. Geography Department Expedition to the Faeroes 1963.

DISCUSSION

The following species were obtained:

- Technitella legumen Norman 1758
- Quinqueloculina agglutinata Cushman 1917
- Quinqueloculina seminulum (Linné) 1758
- Milolitella subrotunda (Montagu) 1803
- Fissurina lucida (Williamson) 1848
- Oolina patannae Haman sp. nov.
- Discorbis bradyi Cushman 1915
- Ammonia beccarii (Linné) 1758
- Elphidium crispum (Linné) 1758
- Cibicides fletcheri Galloway and Wissler 1927
- Cibicides lobatulus (Walker and Jacob) 1798
- Cibicides refulgens Montford 1808

All the above are generally regarded as nearshore cold water species except for Cibicides fletcheri Galloway and Wissler which has only been recorded from the cold waters of Iceland. Oolina patannae is a form specifically close to Oolina borialis Loeblich and Tappan, a cold water species. During studies by the author, Oolina patannae has also been retrieved from Tremadoc Bay, North Wales. It is noticeable that the inshore fauna is composed of the more robust forms such as Cibicides lobatulus (Walker and Jacob), Ammonia beccarii (Linné) and Quinqueloculina seminulum (Linné), whereas the central fjord fauna had, in addition to the above mentioned species, more fragile foraminifera, such as Technitella legumen Norman, Fissurina lucida (Williamson) and Oolina patannae. This difference is associated with a difference in sediment size, the shore samples being composed of fine to coarse sand (.135 mm. - .500. Wentworth), whereas the sediment from the centre of the fjord was silt/mud to very fine sand (.006 mm. - .066 mm. Wentworth).

The associated fauna, obtained from six samples, is dominated by ostracods followed by gastropods and mussels.
SYSTEMATIC DESCRIPTIONS

Superfamily AMMODISCACEA
Family SACCAMMINIDAE
Subfamily SACCAMMININAE
Genus Technitella Norman
Technitella legumen Norman, 1878
Plate 7, figure 1

Remarks.—This fragile form, regarded as occurring typically in cold water, has been recorded from west of Ireland and from the North Sea. It constitutes 4% of sample 9 in the area studied.

Superfamily MILIOLACEA
Family MILIOLIDAE
Subfamily QUINQUELOCULININAE
Genus Quinqueloculina d’Orbigny
Quinqueloculina agglutinata Cushman, 1917
Plate 7, figures 2, 3, 4

Remarks.—This form, recorded from the Arctic region and from off the Washington coast, is stated to have a depth range of 3-24 fathoms. Only one specimen was obtained in the area, at a depth of 15 metres.

Quinqueloculina seminum (Linné), 1758
Plate 7, figures 5, 6, 7

Remarks.—Cushman has stated that the synonymy of this species is voluminous and very difficult to unravel, inasmuch as the name has been used for almost all types of smooth quinqueloculine forms. It is a common species and has been widely recorded from the Arctic to the Antarctic, a cosmopolitan distribution. This species occurs in two samples and comprises 1.7% to 4.2% of the fauna.

Subfamily MILIOLONINELINAE
Genus Miliolinella Wiesner
Miliolinella subrotunda (Montagu), 1803
Plate 7, figures 8, 9, 10

Remarks.—This highly variable species is characteristic of shallow water regions throughout the world and has been recorded from the Arctic to the Antarctic. Forms of this species obtained from more temperate latitudes appear to be more robust, better developed, and occasionally hauerine in type. Three individuals were obtained from two samples.

Superfamily NODOSARIACEA
Family GLANDULINIDAE
Subfamily OOLININAE
Genus Fissurina Reuss
Fissurina lucida (Williamson), 1848
Plate 7, figure 11

Remarks.—The test outline of this species is very variable as is the amount of test thickening. This species has a cosmopolitan distribution but appears to become rarer towards the latitude extremities. Occurred in one station in the area studied.

Genus Oolina d’Orbigny
Oolina patannae Haman, sp. nov.
Plate 7, figures 12, 13, 14

Description.—Test free, small, unilocular, circular in outline, round in cross section. Test has a small, flat, unornamented base and a short, stout, cylindrical neck, with a low transverse rib at the base of the neck. Body ornamented with about 22 longitudinal ribs, originating adjacent to the clear
basal area and extending from the base into the top one-third of the test where they coalesce to form the smooth, thick, upper portion of the test. Ribs are flat topped, wide and separated by grooves of a similar width. Aperture small, circular, terminal, central, at the end of the neck. Faint indication of a short, stout, entosolenian tube, extending only a very short distance into the test. Wall calcareous, translucent, perforate.

