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Lower Triassic foraminifera from the Thaynes Formation in southeastern Idaho and western Wyoming

ABSTRACT

Approximately 600 specimens of arenaceous foraminifera have been recovered from insoluble residues of limestones from the Lower Triassic Thaynes Formation in southeastern Idaho and western Wyoming. Most of the ten species, four of which are new, belong to genera which are far-ranging in age. This is the second reported occurrence of foraminifera from the Lower Triassic in the Western Hemisphere.

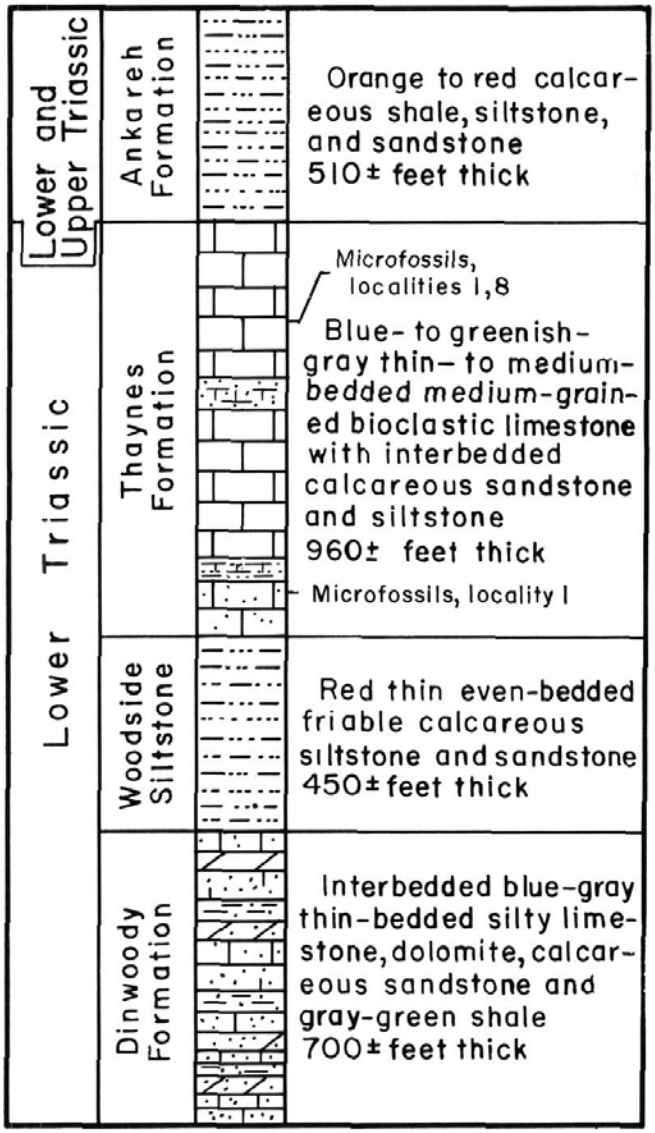
INTRODUCTION

Foraminifera from Lower Triassic rocks are almost unknown in North America. The only occurrence previously reported is that described by Schell and Clark (1960), who have listed five silicified lagenid species, representing four genera, obtained from insoluble residues of limestones in northeastern Nevada. This report concerns 8 genera and 10 species of arenaceous foraminifera, 4 species of which are new, obtained from several thousand insoluble residues of limestone samples from the Lower Triassic Thaynes Formation in southeastern Idaho and western Wyoming. Several of the species are represented by only one or two specimens. Three species belong to the Ammodiscidae, two each to the Lituolidae and Textulariidae, and one each to the Astrorhizidae, Hormosinidae and Ataxophragmiidae. The specimens are better preserved and represent a more varied assemblage of Lower Triassic foraminifera than any known heretofore. The illustrations of the foraminifera were drawn by the author with the use of a camera lucida.

