CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

111. SOME NEW EOCENE FORAMINIFERA FROM JAMAICA

By JOSEPH A. CUSHMAN and P. W. JARVIS

In 1912 the senior author collected material from the White Limestone on the Lapland Estate near Catadupa in the northwestern portion of Jamaica. This material while it produced some foraminifera was not sufficiently well preserved to warrant a description of the species contained therein. Later the junior author collected material in this same locality, and the foraminifera are very much better preserved. Four of the species seem to be new and worthy of description. These are figured here. The foraminifera included in these four species are from two localities. The first three are from indurated clay found in the Yellow Limestone which seems to be of Middle Eocene age. These are from the Lapland Estate, ½ mile E. of Catadupa Station. The other locality from which the *Eponides* is described is on the Jamaica Government Railway, near Catadupa Station, in the 96th mile at the 11th telegraph post. For reference, this last locality is a bed of shale marked "S" on Dr. C. T. Trechmann's diagram No. 3, Page 428 of the Geological Magazine, September, 1922. The descriptions of the species follow.

HAPLOSTICHE JAMAICENSIS Cushman and Jarvis, n. sp.
Plate 10, figures 1 *a*, *b*

Test large, conical, greatest width near the apertural end, thence gently tapering toward the initial end, rounded in transverse section; chambers numerous, short, distinct, very slightly

inflated; sutures distinct, slightly depressed; wall arenaceous, with much cement and rather smoothly finished; aperture consisting of numerous pores in the terminal face, with a series of depressions arranged in a radial manner, the outer ends of which are rounded, thence tapering toward the middle of the face. Length 2.00 mm.; diameter 0.90 mm.

Holotype (Cushman Coll. No. 15735) from the Middle Eocene, Lapland Estate, ½ mile E. of Catadupa Station, Jamaica, B. W. I.

This species is distinct from that previously described from the Miocene of Jamaica in that it is very much shorter, and has more numerous chambers with a much more tapering test. The terminal face shows a series of irregular pores in the center, and about them is a ring of peculiar depressions the outer ends of which are rounded, and then taper in toward the center and become less deep. This structure is similar to that seen in the Miocene species of the genus from Bowden, Jamaica.

QUINQUELOCULINA JAMAICENSIS Cushman and Jarvis, n. sp.

Plate 10, figures 2, 3

Test slightly longer than broad, the ends only slightly produced, in end view with the breadth a little less than half the thickness; chambers distinct, inflated, not very strongly involute; sutures distinct, depressed; wall smooth, except for the ornamentation which consists of numerous shallow pits arranged generally in longitudinal lines which are slightly oblique to the axis of the chamber; aperture large, semicircular, with indications of a simple tooth. Length 1.15 mm.; breadth 0.80 mm.; thickness 0.50 mm.

Holotype (Cushman Coll. No. 15736) from the Middle Eocene, Lapland Estate, ½ mile E. of Catadupa Station, Jamaica, B. W. I.

This species in its peculiar ornamentation of the surface somewhat resembles some of the species described from the Middle Eocene of France, and also some of those from the Upper Eocene of the Coastal Plain Region of the United States. It is, however, distinct from any of these. A transverse section is given (Pl. 10, fig. 3) of the megalospheric form in which there is a large proloculum followed by somewhat smaller chambers. Apparently in the section, the chamber builds a thin base over the previous chambers. This is especially marked as the later chambers are developed, and may be wanting in the youngest ones.

VERTEBRALINA JAMAICENSIS Cushman and Jarvis, n. sp.
Plate 10, figures 5, 6

Test large, much compressed, greatest thickness in the central region represented by the earlier chambers, the adult with as many as four chambers showing in the last-formed coil, becoming increasingly compressed as added, periphery with a distinct, rounded keel, usually without ornamentation; chambers rapidly increasing in size as added in the adult, slightly inflated, very distinct; sutures distinct, depressed, curved; wall ornamented by pits of irregular size, but more or less arranged in a linear series, slightly oblique to the axis of the chamber. Length 2.00 mm.; breadth 1.40 mm.; thickness 0.40 mm.

Holotype (Cushman Coll. No. 15739) from the Middle Eocene, Lapland Estate, ½ mile E. of Catadupa Station, Jamaica, B. W. I.

This is a very unusual form of the genus, its ornamentation reminding one of numerous other species of the Middle Eocene of France and elsewhere. The section (Pl. 10, fig. 6) shows a specimen in which three chambers are developed in the last-formed coil. This specimen, however, was broken, and is not a complete adult as is the type. There is no labyrinthic structure in the interior, and the species seems to be a true *Vertebralina*. It occurs in some numbers at the type locality.

EPONIDES JAMAICENSIS Cushman and Jarvis, n. sp.
Plate 10, figures 4 *a-c*

Test trochoid, compressed, nearly equally biconvex, the ventral side slightly flattened in the middle, periphery acute, slightly keeled; chambers numerous, as many as eighteen in the last-formed whorl, chambers of uniform shape and increasing very slightly in size as added, the last-formed portion of the final whorl in the adult with the chambers becoming somewhat shorter and the whorls narrower as it approaches the apertural end; sutures distinct, very slightly limbate, gently curved, and slightly oblique on both the dorsal and ventral sides; wall on the dorsal side smooth, on the ventral side with the umbilical region marked by a series of irregular, raised patterns in the form of a series of small bosses, or these may be fused into elongate areas; aperture a very narrow slit in the margin of the chamber between the periphery and the umbilical region. Diameter 0.90 mm.; thickness 0.35 mm.

Holotype (Cushman Coll. No. 15732) from the Middle Eocene,

96th mile, 11th telegraph post, on the Jamaica Government Railway, near Catadupa Station, Jamaica, B. W. I.

