

CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

VOLUME 21, PART 2

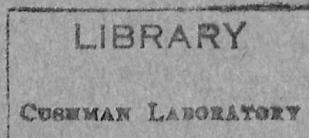
June, 1945

Contents

	PAGE
No. 267. The Species of the Subfamily Reussellinae of the Foraminiferal Family Buliminidae	23
Recent Literature on the Foraminifera	54

SHARON, MASSACHUSETTS, U. S. A.

1945



CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

90 Brook Road, Sharon, Mass., U. S. A.

JOSEPH A. CUSHMAN, Sc.D., *Director*

ALICE E. CUSHMAN, *Secretary, in charge of Publications*

RUTH TODD, M. S., *Research Associate*

These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

Subscription \$2.50 per year post paid.

Volume 1, April 1925—January 1926 (Reprinted, 1935)	\$3.00
Volume 2, April 1926—January 1927 (Reprinted, 1935)	\$3.00
(Volume 3, part 1 now out of print.)	
Volume 3, parts 2-4, June—December, 1927 (Reprinted, 1936)	\$2.00
Volume 4, parts 1-4, March—December, 1928, complete.....	\$2.50
Volume 5, parts 1-4, March—December, 1929, complete.....	\$2.50
Index to Volumes 1—5 inclusive	\$1.00
Volume 6, parts 1-4, March—December, 1930, complete.....	\$2.50
Volume 7, parts 1-4, March—December, 1931, complete.....	\$2.50
Volume 8, parts 1-4, March—December, 1932, complete.....	\$2.50
Volume 9, parts 1-4, March—December, 1933, complete.....	\$2.50
Volume 10, parts 1-4, March—December, 1934, complete.....	\$2.50
Index to Volumes 6-10 inclusive	\$1.00
Volume 11, parts 1-4, March—December, 1935, complete.....	\$2.50
Volume 12, parts 1-4, March—December, 1936, complete.....	\$2.50
Volume 13, parts 1-4, March—December, 1937, complete.....	\$2.50
Volume 14, parts 1-4, March—December, 1938, complete.....	\$2.50
Volume 15, parts 1-4, March—December, 1939, complete.....	\$2.50
Index to Volumes 11-15 inclusive	\$1.00
Volume 16, parts 1-4, March—December, 1940, complete.....	\$2.50
Volume 17, parts 1-4, March—December, 1941, complete.....	\$2.50
Volume 18, parts 1-4, March—December, 1942, complete.....	\$2.50
Volume 19, parts 1-4, March—December, 1943, complete.....	\$2.50
Volume 20, parts 1-4, March—December, 1944, complete.....	\$2.50
Index to Volumes 16-20 inclusive	\$1.00
Volume 21 subscription, 1945.....	\$2.50

Special Publications:

No. 1. Foraminifera, Their Classification and Economic Use. 1928.....	\$5.00
No. 2. A Resumé of New Genera of the Foraminifera Erected Since Early 1928. 193050
No. 3. A Bibliography of American Foraminifera. 1932.....	1.10
(No. 4: Foraminifera, Their Classification and Economic Use, Edition 2. 1933. Out of Print.)	
No. 5. An Illustrated Key to the Genera of the Foraminifera. 1933.....	1.00
Foreign	1.50
No. 6. New Genera and Species of the Families Verneuilinidae and Valvulinidae and of the Subfamily Virguliniinae. 1936.....	1.50

For continuation of this series, see back cover page.

Copies of Volume 21, Part 2, were first mailed June 6, 1945

DORR'S PRINT SHOP, BRIDGEWATER, MASSACHUSETTS, U. S. A.

CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

267. THE SPECIES OF THE SUBFAMILY REUSSELLINAE
OF THE FORAMINIFERAL FAMILY BULIMINIDAE

BY JOSEPH A. CUSHMAN

The species of this subfamily are included in five genera and range from Cretaceous to Recent with the greatest development from Miocene to Recent. The largest number of living species is found in the Indo-Pacific.

An attempt is made to define the species and their geographic and geologic ranges. A number of species, not belonging here, have been referred to some of these genera, and they are noted. Of the others, descriptions and figures are given, and a number of new species are described.

Family BULIMINIDAE .

Subfamily REUSSELLINAE

Test distinctly triserial, at least in the young of most forms, becoming uniserial in the later development of some genera; aperture in simpler forms and young stages elongate, in some uniserial forms cribrate.

Genus REUSSELLA Galloway, 1933

Genotype, *Verneuilina spinulosa* REUSS

Reussella GALLOWAY, Manual Foram., 1933, p. 360.—CUSHMAN, Special Publ. 4, Cushman Lab. Foram. Res., 1933, p. 223; Foraminifera, 3rd Ed., 1940, p. 246; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 40.

Reussia SCHWAGER (not McCoy), Boll. Com. Geol. Ital., vol. 8, 1877, p. 26.

Verneuilina (part) of authors. *Trimosina* (part) CUSHMAN. *Pseudowigerina* (part) CUSHMAN.

Test distinctly triserial throughout, triangular in transverse section, tapering, broadest at the apertural end; wall calcareous, finely or coarsely perforate; aperture elongate, oblique, from the base of the inner margin of the chamber into the apertural face.—Cretaceous to Recent.

In order to make clear the relationships of the various species in the geologic series the following list is given, especially for correlation purposes.

<i>R. cushmani</i> Brotzen	Upper Cretaceous	Sweden, France
<i>R. minima</i> Brotzen	Upper Cretaceous	Sweden
<i>R. californica</i> Cushman and Goudkoff	Upper Cretaceous	California
<i>R. oberburgensis</i> (Freyer)	Eocene	Germany
<i>R. limbata</i> (Terquem)	Eocene	France
<i>R. elongata</i> (Terquem)	Eocene	France
<i>R. obtusa</i> (Terquem)	Eocene	France
<i>R. terquemi</i> n. sp.	Eocene	France
<i>R. recurvata</i> (Halkyard)	Eocene	France
<i>R. subrotundata</i> (Cushman and Thomas)	Eocene	Texas, Louisiana
<i>R. goochi</i> Howe	Eocene	Louisiana
<i>R. sculptilis</i> (Cushman)	Eocene	Southeastern U. S.
<i>R. eocena</i> (Cushman)	Eocene	Southeastern U. S.
<i>R. cognata</i> (Reuss)	Oligocene	Germany
<i>R. rectimargo</i> (Cushman)	Oligocene	Southeastern U. S.
<i>R. rectimargo</i> , var. <i>hebetata</i> n. var.	Oligocene	Southeastern U. S.
<i>R. (?) rectimargo</i> , var. <i>trinitatensis</i> (Nuttall)	Oligocene	Trinidad
<i>R. yumuriana</i> Palmer	Oligocene	Cuba
<i>R. spinulosa</i> (Reuss)	Miocene	Europe
<i>R. spinulosa</i> , var. <i>laevigata</i> n. var.	Miocene	France
<i>R. pulchra</i> n. sp.	Miocene to Recent	Europe, Africa, etc.
<i>R. aperta</i> n. sp.	Miocene	Europe
<i>R. ensiformis</i> (Chapman)	Miocene	Australia
<i>R. decorata</i> (Heron-Allen and Earland)	Miocene	Australia
<i>R. miocenica</i> n. sp.	Miocene	Florida
<i>R. glabrata</i> (Cushman)	Miocene, Pliocene	Southeastern U. S.
<i>R. spinosissima</i> (Costa)	Pliocene	Europe
<i>R. aguayoi</i> Bermudez	Recent	Western Atlantic
<i>R. armata</i> (Parr)	Recent	Australia
<i>R. perforata</i> (Cushman)	Recent	Indo-Pacific
<i>R. simplex</i> (Cushman)	Recent	Indo-Pacific
<i>R. insueta</i> n. sp.	Recent	Indo-Pacific
<i>R. aculeata</i> n. sp.	Recent	Indo-Pacific

The form described by Brotzen as *Reussella* (?) *buliminoides* (Sver. Geol. Under., Ser. C, No. 396, 1936, p. 137, pl. 8, fig. 8, text fig. 48 [1-5]) from the Upper Cretaceous of Sweden may be a *Bulimina*.

CRETACEOUS SPECIES

REUSSELLA CUSHMANI Brotzen (Pl. 5, fig. 1)

Reussella cushmani BROTZEN, Sver. Geol. Under., Ser. C, No. 396, 1936, p. 135, pl. 8, fig. 7; text fig. 47.

Pseudouvierina sp. (?) CUSHMAN, Contr. Cushman Lab. For. Res., vol. 7, 1931, p. 40, pl. 6, fig. 1.

Test elongate, wedge-shaped, triserial, apertural end slightly rounded or flattened, sides somewhat concave, periphery slightly lobulate, in-

itial end subacute; chambers distinct, slightly inflated, increasing gradually and rather evenly in size as added, in the early stages in apertural view all three chambers and sutures visible, in the adult the last-formed chamber occupying most of the area; sutures distinct, slightly depressed; wall calcareous, finely but distinctly perforate; aperture at the inner margin of the last-formed chamber in the early stages, tending to become terminal in the adult. Length of holotype 0.29 mm.; breadth 0.17 mm.

The types of this species are from the Upper Cretaceous, lower Senonian, of Eriksdal, Sweden. The record from Antigua, noted above, was from material received and reported on as very similar to that of the Cretaceous of the Paris Basin. It afterward was shown that material from France was used in drilling the well, and the supposed Antiguan material was really imported from France.

There seems to be a distinct tendency for the aperture to become terminal. Syntype specimens from Dr. Brotzen are in our collection.

REUSSELLA MINIMA Brotzen (Pl. 5, fig. 2)

Reussella minima BROTZEN, Sver. Geol. Under., Ser. C, No. 396, 1936, p. 136, pl. 8, fig. 6; text fig. 48 (6-9).

Test very small, pyramidal, triserial, triangular in end view with the angles rounded in the adult, more acute in the early stages, initial end subacute, apertural end rounded; chambers increasing gradually and rather evenly in size as added, slightly inflated, somewhat narrowed on the inner end in the adult; sutures distinct, slightly depressed, nearly straight in the early portion, in the last-formed portion somewhat S-shaped; wall of the early portion slightly spinose, smooth in the later portion; aperture in the inner end of the apertural face, elongate. Length of holotype 0.17 mm.; breadth 0.12 mm.

The types are from the Upper Cretaceous, lower Senonian, of Eriksdal, Sweden. Type specimens from Dr. Brotzen have been available for study.

REUSSELLA CALIFORNICA Cushman and Goudkoff (Pl. 5, figs. 3-5)

Reussella californica CUSHMAN and GOUDKOFF, Contr. Cushman Lab. Foram. Res., vol. 20, 1944, p. 59, pl. 10, figs. 3-5.

"Test about $1\frac{1}{2}$ times as long as broad, early stages regularly triserial, in the adult irregular, in some specimens tending to become biserial; chambers distinct, tending to become deeply excavated at the base and with a distinct, sharp ridge along the middle of the chamber, more distinct in the later stages; sutures distinct, depressed; wall distinctly and rather coarsely perforate, unornamented; aperture comma-

shaped, at the inner margin of the chamber, with a very slightly raised lip. Length 0.65-0.70 mm.; breadth 0.45-0.50 mm."

The types are from the Cretaceous, North-South road to Vendon, E. ½ of sec. 4, T. 5 N., R. 1 W., Solano Co., Calif.

The species somewhat resembles *R. cushmani* Brotzen but the chambers are more deeply excavated, the sides less concave, and the initial end more broadly rounded.

EOCENE SPECIES

REUSSELLA OBERBURGENSIS (Freyer) (Pl. 5, figs. 6, 7)

Verneuilina oberburgensis FREYER, Ms. in REUSS, Denkschr. Akad. Wiss. Wien, vol. 23, 1864, p. 6, pl. 1, fig. 2.—LIEBUS, Neues Jahrb. für Min., 1901, p. 118; Jahrb. k. k. geol. Reichsanst., vol. 52, 1903, p. 95.

Reussella oberburgensis CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

The types of this species are from the upper Eocene of Oberburg, Steiermark, Germany. No specimens are available from the type area. Liebus recorded it from the Upper Eocene of Priabona and the Oligocene of upper Bavaria but gave no figures. The species is evidently a *Reussella* and may possibly be the same as one of the species described later by Terquem, but this must await the study of the types if they are still extant. A few specimens from Vaudancourt seem different from any of the species of Terquem and may belong here. One of these is figured and, although evidently a young specimen, has the characters of Freyer's species.

REUSSELLA LIMBATA (Terquem) (Pl. 5, figs. 8, 9)

Verneuilina limbata TERQUEM, Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 105, pl. 11 (19), fig. 12.

Reussella limbata CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

"Test elongate, smooth, three-sided, angles angled, apertural end rounded, initial end tapered, subacute, sides arcuate, sutures limbate, chambers irregular, not inflated, very finely perforate, from two sides the chambers quadrangular, on the other side triangular, aperture large, depressed. Height 0.47 mm.; diameter 0.21 mm."