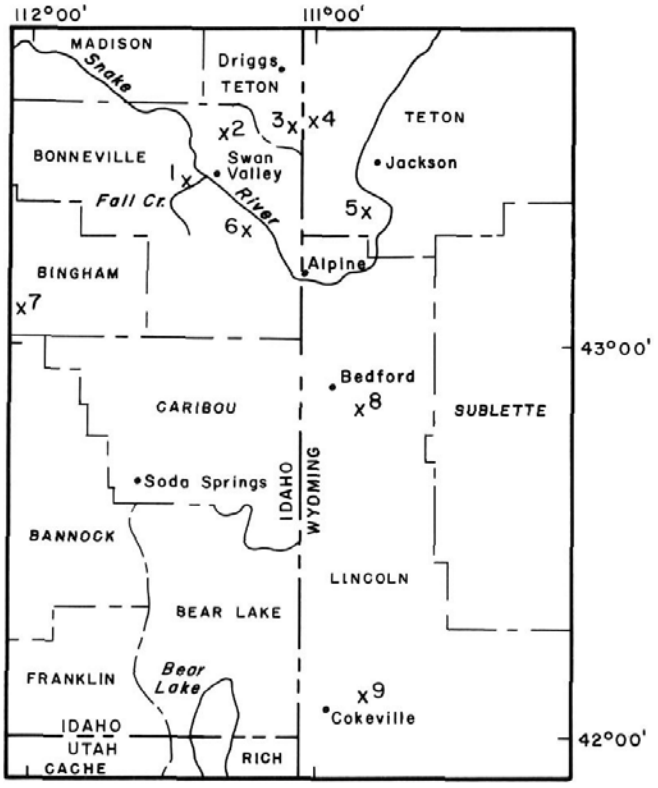
STRATIGRAPHY

The stratigraphic succession of the Lower Triassic strata in the Caribou Range in southeastern Idaho is given in text-figure 1. The fairly thick marine sequence of Triassic age lies along the eastern margin of a marine miogeosynclinal belt that existed here during Early Triassic time. The thickest and most complete section of Lower Triassic rocks in the miogeosyncline is in the area near Locality 7 (text-figure 2). According to Kummel (1954), "to the east, north, and south [of this area], the Dinwoody and Thaynes formations thin and intertongue with the red beds of the Chugwater, Woodside, and Ankareh formations."

The Thaynes Formation in the Caribou Range, about 960 feet thick, consists mainly of a blue-gray to greenish-gray, thin-bedded to medium-bedded, medium-grained, silty bioclastic limestone and interbedded calcareous sandstone and siltstone, with no red-bed intervals. However, nearly all sections of the Thaynes that the author has seen east of the Caribou Range do contain red-bed units, some intervals as much as several hundred feet thick. The distinct ammonoid zones recognized by Smith (1932) in the Thaynes of southeastern Idaho, in ascending order the *Meekoceras, Tirolites* and *Columbites* zones, are not present at Localities 1 and 8. Because the ammonoid zones are found only in the thicker geosynclinal sections to the south of this area, it is impossible to assign the arenaceous foraminifera to any one of the Scythian ammonoid zones.



TEXT-FIGURE 1
Stratigraphic succession of the Lower Triassic in the Caribou Range in southeastern Idaho.



TEXT-FIGURE 2
Index map of localities sampled for foraminifera. Detailed descriptions of localities are listed in text.

COLLECTION OF SAMPLES

The Thaynes was extensively chip-sampled at 1-foot intervals at nine localities during a mapping program by the U. S. Geological Survey in this general area. All limestone samples were dissolved in weak (10 per cent) hydrochloric acid. When any evidence of microfossils was observed, additional limestone samples from the original collection were dissolved in hydrochloric acid and also in acetic acid to obtain any phosphatic forms that might be present. More samples were also collected from the intervals in which the microfossils were found.

The main collection of foraminifera was obtained from the upper 2 feet of a 6-foot, dark-gray, fine-grained carbonaceous limestone interval in the Caribou Range in southeastern Idaho along Fall Creek, about 260 feet from the top of the Thaynes. Associated with the foraminifera at this locality was a varied assemblage of other types of microfossils, consisting of conodonts, sponge spicules, shark teeth and brachiopod spines. Of these, the sponge spicules and shark teeth are relatively numerous and the conodonts relatively scarce – a sample containing only one conodont might have as many as a dozen specimens of the other types.

All attempts to obtain calcareous forms from the Fall Creek locality have been unsuccessful. Thin sections of the upper 2 feet of the limestone did not reveal any calcareous or arenaceous forms. At the interface between the dark-gray limestone and the overlying siltstone, siltstone samples were collected and broken down by boiling in the expectation that calcareous forms might be obtained, but no microfossils or fragmented fossils of any kind were found. Apparently, the upper 2-foot interval contains microfossils concentrated in thin bands rather than scattered throughout the limestone.

The specimens of *Hyperammina* in the collections were obtained about 70 feet above the base of the Thaynes at the Fall Creek locality in a very thin, dark-gray, fine-grained silty limestone bed. Several attempts have been made to relocate the limestone bed from which the original chip sample came, but all attempts have been unsuccessful.

The specimens of *Reophax* were obtained from a 15- to 20-foot, dark-gray to blue-gray silty limestone interval at Locality 8, in western Wyoming, approximately the same distance from the top of the Thaynes as the collection from Fall Creek, Locality 1. No other microfossils were found associated with the foraminifera at this locality. Although all the localities have been extensively sampled, only these two localities, 1 and 8, have yielded any foraminifera.