This species is abundant at the type locality, and in some respects resembles some of the other species described from the Middle Eocene. It has, however, more chambers than most of these, and the peculiar ornamentation of the ventral side is very distinctive. The reduction in the width of the last-formed coil toward the apertural end is also an unusual feature.

112. TWO NEW FORAMINIFERAL GENERA FROM THE SOUTH PACIFIC

By JOSEPH A. CUSHMAN

Recent study of foraminiferal material collected about many of the oceanic islands of the South Pacific has resulted in the finding of numerous new and specialized species. Two of these species represent previously undescribed genera, and are of particular interest from the fact that they fill in the gaps in the phylogeny of their respective groups. The Pacific is a region in which old forms have persisted after they have become extinct

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EXPLANATION OF PLATE 10

FIGS. 1 *a, b.* *Haplostiche jamaicensis* Cushman and Jarvis, n. sp. × 30. *a*, side view; *b*, apertural view.

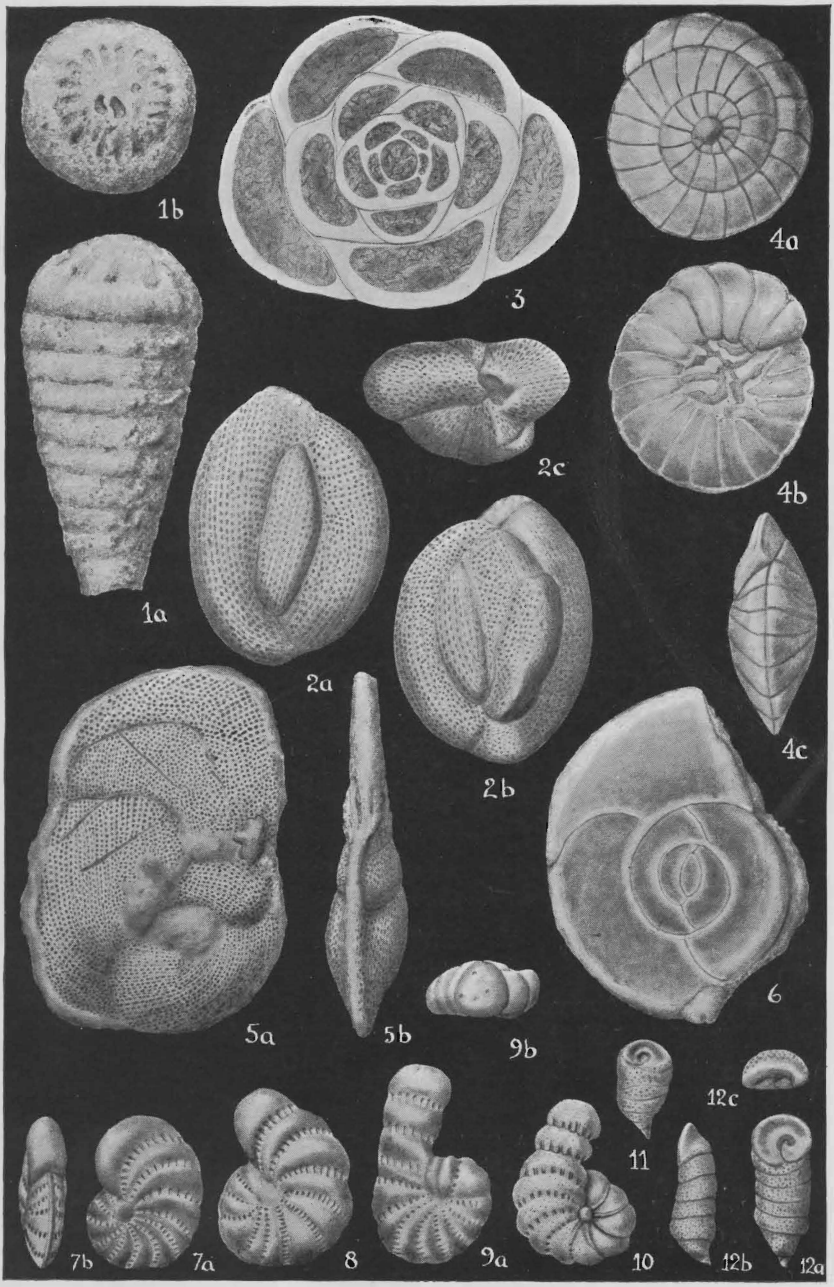
FIGS. 2, 3. *Quinqueloculina jamaicensis* Cushman and Jarvis, n. sp. Fig. 2, × 35. *a, b*, opposite sides; *c*, apertural view. Fig. 3, × 70. Transverse section.

FIGS. 4 *a–c.* *Eponides jamaicensis* Cushman and Jarvis, n. sp. × 35. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 5, 6. *Vertebralina jamaicensis* Cushman and Jarvis, n. sp. × 30. Fig. 5, *a*, side view; *b*, peripheral view. Fig. 6, Longitudinal section.

FIGS. 7–10. *Ozawaia tongaensis* Cushman, n. sp. × 40. Fig. 7, Early stage. *a*, side view; *b*, peripheral view. Fig. 8, Later stage with one chamber showing traces of uncoiling. Fig. 9, Adult with three chambers uncoiled. *a*, side view; *b*, apertural view. Fig. 10, Side view. (After Millett.)