The above is a free translation of Terquem's description. The type is from Vaudancourt, France. It is evident that the type figure represents a broken specimen and is incorrectly drawn, as are most of Terquem's figures as I found by a study of his types in Paris in 1927. Terquem notes that the faces of the test seem concave due to the carinate margins. The figure shows quadrangular chambers on two

sides and triangular ones on the third side as noted in his description. This would indicate a *Gaudryina*-like structure, but is evidently an error. The actual type specimens would have to be restudied to settle this point.

Specimens with fewer and higher chambers occur in our Vaudancourt material and one of these is figured. Specimens that may be referred to this species are in our collection from the Eocene of Grignon, Fleury la Riviera, and Chaussy, France.

REUSSELLA ELONGATA (Terquem) (Pl. 5, figs. 10, 11)

Verneuilina elongata TERQUEM, Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 106, pl.

11 (19), fig. 13.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1909, p. 326.
Reussella elongata CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

“Test elongate, smooth, triangular in section, the angles obtuse, the apertural end rounded, initial end tapering; chambers numerous, forming about 8 whorls, regularly arranged, arched, rounded on the inner end, angled at the periphery and sloping backward; aperture semi-oval at the inner margin, striate. Length 0.72 mm.; diameter 0.32 mm.”

The species is recorded as common at Septeuil and Vaudancourt, France. Terquem notes that this species differs from the others by the elongate test, rounded angles, and the aperture with a striate border.

The type figure of this species is evidently more correctly drawn than some of the others. It is worthy of note that Terquem speaks of the aperture as having a striate border and he figures this character. In topotype specimens from Vaudancourt this did not appear but in those from the Eocene, Calcaire Grossier, of Vivray, Oise, France, one of which is figured, this apertural character is present and in edge view these fine costae appear as very fine, spinose projections.

Besides the topotypes and material from Vivray, specimens seeming to belong to this species are in our collections from the Eocene of Grignon, Fleury la Riviera, and Beauves, France. Heron-Allen and Earland record it from Selsey Bill, England, in shore sands derived from eroded Eocene deposits.

REUSSELLA OBTUSA (Terquem) (Pl. 5, figs. 12-14)

Verneuilina obtusa TERQUEM, Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 106, pl. 11 (19), figs. 14, 15.

Reussella obtusa CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

“Test short, conical, triangular in section, the angles rounded, surface smooth, apertural end subtruncate, initial end obtuse; chambers and sutures flat and indistinct, last 3 chambers curved backward; aperture small. Length 0.42 mm.; diameter 0.25 mm.”

The types are from the Eocene of Vaudancourt, France. A specimen

slightly larger; length 0.54 mm.; diameter 0.39 mm.; is figured from the Eocene of Septeuil, France.

Specimens very similar to these are in our collections from Vaudancourt, and a similar specimen from Chaussy, France. From the series available it would seem that this may be a distinct species with rounded angles, short test, and convex terminal faces of the chambers.

REUSSELLA TERQUEMI Cushman, n. sp. (Pl. 5, figs. 15, 16)

Verneuilina spinulosa TERQUEM (not REUSS), Mém. Soc. géol. France, ser. 3, vol. 2, 1882, p. 107, pl. 11 (19), fig. 16.

Test slightly longer than broad, apertural end convex, base acute, often with a short spine, periphery acute, slightly spinose, sides flat or slightly concave; chambers not inflated, extending back at the periphery and often ending in short spines; sutures not depressed; wall smooth; aperture small, semicircular, at the inner margin of the last-formed chamber. Length 0.37-0.45 mm.; diameter 0.23-0.27 mm.

Holotype (Cushman Coll. No. 44141) from the Eocene, Calcaire Grossier, Vaudancourt, France.

This species differs from *R. spinulosa* Reuss from the Miocene in the smaller size, relatively broader form, the periphery not keeled, and the spinose projections much shorter and less developed. It is to be suspected that the specimens recorded by Heron-Allen and Earland as "*Verneuilina spinulosa*" (Journ. Roy. Micr. Soc., 1909, p. 327; 1910, p. 406) from the reworked Eocene of Selsey Bill, England, are probably this species.

REUSSELLA RECURVATA (Halkyard) (Pl. 5, fig. 19)

Verneuilina recurvata HALKYARD, Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, 1918 (1919), p. 43, pl. 3, fig. 7.

Reussella recurvata CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

"Test hyaline, formed of numerous chambers arranged regularly in three series round a longitudinal axis. The segments are long, narrow, and curved backwards, and each one is considerably longer than the preceding one of the same series. Lateral faces of the shell are excavated. The dimensions of an average specimen are, length, .25 mm., breadth, .25 mm."

"This new form is very easily distinguished from its nearest ally, *V. tricarinata* d'Orb. Its chambers are much narrower and their septal faces are in the form of a high isosceles triangle rather than an equilateral one as in *V. tricarinata*. This last characteristic gives rise to the excavation of the lateral faces, which are hollow and curved inwards instead of being plane as in d'Orbigny's species."

The types are from the Eocene, Blue Marl, of Biarritz, France. I

have searched a number of samples from various levels in the section at Biarritz but have been unable to find a single specimen that could be identified as this species and it must be very rare.

REUSSELLA SUBROTUNDATA (Cushman and Thomas) (Pl. 5, fig. 18)

Reussia subrotundata CUSHMAN and THOMAS, Journ. Pal., vol. 4, 1930, p. 38, pl. 3, fig. 7.

Reussella subrotundata HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 70, pl. 8, figs. 40-42.

"Test small, triserial, tapering from the greatest breadth made by the last whorl to the sub-acute initial end, in end view triangular, the angles somewhat rounded; chambers very regular in position and in their gradual increase in size, slightly inflated; sutures distinct, slightly depressed; wall smooth, finely perforate; aperture at the base of the inner margin of the last-formed chamber. Length 0.22 mm.; breadth 0.11 mm."

The types of this species are from the Eocene, Claiborne, Cook Mountain formation, 3 miles N. of Bronson, Sabine Co., Texas. Howe has recorded the species from the Cook Mountain formation of Louisiana.

The angles are rounded but the test is triangular in section and has the other characters of this genus. It seems to be an index fossil for the Cook Mountain formation.

REUSSELLA GOOCHI Howe (Pl. 5, fig. 17)

Reussella goochi HOWE, Geol. Bull. 14, Louisiana Geol. Survey, 1939, p. 70, pl. 8, figs. 38, 39.

"Test small, triserial, triangular in cross section, chambers distinct with flattened walls; sutures limbate and faintly raised; aperture an arched slit at the base of the inner margin of the last formed chamber."

The holotype measured, length 0.16 mm.; breadth 0.11 mm.

The types are from the Cook Mountain formation of Winn Parish, Louisiana.

The very small size of this species would suggest that it might possibly be the young stage of *R. subrotundata* (Cushman and Thomas) which is also recorded from Louisiana by Howe in the same formation. The angles of the end views, however, seem to be quite different. No specimens are available in our collection.

REUSSELLA SCULPTILIS (Cushman) (Pl. 5, figs. 20-22)

Verneuilina sculptilis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 2, 1926, p. 34, pl. 5, fig. 3.

Reussella sculptilis CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 38, pl. 15, figs. 6, 7;—Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

"Test somewhat longer than broad, pyramidal, three-sided, widest

at about two-thirds its length, triangular in transverse section, sides flattened or even slightly convex, apical end tapering, in well preserved specimens ending in a short point, angles of the test acute; wall sculptured, the sutural lines strongly raised, the central line of each side of the test marked by a strongly raised costa; aperture on the inner border of the last-formed chamber. Maximum length 0.50 mm."

The types of this species are from the Jackson Eocene, Ocala limestone, W. bank of Pea River, 100 yards above its mouth at Geneva, Geneva Co., Ala. It also occurs rarely in the Jackson formation at Jackson, Miss.

This is a beautifully ornamented species and should make a good marker for this part of the Eocene. The raised sutures do not always fuse to make the raised costa in the middle of the side faces but occasionally do so.

REUSSSELLA EOCENA (Cushman) (Pl. 5, fig. 23)

Reussia eocena CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 13, pl. 1, fig. 25.

Reussella eocena CUSHMAN, U. S. Geol. Survey Prof. Paper 181, 1935, p. 38, pl. 15, figs. 4, 5.

Reussella rectimargo CUSHMAN (not *Verneuilina rectimargo* CUSHMAN, 1922), l. c., p. 38.

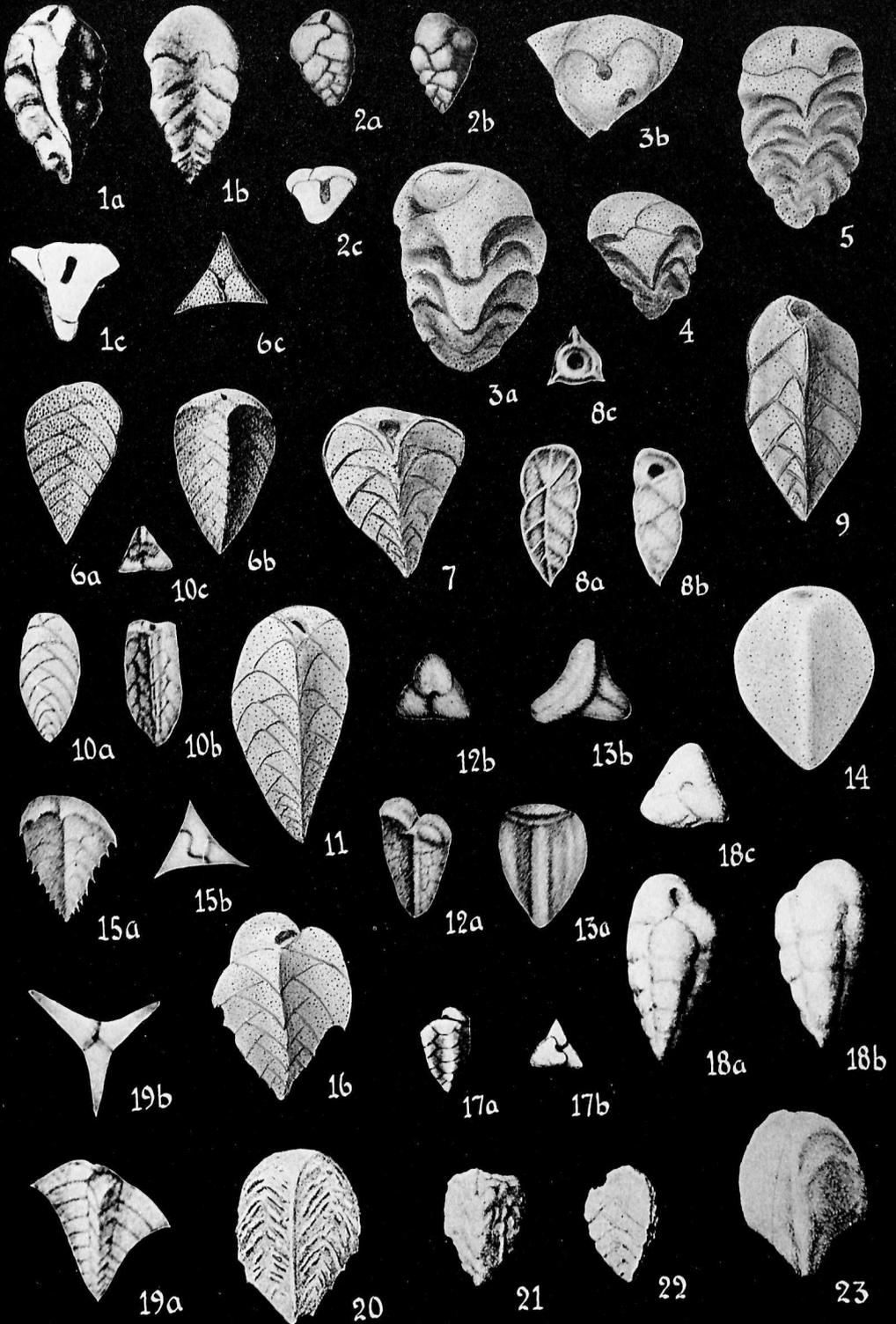
"Test short and broad, pyramidal, three-sided, widest above the middle, triangular in transverse section, the sides in the adult deeply concave, in the young stages nearly flat; angles in the young sharp, in the adult becoming thick and rounded; surface smooth; aperture at the inner border of the last-formed chamber. Maximum length 0.80 mm."

