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THE MOLLUSCA OF THE JACKSON EOCENE OF THE MISSISSIPPI EMBAYMENT (SABINE RIVER TO THE ALABAMA RIVER)

By

Gilbert D. Harris
and
Katherine VanWinkle Palmer

First Section

Including Part I, Bivalves and Bibliography for Parts I and II

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THE MOLLUSCA OF THE JACKSON EOCENE OF THE MISSISSIPPI EMBAYMENT (SABINE RIVER TO THE ALABAMA RIVER)

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ABSTRACT

This report is devoted to the description and illustration of the Jackson Eocene molluscan fauna of the Mississippi embayment area. It is the final number of a series dealing similarly with Eocene stages, from basal Midwayan to upper Jacksonian.[1]

The fauna herewith discussed is most typically displayed in a triangular area with a southern base extending from the Sabine River to the Alabama and with a northern apex in the vicinity of Memphis, Tennessee. This fauna may be taken as a standard wherewith to judge degrees of relationship with faunas to the east and west, as well as those above and below. The number of mollusks herein discussed is about 330 of which 61 are referred to as new species or varieties and four as new genera or subgenera.

[1] Harris, G. D.: *The Midway stage*, Bull. Amer. Paleont., vol. I, No. 4, 1896, 156 pp., 15 pls.; *The Lignitic stage, Pt. I, Stratigraphy and Pelecypoda, op. cit.*, vol. II, No. 9, 1897, 102 pp., 14 pls.; *The Lignitic stage, Pt. II, Scaphopoda, Gastropoda, Pteropoda and Cephalopoda, op. cit.*, vol. III, No. 11, 1899, 128 pp., 12 pls.; *Pelecypoda of the St. Maurice and Claiborne stages, op. cit.*, vol. VI, No. 31, 1919, 268 pp., 59 pls.; *Turrid illustrations mainly Claibornian*, Palaeontographica Americana, vol. II, No. 7, 1937, 122 pp., 14 pls.; Palmer, K. V. W., *The Claibornian Scaphopoda, Gastropoda, and dibranchiate Cephalopoda of the southern United States, op. cit.*, vol. VII, No. 32, 1927, 730 pp., 90 pls.

*Manuscript completed May, 1945.

INTRODUCTION

The differentiation of the Jackson from other Eocene stages may be credited primarily to the joint work of B. L. C. Wailes of Mississippi and T. A. Conrad of the Academy of Natural Sciences of Philadelphia. Wailes stated on page 232 of his Report on the Agriculture and Geology of Mississippi that the Tertiary greensand marl at Jackson contains "an immense quantity of shells of the eocene period, differing from those at Vicksburg, and including species that are new and undescribed." Four plates (plates 14-17) and a list of 39 molluscan species by Conrad accompany this report. Descriptions were published in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1855, pages 257-263. Herein Conrad gave the sequence of Tertiary stages in the Gulf states as Claiborne, Jackson, Vicksburg.

In 1865 Conrad added 19 more specific characterizations of Jackson forms forwarded to the Academy of Natural Sciences of Philadelphia by Dr. Spillman. The shells were then supposed to be from Enterprise though now understood to have come from Garland Creek, Mississippi. (See Amer. Jour. Conch., vol. I, 1865, pp. 137-142, pl. 10.)

The sequence of stages mentioned above was fully corroborated by the stratigraphic work of Dr. E. W. Hilgard, State Geologist of Mississippi, and the paleontologic determinations of Prof. W. D. Moore of the State University (Report on the Geology and Agriculture of the State of Mississippi, 1860, p. XVII). On page 132 Moore listed more than 75 molluscan forms from the Jackson horizon at Jackson and on page 136 he enumerated more than 45 forms from a horizon between the Jackson and Vicksburg at Red Bluff. No descriptions nor illustrations were given.

A quarter of a century later the stratigraphic work of Prof. E. A. Smith and the paleontologic studies of the Honorable T. H. Aldrich gave the Gulf Coast Eocene geology a remarkable impetus. Aldrich's earlier descriptions and illustrations of species were summarized in Bulletin No. 1 of the Alabama Geological Survey, 1886, and were accompanied by descriptions and illustrations by Otto Meyer of many smaller Eocene species which ranged from lower Eocene to Vicksburg in age. Meyer's work will ever be remembered by his futile attempt to reverse the true order of these stages and make the Vicksburg the oldest and the Claiborne the youngest. (See Amer. Jour. Sci., vol. 129, 1885, p. 457.) Characterizations and illustrations of other small Jacksonian species will be found in his article, "Beitrag zur Kenntnis der Fauna des Alttertiärs von Mississippi und Alabama," (Bericht Senckenberg. naturf. Gesell. in Frankfurt a. M., 1886, (1887), 22 pp., 2 pls.) and a few were included in the Proceedings of the Academy of Natural Sciences of Philadelphia for 1887, pages 51-56, 1 plate.

During the next two decades Jackson paleontology was advanced by Dall's review of the Tertiary fossils of the Southern States, published in volume III of the Transactions of the Wagner Free Institute of Science of Philadelphia (1890-1903). Vaughan described several Jackson species in Bulletin 142 of the United States Geological Survey (1896).

The considerable development of Jacksonian species in the State of Arkansas was shown by G. D. Harris in volume 2 of the Geological Survey of Arkansas for the year 1892 (published 1894), pages 144-172, plates 6 and 7. This author also illustrated 18 Jacksonian mollusks in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1896, pages 470-474, plates 18, 19, mainly from the State of Mississippi. Notable consideration was given by Harris to the diminutive Jackson species, *Alveinus minutus* and *Kelliella bœttgeri*, in his monograph, "The Genera *Lutetia* and *Alveinus* especially as developed in America," (Palæont. Amer., vol. I, No. 2, 1920, 14 pp., 1 pl., text figs.)