FIGS. 11, 12. *Ungulatella pacifica* Cushman, n. sp. × 60. Fig. 11, Front view of smaller specimen. Fig. 12, Adult. Holotype. *a*, front view; *b*, side view; *c*, apertural view.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elsewhere, and at the same time it seems to be an area where new forms are being developed. Such genera as *Operculina, Heterostegina, Calcarina,* etc., still persist in great numbers and in large sized species, whereas they have become nearly extinct in other parts of the world. There are other genera, however, which are known only from Recent material or from the very Late Tertiary of the Indo-Pacific. The two genera described here will fit into this latter group, although it is possible that they may be found elsewhere, but are much more likely to be confined to limited areas even in the Indo-Pacific area.

Family NONIONIDAE

Genus OZAWAIA Cushman, n. gen.

Genoholotype, *Ozawaia tongaensis* Cushman, n. sp.

Test free, in the early stages planispiral, compressed, later uncoiling and becoming circular in transverse section, bilaterally symmetrical; sutures marked by retral processes both in the early stages and in the adult; wall calcareous, finely perforate; aperture in the early stages made up of numerous pores at the base of the apertural face, in the adult a series of rounded pores in the terminal face in the last-formed chamber.

This genus is named in honor of the late Professor Yoshiaki Ozawa. It represents a development from *Elphidium* in which the uncoiled stage is added to the usual close coiled form. In this group, forms related to *Elphidium* have become trochoid in two genera, in *Faujasina* with the ventral side convex and the dorsal side flattened, and in *Polystomellina* which is also trochoid and plano-convex, but with the ventral side flattened and the dorsal side convex. This last genus is a development which occurs only in the Late Tertiary and Recent material of the region about Japan. Millett had already recognized these uncoiled forms in his collections from the Malay Archipelago.

OZAWAIA TONGAENSIS Cushman, n. sp.

Plate 10, figures 7-10

Polystomella crispa MILLETT (not LINNÉ), Journ. Roy. Micr. Soc., 1904, p. 603, pl. 11, fig. 2.

Test in the early stages close coiled, almost completely involute, somewhat keeled and with a distinct boss in the umbilical

region; chambers distinct, inflated, in the early portion much compressed, in the uncoiled portion almost circular in transverse section; sutures distinct, depressed, rather strongly curved, retral processes short, but numerous and distinct; aperture in the coiled portion at the base of the apertural face, later becoming numerous rounded pores in the terminal face of the chamber in the uncoiled portion. Length up to 0.60 mm.; breadth 0.35 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 15676) from 18 fathoms, Vavau Anchorage, Tonga Islands.

This is evidently the same species that Millett figured from the Malay Archipelago in the above reference. It is very abundant at Vavau Anchorage, Tonga Islands, the type station, and there are a few other less well developed specimens in our collections from the South Pacific. It may be that this will be found with further study to be more widely distributed in the Indo-Pacific region in shallow water than the present rather limited records seem to show. It is evidently a very recent development in the history of this family.

Family BULIMINIDAE

Genus UNGULATELLA Cushman, n. gen.

Genoholotype, *Ungulatella pacifica* Cushman, n. sp.

Test with the early portion conical and probably consisting of a series of spirally coiled chambers, later chambers uniserial, forming an elongate, subcylindrical test or somewhat compressed toward the apertural end; wall rather coarsely perforate, calcareous; aperture a somewhat comma-shaped opening in the terminal face which is flattened or somewhat concave.

This genus is apparently derived from forms such as *Buliminella* by the addition of a uniserial development of chambers making up the later subcylindrical body of the test. It represents an uncoiled rectilinear development which has already been noted in most of the other lines of development taken on by the Buliminidae. Such forms as *Siphonodosaria* and *Dentalinopsis* are uniserial forms developed from the triserial *Bulimina*. Uniserial forms such as *Rectobolivina* and *Bifarina* have been developed from the biserial forms through *Bolivina*. It is, therefore, inter-

esting now to find a uniserial development coming from the more primitive *Buliminella* group. The genus *Buliminoides,* which is somewhat related to this new genus, tends to become somewhat uncoiled or rather loosely coiled in its later development.

UNGULATELLA PACIFICA Cushman, n. sp.
Plate 10, figures 11, 12

Test elongate, the early portion abruptly tapering, later portion in front view with the sides nearly parallel, in side view somewhat progressively compressed toward the apertural end; chambers in the adult uniserial, low and broad, becoming somewhat oblique in the apertural face, flattened or slightly concave; sutures distinct, very slightly limbate, flush with the surface; wall with numerous, comparatively large, and distinct perforations except on the apertural face which is smooth; aperture somewhat comma-shaped, at or near the ventral side of the apertural face. Length 0.35 mm.; breadth 0.12-0.14 mm.; thickness at the apertural end 0.08-0.10 mm.

Holotype (Cushman Coll. No. 15742) from shallow water off the island of Rangiroa in the South Pacific.

This species is fairly common at the type locality, and is represented by enough specimens to show its development and range of variation. The sutures of the early portion are somewhat indistinct, but those of the later portion are very definite and limbate. The shape of the early portion and the aperture connect this species with the ancestral forms in the genus *Buliminella.* As already noted, it represents a uniserial development from some of the Indo-Pacific species of *Buliminella.* It has not been found in any of the other shallow water dredgings, but is probably to be found about others of the island groups of the South Pacific.

113. GLANDULINA OZAWAI CUSHMAN, NEW SPECIES

By JOSEPH A. CUSHMAN

In the work "A Monograph of the Foraminiferal Family Polymorphinidae Recent and Fossil" (Proc. U. S. Nat. Mus., vol. 77, art. 6, 1930, p. 144, pl. 40, figs. 2 *a*, *b*) Dr. Ozawa and I gave the name *Glandulina reussi* to the species which Reuss originally described as *Psecadium acuminatum* as the name *acuminata* was already preoccupied by d'Orbigny. At that time we overlooked the fact that Neugeboren had already described a *Glandulina reussi* (Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 69, pl. 1, fig. 6). The species we called *Glandulina reussi*, therefore, must have a new name given to it, and it is with much pleasure that I rename this species for the late Dr. Ozawa. The name should, therefore, with synonyms be as follows:

GLANDULINA OZAWAI Cushman, n. sp.