Detailed description of localities sampled for foraminifera:

1) Fall Creek locality, eastern Idaho, N½SE¼ sec. 18, T. 1 N., R. 43 E., Boise meridian.
2) Pine Creek locality, eastern Idaho, C SW¼ sec. 29, T. 3 N., R. 44 E., Boise meridian.
3) Pole Canyon locality, eastern Idaho, C NE¼ sec. 27, T. 3 N., R. 45 E., Boise meridian.
4) Nordwall Canyon locality NW¼SE¼ sec. 8, unsurveyed, T. 41 N., R. 118 W., sixth principal meridian.
5) Rock Creek locality, SE¼ sec. 8, unsurveyed, T. 39 N., R. 117 W., sixth principal meridian.
6) Calamity Point locality, NE¼SE¼ sec. 18, T. 1 S., R. 44 E., Boise meridian.
7) Ross Creek locality, SE¼ sec. 12, unsurveyed, T. 4 S., R. 37 E., Boise meridian.
8) Turnerville locality, western Wyoming, C S½ sec. 18, unsurveyed, T. 33 N., R. 117 W., sixth principal meridian.
9) Cokeville locality, S½ sec. 35, T. 25 N., R. 118 W., sixth principal meridian.

CHARACTER OF THE TRIASSIC FORAMINIFERA

The assemblage of foraminifera found in the Thaynes Formation differs from other described Triassic faunas in the United States. Four of the ten species belong to the superfamily Ammodiscacea, one of these in the family Astrorhizidae and three in the Ammodiscidae. The remaining six species belong to the superfamily Lituolacea, one in the Hormosinidae, two in the Lituolidae, two in the Textulariidae, and one in the Ataxophragmiidae. All five of the species described from the Lower Triassic in Nevada by Schell and Clark (1960) were silicified forms belonging to the family Nodosariidae. The only other Triassic fauna in North America with which one can make a comparison is that described by Tappan (1951) from the Upper Triassic of northern Alaska. Of the 26 species described, 12 belong to the Nodosariidae, 5 to the Polymorphinidae, 2 to the Lituolidae, 2 to the Trochamminidae, and 1 each to the Ammodiscidae, Ataxophragmiidae, Bolivinitidae, Spirillinidae and Discorbidae.

In the Triassic occurrences in Nevada and Alaska the Nodosariidae are predominant. No species of Nodosariidae were found in the Thaynes, but this would be expected since the specimens were recovered by dissolving limestones in acid and any calcareous forms would be lost in the process, unless replaced by siliceous or other insoluble material. No zonations can be established until more is known about the distribution of these species. Most of the species belong to simple arenaceous genera that, with the exception of *Verneuilinoides*, range throughout the post-Paleozoic, and some of the simpler forms, such as *Tolypammina* and *Hyperammina*, are known from the Ordovician and Silurian to the Recent.

COMPOSITION OF TESTS OF TRIASSIC FORAMINIFERA

It does not seem probable that secondary silicification has affected the original composition of the foraminiferal tests found in the Thaynes Formation because 1) most of the tests of the foraminifera are in a good state of preservation and 2) no representative of the Nodosariidae was recovered. Although the latter might be considered questionable evidence, it would seem logical that if any secondary silicification had occurred, it would have also included the calcareous tests of the Nodosariidae, since the Nodosariidae have dominated the foraminiferal assemblages previously described from Triassic strata.

ACKNOWLEDGMENTS

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SYSTEMATIC PALEONTOLOGY

All type forms and figured specimens are to be deposited in the U. S. National Museum, and their serial numbers are included in the plate explanations. Unless otherwise indicated, all forms were obtained from the upper part of the Thaynes at Locality 1. The classification followed in the text is that given by the *Treatise on Invertebrate Paleontology* for the "Foraminiferida".

Order FORAMINIFERIDA
Superfamily AMMODISCACEA
Family AMMODISCIDAE
Subfamily TOLYPAMMININAE
Genus AMMOVERTELLA Cushman, 1928

Ammovertella liassica Barnard
Plate 1, figures 1–2

Ammovertella liassica BARNARD, 1950, p. 354, text-fig. 1c.

Description: Test attached, with attached side flat and unattached side convex, consisting of a proloculus and a tunnel-shaped second chamber initially planispirally coiled with adjacent parts of tube used as wall, then extending out in one general direction of growth; extended tube increasing only slightly in diameter; whorls about four in number; wall composed of fine quartz silt, well-cemented; aperture at end of extended tube.

Dimensions: Specimen illustrated in figure 1, diameter of coil 0.28 to 0.35 mm., length of extended tube 0.42 mm.

Remarks: Barnard described this species from the Lower Jurassic of the Dorset coast, England, where he found it to be fairly common. Only two complete specimens were found in the Thaynes, but they fit Barnard's description and illustration perfectly. The direction of growth of the planispirally coiled portion of the test may be either clockwise or counterclockwise. Both types of coiling are illustrated here. The attached side (figure 1b) is partly crusted over, hence the discontinuity of the chamber in places.

Ammovertella inclusa ? (Cushman and Waters)
Plate 1, figure 4a–b

?Psammophis inclusus CUSHMAN and WATERS, 1927, p. 148, pl. 26, fig. 12.
?Tolypammina inclusa (Cushman and Waters). – GALLOWAY and RYNIKER, 1930, p. 11, pl. 1, figs. 12–13.
?Ammovertella inclusa (Cushman and Waters). – CUSHMAN and WATERS, 1930, p. 44, pl. 7, fig. 13.

