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UNITED STATES DEPARTMENT OF THE INTERIOR

**NOTES ON FOSSILS
FROM THE EOCENE OF THE
GULF PROVINCE**

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Professional Paper 193—B

NOTES ON FOSSILS FROM THE EOCENE OF THE GULF PROVINCE

- I. THE ANNELID GENUS *TUBULOSTIUM*
II. THE GASTROPOD FAMILIES CASSIDIDAE,
FICIDAE, AND BUCCINIDAE

BY
JULIA GARDNER

Shorter contributions to general geology, 1938-39

(Pages 17-44)



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NOTES ON FOSSILS FROM THE EOCENE OF THE GULF PROVINCE

By JULIA GARDNER

ABSTRACT

The genus *Tubulostium* has been in need of clarification, and as a contribution toward this end four species from the Eocene of the Gulf Province are described. It is concluded that the genus is probably to be placed with the annelids. The generic name is dubious but is retained until a broader study can be made. Of the Cassididae, species belonging to *Galeodea* and *Sconsia* are described; of the Ficidae, species belonging to *Priscoficus*, *Perissolax*, and *Ficus*; of the Buccinidae, the new genus *Bolis*. These forms have a considerable geographic distribution and rather short stratigraphic range and are therefore valuable in wide correlation of deposits.

INTRODUCTION

By virtue of a grant from the Penrose Bequest of the Geological Society of America I have been enabled to make certain studies on the Tertiary faunas of north-eastern Mexico that supplement previous work on the faunas of other parts of the Atlantic and Gulf provinces. The Society has kindly permitted me to abstract these notes from a larger paper, now completed. I wish to acknowledge my indebtedness and to express my gratitude to the Council of the Geological Society of America.

Tubulostium is presented in the hope that new material may clarify the obscure relationships of this group of forms.

Representatives of the Cassididae, Ficidae, and Buccinidae are offered, which are of interest because of their wide geographic and relatively narrow geologic range. These families include, for the most part, species of at least moderate dimensions and distinctive aspect, not readily overlooked in collecting. Generalizations upon their occurrence can for that reason be made with more confidence than assumptions based upon the occurrence of small and inconspicuous forms. A new genus referred to the Buccinidae is notable biologically because of its distinctive aspect and geologically because of the narrow stratigraphic zone to which it is apparently confined.

No attempt has been made to cite complete synonymies in either part of this paper.

The species *Galeodea (Gomphopages?) millsapsi*, described on page 26, is to be attributed to Prof. John Magruder Sullivan, of Millsaps College, Jackson, Miss., and the present author jointly, and is included here through the kindness of Professor Sullivan.

I. THE ANNELID GENUS TUBULOSTIUM

The name and the systematic position of certain small shelly planospiral or nearly planospiral tubes

with a tangent apertural extremity have never been stabilized. Such an end is not gained in this paper, but an attempt is made to assemble references pertinent to the genus and to survey the species reported from the Tertiary of the Gulf province. I acknowledge with gratitude the interest and cooperation of Dr. T. H. Withers, of the British Museum, who has perhaps indicated the proper placement of this obscure group.

Genus TUBULOSTIUM Stoliczka

July 1860. ?*Moerchia* Mayer, Description d'un genre nouveau de Protopodes: Jour. conchyliologie, 2d ser., vol. 4, p. 308. Description founded on *Solarium nysti[i]* Galeotti, 1837, though *Serpula turbinata* is also included. "J'ai étudié les caractères du prétendu *Solarium* de Galeotti, et me suis assuré qu'il constituait un genre nouveau dans l'ordre des Protopodes. Je me permets de dédier ce genre à mon éminent collaborateur au Journal de conchyliologie, M. Moersch." The genotype is a low cone with a subcircular or cylindrical aperture and all the whorls (about 4) visible on both the apical and umbilical surfaces. It has the aspect of some of the vitrinellids.

Not *Moerchia* A. Adams, Annals and Mag. Nat. History, ser. 3, vol. 5, p. 301, April 1860.

April 1861. *Burtinella* Mörch, Review of the Vermetidae: Zool. Soc. London Proc. for 1861, p. 147. Original list includes *Trochus contrarius* Schröter, *Solarium nystii* Galeotti, *Serpula turbinata* Philippi, *Vermicularia sowerbii* Mantell, *Vermicularia nodus* Phillips.

1868. *Tubulostium* Stoliczka, Geol. Survey India Mem., Palaeontologia indica, Cretaceous fauna of southern India, vol. 2, pp. 236-237. No type designation. Species cited: "Of these the *Serpulae* like *S. spirulaea* Lamarck will probably have to be placed in this genus, although I am for the present unable to compare good specimens of this species with our originals. The Jurassic *Verm[etus] tumidus* Sow[erby] is certainly a *Tubulostium*. The *Spirorbis leptostoma* Gabb, * * * from the American Tertiaries, would seem to belong also to this genus; and several others may be found subsequently. The two new species from South India are *T. discoideum* and *T. callosum*."

1891. *Tubulostium* Whitfield, Observations on some Cretaceous fossils from the Beyrût district of Syria: Am. Mus. Nat. History Bull., vol. 3, p. 424, pl. 9, figs. 15, 16. Under *Tubulostium rugosum* Whitfield: "This species closely resembles the type species of *Tubulostium*, *T. discoideum* Stoliczka, Pal. indica, vol. 2,

p. 240, pl. 18, figs. 20-25, in its general appearance except for the rugose character of the surface markings."

1904. *Tubulostium* Stoliczka. Rovereto, Contributo allo studio dei Vermeti fossili: Soc. geol. italiana Boll., vol. 23, p. 74. No type designation, but *Serpula spirulaea* Lamarek is referred definitely to *Tubulostium* and is considered, though incorrectly, a form apart in that it is the only species of the original list to which, according to Rovereto, the phrase *testa libera* is pertinent. *Vermicularia bogneriensis* Sowerby is referred to *Tubulostium*, and its relationship to other species of the restricted group is discussed.
1912. *Tubulostium* Stoliczka. Cossmann, Essais de paléontologie comparée, vol. 9, p. 140. Considered a synonym of *Burtinella* Mörch, 1861, but mention of a genotype is made ("Stoliczka a créé *Tubulostium* (G.-T.: *Serpula spirulaea* Lk.) pour le facies trochiforme de *Burtinella*").
1926. *Tubulostium* Stoliczka. Doncieux, Catalogue descriptif des fossiles nummulitiques de l'Aude et de l'Hérault, pt. 2, fasc. 3, Corbières septentrionales: Univ. Lyons Annales, n. ser., fasc. 45, p. 4 (as subgenus of *Vermetus*). No generic discussion but "*Vermetus* (*Tubulostium*) *angulosus* Chenu," abundant from the Sparnacien to the top of the middle Lutetien, is very fully discussed and fully figured.

There is some difficulty in fixing the Lamarekian *Serpula spirulaea*,¹ the type designated by Cossmann. Lamarek cites "Le Datin?" of Adanson² and under "Habite", "Fossile des environs de Bayonne et de Montbart." The Recent Senegalese shell is clearly of a group distinct from that of *Tubulostium discoideum* Stoliczka and *Spirorbis leptostoma* Gabb. There is, however, such a shell in the Eocene of southern France which has been accepted as *Serpula spirulaea*. Stoliczka's other species of *Tubulostium*, *T. callosum*, is a turbinated form similar to those referred to *Burtinella*.

Whether or not *Burtinella* is congeneric with *Tubulostium* must be decided by one familiar with the annelids. *Burtinella* Mörch³ replaced the preoccupied *Möerchia* Mayer.⁴ Mayer's description was founded upon *Solarium nystii* Galeotti, 1837, which may become the type by original designation. *Serpula turbinata* was also discussed but was considered a probable synonym of *Solarium nystii*. The genotype of *Burtinella* is a low cone with a subcircular or cylindrical aperture and all of the whorls visible on both the apical and the umbilical surfaces.

As a matter of fact, it is doubtful whether either *Tubulostium* or *Burtinella* is in good standing.

Certain characters—the inner calcareous tube, the lack of symmetry, and the mode of attachment of the early whorls—seemed so unlike those of any recognized gastropod that I sent some examples of our western Gulf species to Dr. T. H. Withers, of the British

Museum, asking him to compare them with Stoliczka's material and requesting his opinion upon the generic identity of *Tubulostium discoideum* and *T. callosum*. His word is the latest upon the systematic position of the group:

If these forms are to be differentiated from the genus *Serpula*, then it does seem that *Tubulostium* Stoliczka (1868) is not a valid name, for the forms included in it are no different from those included by DeFrance, 1827, Dictionnaire des sciences naturelles, vol. 46, p. 322, in *Rotularia* (*Rotularia*) *complancta* DeFrance (*Serpula spirulaea* Lamarek, Histoire naturelle des animaux sans vertèbres, vol. 5, p. 366, 1818). *Vermicularia* is even an earlier (1822) name, but the forms are not flat or disklike, for the tube is invariably uncoiled for some distance from the aperture.

But, Dr. Withers continues, "without surveying the whole of the fossil Annelida" it will be impossible to determine their relationships.

As such a survey is entirely beyond my capacity or the scope of this paper, *Tubulostium* is here used for a certain compact group with recognizable shell characters and with world-wide distribution in the late Cretaceous and early Tertiary. In this report it includes small, shelly tubes coiled in a single or close to a single plane, irregular, and attached during the initial growth stages. The tubes may be and in many species are flattened upon one or more of the surfaces; the section of the exterior in some species is rudely quadrate, although the interior is rounded. The outer surface is corrugated in many species and corded at the peripheral angles, but with no definite sculpture pattern. The apertural extremity is free from the body wall and may be tangent to it for an appreciable distance. The inner wall of the aperture is circular in most of the observed material.

Although the systematic position of the group may be only vaguely defined stratigraphically, it is surprisingly coherent, and the sharpness of the stratigraphic limits is in itself evidence of a biologic entity. *Tubulostium* is for the most part a Cretaceous and early Tertiary group. There are a number of interesting factors in the distribution, among them the wide occurrence of *Tubulostium* south of the Equator during the Upper Cretaceous and the apparent absence of *Tubulostium* in the Paris Basin, although it is present in the London clay and in southern France.

I am greatly indebted to Dr. Charles W. Carter, of the Geological Survey of the State of Illinois, who has made the sections and the accompanying line drawings and has assisted me in the arrangement of the material.

Tubulostium mcglameryae Gardner, n. sp.

Plate 6, figures 11-13

Tubes small for the group, discoidal, coiled in a single or approximately a single plane. Area of attachment small; the inner tube unprotected initially, asymmetrically twisted or coiled. Adult tube performing about three complete volutions; the whorls bicarinate, an additional layer of dense grayish calcite en-

¹ Lamarek, J. B. P. A. de Monet de, Histoire naturelle des animaux sans vertèbres, vol. 5, p. 366, 1818.

² Adanson, Michel, Histoire naturelle de Sénégal, p. 165, pl. 11, figs. 4a, 4b, 1757.

³ Mörch, O. A. L., Review of the Vermetidae, Zool. Soc. London Proc. for 1861, pt. 2, p. 147.

⁴ Mayer, Carl, Description d'un genre nouveau de Protropodes: Jour. conchyliologie, 2d ser., vol. 4, p. 308, July 1860 (not *Möerchia* A. Adams (Annals and Mag. Nat. History, April 1860).

veloping the chalky inner tube. Outer whorls more or less overlapping the inner, the shell bulging in front of the sutures on both the upper and the lower surfaces; slightly concave directly in front of the peripheral keel. Periphery vertical, the upper and lower keels similar and sharply corded. Free terminal portion of the tube short and tangent to the preceding whorl. Aperture circular. Surface sculpture restricted to a roughening of the shell.

Dimensions of holotype: Height, 1.5 millimeters; diameter, 5.3 millimeters; length of free tangential tube, 2.6 millimeters.

Holotype and paratype in cross section: U. S. Nat. Mus. 496015.

Type locality: 3 miles south of Estelle, Wilcox County, Ala. Sucarnoochee clay of the Midway group.

I have the pleasure of naming this species in honor of Miss Winnie McGlamery, of the Paleontological Laboratory of the University of Alabama, who was the first to bring it to my attention. It is the smallest and the most regularly formed of the species under consideration. Some of the individuals referred to *Tubulostium tobar* Gardner from the Midway group of Texas approach closely the Midway species from Alabama, but they are larger and more crudely formed.

Tubulostium mcglameryae has been certainly recognized only in the vicinity of the type locality. The range of variation in these forms is not very well known, and possibly these two Midway species may be only varietally distinct.

A species that packs the limy sands of Fee 2, T. 6 N., R. 1 E., Hinds County, Miss., at a depth of 2,469 to 2,472 feet may be referable to *Tubulostium mcglameryae*. The characteristic stratigraphic position of both *T. mcglameryae* and an unnamed, possibly specifically identical species from Caldwell County, Tex., is within the lower 4 feet of the basal Midway. *Tubulostium tobar*, however, occurs in both the lower and the upper parts of the Midway in southern and central Texas.

***Tubulostium horatianum* Gardner, n. sp.**

Plate 6, figures 1-3, 7

Shell small, solid, compressed, discoidal or low turbinata in outline, probably adnate in youth. Earliest and most elevated portion of tube relatively very small and only traces of it preserved, probably because of the very thin shell unprotected by the denser and much heavier outer layer developed on the succeeding whorls. Adult portion of shell of two or three rapidly and regularly increasing whorls coiled approximately in a single plane. Whorls in contact as far as the short, constricted apertural portion, which is devoid of sculpture, except growth lines, and terminates in a small circular orifice. Surface of adult shell sharply though minutely wrinkled, the ridges crowded and fairly regular in spacing and elevation upon the convex outer

portion of the whorl, broken, bifurcating, occasionally diastomosing on the compressed portion in front of the suture and directly in front of and behind the sharply defined and corded periphery. Outer volution largely enveloping the preceding, but a small central depression suggesting an umbilicus usually visible.

Dimensions of holotype: Height, 3.0 millimeters; maximum diameter, 10.5 millimeters; diameter at right angles to maximum diameter, 8.3 millimeters.

Holotype: U. S. Nat. Mus. 483777.

Type locality: U. S. G. S. station 5142, 1½ miles west of Sabinetown, Sabine County, Tex. Wilcox formation.

Tubulostium horatianum is remarkable for the rugosity of the small shell, for the prominent corded periphery and the brevity of the free apertural portion of the tube. The vertical section (fig. 1) indicates the elevation of the first whorls and the single plane in which the later whorls are coiled.

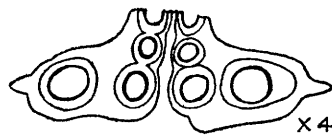


FIGURE 1.—*Tubulostium horatianum* Gardner, n. sp., cross section of the tube; Wilcox formation, 1½ miles west of Sabinetown, Sabine County, Tex.

***Tubulostium leptostoma* (Gabb)**

Plate 6, figures 4-6, 8-10, 14, 15

1860. *Spirorbis leptostoma* Gabb, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 4, p. 385, pl. 67, fig. 36 (by error in text "fig. 41").

1931. *Spirorbis (Tubulostium) leptostoma* Gabb. Renick and Stenzel, Texas Univ. Bull. 3101, p. 105, pl. 7, fig. 29. Referred to "Annelida-Chaetopoda."

Discoid: Whorls three, carinated and partly enveloping the preceding whorl; mouth contracted, circular and advanced at a tangent from the subjacent whorl; surface marked by irregular undulating transverse striae.

Dimensions.—Diameter 0.3 inch.

Locality.—Common from Wheelock and found in Caldwell County.—Gabb, 1860.

Shell small, solid, discoidal or low turbinata in outline, adnate centrally in some if not in all individuals. Earliest observed portion of shell a very thin calcareous tube, smooth except for faint growth striae, not regularly coiled but doubled back upon itself without symmetry; a denser outer layer of shell developed at a diameter of 1 to 2 millimeters, this shell or callus fusing between the contiguous portions of the tube and making a common body wall. A few, usually four or five fairly regular whorls, the first two or three low turbinata, the last two coiled in the same plane. The final portion of the tube free from the final whorl and tangent to it; constricted at the extremity into the circular aperture. Growth sculpture heavy upon the final whorls, the periphery usually sharply bicarinate.

Gabb's species occurs, for the most part, in a glauconitic sandstone, in a badly weathered state, and it is

difficult to determine the essential characters and the range in variation. It seems improbable that there is more than a single species represented at Moseleys Ferry. The early whorls, when preserved, though they rarely are, are turbinate. Remnants of the thin, unprotected, unadorned, and irregularly coiled or folded tube are preserved in a few of the specimens. The dense callus developed when the shell reached $1\frac{1}{2}$ or 2 millimeters in diameter masks the inner tube. The vertical section (fig. 2) indicates the pattern of the coiling of the later whorls. It is a much more smoothly elevated spiral than that of *Tubulostium horatianum* Gardner, in which the axis of the earlier turns approaches the vertical and that of the later approximates the horizontal. The external sculpture of the fresh shell probably did not differ very greatly from

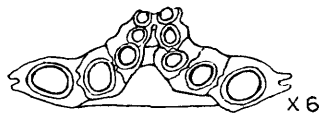


FIGURE 2.—*Tubulostium leptostoma* (Gabb), cross section of the tube; Cook Mountain formation, Moseleys Ferry, Brazos River, near Stone City, Brazos County, Tex.

that of the Sabine River species; it was a little coarser, apparently, and perhaps not so deep. In most of the Moseleys Ferry individuals there is no fresh surface. The periphery on well-preserved specimens is bicarinate, one at the upper margin of the whorl, the other at the lower margin, and the area between them concave. In many of the weathered specimens no trace of these nor of the sculpture remains.