Dimensions.—Length 0.36 mm., Diameter 0.30 mm.

Remarks.—This species differs markedly from the related species Oolina borealis Loeblich and Tappan in general shape, nature of the costae, and also in the nature of the apertural collar and neck. Two specimens of this species were obtained from sample 9. Identical forms have been retrieved from Tremadoc Bay, North Wales, as mentioned previously.

Discorbis globularis (d'Orbigny) var. bradyi Cushman, 1915

Plate 7, figures 15, 16


Remarks.—This species is subject to great variation according to development and mode of growth, sessile forms being quite flat and scale-like, while free types are often inflated and dome shaped. A typical shallow water form from all latitudes including the Arctic and Antarctic especially where rocks afford shelter. Occurs in one sample where it constitutes over 9% of the fauna.

Superfamily ROTALIACEA
  Family ROTALIIDAE
  Subfamily ROTALINAE
  Genus Ammonia Brunnich
    Ammonia beccarii (Linne), 1758

Plate 7, figures 17, 18, 19


Remarks.—This highly controversial and variable species is widespread throughout the world, and although it is cosmopolitan, is especially common in shallow water areas with considerable size and ornament variations. It has been found in sample 10 where it constitutes 40% of the fauna.

Family ELPHIDIDAE
  Subfamily ELPHIDINAE
  Genus Elphidium de Montford
    Elphidium crispum (Linne), 1758

Plate 7, figures 20, 21


Polystomella crispa (Linne). JEPPE, M. W., 1956, The Protozoa Sarcodina, p. 73, t. fig. 34.


Remarks.—Brady (1884) comments that this is one of the most abundant shallow water Foraminifera. It is typically cosmopolitan, the main limiting factor appearing to be that of salinity (Murray 1963). Present in one sample in the area studied.

Superfamily ORBITOIDACEA
  Family CIBICIDINAE
  Subfamily CIBICIDINAE
  Genus Cibicides de Montford

Cibicides fletcheri Galloway and Wissler, 1927

Plate 7, figures 22, 23

Cibicides fletcheri Galloway and Wissler, 1927, Journ. Pal. vol. 1, no. 1, p. 64, pl. 10, figs. 8a-c.


Remarks.—The only cold water record for this species is from Iceland, and cool water record from Hudson Bay. It comprises 4% of the fauna of sample 3.

Cibicides lobatus (Walker and Jacob), 1798

Plate 7, figures 24, 25, 26

Nautilus lobatus WALKER and JACOB, 1798, p. 642, pl. 14, fig. 36.


Cibicides lobatus (Walker and Jacob). PHLEGER,

Remarks.—Brady states that this species is common at every latitude from the most northerly points of the Arctic Ocean to the Antarctic Ice Barrier. It is generally acknowledged that the high degree of variation in the form of the test of this species is attributed to method and substance of attachment as each individual tends to conform to the substrate configuration. Abundant at all depths but common in shallow water, and in all types of sediment but with highest frequencies in pebbly, gravelly substrates. It is for the above reason that it is extremely difficult to separate Cibicides lobatulus and Cibicides refugens with any degree of certainty as it is possible that these two forms are the ends of a bioseries.

This species is the dominant form in the area studied comprising between 60% to 100% of the fauna in four samples, most abundant in theshore sands.

Cibicides refugens Montford, 1808
Plate 7, figures 27, 28

Cibicides refugens MONTFORD, 1808, Conch. Syst. vol. 1, pt. 22.
Remarks.—As stated above, this species is very difficult to separate from Cibicides lobatulus but in this study the factor for differentiation is the height of the test, namely Cibicides refugens being the high conical form. Occurs in one sample where it constitutes 4% of the fauna.

CONCLUSION
The Faeroe fjords appear to provide a fairly hospitable environment for a number of different foraminifera types, both fragile and robust forms. As stated in the introduction, the area studied can, on foraminiferal evidence, be provisionally divided into two environmental areas:

a) the central fjord
b) lateral shore (inter-tidal)
with distinct faunal associations and sediment types.

ACKNOWLEDGMENTS
The author is indebted to Dr. J. Frampton for providing study material and to Dr. J. R. Haynes for critically reading this manuscript.

REFERENCES


Montagu, G., 1803, Testacea Britannica. 3 Vols.