Description: Test attached, incomplete with initial portion broken off, attached side flattened, unattached side convex, consisting of an elongate tunnel-shaped chamber that enlarges gradually, uses adjacent parts of the tube as a common wall and is flexed back and forth in a common plane with later stages extended over earlier portions of tube.

Dimensions: Diameter of test 0.35 to 0.40 mm., diameter of tube 0.07 to 0.10 mm.

Remarks: Only one specimen was found. The specific determination is questioned since the initial portion of the test is gone, but the portion of the specimen present is similar to the corresponding portion of *A. inclusa*. Cushman and Waters (1930) found this species in the South Bend Shale Member of the Graham Formation of the Cisco Group in central Texas. *Ammovertella elevata* Ireland is also similar in its general shape and size, but the tube of that species coils more extensively over the test, elevating it much higher than in *A. inclusa*. Ireland (1956) found this species to be present in many of the beds of Virgil age in Kansas.

Genus TOLYPAMMINA Rhumbler, 1895

Tolypammina sp.
Plate 1, figure 3

Description: Test incomplete, consisting of a tubular second chamber partially coiled, with the proloculus and initial portion broken off; tube increasing only slightly in diameter; wall fine to medium quartz silt, well-cemented; surface smooth to slightly rough; aperture at open end of tube.

Dimensions: Length of tube about 1.2 mm., greatest width of tube 0.13 mm.

Remarks: Only one specimen of *Tolypammina* was found in the Thaynes. Not enough of the specimen is present to define it at the specific level. However, its general dimensions and smoothness of test wall suggest that it is most similar to *Tolypammina polyverta* Ireland. Ireland (1956) found this form to be the most common of the tolypamminids in the rocks of the Virgil Series in Kansas.

Family HORMOSINIDAE
Genus REOPHAX Montfort, 1808

Reophax finleyi Schroeder, **n. sp.**
Plate 1, figures 5–9

Description: Test small, elongate, composed of a proloculus and as many as eight gradually expanding chambers; last chamber about as wide as high, only occasionally pyriform in shape; preceding chambers usually tapering to initial extremity, with greatest diameter usually in upper portion of chamber; early chambers with a greater diameter than height; chambers rarely aligned along a straight axis, greatest deviations usually occurring in earlier portions of test; length of test ranging from about 4.5 to 5.5 times the maximum diameter; proloculus and the following several chambers broken off in many specimens; aperture a simple rounded terminal opening in last chamber; test of medium-coarse quartz silt, with fine quartz grains occasionally incorporated into test; color of test white.

TABLE 1
Measurements of *Reophax finleyi* in mm.

Specimen (Pl. 1)	Length	Height, last chamber	Diameter, last chamber	Height, first chamber	Diameter, first chamber
Fig. 5	0.46	0.07	0.10	0.03	0.04
Fig. 6	0.51	0.10	0.09	0.03	0.04
Fig. 7	0.56	0.11	0.11	0.05	0.09
Fig. 8	0.76	0.14	0.13	0.03	0.06

Dimensions: See table 1.

Remarks: The diagnostic features of this new species are the slowly expanding chambers, producing a test that has a length of 4.5 to 5.5 times the maximum chamber diameter, the sharply incised sutures, the single simple aperture at the end of a regular final chamber, the medium-coarse grain silt test, the low early chambers, and the later chambers of approximately equal dimensions.

Both *Reophax northviewensis* Conkin and Conkin, 1964, and *Reophax minutissimus* Plummer, 1945, are somewhat similar to *R. finleyi* in the length of the test, number of chambers, and low early chambers, but differ from this new species in having pyriform chambers, an aperture at the end of a short neck extending from the last chamber, a greater diameter of the last chamber, and a length shorter in comparison with the maximum diameter.

This new species is well represented in the collections, more than 60 specimens being present. Most of the specimens, however, are only fairly well preserved. The holotype is one of the bigger specimens found. Measurements for the specimen illustrated by figure 9 on plate 1 are not given because it is an internal mold and the dimensions might be misleading. An indication of the thickness of the test wall may be obtained by comparing the mold to figure 8, which is about the same height. The pyriform final chamber of the specimen illustrated by figure 5 on plate 1 is rare in that the height/diameter ratio of the final chamber is usually about equal. Because the proloculus is missing on many specimens, it is impossible to determine its exact form, but, where observed, it generally seems to be round to slightly prolate.

This new species of *Reophax* is named in honor of E. A. Finley, who is Chief of the Branch of Mineral Classification, U. S. Geological Survey.

Family ASTRORHIZIDAE
Subfamily HIPPOCREPININAE
Genus HYPERAMMINA Brady, 1878

Hyperammina glabra? Cushman and Waters
Plate 1, figures 10–11

?Hyperammina glabra CUSHMAN and WATERS, 1927, p. 146, pl. 26, fig. 1.