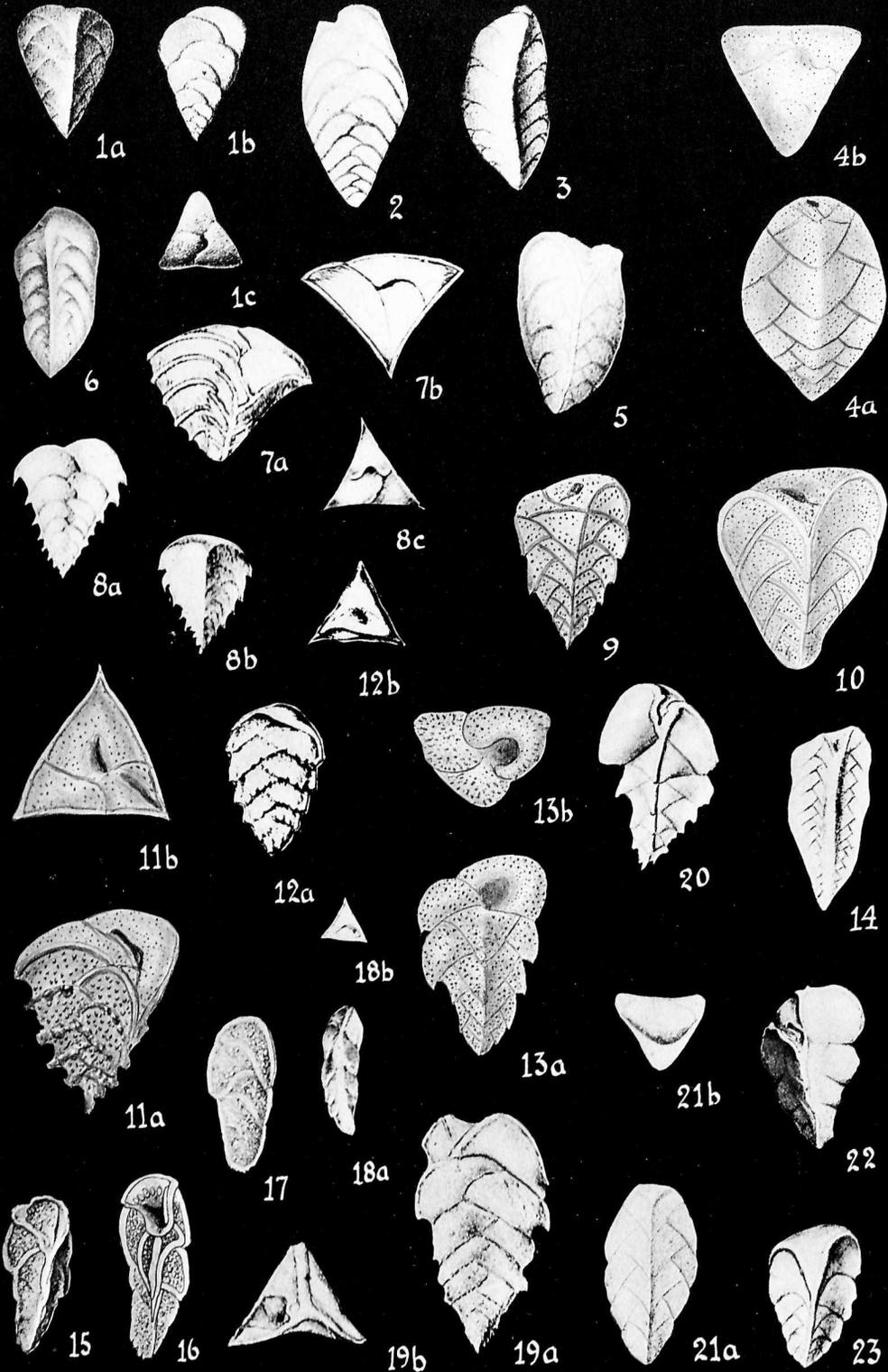
EXPLANATION OF PLATE 5

FIG. 1. *Reussella cushmani* Brotzen. (After Brotzen). × 50. *a, b*, opposite sides; *c*, apertural view. 2. *R. minima* Brotzen. (After Brotzen). × 100. *a, b*, opposite sides; *c*, apertural view. 3-5. *R. californica* Cushman and Goudkoff. (After Cushman and Goudkoff). × 60. 3, Holotype, *a*, front view; *b*, apertural view. 4, 5, Paratypes. 6, 7. *R. oberburgensis* (Freyer). 6, (After Reuss). *a, b*, opposite sides; *c*, apertural view. 7, Specimen from Vaudancourt, France. × 90. 8, 9. *R. limbata* (Terquem). 8, (After Terquem). × 45. *a, b*, opposite sides; *c*, apertural view. 9, Topotype. × 90. 10, 11. *R. elongata* (Terquem). 10, (After Terquem). × 25. *a, b*, opposite sides; *c*, apertural view. 11, Specimen from Eocene of Vivray, France. × 60. 12-14. *R. obtusa* (Terquem). 12, 13, (After Terquem). × 35. *a, a*, front views; *b, b*, apertural views. 14, Topotype. × 60. 15, 16. *R. terquemi* Cushman, n. sp. 15, (After Terquem). × 45. *a*, front view; *b*, apertural view. 16, Holotype. × 75. 17. *R. goochi* Howe. (After Howe). × 80. *a*, front view; *b*, apertural view. 18. *R. subrotundata* (Cushman and Thomas). (After Cushman and Thomas). × 130. *a, b*, opposite sides; *c*, apertural view. 19. *R. recurvata* (Halkyard). (After Halkyard). × 60. *a*, front view; *b*, apertural view. 20-22. *R. sculptilis* (Cushman). (After Cushman). 20, Holotype. × 50. 21, 22, × 40. 23. *R. eocena* (Cushman). (After Cushman). Holotype. × 40.

LIBRARY

CUSHMAN LABORATORY





The types are from the Eocene, Ocala limestone, of Pineola, Fla.

The species is characterized by the short test becoming very broad in the adult stage, and the deeply concave sides. It is apparently a good index fossil for the Jackson Eocene, occurring in the Cooper marl of South Carolina, in the Ocala limestone of Georgia and Florida at many localities given in the second reference above, and in the Jackson formation of Mississippi.

The single specimen recorded as "*Reussella rectimargo* (Cushman)" from the Ocala limestone, 1 mile E. of Beck, Ala., is probably to be included under *R. eocena*. The specimen is not complete.

OLIGOCENE SPECIES

REUSSELLA COGNATA (Reuss) (Pl. 6, fig. 1)

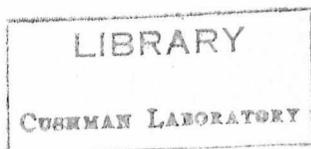
Verneuilina cognata REUSS, Sitz. Akad. Wiss. Wien, vol. 50, pt. 1, 1864, p. 448, pl. 1, fig. 1.—HOSIUS, Nat. Ver. Osnabrück, Jahrb., 1893-94 (1895), p. 169.

Reussella cognata CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

Reuss figures a specimen with a regularly tapering test and subacute borders, and the sides nearly flat or very slightly concave. This figure is copied on our plate. The type is from the upper Oligocene of Germany. Hosius also records it from the upper Oligocene of Doberg, near Bünde, Germany. Several specimens in our collection from this locality are very much like Reuss' figure which seems to have been well drawn. Liebus records this species from the Eocene, Blue Marl, of Biarritz, France, but gives no figure (Jahrb. k. k. geol. Reichsanst., vol.

EXPLANATION OF PLATE 6

FIG. 1. *Reussella cognata* (Reuss). (After Reuss). *a*, *b*, opposite sides; *c*, apertural view. 2, 3. *R. rectimargo* (Cushman). (After Cushman). × 35. 4, 5. *R. rectimargo* (Cushman), var. *hebetata* Cushman, n. var. 4, Holotype. *a*, front view; *b*, apertural view. × 60. 5, (After Cushman and McGlamery). × 100. 6. *R.* (?) *rectimargo* (Cushman), var. *trinitatensis* (Nuttall). (After Nuttall). × 15. 7. *R. yumuriana* Palmer. (After Palmer). *a*, front view, × 65; *b*, apertural view, × 70. 8, 9. *R. spinulosa* (Reuss). 8, (After Reuss). *a*, *b*, opposite sides; *c*, apertural view. 9, Specimen from Miocene of Lapugy, Hungary. × 60. 10. *R. spinulosa* (Reuss), var. *laevigata* Cushman, n. var. Holotype. × 60. 11, 12. *R. pulchra* Cushman, n. sp. 11, Holotype. *a*, front view; *b*, apertural view. × 60. 12, (After Macfadyen). *a*, front view; *b*, apertural view. × 30. 13. *R. aperta* Cushman, n. sp. Holotype. *a*, front view; *b*, apertural view. × 60. 14. *R. ensiformis* (Chapman). (After Chapman and Parr). × 30. 15-18. *R. decorata* (Heron-Allen and Earland). 15-17, (After Heron-Allen and Earland). × 20. 18, (After Parr). *a*, front view; *b*, apertural view. × 45. 19, 20. *R. miocenica* Cushman, n. sp. 19, Holotype. *a*, front view; *b*, apertural view. × 60. 20, (After Cushman and Ponton). × 48. 21-23. *R. glabrata* (Cushman). 21, (After Cushman). Holotype. *a*, front view; *b*, apertural view. × 40. 22, (After Cole). × 50. 23, (After Cushman and Ponton). × 55.



56, 1906, p. 359). I have a single specimen from Biarritz that somewhat resembles this general form but is more likely a young specimen of one of Terquem's Eocene species.

REUSSELLA RECTIMARGO (Cushman) (Pl. 6, figs. 2, 3)

Verneuilina rectimargo CUSHMAN, U. S. Geol. Survey Prof. Paper 129-F, 1922, p. 127, pl. 29, figs. 4, 5; Prof. Paper 133, 1923, p. 21.

Reussella rectimargo CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

"Test elongate, triangular in cross section, early portion tapering, adult portion with the sides nearly parallel and straight; chambers numerous, arranged triserially; sutures not depressed, often slightly concave; peripheral angles rounded; aperture slightly elongate at the base of the inner margin of the last-formed chamber; wall finely punctate. Length 1 millimeter or less."

The types are from the Oligocene, Mint Spring calcareous marl, shell and sand bed at foot of high waterfall, Mint Spring Bayou, Vicksburg, Miss. It also occurs in the Oligocene in the Glendon limestone of Mississippi and Alabama, the Marianna limestone of Alabama and the Red Bluff clay of Mississippi. The specimen recorded under this name from the Ocala limestone from Beck, Ala., is probably *R. eocena* (Cushman).

REUSSELLA RECTIMARGO (Cushman), var. HEBETATA Cushman, n. var.

(Pl. 6, figs. 4, 5)

Verneuilina spinulosa REUSS, var. *glabrata* CUSHMAN (not *Verneuilina glabrata* CUSHMAN, 1918), U. S. Geol. Survey Prof. Paper 129-E, 1922, p. 92; Prof. Paper 133, 1923, p. 21.

Reussia spinulosa (REUSS), var. *glabrata* HOWE, Journ. Pal., vol. 2, 1928, p. 175 (list).

—COLE and PONTON, Bull. 5, Florida State Geol. Survey, 1930, p. 39.

Reussella spinulosa (REUSS), var. *glabrata* CUSHMAN and McGLAMERY, U. S. Geol. Survey Prof. Paper 197-B, 1942, p. 72, pl. 6, fig. 3.

Variety differing from the typical in the angles of the test which are bluntly angled or even rounded.

Holotype of variety (Cushman Coll. No. 1205) from the Oligocene, Byram marl, of Vicksburg, Miss. It also occurs in the Byram marl at Byram, Haynes Bluff, Brandon, Leaf River, and Woodward, Miss.; in the Marianna limestone at St. Stephens, Ala., and in the Chickasawhay marl, near Millry, Ala. It is also recorded by Howe from the Red Bluff clay of Hiwatee, Miss., and by Cole and Ponton from the Marianna limestone of Florida.

The form is evidently related to *R. rectimargo* (Cushman) and as the name *glabrata* had already been used a new varietal name is proposed.

REUSSELLA (?) RECTIMARGO (Cushman), var. **TRINITATENSIS** (Nuttall)
(Pl. 6, fig. 6)

Verneuilina glabrata CUSHMAN, var. *trinitatensis* NUTTALL, Quart. Journ. Geol. Soc., vol. 84, 1928, p. 75, pl. 3, fig. 11.

Reussella glabrata (CUSHMAN), var. *trinitatensis* CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

No specimens of this form are available but it is to be suspected that it is not a *Reussella*. Nuttall speaks of the surface as being granular and, from the magnification given, the specimen must have been nearly 2 mm. in length. It is probably a *Verneuilina* or possibly a *Gaudryina*.

REUSSELLA YUMURIANA Palmer (Pl. 6, fig. 7)

Reussella yumuriana PALMER, Mem. Soc. Cubana Hist. Nat., vol. 14, 1940, p. 303, pl. 52, figs. 9, 10.

"Test small; triangular in cross section; broadest at apertural end; angles sharp, bordered by narrow keels; sides very slightly concave; apertural face convex; sutures distinct, marked by narrow, sharp costae. Aperture distinct, without lip; surface very finely perforate. Length of holotype 0.32 mm."

The types of this species are from the Oligocene, lower part of the Cojimar formation, Cuba.

No specimens of this species have been available for study, but the type figure, which is reproduced on our plate, suggests a relationship to *R. sculptilis* (Cushman).

MIOCENE SPECIES

REUSSELLA SPINULOSA (Reuss) (Pl. 6, figs. 8, 9)

Verneuilina spinulosa REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12; Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 159.—(?) EGGER, Neues Jahrb. für Min., Jahrg. 1857, p. 292, pl. 9, figs. 17, 18.—REUSS, Sitz. Akad. Wiss. Wien, vol. 39, 1860, p. 212.—KARRER, Sitz. Akad. Wiss. Wien, vol. 58, pt. 1, 1868, p. 126.