In 1904 Thomas Casey named and described (without illustrations) a half dozen rather obscure turrids, mainly from Louisiana and Mississippi, in the Transactions of The Academy of Sciences of St. Louis, pages 131-170.

In 1918 C. W. Cooke had 200 molluscan species listed from the type locality, Jackson, Mississippi (Jour. Washington Acad. Sci., vol. 8, p. 190). In 1926 he described and figured 17 new forms from the same locality (*ibid.*, vol. 16, pp. 132-138).

The Jackson species of separate molluscan families have been given attention in various monographs and short papers on special subjects. The Jackson forms of the Arcidæ have been discussed by Sheldon,[2] of the Veneridæ by Palmer,[3] of *Aturia* by Stenzel,[4] of the Turritellidæ by Bowles, and Stenzel and Turner,[5] of the *Venericardia planicosta* group by Gardner and Bowles,[6] of the Cassididæ by Gardner,[7] and of *Lapparia* by Stenzel and Turner.[8] The species of the Jackson Mollusca have accordingly been included by the last authors in their card catalogue so far done on the Eocene in the "Type Invertebrate Fossils of North America."

The above-cited works, together with the references they contain, constitute the framework on which the present study is based. But our own five expeditions (two of which were aided by Grant No. 24338, Geological Society of America) have furnished nearly all of the specimens herewith illustrated. In the area under consideration we now enumerate about 330 molluscan forms.

As to relationship of species of Jackson beds to the species in the beds below and above, it is interesting to note the lack of many large and seemingly virile Gosport forms and the presence of forms having close relationship with pre-Gosport species. One might well expect *Crassatella alta*, *Venericardia alticostata*, *Lacinia alveata*, *Cornulina armigera*, and others to continue at least in the lower Moodys Branch fauna, but so far they have not appeared in any Jackson horizon. Again *Leda mutilineata*, found in pre-Gosport beds in Texas, does not occur in typical Gosport sand beds at Claiborne or Gosport. That species does filter into the uppermost Gosport beds at Gopher Hill and becomes one of the most widely distributed and characteristic species of the Jackson stage. At this locality, above the Gosport sand, the typical *Platyoptera*

[2] Sheldon, P. G.: Palæont. Amer., vol. I, No. 1, 1916, pp. 13, 21, pl. II, figs. 8-12.

[3] Palmer, K. V. W.: Palæont. Amer., vol. I, No. 5, 1927, 1929, pp. 17, 75, 87, pl. II, figs. 12, 14, 15; pl. XIV, figs. 17, 20; pl. XV, figs. 10, 12, 15.

[4] Stenzel, R. B.: Jour. Paleont., vol. 9, No. 7, 1935, p. 556, pl. 63, figs. 2 a-b, text fig.

[5] Bowles, E.: Jour. Paleont., vol. 13, 1939, pp. 275, 283, 306-308, pl. 31, figs. 5-7; pl. 32, figs. 1, 11; Stenzel, H. B., and Turner, F. E., Univ. Texas Publ. 3945, 1940, p. 841, pl. 47, figs. 4, 5.

[6] Gardner, J., and Bowles, E.: U. S. Geol. Survey, Prof. Paper, 189-F, 1939, pp. 176, 192, 193, pl. 37, fig. 13; pl. 38, figs. 5, 6; pl. 43, fig. 8; pl. 45, figs. 15, 16.

[7] Gardner, J.: U. S. Geol. Survey, Prof. Paper, 193-B, 1939, p. 26, pl. 8, figs. 2, 3, 6.

[8] Stenzel, H. B., and Turner, F. E.: *Op. cit.*, pp. 819-822, pl. 45, fig. 2; pl. 45, figs. 4, 6, 8, 9.

extenta indicates clearly the Moodys Branch horizon though here the rock consists of endurated calcareous sandy ledges instead of the marls of the type locality. We have as yet observed no abrupt change in sedimentation in passing from Jackson to Red Bluff formations. But below, the transition to Gosport or *Ostrea selleformis* beds in Alabama in the east or the Yegua (Cockfield) beds in the west is marked by clearly defined sedimentary changes. Cooke[9] found "at Willow Branch [western Alabama] and one or two other places there is evidence strongly suggestive of unconformity between this bed [basal Jackson] and the underlying Gosport sand." The subsequent inclusion of the Gosport sand in the Jackson Eocene by this author[10] and especially his use of the name "Moodys marl," to include all these beds, thus deleting the term Gosport or Claiborne sand as heretofore understood, seem uncalled for from stratigraphic data thus far obtained and unjustified from the standpoint of paleontology. (See Science, n. ser., vol. 92, 1940, p. 257.) The distinct lithologic and faunal differences between the Gosport sand and the typical Moodys Branch marl is well understood (Toulmin, Geol. Survey Alabama, Bull. 46, 1940, p. 41; First Field Trip S. E. Geol. Soc., S. W. Alabama, June, 1944).

From our studies of the fossils, they would suggest the following sequence in Mississippi, the type state, from the older to younger beds, represented by outcrops at Sims Siding, Garland Creek, Moodys Branch (the former probably being slightly older than Moodys), and Shubuta. In Louisiana and Louisiana-Texas line, the typical Jackson beds are present near Montgomery, on the Red River, Grant Parish, on the Sabine River, near Robinson's Ferry, Sabine County, Texas, and on the Ouachita River, in Caldwell Parish, Louisiana, from Stock Landing to Bunker Hill Landing. The Ouachita River section includes successively younger strata southward through the upper Jackson at Danville Landing, Carter Landing on the Ouachita and Bayou Toro in Vernon Parish. For a knowledge of the stratigraphic sequence

[9] Cooke, C. W.: Jour. Washington Acad. Sci., vol. 8, 1918, p. 190.