The species is probably restricted in its stratigraphic range to the horizon directly above the Moseley limestone of Renick and Stenzel, a horizon within the lower 100 feet of the Cook Mountain formation of the Brazos River Valley.

Tubulostium cortezi Gardner, n. sp.

Plate 6, figures 16-19

Shell moderately compressed, discoidal or low turbinate, rather small but heavy and crude. Early adnate portion of shell relatively large but known only from the merest fragments still retained on a few individuals. Adult portion of tube shielded by dense callus, performing between one and two visible turns, the final whorl largely enveloping the preceding and dextral or sinistral to the attached area. Apertural portion produced tangent to the shell, occasionally, as in the holotype, to a length as great as the diameter of the disk. Both upper and lower surfaces of disk rudely furrowed, the portion near the suture convex and cut off from the flattened outer portion, which simulates a wide peripheral flange; commonly an abrupt change in the sculpture pattern on the free portion of the tube, which may record only the growth lines and heavy resting stages and may be polygonal in outline; the free part of the

tube subject to breakage, the fragment often suggesting *Hamulus* in outline and texture. A pronounced thickening of the shell frequently observed at the angle between the disk and the tangent tube. A small central depression suggesting an umbilical opening usually visible.

Dimensions of holotype: Height, 3.7 millimeters; maximum diameter, 9.2 millimeters; diameter at right angles to maximum diameter, 9.8 millimeters; length of free portion of tube, 9.0 millimeters.

Holotype: U. S. Nat. Mus. 497155.

Type locality: U. S. G. S. station 13630, exposures along north edge of gravel scarp near Tamaulipas-Nuevo León State line and east of road from Presa Nueva to Estacas, Nuevo León, Mexico.

Tubulostium cortezi exhibits several characters by which it may be separated from the other *Tubulostium*s of the Eocene of the western Gulf—the relatively large attachment area, the crudeness of the shell, the irregular surface of the disk, the much-produced free apertural portion, and the tendency to develop irregular bumps and depressions upon it. Like others of the genus, it is abundantly represented at the type locality.

The determination of *Tubulostium* occurring in abundance at Alabama Crossing on the Trinity River, 10 miles west of Porters Springs, Houston County, Tex., has not been satisfactorily made. The fossils probably represent a new species, resembling *T. cortezi* in the surface contours and the extended tangential extremity but smaller and much more compressed. No very good vertical sections were made of either species, but no critical difference was noted in the imperfect ones that were cut. It is possible that the *Tubulostium leptostoma* (Gabb) of Renick and Stenzel, from Cedar Creek, 3.25 miles northeast of Edge, is specifically identical with the Alabama Crossing form. At least, there are such specimens in the National Museum collections from the San Antonio road 1 mile south of the intersection with the road from Edge, at the Robertson-Brazos County line. This horizon is distinctly higher than that at Alabama Crossing or that from which *Tubulostium leptostoma* was recovered. Renick and Stenzel report *T. leptostoma* from only a single horizon on the Brazos River—that directly above their Moseley limestone, which Stenzel considers the top of his Stone City beds.⁵ It is possible that *Tubulostium* may have some value as an evidence of a depositional break. Both *T. meglameryae* Gardner and *Tubulostium* sp. from Caldwell County, Tex., occur at the base of the Midway; *T. leptostoma* no more than 3 feet above the Moseley limestone, in a bed which Stenzel considers the basal conglomerate of the Crockett marl of E. A. Wendlandt and G. M. Knetel; and *T. cortezi* directly above the *Ostrea lisbonensis* zone at the top of the Mount Selman of northeastern Mexico.

⁵ Stenzel, H. B., A new formation in the Claiborne group: Texas Univ. Bull. 3501, pp. 267-279, 1936.

II. THE GASTROPOD FAMILIES CASSIDIDAE, FICIDAE, AND BUCCINIDAE

Family CASSIDIDAE

The Cassididae, the "helmet shells," like the Ficidae, are, with the exception of an *Oniscia* from the Upper Cretaceous of India described by Stoliczka, restricted in time to the Tertiary and post-Tertiary faunas and in space to the tropical and subtropical to warm-temperate waters. They are, as a rule, rather thick and heavy, with low, broad spires, a relatively large and inflated body, with or without varices, and a more or less conspicuous development of callus on each side of the aperture.

Genus GALEODEA Link

1807. *Galeodea* Link, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, vol. 3, p. 113.

Type by monotypy: *Buccinum echinophora* Linnaeus. Recent in the Mediterranean.

Wrigley, in a very excellent paper,⁶ writes that the genotype of *Galeodea* is happily chosen, "for it is notoriously variable from long to short forms and between very nodose varieties and those with faintly denticulated or even simple carinae. This great variation prescribes a latitude in defining other species of the genus and checks the creation of unnecessary subgenera or sections."

Cossmann⁷ used *Cassidaria* Lamarck, 1812, maintaining that *Galeodea* was preoccupied by Olivier, 1791, and Bolten, 1798. Both Olivier and Bolten, however, used the form *Galeodes* rather than *Galeodea*, so that the name *Galeodea* was still available in 1807. *Galeodaria* Conrad (monotype, *Galeodaria petersoni* Conrad) and *Doliopsis* Conrad (monotype, *Doliopsis tricarinatum* Conrad), possibly a nomen nudum, both published without other description than the citation of the type,⁸ may be included within the confines of *Galeodea*.

The western Tertiary representatives are monographically treated in papers by Schenck⁹ and Miss Tegland.¹⁰

Galeodea covers the helmet shells of moderate size and thickness, with relatively few whorls, six to eight in the specimens of the genotype observed, including the small paucispiral naticoid protoconch. The whorls of the spire are low and increase rapidly in diameter; the body whorl is relatively very large, inflated, and girdled with a few prominent spiral bands that may or may not carinate the whorl and are, at least on the posterior portion of the body, usually nodular. The nodes are not remnants of an axial sculpture and, to

⁶ Wrigley, Arthur, English Eocene and Oligocene Cassididae, with notes on the nomenclature and morphology of the family: Malacol. Soc. London Proc., vol. 21, pp. 108-130, pls. 15-17, 1934.

⁷ Cossmann, Maurice, Essais de paléontologie comparée, vol. 5, p. 129, 1903.

⁸ Conrad, T. A., Catalogue of the Eocene and Oligocene Testacea of the United States: Am. Jour. Conchology, vol. 1, p. 26, 1865.

⁹ Schenck, H. G., Cassididae of western America: California Univ., Dept. Geol. Sci., Bull., vol. 16, no. 4, pp. 69-98, pls. 12-15, 1 text fig., 1926.

¹⁰ Tegland, N. M., The gastropod genus *Galeodea* in the Oligocene of Washington: California Univ., Dept. Geol. Sci., Bull., vol. 19, no. 18, pp. 397-434, pls. 59-65, 1931.

quote Wrigley, their position on the successive spirals is commonly "staggered." A secondary spiral liration may or may not be developed. The terminal varix is prominent, and traces of former terminal varices may or may not be retained. Wrigley noted that, when present, they occur at intervals of 180° or 270°. The inner lip is widely reflected over the body wall and in the genotype is free from it at the base of the body. Rugosities in the form of denticles or lirae are usually developed upon the inner labral surface and the pillar and parietal walls. The anterior canal is very narrow, the fasciole compressed and, in the genotype, curved sharply backward.

Galeodaria Conrad, from the Jackson of Mississippi, is a smaller, thinner shell than *Galeodea echinophora* but is closer to *Galeodea* s. s. than the tricarinate and bicarinate members of the group, with long anterior canals, that are widely distributed in the lower Tertiary. These have been segregated under the section *Mambrinia*.

The distribution of *Galeodea* in time and space is remarkable. None of the records of the genus from the pre-Tertiary have been verified. *Morio* (*Sconsia*) *tuberculatus* Gabb, described presumably from the Cretaceous of California, occurs in fact in the Eocene. *Cassidaria cretacea* Müller, described from the Aachener Kreide of western Germany, was determined by Holzappel¹¹ to be an *Acteonella*. In any case, the holotype was an internal mold, which, according to Wrigley,¹² cannot be found. *Sconsia alabamensis* Gabb, 1864, is not a *Galeodea*. There is no record of the genus in the earliest Tertiary (Paleocene), but in the remaining lower Tertiary the distribution is that commonly interpreted as characteristic of a long established race. In the lower and middle Eocene and in the Oligocene closely related species are widely distributed in the temperate and warmer deposits, though nowhere abundantly represented. The group includes *Galeodea koureos* Gardner, from the Wilcox of the eastern and western Gulf; possibly *Cassidaria dubia* Aldrich, from the Wilcox of Woods Bluff, Ala.; *Cassidaria planotecta* Meyer and Aldrich, the type of the section *Mambrinia*, from the Lisbon formation (Claiborne) of Mississippi; *Cassidaria brevidentata* Aldrich, from the Red Bluff (basal Oligocene) of Mississippi; *Galeodea gallica* Wrigley and the subspecies *clarendonensis*, from the London clay; *Cassidaria enodis* Deshayes from the upper Bracklesham beds of England and the Lutetian of the Paris Basin; a species from Kressenburg, in southern Bavaria; a species from the Bordeaux Basin; *Cassis postalensis* Oppenheim, from the Monte Postale beds of northern Italy; and *Galeodea sutterensis* Dickerson and *Galeodea susanna* Schenck, from the California section, the one from the Meganos and the other from the Domengine. In the later Tertiary and in the

¹¹ Holzappel, Eduard, Die Mollusken der Aachener Kreide: Palaeontographica, vol. 34, p. 82, pl. 7, figs. 11, 14-16, 1888.

¹² Wrigley, Arthur, op. cit., p. 128, footnote.

Recent seas, *Galeodea* is for the most part Mediterranean in distribution, although there are two species in the Orient. *Galeodea echinophorella* Hirase, a Recent species described from Japan, is closer to the lower Tertiary forms than *G. leucodoma* Dall, the only other oriental *Galeodea* of which I have record. *Cassis coronadoi*, rare in the Recent West Indian faunas, has

part, nodes running transversely, with another finer nodulous line above; center of body whorl with a strongly raised line, a lesser one above, with fine close-set ones between; below the center are four raised lines with finer ones between; beak nearly straight, the outer lip meeting it at an acute angle; aperture ovate, the revolving lines passing into it; labium with rugose plaits below, upon a reflected callus; labrum reflected, with strong plaits in pairs on the edge. Length, $\frac{3}{10}$ of an inch; breadth, $\frac{1}{10}$.

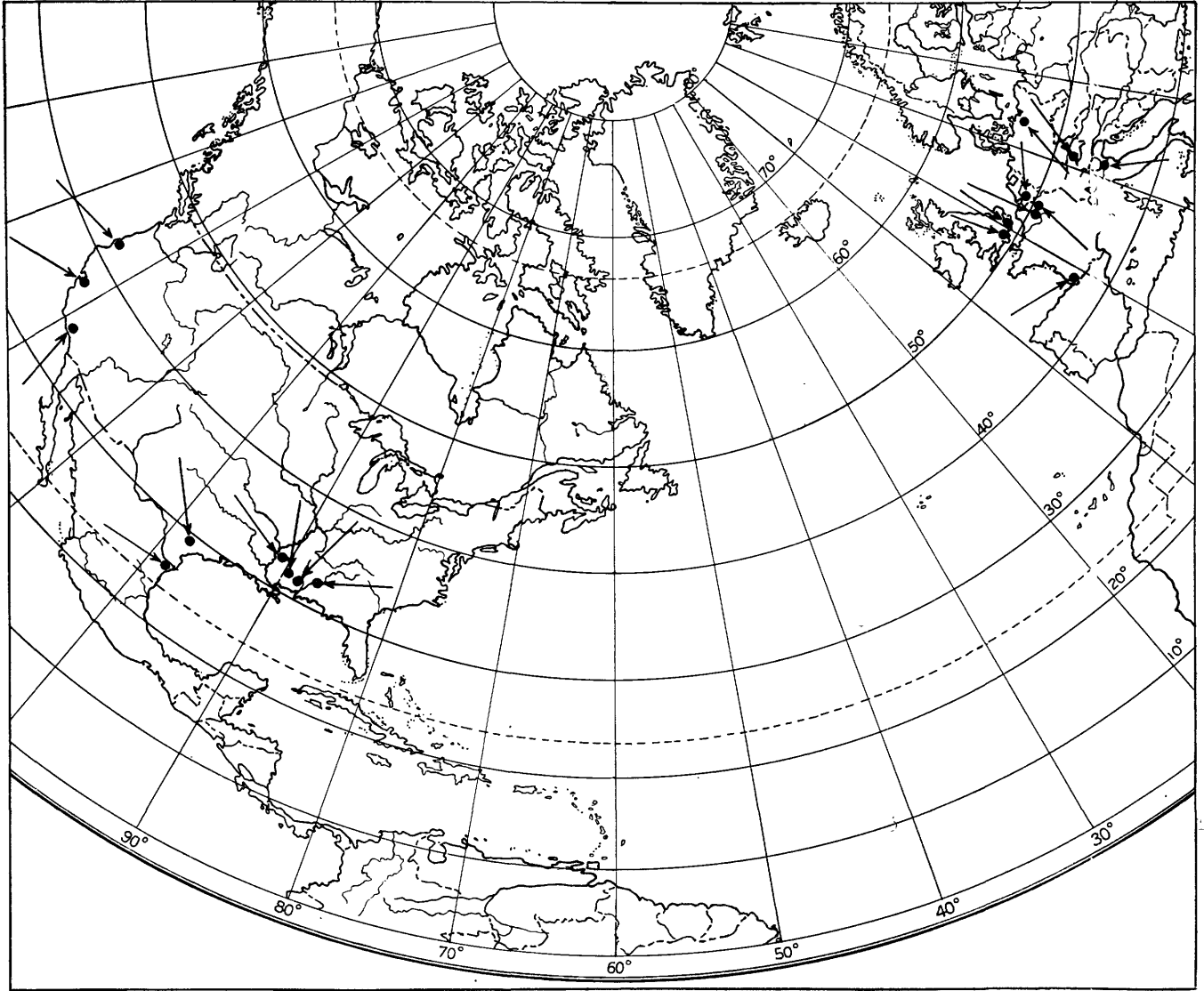


FIGURE 3.—Map showing distribution of *Galeodea*.

been referred to *Galeodea*. It is a thin shell, more than 12 centimeters high, with the anterior notch of a *Cassis*.

The geographic distribution of *Galeodea* is shown in figure 3.

***Galeodea? shubutensis* (Aldrich)**

1885. *Cassis* (*Semicassis*) *shubutensis* Aldrich, Cincinnati Soc. Nat. Hist. Jour., vol. 8, p. 147, pl. 2, figs. 5a, 5b.

1886. *Cassis* (*Semicassis*) *shubutensis* Aldrich, Alabama Geol. Survey Bull. 1, p. 33, pl. 2, figs. 5a, 5b.

Shell rather thin, oblong-oval; whorls six, convex, the surface with revolving lines; suture distinct; apex pointed; spire elevated, the first three whorls nearly smooth, the next two slightly carinate; body whorl with a sharp nodulous line on the upper

Localities: 200 yards north of railroad bridge below Shubuta, Miss., and also at Red Bluff.

Differs from all other forms by its prominent lines, absence of any varices, only two nodulous lines, and size.—Aldrich, 1885.

Both the generic determination of *shubutensis* and the specific determination of our Mexican material are dubious. The species does not show the strong backward twist to the extremity of the canal that characterizes *Galeodea*, but possibly the few examples observed of this rare form had not reached full maturity. Even so, it has too much in common with *Galeodea* (*Galeodaria*) *petersoni* Conrad to be isolated generically. The Mexican specimens are probably distinct, at least sub-

specifically, but none of the apertures are perfect, and there is a possibility of finding better material to serve as types.

The Mexican specimens seem to run smaller than *shubutensis* from Mississippi, with lower spires and a more decided sculpture pattern. The nodes upon the shoulder spiral are more prominent and the body primary spirals more elevated. The number is constant, however, in the Mexican species and in that from Mississippi, and the character of the secondary threading is similar in the two forms. The labral varix and the parietal callus are heavier in the smaller form. The canal has not been preserved on any of the four Mexican specimens.