"Test acute pyramidal, triangular, tricarinate, outer end convex, perforate; carinae spinulose; the spire with 7-8 whorls; chambers arcuate; sutures level with the surface; aperture at the inner margin of the last chamber, semilunar, short. Length 0.3-0.4 mm."

The above is a free translation of Reuss' original description. It agrees very well with specimens from the Miocene of the Vienna Basin where Reuss records it from Grinzing and Nussdorf. Specimens from Nussdorf in our collections fit perfectly the type figure and description, but with them are other specimens that evidently belong to other species. The specimens from the Pliocene of Castel Arquato, Italy, recorded by Reuss, belong elsewhere as will be noted.

It is very evident, from a study of a large series of specimens, that a number of species have been recorded from various parts of the world and from Eocene to Recent under this name. In our collections are typical specimens from Nussdorf, near Vienna, Austria, from Lapugy, and from Kostej, Banat region of Hungary. These measure up to 0.75-0.85 mm. in length and from 0.50-0.62 mm. in diameter. A few specimens, somewhat similar, occur in the Miocene of St. Paul de Dax, Landes, France. All these show more or less development of supplementary, rounded apertures in the apertural face.

REUSSELLA SPINULOSA (Reuss), var. **LAEVIGATA** Cushman, n. var. (Pl. 6, fig. 10)

Variety differing from the typical in the lack of the spinose angles and in the bluntly pointed initial end.

Holotype of variety (Cushman Coll. No. 44170) from the Miocene, railroad cut, La Brede, Bordelais, France. Similar specimens also occur in Miocene material from Pont Gourguet, Bordelais, France.

This variety seems very much like the typical form in size and shape, but the spines on the angles and initial end are lacking. The small, rounded openings in the apertural face are usually present.

REUSSELLA PULCHRA Cushman, n. sp. (Pl. 6, figs. 11, 12)

Verneuilina spinulosa MACFADYEN (not REUSS), Geol. Survey Egypt, 1930 (1931), p. 50, pl. 1, fig. 8.

Test averaging about $1\frac{1}{2}$ times as long as broad, triangular in transverse section, the sides carinate and with a spine at the base of each chamber and a distinct spine at the initial end; chambers distinct, not inflated; sutures very distinct, limbate, raised well above the surface and often finely spinose to give a sculptured appearance to the test; wall distinctly and rather coarsely perforate; aperture a narrow opening, slightly curved, in the inner margin of the last-formed chamber, often with a distinct lip. Length 0.40-0.50 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 44160) from the Miocene of Baden, near Vienna, Austria. There are also specimens in our collection from the Miocene of Nussdorf, near Vienna; Kostej, Banat region of Hungary; Bujtur, Roumania; Dingden, Germany, and from Wadi el Bir and Wadi Rieina, Egypt. Specimens that seem to belong in the range of this species are in our collections from the Pliocene of Monte Mario, near Rome, Italy, and from the Miocene of Australia from Curlewis near Geelong and from Altona Bay Coal Shaft near Port Philip. Recent specimens from *Albatross* D 5179, 37 fathoms, off Romblon, Philippines, seem to belong here as well as from other Philippine stations; and off Pago Pago Harbor, Samoa; and 13 fathoms, off Singapore.

REUSSELLA APERTA Cushman, n. sp. (Pl. 6, fig. 13)

Test about $1\frac{1}{2}$ times as long as broad, initial end acute, usually with a short spine, test triangular in section, the angles of the early portion acute, becoming rounded in the adult, apertural end in the adult obliquely truncate; chambers distinct, rather high, later ones slightly inflated, in the earlier stages the borders with a limbate keel projecting backward at the periphery to form a stout spine, later chambers with a rounded periphery; sutures distinct, in the early portion limbate, in the adult stage slightly depressed; wall in the adult smooth, coarsely and distinctly perforate; aperture a comparatively large, broadly oval opening at the inner margin of the last-formed chamber, asymmetrical, without any sign of small, supplementary apertures. Length 0.40-0.50 mm.; diameter 0.27-0.33 mm.

Holotype (Cushman Coll. No. 44157) from the Miocene of Bujtur, Roumania, where it is fairly common. A single specimen from the Miocene of Lapugy, Hungary, also seems to be this species. It differs from *R. spinulosa* (Reuss) in the larger, more hooked spines, the rounded later chambers, depressed sutures, and broadly rounded aperture.

REUSSELLA ENSIFORMIS (Chapman) (Pl. 6, fig. 14)

Verneuilina ensiformis CHAPMAN, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 271, pl. 2, fig. 1.—(?) HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1924, p. 138, pl. 7, figs. 5, 6.

Reussia ensiformis CHAPMAN and PARR, Journ. Roy. Soc. W. Australia, vol. 21, 1934-5, p. 4, pl. 1, fig. 1.

Reussella ensiformis CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.
Verneuilina sp. HOWCHIN, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 7.

"Test triangular, elongate, very slightly tapering; septa nearly flush with the surface, or slightly depressed. Surface of test slightly rough, granulate near the aboral end, but not spinous, as in *V. spinulosa* Reuss, to which this form bears some resemblance. Length, .517 mm.; greatest breadth, .224 mm."

"Remarks—This species is probably that referred to by Mr. Howchin as *Verneuilina* sp., and he remarks (loc. cit.) that it resembles *V. spinulosa*, but for the elongate contour, the plane surfaces and absence of spines."

The type specimen is from the Miocene, Batesford limestone, Filter Quarries, Victoria, Australia. A specimen in our collection from the type locality agrees very well with Chapman's figure and description. It measures: length 0.60 mm.; diameter 0.25 mm. Chapman and Parr figure a Recent specimen from off Australia. The form figured by Heron-Allen and Earland in the reference given is evidently not this

form which has nearly parallel sides and comparatively high and few chambers. From their figures the chambers are uniserial rather than alternating and the reference to this genus is doubtful.

REUSSELLA DECORATA (Heron-Allen and Earland) (Pl. 6. figs. 15-18)

Verneuilina decorata HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1924, p. 138, pl. 7, figs. 7-9.

Reussia decorata PARR, Proc. Roy. Soc. Victoria, vol. 44, 1932, p. 13, pl. 1, fig. 22.

Reussella decorata CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

"This large and handsome species is not uncommon in the deposit. It is characterized by a series of about eight sets of chambers, rapidly increasing in size, the surfaces of which are thickly studded with tubercular shell growth. Early sutures indistinct, flush or limbate, but the sutural lines between the later chambers are deeply sunk. Edges of the shell produced into a thick solid keel devoid of spines. Aperture very large, but more or less completely closed with a plate perforated with one or more slit-like orifices."

The types are from the Miocene of Filter Quarry, Batesford, Victoria, Australia.

From the figures the length would be as much as 1:30 mm. which is very large for this genus. The aperture is not typical of *Reussella*. The figure given by Parr of a Recent specimen from off Australia seems more like a *Reussella*.

REUSSELLA MIOCENICA Cushman, n. sp. (Pl. 6. figs. 19. 20)

Reussia spinulosa CUSHMAN (not REUSS), Bull. 4, Florida State Geol. Survey, 1930, p. 48, pl. 8, fig. 17.—CUSHMAN and PONTON (part), l. c., Bull. 9, 1932, p. 84, pl. 12, fig. 14, 16? (not 15).—CUSHMAN and CAHILL, U. S. Geol. Survey Prof. Paper 175-A, 1933, p. 27, pl. 9, fig. 1.

Test nearly twice as long as broad, triangular in end view, sides flattened or slightly concave, angles acute, serrate; apertural end convex, initial end acute, usually with a short spine; chambers distinct, increasing rather rapidly in size and height as added, very slightly inflated, later ones with a prominent spinose projection at the peripheral angle; sutures distinct, often somewhat limbate, the later ones sometimes slightly depressed; wall distinctly perforate, slightly roughened in the early portion with short spines, later smooth; aperture a small opening on the inner margin of the last-formed chamber. Length 0.45-0.52 mm.; diameter 0.27-0.30 mm.

Holotype (Cushman Coll. No. 16389) from the Miocene, *Cancellaria* zone, Choctawhatchee marl, Jacksons Bluff, borrow pit just E. of power dam, Ocklocknee River, Leon Co., Fla. This species seems to be confined to the *Cancellaria* zone of the Choctawhatchee marl and should

make a good index fossil for this part of the Miocene. Besides the type locality, there are specimens in our collections from the *Cancellaria* zone from the following Florida localities: Harvey Creek, sec. 16, T. 1 S., R. 3 W., at old Yankeetown, Leon Co.; Harvey Creek, 1½ mi. E. of Florida road No. 19, Leon Co.; Harvey Creek, highest bed at old mill, sec. 8, T. 1 S., R. 3 W., Leon Co.; Double Branch, sec. 8, T. 1 S., R. 3 W., Leon Co.; R. L. Gainer farm on Econfina River, sec. 26, T. 1 S., R. 13 W., Bay Co.; Gully Sink, about 3½ mi. E. of Greenhead, "The Deadens", Washington Co.; Hosford Mill (Old Coe Mill), about 2 mi. N. by E. of Hosford, Liberty Co.; Robinson Mill (abandoned), about 1 mi. N. of Hosford Mill, Liberty Co.

The species differs from *R. spinulosa* (Reuss) in the more elongate form, higher and fewer chambers, and the very coarsely serrate edge with a large, stout spine from each adult chamber.

PLIOCENE SPECIES

REUSSELLA GLABRATA (Cushman) (Pl. 6, figs. 21-23)

Verneuilina glabrata CUSHMAN, Bull. 676, U. S. Geol. Survey, 1918, p. 9, pl. 1, fig. 2.

Reussella glabrata CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

—GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 423, pl. 31, fig. 8.

Reussia spinulosa COLE (not REUSS), Bull. 6, Florida State Geol. Survey, 1931, p. 43, pl. 2, fig. 6.—CUSHMAN and PONTON (part), l. c., Bull. 9, 1932, p. 84, pl. 12, fig. 15 (not 14, 16).

Reussella spinulosa (REUSS), var. PALMER, Bull. Amer. Pal., vol. 29, No. 115, 1945, p. 49.

Test 1½ to 2 times as long as broad, triangular in end view, sides flattened or slightly concave, angles acute but not spinose, periphery slightly indented at the sutures, initial end acute but without a spine; chambers distinct, relatively high; sutures distinct, slightly limbate, not depressed; wall smooth, distinctly perforate; aperture a curved slit at the inner margin of the last-formed chamber. Length 0.40-0.65 mm.; diameter 0.25-0.35 mm.

The types of this species are from the Pliocene, Waccamaw formation, of Cronly, N. C. It occurs in the Miocene, *Arca* zone, Choctawhatchee marl, at the following Florida localities, all in Walton Co.: Jim Kennedy Branch, 1 mi. E. of Red Bay; John Anderson farm, near Red Bay; E. Gomillion farm, ½ mi. E. of Red Bay; Bell farm, sec. 29, T. 2 N., R. 19 W. Cole figures a similar form from the Pliocene of Florida, Galloway and Heminway record it from the Miocene of Haiti, and Mrs. Palmer records it from the Bowden marl of Jamaica.

REUSSELLA SPINOSISSIMA (Costa) (Pl. 7, figs. 1-3)

Verneuilina spinosissima COSTA, Atti Accad. Pont., vol. 7, pt. 2, 1856, p. 263, pl. 23, figs. 5A-C.

Reussella spinosissima CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 20.

Verneuilina spinulosa SIDEBOTTOM (not REUSS), Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 10, pl. 2, fig. 5.

Test about twice as long as broad, slender, tapering from the initial end which has a distinct, often large, spine to the last whorl, or in adult specimens somewhat decreasing in diameter in the last 1 or 2 whorls, triangular in transverse section, angles acute, spinose; chambers distinct, not inflated, increasing only gradually in size and height as added; sutures distinct, limbate, usually slightly raised, earliest ones often slightly spinose; wall with a prominent row of pores near the borders of the chamber with the central part clear; aperture an arched opening at the inner edge of the last-formed chamber. Length 0.42-0.50 mm.; diameter 0.23-0.27 mm.

The types are from the Pliocene of Italy. Like most of Costa's species this one is very poorly figured. In our collections there are specimens referable to this species from the Pliocene of Monte Mario, near Rome, and Castel Arquato, Italy, and from the Pliocene of Garaut, near Nice, France. As a recent species it occurs off Villefranche, France; off Nigare and Nauplie, Greece, and off Port Said in the Red Sea. Side-bottom figures it from off the Island of Delos in the Mediterranean.

RECENT SPECIES

REUSSELLA AGUAYOI Bermudez (Pl. 7, fig. 6)

Reussella aguayoi BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 13, 1939, p. 250, pl. 33, fig. 5.

"Test triangular with the three sides slightly concave; initial end acute, apertural end truncate; chambers numerous, six or eight visible on the outer surface and gradually increasing in size; with very sharp keels and terminating in prominent spines which correspond to the end of the sutures which are slightly limbate; wall thick, calcareous with a glassy luster and with numerous fine perforations; aperture simple, comma-shaped, in the septal face of the last-formed chamber. Length 0.9 mm."