[10] Cooke, C. W.: Jour. Paleont., vol. 13, No. 3, 1939, pp. 337-340; Cooke, C. W., and Gardner, J., Bull. Geol. Soc. Amer., vol. 54, No. 11, 1943 correlation chart, No. 12.

of the Jackson formations in Louisiana since Veatch's[11] report on his memorable trip down the Ouachita, reference should be made to the several Bulletins published by Prof. Henry V. Howe and his associates.[12]

ACKNOWLEDGMENTS

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To Drs. Paul Bartsch and Harald Rehder of the United States National Museum, Dr. Horace G. Richards and Anne Harbison of the Academy of Natural Sciences at Philadelphia, Dr. Chas. Berry, Prof. J. T. Singewald, Jr., of the Johns Hopkins University, Miss Winnie McGlamery of the Geological Survey of Alabama, Dr. William J. Clench and Mrs. Margaret Frazier of the Museum of Comparative Zoölogy, and to Dr. A. K. Miller of Iowa State University, the authors wish to extend their thanks for many favors and courteous assistance given in connection with specimens and literature. Dr. William M. Ingram, of Mills College, graciously loaned photographs of the Cypræidæ.

We are grateful to Dr. Henry Howe of the Geology Department of Louisiana State University at Baton Rouge for the facilities offered for the study of the Jackson material in his laboratory.

LOCALITY LIST

The numbers given to the following localities are as listed in the station book of the Paleontological Research Institution. The age of the localities, unless otherwise stated, is Jackson Eocene.

Numbers 1, 2, 6, 7, 8, 9, 16, and 20 refer to collections made by A. C.

[11] Veatch, A. C.: Louisiana St. Exp. Sta. Geol. Agr. Louisiana, pt. 6, Sp. Rept. 4, 1902, pp. 149-172.

[12] Howe, H. V., and Wallace, W. E.: Louisiana Dept. Con., Geol. Bull., No. 2, 1932, 118 pp., 15 pls.; Howe, H. V., and Chambers, Jack, *ibid.*, Bull. No. 5, 1935, 65 pp., 6 pls.; Chawner W. D. *ibid.*, Bull. No. 9, 1936, pp. 81-93; Fisk, H. N., *ibid.*, Bull. No. 10, 1938, pp. 89-123; Huner, J., Jr., *ibid.*, Bull. No. 15, 1939, pp. 142-167; Welch, R. N., *ibid*, Bull. No. 22, 1942, pp. 26-33.

Veatch along the Ouachita River, Louisiana. A description of the localities and sections is found in Geol. Survey La., Rept. for 1902, Spec. Rept. No. 4, pp. 164-167, map pl. XXXIX.

1. Bunker Hill Landing, Ouachita River, Caldwell Parish, La.

2. Wyant Bluff [Myatt, Veatch, *op. cit.*, p. 166], Caldwell Parish, La.

4. Sabine River, just below Robinson's Ferry, Texas side. Veatch, Geol. Survey La., Rept. for 1902, Spec. Rept. No. 3, pp. 131, 132, map. pl. XXXIII, II.

6. Danville Landing, Ouachita River, Catahoula Parish, La.

7. One mile above Gibson Landing, Ouachita River, Caldwell Parish, La.

8. One-half mile below Gibson Landing, Ouachita River, La.

9. Gibson Landing, Ouachita River, La.

10. Montgomery Landing, Red River, Grant Parish, La. Coll. G. D. Harris and A. C. Veatch, 1899. Geol. Survey La., 1899, p. 91.

11. Upper bed, Montgomery Landing, Red River, Grant Parish, La. Coll. G. D. Harris and A. C. Veatch, 1899.

12. Tullos, Winn Parish, La., G. D. Harris and A. C. Veatch, 1899. *Loc. cit.*

14. Bayou Toro, SE. ¼ NW. ¼ sec. 6, T. 3 N. R. 11 W., Vernon Parish, La. Coll. G. D. Harris and A. C. Veatch, 1899. *Op. cit.*, p. 90.

15. Montgomery Landing, lower bed, Red River, Grant Parish, La. Coll. G. D. Harris and A. C. Veatch, 1899. *Op. cit.*, p. 91.

16. Grandview Bluff, Ouachita River, Caldwell Parish, La.

20. Carter Landing, Ouachita River, Catahoula Parish, La.

64. Opposite center of sec. 6, T. 3 N., R. 12 W., Texas, Sabine River, A. C. Veatch, coll., locality 30 (1902, pp. 131, 132). Same as Stas. 4 and 922, this list.

76. Jackson, Miss.

693. Jackson, Miss. Coll. Dr. J. M. Sullivan, 1925.

698. Hammaker's well, 12 S., 9 W., sec. 8, Arkansas, G. D. Harris.

699. Moodys Branch, Jackson, Miss.

700. Garland Creek, Clarke County, Mississippi.

702. White Bluff, Arkansas River, Jefferson County, Arkansas.

744. "Angelina Co., Texas southeast corner of Eliz. Bridges Sur. Taber Switch. T. & N. O. Just northwest of Shawnee Sta. '*Textularia dibollensis*' zone of the basal Jackson Eocene. Secured from the Humble O. & R. Co." Sent by L. C. Reed.