The species is known from a single locality, U. S. G. S. station 13510, 3,400 feet south and 1,000 feet east of Rancho la Copa, Zacate, Nuevo León, Mexico. The horizon is probably the same or close to that from which *shubutensis* was recovered.

Galeodea? sp.

A species, known only from fragmentary material, in the tricarinate body, the absence of axial sculpture, and the character of the spiral sculpture, recalls *Galeodea* (*Galeodaria*) *petersoni* Conrad, the genotype of his *Galeodaria*, described from the Jackson of Jackson, Miss. The aperture is not preserved on any of the four specimens, but the fragments indicate a longer, less twisted canal than that of *petersoni*. The Mexican species are of Oligocene age and were collected at U. S. G. S. station 13581, southeast from Rancho Gigante, Escondido, Mendez, Tamaulipas, Mexico; and U. S. G. S. station 13539, south of Rancho Miralejas, Carlos Cantú, Nuevo León, Mexico. The age of the Nuevo León species is probably middle Oligocene; that from Mendez, Tamaulipas, may be younger. Possibly these fragments may indicate the persistence of the *petersoni* stock in the Oligocene of the western Gulf.

Galeodea? sp.

Incomplete specimens with the apertural characters not preserved but suggesting in outline and general sculpture pattern "*Galeodia*" *tricarinata* Conrad from the Vicksburg have been recovered from three localities in the Oligocene of northeastern Mexico. The Mexican species is probably not identical with that from Mississippi, for the number of shoulder spirals is lower, but the affiliation seems sufficiently close to be significant. *G. tricarinata* Conrad is a larger form than *G. shubutensis* Aldrich from the Red Bluff, the early whorls are buccinoid in outline, and the shoulder ramp is not developed in the type specimen until the final whorl of the spire. The sculpture upon the early whorls is evenly and delicately reticulate in *tricarinata*, and the liration upon the shoulder and between the keels is sharper and more regular than it is in *shubutensis*.

The undetermined species has been recognized from the following localities in the Oligocene of northeastern Mexico: U. S. G. S. station 14147, NE. from Rancho Palo Blanco, Carlos Cantú, Nuevo León, Mexico; U. S. G. S. station 14145, 10 or 20 meters deep in dug well at Rancho los Ebanitos, Carlos Cantú, Nuevo León, Mexico; and U. S. G. S. station 13582, south-east from Rancho el Tigre, Mendez, Tamaulipas, Mexico.

Section MAMBRINIA Gardner, n. sec.

Type: *Cassidaria planotecta* Meyer and Aldrich. Lisbon formation (Claiborne) of the Gulf province.

The section *Mambrinia* is created to include a group of species of the genus *Galeodea* intimately related biologically, restricted in their known stratigraphic range, and rather widely distributed geographically. The characteristic features of the shell are the bicarinate or obscurely tricarinate outline of the body whorl, the keels outlined by noded spirals, the remaining spiral sculpture usually fine and simple, only a single varix and that terminal, and a long, slender anterior canal produced in the plane of the aperture but not of the axis of the body and spire.

The group has been recognized in the Wilcox of the eastern and western Gulf, the Meganos of California, and the London clay of England; in the upper part of the lower Claiborne of the United States and of Mexico; in the Domengine of the western Tertiary, the Lutetian of the Paris Basin, and the Bracklesham beds of England; and in the Red Bluff of Mississippi and the Oligocene of Germany.

Galeodea (*Mambrinia*) *koureos* Gardner, n. sp.

1899. *Cassidaria brevidentata* var. Harris, Bull. Am. Paleontology, vol. 3, p. 67, pl. 8, fig. 18.

Shell of moderate dimensions, not very heavy for the group. Spire moderately high, the early whorls of the conch broadly rounded, the later ones broadly shouldered and carinate a little behind the suture line. Body whorl highly inflated, broadly and somewhat obliquely shouldered. Protoconch not preserved in any of the available material. Four or five whorls of the conch still retained. Ornamentation spiral. The posterior of the three major spirals the most prominent, outlining the periphery and the outer margin of the shoulder; traceable to the apex of the imperfect shell, though it does not carinate the earlier whorls; sharply crenulated with 14 nodes. Medial spiral girdling the body from the posterior extremity of the aperture to the labrum, separated from the anterior and medial spirals by slightly concave areas, placed a little closer to the anterior than to the posterior, obscurely crenulated, the nodes irregular and not in line with those of the posterior spiral, 11 in number. Anterior spiral at the base of the body, not so strong as the two in front of it and not regularly noded. A single relatively sharp,

usually beaded threadlet midway between the peripheral spiral and the posterior suture. Entire surface very finely and closely lirae, the lirae overridden by the sharp and crowded incrementals. Aperture moderately wide, slightly oblique. Outer lip varicose, not overridden by the spirals, thickened within and without, the constituent lamellae visible on the outer surface, the edge sharp and the inner surface smooth except for a thickening of the shell, too obscure to be called a denticle, opposite the posterior spiral and at the entrance to the anterior canal. Inner margin of aperture sigmoidal. Parietal glaze so thin that the medial and anterior spirals may be traced through it but so dense in texture that it stands free from the body wall at the base. Anterior fasciole narrow, compressed, finely threaded, twisted sharply backward and to the left of the aperture, probably not emarginate at its extremity, although this is not preserved.

Dimensions of holotype: Height, 30 millimeters; greatest diameter, 20.0 millimeters.

Type material: Holotype, U. S. Nat. Mus. 484078, from U. S. G. S. station 3098, Bells Landing, Alabama River, Monroe County, Ala. Paratype: U. S. Nat. Mus. 484079, from U. S. G. S. station 13661, west of Los Aldamas, Nuevo León, Mexico.

Galeodea (Mambrinia) koureos bears slight resemblance to *C. brevidentata* Aldrich from the Red Bluff but is a well-characterized species that seems to have been rather widely distributed if not abundantly represented in the lower part of the Wilcox. An imperfect specimen was collected at Pendleton Ferry, on the Texas side of the Sabine River, at a horizon that has been correlated with the Tusahoma. This individual shows the three characteristic body spirals.

The Mexican species shows no characters by which it can be separated from the forms from Bells Landing. All the forms are of about the same size and are rather thin. The other *Galeodea* from the Wilcox of Mexico, described below, is a third larger, the crenulation of the posterior spiral appears earlier upon the spire, and the body is bicarinate with no trace of the third major spiral preserved on any of the numerous examples. The specimens of *Galeodea (Mambrinia) koureos* give evidence of maturity, so that it is not possible to account for the differences in size and sculpture by age.

Distribution in Mexico: Wilcox group, U. S. G. S. station 13661, west of Los Aldamas, Nuevo León, Mexico; (?) U. S. G. S. station 13671, near southwest end of presa on El Puerto-Cañada del Agua road, Nuevo León, Mexico.

Galeodea (Mambrinia) sp.

Plate 7, figures 3-5

Molds to which fragments of the sculptured shell are still adherent occur abundantly in the sandstones of the Indio formation in the vicinity of Rancho Blanco, Nuevo León. The molds indicate a relatively large

species, probably at least 50 millimeters high. The whorls are few and are wound so that the carinate periphery of the whorl is usually visible a little behind the suture line. The body is strongly bicarinate, with each of the keels bearing possibly 10 to 15 nodes that tend to alternate in position. There is no indication of a third keel on either the young or the very old specimens. Fragments of adherent shell indicate a fine liration, which probably covered the entire shell. The characters of the aperture are not preserved, but traces of a varicose outer lip are still retained on a few specimens. The canal is broken on all the individuals observed.

The absence of any indication of a third keel in front of the other two makes it improbable that these are conspecific with the species occurring in the Wilcox on the Rio San Juan. It is larger than any of the other Eocene forms recognized and in profile suggests a low-spined member of the group of *Levifusus trabeatus*.

Distribution: Wilcox group, U. S. G. S. station 13681, southwest of Rancho Blanco; U. S. G. S. station 13466, 4 kilometers north of estación Herreras, Nuevo León, Mexico.

Galeodea (Mambrinia) planotecta (Meyer and Aldrich)

Plate 7, figures 1, 2, 10, 15

1886. *Cassidaria planotecta* Meyer and Aldrich, Cincinnati Soc. Nat. History Jour., p. [43] (no printed pagination), pl. 2, fig. 14.

Spire very much flattened. Three and a half embryonic whorls form a subglobular nucleus. Adult whorls four. Body whorl with two carinas, the upper one carrying subspines. Surface covered with rather distant, elevated revolving lines. Inner lip spread over the body whorl. Columella irregularly tuberculated.

Newton.

The figure on the plate, though still representing a fragment, is restored from two specimens. The form is characterized by its flat spire.—Meyer and Aldrich, 1886.

The specimen figured by Meyer and Aldrich did not retain the long obliquely directed anterior canal. A much more perfect example was later collected from Indian Mound, sectioned by the Alabama & Vicksburg Railroad 3 miles east of Newton, Miss., a locality that has been renowned since Aldrich's day. It is highly probable that the collection studied by Aldrich and Meyer was made in that cut, the best and the best-known fossil locality in the vicinity of Newton.

The shell from Indian Mound figured in the present report includes two nuclear and four post-nuclear whorls. The first protoconchal turn is very small and largely submerged, the second much larger, broadly rounded, entirely smooth, and of a dull luster. The break between the nuclear and postnuclear turns is marked by a varicose resting stage, a change in the texture and color of the shell, and the initiation of about half a dozen fine equal spiral lirae, equally spaced, with the addition of two even finer lirae directly in front of the

suture line, which give a somewhat shouldered aspect to the whorl. The first whorl and the greater part of the second whorl of the conch are relatively high and broadly rounded and were probably included in the original description in the "subglobular nucleus." Near the end of the second turn of the conch the whorl rather abruptly flattens, and the spiral sculpture becomes more strong and less regular. No axial sculpture is developed, however, until the final turn. The body exhibits a broad, flat shoulder serrated with 12 spiny tubercles, which increase in strength toward the aperture. A second but less prominent series girdles the basal periphery. The tubercles in the second series are only eight, not spiny, and inclined to stagger the shoulder tubercles. The body between the shoulder and basal series is flattened or slightly concave. A spiral sculpture with secondaries intercalated with a fair degree of regularity is developed over the entire body. The base of the body is abruptly and obliquely constricted into the very slender canal. The outer lip is varicose, with a *Cassis*-like flare. The parietal wash is very heavy and stands free from the body wall in the umbilical area. A few irregular transverse wrinkles corrugate both the body and pillar callus. The throat and margin of the outer lip are smooth except for a single posterior fold, which marks off the posterior siphonal fasciole, and a similar fold at the entrance to the anterior canal. The canal is not far from half as long as the entire shell, produced in the plane of the aperture but not in the axis of the body and spire, with parallel and closely proximate margins.

Dimensions of figured topotype (?): Height, 43.5 millimeters; greatest diameter, 25.0 millimeters.

Figured topotype (?): U. S. Nat. Mus. 494958.

Locality: Indian Mound, 3 miles east of Newton, Miss., in cut of Alabama & Vicksburg Railroad.

There is no closely comparable American species.

The European *Galeodea enodis* (pl. 7, figs. 11, 12, 14), which *G. planotecta* resembles in general aspect, is tricarinate rather than bicarinate and differs further in the corrugation of the inner margin of the outer lip. The fragmentary Mexican material is a little more coarsely lirated than that from Mississippi, and the difference may prove to be something more than individual. With the exception of a single imperfect mold, the Mexican individuals come from the upper part of the Cook Mountain. The shell fragments adherent to the imperfect mold indicate a sculpture pattern differing slightly from that displayed by the individuals from the higher horizon.

The single mold to which reference has been made comes from the lower part of the Cook Mountain at U. S. G. S. station 13559, east of Dr. Coss, Zacate, Nuevo León, Mexico.

Distribution: Upper part of the lower Claiborne group, Indian Mound, 3 miles east of Newton, Miss.; U. S. G. S. station 13553, on road from La Paroda to

General Bravo, 2.7 kilometers west of Rancho Paroda, Carlos Cantú, Nuevo León, Mexico; U. S. G. S. station 13800, southeast from Rancho Magueyes and northwest from Arcebus on Rio San Juan, Mexico; (?) U. S. G. S. station 13535, southwest of Rancho Miralejas, Carlos Cantú, Nuevo León, Mexico; and (?) U. S. G. S. station 13984, southeast from La Presa No. 1, Tamaulipas, Mexico.

Subgenus **GOMPHOPAGES** Gardner, n. subgen.

Type: *Galeodea (Gomphopages) turneri* Gardner. Mount Selman formation, Bastrop County, Tex.

Shell of moderate dimensions, heavy, porcelaneous; the body relatively very large, embracing the spire, of which only the shoulders of a few broadly inflated spirally lirated whorls are visible. Body whorl bicarinate, the shoulder broad and outlined by a row of triangular tubercles, flattened in a vertical plane and inclined slightly away from the aperture. A basal series of similar though much less prominent spines in line with those that coronate the shoulder and united to them by low axials. Shell in front of the basal carina concave and compressed. Aperture irregular in outline, narrow posteriorly, expanding at the base of the body and constricted abruptly at the entrance to the canal. Aperture, except for the narrow opening into the canal, entirely surrounded by a heavy callus, padded so that the shell, aperture downward, rests upon a flat surface. Outer lip varicose, flattened at the margin, not dentate within but with a shallow depression corresponding to the shoulder keel; behind the depression a crude tubercle facing the heavy callus upon the inner wall, so that the aperture is constricted, doubtless for the extrusion of the posterior siphon. Callus widely reverted over the body wall and around the posterior commissure, the margin free from the wall at the base of the body. Inner margin of columellar wall rugose. Canal more than half the length of the aperture, compressed at right angles to the axis of the shell and bent obliquely backward and to the left; the margins of the canal parallel and proximate.

The shells of the subgenus *Gomphopages* are heavier and more chalky than those of *Galeodea* s. s. The shoulder tubercles are more prominent and show a characteristic flattening in the plane of the axis. The tubercles of the secondary series at the base of the body do not exhibit the characteristic "staggering" but are in line with the shoulder nodes and united with them by low, regular axial riblets. The anterior canal is broad, compressed and of no more than medium length.

The subgenus is known only from the subgenotype.

Galeodea (Gomphopages) turneri Gardner, n. sp.

Plate 8, figures 1, 4

Shell of usual dimensions for the group, unusually heavy. Spire very low, the apex scarcely rising above the reverted lip at the posterior extremity of the

aperture. Body widely shouldered, deeply serrate at the periphery and serrate but less deeply at the second carina which outlines the base of the body. Inner lateral margin deeply and abruptly constricted at the base of the body, the outer lateral margin scarcely at all. Anterior canal horizontally compressed and turned sharply to the left and backward. A single nuclear whorl preserved. Four rapidly enlarging postnuclear whorls, the incised suture following the periphery and on the last whorl crenulated by the coronal spines. Entire surface spirally lirae, the lirae tending to alternate in strength and running about five primaries to each of the whorls of the spire and the shoulder of the body, finer and less regular upon the medial portion of the body, coarser toward the anterior fasciole. Axial sculpture developed only upon the final whorls. Peripheral spines very strong, laterally compressed, nine on the unique type, one of the nine partly concealed by the reverted outer lip; series at the base of the body less prominent, more conical than those on the periphery but in line with them. Incremental sculpture relatively strong, retractive upon the shoulder. Aperture narrow, obliquely lenticular, bent toward the apex and obtusely angulated posteriorly, obscurely angulated also at the periphery, compressed anteriorly into a slotlike opening. Apertural opening entirely surrounded by heavily callused margins. Outer lip very much thickened and reverted, with a suggestion of a *Cassis*-like flattening and, at the opening to the anterior canal, a suggestion of a constriction such as that upon *Strombus* for the extrusion of the eye stalks; reverted lip continuous around the posterior commissure, encroaching slightly upon the preceding whorl and spread widely and heavily over the body wall, but free from it between the keel at the base of the body and the anterior fasciole. Fasciole conspicuously wide and conspicuously compressed, oblique to the axis of the shell.

Dimensions of holotype: Height, 43.0 millimeters; greatest diameter, 38.0 millimeters; diameter at right angles to the greatest diameter, 32.0 millimeters.

Holotype: U. S. Nat. Mus. 495184.

Type locality: U. S. G. S. station 13808, bend of the Colorado River 3 miles above old Burleson Ferry, Bastrop County, Tex. Lower part of Mount Selman formation.

There is no comparable form.

The species is honored with the name of Dr. F. E. Turner, of the faculty of the Agricultural and Mechanical College, Bryan, Tex. Dr. Turner is particularly interested and concerned with the Reklaw fauna, but he generously waived his interest in this fine specimen.

Distribution: Type locality only.

Galeodea (Gomphopages?) millsapsi Sullivan and Gardner, n. sp.