Psecadium acuminatum REUSS, Sitz. Akad. Wiss. Wien, vol. 62, pt. 1, 1870, p. 478.—V. SCHLICHT, Foram. Pietzpuhl, 1870, pl. 25, figs. 1-10.
Glandulina reussi CUSHMAN and OZAWA (not NEUGEBOREN), Proc. U. S. Nat. Mus., vol. 77, art. 6, 1930, p. 144, pl. 40, figs. 2 *a*, *b*.

The type locality is the Oligocene of Pietzpuhl, Germany.

114. HASTIGERINELLA AND OTHER INTERESTING FORAMINIFERA FROM THE UPPER CRETACEOUS OF TEXAS

By JOSEPH A. CUSHMAN

The genus *Hastigerinella* was originally described from Recent material by Rhumbler. It has since been found to be fairly common in the Eocene of Trinidad, and other Tertiary forms have been described from Mexico. It is of much interest, therefore, to be able to record this genus as far back as the lower portion of the Gulf Series of the Upper Cretaceous of the United States, and to see the development of the more primitive species of the genus from *Globigerina* or *Globigerinella*. The develop-

ment of the group starts with the more simple species as might be expected, but in the Austin Chalk there are developed two species of very advanced form corresponding rather closely to this species developed in the Eocene. These were all probably pelagic forms, and some of them at least show traces of having been spinose in their living condition. Another interesting find in this material is that of *Hantkenina* connecting the Austin Chalk of Texas with the Upper Cretaceous series of Canada from which *Hantkenina* has previously been recorded. A description of the three species of *Hastigerinella* follow.

EXPLANATION OF PLATE 11

FIGS. 1–3. *Hastigerinella moremani* Cushman, n. sp. × 60. Fig. 1 *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 4, 5. *Hastigerinella watersi* Cushman, n. sp. × 60. Fig. 4, Immature specimen. Fig. 5, Holotype. *a*, *b*, opposite sides; *c*, peripheral view.

FIGS. 6–9. *Hastigerinella alexanderi* Cushman, n. sp. × 60. Fig. 6, Holotype. *a*, *b*, opposite sides; *c*, peripheral view.

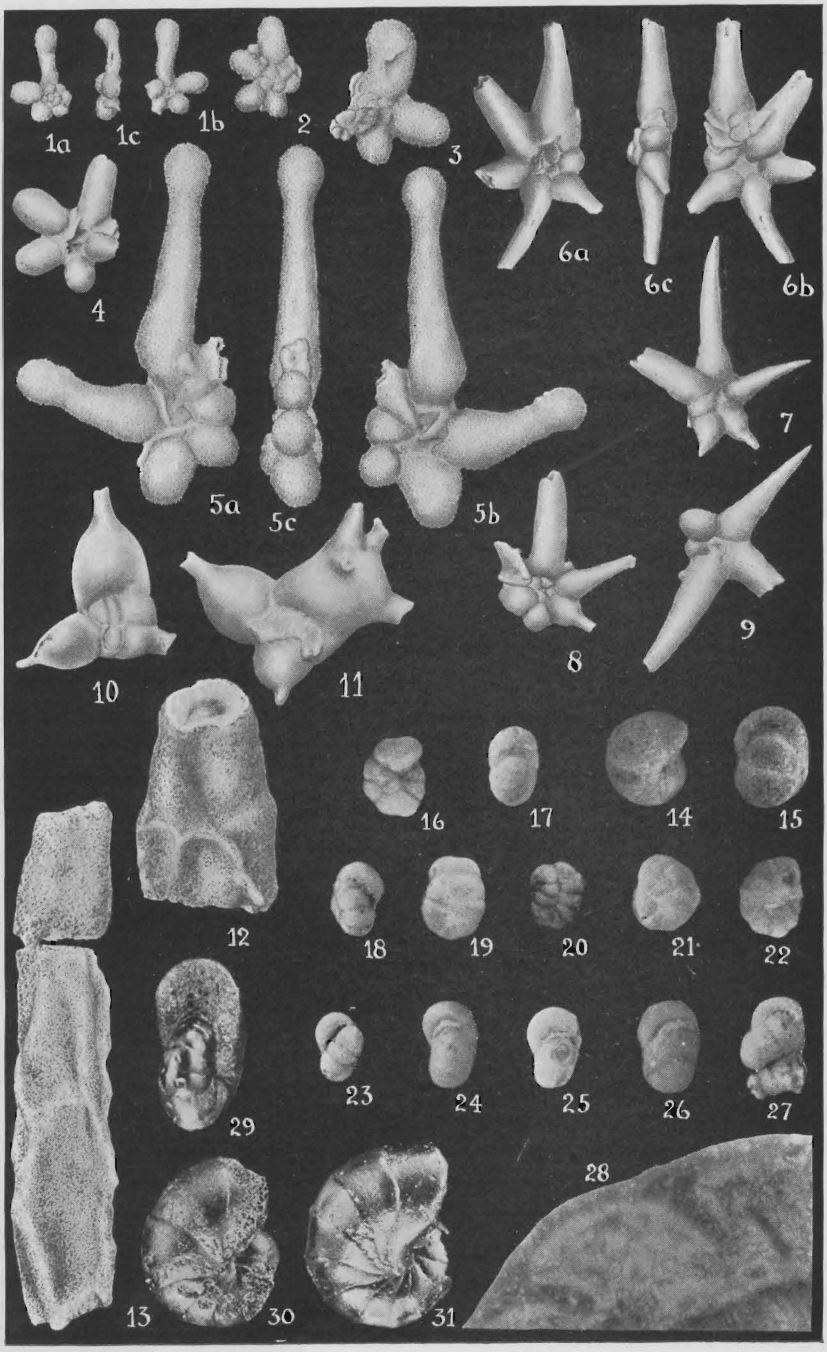
FIGS. 10, 11. *Hantkenina multispinata* Cushman and Wickenden. × 135. Fig. 10, Immature specimen. Fig. 11, Mature specimen with several spines on the final chamber.