"Holotype from *Atlantis* station 2977 (Lat. 21° 42' N., Long. 76° 59' W.) at a depth of 1175 fathoms. Rare. It is easily distinguished from *Reussella spinulosa* (Reuss), by its much shorter and broader shape and its more prominent spines."

The above is a translation of the original description. I have had no other material that would seem to be identical with the holotype. It is apparently a species of deep water of the Western Atlantic.

REUSSELLA ARMATA (Parr) (Pl. 7, figs. 7, 8)

Reussia armata PARR, Proc. Roy. Soc. Victoria, vol. 44 (n. ser.), pt. 2, 1932, p. 224, pl. 22, figs. 49, 50.

"Test in the adult rhombohedral, with the initial end armed with a short spine, apertural end rounded, the sides slightly concave, margin sharp and with one or two spines on each of the outer angles; chambers arranged in three series, with about twelve in each, increasing in height as added, wider than high; sutures distinct, flush, slightly curved; wall calcareous; smooth, of medium thickness, finely perforate; aperture a curved slit at the base of the inner edge of the last-formed chamber; colour white."

"Length up to 0.77 mm."

The type is from shore sand, Hardwicke Bay, South Australia.

There are two paratypes in our collection sent by Mr. Parr. This is a unique species. The only other like it in the rapid expansion of the early portion and parallel sides in the adult is *R. insueta* Cushman, n. sp.

REUSSELLA PERFORATA (Cushman) (Pl. 7, fig. 4)

Trimosina perforata CUSHMAN, Journ. Washington Acad. Sci., vol. 19, 1929, p. 157, text fig. 1; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 44, pl. 12, fig. 6.

"Test small, generally triangular in both side and end views, angles acute; chambers triserial throughout, rapidly increasing in size as added, the angles of the chambers usually protruding and early chambers sometimes twisted; sutures distinct, not depressed, slightly limbate; wall calcareous, finely perforate with coarser perforations along the borders near the sutures connecting with the interior by definite tubules, generally smooth, thin and nearly transparent; apertural face convex, with numerous ridges and irregular projections, aperture consisting of a long narrow opening connecting with the basal margin by a narrow slit at a sharp angle to the axis of the main opening, bordered by a distinct thickened lip, the apertural face with numerous irregularly rounded openings."

Length 0.50 mm.; breadth 0.35 mm.

The types of this species are from 40 to 50 fathoms, off Fiji.

Although described as a *Trimosina*, it would seem as though this and the following species belong in that group of *Reussella* that trends toward *Chrysalidinella*.

REUSSELLA SIMPLEX (Cushman) (Pl. 7, fig. 5)

Trimosina simplex CUSHMAN, Journ. Washington Acad. Sci., vol. 19, 1929, p. 158, text fig. 2; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 44, pl. 12, fig. 7.

"Test of medium size, triangular in both side and end views, angles acute; chambers triserial throughout, uniformly increasing in size as added, angles of the chambers slightly spinose, the outer angle thickened, almost carinate; sutures distinct, not depressed, very slightly limbate, rather evenly curved; wall calcareous, coarsely perforate, especially along the borders, smooth, fairly thick but translucent; apertural face slightly convex, fairly smooth, the aperture elongate without a lip, and with a few supplementary openings in the center of the terminal face."

Length up to 1 mm.; breadth 0.50 mm.

The types are from 40 to 50 fathoms, off Fiji.

Recent material, evidently belonging to this species, is in our collections from off Samoa; Midway Id.; Ocean Id.; Layson Id.; Hawaiian Ids.; Philippines; south of Japan; Eldad Reef, China Sea; off Zanzibar; and off Tamatave, Madagascar. There are specimens also from Wool Bay, Yorke Peninsula, So. Australia, and similar forms occur in the Miocene of Filter Quarry, Batesford, and from Muddy Creek, Victoria, Australia.

REUSSELLA INSUETA Cushman, n. sp. (Pl. 7, fig. 9)

Test about twice as long as broad, triangular in transverse section, sides slightly concave, angles acute, carinate, apertural end truncate, initial end with a stout spine, early portion expanding rapidly, adult portion with the sides nearly parallel; chambers distinct, few, high, rapidly increasing in size and height as added, without spines in the early portion, later with 2 or 3 chambers with a strong basal spine and in the adult with a well developed peripheral keel fusing in adjacent chambers; sutures distinct, curved, somewhat limbate; wall clear except along the edges of the chamber where there is a single row of distinct perforations; aperture a low opening at the inner margin of the last-formed chamber. Length of holotype 0.48 mm.; diameter 0.26 mm.

Holotype (Cushman Coll. No. 44183) from near Nairai, Fiji. The species is fairly common about the Fiji Islands, occurring at 12 and 24 fathoms, off Nairai, and in 21 fathoms, Viva Anchorage, Fiji. It also occurs in 7 fathoms, off Rotonga.

This species is probably related to *R. armata* (Parr), but differs in the fewer and higher chambers, parallel sides in the adult, and more spinose early stages.

REUSSELLA ACULEATA Cushman, n. sp. (Pl. 7, figs. 10, 11)

Verneuilina spinulosa H. B. BRADY (part) (not REUSS), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 384, pl. 47, figs. 3, 2(?), (not 1).

Reussia spinulosa HADA (not REUSS), Sci. Rep't Tohoku Imp. Univ., ser. 4, Biol., vol. 6, 1931, p. 133, text fig. 90.

Test increasing gradually in diameter from the acute initial end to the greatest width formed by the last whorl of chambers, triangular in transverse section, sides flattened or slightly concave, periphery acute with a distinct, backwardly projecting, slender spine at the basal angle of each chamber, continuing from the thickened border; chambers distinct, not inflated, increasing rapidly in height as added, the margins slightly thickened; sutures distinct, slightly limbate; wall smooth, perforate near the margin of each chamber; aperture a low opening at the inner margin of the last-formed chamber. Length 0.35-0.40 mm.; diameter 0.25-0.28 mm.

Holotype (Cushman Coll. No. 44189) from Mokaujar Anchorage, Fiji. Specimens also occur in 12 fathoms, off Nairai, Fiji; in 50 and 17 fathoms, off Pago Pago Harbor, Samoa; off Zanzibar; and off the Philippines. Brady's *Challenger* material (Pl. 47, fig. 3) which is evidently the same, is from off Papua. Hada figures a specimen from Mutsu Bay, Japan, which is also similar.

The species differs from *R. spinulosa* (Reuss) in the more tapering form and the long, basal spine and long, curved spines from each chamber.

Genus TRIMOSINA Cushman, 1927

Genotype, *Mimosina spinulosa* MILLETT, var.

Trimosina CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 64; Special Publ. 1, 1928, p. 241; Special Publ. 4, 1933, p. 223; Foraminifera, 3rd Ed., 1940, p. 247; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 43.

Mimosina (part) MILLETT.

Test triserial; chambers with a single, acicular spine which may become obsolete; wall calcareous, vesicular; aperture elongate, removed from the margin, sometimes with an added series of rounded pores along the base of the apertural face.—Recent, Indo-Pacific.

TRIMOSINA SPINULOSA (Millett) (Pl. 7, fig. 12)

Mimosina spinulosa MILLETT, Journ. Roy. Micr. Soc., 1900, p. 548, pl. 4, fig. 12.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 650.

Test triserial, triangular in transverse section, elongate, tapering from the subacute initial end to the greatest breadth formed by the last whorl of chambers, sides slightly convex, angles slightly carinate; chambers distinct, very slightly inflated, increasing rapidly in size as

added; sutures distinct, slightly depressed; wall with perforations arranged in longitudinal lines; aperture apparently double, one narrow and elongate at the base of the inner margin of the last-formed chamber, the other large, triangular or semi-lunar, in the terminal face of the chamber. Length 0.50 mm.

The types of this species are from the waters of the Malay Archipelago. Heron-Allen and Earland record it from the Kerimba Archipelago.

The type figure reproduced on our plate appears to have the terminal face of the chamber broken, but Millett speaks of the openings as "triangular or semilunar." It is recorded as abundant so it may be supposed that Millett had enough specimens to be certain of the apertural characters. The triangular, triserial test outside of the apertural features would take this species out of *Mimosina* and with the apertural character would place it in *Trimosina*. I have had no material that could definitely be referred to it.

TRIMOSINA MILETTI Cushman (Pl. 7, fig. 13)

Mimosina spinulosa MILLETT, var., Journ. Roy. Micr. Soc., 1900, p. 548, pl. 4, fig. 13.

Trimosina milletti CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 64, pl. 13, fig. 20; Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 22, fig. 20; Special Publ. 5, 1933, pl. 28, fig. 6; Foraminifera, 3rd Ed., 1940, pl. 22, fig. 20; Key, pl. 28, fig. 6.

Test triserial, triangular in transverse section, about $1\frac{1}{2}$ times as long as wide, the initial end acute with a short spine, thence rapidly broadening to the greatest breadth above the middle of the test, thence tapering to the bluntly rounded apertural end, periphery keeled and spinose; chambers distinct, inflated in the later stages, increasing very rapidly in size as added, the last whorl making up more than half of the test, each chamber in the adult with a large spine in the middle of the periphery, nearly at right angles to the long axis of the test; sutures distinct, depressed; wall smooth except for the edges of the chambers which are keeled and spinose; aperture an elongate, somewhat curved opening, slightly enlarged and rounded at the ends, in the terminal face of the last-formed chamber. Length of type specimen figured, 0.42 mm.; diameter including spines, 0.30 mm.

The types are from the Malay Archipelago.

TRIMOSINA ORIENTALIS Cushman (Pl. 7, fig. 14)

Trimosina orientalis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 78, pl. 8, fig. 4; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 43, pl. 12, figs. 1-5.

"Test elongate, tapering, two or three times as long as broad, the

basal ends of the chambers much angled, especially in the young stages; chambers very distinct, inflated, the early ones very angular, those of the adult becoming less so; sutures distinct, depressed; wall coarsely perforate; aperture an elongate, curved, slit-like opening becoming broader in the last-formed chamber. Length up to 0.55 mm.; diameter 0.25 mm."

The types of this species are from 7 fathoms, off Rotonga, in the Pacific. All the records for this species are from warm, shallow water of the Pacific, including the following localities in the vicinity of the Fiji Islands: 12 and 24 fathoms, off Nairai; 12 fathoms, off Levuka; 3 fathoms, Viva Anchorage; 40 to 50 fathoms, off Fiji; and Mokaular Anchorage. It also occurs commonly in 18 fathoms, Vavau Anchorage, Tonga Ids., and Rongelab Atoll, Marshall Ids.

There is a tendency for this species to develop a large, rounded, nearly terminal aperture, and it is therefore kept in the genus *Trimosina*.

Genus MIMOSINA Millett, 1900

Genotype, *Mimosina hystrix* MILLETT

Mimosina MILLETT, Journ. Roy. Micr. Soc., 1900, p. 547.—CHAPMAN, The Foraminifera, 1902, p. 174.—CUSHMAN, Publ. 342, Carnegie Inst. Washington, 1924, p. 24; Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 64; Special Publ. 1, 1928, p. 241; Special Publ. 4, 1933, p. 224; Foraminifera, 3rd Ed., 1940, p. 247.—Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 45.

Test triserial in the early stages, later biserial in the adult; chambers with a single acicular spine at the peripheral angle; wall calcareous, vesicular; aperture of two parts, one rounded and nearly terminal, the other below, near the inner border of the chamber, more elongate, arched.—Recent, Indo-Pacific.

This genus was evidently derived from *Trimosina* by the development of a biserial stage.

MIMOSINA AFFINIS Millett (Pl. 7, figs. 15, 16)

Mimosina affinis MILLETT, Journ. Rôy. Micr. Soc., 1900, p. 548, pl. 4, fig. 11; 1901, p. 1, pl. 1, fig. 1.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 650.

"Test ovate; chambers globular, arranged tri-serially and rapidly increasing in size; sutures depressed. Sutural orifice a slit, usually cribrate; superior orifice a curved depression with the extremities rounded. Length 0.35 mm."

The above is Millett's original description. It is recorded as abundant in the Malay Archipelago. Both figures given by Millett are reproduced here, the second front view being a correction of the first which was

somewhat incorrect in the apertural features. The species is recorded by Heron-Allen and Earland from the Kerimba Archipelago. The biserial character is not entirely developed, indicating that this species, while placed in *Mimosina*, shows its development from the *Trimosina* source.

MIMOSINA HYSTRIX Millett (Pl. 7, figs. 17, 18)

Mimosina hystrix MILLETT, Journ. Roy. Micr. Soc., 1900, p. 549, pl. 4, figs. 14, 15.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 190; Special Publ. 4, 1933, pl. 22, fig. 21; Special Publ. 5, 1933, pl. 28, fig. 7; Foraminifera, 3rd Ed., 1940, pl. 22, fig. 21; Key, pl. 28, fig. 7.

"Test oblong, ovate; tri-serial in the earlier stage, subsequently becoming biserial. Chambers inflated, those of the biserial portion provided with a spine at the rounded peripheral margin; sutures sunk. Aperture: both orifices circular or oval with a bordered margin. Length 0.50 mm."