Description: Test free, elongate, consisting only of tapered tubular second chamber, incomplete, initial extremity broken off; wall of fine arenaceous material with much cement, with very fine quartz sand and euhedral quartz crystals occasionally incorporated into cement; aperture formed by open end of tube.

Dimensions: Specimen illustrated in figure 10, length of test 0.58 mm., width of tube 0.05 to 0.10 mm.; specimen illustrated in figure 11, length of tube 0.50 mm., width of tube 0.06 to 0.11 mm.

Remarks: Only eight fairly complete specimens were found, along with a lot of other fragmented material. Each of the eight specimens lacks a proloculus. Because the proloculi are missing, the specific determination is questioned, but these specimens otherwise fit fairly closely the description given by Cushman and Waters for *H. glabra*. Cushman and Waters (1927) found this species near the top of the Strawn and also (1930) in the South Bend Shale Member of the Graham Formation of the Cisco Group. Ireland (1956) found this species in many of the beds throughout the Virgil Series in Kansas.

This form was found about 70 feet above the base of the Thaynes along Fall Creek, Locality 1. Various attempts to find the original limestone bed from which the samples were obtained have been unsuccessful.

Superfamily LITUOLACEA
Family LITUOLIDAE
Subfamily LITUOLINAE
Genus AMMOBACULITES Cushman, 1910

Ammobaculites duncani Schroeder, **n. sp.**
Plate 1, figures 12–16

Description: Test elongate, slender, consisting of a proloculus and usually four (only seldom five) chambers planispirally coiled, followed by a maximum of eight rectilinear inflated chambers which increase in diameter only slightly, producing a terminal portion with essentially parallel sides; initial rectilinear chambers of microspheric form lower than those of megalospheric form, resulting in several additional chambers in tests of equal length; sutures distinct, slightly depressed; wall composed of fine-grained quartz silt, well-cemented, surface smooth to slightly rough; aperture circular, terminal in last chamber; color of test white to rusty gray.

TABLE 2
Measurements of *Ammobaculites duncani* in mm.

Specimen (Pl. 1)	Length	Diam., coil	Length, rect. part	Diam., last chamber	Height, last chamber	No. of coiled chambers	No. of rect. chambers
Fig. 12	0.65	0.14	0.53	0.10	0.12	4	6
Fig. 13	0.58	0.12	0.46	0.10	0.13	5	6
Fig. 14	0.63	0.13	0.52	0.11	0.12	4	5
Fig. 15	0.54	0.09	0.47	0.10	0.11	4	7
Fig. 16	0.31	0.11	0.22	0.09	0.09	4	3

Dimensions: See table 2.

Remarks: The diagnostic features of this new species are the four chambers in the planispiral coiled portion and as many as eight chambers in the rectilinear portion, the sutures sharply incised into the wall, the finely arenaceous wall, and the simple aperture at the end of the final chamber.

Ammobaculites parallelus Ireland from the Pennsylvanian of Kansas is similar to *A. duncani* in its long test and rectilinear series with essentially parallel sides, but it differs in having more chambers, five to six in the coil instead of usually four, and in having a test composed of medium to coarse quartz silt.

Ammobaculites inconspicuus Cushman and Waters from the Pennsylvanian of Texas is similar in the dimensions of the test, the finely arenaceous wall, and the number of chambers in the rectilinear series, but *A. duncani* differs in usually having four chambers in the coil and a rectilinear series in which the chambers are usually parallel.

Ammobaculites rectus (Brady), as described by Harlton (1928) from the Pennsylvanian of Texas, also has a long test with a smooth finish, but it has a gently tapering test and more than four chambers in the coil. *Ammobaculites fisheri* Crespin, 1953, from the Lower Cretaceous of Australia is similar in the well-defined chambers in the planispiral and uniserial portions of the test, and the small number of chambers, three to five, in the coil, but differs in usually having five chambers in the rectilinear portion, a subpyriform last chamber, a rough surface, and an aperture that varies in shape from circular to elliptical and is surrounded by a slight lip.

This form is the most abundant species of the foraminifera found in the Thaynes, more than 300 specimens being present in the collections. Of all the specimens, 98 per cent or more have four chambers in the coil, which is the dominant characteristic separating the species from others with an elongate rectilinear series. Some of the longer specimens show a tendency to be slightly twisted. This twisting is believed to happen during the final compaction of the sediment rather than to be an inherent characteristic of the species, since none of the shorter specimens show this characteristic. One of the remarkable features of the species is its selection of grain size for the wall. All of the specimens in the collections have used a very fine-grained quartz silt in the construction of the test.

This new species of *Ammobaculites* is named in honor of H. J. Duncan, formerly with the U. S. Geological Survey, who recently retired after 22 years of service as Chief of the Conservation Division.