EXPLANATION OF PLATE 7

Figs.
1. Technitella legumen Norman, × 108
2, 3, 4. Quinqueloculina agglutinata Cushman, × 76
5, 6, 7. Quinqueloculina seminulum (Linné), × 76
8, 9, 10. Miliolabella subrotunda (Montagu), × 146
11. Fissurina lucida (Williamson), × 146
12, 13, 14. Oolina patamnae Haman, sp. nov. × 146
15, 16. Discorbus bradyi Cushman, × 156
17, 18, 19. Ammonia beccarii (Linné), × 104
20, 21. Elphidium crispum (Linné), × 180
22, 23. Cibicides fletcheri Galloway and Wissler, × 104
24, 25, 26. Cibicides lobatulus (Walker and Jacob), × 118
27, 28. Cibicides refugens Montford, × 104

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317. QUINQUELOCULINA NEOSIGMOILINOIDES, NEW NAME FOR QUINQUELOCULINA SIGMOILINOIDES VELLA, PREOCCUPIED
JAMES P. KENNETT
New Zealand Oceanographic Institute,
Department of Scientific and Industrial Research, Wellington

While carrying out a study of Foraminifera from the Ross Sea, Antarctica, it was discovered that Quinqueloculina sigmoilinoides Vella (1957, p. 24, pl. 6, figs. 115-117) from the Recent of New Zealand is preoccupied by Q. sigmoilinoides Gianotti (1953, p. 43, pl. 4, fig. 1) from the middle Miocene of Italy.

On indicating this to Dr. Paul Vella (pers. comm.) he authorized me to rename his form. The new name Quinqueloculina neosigmoilinoides is proposed for Q. sigmoilinoides Vella.

REFERENCES
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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.


AUDLEY-CHARLES, M. G. A Miocene gravity slide deposit from eastern Timor.—Geol. Mag., v. 102, No. 3, 1965, p. 267-276, pls. 8, 9, text fig. 1 (map).—Age determined by upper Miocene Foraminifera mixed with others as old as Permian.

BANDY, ORVILLE L., INGLE, JAMES C., JR., and RESIG, JOHANNA M. Modification of foraminiferal distribution by the Orange County outfall, California.—Ocean Science and Ocean Engineering, Washington, D.C., June 1965, p. 55-76, text figs. 1-10 (loc. map, distrib. maps, fence diagrams).—This moderate-sized sewage outfall shows abundance aureoles of living Foraminifera and a small depressed zone at the outfall point, with the same species as those previously reported at larger and smaller outfalls along the southern California coast. Study is based on live and dead populations from 65 stations. Greater prominence of arenaceous forms in the dead than in the living assemblages suggests post-depositional solution of calcareous forms.

BOLLI, HANS M., and BERMUDEZ, PEDRO J. Zonation based on planktonic Foraminifera of middle Miocene to Pliocene warm-water sediments.—Bol. Informativo, Asoc. Venez. Geol., Min. Petrol., v. 8, No. 5, May 1965, p. 121-149, pl. 1, tables 1, 2.—An important paper proposing 6 new planktonic zones: 1 in the middle Miocene (above the Globorotalia menardii zone), 3 in the upper Miocene, and 2 in the Pliocene. The study is based on 4 sections: coastal northeastern Venezuela, coastal northwestern Venezuela, Jamaica, and cores from Bodjonegoro-I well in Java. The occurrence and range of 10 critical species in these 4 sections are indicated graphically. Four new species and a new subspecies are described. The probable effects of ecologic factors (temperature, depth, and salinity) on viability of planktonic species are shown, using Globorotalia tumida, G. truncatulinoides, Sphaeroidinella seminulina and S. dehiscens as examples.


The subtropical/subantarctic zone of convergence (Atlantic Ocean, western part) (in Spanish with English Summary).—Argentina Serv. Hydro, Naval, Publ. H640, 1966, p. 1-69, pl. 1, maps 1-IV, graphs 1-3, tables 1-5.—By study of 320 planktonic samples obtained during 3 expeditions (summer, early autumn, and late winter) off the southeastern coast of South America (between 27° and 55° S), the zone of convergence is recognized through the relative abundances of species characteristic of subtropical and those characteristic of subantarctic water. The zone of convergence extends through about 18° of latitude and consists of alternating patches of subtropical water, subantarctic water, and mixed water with either subtropical or subantarctic predominance of species. Of the 22 species present, 5 are useful as indicators of subantarctic water and 3 of subtropical water; the remainder are either too rare in the present collections or occur in both water types. Data are included on coiling direction, number of specimens per volume of water, variation in size, vertical migration, benthonic specimens in planktonic hauls, and changes in temperature and salinity across the patches of alternating water types within the zone of convergence.
BRODE, J. W. Capricorn Seamount, South-West Pacific Ocean.—Trans. Roy. Soc. New Zealand, Geol., v. 3, No. 10, Aug. 6, 1965, p. 151-158, pls. 1, 2, text figs. 1, 2 (maps).—In limestone dredged from the summit are 2 generations of Cycloclypeus; Miocene ones within fragments and Pliocene to Recent ones within the matrix.