785. Town Creek in Jackson, Miss. Collected by G. D. Harris, K. V. W. Palmer, and R. H. Flower, 1935.

786. Moodys Branch, Jackson, Miss. Collected by G. D. Harris, K. V. W. Palmer, and R. H. Fowler, 1935.

787. Jackson marl, Jackson, Miss. Presented by Gideon Meador, Millsaps College, Jackson, Miss. 1935.

794. About 2-3 miles east of Shubuta, Clarke County, Miss. Zeuglodon locality, Jim Nelson's place. Collected by G. D. Harris, K. V. W. Palmer, and R. H. Flower, in 1935.

879. 1000 Poplar Boulevard at Peach Tree Street in bank of Moodys Branch on Dr. Day's property, Jackson, Miss. Collected by K. V. W. and E. L. Palmer, Sept. 1938. Geol. Soc. Amer. Grant No. 24338.

879B. Yazoo clay, overlying the Moodys Branch at Sta. 879. Collected by same as 879.

880. Town Creek, under and below G. M. & N. R. R. Bridge, end of State Street, Jackson, Miss. Presented by Sale Watkins, Jackson, Miss.

881. Town Creek, under and below G. M. & N. R. R. and new boulevard bridge, continuation of State Street, Jackson, Miss. Collected by G. D. Harris, K. V. W. Palmer, E. L. Palmer, and Sale Watkins, Sept. 1938. Geol. Soc. Amer. Grant No. 24338.

883. Montgomery, La., about one-half mile below the ferry, on the Red River, Grant Parish. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 1938. Geol. Soc. Amer. Grant 24338.

886. Danville Landing, Ouachita River, at E. D. Blyght house, Catahoula Parish, La. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 1938. Geol. Soc. Amer. Grant No. 24338.

894. Crow Creek, St. Francis Co., beneath, above and below road bridge on Highway 70 about 2 miles east of Forrest City, Ark. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 1938. Geol. Soc. Amer. Grant No. 24338.

895. In small stream bed on west bank of Crow Creek, St. Francis Co., about 800 feet south of road bridge or Sta. 894, Ark. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 8, 1938. Geol. Soc. Amer. Grant, No. 24338. (Zeuglodon locality.)

896. On west bank of Arkansas River, at White Bluff, Jefferson County. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 8, 1938. Geol. Soc. Amer. Grant No. 24338.

897. Vince Ferry, Saline River, Cleveland County, about 18 miles southeast of Rison, Cleveland County, Ark. Collected by G. D. Harris K. V. W. Palmer, and E. L. Palmer, Sept. 1938. Geol. Soc Amer. Grant No. 24338.

900. Garland Creek, near Shubuta, Clarke County, Miss. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 1938, Geol. Soc. Amer. Grant No. 24338.

912. Gibson Landing, Ouachita River, at the water's edge ¾ mile below the landing, La. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 14, 1938. Geol. Soc. Amer. Grant No. 24338.

913. Wyant Bluff [Myatt], west bank of Ouachita River, about 15 miles south of Columbia on Highway 106, La. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 1938. Geol. Soc. Amer. Grant No. 24338.

914. First R. R. cut south of City Water Works on G. M. & N. R. R., Jackson, Miss. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept. 1938. Geol. Soc. Amer. Grant No. 24338.

915. About 1 mile southwest of Sta. 914, in R. R. cut of G. M. & N. R. R., first cut northeast of freight station. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept., 1938. Geol. Soc. Amer. Grant No. 24338.

921. Moodys Branch, Jackson, Miss. Collected by A. A. Olsson.

922. Sabine River, Texas side opposite center sec. 6, T. 3 N., R. 12 W. Collected by A. C. Veatch. Same as Stas. 4 and 64 this list.

923. Bunker Hill, in road near top of the hill from Ouachita River, Caldwell Parish, La. Collected by G. D. Harris, K. V. W. Palmer, and E. L. Palmer, Sept., 1938. Geol. Soc. Amer. Grant No. 24338.

1046. Crow Creek, at bridge, St. Francis County, Ark. Collected by G. D. Harris, Nov. 3, 1940. Same place as locality 894.

1047. Crow Creek, zeuglodon bed, St. Francis County, Ark. Collected by G. D. Harris, Nov. 4, 1940. Same place as locality 895.

1048. Little Crow Creek, south of R. R. and highway on Crow Creek, about 2 miles east of Forrest City, Ark. Collected by G. D. Harris, Nov. 3, 1940.

1049. White Bluff, south bank Arkansas River, Jefferson Co., Ark. Mostly upstream from locality 896. Collected by G. D. Harris, Nov. 2, 3, 1940.

1050. Sims Siding about 8 miles north of Yazoo City, Miss. Collected by G. D. Harris, Oct., 1940.

1051. Town Creek, Jackson, Miss. Collected by G. D. Harris, Oct., 1940.

1052. End of railroad switch, ½ mile from water works, Jackson, Miss. Same place as locality 915. Collected by G. D. Harris, Oct., 1940.

1054. Lower layer (Moodys Branch marl), Red River, near Montgomery, La. Collected by G. D. Harris, Oct. 1940.

1056. Gopher Hill, above St. Stephens, first hard ledge above *Scutella* bed. Collected by G. D. Harris, Oct. 3, 1940.

1059. Gopher Hill, perhaps 30 ft. + above 1056. Collected by G. D. Harris, Oct., 1940.

1072. Perhaps 1 3 mi. above Gosport sand horizon, Little Stave Creek, about 4 miles north of Jackson, Ala. Collected by G. D. Harris, Oct. 4, 1940.