Plate 8, figures 2, 3, 6

Shell large for the group, heavy. Outline cassidiform, the apertural face flattened, and the spire very low; the whorls expanding rapidly to the coronated

periphery of the body. Protoconch and possibly the first whorl of the conch lost. Conch known from the five remaining whorls. Earliest known whorl of conch and a part of the succeeding turn inflated medially, flattening, however, toward the end of the second known turn; later whorls broadly shouldered, the suture following the periphery. Body bicarinate, the shoulder tubercles more prominent than the series toward the base of the body. Sculpture, on earliest whorls, of spiral lirae that tend to alternate in strength; on the later whorls of the spire stronger on the medial portion of the shoulder than in front of or behind it and tending to become obsolete upon the shoulder of the body. Lirae feebly overriding both the shoulder carina and that near the base of the body, even more faint upon the slightly concave lateral area between the carinae; fine but fairly sharp in front of the second carina and least fine and most regular upon the anterior fasciole. Incrementals sufficiently strong to crinkle the spirals minutely, retractive upon the shoulder. Periphery of body crenulated with 14 to 15 tubercles, compressed at right angles to the axis of the shell, directed outward and slightly backward; a second series of about eight nodes, "staggered," axially compressed, and pinched, girdling the body just above the base. Aperture oblique to the axis of the shell, the margins not far from parallel, widening slightly with the basal constriction of the body and narrowing with a slight change in direction at the entrance to the short, sinistrally inclined canal. Outer margin of aperture thickened, forming a flat outer lip on which the component laminae are traceable; notched at the fasciole and at a point corresponding in position to the peripheral keel, produced backward and continuous with the heavy callus of the reverted inner lip, which thickly washes the body wall; the callus standing apart from the body wall at the base but adnate at the fasciole, the edge of the callus free and sharp throughout its extent. A few rugosities developed upon the inner margin of the pillar, but no folds. Anterior fasciole compressed but to a less marked degree than in *Galeodea (Gomphopages) turneri* Gardner; the direction of the short anterior canal and its proximate parallel margins similar to those of *Gomphopages*.

Dimensions of holotype: Height, 60.0 ± millimeters; greatest diameter, 49.0 millimeters; diameter at right angles to greatest diameter, 45.0 millimeters.

Holotype: U. S. Nat. Mus. 496019.

Type locality: Town Creek, Jackson, Miss. Moodys marl member of the Jackson formation.

This largest and finest of our Eocene *Galeodea* was generously deposited in the U. S. National Museum by the collector and senior author of the species, Dr. John Magruder Sullivan, professor of geology at Millsaps College, Jackson, Miss., the institution in whose honour it is named.

There is nothing closely comparable with *Galeodea millsapsi*. Imperfectly known forms from the Wilcox

of northeastern Mexico show comparable dimensions and outline, but the canal was probably longer, and they are referred to the subgenus *Mambrinia*. The other Jackson species, *Galeodea petersoni* (Conrad), is smaller, much less angular, and, like the genotype, girdled with several, usually four, prominent spirals, which are not spinose. *Galeodea susannae* Schenck, from the Domengine, is also smaller and has much the same outline, and the sculpture pattern, though similar in a general way, is much more vigorously developed. *Galeodea geminata* Wrigley is another bicarinate *Galeodea* with a low spire and short anterior canal, but the sculpture pattern differs and the aperture is more expanded. The specimen figured by Wrigley, less than half the size of *G. millsapsi*, was collected from the lower Bracklesham beds at Southampton Dock. In many characters—the general outline, much of the sculpture detail, and the character of the anterior fasciole—the Jackson species recalls *Galeodea (Gomphopages) turneri*, from Mount Selman, but one of the characters that has been considered important in the *Galeodea* group is the relationship of the nodes in the different series. They are most commonly “staggered”, as in *G. millsapsi*, but in the subgenotype of *Gomphopages* the shoulder nodes and those at the base of the body are in line. There is not sufficient material to be sure that this feature is of superspecific importance.

Distribution: The type is unique.

Genus *SCONSIA* Gray

1847. *Sconsia* Gray, Zool. Soc. London Proc., pt. 15, p. 137.

Type by original designation: *Cassidaria striata* Lamarck. Recent in the West Indies.

Shell of medium or rather large size, ovoid, the spire low and broad, the body broadly inflated. Protoconch horny, small, paucispiral, smooth, the initial turn immersed at the tip. Whorls of spire trapezoidal, increasing rapidly in diameter. Body broadly inflated, relatively large, the aperture more than two-thirds the height of the shell. Sutures impressed. Entire surface spirally lirate, the lirae crowded and flattened except upon the earlier whorls of the spire and the fasciole. No axial sculpture except growth riblets, a terminal varix, and usually, though not invariably, a body varix, so placed that its sharply defined margin intercepts the reverted pillar callus at the extreme base of the body. Terminal varix heavy, defined exteriorly by a shallow groove, lirate within. Parietal wash thin but widely spread, thickening toward the base of the body, corrugated at the base of the body, and lirate at right angles to the margin of the pillar. Anterior canal short, broad, the margins proximate, nasute and emarginate at its extremity.

The genus has been discussed by Dall,¹³ Pilsbry,¹⁴

Woodring,¹⁵ Wrigley,¹⁶ and a number of other authors.

The inflated anterior fasciole and deep, obliquely directed terminal notch that characterize *Cassia* and *Semicassia* are not developed in *Sconsia*, and both the labral and the parietal callus are relatively thin for the family. Because of its prominent anterior fasciole Woodring excludes from *Sconsia* the species “*Cassia*” *nuperus* Conrad, from the Gosport sand—a species cited both by Dall and by Pilsbry as an ancestral form from which have descended *lintea* Conrad of the Vicksburg fauna and *hodgii* Conrad of the Dulpin fauna. Wrigley stresses the close affiliation to *Semicassia* rather than to *Galeodea*, under which *Sconsia* was given subgeneric status by Dall.

True *Sconsia* is apparently represented in the upper Eocene of northeastern Mexico, but in the eastern Gulf province it has not been recognized in strata earlier than the Oligocene, and Woodring, 1928, affirms that “no *Sconsias* are recorded from tropical America from deposits older than lower Miocene.” The Recent species are restricted in their known distribution to the West Indies.

Sconsia zacatensis Gardner, n. sp.

Plate 7, figure 9

Shell rather small for the group, thick, heavy, and stout fusiform in outline. Spire short, tapering rapidly to an acute apex. Body whorl ovate. Outer surface of spire decorticated, the apex decollated. Remaining whorls numbering seven and a fraction, six of them apparently included in the conch, although the dividing line is rather obscure. Protoconch probably small, smooth and paucispiral. Whorls of the conch increasing rapidly in diameter, with a broad, steeply sloping, slightly concave shoulder. Axial sculpture of numerous low riblets, not very regular and tending to complete evanescence in front of the periphery of the body on the first half turn, but fairly strong and persistent directly behind the labrum. A single varix, which is nothing more than a greatly exaggerated resting stage, developed upon the body of the type at about the end of the first quarter turn. Entire surface of conch closely and not very regularly lirate spirally; the spiral that outlines the ill-defined periphery nodulated at the intersection with the axials; a spiral a little behind it which is almost as strong as the peripheral spiral and only a little less strongly noded, probably no stronger than the other shoulder spirals upon the earlier whorls. Aperture somewhat obliquely lenticular, almost two-thirds the entire length of the shell, acutely angulated posteriorly. Outer lip thickened marginally, nearly parallel to the axis posteriorly and medially, bent toward it anteriorly; reinforced within by well-developed parallel rugae,

¹³ Dall, W. H., Contributions to the Tertiary paleontology of the Pacific coast: I. The Miocene of Astoria and Coos Bay, Oregon: U. S. Geol. Survey Prof. Paper 59, p. 66, 1909.

¹⁴ Pilsbry, H. A., Review of W. M. Gabb's Tertiary Mollusca of Santo Domingo: Acad. Nat. Sci. Philadelphia Proc., vol. 73, pp. 361-363, 1922.

¹⁵ Woodring, W. P., Miocene Mollusks from Bowden, Jamaica, pt. 2, Carnegie Inst. Washington Pub. 385, pp. 308-309, 1928.

¹⁶ Wrigley, Arthur, English Eocene and Oligocene Cassididae, with notes on the nomenclature and morphology of the family: Malacol. Soc. London Proc., vol. 21, pp. 114-116, 1934.

normal to the margin but not quite reaching it, more or less irregular in size and spacing. Margin of outer lip much thickened and revealing the component lamellae, merging posteriorly with the heavy parietal callus. Inner wall of aperture rugose from the commissure to the canal, the rugae nearly perpendicular to the axis and reaching far within the aperture but abruptly disappearing at the mouth at a perceptible distance from the sharp edge of the parietal callus. Anterior extremity notched, the margins of the incipient canal thickened and proximate.

Dimensions of holotype: Height, 22.7 millimeters; greatest diameter, 14.0 millimeters; length of aperture, 16.5 millimeters.

Holotype: U. S. Nat. Mus. 497067.

Type locality: U. S. G. S. station 13509, southeast of Rancho la Copa, Zacate, Nuevo León, Mexico. Upper part of the Jackson.

Sconsia zacatensis is known only from the environs of the type locality. *Sconsia linteata* Conrad, from the Vicksburg, develops little or no axial sculpture, and the spiral sculpture is finer than that of the species from the Jackson of Mexico. However, the two species have much in common, and a lineal relationship may be indicated. The relatively heavy parietal wash and the crude axial sculpture of *Sconsia zacatensis* are probably primitive characters.

This is the first record of true *Sconsia* in the Eocene of the eastern American faunas.

Distribution: Upper part of the Jackson. U. S. G. S. stations 13509 and 13511, southeast of Rancho la Copa, Hacienda Zacate, Nuevo León, Mexico.

Family FICIDAE

The Cenozoic "fig shells" have in common a paucispiral protoconch with a flattened apex, a finely reticulate sculpture of incrementals and spiral threadlets, and a bridging of the posterior commissure with the enamel lining of the aperture. The Eocene representatives of the Ficidae were much smaller than the Recent shells, less smoothly rounded, more simply netted, and usually with more whorls both in the conch and in the protoconch.

Genus PRISCOFICUS Conrad

1866. *Priscoficus* Conrad, Am. Jour. Conchology, vol. 2, p. 100 (footnote).

Type by subsequent designation:¹⁷ *Ficus intermedia* Melleville. Paleocene of the Anglo-Parisian basin.

Conrad's description was in the old manner:

There are some other Eocene forms in Europe allied to these [*Ficopsis*] which I think may constitute a genus, *Priscoficus*. Examples: *P. intermedia* Mel[le]ville; *P. smithii* Sowerby.—Conrad, 1866.

Both in the Eocene of the mid-Americas and in that of the Paris Basin, a group of obtusely bicarinate or

tricarinate pyriform shells have in common a low or moderately elevated, acutely tapering spire; a thin, expanded outer lip; and the body smoothly constricted into a moderately long and straight or slightly flexed anterior canal. The axial sculpture is expressed in the carinal nodes and in the sharp and regular incrementals, and a fine spiral threading is developed over the greater part of the shell in many of the species. They have appeared under many names, as *Ficus* Bolter, *Pirula* or *Pyrula* Lamarck, and *Ficula* Swainson in the works of the earlier systematists, and as *Fusoficula* and *Fulguroficus* in Harris, 1899; *Fulguroficus* in Sacco, 1891; and *Urosyca* Gabb in Sacco, 1904. Stewart, in 1927, placed them under *Ficopsis* Conrad, 1866, the genotype of which, *Fusus remondii* Gabb, from the Eocene of California, is a species with the delicately reticulate sculpture of *Ficus* and without the noded carinae of *intermedia* Melleville.

In the lower Eocene of the Gulf and of the Paris Basin the species referred to *Priscoficus* fall naturally into two groups. *Priscoficus* s. s. includes the genotype, *Pyrula intermedia* Melleville, from the Thanetian of the Anglo-Parisian Basin; *Murex smithii* Sowerby, from the London clay; three closely related species described by Wrigley, also from the London clay; *Fulgur triserialis* Whitfield, from the Tuscahoma (lower part of the Wilcox) of Alabama; and *Fulgur argutus* Clark, from the lower Eocene of Maryland. These are the forms characterized by Wrigley¹⁸ as "the nodosely carinated species of early Eocene times." The shells of *Priscoficus* s. s. are larger, the spire is lower, the shoulder broader, and the general aspect more *Galeodea*-like than that of the subgenus *Fulguroficus* Sacco, restricted, under which the second group has been segregated. The shells of *Fulguroficus* develop a fine reticulated sculpture resembling that of the Recent *Ficus*. As Wrigley suggested, the hollow knobs and spinose processes of *Priscoficus* s. s. were probably devised to strengthen a thin and fragile shell, but in the group of *Fulguroficus* the same result is obtained by the netted spirals and incrementals. The two sculpture patterns seem to be mutually exclusive, and they are not both typically developed in any single recorded species. The general aspect and distribution of *Priscoficus* suggest a dying race, although the Cretaceous ancestry cannot be definitely traced.

The Eocene species are few in number but widely distributed (see fig. 4), and both in *Priscoficus* s. s. and in *Fulguroficus* transoceanic resemblances are as close as any offered in the recorded gastropods. The species described by Whitfield in 1865 as *Fulgur triserialis* was listed by Aldrich, 1885, as *Pyrula smithii* (pl. 7, fig. 20), and the resemblance of *Pyrula juvenis* Whitfield to *P. tricostata* Deshayes is so marked that a trained observer such as Wrigley¹⁹ stated that the differences

¹⁸ Wrigley, Arthur, Malacol. Soc. London Proc., vol. 18, pt. 5, p. 250 1929.

¹⁹ Idem, p. 247.

¹⁷ Stewart, R. B., Acad. Nat. Sci. Philadelphia Proc., vol. 78, p. 380, 1927.

"are not sufficiently important to justify specific separation, but in a trinomial nomenclature *juvenis* could be retained as a second or 'form' name." Both of the Gulf species are characteristic of the lower Eocene Tusahoma sand of the Wilcox group; *Priscoficus smithii* is from the probably synchronous London clay and *P. (Fulguroficus) tricostata* from the possibly

1885. *Pyrula smithii* (Sowerby). Aldrich, Cincinnati Soc. Nat. History Jour., vol. 8, no. 2, pp. 154-155, pl. 3, figs. 23, b.
1886. *Fulgur triserialis* Whitfield. Aldrich, Alabama Geol. Survey Bull. 1, pp. 24, 56, pl. 1, fig. 23b.
1899. *Fulguroficus triserialis* (Whitfield). Harris, Bull. Am. Paleontology, vol. 3, Bull. 11, p. 67, pl. 8, fig. 17. (Synonymy in part excluded.)

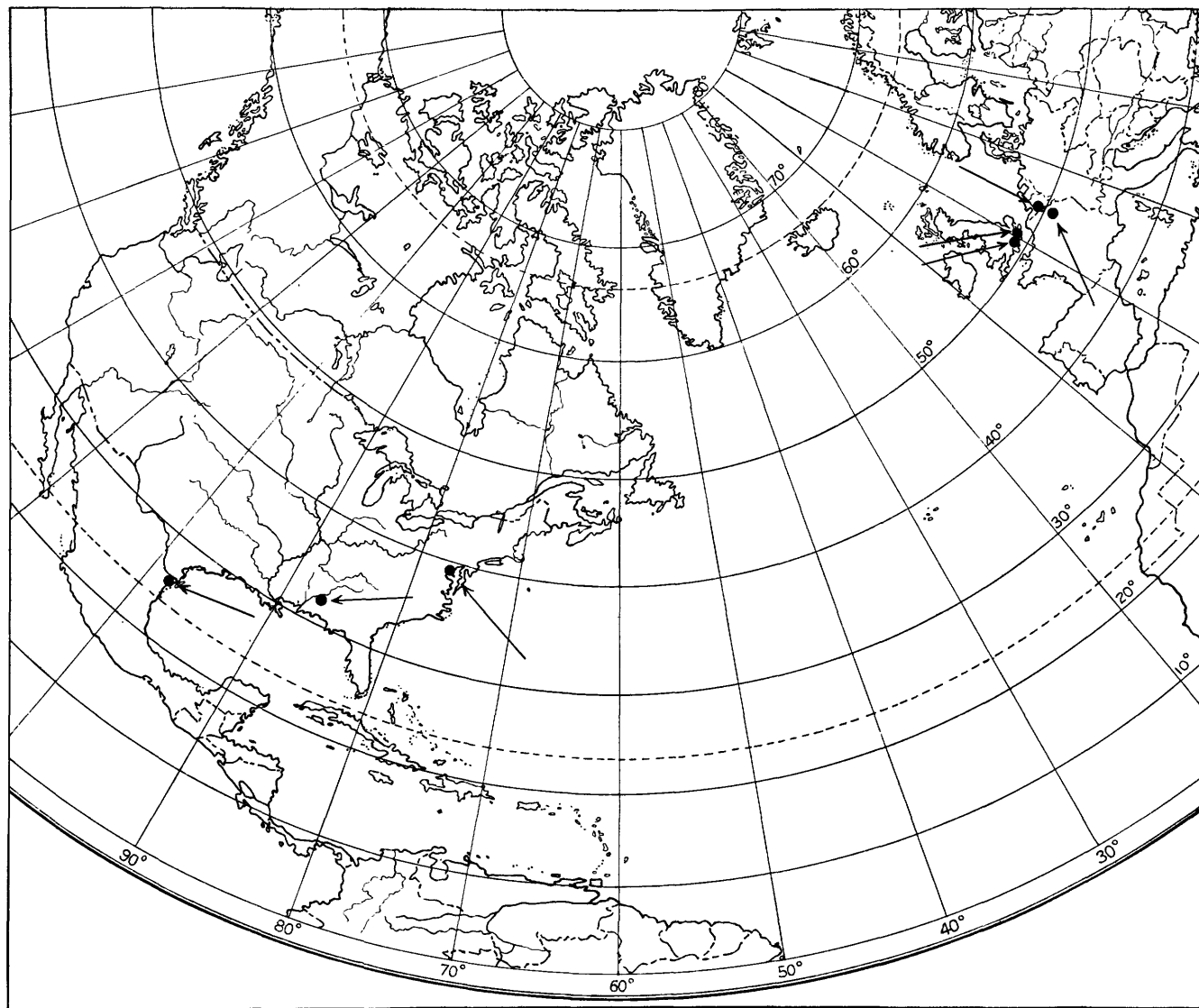


FIGURE 4.—Map showing distribution of *Priscoficus (Priscoficus)*.

later Cuisian.²⁰ The relationships of the west coast species are less obvious.