FIGS. 12, 13. *Bathysiphon taurinensis* Sacco. × 30. Fig. 12, Specimen showing aperture. Fig. 13, Side view of a somewhat collapsed specimen.

FIGS. 14, 15. *Cribrostomoides bradyi* Cushman. × 10. *Albatross* D2039, Lat. 38° 19′ 26″ N., Long. 68° 20′ 20″ W., 2,369 fathoms. Fig. 14, Side view. Fig. 15, Anterior view of another specimen.

FIGS. 16–28. *Endothyra baileyi* (Hall). Figs. 16-27, × 10. Fig. 28, × 70. Spergen limestone, Mississippian, Harrodsburg, Indiana. Fig. 16, Side view, showing at umbilicus two chambers of a previous whorl. Fig. 17, Anterior view. Fig. 18, Anterior view, showing false appearance of multiple apertures. Figs. 19, 20, Right sides of sinistral specimens, showing a common type of slight departure from spiral growth. Fig. 21, Right side of dextral specimen. Fig. 22, Left side of a sinistral specimen. Fig. 23, Anterior view of a very asymmetrical specimen with open aperture. Fig. 24, Anterior view, the usual type of specimen figured. Figs. 25-27, Anterior views of three specimens with apertural fillings. Fig. 28, Portion of a thin section.

FIGS. 29–31. *Cyclammina cancellata* H. B. Brady. × 8. *Albatross* D5236, off Philippine Islands, 492 fathoms. Fig. 29, Anterior view. Figs. 30, 31, Side views of two specimens. Eroded portions show labyrinthic structure.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HASTIGERINELLA MOREMANI Cushman, n. sp.
Plate 11, figures 1-3

Test somewhat trochoid, but the spire very much depressed so that the chambers are for the most part in a single plane in the adult whorl; chambers in the early portion globular, later becoming more elongate, clavate, and slightly expanded toward the tip, usually five chambers in each whorl; sutures distinct, slightly depressed; wall finely spinose throughout, slightly more so toward the tip of the elongate chambers; aperture mostly ventral, with a slightly overhanging lip. Diameter 0.18-0.25 mm.; thickness 0.05-0.08 mm.

Holotype (Cushman Coll. No. 15746) from the Eagleford, 1 mile North of Lovelace, Texas.

This species represents a primitive one of this genus, and unless specimens are found to occur in the Lower Cretaceous, it indicates the beginnings of this genus. The early stages of this species are trochoid, and closely allied to Globigerinas of the same formation. The later chambers are gradually more and more elongate. In a superficial way they resemble *Globigerina subdigitata* Carman from the Niobrara Chalk of Wyoming and also *G. digitata* from the present ocean. The chambers are distinctly clavate, somewhat similar to the following species from the Austin Chalk, but are very different in their shape in the adult chambers as a comparison of the two forms will show.

The species is named for Dr. W. L. Moreman of Texas Christian University, Fort Worth, Texas, whose collections of Eagleford material have been of much help to the writer.

HASTIGERINELLA WATERSI Cushman, n. sp.
Plate 11, figures 4, 5

Test slightly trochoid, the spire very much compressed so that all the chambers appear to be nearly in one plane; earliest chambers subglobular and very small compared to the later ones, the spire which they form being in a depressed area of the dorsal side, later chambers gradually increasing in size, and in the adult whorl becoming more and more elongate, the final chambers being about five times as long as broad, the base widest, thence gradually and slightly tapering toward the outer end, which is again expanded to form a slightly bulbous tip; sutures distinct, depressed; wall finely spinose throughout, the outer end of each

chamber slightly coarser, and possibly forming the base of elongate spines; aperture on the ventral side, and extending toward the periphery, with a slight overhanging lip. Diameter 0.80 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 15748) from yellowish, calcareous clay of Austin Chalk age in the eastern slope of a deep road cut between two railroad underpasses near the northern edge of the town of Howe, Grayson County, Texas, collected by C. I. Alexander.

This species represents a decided advance upon the previous one. The spire is depressed so that the species represents a development apparently from *Globigerinella*. In the early stages, in the last-formed whorl, the chambers somewhat resemble those of *Hastigerinella moremani*, but in the adult, the peculiar, elongate, tapering chambers with a distinct bulbous tip are markedly different and distinctive. From the coarseness of the spines at the tips of the adult chambers it is to be expected that there were developed very elongate spines when the form was living, similar to those developed in the Recent species of the genus.

The species is named for Mr. James A. Waters, Paleontologist of the Sun Oil Company, Dallas, Texas.

HASTIGERINELLA ALEXANDERI Cushman, n. sp.
Plate 11, figures 6-9

Test nearly planispiral, the early chambers largely concealed from both sides; chambers greatly expanded in the adult coil, consisting typically of six chambers, but occasionally only five, the earliest ones subglobular, but quickly expanding and greatly elongating, tapering rather uniformly to a pointed outer end; sutures distinct, slightly depressed; wall nearly smooth, or finely hispid; aperture nearly at the peripheral margin at the base of the chambers, with a very slight lip. Diameter 0.60-0.75 mm.; thickness 0.10-0.12 mm.