1076. Athletic field, Millsaps College, Jackson, Miss. Collected by G. D. Harris, Oct. 1940.

1091. Old field just south of Silas-Waynesboro Road, about 5 miles west of Silas, Ala. Collected by G. D. Harris, Oct., 1940.

1098. Garland Creek about 4 miles northeast of Shubuta, Clarke Co., Miss. (type locality). Collected by G. D. Harris, Oct., 1940.

1099. Garland Creek, 1-2 miles above bridge site at type locality, Miss. Collected by G. D. Harris, Oct., 1940.

1100. Garland Creek ½-1 mile below old bridge site, Miss. Collected by G. D. Harris, 1940.

1111. Garland Creek, loose material in bed of stream 2-3 miles south of bridge site, Miss. Collected by G. D. Harris, Oct., 1940.

1118. From ravines in little stream ½-1 mile back of Bunker Hill, Ouachita River, Caldwell Parish, La. Collected by G. D. Harris, Oct. 31, 1940.

1119. Bunker Hill bluff on Ouachita River, La. Collected by G. D. Harris, Oct. 31, 1940.

1120. Bayou Toro, "first bluff," Vernon Parish, La. Collected by G. D. Harris, Oct., 1940.

1121. One mile below Robinson's Ferry, Sabine River, Texas side. Collected by G. D. Harris, Oct., 1940. Probably same place as Sta. 4, 64, and 922 this list.

1122. Wooley's bluff, southeast of small creek, behind old Wooley housesite, about 100 yards from highway NW. ¼ SE. ¼ sec. 4. T. 3 N., R. 12 W., Sabine Parish, La. Collected by G. D. Harris, Oct., 1940.

PART I. BIVALVES
By
Gilbert D. Harris

Genus **GRYPHÆOSTREA** Conrad, 1865

(Name first used in American Journal of Conchology, vol. 1, p. 15; defined in U. S. Geological Survey of the Territories, vol. 9, 1876, p. 11.)

Genotype.—*Gryphæa vomer* Morton, Acad. Nat. Sci. Philadelphia, Jour., 1st. ser., vol. 6, 1828, p. 83.

Illustration.—*Gryphæa vomer* Morton, Amer. Jour. Sci., vol. 18, 1830, pl. 3, figs. 1, 2; Whitfield, U. S. Geol. Survey, Mon., No. 9, 1885, pl. 26, figs. 11, 12; Weller, New Jersey Geol. Survey, Paleont. vol. 4, Plates, 1907, pl. 44, figs. 10, 11.

The name *Gryphæa vomer* was proposed by Morton (1828, p. 83) for fragments "found abundantly in one of the upper marl beds near Egypt, N. J." The description of the species is incomplete and confused, with figures admitted by the author to be of another species. In "Silliman's Journal," vol. 17, Morton (1830, p. 283) noted that he had suspected the fragments referred to might belong to *G. convexa*, but that new and better material had come to hand fully establishing "the correctness of the specific designation allotted to this fossil." He proposed to give "an accurate drawing and description of it in the next number of this work," and later in 1830 the proposed figure did appear (vol. 18, pl. 3, figs. 1, 2); whereas the revised description was given in the Journal of the Academy of Natural Sciences of Philadelphia (1830, vol. 6, p. 198). As these figures and descriptions constitute the data on which the species *vomer* would seem to rest, we have copied the figures (Pl. 1, figs. 3, 4) and repeat the description:

Shell irregularly oblong; *upper valve* thin, fragile, slightly concave, with from seven to ten distinct squamous plates; *lower valve* convex, indistinctly lobed, lobed margin obliquely produced; *beak* prominent, pointed, crossing the hinge margin transversely, and recurving at the side.

It is but very recently that I have obtained entire specimens of this fossil; the Marl pits of New Egypt now afford them in considerable numbers.

In 1833, Morton began to take cognizance of the so-called "Newer Cretaceous" formations and fossils of Alabama and South Carolina (the result, evidently, of Conrad's famous trip through the South). In the American Journal of Science (1833, p. 293) he mentioned, *inter alia*, a *Gryphæa plicatella* as "a small species from the overlying limestone in Alabama," but deferred "further notice of it in hope of obtaining larger specimens." He illustrated this particular specimen, however, as figure 4, plate 9 of the Journal in advance of his "Synopsis" of 1834, while in this later work, he remarks (1834, p. 55), "The *G. plicatella*, published by me in the American Journal of Science, proves to be a variety of *G. vomer*." In the explanation of plate 9, figure 4, it is styled *Gryphæa vomer* (young shell).

Our figure 6, Plate 1, copied from Morton, is the *G. vomer* adult form, as understood by that author in 1834. This corresponds fairly well with the figures of that species by Whitfield and Weller as noted above. We may, therefore, cite *vomer*, as typically occurring in the Eocene beds about Egypt, N. J., and occurring in modified forms in Eocene beds farther south.

The propriety of designating the smaller, less arcuate—and, in general, simple Cretaceous—forms by the same specific name is at present an open question. (See Pl. 1, figs. 1, 2.)

Conrad first mentioned *Gryphæostrea* (1865, p. 15) as a subgenus under *Ostrea* and added, "*O. subeversa* C. Amer. Jr. Conch., 1865. U. Marlboro, Maryland." But as this is a *nomen nudum*, the characters of the subgenus may be regarded as having been duly established in 1876 in his letter (1876, p. 11, note) to F. B. Meek, where he gives them as follows:

> Shell thin, elongate, straight, narrow; lower valve rather deep and smooth; upper valve flat or slightly concave, and ornamented with distant, regular, thin, concentric laminæ; beak of lower valve contorted, or turned to one side; cartilage pit narrow, oblique.—*Gryphæa vomer* Morton.