The greater part of the material is in the form of molds, and the sculpture detail has not been preserved.

The noded and carinated fig shells are characteristic of the early Tertiary, and there is no record of the group in post-Tertiary faunas.

***Priscoficus triserialis* (Whitfield)**

Plate 7, figure 19

1865. *Fulgur triserialis* Whitfield, Am. Jour. Conchology, vol. 1, p. 260.

²⁰ Wrigley, Arthur, and Davis, Arthur G., Occurrence of *Nummulites planulatus* in England: Geol. Assoc. London Proc., vol. 48, pt. 2, pp. 203-208, 1931.

1890. "*Fulgur*" *triserialis* Whitfield. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 109.

1927. *Priscoficus triserialis* (Whitfield). Stewart, Acad. Nat. Sci. Philadelphia Proc., vol. 78, p. 380.

Shell thin, clavate or pyriform; spire short, consisting of four (or more) volutions, flattened above, and produced below into a long, slender canal; marked on the periphery or largest part of the volution by three rows of lanceolate nodes or subspines, the upper one being the most prominent; aperture large, elongate elliptical; canal straight; columella slender and smooth; entire surface marked by sharp revolving lines.

Locality: Nine miles below Prairie Bluff, Ala.—Whitfield, 1865.

The holotype has been loaned to me through the kindness of the Walker Museum.

Dimensions of holotype: Height, 20 millimeters; diameter, 12.5 millimeters.

Type material: Holotype, No. 24515, Walker Museum, University of Chicago.

The holotype is an exceptionally well-preserved specimen except that the outer lip and the extreme tip of the anterior canal have been broken away. There are three whorls in the conch and between two and three in the small, smooth naticoid protoconch. The first postnuclear turn is broadly convex at its beginning, the shoulder flattening being evident by the end of the turn. On the second postnuclear whorl little more than the broad shoulder is visible. The axials on the first whorl of the conch are narrow, slightly arcuate and protractive ribs persistent from suture to suture, but with the development of the shoulder they are gradually altered to a series of strong and regular peripheral nodes, decreasing from the 14 to 15 upon the first turn to 9 on the body. A second less prominent series girdles the body; and a third series is incompletely developed at the base. The nodes of the three series are in alignment and connected by low, broad, ill-defined ribs. The entire shell is spirally lirate. The lirae are narrow, sharp, fairly regular in size and spacing, with occasional fortuitous secondaries upon the shoulder and on the sides of the body. The constriction in front of the anterior series of nodes is smooth but strong, and the liration on the canal thus differentiated is more regular but more distant than upon the side of the body. The suture is slightly impressed and follows a little in front of the peripheral nodes, which undulate it. The characters of the aperture are lost in part by the breaking of the outer lip, and it is possible that the shell may not be fully mature, for the wash upon the inner lip is so thin that the sculpture is scarcely obscured. The anterior extremity of the canal is very slender with parallel proximate margins.

Harris united *Fulguroficus arguta* Clark, 1895, with *Priscoficus triserialis*. The resemblance is close, but if my material is adequate, they are not conspecific.

Priscoficus triserialis has not been recognized in the western Gulf region. Harris, 1899, states that the species is "not uncommon at Gregg's Landing, where doubtless Whitfield's specimens were obtained." In the known distribution it is restricted to the Tusahoma sand.

Subgenus FULGUROFICUS Sacco, emended

1890. *Fulguroficus* Sacco, R. Univ. Torino, Mus. zool. anat. comp., Boll., vol. 5, no. 86, p. 27.
 1891. *Fulguroficus* Sacco, Molluschi terreni terziarii di Piemonte e Liguria, pt. 8, p. 41.
 1904. *Urosyca* Sacco (part) idem, pt. 30, p. 102. Not *Urosyca* Gabb, California Geol. Survey, Paleontology, vol. 2, p. 159, 1869. Genotype: *Urosyca caudata* Gabb (Martinez of California).

1929. *Fulguroficus* Wrigley, Malacol. Soc. London Proc., vol. 18, pt. 5, p. 249.

Type by subsequent designation (Sacco, 1891): *Pyrula burdigalensis* Sowerby. Burdigalian (Miocene) of southern France and northern Italy.

Sacco's conception of his genus was wider than the concept of "*Fulguroficus*" of Wrigley. In fact, Sacco included under it the low-spined species of relatively large size here referred to *Priscoficus* s. s. and later accepted Cossmann's dictum²¹ that *Fulguroficus* is synonymous with *Urosyca* Gabb, 1869. *Urosyca caudata* Gabb, the genotype, from the Martinez of California, is, however, a form with a very low spire and a less sloping shoulder than the species typified by *Pyrula burdigalensis*. For the small *burdigalensis* group, which exhibits an extraordinary similarity of shell characters in its widely separated occurrences, the name *Fulguroficus* is here retained. The implied genetic relationship is not unreasonable, for the group may well have arisen from a common Mesozoic stock. The maximum development was attained during the Eocene. The group is thus summarized by Wrigley,²² who had at his command the wealth of the collections of the British Museum:

High-spined forms with a very finely reticulated sculpture and a tendency to develop one or more carinae and to assume nodular forms. These appear throughout Eocene times and may have finally disappeared with the Miocene *F. burdigalensis*.

Among them are included the strikingly similar *Pyrula juvenis* Whitfield, from the lower Eocene of the Gulf, and "*P. tricostata* Deshayes" (pl. 7, figs. 13, 16) from the Cuisian of the Paris Basin. The likeness is evident in the illustrations, notably those of Cossmann and Pissarro.²³ The Cossmann and Pissarro figures are so unlike the originals of Deshayes that it seems possible that more than one species is involved. For that reason *tricostata* Deshayes has been placed within quotation marks. The genotype is girdled with more than three noded spirals and, as Wrigley suggested, may be an offshoot from some of the early noncarinate forms, such as *Ficopsis remondii* (Gabb). In case this is demonstrated, a new name must be found for the *juvenis* group.

Fulguroficus, represented in the Wilcox by *F. juvenis* Whitfield, in the London clay by *F. multiformis* Wrigley, and in the Cuisian by *F. tricostata* Deshayes, probably developed a little later than *Priscoficus* and may have made its last appearance with the subgenotype, *Fulguroficus burdigalensis* Sowerby, from the lower Miocene of southern France and northern Italy. The geographic distribution of *Fulguroficus* is shown in figure 5.

²¹ Cossmann, Maurice, Essais de paléoconchologie comparée, pt. 6, p. 124, 1904.

²² Wrigley, Arthur, op. cit., 250.

²³ Cossmann, Maurice, and Pissarro, G., Iconographie, vol. 2, pl. 33, figs. 164-165, 1911.

Priscoficus (Fulguroficus) juvenis (Whitfield)

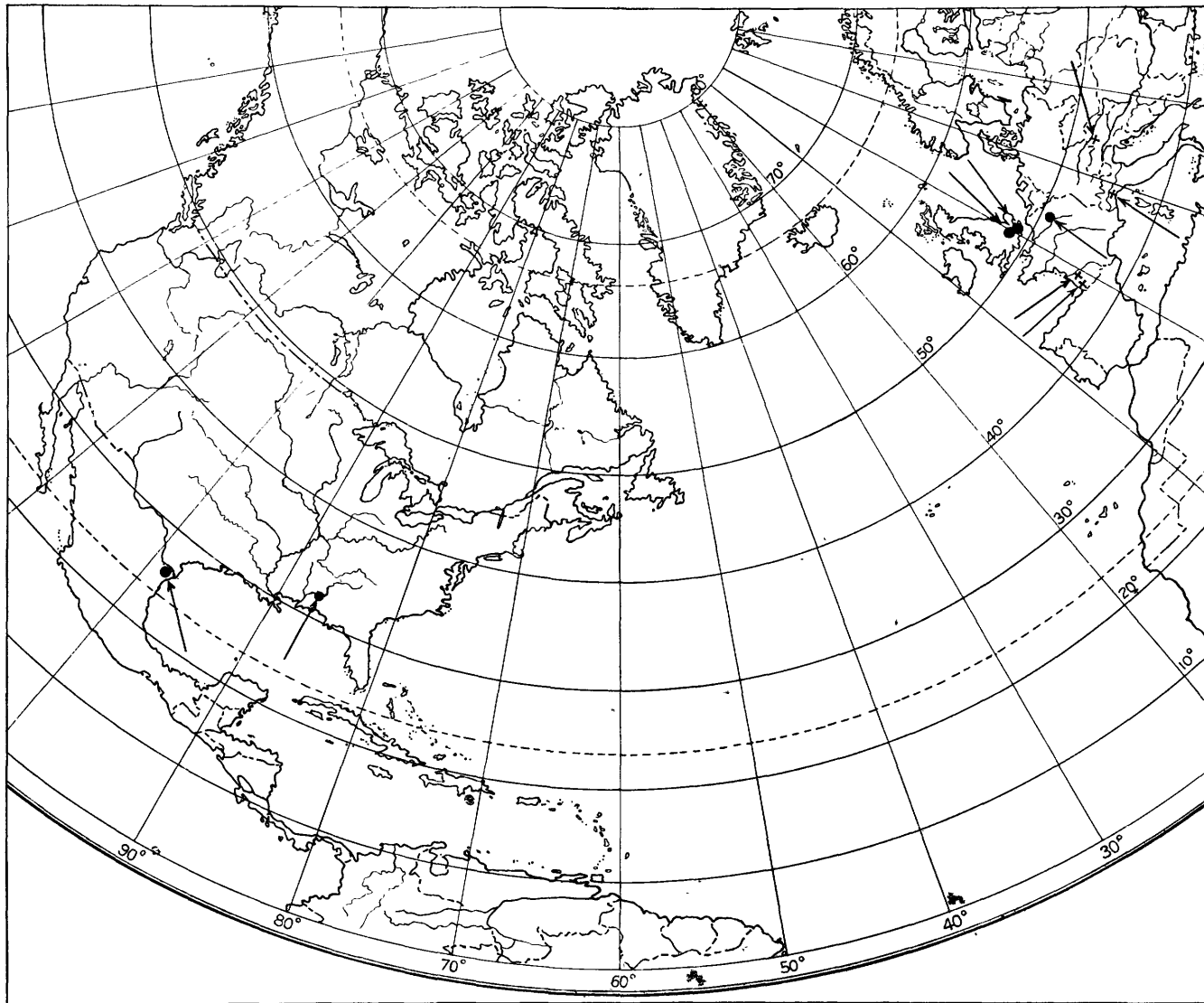
Plate 7, figure 17

1865. *Pyrula juvenis* Whitfield, Am. Jour. Conchology, vol. 1, p. 259.
 1881. *Pyrula multangulata* Heilprin, Acad. Nat. Sci. Philadelphia Proc. for 1880, p. 374, pl. 20, fig. 2.
 1886. *Pyrula juvenis* Whitfield. Aldrich, Alabama Geol. Survey Bull. 1, p. 25, pl. 6, fig. 8.

nae or subangular revolving ridges, the upper one marked with closely arranged, longitudinally elongate nodes, the others simple; entire surface marked by very fine revolving lines, which are somewhat fasciculate below the lower carina, there being three finer ones between each large one.

Dimensions: Length 0.6 inch, transverse diameter a little less than 0.3 inch.

Locality: Six miles above Claiborne, Ala., west side of river.—Whitfield, 1835.



● Eocene localities + Miocene localities

FIGURE 5.—Map showing distribution of *Priscoficus (Fulguroficus)*.

1890. *Ficula juvenis* Whitfield. De Gregorio, Monographie du faune éocénique de l'Alabama, p. 101, pl. 7, fig. 54.
 1896. *Pyrula juvenis* Whitfield [part]. Harris, Bull. Am. Paleontology, vol. 1, no. 4, p. 102, pl. 10, fig. 6 (fig. 5 excl.).
 1899. *Fusoficula juvenis* Whitfield [part?]. Harris, Bull. Am. Paleontology, vol. 3, no. 11, p. 66, pl. 8, figs. 15, 16(?).
 1927. *Ficopsis juvenis* (Whitfield). Stewart, Acad. Nat. Sci. Philadelphia Proc., vol. 78, p. 375.
 1935. *Ficus juvenis* (Whitfield)? [part]. Gardner, Texas Univ. Bull. 3301, p. 263.

Shell small and fragile; spire elevated; columella slender, slightly bent; aperture large, elongate, ovate or subelliptical; volutions three, marked on the periphery by three distinct cari-

Through the courtesy of the Walker Museum of the University of Chicago, I have obtained the loan of the Whitfield types in the so-called Hall collection. The type of *Priscoficus juvenis* is a rather worn shell of two and one-half to three nuclear and two postnuclear whorls. The initial nuclear turn is very small and is for the most part immersed in the succeeding volution. The later nuclear turns are also small, polished and obtusely shouldered; on the last quarter turn of the nucleus five or possibly six faint and very fine spiral threadlets are initiated, the anterior slightly less faint

than those behind them and than those upon the shoulder, which are the last to appear. These are minutely cancellated by the growth lines. The end of the protoconch is indicated by an obtuse axial rib. The whorls of the conch are obliquely tabulated, and the obtuse periphery is emphasized by the relatively strong spiral threads, the axial nodes, and the slight depression of the whorl in front of the periphery. A second carina, differing from the peripheral one in the absence of axial nodding, girdles the body and is visible in some individuals directly behind the suture, which follows closely upon it. One and in some individuals two additional carinae are developed upon the anterior portion of the body. These are less prominent than those behind them. The interval between the carinae is slightly concave. The entire conchal surface is finely cancellated by the spirals and the growth lines. The aperture is somewhat obliquely lobate, the posterior angle acute; the outer lip is thin, sharp, and crenated by the carinae; the columella is bent slightly to the right near the anterior extremity. The inner wall of the aperture is almost free from glaze, and the anterior extremity is moderately wide and open and there is no terminal notch.

Dimensions of cotype: Height, 15.3 millimeters; diameter, 8.0 millimeters.

Cotype: Walker Museum, University of Chicago, no. 24503.

The locality given by Whitfield is probably incorrect. He did not himself make the collection, but in his preface to the systematic descriptions he states that: "The following species of fossils were received, among others, from Mr. T. J. Hale, formerly of Madison, Wis., who collected them, several years since, at the localities mentioned under the descriptions." The species is widespread, though not abundant, in the lower Eocene of the Gulf province. The forms in my collections resembling most closely the Whitfield cotype are those from the Greggs Landing marl member of the Tusahoma sand.

A close analogy has been drawn by Wrigley²⁴ between *Pyrula juvenis* Whitfield, from the Tusahoma and *Pyrula tricostata* Deshayes, from the Cuisian.

The Mexican material is too poorly preserved to determine specifically, but certainly there are no characters retained by which these molds and impressions can be separated from *Priscoficus juvenis* of the eastern Gulf.

Distribution in Mexico: Upper part of Midway, U. S. G. S. station 13462, Rio San Juan; U. S. G. S. station 13758, on Rancho Durazno-Encadenado road near Rancho Durazno, Nuevo León, Mexico.

Wilcox group, U. S. G. S. station 13675, southwest of northeast corner of lot 13; U. S. G. S. station 13698, Casa Salinas, Las Burras section, Nuevo León, Mexico.

²⁴ Wrigley, Arthur, op. cit., p. 247.

Priscoficus (Fulguroficus) tritiara Gardner, n. sp.