BÜRGL, HANS. El limite Oligo-Mioceno en el Terceario Marino de Colombia.—Rev. Acad. Colombiana Ciencias Exactas, Fisicas y Naturales, v. 12, No. 47, Aug. 1965, p. 245-258, text figs. 1-7 (correl. charts, maps, geol. sections), tables 1-3.—Globigerina oligoecaena zone recognized in Colombia.

CHIJI, MANZO. Foraminiferal faunules from the Uemati Formation, Osaka City.—Bull. Osaka Mus. Nat. Hist., No. 16, March 1963, p. 53-67, pls. 5-7, text figs. 1, 2 (map, columnar section), tables 1, 2.—Illustrated catalog of 37 species and varieties (9 indeterminate) from a late Pleistocene terrace deposit.

DOUGLAS, ROBERT. An occurrence of Shepheardella Siddal (Foraminiferida) from the West Coast of North America.—Jour. Protozoology, v. 11, No. 4, Nov. 1964, p. 484-486, text figs. 1-3.—Shepheardella taeniformis Siddal living in tide pools near Malibu, California.


GRAHAM, J. J., DE KLASZ, I., and RÉRAT, D. Quelques importants Foraminifères du Tertiaire du Gabon (Afrique Equatoriale).—Revue de Micropaléontologie, v. 8, No. 2, September 1965, p. 71-84, pls. 1, 2, text fig. 1 (map).—Nineteen species (13 new) and 6 subspecies (all new) from Paleocene to lower Miocene.


RAMAUDI, M. On a new subgenus of Hedbergella (Foraminiferida).—Israel Jour. Earth-Sciences, v. 13, No. 3-4, March 1965, p. 133-142, pls. 1, 2.—Asterohedbergella (type species H. (A.) asterospinosa n. sp.) from the upper Cenomanian of Israel.


HAUSMANN, HELLMUT E. Foraminiferenfauna und Fein stratigraphie des mitteloligozänen Septarien tones im Raum zwischen Magdeburg und Dessau. Teil II: Fein stratigraphie und Ökologie.—Hercynia, Leipsig, v. 2, heft 3, 1965, p. 267-290, text figs. 1, 2 (correl. chart, diagram), diagrams 1-5 (check lists, abundance graphs).—Six Foraminifera horizons present in two borings. Correlation by fluctuating abundance of a few selected species.


JANNIN, FRANÇOISE. Contribution à l'étude du stratotype de l'Albian: variations des microfaunes dans la partie inférieure des argiles tégulines.—Revue de Micropaléontologie, v. 8, No. 2, September 1965, p. 106-117, text figs. 1-4 (map, graphs), diagrams 1-7 (pie diagrams, frequency diagram).—Quantitative analysis of species of Foraminifera in 6 samples from 3 different outcrops of the Albian.

KELLOUGH, GENE ROSS. Paleocology of the Foraminiferida of the Wills Point Formation (Midway Group) in northeast Texas.—Trans. Gulf Coast Assoc. Geol. Soc., v. 15, 1965, p. 73-153, pls. 1-15, text figs. 1-27 (maps, profiles, correl. chart, columnar section, geol. sections, electric logs, check lists, graphs, outcrop photographs).—Basing paleoecology on numbers of species and of specimens and on benthonic or planktonic dominance, transgression and regression, with fluctuating depth and open marine to intertidal or brackish conditions, are interpreted. An illustrated systematic catalog of about 185 species (1 subspecies new) is included.


MCGOWRAN, BRIAN. Two Paleocene foraminiferal faunas from the Wangerrip Group, Pebble Point coastal section, Western Victoria.—Proc. Roy. Soc. Victoria, v. 79, pt. 1, Dec. 10, 1965, p. 9-74, pls. 1-6, text figs. 1-14 (drawings), table 1.—About 120 species (1 described as new and 13 others indeterminate) recorded and illustrated from two faunas, one middle Paleocene and one upper Paleocene. Correlation is by planktonics.

MCGUGAN, A. Liassic Foraminifera from Whitepark Bay, County Antrim.—Irish Naturalists' Jour., v. 15, No. 4, Oct. 1965, p. 85-87, pl. 1.—Eleven species (4 indeterminate), none new; all but one lagenids.