Naturally we do not know which of the Mortonian forms Conrad had in mind when writing the above note, nor whether he would include his Upper Marlboro *subeversa* of 1865 with this *vomer* of 1876. But certainly there can be no ambiguity in the use of *Gryphæostrea* if based on the Eocene *vomer* as above described and as here illustrated by our figures 3-6, Plate 1.

We agree entirely with Whitfield (1885, p. 196) in according this full generic rank, as it certainly has very marked characteristics: large, smooth lower valve; oyster-like ligament more or less hidden by a laterally curved beak; shell margin (especially the posterior) tending to expand into alate attachment lamellae;

small, more or less concave upper valve with few, concentric lamellæ, and often with traces of two or three radiating folds toward the basal margin. As good representatives of this genus in the Old World may be mentioned the so-called *Ostrea lateralis* Nilsson, 1827, and *Gryphæa eversa* Mell 1843, from Cretaceous and Eocene horizons respectively. It may be here stated that as some American writers have referred the *vomer*-like forms to *lateralis* (presumably on the basis of priority) the foundation on which Nilsson's species rests seems quite as unstable (at least up to the time of Reuss's figures in 1846) as that underlying Morton's *vomer* up to 1830. (See Coquand, Monographie du genre *Ostrea*, 1869, p. 96, pl. 18, fig. 12; pl. 30, figs. 11-14.

Gryphæostrea vomer, var. **plicatella** (Morton) Plate 1, figs. 5, 7-13

Gryphæa plicatella Morton, 1833, Amer. Jour. Sci., vol. 23, p. 293; *idem.*, 1833, vol. 24, pl. 9, fig. 4.

Gryphæa plicatella Morton, 1834, Synopsis Organic Remains. Cret. Group, p. 55, pl. 9, fig. 4.

Morton's name *plicatella* seems to have been largely deleted from the paleontological literature of the past century; doubtless owing to the fact that he stated in 1834 that it "proves to be a variety of *G. vomer*." This identification by Morton, together with the literal meaning of *plicatella* and the fact that the type was "from the overlying limestone of Alabama" suggest that we may find Morton's name *plicatella* applicable to our Jackson representatives of *vomer* stock. Here as with the New Jersey types, there are practically as many forms as there are specimens, some of which we herewith illustrate. The valves are thin, and the upper (right) shows the typical concentric, heavy liration of *Gryphæostrea*. The lower valve is deep and smooth, with an umbonal twist to the rear. The adductor muscular scar is very slightly impressed, rather high and near the posterior margin. The bulk of the shell, instead of extending more or less posteriorly as in *Exogyra*, is projected anteriorly as in the genus *Lima*. The opisthogyrate beak nearly hides the small ligamental pit. Anchorage is brought about by intermittent growths of the post-superior shell margin. As growth proceeds, new laminæ are sent out, sometimes with hollow, spinelike projections recalling somewhat the labial projections of certain strombs or rostellaroids, *Locality.*—We have found this species in old fields from two to three miles east of Shubuta, Miss., associated with zeuglodon remains in calcareous clays. Similar beds, constituting the uppermost layers in the high bluff one and one-half mile north of Shubuta on the Chickasawhay River, contain good specimens of this species. The highly bryozonal layers in the cuts along the railway between the city water works and Jackson, Miss., likewise yield specimens of this species. We are not certain as to the exact locality about Claiborne where Morton's types were found, but in a road cut and old fields three miles west of Grove Hill and in an old field just south of the Silas-Waynesboro road, five miles west of Silas, good specimens are associated with zeuglodon and fish remains, together with fragments of a large *Aturia*.

The material here listed and figured is to be found in the cabinet of the Paleontological Research Institution, Ithaca, N. Y.

Genus **OSTREA** Linné, 1758
(Systema Naturæ, 10th ed., p. 696)

Genotype.—*Ostrea edulis* Linné, by Children, Quart. Jour. Sci. Lit. and Arts, vol. 15, 1823, p. 44.
Illustration.—*Ostrea edulis* Linné in Brown, Illustrations of the Recent Conchology of Great Britain and Ireland, 2d ed. 1842, pl. 30, figs. 6, 7; H. and A. Adams, Genera of Recent Mollusca, 1858, pl. 129, figs. 5a, b.

Ostrea vicksburgensis Conrad — Plate 1, figs. 15, 16; Plate 2, figs. 1-7

Ostrea vicksburgensis Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc., p. 296; 1848, *idem.*, Jour., vol. 1, ser. 2, p. 126, pl. 13, figs. 5, 37.
Ostrea mortoni Gabb, 1861, Acad. Nat. Sci. Philadelphia, Proc., p. 329.
Ostrea vicksburgensis Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 682.

The name "*Ostrea crista-galli*" was at first applied by Morton (1828, p. 92) to a single specimen from St. George's, Del. Two years later (1830, p. 284) he wrote, "I found a few valves at St. George's which have so much resemblance to this species that I shall for the present adopt the name. The *cristagalli* is a well-known fossil of the English Chalk."

Later (1830, pl. 3, fig. 22) the "*O. cristagalli?*" is illustrated, and still later (1833, p. 293) a new name, *panda*, is substituted. In the "Synopsis" (1834, pl. 3, fig. 6) a more detailed figure, seemingly of the same specimen, is given, while plate 19, figure 10 of the same work illustrates a more perfect specimen, supposed to be from Alabama. This is labelled "type" of Morton's *panda* (and Gabb's *mortoni*) in the collection of the Philadelphia Academy. On page 51 of the "Synopsis" occurs Morton's first description of *panda*, which is as follows:

Specific character.—Surface irregularly costate or undulated, plaited at the margin; with an irregular gibbosity, sometimes at the side, in others in the center of the shell.