Holotype (Cushman Coll. No. 15750) from yellowish calcareous clay of Austin Chalk age in the eastern slope of a deep road cut between two railroad underpasses near the northern edge of the town of Howe, Grayson County, Texas, collected by C. I. Alexander.

This species represents the highest development of the genus so far known in the Upper Cretaceous. The very elongate chambers give a stellate appearance to the test, and the shape of the

individual chambers is very distinct from that of any of the other known species.

The species is named for Dr. C. I. Alexander of Texas Christian University, Fort Worth, Texas, the collector of this material.

HANTKENINA MULTISPINATA Cushman and Wickenden
Plate 11, figures 10, 11

Hantkenina multispinata CUSHMAN and WICKENDEN, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 40, pl. 6, figs. 4-6.

When this species was described from Upper Cretaceous material on the North bank of Boyne River, southern Manitoba, it was stated that the species would probably be found in the Gulf Series of Texas. This prediction is now confirmed by the finding of this species in the material collected by Dr. Alexander from the Austin Chalk, locality for which is given above. Two of the specimens are here figured, and show that the species has a wide geographic range with little change in its development and general characters.

BATHYSIPHON TAURINENSIS Sacco
Plate 11, figures 12, 13

Bathysiphon taurinensis SACCO, Bull. Soc. Géol. France, 1896, p. 168, fig. 2 (in text).—SCHUBERT, Beitr. Pal. Oest.-Ung., vol. 14, 1902, p. 18, pl. 1, figs. 14, 15; Jahrb. k. k. Geol. Reichs., vol. 53, 1903, p. 412, pl. 19, figs. 10-12.

The finding of this species described by Sacco and figured by

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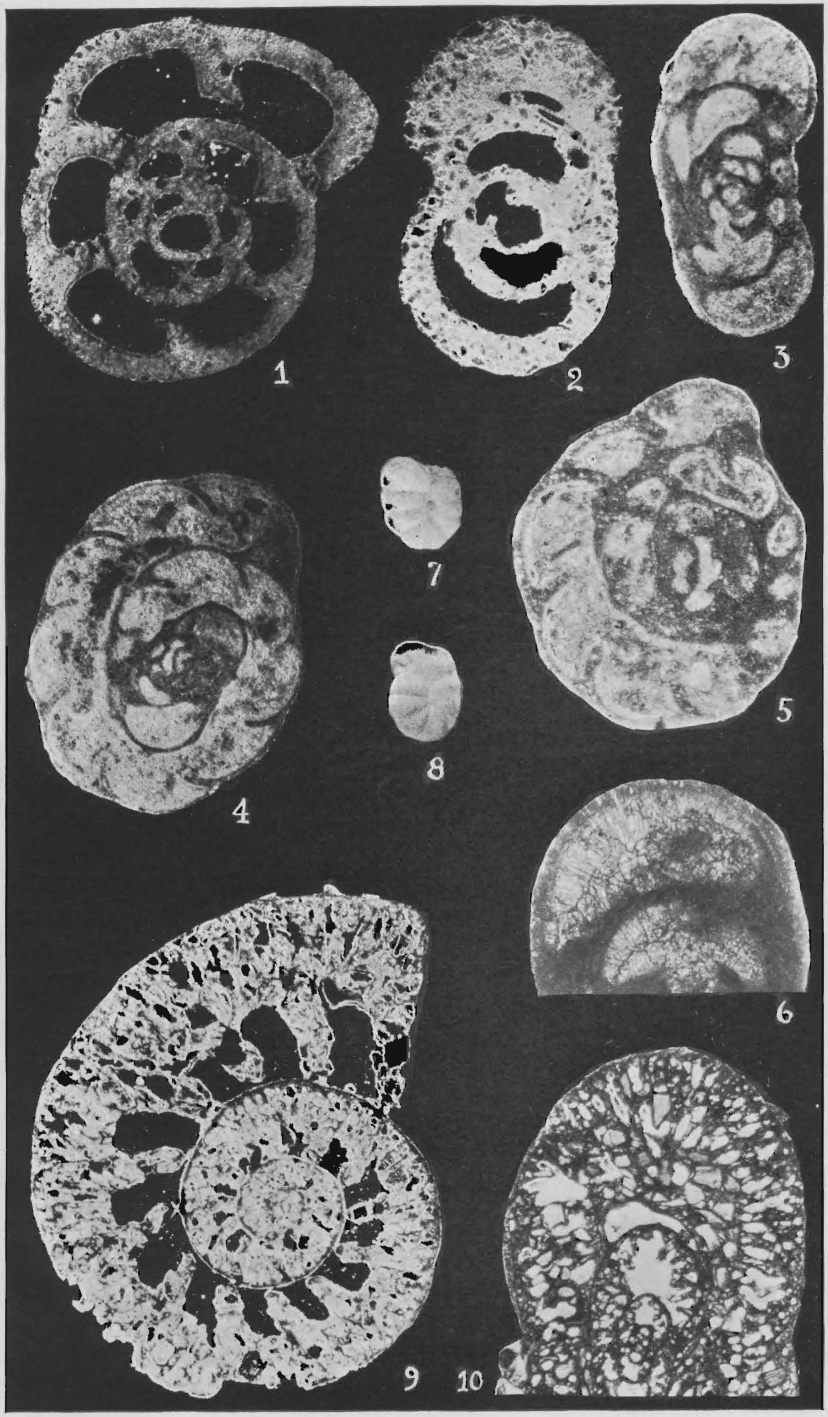
EXPLANATION OF PLATE 12

FIGS. 1, 2. *Cribrostomoides bradyi* Cushman. × 40. Fig. 1, Sagittal section. Fig. 2, Axial section. These specimens were photographed by dark field illumination; accordingly the luminosity of the different portions is commonly the reverse of that where bright field illumination is used.