Plate 7, figure 6

Shell moderately large for the group and relatively high-spired. Protoconch not preserved in its entirety, probably naticoid. All of the conch and possibly the later protoconch included in the five whorls still remaining. Whorls of spire rapidly enlarging, the earliest whorls broadly rounded but the shoulder already developed upon the third whorl from the aperture. Later whorls of spire strongly tabulated, the horizontal area behind the periphery of about the same width as the vertical area in front of it. Body tricarinate, the posterior keel outlining the shoulder, the medial keel in line with the posterior angle of the aperture and the suture, and the anterior keel about midway between the medial keel and the opening of the anterior canal. Entire shell very finely and closely lirate spirally. Axial sculpture indicated in the noded periphery and the obscure nodulation of the medial and anterior spirals. Characters of the aperture imperfectly preserved. Outer lip expanded, contour indented by the three strong body spirals. Base of the body not strongly constricted but gradually narrowing, apparently, into a moderately wide anterior canal. Threading upon the canal similar to that upon the rest of the conch.

Dimensions of holotype: Height, 25.0 millimeters; diameter, 12.0 millimeters.

Holotype: U. S. Nat. Mus. 495180.

Type locality: U. S. G. S. station 13488, Rio San Juan, near the Rancho Viejo, below China, Nuevo León, Mexico. Upper part of the Midway.

Priscoficus tritiara differs from *Priscoficus juvenis* Whitfield, its close analog of the eastern Gulf region, in the rather larger, coarser shell, the whorls of the conch apparently more numerous by one, and the more strongly noded medial and anterior spirals.

The type is unique

Distribution: Type locality only.

Priscoficus (Fulguroficus) sp. undet.

Small examples of one or possibly more species of *Priscoficus* doubtless closely related to *Priscoficus juvenis* Whitfield and *P. tritiara* Gardner, but possibly not specifically identical with either, have been recovered from several lower Eocene localities in north-eastern Mexico. Most of the individuals are immature, and none of them are well preserved, but they at least indicate the fairly wide and common distribution of the subgenus within the area designated.

Distribution: Upper part of the Midway, U. S. G. S. station 13550, Rio San Juan, Nuevo León, Mexico.

Wilcox group, U. S. G. S. station 13661, west of Los Aldamas; U. S. G. S. station 13669, road north of La Laja; U. S. G. S. station 13695, west of kilometer 124

on pipe-line brecha, Los Aldamas; U. S. G. S. station 13697, El Coyote concession, Las Burras section, Nuevo León, Mexico.

Genus *PERISSOLAX* Gabb

1861. *Perissolax* Gabb, Am. Philos. Soc. Proc., vol. 8, p. 122.
 1918. *Pseudoperissolax* Clark, California Univ. Pub. Geology, vol. 11, p. 180.
 1927. *Pseudoperissolax* Clark. Stewart, Acad. Nat. Sci. Philadelphia Proc., vol. 78, pp. 429, 430.
 1930. *Perissolax* Gabb. Stewart, Acad. Nat. Sci. Philadelphia Special Pub. 3, p. 41. Type by subsequent designation (Stewart, 1930, p. 41): *Perissolax trivolvus* Gabb. Vincentown sand (lower Eocene) of New Jersey.

(*Ranularia*), but there are no examples in my material to indicate the diagnostic twist of the *Ranularia* canal. The protoconchal characters and the early conchal whorls of the Gulf *ecensis* are similar to those of *Galeodea*, the outer lip shows the characteristic thickening and inner dentition, and the parietal wall shows the characteristically heavy wash. The general contour of the body and the spire is similar in *Galeodea* (*Mambrinia*) and in the species *ecensis*, but the spire is lower and the axial sculpture much more decided in *Mambrinia*. The incremental grating and the very fine spiral threading of *ecensis* recall the *Ficidae*, and it is

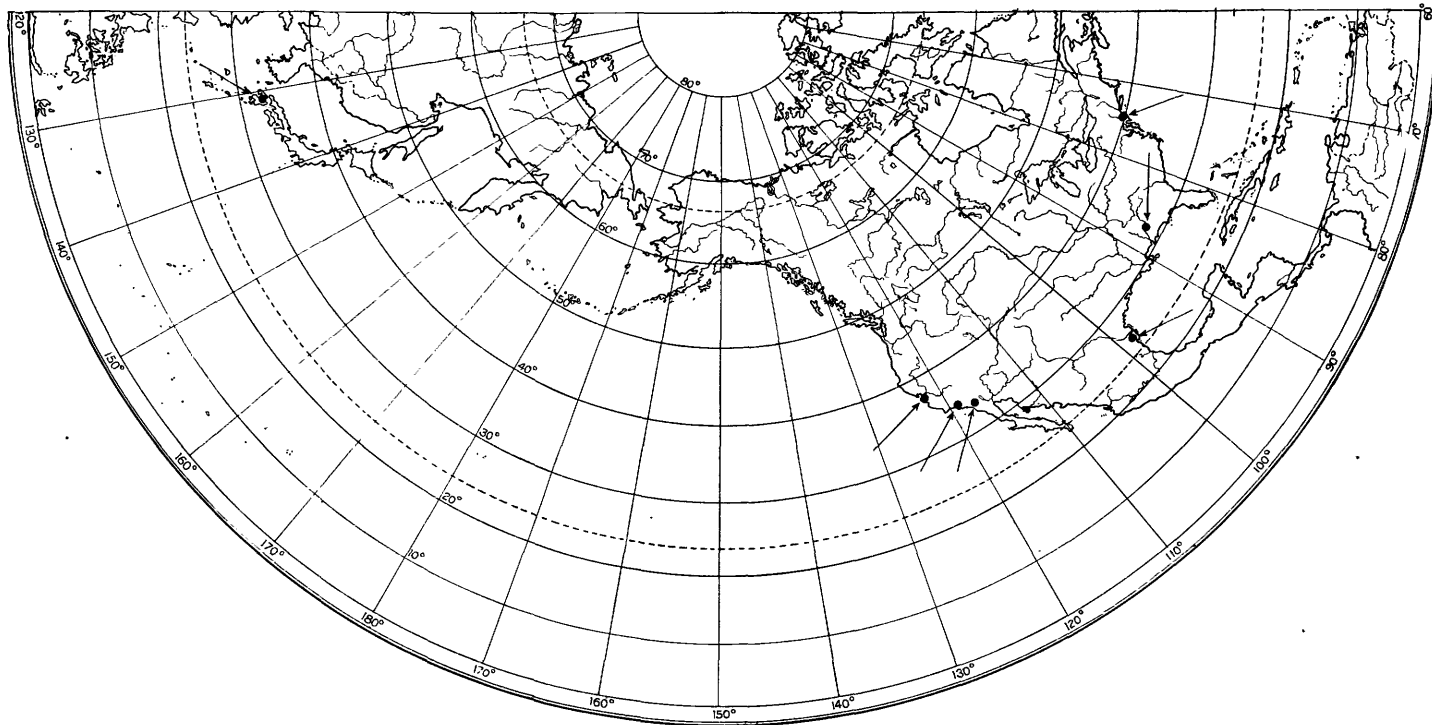


FIGURE 6.—Map showing distribution of *Perissolax*.

The types of both *Perissolax* and *Pseudoperissolax* were described from ill-preserved material of debatable age. *Busycon? blakei* Conrad, the type of *Pseudoperissolax* by original designation, was first proved to be of Eocene rather than Cretaceous age, and the similarity of this species to the type of *Perissolax* was one of the arguments for the Eocene age of the Vincentown fauna and for the abandonment by Stewart of *Pseudoperissolax*. I have no good examples of these genotypes, but there are excellent specimens of *Fulgur eocense* Aldrich,²⁵ which Stewart considered congeneric. *Fulgur eocense*, the type of which is deposited in the Johns Hopkins University, has been recovered from faunas both from the Midway and from the lower part of the Wilcox. Harris²⁶ referred Aldrich's species to *Triton*

probable that the two families were convergent in the early Eocene.

Perissolax, as defined, includes only the genotype, a few species from the west coast, *ecensis* (Aldrich) from the Gulf, a new species, *Perissolax diga*, from Mexico and, to quote Dickerson and later Stewart, "*Fusus* sp." from the Miike coal field, Japan. The west coast species are all Eocene forms, and the Gulf and Mexican species are of Midway and early Wilcox age. The geographic distribution is shown in figure 6.

Marshall²⁷ described in 1917 a species from the Wangaloa beds which he called *Perissolax obtusa*. One of his figures (fig. 22) resembles *Priscoficus* (*Fulgurificus*) but may be properly referable to *Perissolax*. His

²⁵ Aldrich, T. H., Bull. Am. Paleontology, vol. 1, no. 2, p. 10, pl. 3, figs. 7, 7a, 1895.

²⁶ Harris, G. D., Bull. Am. Paleontology, vol. 1, no. 4, p. 101, pl. 10, fig. 3, 1896.

²⁷ Marshall, P., The Wangaloa beds: New Zealand Inst. Trans. and Proc., vol. 49 pp. 454, 460, pl. 35, figs. 22, 23, 1917.

figure 23, however, exhibits the general aspect of *Cornulina*.

Perissolax diga Gardner, n. sp.

Plate 7, figures 7, 8

Shell rather small, low-spined, and highly inflated. Early whorls lost, the protoconch probably naticoid. The entire conch and possibly some of the protoconch represented in the four and a fraction whorls still preserved. Early whorls of conch broadly rounded, rapidly enlarging, the tabulated shoulder and peripheral keel first becoming noticeable near the beginning of the penultimate whorl and typically developed by the beginning of the body. Body tricarinate, the posterior keel outlining the shoulder, the medial keel girdling the body in line with the posterior angle of the aperture, and the anterior keel about midway between the second carina and the opening of the anterior canal. Early whorls closely and regularly threaded, with no trace of an axial sculpture other than the incrementals. Both coarser and finer spirals ornamenting the body, the coarser outlining the carinae, the finest almost as fine as the incrementals, which they minutely cancellate. Axial sculpture indicated in the crenulation of the peripheral keel. Aperture more than half as long as the entire shell exclusive of the anterior canal, obliquely lobate. Outer lip varicose. Inner wall of aperture heavily glazed. Anterior canal broken away.

Dimensions of holotype: Height, exclusive of anterior canal, 14.0 millimeters; diameter, 11.0 millimeters.

Holotype: U. S. Nat. Mus. 495179.

Type locality: U. S. G. S. station 13462, Rio San Juan, near the Rancho Viejo, Nuevo León, Mexico.

Perissolax diga differs from *P. eocensis* (Aldrich), from the lower Eocene of the Gulf, in the possibly larger size, the earlier development of the peripheral keel, and the finer threading upon the spire in *P. eocensis*. The type is unique.

Distribution: Type locality only.

Genus *FICUS* "Bolten" Roeding

1793. *Ficus* "Bolten" Roeding, Mus. Boltenianum, pt. 2, p. 148.

1799. *Pyrula* Lamarek, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat. Paris Mém., p. 73. Type by monotypy: *Bulla ficus* Linnaeus.

1810. *Pirula* Montfort, Conchyliologie systématique, vol. 2, p. 486. Type by monotypy: *Murex ficus* Linnaeus. Recent in the East Indies.

Type by monotypy: *Ficus communis* "Bolten" Roeding = *Ficus variegata* "Bolten" Roeding = *Bulla ficus* Gmelin = *Murex ficus* Linnaeus. The only other species cited by Roeding is *Ficus picta*, a nomen nudum.

Shell rather large; thin, almost papyraceous; inflated; fig-shaped; imperforate. Spire low, rounded rather than angulated. Protoconch smooth, obtuse, few-whorled. Sculpture of conch spiral or delicately reticulate. Aperture wide, pyriform, terminating anteriorly in a long, open canal; outer lip thin, simple,

arcuate; columellar lip slightly sinuous, destitute of plications.

Ficus was initiated after the Cretaceous and culminated in the Tertiary. The representation in Recent waters is rather meager and confined to tropical and subtropical regions, notably the Antilles, the Indian Ocean, and the Philippine Islands.

Ficus amichel Gardner, n. sp.

Plate 7, figures 21, 23

Pyrula penita of authors (part). Not *Pyrula penita* Conrad, Fossil shells of the Tertiary formations of North America, p. 32, 1833.

Shell rather small for the group. Fig-shaped. Known only from three whorls of the conch, but the missing apex probably including not more than a fraction of a conchal whorl and the protoconch; remaining whorls of the spire broadly curved, rapidly enlarging; body obtusely shouldered, constricting smoothly into the broad and probably long anterior canal, of which the extremity is unfortunately lost. Sculpture a delicate netting of relatively strong primary spirals and intercalated secondaries, overridden by a very fine and regular axial lineation; two or three primary spirals upon each of the whorls of the spire, probably about 20 upon the body, those upon the inflated portion of the body the most prominent and the most widely spaced. Suture line obscure, fringed by the fine axials, which creep back a little upon the preceding whorl and adhere closely to it. Body as viewed from the front, slender, the aperture relatively wide; outer lip broken. Inner wall of aperture free from glaze. Anterior canal rather slender for the genus.

Dimensions of holotype: Height, 25.0 ± millimeters; diameter, 15.0 ± millimeters.

Holotype: U. S. Nat. Mus. 496032.

Type locality, U. S. G. S. station 13567, Doctor Coss, Zacate, Nuevo León, Mexico. Cook Mountain.

This species seems to be eligible to admission within the narrow limits of true *Ficus*. The sculpture has the delicacy and sharpness of that of the Recent *papyratia* (pl. 7, figs. 18, 24), and the diagnostic difference is one not shared by any of the described older members of the Ficidae. The prominence of the primaries upon the expanded medial portion of the shell is not due to the sharpness or breadth of the lirae, which are both narrow and ill-defined, but to the fact that they follow the crests of narrow ridges. The interprimary areas are much wider than the primaries, broadly concave, and beautifully netted by the secondary spirals and the incrementals. The species, like most of the rest of the group, is not abundantly represented, but it has been observed at several localities in the Cook Mountain of Webb County, Tex., notably in the green sandstones near La Perla ranch house; also in the probably synchronous gray sandstones of Tamaulipas and Nuevo León, Mexico.

Indeterminate juveniles, probably representing a closely allied species, were collected in the Mount Selman formation at U. S. G. S. station 13632, 2,100 meters east of Rancho Presa Nueva, Santa Ana, Nuevo León, Mexico.

Distribution in Mexico: Cook Mountain formation, U. S. G. S. station 13567, Doctor Coss, Zacate, Nuevo León, Mexico; U. S. G. S. station 13570, General Bravo, Carlos Cantú, Nuevo León, Mexico; U. S. G. S. station 13553, west of Rancho Paroda, Carlos Cantú, Nuevo León, Mexico; U. S. G. S. station 13547, on old road southeast from triangulation point Banquette 300 meters south of Monterrey-Reynosa Highway, Nuevo León, Mexico; (?) U. S. G. S. station 13556, on road from Rancho Minitas to General Bravo, northwest of Rancho Minitas, Nuevo León, Mexico; and U. S. G. S. station 13593, General Bravo, Carlos Cantú, Nuevo León, Mexico.

Claiborne, (?) U. S. G. S. station 13545, east of Rancho Venadito, Carlos Cantú, Nuevo León, Mexico.

Ficus sp.

Ficus filia (Meyer), described from the Jackson of Mississippi, has not been recognized in the western Gulf, but the genus is represented by two species, locally abundant, that are apparently intermediate between *filia* and *mississippiensis* Conrad from the Vicksburg of Mississippi. The characters of the protoconch, which are of unusual importance in the taxonomy of the group, have not been preserved in either one of these species, and for that reason, as well as their generally poor state of preservation, they have not been named. The conch of the lower Jackson species, which is abundant at U. S. G. S. station 13503, 20.8 kilometers southeast of Ciudad Camargo, Tamaulipas, Mexico, seems relatively short and inflated, but it is known only from molds. The sculpture of both of the Jackson species from the western Gulf differs from that of *mississippiensis* in the less prominent primary spirals and from both *filia* and *mississippiensis* in the more pronounced cancellation of the interprimary areas. The interprimary areas of the body of *filia* are grated with 10 or a dozen exceedingly fine subequal spiral threadlets, those of *mississippiensis* by 1 to 3, the medial secondary, if there are 3, being stronger than those on either side. In the western lower Jackson species the number may run up to 7, with the medial spiral the strongest, whereas in the higher Jackson the number may be decreased and a tertiary system of spirals is frequently observed. The second species has been recognized only in the higher Jackson of the western Gulf at U. S. G. S. station 14009, west of Rancho la Coma, Zacate, Nuevo León, Mexico; at U. S. G. S. station 13598, Presa del Mescal, Zacate, Nuevo León, Mexico; U. S. G. S. station 13513, west of Río Panorama, Zacate, Nuevo León, Mexico; and

at U. S. G. S. station 13509, southeast of Rancho la Copa, Zacate, Nuevo León, Mexico. The same species is present in the Jackson fauna of Montgomery, La.

Ficus mississippiensis Conrad

Plate 7, figure 22

1848. *Ficus mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 1, p. 117.

1907. *Pyrula mississippiensis* Conrad. Burnett Smith, Acad. Nat. Sci. Philadelphia Proc., pp. 210, 214, 215, 216, pl. 17, fig. 5 (initial whorls only).