The gibbosity of this species is very remarkable, but is very inconstant, and sometimes absent. Referred in the former edition to *O. cristagalli*.

Chiefly found at St. George's, Delaware, and since in South Carolina and Alabama, where it is one of the most charactertistic fossils of the newer Cretaceous strata.

Whitfield (1885, p. 30) has limited the name *panda* wholly to southern, Eocene specimens. Weller (1907, p. 438) writes:

Judging from the Delaware locality given by Morton, St. George's, the original specimens of the species must certainly have been from the Cretaceous.

Since the name *panda* (like that of *vomer*) was first applied to northern material before southern material was taken into consideration, it would seem that it should be used only for the northern, Cretaceous specimens, while other designations should be given the distantly related southern, Tertiary forms. That this was Gabb's view is evident from the following passage from the Proceedings of the Philadelphia Academy (1861, p. 328):

I have before me full series of both [species]. The cretaceous form, the one to which the name [*panda*] will have to apply, is, without exception, the most irregular oyster I have ever seen. It varies from crescentic to obliquely ovoid, sub-quadrate, oval or almost circular, and is marked by from two or three undulations or contortions to nearly twenty radiating ribs, which are sometimes smooth, and at others coarsely imbricated. The lower valve is usually attached, but, when free, is flat for half or two-thirds of its length and is then bent upwards at various angles, often nearly a right angle. The line at which the two valves meet is well defined.

The shell is usually about an inch long. I have never seen one more than an inch and a half in length. Professor Safford, State Geologist of Tennessee, sent me numerous species [specimens?] from the Ripley group of that state. I shall name the Eocene species in honor of Dr. Morton.

The name, *mortoni*, proposed by Gabb for the southern, Eocene, form and based on the specimen now labelled as the type of *panda* and *mortoni* in the Academy's collection, may perhaps be useful to designate the more angular, often spinose ribbed, forms of *vicksburgensis* Conrad, abundant in the zeuglodon beds of the southern states, while *vicksburgensis, s. s.* may be regarded as more characteristically represented by the larger, more rounded-ribbed forms illustrated by Conrad on plate 13, figure 5, of the Philadelphia Academy's Journal as noted above in the synonymy. His figure 37, however, seems to be a more or less deformed variety of the *mortoni* type.

To complete the definition of *mortoni*, we quote the description of the same as given by Gabb (1861, p. 329):

O. Mortonii G., *O. panda* M. *pars*, Syn. pl. 10 [19], fig. 10. Shell oblique, triangular to subquadrate. Both valves strongly plicated. Lower valve, especially in young specimens, usually convex, deepest in the middle, but rarely bent abruptly, and then usually from having been encrusting. Hinge distinct, very oblique and nearly as high as wide, with a distinct medial depression. Placing the lower valve in its natural position, with the beak farthest off, the left basal angle is always most produced, the right side from the hinge to this angle being more or less regularly curved, and the left side nearly or quite straight. Surface marked by a slightly variable number of ribs, usually about eleven, one or two of which are often much larger than the others; the longest side being without ribs, except in very large specimens, when there will sometimes be found a dozen small supplementary ones. Upper valve nearly or quite flat, and always plicated as strongly as the lower ones, and in a corresponding manner. As the shell increases in size, the form and markings become less regular, sometimes the plications equalling in depth one third of the length of the shell.

Mr. Morton's figure is a very accurate representative of the original, now before me. Another specimen from the same bed is 2.5 in. long. Width, 3 in. Diameter 1.5 in. Greatest oblique width, 3.5 in.

Very common in the Eocene limestone of South Carolina, and in the same formation from Alabama.

Ostrea Vicksburgensis Cuv. [Con.] can be distinguished from this species by its more regular form, deeper valves, and smooth rounded ribs.

Locality.—Broadly plicate forms: Bunker Hill and Gibson Landing on the Ouachita River, also at Tullos and Tancock Prairie in Louisiana; Shubuta in Mississippi; St. Stephens in Alabama. Sharply spinose, or more sharply plicate forms: Shubuta and especially one mile south of Melvin, Miss.; site of old Cocoa Post Office and St. Stephens, Ala.; not rare in Red Bluff and Vicksburg beds in Mississippi.

Specimens figured.—Paleontological Research Institution.

Ostrea cretacea Morton

This name was given by Morton (1834, p. 52, pl. 19, fig. 3) who wrote:

. . . Common in the older cretaceous strata of Green County, Alabama. This species is very abundant in the bluff at Erie where it constitutes a distinct stratum. It is also common in the calcareous strata of South Carolina.

Various authors have applied the name to specimens found in the calcareous layers of the upper Eocene of the Gulf States.

The figured type, in the Philadelphia Academy's collection, is labelled "Upper Cretaceous, near Charleston, S. C."

In 1892, after studying this type with accompanying specimens, we found nothing in common between it and any known Eocene form. Stephenson (1923, vol. 5, p. 136) wrote concerning the species:

In the collection of the Academy of Natural Sciences of Philadelphia are four specimens labelled *Ostrea cretacea* Morton, from Charleston, S. C.; one of them, a lower valve marked type, appears to be the figured specimen. I have compared the type and the three accompanying paratypes with numerous authentic specimens from Erie Bluff, Warrior River, Ala., and am convinced that the types are incorrectly labelled and came from Erie Bluff instead of from South Carolina. Two of the paratypes have the two valves attached to each other and the matrix inclosed between them, a loose gray, sparingly glauconitic sand, appears to be identical with that in which the Erie Bluff specimens are found.