The types are from the Malay Archipelago where Millett records it as abundant but localized. It is a very striking species but has not been found elsewhere.

MIMOSINA RIMOSA Heron-Allen and Earland (Pl. 7, fig. 19)

Mimosina rimosa HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 650, pl. 50, figs. 5-11.

"Test free, hyaline, consisting of three to five pairs of chambers arranged in a regular biserial order. The initial portion of the test is sometimes triserial. The chambers somewhat inflated, giving slightly depressed sutural lines. Shell-wall coarsely perforate, in the usual mimosine manner; surface of the test smooth and glassy, usually very transparent. Aperture mimosine or double, but abnormal, consisting of a long fissure extending all round the lower half of each chamber midway between the two faces of the test and forming a compressed funnel which opens into the internal cavity of the chamber. In the fissure, and near the point of junction of the last two chambers, is a small secondary opening into the chamber which is not connected with the funnel."

Length 0.30 mm.; breadth 0.18 mm.; thickness 0.10 mm.

The types are from the Kerimba Archipelago where it is apparently common but there are no further records for it. The apertural characters are very unique.

MIMOSINA ECHINATA Heron-Allen and Earland (Pl. 7, figs. 20-22)

Mimosina echinata HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 651, pl. 50, figs. 12-18.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 128.—CUSHMAN, Publ. 342, Carnegie Instit. Washington, 1924, p. 24, pl. 7, fig. 1.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 9, 1935, p. 197.

Mimosina hystrix MILLETT, var. *SIDEBOTTOM*, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 16, pl. 3, fig. 9; vol. 54, pt. 3, 1910, p. 13.

Mimosina hystrix HERON-ALLEN and EARLAND (not MILLETT), Trans. Zool. Soc. London, vol. 20, 1915, p. 651, pl. 50, fig. 19.

Test with the early chambers triserial, later ones biserial; sutures largely obscured by the surface ornamentation which is of a hispid character with a few larger spines; aperture double, one at the base of the last-formed chamber, the other also elongate, somewhat crescentiform and directly above. Length 0.14-0.16 mm.; breadth 0.10-0.14 mm.

The types are from the Kerimba Archipelago and it has been recorded from off the east coast of Australia, Samoa, the Mediterranean, and off Cuba. Most of these records are without figures, and more than one species may be represented.

MIMOSINA PACIFICA Cushman (Pl. 7, fig. 23)

Mimosina pacifica CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 77, pl. 8, fig. 3; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 45, pl. 12, fig. 8.

"Test irregularly triserial except in the adult portion which becomes biserial, tapering from an acute initial end to the broad, rounded, apertural end, nearly circular in end view; chambers distinct, inflated; sutures of the early portion indistinct, later ones slightly depressed; wall calcareous, finely perforate, the initial portion with short spines which in the later portion become largely confined to the base of the inner margin of the last-formed chamber, above which is a low, elongate, supplementary opening. Length of holotype 0.35 mm.; diameter 0.25 mm."

The types of this species are from 12 fathoms, off Levuka, Fiji. It also occurs in shallow water at Mokaujar Anchorage, Fiji, and Rongelab Atoll, Marshall Ids.

Genus PAVONINA d'Orbigny, 1826

Genotype, *Pavonina flabelliformis* d'ORBIGNY

Pavonina d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 260.—H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 374.—CHAPMAN, The Foraminifera, 1902, p. 169.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 30; Bull. 104, pt. 3, 1922, p. 51; Contr. Cushman Lab. Foram. Res., vol 3, 1927, p. 59; Special Publ. 1, 1928, p. 230; Special Publ. 4, 1933, p. 224; Foraminifera, 3rd Ed., 1940, p. 247.

Test in the early stages triserial and like *Reussella*, later uniserial, fan-shaped, chambers tending to become annular; wall calcareous, coarsely perforate; apertures in the adult consisting of numerous small rounded openings on the peripheral face.—Oligocene?, Miocene to Recent.

A number of species have been referred to this genus which evidently do not belong here. The following are evidently to be placed in this genus:

<i>P. miocenica</i> Cushman and Ponton	Miocene	Florida, Jamaica
<i>P. triformis</i> Parr	Oligocene, Miocene	Australia
<i>P. flabelliformis</i> d'Orbigny	Recent	Indo-Pacific
<i>P. atlantica</i> Cushman	Recent	Western Atlantic

PAVONINA MIOCENICA Cushman and Ponton (Pl. 8, fig. 1)

Pavonina miocenica CUSHMAN and PONTON, Bull. 9, Florida State Geol. Survey, 1932, p. 73, pl. 12, fig. 19.—PALMER, Bull. Amer. Pal., vol. 29, No. 115, 1945, p. 49.

"Test much compressed, flattened sides nearly parallel, periphery of basal portion forming a broad angle, carinate, outer portion forming a broad curve, concave and keeled at each side; early chambers biserial, later ones uniserial, broad and low, curved, extending across the whole outer peripheral face; sutures distinct, not raised, somewhat limbate; wall coarsely perforate; aperture consisting of several small pores irregularly arranged in the outer peripheral face. Length 0.60 mm.; breadth 0.70 mm.; thickness 0.10 mm."

The types of this species are from the Miocene, Choctawhatchee formation, Harveys Creek, sec. 9, T. 1 S., R. 3 W., Leon Co., Fla. It has been recorded by Mrs. Palmer from the Miocene, Bowden marl, of Bowden, Jamaica.

It is evidently the ancestral form of *P. atlantica* Cushman.

PAVONINA TRIFORMIS Parr (Pl. 8, figs. 2-5)

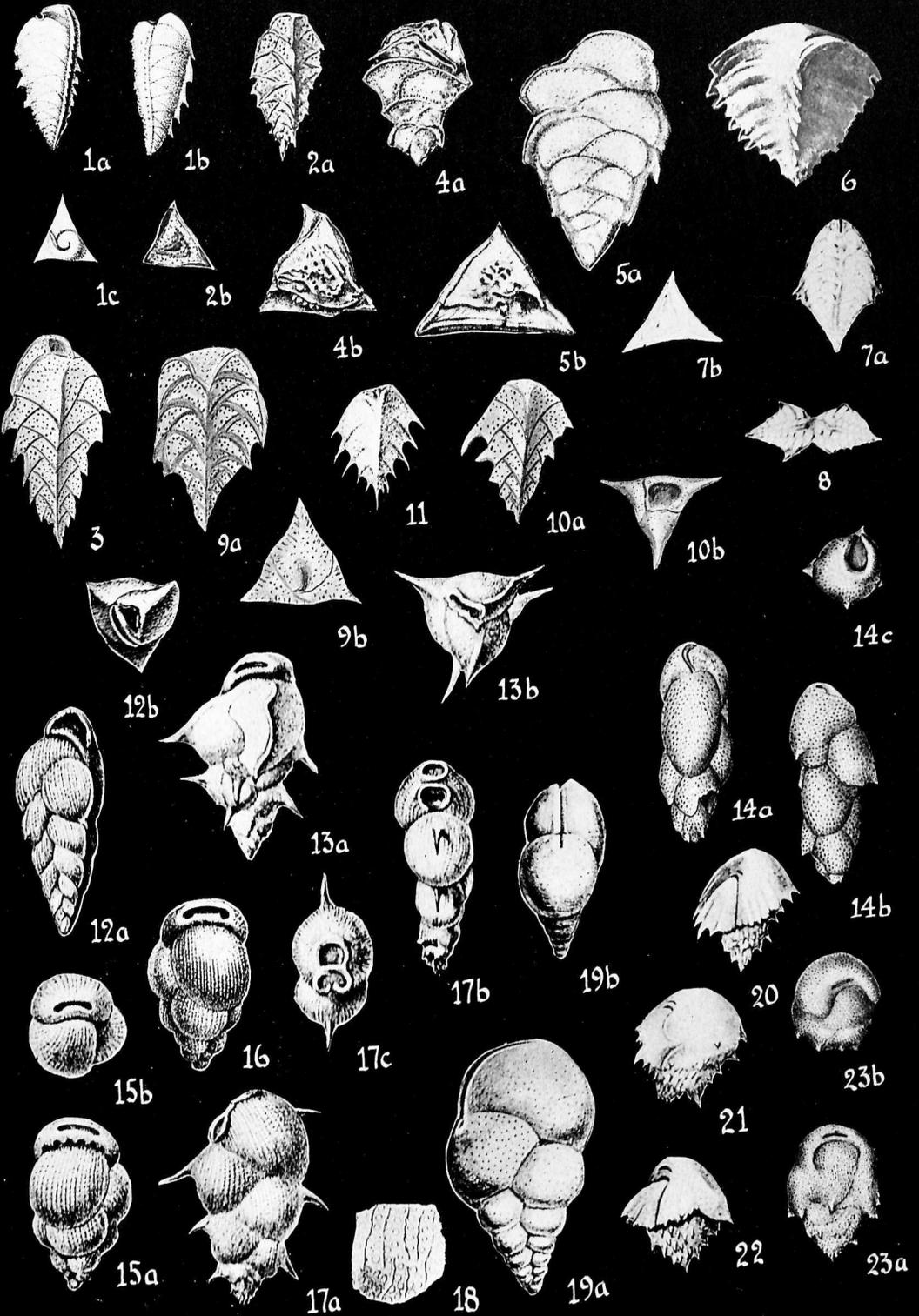
Pavonina triformis PARR, Proc. Roy. Soc. Victoria, vol. 45, 1933, p. 29, pl. 7, figs. 1-3.—