Pyriform, thin and fragile, latticed, with acute prominent lines, the revolving ones largest and distant, the interstices with minute revolving lines; longitudinal lines closely arranged, equal; spire very short, whorls convex, the two nearest the apex en ire; large volution flattened at top. Length $1\frac{1}{4}$ [inches].—Conrad, 1848.

The species, except for the early whorls, has not been figured. The specific characters are, in the main, those of the genus. Burnett Smith in his "Contribution to the morphology of *Pyrula*" emphasized the monophyletic aspect of the group and the extraordinary similarity of the grosser morphologic features of the constituent species. These features, which are shared by *Ficus mississippiensis*, include the thin shell, the low, evenly and broadly rounded whorls of the spire, and the intricate cancellate sculpture. The protoconch is distinct, however, and exhibits three smooth, rapidly enlarging whorls. The spirals are initiated a fraction of a whorl before the axials, but the cancellate sculpture is well established by the end of the first quarter turn of the conch. In the genus *Ficus* the earlier species, the Jackson *F. filia* and the Oligocene *F. mississippiensis*, include the greatest number of whorls in the protoconch. With the decrease in the number of whorls as the group advances through the later Tertiary and into the Recent there is an increase in the size of the initial whorl. In *F. papyratia* of the Recent Floridian fauna, which is similar to *F. mississippiensis* in the general character of the conch, there is a single nuclear volution, but it is relatively large and tumid.

Distribution in Mexico: Oligocene, U. S. G. S. station 13539, south of Rancho Miralejas, Carlos Cantú, Nuevo León, Mexico; U. S. G. S. station 13511, southeast of Rancho la Copa, Hacienda Zacate, Nuevo León, Mexico; U. S. G. S. station 14056, southeast of triangulation point Cuevito No. 2, Zacate, Nuevo León, Mexico; U. S. G. S. station 13505, 21 kilometers southeast of Ciudad Camargo, Tamaulipas, Mexico; U. S. G. S. station 13518, road from El Amole to Espiranza, Nuevo León, Mexico; U. S. G. S. station 14034, 2 kilometers west of Mendez, Tamaulipas, Mexico; U. S. G. S. station 14145, well at Rancho los Ebanitos, Carlos Cantú, Nuevo León, Mexico; and U. S. G. S. station 14147, northeast of Rancho Palo Blanco, Carlos Cantú, Nuevo León, Mexico.

Family BUCCINIDAE?

Genus BOLIS Gardner, n. gen.

Neptunea and *Chrysodomus* of authors. Not *Neptunea* Bolten, 1798 = *Chrysodomus* Swainson, 1840.

1937. *Sycostoma* Palmer. Not *Sycostoma* Cox, 1931 = *Sycum* Bayle, 1880.

Shell buccinoid. Spire elongated. Whorls rounded and shouldered by the deep incision of the sutures. Nucleus very small, paucispiral, and unsculptured. Sculpture of conch restricted to fine revolving lines and indistinct incrementals. Aperture rather narrow, obliquely lenticular, and, in the adult, almost as long as the spire, channeled posteriorly. Outer lip simple or lirate within. Columella straight, in the adults, feebly flexed in the young; reinforced by a heavy reverted callus, which completely conceals the umbilical opening. Anterior canal short, broad, only very slightly recurved, and truncate.

Genotype: *Bolis lisboa* Gardner, n. sp. Lower Claiborne of Alabama.

Bolis is referred to the hospitable group of the Buccinidae with no conviction. The aperture is too narrow, the outer lip too little expanded, the anterior fasciole not sufficiently elevated and the terminal notch, in consequence, too shallow. The forward swing of the growth lines upon the shoulder suggests *Sycostoma* to which Mrs. Palmer referred the species. The sycostomid characters are more accentuated in the juveniles than they are in the adult individuals. In the adults, the aspect becomes more buccinoid; the spire is higher relatively in the adults, the sutures channeled, the parietal wash heavy. There is, however, very little constriction of the inner lip at the base of the body. The pillar in *Bolis* displays nothing of the flattening which characterizes the pillar of *Melongena*. *Sycostoma* is placed by the systematists close to *Fulgur*. Certainly there is nothing in the aspect of the adult *Bolis* to suggest such a relationship.

The type species of *Neptunea* Bolten, as designated by Cossmann²⁸ in 1901, is *Fusus antiquus* Linnaeus, a Pliocene-Recent species of western Europe. *Bolis* differs from *Neptunea* in its shorter and less recurved anterior canal, its much more deeply incised sutures, which shoulder the whorls, and its lack of any strong spiral sculpture.

Only three species are assigned to this genus: *B. lisboa* Gardner, *B. enterogramma* (Gabb), and *B. mexicana* Gardner, the three of them restricted to the Claiborne of the Gulf Eocene.

***Bolis lisboa* Gardner, n. sp.**

Plate 8, figures 8, 9, 11, 12

1886. *Neptunaea enterogramma* Gabb. Aldrich, Alabama Geol. Survey Bull. 1, p. 47. Not *Neptunea enterogramma* Gabb, 1860.

²⁸ Cossmann, Maurice, Essais de paléonchologie comparée, vol. 4, p. 99, pl. 4, fig. 15, 1901.

1894. *Neptunaea enterogramma* Gabb. Aldrich, in Alabama Geol. Survey Rept. for 1894, p. 233.

1937. *Sycostoma enterogramma* (Gabb). Palmer, Bull. Am. Paleontology, vol. 7, p. 323 (ex parte), pl. 46, fig. 2?

Shell buccinoid in form, with a gradually tapering spire. Aperture more than half as high as the entire shell. Whorls straight-sided in the adults and strongly shouldered by the deep channeling of the sutures. Body constricted at the base. Protoconch not preserved but certainly of small size. Sculpture on the adult whorls consisting of a few ill defined revolving lines, crossed by indistinct incrementals, which strengthen slightly toward the mouth. Aperture obliquely lenticular, grooved at the posterior commissure. Outer lip nearly straight, unfortunately broken in the type specimens. Columella thickened by a heavy callus, which completely closes the umbilicus. Anterior canal short, truncated, and but very slightly recurved.

Dimensions of holotype: Height, 112.0 millimeters; greatest diameter, 62.0 millimeters.

Holotype: U. S. Nat. Mus. 494980.

Paratype: U. S. Nat. Mus. 494981.

Type locality: U. S. G. S. station 13433, bed 4 of C. W. Cooke's section at Lisbon Bluff, Monroe County, Ala.

Horizon: Lisbon formation, Claiborne group, Eocene.

Bolis lisboa differs from *B. enterogramma* (Gabb) in the much larger size, the more deeply incised sutures, the less rounded whorls, and in the more decided constriction of the adult body at the canal. *Bolis mexicana* is also smaller, and the more abruptly ascending spire includes fewer whorls than that of the Alabama species.

Mrs. Palmer has figured an excellent example of *Bolis* from Smithville. The contour both of the body and the spire seems more closely to resemble *lisboa* than *enterogramma*. The occurrence of *B. lisboa* at Smithville would be of unusual interest since it would forge another link in the chain which binds the Smithville fauna to that of bed 4 at Lisbon Bluff. Other diagnostic species common to the two faunas include *Ostrea lisbonensis* Aldrich and a race of *Venericardia planicosta* which is closer to the type from the Paris Basin than any other recognized in the Gulf province. True *Bolis enterogramma* seems, however, to be present in the Weches fauna upon the Sabine River so that the occurrence of *B. lisboa* at Smithville would certainly not be anticipated.

Distribution: Lisbon formation (bed 4), U. S. G. S. stations 5511, 13433, and 90943, Lisbon Bluff, Monroe County, Ala.

***Bolis enterogramma* (Gabb)**

Plate 8, figure 10

1860. *Neptunea enterogramma* Gabb, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 4, p. 378, pl. 67, fig. 14.

1881. *Neptunea enterogramma* Gabb. Miller, Cincinnati Soc. Nat. History Jour., vol. 4, no. 1, p. 9. Not *Neptunaea enterogramma* Gabb 1886, Aldrich, Alabama Geol. Survey Bull. 1, p. 47.

1891. *Clavella? enterogramma* Gabb. Heilprin, Acad. Nat. Sci. Philadelphia Proc. for 1890, p. 395. Not *Neptunaea enterogramma* Gabb 1894, Aldrich, in Alabama Geol. Survey Rept. for 1894, p. 233.
1914. *Neptunaea enterogramma* Gabb. Deussen, U. S. Geol. Survey Water-Supply Paper 335, p. 58.
1920. *Neptunaea enterogramma* Gabb. Dumble, Texas Univ. Bull. 1869, p. 94.
1920. *Chrysodomus enterogramma* Gabb. Dumble, Texas Univ. Bull. 1869, pp. 96, 97, 99.
1931. *Neptunaea enterogramma* Gabb. Renick and Stenzel, Texas Univ. Bull. 3101, p. 102.
1933. *Neptunaea enterogramma* Gabb. Plummer, Texas Univ. Bull. 3232, p. 663.
1937. *Sycostoma enterogramma* (Gabb). Palmer, Bull. Am. Paleontology, vol. 7, p. 323 (ex parte), pl. 46, figs. 2?, 5, 8.

Fusiform, smooth; whorls six, those of the spire rounded or obscurely angulated above the middle; suture deep; outer lip striate internally.

Dimensions: Length 0.9 inch, width of body whorl 0.5 inch, length of aperture 0.6 inch.

Locality: Wheelock, Tex. Smithsonian collection.

The striae on the inner side of the outer lip of the only specimen I have seen consist of four prominent lines above the middle and a few obsolete ones below. There are traces of a few impressed lines on the beak.—Gabb, 1860.

Gabb reports that the type specimen is in the Smithsonian collections, but I have been unable to find it either in the National Museum or with the rest of Gabb's Texas material in the Academy of Natural Sciences of Philadelphia. Gabb apparently described an immature specimen, but the species is well characterized and easily identified. *Bolis enterogramma* is the smallest of the species and the broadest relatively. It differs further from *B. lisboa* in the more sharply truncate anterior canal, more rounded whorls, less deeply impressed sutures, and in the striations on the inner surface of the lip, which may, however, have been present in the very young stages of the Alabama form.

The protoconch of *enterogramma* is paucispiral. That of a topotype includes two whorls, the initial turn somewhat flattened and immersed at the tip, the succeeding and final volution laterally compressed and relatively high.

Distribution: Weches greensand member of the Mount Selman formation, U. S. G. S. station 11104, west side of the Sabine River, 10 to 20 feet below the typical Cook Mountain formation, Sabine County, Tex.; U. S. G. S. station 11105, about 10 feet below the typical Cook Mountain formation, 2½ miles south of Low's Creek, Sabine River, on north side of John

Moore survey, half a mile east of intersection of survey line and Sabine River, Sabine County, Tex.

Cook Mountain formation, U. S. G. S. stations 5473, 10343, Moseleys Ferry, Burleson County, Tex.

Bolis mexicana Gardner, n. sp.

Plate 8, figures 5, 7

Shell of moderate dimensions for the genus, thick, biconic, the greatest diameter falling a little behind the median horizontal. Apex, including the entire protoconch, lost in all available material. Whorls of remaining conch numbering about six, broadly arcuate and rapidly enlarging after the manner of the buccinoids, the posterior margin rolled in at the deeply impressed suture. Outer surface smooth except for the incrementals and exceedingly faint and irregular spiral striae. Aperture rather narrow, obliquely lenticular, its characters very imperfectly preserved. Curvature of inner wall of aperture broad and smooth. Callus on inner wall unusually heavy. Anterior canal short, broad, and straight, the extremity broken in all of the specimens. Dimensions of imperfect holotype: Height, 72.5 millimeters; diameter, 37.0 millimeters.

Holotype: U. S. Nat. Mus. 495054.

Type locality: U. S. G. S. station 13790, 7½ miles southwest of Mier on main road from Mier to General Treviño, Tamaulipas, Mexico. Upper part of the Cook Mountain formation.

The species has been recognized also on the Texas side of the Rio Grande, in Zapata County, Tex.

Bolis mexicana is intermediate in size between *B. lisboa*, the Alabama species, and *B. enterogramma*, from eastern and central Texas. In relative dimensions *mexicana* more closely resembles the genotype, but the spire is lower and does not include so many whorls. The channeling of the sutures is similar in *lisboa* and *mexicana*, and the characters of the aperture are apparently similar in the three species.

Bolis mexicana has been recovered only from the upper part of the Cook Mountain in southern Zapata County and from Tamaulipas in the general vicinity of Mier.

Distribution: Cook Mountain formation, U. S. G. S. station 13170, Arroyo Veleño, 1 mile above highway bridge, Zapata County, Tex.; U. S. G. S. station 13790, 7½ miles southwest of Mier on Cerralvo road, Tamaulipas, Mexico; U. S. G. S. station 13980, on telegraph line Mier-Cerralvo, Tamaulipas, Mexico; and U. S. G. S. station 13986, on north boundary of lot 6, due east from northwest corner, Tamaulipas, Mexico.

PLATES 6-8

PLATE 6

FIGURES 1-3. *Tubulostium horatianum* Gardner, n. sp. (p. 19).

1. Attached surface of holotype (U. S. N. M. 483777), $\times 5$.
2. Medial portion of attached surface of holotype, $\times 10$.
3. Free surface of holotype, $\times 5$.

FIGURES 4-6. *Tubulostium leptostoma* (Gabb) (p. 19).

4. Free surface of specimen (U. S. N. M. 483778), $\times 5$.
5. Attached surface of specimen (U. S. N. M. 483779), $\times 5$.
6. Attached surface of specimen (U. S. N. M. 497153), $\times 10$.

FIGURE 7. *Tubulostium horatianum* Gardner, n. sp. (p. 19). Apertural view of holotype (U. S. N. M. 483777), $\times 5$.

FIGURES 8-10. *Tubulostium leptostoma* (Gabb) (p. 19).

8. Attached surface of specimen shown in figure 4, $\times 5$.
9. Apertural view of specimen shown in figure 4, $\times 5$.
10. Free surface of specimen shown in figure 5, $\times 5$.

FIGURES 11-13. *Tubulostium mcglameryae* Gardner, n. sp. (p. 18).

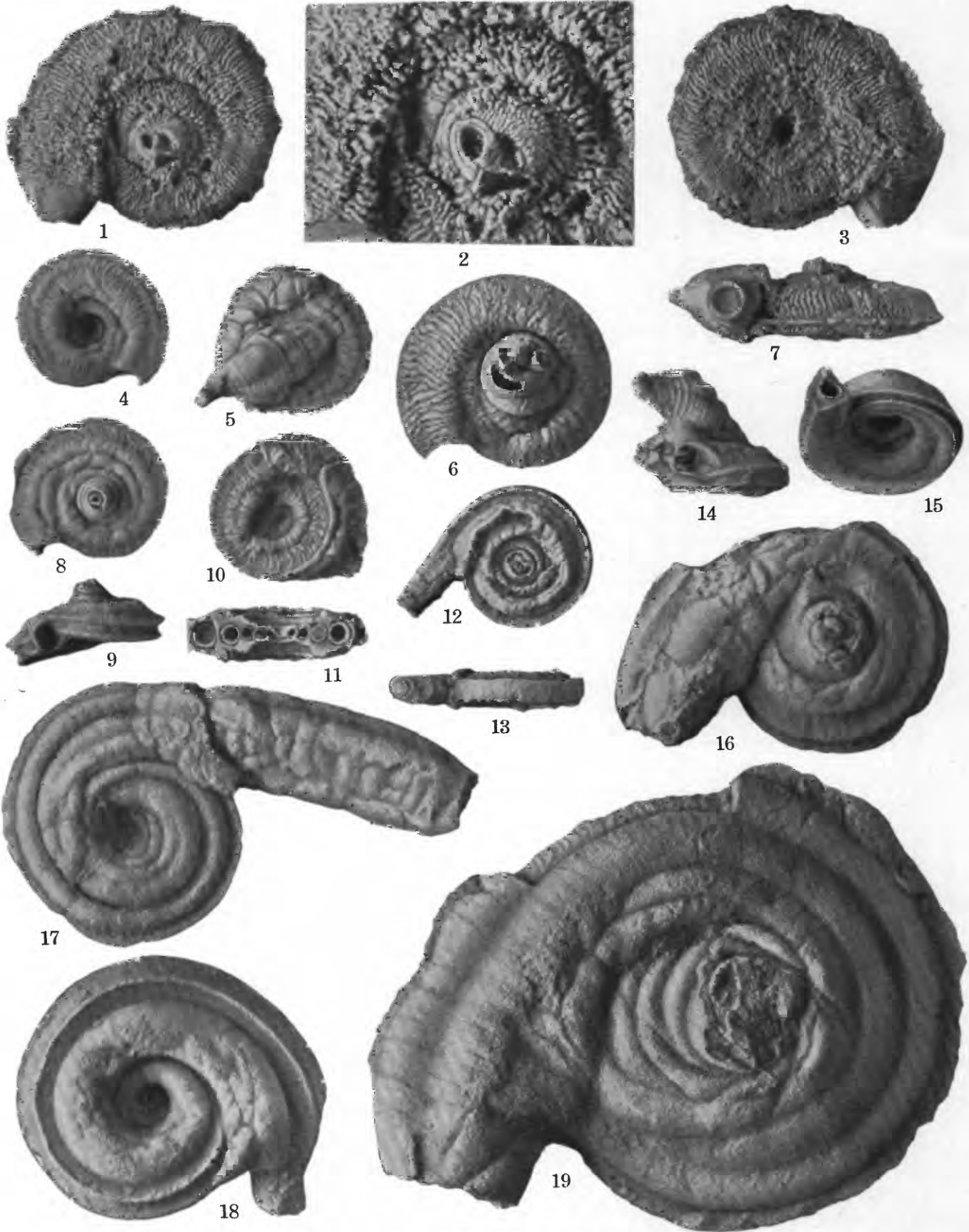
11. Cross section of paratype (U. S. N. M. 496015), $\times 5$.
12. Attached surface of holotype (U. S. N. M. 496015), $\times 5$.
13. Apertural view of holotype, $\times 5$.