FIGS. 3–8. *Endothyra baileyi* (Hall). Figs. 3-5, × 40. Fig. 6, × 84. Figs. 7, 8, × 13. Spergen limestone, Mississippian, Harrodsburg, Indiana. Fig. 3, Axial section. Fig. 4, Sagittal section (dark field). Fig. 5, Sagittal section. Fig. 6, Portion of same specimen as Fig. 3, most of the outer zone eroded. Fig. 7, Left side of sinistral specimen. Fig. 8, Right side of dextral specimen.

FIGS. 9, 10. *Cyclammina cancellata* H. B. Brady. × 30. *Albatross* D5236, off Philippine Islands, 492 fathoms. Fig. 9, Sagittal section (dark field). Fig. 10, Portion of an axial section. Note densely textured outer zone of the test in contrast with *Cribrostomoides* which has the reverse relationship.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Schubert from Europe is an interesting one, as it extends the range of this genus into the Cretaceous of America. Egger had already described and figured a species of the genus from the Cretaceous of Europe which he referred to *Bathysiphon filiformis*. A single fragmentary specimen is figured here. In the well preserved specimens the exterior has a dark color similar to that in some Recent forms. The wall itself is largely siliceous, and the canal is comparatively small, much smaller than in most Recent species.

115. THE SPECIES ENDOTHYRA BAILEYI (HALL)

By LLOYD G. HENBEST*

The name *Endothyra baileyi* (Hall) is everywhere known by American geologists, but even though it has been mentioned frequently in paleontologic literature, the fossils themselves are not well known. The following description is submitted to supply some needed information about the species.

Endothyra occupies a position of unusual interest among middle Mississippian foraminifera. It is supposed to have been the ancestral stock from which the Fusulinidae and kindred forms sprang; and consequently, a better understanding of *Endothyra* is critically important in understanding a number of Pennsylvanian genera and families.

Figures of *Cyclammina* and *Cribrostomoides* are presented along with those of *Endothyra* for comparing the shell structure and composition. The *Cyclammina* shell is zoned as to texture in the same manner as *Endothyra;* i.e., the coarse particles are beneath the very finely textured zone. The latter is composed mainly of cement. The reverse relationship exists in *Cribrostomoides*.

ENDOTHYRA BAILEYI (Hall)
Plate 11, figures 16-28; plate 12, figures 3-8

Rotalia baileyi HALL, Trans. Albany Institute, vol. 4, 1858-1864 (Read Nov. 27, 1856), p. 34.

Endothyra baleyi (HALL). WHITFIELD, Bull. Amer. Mus. Nat. Hist., vol. 1, No. 3, 1882, p. 42, pl. 9, figs. 34-36.

The shells are large, coiled, and commonly involute. The

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largest diameter of thirty-one adult specimens chosen at random, ranges from 0.7 to 1.2 mm., but the average size is 0.9 mm. The chambers while distinct are rather well merged with the general form of the shell. In most adult specimens, there are 8-10 chambers in the last whorl. The sutures are depressed, but much more in some individuals than in others. There is no distinct boundary between the antetheca and the spiral wall. The antetheca commonly is not parallel with the axis, but, for instance, where the shell is sinistral, it extends farthest forward at the right side, crosses the periphery obliquely and backward toward the left pole. The aperture, if open, is crescentic in shape, and usually extends at least one-half to three-fourths of the way across the base of the antetheca, wherever the antetheca may be located. In other normal individuals the aperture may be filled with a sort of moraine-like heap of sand and silt. This deposit may extend one-half the width of a chamber in front of the base of the antetheca and as far behind the antetheca in the last chamber. It is honeycombed with tubules, and if weathered away in an appropriate fashion, it makes the shell appear to have a polystomate aperture.

The volutions are irregular in several ways. There seems to be a general tendency toward a conico-spiral direction of growth, but the axis of each volution is likely to have a different direction from that of the others. This plan, or lack of plan in coiling, along with the asymmetrical attitude of the chambers as seen from a front view, makes possible several highly variable features. The presence or absence of an umbilicus on either side depends upon the degree of coincidence between the pole of one whorl and that of the previous one, for if the pole of one volution happens to overlie the pole of the previous whorl, a distinct umbilicus is likely to be formed, but if the pole overlies the periphery of a previous whorl, it is most likely not to be marked by any depression except an irregular conjunction of the shallow, linear, sutural depressions (see pl. 11, fig. 19-21). A few specimens have two umbilici, the kind usually figured in the literature, but the majority have only one, or none at all. Another feature that is conditioned by the irregular plan of coiling is a quasi-biserial arrangement of the chambers on one side while from the other polar view, the same chambers appear to have a normal radial and spiral arrangement (see pl. 11, fig. 19, 20). This feature depends upon the relative attitude of the whorls. Al-

though most individuals are completely involute, it is not uncommon to find examples where a few chambers of a previous whorl are partly visible. There is no uniformity in orientation. Probably the majority are sinistral.

On first sight, the features just described appear to afford criteria for a subdivision of these fossils into two or more species, but it seems evident that these variations are entirely too irregular for any consistent scheme of grouping.