Subfamily HAPLOPHRAGMOIDINAE
Genus TROCHAMMINOIDES Cushman, 1910

Trochamminoides sp.
Plate 1, figure 17a–b

Description: Test free, tiny, planispiral, not involute, consisting of about two whorls; about seven chambers in last whorl; chambers not globular but enlarging regularly from proloculus to last chamber; sutures sharp, only slightly depressed; wall finely arenaceous and smoothly finished; aperture simple, at end of the last chamber.

Dimensions: Greatest diameter of specimen represented in figure 17 0.33 mm., least diameter 0.25 mm., greatest thickness 0.13 mm.

Remarks: Only two specimens were found, but both are well preserved and well developed. *Trochamminoides vertens* Tappan, 1957, from the Upper Triassic of Alaska is similar to the two specimens found in the Thaynes in general size, but differs in having more globular and inflated chambers and nine chambers to a whorl. It is not believed wise to erect a new species on the basis of two specimens, and designation of a new species will be delayed until more specimens can be obtained.

Family TEXTULARIIDAE
Subfamily TEXTULARIINAE
Genus BIGENERINA d'Orbigny, 1826

Bigenerina lindae Schroder, **n. sp.**
Plate 1, figures 18–23

Description: Test small, elongate; biserial portion fairly blunt to gradually tapered, consisting of seven to eight chambers; rectilinear series composed of three to four inflated chambers, with first chamber wedge-shaped and sharply set off at an angle from biserial portion, later chambers usually having sinuous or winding growth in a plane identical with a plane determined by the length and the width of the biserial portion; chambers of rectilinear series usually of equal width and height but early chambers may occasionally be depressed; sutures well defined and depressed in rectilinear series but only fairly well defined and depressed in biserial portion; wall of fine to coarse quartz silt, well-cemented; aperture round and terminal at end of a low protuberance on last chamber.

Dimensions: See table 3.

Remarks: The diagnostic features of this new species are the sinuous growth in the uniserial series in a plane identical with that of the biserial part, the inflated uniserial chambers, the circular aperture at the end of a small protuberance on the last chamber, the well-

TABLE 3
Measurements of *Bigenerina lindae* in mm.

Specimen (Pl. 1)	Length	No. of biserial chambers	No. of uniserial chambers	Diameter, last chamber	Width, biserial part
Fig. 18	0.40	8	4	0.10	0.10
Fig. 19	0.41	7	4	0.13	0.10
Fig. 20	0.42	7	3	0.13	0.13
Fig. 21	0.32	8	3	0.09	0.10
Fig. 22	0.30	7	2	0.10	0.11
Fig. 23	0.28	8	2	0.11	0.11

defined break between the biserial and uniserial parts, and the coarseness of the test.

Bigenerina burri Finlay, 1947, from the Paleocene of New Zealand is similar to *B. lindae* in the coarseness of its test, the number of chambers in the biserial portion, and the sinuous growth of the early chambers in the uniserial portion. *B. lindae* differs, however, in usually having inflated uniserial chambers, a circular aperture at the end of a small protuberance on the last chamber, sinuous growth of the uniserial series in a plane identical with that of the biserial part, and a well-defined break between the biserial and uniserial part. *B. burri* shows a transition between the biserial and uniserial parts, the first two chambers in the uniserial portion being loosely biserial before being followed by one to two normal uniserial chambers.

Bigenerina lindae is well represented by more than 60 specimens in the collection. It is believed that the figured specimens show most of the range of variation in the species. The specimen illustrated in figure 21 on plate 1 is unique in that it is the only specimen found in which the growth of the chambers in the uniserial portion of the test is in a plane perpendicular to the greatest width of the biserial portion. This species has probably been the hardest to define of any encountered in the Thaynes Formation because of the coarse quartz silt frequently found in the uniserial portion of the test, masking the sinuous growth of many of the specimens.

Bigenerina sp. cf. ***B. perexigua*** Plummer
Plate 1, figure 24

Cf. *Bigenerina perexigua* PLUMMER, 1945, p. 243, pl. 16, figs. 19–20.

Description: Test small, elongate; biserial portion tapered, consisting of 8 to 10 chambers with early chambers poorly defined; rectilinear portion straight, composed of four chambers of uniform width; not much change in width of test between rectilinear series and biserial portion; wall composed of medium-grained quartz silt, well-cemented, having a smooth appearance; sutures sharply distinct but not greatly depressed; aperture central and terminal on last chamber.

Dimensions: Length of test 0.38 mm., width of rectilinear series 0.10 mm., length of biserial portion 0.15 mm.

Remarks: Only one well-preserved specimen is in the collections, but it is very similar to the description given by Mrs. Plummer (1945) for forms that she found in the Pennsylvanian rocks of central and northern Texas. Ireland (1956) also found this form in some of the limestones of the Virgil Series in Kansas.

Family ATAXOPHRAGMIIDAE
Genus VERNEUILINOIDES Loeblich and Tappan, 1949

Verneuilinoides edwardi Schroeder, **n. sp.**
Plate 1, figures 25–26

Description: Test free, small, triserial, generally subcircular in transverse section but sometimes subtriangular; chambers tightly coiled, not globular, enlarging slowly; sutures slightly depressed, well defined only between last several chambers; wall of fine to medium-grained quartz silt, well-cemented; surface smooth to slightly rough; aperture a very low arch at base of last chamber.