FIGURES 14, 15. *Tubulostium leptostoma* (Gabb) (p. 19).

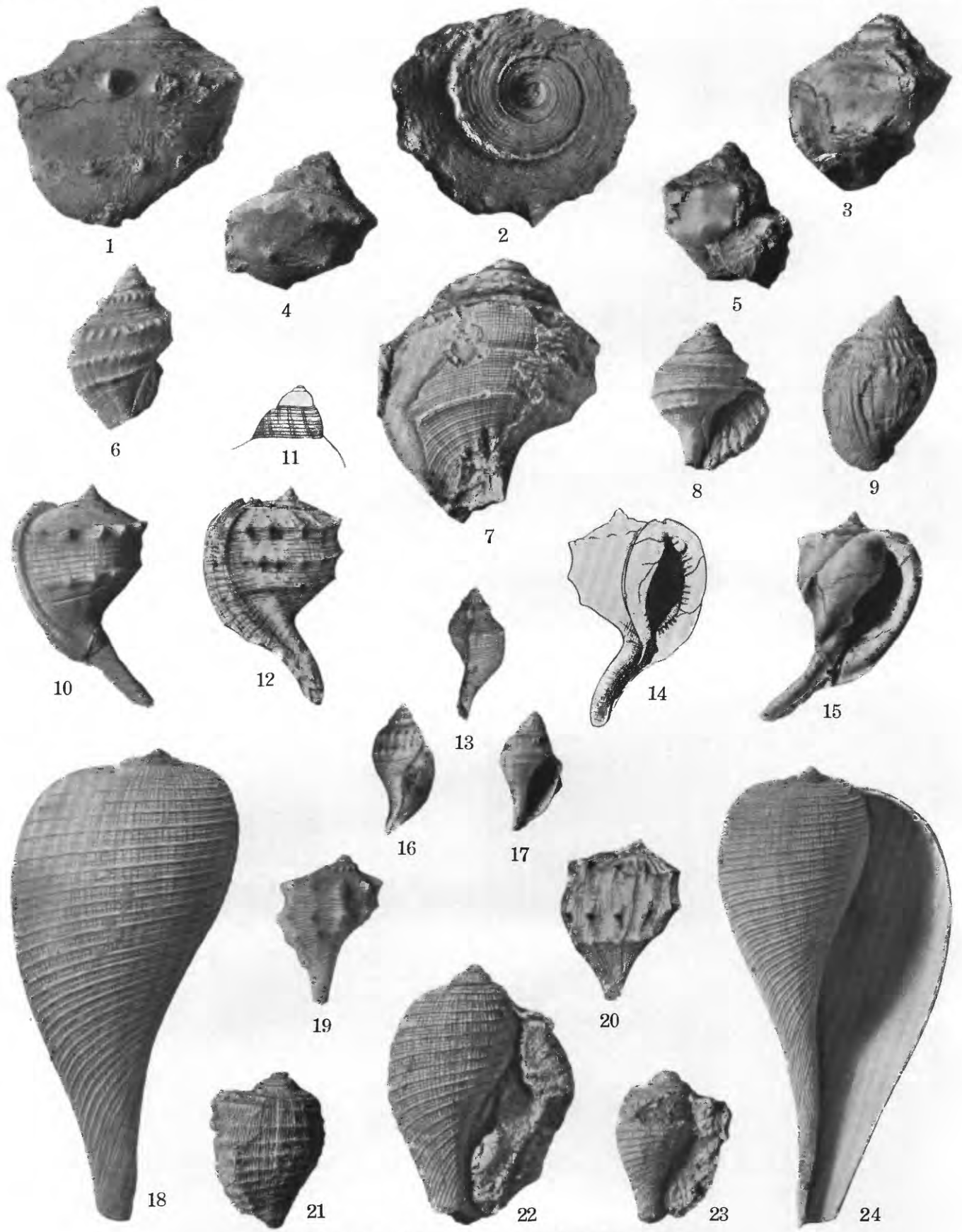
14. Apertural view of specimen shown in figure 5, $\times 5$.
15. Apertural view of specimen (U. S. N. M. 497154), $\times 5$.

FIGURES 16-19. *Tubulostium cortezi* Gardner, n. sp. (p. 20).

16. Attached surface of paratype (U. S. N. M. 497157), $\times 5$.
17. Free surface of holotype (U. S. N. M. 497155), $\times 5$.
18. Free surface of paratype (U. S. N. M. 497158), $\times 5$. Note variation in surface contour.
19. Attached surface of paratype (U. S. N. M. 497156), $\times 5$. Figured to show traces of unprotected inner tube.



ANNELIDS FROM THE EOCENE OF THE GULF PROVINCE.



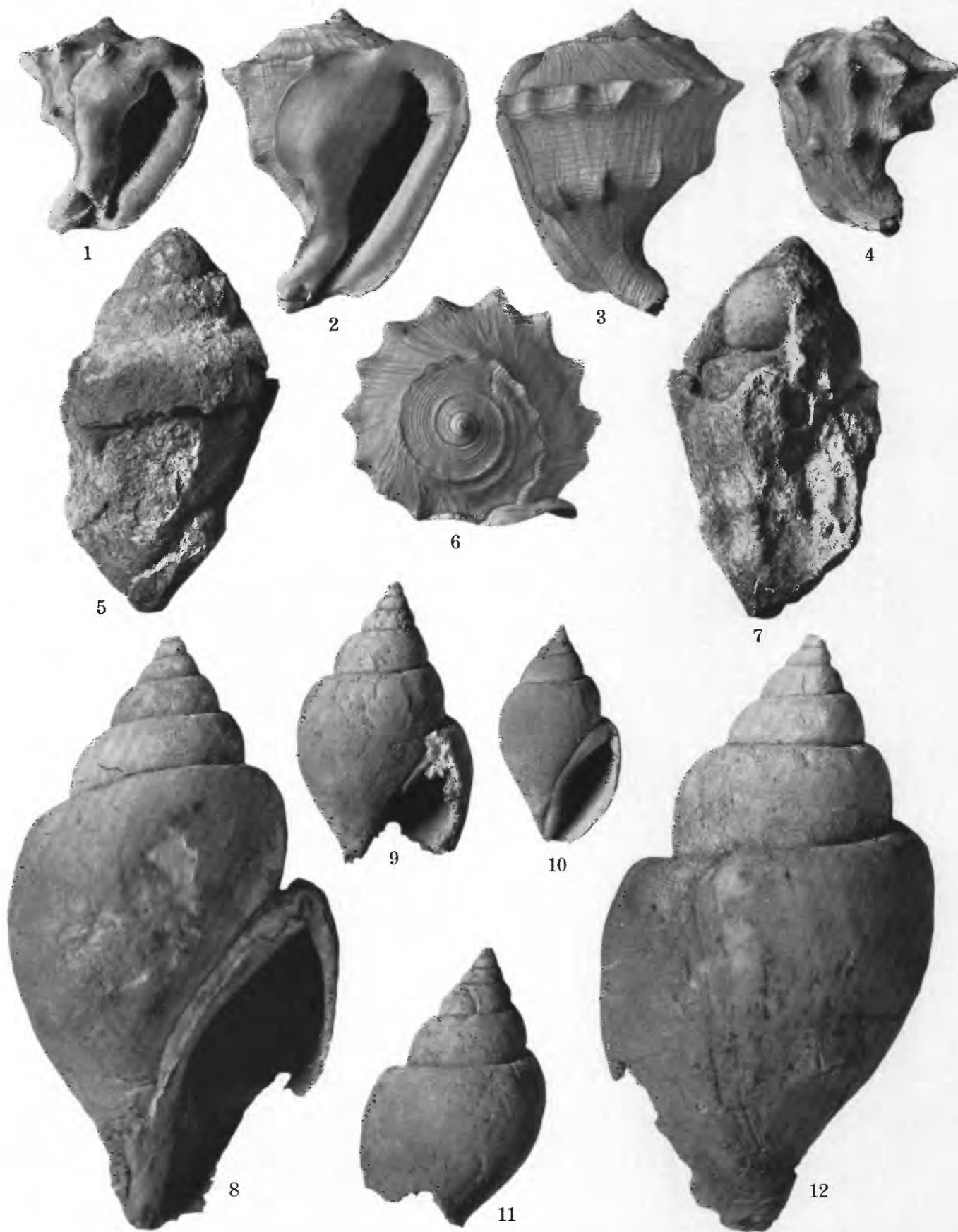
GASTROPODS FROM THE EOCENE OF THE GULF PROVINCE.

PLATE 7

- FIGURES 1, 2. *Galeodea (Mambrinia) planotecta* (Meyer and Aldrich) (p. 24).
 1. Rear view of specimen (U. S. N. M. 497066) from Carlos Cantú, Nuevo León, Mexico, $\times 2$.
 2. Apical view of specimen shown in figure 1. $\times 2$.
- FIGURES 3-5. *Galeodea (Mambrinia)* sp. (p. 24). Two imperfect specimens (U. S. N. M. 494973) from locality 4 kilometers north of estación Herreras, Herreras, Nuevo León, Mexico.
 3. Rear view of larger specimen, $\times 1$.
 4. Rear view of smaller specimen, $\times 1$.
 5. Apertural view of smaller specimen, $\times 1$.
- FIGURE 6. *Priscoficus (Fulguroficus) triliara* Gardner, n. sp. (p. 32). Rear view of holotype (U. S. N. M. 495180), from the Rio San Juan near the Rancho Viejo, below China, Nuevo León, Mexico, $\times 1\frac{1}{2}$.
- FIGURES 7, 8. *Perissolax diga* Gardner, n. sp. (p. 34). Holotype (U. S. N. M. 495179) from the Rio San Juan near the Rancho Viejo, Nuevo León, Mexico.
 7. Rear view of holotype enlarged to show sculpture detail, $\times 4$.
 8. Apertural view of holotype. $\times 2$.
- FIGURE 9. *Sconsia zacatensis* Gardner, n. sp. (p. 27). Rear view of holotype (U. S. N. M. 497067) from locality near Rancho La Capa, Zacate, Nuevo León, Mexico. Height, 22.7 millimeters; greatest diameter, 14.0 millimeters. $\times 1\frac{1}{2}$.
- FIGURE 10. *Galeodea (Mambrinia) planotecta* (Meyer and Aldrich) (p. 24). Rear view of topotype (?) (U. S. N. M. 494958) from Indian Mound, 3 miles east of Newton, Miss. Height, 43.5 millimeters; greatest diameter, 25.0 millimeters. (Shell broken at anterior canal and repaired.)
- FIGURES 11, 12. *Galeodea (Mambrinia) enodis* (Deshayes) (p. 25). Specimen (British Museum 56039) from the upper Bracklesham beds, southern England.
 11. Early whorls enlarged. (After Wrigley.)
 12. Rear view. (After Wrigley.)
- FIGURE 13. *Priscoficus (Fulguroficus) "tricostata* (Deshayes)" (p. 30). Side view of a specimen from Cuise, France. Height, 34.0 millimeters; diameter at right angles to greatest diameter, 15.0 millimeters. Slightly reduced. (After Cossmann and Pissarro.)
- FIGURE 14. *Galeodea (Mambrinia) enodis* (Deshayes) (p. 25). Apertural view of specimen shown in figure 12. (After Wrigley.)
- FIGURE 15. *Galeodea (Mambrinia) planotecta* (Meyer and Aldrich) (p. 24). Apertural view of topotype (?) shown in figure 10.
- FIGURE 16. *Priscoficus (Fulguroficus) "tricostata* (Deshayes)" (p. 30). Apertural view of specimen shown in figure 13, slightly reduced. (After Cossmann and Pissarro.)
- FIGURE 17. *Priscoficus (Fulguroficus) juvenis* (Whitfield) (p. 31). Apertural view of cotype (Walker Museum, University of Chicago, no. 24503). Height, 15.3 millimeters; greatest diameter, 8.0 millimeters. $\times 1\frac{1}{2}$
- FIGURE 18. *Ficus papyratia* (Say) (p. 34). Rear view of specimen (U. S. N. M. 325427) from the Pliocene of the Caloosahatchee River, Florida. Height, 87.0 millimeters; greatest diameter, 43.0 millimeters.
- FIGURE 19. *Priscoficus triserialis* (Whitfield) (p. 29). Rear view of holotype (Walker Museum, University of Chicago, no. 24515). Height, 20.0 millimeters; greatest diameter, 12.5 millimeters. $\times 1\frac{1}{2}$.
- FIGURE 20. *Priscoficus smithii* (J. de C. Sowerby) (p. 28). Rear view of specimen (British Museum, Geology 41, Morris collection) from the London clay of Portsmouth Docks, southern England. Reduced. (After Wrigley.)
- FIGURE 21. *Ficus amichel* Gardner, n. sp. (p. 34). Rear view of holotype (U. S. N. M. 496032) from Doctor Coss, Zacate, Nuevo León, Mexico. Height, 25.0 \pm millimeters; greatest diameter, 15.0 \pm millimeters. $\times 1\frac{1}{2}$.
- FIGURE 22. *Ficus mississippiensis* Conrad (p. 35). Apertural view of specimen (U. S. N. M. 495003) from locality near Rancho Gigante, Escondido, Tamaulipas, Mexico. $\times 2$.
- FIGURE 23. *Ficus amichel* Gardner, n. sp. (p. 34). Apertural view of holotype shown in figure 21. $\times 1\frac{1}{2}$.
- FIGURE 24. *Ficus papyratia* (Say) (p. 34). Apertural view of specimen shown in figure 18.

PLATE 8

- FIGURE 1. *Galeodea (Gomphopages) turneri* Gardner, n. sp. (p. 25). Apertural view of holotype (U. S. N. M. 495184) from locality 3 miles above the old Bureson Ferry, Bastrop County, Tex. Height, 43.0 millimeters; greatest diameter, 38.0 millimeters.
- FIGURES 2, 3. *Galeodea (Gomphopages?) millsapsi* Sullivan and Gardner, n. sp. (p. 26).
2. Apertural view of holotype (U. S. N. M. 496019) from Town Creek, Jackson, Miss. Height, \pm 60.0 millimeters; greatest diameter, 49.0 millimeters.
3. Rear view of same.
- FIGURE 4. *Galeodea (Gomphopages) turneri* Gardner, n. sp. (p. 25). Rear view of holotype shown in figure 1.
- FIGURE 5. *Bolis mexicana* Gardner, n. sp. (p. 37). Rear view of imperfect holotype (U. S. N. M. 495054) from locality $7\frac{1}{2}$ miles southwest of Mier on the road to General Treviño, Tamaulipas, Mexico. Height, 72.5 millimeters; greatest diameter, 37.0 millimeters.
- FIGURE 6. *Galeodea (Gomphopages?) millsapsi* Sullivan and Gardner, n. sp. (p. 26). Apical view of holotype shown in figure 2.
- FIGURE 7. *Bolis mexicana* Gardner, n. sp. (p. 37). Apertural view of holotype shown in figure 5.
- FIGURE 8. *Bolis lisboa* Gardner, n. sp. (p. 36). Apertural view of holotype (U. S. N. M. 494980) from Lisbon Bluff, Alabama River, 6 miles above Claiborne, Ala. Height, 112.0 millimeters; greatest diameter, 62.0 millimeters.
- FIGURE 9. *Bolis lisboa* Gardner, n. sp. (p. 36). Apertural view of imperfect paratype (U. S. N. M. 494981) from Lisbon Bluff, Alabama River, 6 miles above Claiborne, Ala. Greatest diameter, 33.0 millimeters.
- FIGURE 10. *Bolis enterogramma* (Gabb) (p. 36). Apertural view of specimen (U. S. N. M. 495020) from the Sabine River $2\frac{1}{2}$ miles south of Lows Creek, Sabine County, Tex. Height, 40.0 millimeters; greatest diameter, 22.5 millimeters.
- FIGURES 11, 12. *Bolis lisboa* Gardner, n. sp. (p. 36).
11. Rear view of paratype shown in figure 9.
12. Rear view of holotype shown in figure 8.



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