The interior of the shell as exposed by sections, is fully as irregular as the exterior. In fact, great irregularity might be considered a distinctive feature of the species if descriptions of other species are truly representative. The orientation of the interior may lie at any angle with that of the exterior; accordingly any section may be sagittal for the first whorl, oblique for the next, and axial for the third. Asymmetrical coiling appears in the first volution apparently.

Measurements of several specimens show that the proloculum varies from 0.10-0.17 mm. in diameter.

The spiral and septal walls (differing only in position) are composed of two indistinct layers. The inner layer has an obviously granular texture. Some of the grains are sufficiently large to extend entirely through the inner zone. Such large grains usually lie in a groundmass of finer grains and other indeterminable material. The outer zone is of such fine texture that its granular character is scarcely visible at low magnifications. Wherever the outer zone is eroded, the shell may have a porous appearance, due to the fact that the larger grains of the inner layer are more transparent than the surrounding portion. It is this feature that caused Möller (1878 and 1880) to draw, by mistake, his illustrations of *Endothyra* as porous. Irregularity of shape is characteristic of these grains and makes the supposition that they are pores filled with clear calcite seem improbable. Brady arrived at a similar opinion in 1876. Where quartz sand was available, it is likely that the same species may have used quartz instead of calcite grains.

It seems to be the better plan to recognize *E. baileyi* (Hall) as a valid species until typical specimens of *E. bowmani* Phillips can be studied. Brady made them synonymous, but the specimens from Indiana are about twice the size of those from Great Britain figured and described by Brady (1876) as *E. bowmani*. Brady's specimens of *E. bowmani* appear to have deeper and wider umbilici and to be more symmetrical.

Age and Distribution.—Endothyra baileyi is very numerous in the Spergen limestone, Mississippian, of Indiana. In fact, the limestone is composed largely of the tests of this foraminifer. Representative outcrops of the Spergen may be found near Salem, Bedford, Bloomington and Harrodsburg, Indiana. The collection on which this paper is principally based comes from Harrodsburg. The large numbers of *Endothyra* tests in the Spergen give it an oölitic appearance, but actually grains of concretionary structure are uncommon. The limestone is not well indurated, and shows unusually small evidence of secondary mineralization and change of composition. This increases our confidence that the arenaceous appearance of the shell walls is not produced by some secondary replacement phenomenon.

RECENT LITERATURE ON THE FORAMINIFERA

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

Silvestri, A.
Fossili Miocenici nel Territorio di Bivona (Agrigento).
(Riv. Ital. Pal., Anno XXXVII, 1931, pp. 29-36, pls. 4, 5.) *Pavia.*
Records and figures several Lepidocyclinas.

Silvestri, A.
Sul genere Chapmanina e sulla Alveolina maiellana n. sp.
(Boll. Soc. Geol. Ital., vol. L, 1931, pp. 63-73, pl. 1.) *Rome.*
Notes apparent relationships between *Chapmanina* and *Annulopatellina,* and describes a new species of *Alveolina* with figures.

Silvestri, A.
Sul Modo di Presentarsi di Alveoline Eoceniche in loro giacimento secondario.
(Mem. Pont. Accad. Sci. Nuovi Lincei, vol. XV, 1931, pp. 203-231, pl. 1, figs. 1-3 [in text].) *Rome.*
Notes structure and distribution, and proposes a new classification of the group with 6 subgenera under *Alveolina.*

Berry, Willard.
Contributions to the paleontology of Peru, V. Nodosaria pozoensis W. Berry, n. sp.

(Journ. Washington Acad. Sci., vol. 21, No. 17, Oct. 19, 1931, p. 415, fig. 1 [in text].) *Baltimore.*

A new species from the Eocene.

Macfadyen, W. A.

Miocene Foraminifera from the Clysmic Area of Egypt and Sinai. With an Account of the Stratigraphy and a Correlation of the Local Miocene Succession.

(Survey of Egypt.—Geological Survey Government Press, Cairo, 1930 [May, 1931], pp. 1-149, pls. 1-4, figs. 1, 2 [in text], and maps.) *Cairo.*

Records 185 species and varieties (6 new), and figures many of them. An appendix gives a list and key to the species and varieties of *Bolivina* described to June, 1927.

Hanzawa, Shoshiro.

Notes on Tertiary Foraminiferous Rocks from the Kwanto Mountainland, Japan.

(Sci. Rep't Tohoku Imper. Univ., ser. 2, [Geol.], vol. XII, No. 2, A, 1931, pp. 141[1]-157[17], pls. XXIV[I]-XXVI[III].) *Sendai.*

Numerous species described and figured, 4 new.

Hanzawa, Shoshiro.

On Some Miocene Rocks with Lepidocyclina from the Izu and Boso Peninsulas.

(l. c., ser. 2, [Geol.], vol. XII, No. 2, A, 1931, pp. 159[1]-170[12], pls. XXVII[I], XXVIII[II], figs. 1, 2 [in text].) *Sendai.*

Three new species, 1 new variety.

Hanzawa, Shoshiro.

Notes on Some Eocene Foraminifera Found in Taiwan (Formora), with Remarks on the Age of the Hori Slate Formation and Crystalline Schists.

(l. c., ser. 2 [Geol.], vol. XII, No. 2, A, 1931, pp. 171[1]-194[24], pl. XXIX[I].) *Sendai.*

Several species, 1 new, with very full synonymies.

Hofker, J.

Notizen über die Foraminiferen des Golfes von Neapel.

(Pubbl. Straz. Zool. Napoli, vol. 10, 1930, pp. 365-406, pls. 12, 13, figs. 1-22 [in text].) *Naples.*

Discusses particularly life histories of various species.

J. A. C.