Dimensions: Specimen illustrated in figure 25, height 0.25 mm., greatest width 0.14 mm.; specimen illustrated in figure 26, height 0.25 mm., greatest width 0.13 mm.

Remarks: The diagnostic features of this new species are the small size, the low apertural arch, the finely arenaceous wall, and the slowly enlarging chambers resulting in an appressed test.

More than 70 specimens of *V. edwardi* are in the collections, and this new species is quite different from all of the other described species of *Verneuilinoides*. The range of variation within the species is small. Almost universally the height of the specimens is about 0.25 mm., varying no more than 0.02 mm. Occasionally a specimen will tend to have its sides close to parallel, as illustrated by figure 26. None of the specimens in the collections has any coarse-size material in the wall, which is composed of a very fine-grained quartz silt.

This is the first reported occurrence of *Verneuilinoides* in rocks of Triassic age, the *Treatise of Invertebrate Paleontology* listing the range of the genus as Jurassic to Cretaceous. Harlan Bergquist of the U. S. Geological Survey (written communication, 1966) has suggested that the specimens may be the triserial stage of a *Gaudryina*, which is the only genus of the subfamily Verneuilininae that the *Treatise* lists as occurring in rocks older than Jurassic. This, however, seems un-

likely. Of the 70 or more specimens available in the collections, all appear triserial throughout and show no tendency to develop a biserial portion. If these were only the triserial stages of a *Gaudryina*, it would indicate either 1) that the population was killed off in an immature stage or 2) that the environment was too harsh for full development. However, the other foraminifera found in this same 2-foot zone in the Thaynes have well-developed populations with no sign of living in a harsh environment which might have retarded their growth or prevented full maturity. Consequently, the author regards these specimens as belonging to the genus *Verneuilinoides* rather than as being an initial stage of *Gaudryina*.

The range of the genus may actually extend back into the Paleozoic. Ireland (1956) described a new species of *Verneuilina* from the Virgil Series of the Pennsylvanian in Kansas. *Verneuilina* and *Verneuilinoides* are in the same subfamily and are very closely related, both being triserial and having an apertural arch at the base of the final chamber. *Verneuilinoides* differs from *Verneuilina* in having more inflated chambers and being rounded in cross section. Ireland's illustrations seem to more closely fit the description of *Verneuilinoides* than that of *Verneuilina*. If subsequent study shows that this species belongs to the genus *Verneuilinoides*, the range of *Verneuilinoides* will be extended from the Pennsylvanian to the Cretaceous. The study of Paleozoic foraminifera has been increasing in the last 10 years, and doubtless the range of more genera will be extended back into the Paleozoic as more information is obtained.

PLATE 1

All figures ×80

1–2 *Ammovertella liassica* Barnard
1, USNM 643516, specimen showing clockwise coiling of planispiral portion; a, unattached side; b, attached side; 2, USNM 643517, specimen viewed from unattached side, showing counterclockwise coiling of planispiral portion, as well as partial overlap of tube over last whorl.

3 *Tolypammina* sp.
USNM 643518, incomplete specimen.

4 *Ammovertella inclusa?* (Cushman and Waters)
USNM 643519, specimen showing meandering nature of tubular chamber; a, unattached side; b, attached side.

5–9 *Reophax finleyi*, Schroeder, n. sp.
5, paratype, USNM 643520, showing coarseness of test, subpyriform last chamber, and contrast with other specimens; 6, paratype, USNM 643521, showing some tiny quartz crystals incorporated in the test; 7, paratype, USNM 643522, showing poorly preserved nature of test, fairly typical of many of the specimens found; 8, holotype, USNM 643523, showing slowly enlarging chambers and sutures sharply but not deeply incised into test; 9, USNM 643524, internal mold.

10–11 *Hyperammina glabra?* Cushman and Waters
10, USNM 643525, specimen showing slowly enlarging tubular second chamber; 11, USNM 643526, specimen showing sudden but uncommon enlargement of test.