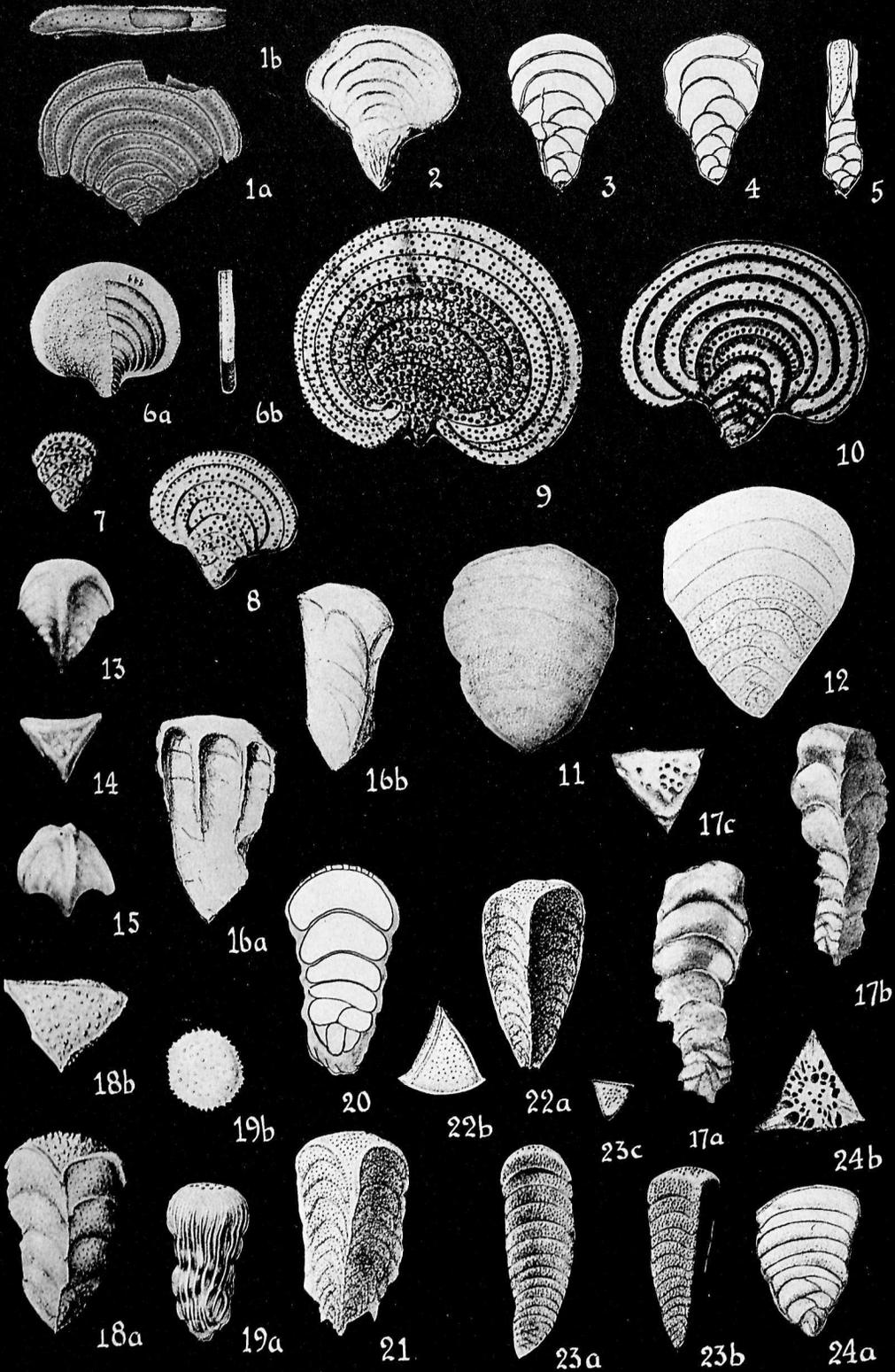
EXPLANATION OF PLATE 7

Figs. 1-3. *Reussella spinosissima* (Costa). 1, (After Costa). *a, b*, opposite sides; *c*, apertural view. 2, (After Sidebottom). *a*, front view; *b*, apertural view. $\times 45$. 3, Recent, from Villefranche sur Mer, France. $\times 60$. 4. *R. perforata* (Cushman). (After Cushman). *a*, front view; *b*, apertural view. $\times 45$. 5. *R. simplex* (Cushman). (After Cushman). *a*, front view; *b*, apertural view. $\times 45$. 6. *R. aguayoi* Bermudez. (After Bermudez). $\times 30$. 7, 8. *R. armata* (Parr). (After Parr). 7*a*, front view; 7*b*, apertural view. 8, Two specimens clinging together. $\times 32$. 9. *R. insueta* Cushman, n. sp. Holotype. *a*, front view; *b*, apertural view. $\times 60$. 10, 11. *R. aculeata* Cushman, n. sp. Holotype. *a*, front view; *b*, apertural view. $\times 60$. 11, (After H. B. Brady). $\times 60$. 12. *Trimosina spinulosa* (Millett). (After Millett). *a*, front view; *b*, apertural view. $\times 60$. 13. *T. milletti* Cushman. (After Millett). *a*, front view; *b*, apertural view. $\times 70$. 14. *T. orientalis* Cushman. (After Cushman). *a, b*, opposite sides; *c*, apertural view. $\times 60$. 15, 16. *Mimosina affinis* Millett. (After Millett). $\times 80$. 15*a*, side view; *b*, apertural view. 17, 18. *M. hystrix* Millett. (After Millett). 17*a*, front view; *b*, side view; *c*, apertural view. $\times 60$. 18, Surface ornamentation. $\times 145$. 19. *M. rimosa* Heron-Allen and Earland. (After Heron-Allen and Earland). *a*, front view; *b*, apertural view. $\times 140$. 20-22. *M. echinata* Heron-Allen and Earland. (After Heron-Allen and Earland). $\times 115$. 23. *M. pacifica* Cushman. (After Cushman). *a*, side view; *b*, apertural view. $\times 60$.

LIBRARY

CUSHMAN LABORATORY





CRESPI, Bull. 9 (Pal. Ser. No. 4), Commonwealth of Australia, Min. Res. Survey, (mimeographed), 1943, p. 82 (list).

Pavonina flabelliformis HOWCHIN (not d'ORBIGNY), Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 7.—HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1924, p. 141, pl. 8, fig. 22.

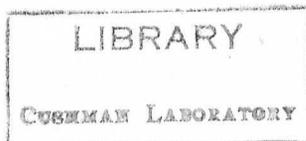
"Test many chambered, in side view roughly triangular in the early stages, later becoming sub-flabellate, about as wide as long, early portion of the test trihedral, with the angles limbate and sharp, the earliest chambers triserial, followed by a series of chambers arranged alternately, adult chambers curved and spreading, but never more than semi-annular, uniserial; sutures limbate, depressed, distinct; wall usually thin and coarsely punctate, except that of the early portion of the test, which is thickened and ornamented by longitudinal costae and beads; these sometimes cover the whole test, when they become weaker as they approach the periphery; apertures a series of coarse perforations in the depressed peripheral face. Diameter up to 0.7 mm."

The types of this species are from the Miocene, marl bed in polyzoal limestone, base of cliffs, N. end of bathing beach, Torquay, Victoria, Australia. The following additional Australian localities are given by Parr: Oligocene, Altona Bay Coal Shaft; Miocene, marl overlying limestone, Filter Quarry, Batesford; Lower Beds, Muddy Creek, near Hamilton. Thanks to Mr. Parr there are topotypes in our collections as well as specimens from Filter Quarry and Muddy Creek.

This is evidently the ancestral form of *P. flabelliformis* d'Orbigny. The early stages show the close relationship of *Pavonina* to *Reussella*.

EXPLANATION OF PLATE 8

FIG. 1. *Pavonina miocenica* Cushman and Ponton. (After Cushman and Ponton). *a*, front view; *b*, apertural view. $\times 40$. 2-5. *P. triformis* Parr. (After Parr). 2-4, front views; 5, peripheral view. $\times 50$. 6-10. *P. flabelliformis* d'Orbigny. 6, (After d'Orbigny). *a*, front view; *b*, peripheral view. 7-10, (After Heron-Allen and Earland). 7, Early stage, mostly biserial. 8, 10, Later stages. 9, Adult with chambers nearly annular. 7-9, $\times 38$. 10, $\times 52$. 11, 12. *P. atlantica* Cushman. (After Cushman). 11, Holotype. $\times 32$. 12, Specimen showing early biserial stage. $\times 80$. 13-15. *Chrysalidinella cubana* Cushman and Bermudez. (After Cushman and Bermudez). 13, 15, front views; 14, apertural view. $\times 48$. 16. *C. (?) cubensis* Palmer. (After Palmer). *a*, front view, $\times 45$; *b*, side view, $\times 60$. 17. *C. pulchella* (Cushman). (After Cushman). *a*, *b*, opposite sides; *c*, apertural view. $\times 70$. 18. *C. miocenica* Cushman, n. sp. Holotype. *a*, front view; *b*, apertural view. $\times 80$. 19, 20. *C. costata* (Heron-Allen and Earland). (After Heron-Allen and Earland). 19*a*, front view; 19*b*, apertural view. $\times 50$. 20, Longitudinal section. $\times 50$. 21, 22. *C. dimorpha* (H. B. Brady). (After H. B. Brady). 22*a*, front view; 22*b*, apertural view. $\times 60$. 23. *C. earlandi* Cushman, new name. (After Heron-Allen and Earland). *a*, *b*, opposite sides; *c*, apertural view. $\times 33$. 24. *C. fijiensis* Cushman, n. sp. (After Cushman). Holotype. *a*, front view; *b*, apertural view. $\times 45$.



PAVONINA FLABELLIFORMIS d'Orbigny (Pl. 8, figs. 6-10)

Pavonina flabelliformis d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 260, pl. 10, figs. 10, 11; Modèles No. 56, 1826.—CUVIER, Règne Animal, vol. 9, 1836-46, p. 35, pl. 15, fig. 13.—d'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 72, pl. 21, figs. 9, 10.—H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 68, pl. 8, figs. 29, 30.—MOEBIUS, Foraminiferen von Mauritius, 1880, p. 91, pl. 8, figs. 13-15.—H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 374, pl. 45, figs. 17, 19-21 (not 18).—BASSET, Ann. Soc. Sci. Nat. Charente-Inf., 1884 (1885), p. 161, fig.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 7.—CHAPMAN, Proc. Zool. Soc. London, 1902, p. 231.—BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 132.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 30, text figs. 51, 52.—HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 632, pl. 48, figs. 1-6; Journ. Linn. Soc., Zool., vol. 35, 1924, p. 619.—CUSHMAN, Bull. 27, Bernice P. Bishop Mus., 1925 (1926), p. 126; Proc. U. S. Nat. Mus., vol. 67, Art. 25, 1926, p. 20, pl. 6, figs. 1-4; Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 22, fig. 19; Special Publ. 5, 1933, pl. 28, fig. 8.—PARR, Proc. Roy. Soc. Victoria, vol. 45, 1933, p. 28, pl. 7, figs. 4, 5.—CUSHMAN, Foraminifera, 3rd Ed., 1940, pl. 22, fig. 19; Key, pl. 28, fig. 8.

Test strongly compressed, with the early portion in the microspheric form triserial, then becoming biserial, and in the adult uniserial, early stages with the biserial portion triangular in front view, the later stages becoming nearly circular and overlapping the earlier portion; chambers distinct, except in the very earliest portion, the uniserial ones becoming very wide and forming almost annular chambers in the extreme adult, of about uniform height throughout the later stages; sutures distinct, except in the very earliest portion, slightly if at all depressed; wall thin, typically with small but distinct papillae about the coarse punctae of the surface; aperture in the adult composed of numerous, small, rounded openings in the peripheral face in one or more rows. Diameter up to 1 mm. or slightly more.

The types of this species were from off Madagascar. It is widely distributed in the Indo-Pacific region in very shallow water down to 1,033 fathoms. Most of the records, however, are from depths of less than 100 fathoms. Heron-Allen and Earland have figured very beautiful specimens from the Kerimba Archipelago and some of their figures are reproduced on our plate.

PAVONINA ATLANTICA Cushman (Pl. 8, figs. 11, 12)

Pavonina atlantica CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 51, pl. 19, fig. 1; Proc. U. S. Nat. Mus., vol. 67, Art. 25, 1926, p. 21, pl. 6, figs. 5, 6.

Pavonina flabelliformis H. B. BRADY (part) (not d'ORBIGNY), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 374, pl. 45, fig. 18 (not 17, 19-21).—WOODWARD, The Observer, vol. 4, 1893, p. 104.

“Test subtriangular, slightly longer than broad, initial end with a short spine, very much compressed, the sides carinate; chambers com-

paratively few, the earliest ones alternating, biserial, those of the adult uniserial, broad, extending across the width of the test, slightly curved backward at the ends; sutures somewhat limbate, wall thin and translucent, finely perforate; apertures numerous on the terminal wall of the last-formed chamber. Length up to 0.5 mm."

The type of this species is from off Sand Key, Florida, in 92 fathoms. It is recorded from off Ragged Key, Florida, in 75 fathoms; off Fowey Rocks, Florida, in 55 fathoms; and at two *Albatross* stations, D 2420 in 104 fathoms, and D 2641 in 60 fathoms. It occurs in shallow water in the lagoon at the Dry Tortugas, off Florida. Brady figures a specimen from *Challenger* station 24 in 390 fathoms, off Culebra, Island.

The following species referred to the genus *Pavonina* seem to belong elsewhere:

- Pavonina italica* Costa, Atti Accad. Pont., vol. 7, pt. 2, 1856, p. 178, pl. 16, figs. 26-28. (= *Discospirina*)
- P. liburnica* Stache, Abhandl. k. k. geol. Reichs., vol. 13, pt. 1, 1889, p. 89, pl. 5a, figs. 15-18. (= *Discospirina* ?)
- P. liburnica* Stache, var. *trilobata* Stache, l. c., p. 89, pl. 5a, fig. 19. (= *Discospirina* ?)
- P. (?) agglutinans* Schubert, Pal. Geol. Inst. Univ. Wien, vol. 14, 1902, p. 23, pl. 1, fig. 31. (= ?)
- P. advena* Cushman, U. S. Geol. Survey Prof. Paper 133, 1923, p. 24, pl. 1, fig. 10. (= Young of an orbitoid ?)
- P. mexicana* Cushman, Proc. U. S. Nat. Mus., vol. 67, Art. 25, 1926, p. 22, pl. 6, figs. 7-9. (= *Ammospirata*)

Genus CHRYSALIDINELLA Schubert, 1907

Genotype, *Chrysalidina dimorpha* H. B. BRADY

Chrysalidinella SCHUBERT, Neues Jahrb. für Min., vol. 25, 1907, p. 242.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 68; Special Publ. 1, 1928, p. 254; Special Publ. 4, 1933, p. 224; Foraminifera, 3rd Ed., 1940, p. 247; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 45.

Chrysalidina of authors (not d'ORBIGNY).

Test tapering, triangular in transverse section, early stage triserial, adult uniserial; wall calcareous, perforate; aperture in adult cribrate, of numerous rounded openings scattered over the triangular apertural face.—Eocene to Recent.

The following species belong in this genus:

<i>C. cubana</i> Cushman and Bermudez	Eocene	Cuba
<i>C. (?) cubensis</i> Palmer	Oligocene	Cuba
<i>C. pulchella</i> (Cushman)	Miocene	Panama
<i>C. miocenica</i> n. sp.	Miocene	Florida
<i>C. costata</i> (Heron-Allen and Earland)	Miocene	Australia
<i>C. dimorpha</i> (H. B. Brady)	Recent	Indo-Pacific
<i>C. earlandi</i> new name	Recent	Indo-Pacific
<i>C. fijiensis</i> n. sp.	Recent	Indo-Pacific

There is a possibility that the species described as *Bigenerina ferox* Heron-Allen and Earland from the Miocene of Australia (Journ. Roy. Micr. Soc., 1924, p. 140, pl. 8, figs. 15-21) may belong here.

This genus follows the trend of many other groups with genera originating in the early Tertiary of the West Indian region, migrating to the Pacific during the Miocene, and persisting there while it became extinct in the Atlantic.

CHRYSALIDINELLA CUBANA Cushman and Bermudez (Pl. 8, figs. 13-15)

Chrysalidinella cubana CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 15, pl. 1, figs. 53-55.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 11, 1937, p. 344.