MEGURO, HIROSIIH, YOSHIDA, UCHIO, TAKAYASU, KIGOSHI, KUNIHIKO, and SUGAWARA, KEN. Quaternary marine sediments and their geological dates with reference to the geomorphology of Kronprins Olav Kyst.—Antarctic Geology, SCAR Proc., 1963, p. 73-80, text figs. 1-2 (map, profiles), tables 1-3.—Along Prince Olav Coast of Antarctica, Foraminifera from marine sediments of Pleistocene age, raised up to 20 meters above sea level, are dated by radio-carbon as 23,000 years or older.

DE MEUTER, F. Etude paléo-écologique des Foraminifères des Sables d’Edegem (Miocène Moyen) à Terhagen (prov. d’Anvers).—Bull. Soc. Belge Géol., Tome 74, fasc. 1, 1965, p. 53-59, text figs. 1, 2 (map, graphs).—Middle Miocene Edegem Sands subdivided on the basis of quantitative analysis of 15 species into 3 ecologic members, the lower and upper ones deposited under littoral conditions and the middle member indicating influence of a northern open sea.


NEUMANN, M. Conribution à l’étude de quelques Lithoidal des Cénomanien d’île Madame (Charente-Maritime).—Revue de Micropaléontologie, v. 8, No. 2, September 1965, p. 90-95, pls. 1, 2.—Three genera discussed, 2 new: Maynica (type species Daxia d’orbignyi Cuviellier and Szakall) and Charentia (type species Charentia cuvieri n. sp.).

PANTJK, SMILJKA. Pilaminella densa n. gen., n. sp. and other Ammodiscidae from the Middle Triassic in the Crmnica (Montenegro).—Bull. Geol., Inst. Recherches Geol. Zagreb et Soc.
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POIGNANT, ARMELLE. Deux nouvelles espèces de Foraminifères d'Aquitaine méridionale.—Revue de Micropaléontologie, v. 8, No. 2, September 1965, p. 103-105, pl. 1.—Rotalia cavillleri from the upper Oligocene and Queraltina abrardi from Eocene-Oligocene passage beds.

PREMOLI SILVA, ISABELLA. Permian Foraminifera from the Upper Hunza Valley.—Ital. Exped. to the Karakorum (K2) and Hindu Kush, Sci. Repts., IV, 1965, p. 89-125, pls. 10-18 (on p. 364-381), text fig. 1 (drawings).—From rock studied in thin section, 27 species (1 new and 15 indeterminate).


RAUZER-CHERNOUSOVA, D. M. Dating the emergence of new species in the geologic past (translation).—Internat. Geol. Rev., v. 7, No. 11, Nov. 1965, p. 2049-2053.—There may be a considerable time lag following the initial stage of formation of new forms, through mutations at different times and in different parts of a habitat, before the more easily recognizable stage of rapid dispersal of a viable new species.

ROCHA, A. TAVARES, and UBALDO, M. LOURDES. Contribution for the study of Foraminifera from sands of Diu, Gogolá and Simbor.—García de Orta, Lisboa, v. 12, No. 3, 1964, p. 407-420, pls. 1-5, text fig. 1 (map), distrib. and abund. chart.—Fifty-two species (none new) recorded and illustrated from 10 samples of beach and dune sands along the southern Kathiawar peninsula, India.


ROSS, CHARLES A. Late Pennsylvanian Fusulinidae from the Gaptank Formation, west Texas.—Jour. Paleontology, v. 39, No. 6, Nov. 1965, p. 1151-1176, text figs. 1-8 (map, columnar sections, diagrams, range chart, correl. chart), tables 1, 2.—Sixteen species; 10 species of Triloculites are new.


SAMANTA, BIMAL K. Discocyclina from the upper Eocene of Assam, India.—Micropaleontology, v. 11, No. 4, Oct. 6, 1965, p. 415-430, pls. 1-4, text figs. 1-3 (maps), tables 1-3.—Eleven species, none new.

TAPPAN, HELEN, and LOEBLICH, ALFRED R., JR. Foraminiferal remains in palynological preparations.—Revue de Micropaléontologie, v. 8, No. 2, Sept. 1965, p. 61-63.—Examples of generic names given to pseudochitinous remains and inner linings of specimens already having names.

THOMPSON, M. L., and SHAVER, R. H. Early Pennsylvanian microfaunas of the Illinois Basin.—Trans. Illinois Acad. Sci., v. 57, No. 1, March 1964, p. 3-23, pls. 1-5, text figs. 1, 2 (map, stratigraph. sections), tables 1, 2.—Profusulinella burrensis n. sp.