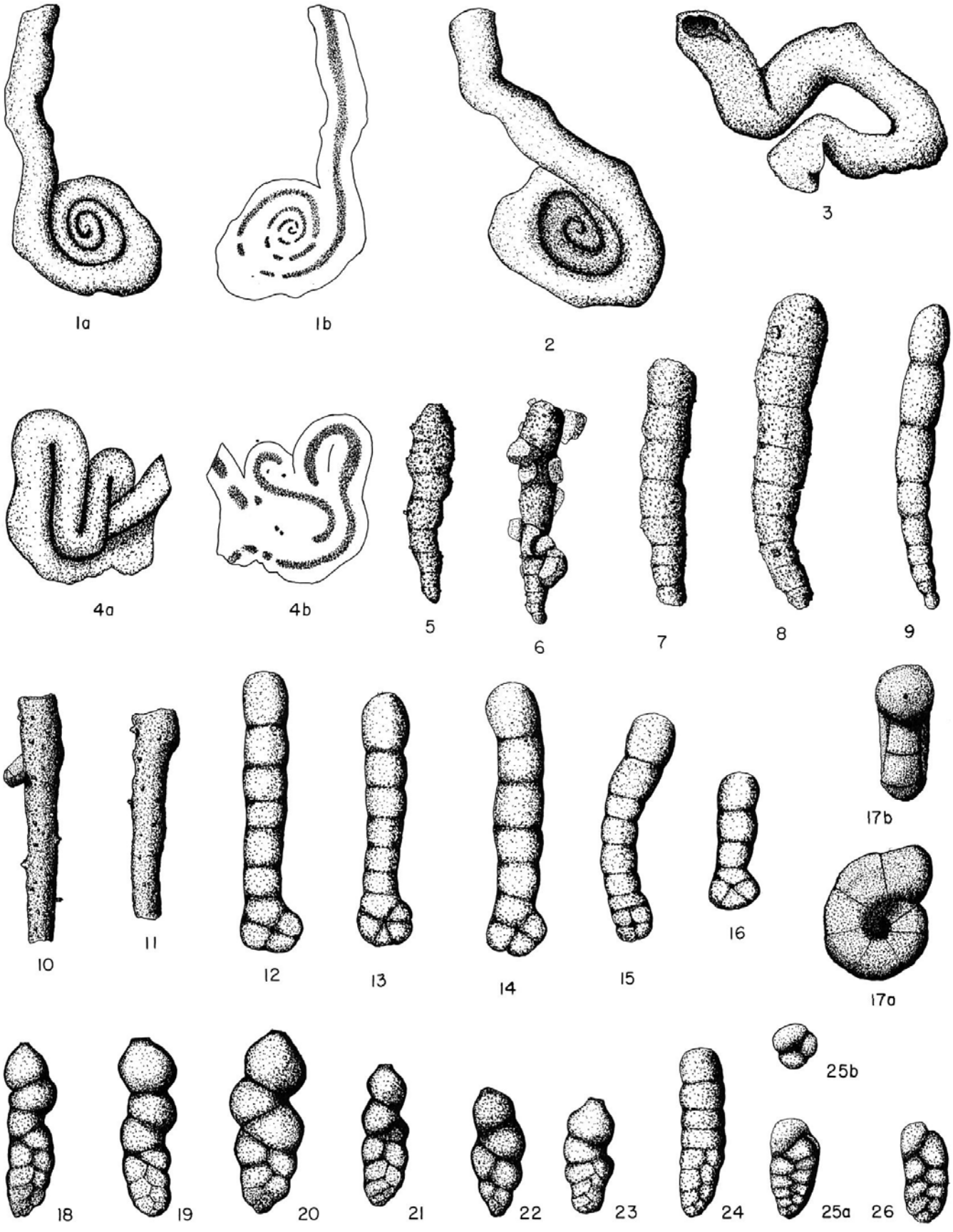
12–16 *Ammobaculites duncani* Schroeder, n. sp.
12, holotype, megalospheric form, USNM 643527, showing four chambers in coil, smoothness of test, and rectilinear series with chambers having parallel sides; 13, paratype, USNM 643528, showing uncommon feature of five chambers in coil; 14, paratype, USNM 643529, showing slight deviation in suture line from the horizontal; 15, paratype, microspheric form, USNM 643530, showing depressed nature of some chambers, resulting in a greater number of chambers compared with a megalospheric form of equal length; 16, paratype, USNM 643531, immature specimen.

17 *Trochamminoides* sp.
Holotype, USNM 643532, showing gradually enlarging chambers, sutures sharply but not deeply incised into test, and finely arenaceous test wall; a, side view; b, apertural view.

18–23 *Bigenerina lindae* Schroeder, n. sp.
18, holotype, USNM 643533, and 19–20, paratypes, USNM 643534 and 634545, showing inflated wedge-shaped uniserial chambers having sinuous growth in plane identical with that of greatest length and greatest width of biserial portion, and circular aperture at end of small protuberance of last chamber; 21, paratype, USNM 643536, showing unique specimen having rectilinear series in a plane perpendicular to that of greatest length and greatest width of biserial portion; 22–23, paratypes, USNM 643537 and 643538, immature specimens.

24 *Bigenerina* sp. cf. *B. perexigua* Plummer
USNM 643539, specimen showing uniserial chambers of equal width, sutures sharply incised in the test wall, and lack of restriction between the biserial and uniserial portions.

25–26 *Verneuilinoides edwardi* Schroeder, n. sp.
25, holotype, USNM 643540, showing small size, slowly enlarging chambers, appressed test, and very low apertural arch; a, side view; b, apertural view; 26, paratype, USNM 643541, showing almost parallel sides, a rare feature in this species.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