“Test about as long as broad, triangular in end view, sides concave, initial end pointed, thence increasing gradually in width in the microspheric form, rapidly in the megalospheric, to the greatest breadth at the base of the last-formed whorl of chambers; chambers numerous, increasing rather rapidly in breadth as added, not inflated, earlier ones triserial, later ones uniserial; sutures strongly oblique, not depressed; wall smooth; aperture cribrate, in the terminal face. Length 0.40-0.50 mm.; diameter 0.30-0.40 mm.”

The types are from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba.

This species may be distinguished from *C. pulchella* (Cushman) by its relatively shorter, broader test, lower and broader chambers which are strongly recurved in the adult, and the very strongly tapering test.

CHRYSALIDINELLA (?) CUBENSIS Palmer (Pl. 8, fig. 16)

Chrysalidinella (?) cubensis PALMER, Mem. Soc. Cubana Hist. Nat., vol. 15, 1941, p. 181, pl. 15, figs. 12, 13.

“Test small, elongate; early chambers probably triserial, sutures scarcely discernible; later uniserial, sutures indistinct; first chambers of uniserial portion smaller in diameter than the multiserial portion, gradually increasing in diameter. Low, sharp costae extend the length of the test, becoming obsolete on the final chamber; the costae are about 3 in number on the early portion and increase to 5 to 6 on the adult

test. Surface with a frosted appearance, not transparent, but without definite ornamentation. Aperture obscure; the flattened area at the center of the final chamber may be porous." Length of adult specimen 0.64 mm.

The types are from the upper Oligocene, lower part of the Cojimar formation, of Cuba. They were evidently not well enough preserved to give complete details and the generic position must remain in some doubt as indicated by Mrs. Palmer. The type figures are reproduced on our plate.

CHRYSALIDINELLA PULCHELLA (Cushman) (Pl. 8, fig. 17)

Chrysalidina pulchella CUSHMAN, Bull. 103, U. S. Nat. Mus., 1918, p. 54, pl. 20, fig. 2; Special Publ. 8, Cushman Lab. Foram. Res., 1937, p. 55.

Test elongate, gradually tapering, broadest at the apertural end which is slightly convex, triangular in transverse section, angles acute, sides flattened or very slightly concave; chambers distinct, not inflated, those of the early portion triserial, followed by as many as 6 uniserial chambers in the adult, increasing very gradually in size as added; sutures distinct, curved backward at the angles of the test, slightly limbate; wall smooth, except at the sutures; aperture consisting of several, small, rounded openings in the terminal face in the adult. Length up to 0.5 mm.; diameter 0.20 mm.

The types of this species are from the Miocene, Gatun formation, Monkey Hill, Mount Hope Station, Panama.

The species may be distinguished by its elongate, very gradually tapering test and the limbate sutures. Specimens referred to this species from the Miocene of Florida belong in *C. miocenica* Cushman, n. sp.

CHRYSALIDINELLA MIOCENICA Cushman, n. sp. (Pl. 8, fig. 18)

Chrysalidinella pulchella CUSHMAN (not 1918), Bull. 4, Florida State Geol. Survey, 1930, p. 48, pl. 8, fig. 16.—CUSHMAN and PONTON, l. c., Bull. 9, 1932, p. 85.—CUSHMAN and CAHILL, U. S. Geol. Survey Prof. Paper 175-A, 1933, p. 27, pl. 9, fig. 2.

Test about 1½ times as long as broad, tapering from the acute initial end to the greatest breadth near the broadly rounded apertural end, triangular in transverse section, the angles acute, sides flattened or slightly concave; chambers of the early triserial portion somewhat indistinct, in the adult with about 3 uniserial chambers, gradually increasing in breadth, slightly inflated; sutures of the later portion distinct, slightly limbate; wall smooth, coarsely perforate; aperture composed of numerous, small, rounded openings in the terminal face, each at the end of a small papilla. Length of holotype 0.40 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 42711) from the Miocene, Choctawhatchee marl, Jim Kennedy Branch, 1 mi. E. of Red Bay, Walton Co., Fla. It also occurs in the Shoal River and Oak Grove marls of the Florida Miocene.

This is not the same as *C. pulchella* (Cushman) of the Gatun formation of the Panama Canal Zone. It is much shorter and broader, more evenly tapering, with the apical end evenly pyramidal and pointed.

* **CHRYSALIDINELLA COSTATA** (Heron-Allen and Earland) (Pl. 8, figs. 19, 20)

Chrysalidina costata HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1924, p. 139, pl. 8, figs. 12-14.

Chrysalidinella costata CUSHMAN, Special Publ. 8, Cushman Lab. Foram. Res., 1937, p. 55.

"Test free, consisting of 3-5 chambers arranged triserially, followed by about the same number of round chambers, rapidly increasing in diameter and arranged in a straight series. The final chamber somewhat turgid at the oral extremity, which is perforated by a series of distinct pores. The initial triserial portion of the shell is covered with stout costae, which give it a strong resemblance to a small specimen of *Uvigerina pygmaea*; these costae become more delicate as they extend over the uniserial chambers, and die away on the oral surface of the last chamber. Between the costae are lines of coarse perforations. Size, length 0.40-0.70 mm.; maximum breadth 0.20-0.35 mm."

"Nearly all the specimens found have the final chamber broken. The pores perforating the septal face thus exposed are always much larger than the corresponding pores on the face of an unbroken specimen, so it would appear that absorption of the oral septum commences as soon as a new chamber is formed."

The types of the species are from the Miocene, "Filter Quarry", Moorabool River, Victoria, Australia. The single topotype specimen in our collection is much more rapidly tapering than the type and may represent the microspheric form.

CHRYSALIDINELLA DIMORPHA (H. B. Brady) (Pl. 8, figs. 21, 22)

Chrysalidina dimorpha H. B. BRADY, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 24; Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 388, pl. 46, figs. 20, 21.—MILLETT, Journ. Roy. Micr. Soc., 1900, p. 12, pl. 1, fig. 14.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 60, text figs. 96, 97.

Chrysalidinella dimorpha SCHUBERT, Neues Jahrb. für Min., vol. 25, 1907, p. 243.—CUSHMAN, Special Publ. 1, Cushman Lab. Foram. Res., 1928, pl. 37, fig. 16; Special Publ. 4, 1933, pl. 22, fig. 18; Special Publ. 5, 1933, pl. 28, fig. 5; Special Publ. 8, 1937, p. 55; Foraminifera, 3rd Ed., 1940, pl. 22, fig. 18; Key, pl. 28, fig. 5.

Test about twice as long as broad, triangular in transverse section,

the early triserial portion with the sides nearly parallel, periphery acute, the earlier portion typically with backwardly projecting spinose processes, sides slightly concave; chambers distinct, not inflated; sutures distinct, not depressed, slightly limbate, strongly curved, especially toward the angles of the test; wall smooth, distinctly perforate; aperture consisting of a series of fine rounded pores on the apertural face. Length of holotype 0.50 mm.; diameter 0.25 mm.

The types of this species are from off Hong Kong, and Brady also figures it from a station off Honolulu. Millett's figures from the Malay Archipelago are probably of this species.

There are a large number of references to this species but, without figures and without seeing the original material, it is difficult to place them.

CHRYSALIDINELLA EARLANDI Cushman, new name (Pl. 8, fig. 23)

Chrysalidina dimorpha HERON-ALLEN and EARLAND (not H. B. BRADY), Trans. Zool. Soc. London, vol. 20, 1915, p. 632, pl. 47, figs. 29-31.—CUSHMAN, Publ. 342, Carnegie Instit. Washington, 1924, p. 22.

Test elongate, about $2\frac{1}{2}$ times as long as wide, very gradually tapering from the acute initial end to the broadly rounded apertural end, triangular in transverse section, sides flattened, slightly concave, angles subacute; chambers distinct, not inflated, earliest ones triserial, very early becoming uniserial, as many as 14 or 15 in the uniserial series, very gradually increasing in height and breadth; sutures distinct, only slightly curved, little if at all depressed; wall smooth, distinctly perforate; aperture consisting of numerous, small, rounded openings in the terminal face. Length up to nearly 1 mm.; diameter up to 0.30 mm.

The types of this species are from the Kerimba Archipelago as figured by Heron-Allen and Earland.

This species differs from *C. dimorpha* (H. B. Brady) in the more elongate form, greater number of uniserial chambers, less acute angles, and much less curved sutures. The original figures of Heron-Allen and Earland are copied on our plate. A single specimen very similar to these figures is in our collection from Aua Reef, Pago Pago Harbor, Tutuila, Samoa.

CHRYSALIDINELLA FIJIENSIS Cushman, n. sp. (Pl. 8, fig. 24)

Chrysalidinella dimorpha CUSHMAN (not H. B. BRADY), Journ. Washington Acad. Sci., vol. 19, 1929, p. 159, text fig. 3; Bull. 161, U. S. Nat. Mus., pt. 3, 1942, p. 46, pl. 13, fig. 1.

Test about $1\frac{1}{2}$ times as long as broad, triangular in transverse section, gradually increasing in width from the subacute initial end to the

greatest width at the slightly convex apertural end, angles acute or even slightly keeled, sides flattened; chambers distinct, not inflated, initial triserial chambers few, 8 to 10 in the adult, low and broad, of nearly even height throughout; sutures distinct, slightly limbate, very slightly curved, not depressed; wall smooth, finely but distinctly perforate; aperture consisting of numerous, small, rounded openings in the terminal face. Length of holotype 0.50 mm.; diameter 0.37 mm.

Holotype (Cushman Coll. No. 10367) from 40 to 50 fathoms, off Fiji.

This species differs from *G. dimorpha* (H. B. Brady) in its shorter, broader form, few and large triserial chambers, low uniserial chambers, and very slightly curved sutures.

RECENT LITERATURE ON THE FORAMINIFERA

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

- Rao, S. R. Narayana.** A Revision of Some Foraminifera Described by Douvillé from the Kam-pa System of Tibet.—Proc. Nat. Acad. Sci. India, vol. 14, pt. 3, Oct. 11, 1944, pp. 93-101, 1 plate, 5 text figs.—The genus *Orbitosiphon* Rao, 1940, is defined and several of Douvillé's species discussed and refigured.
- Applin, E. R. and Louise Jordan.** Diagnostic Foraminifera from subsurface formations in Florida.—Journ. Pal., vol. 19, No. 2, March 1945, pp. 129-148, pls. 18-21, 2 text figs.—Forty species are figured, 29 new.
- Cushman, Joseph A.** The Species of Foraminifera Recorded by d'Orbigny in 1826 from the Pliocene of Castel Arquato, Italy.—Special Publication No. 13, Cushman Lab. Foram. Res., March 7, 1945, 27 pp., 6 pls.—An attempt is made, by a study of topotypes, to straighten out the various species described by d'Orbigny.
- Cushman, Joseph A. and R. M. Stainforth.** The Foraminifera of the Cipero Marl Formation of Trinidad, British West Indies.—Special Publication No. 14, Cushman Lab. Foram. Res., April 21, 1945, 91 pp., 16 pls., 2 charts.—There are 256 species and varieties recorded, 51 new, mostly figured. One new genus, *Globigerinatella* (Genoholotype *G. insueta* n. sp.), is erected.
- Cushman, Joseph A.** Foraminifera of the United States Antarctic Service Expedition 1939-1941.—Proc. American Philosophical Society, vol. 89, No. 1, April 30, 1945, pp. 285-288, 1 plate.—Fifteen species are figured, none new.

FORAMINIFERA

- Special Publ. No. 7. A Monograph of the Foraminiferal Family Verneulinidae. 170 pages and 20 plates.....\$3.50
- Special Publ. No. 8. A Monograph of the Foraminiferal Family Valvulinidae. 210 pages and 24 plates.....\$4.00
- Special Publ. No. 9. A Monograph of the Subfamily Virguliniinae. 240 pages and 24 plates.....\$4.00
- Special Publ. No. 10. The Genus *Articulina* and Its Species. 21 pages and 4 plates—(Extra plates, 30c).....\$1.00
- Special Publ. No. 11. The Genus *Spiroloculina* and Its Species. 82 pages and 9 plates—(Extra plates 2-9, 50c).....\$1.50
- Special Publ. No. 12. Foraminifera from the Shallow Water of the New England Coast. 37 pages and 4 plates—(Extra plates, 30c).....\$1.00
- Special Publ. No. 13. The Species of Foraminifera Recorded by d'Orbigny in 1826 from the Pliocene of Castel Arquato, Italy. 27 pages and 6 plates—(Extra plates 2, 3, 5, 6, 30c).....\$0.50
- Special Publ. No. 14. The Foraminifera of the Cipero Marl Formation of Trinidad, British West Indies. 91 pages, 16 plates and 2 charts—(Extra plates, 50c).....\$1.50

Price list of available foraminiferal literature sent on request.
Topotypes of many species available: 50c per slide.

CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

SHARON, MASS., U. S. A.

FORAMINIFERA

Their Classification and Economic Use

THIRD EDITION, REVISED AND ENLARGED WITH
AN ILLUSTRATED KEY TO THE GENERA

by JOSEPH A. CUSHMAN

viii + 480 pages, 78 plates, 8 text figs.

PRICE: \$6.00*

ORDER FROM:

Harvard University Press, Cambridge, Mass., U. S. A.

*Postage paid on orders accompanied by remittance.