From the above remarks it seems unnecessary to give details of the supposed occurrences of this species in Eocene deposits.

Ostrea falco Dall — Plate 3, figs. 1-9

Ostrea falco Dall, 1895, U. S. Nat. Mus., Proc., vol. 18, p. 22.
Ostrea falco Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 682, pl. 30, figs. 4,11.

Dall's description.—Shell thin, the fixed valve thin, irregular, cellular or deep, adherent over most of its surface, having a deep umbonal cavity under the cardinal border; the exterior rude not perceptibly sculptured; free valve flat, thin, with a very acute usually curved flat beak; the interior margins with a row of strong pustules extending two-thirds the length of the valve from the beak and fitting into corresponding pits in the fixed valve; adductor scar small, rather laterally situated; the valves as a whole more or less arcuate; exterior showing remains of a purplish tint, with low, numerous, even, concentric imbrications, each of which is finely radially threaded with rather wide interspaces between the threads; general outline flabelliform, wide and rounded in front and acutely pointed behind. Height of a medium-sized specimen, 52; width, 35; diameter about 19 mm. but very irregular in different specimens.

Jackson Eocene in the Zeuglodon bed near Cocoa post-office, southern Alabama, collected by Messrs. Burns and Schuchert.

Type No. 129972 U. S. N. M.

Oysters are proverbially difficult and obscure mollusks; but probably no other species, recent or fossil, is more characteristic and distinct than the one above described.

Our specimens from Shubuta, Miss., show clearly the main characters of this species: the clear-cut arcuate form figured by Dall is of somewhat rare occurrence. Notice the difference in exterior sculpturing brought about mainly by differing strength of concentric striation. Compare figure 4, from Shubuta, with figure 9, from Montgomery, La.

This type of oyster is clearly foreshadowed by *O. rabelaisi* (of the Cretaceous Campanian stage) as described and illustrated by Coquand (1869, p. 66, pl. 37, figs. 26, 27).

Locality.—We have found this species most abundantly in the old fields about two miles east of Shubuta along with abundant zeuglodon remains. Dall's type seems to have been from near the site of old Cocoa Post Office; we have it from an old field, Silas—Waynesboro road, about five miles west of Silas, Ala., and from Montgomery, La. This last-mentioned horizon probably represents a somewhat lower one than that of the other localities.

Specimens figured.—All are now in the Paleontological Research Institution.

Ostrea trigonalis Conrad Plate 4, figs. 1-6
Plate 5, figs. 1-3

Ostrea trigonalis Conrad, 1854, Wailes, Rept. Agric. and Geol. Mississippi, pl. 14, fig. 10; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 259; 1865, Amer. Jour. Conch., vol. 1, p. 15.

Ostrea panda formis Gabb, 1861, Acad. Nat. Sci. Philadelphia, Proc., p. 328.

Ostrea tuomeyi Conrad, 1865, Acad. Nat. Sci. Philadelphia, Proc., p. 184.

Ostrea mortoni Aldrich, 1887, Cincinnati Soc. Nat. Hist., Jour., vol. 10, p. 79.

Ostrea trigonalis Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 681.

Conrad's description.—Triangular, flat, surface irregular, with some indistinct radiating lines; muscular impression obliquely suboval, situated nearer the summit than the base; margin somewhat ascending, submargin carinated.

A single imperfect upper valve is all that I have seen of this shell, but it is widely different from any other Eocene species known to me.

Conrad's description, though brief and based on one imperfect upper valve, points out some marked characteristics of this species. Our specimens indicate that, when young, this species tends to have a thin, flat, circular or *Anomia*-like shell. The adherent valve generally is flat and thin until a diameter of 20 or

30 or more millimeters is reached. Afterwards it may be bent up marginally, *Leptæna*-like, and become very ponderous. The muscular scar then becomes very deeply impressed and seems centrally located; hinge area becomes flat and broad, and the central channel deeply grooved; the resemblance to *O. percrassa* becomes marked. The upper valve generally remains comparatively thin and flat, but may be locally flexed and concave; ends of hinge line generally showing "vermicular structure" (Dall) and raised, forming a secondary type of articulation somewhat after the manner of old specimens of large Cucullæas, or, more exactly, like this structure in *O. latissima* Deshayes of the Paris Basin. Exteriorly this valve often develops a radiate etching, precisely as in *Gryphæa vesicularis* Lamarck, though usually, with the thickening of the shell, concentric structure becomes strongly developed, and all traces of radiation disappear.

For convenience in future study of this species, the names and descriptions given by Gabb and Conrad for large specimens, as cited in the synonymy, are herewith incorporated.

Gabb's description of *pandæformis*:

Subquadrate. Lower valve very convex, nearly pyramidal, most prominent in the center, from which point the sides slope abruptly, the anterior half forming nearly a right angle with the line running from the beak to the crest. Laterally the slope is not so great. Upper valve flat, for the first third of its length, then convexly curved downwards, the anterior half becoming deeply concave in the middle.

Holding the shell so that the beaks are farthest off, the right side is entire; the left side is emarginate towards the basal margin. Surface strongly imbricated, the surfaces of the layers being smooth; no costæ visible on the surface.

Length, 3 in. Width, 2.5 in. Greatest depth, 2 in.

Locality, "seven miles below Yazoo, Mississippi." My collection. From Dr. Janeway, U. S. A. Most probably Cretaceous.

The irregular form of this shell makes it exceedingly difficult to describe. It resembles, remotely, some of the regular forms of *O. panda* Morton, but can be distinguished by its much greater size, the deeper inferior valve, the entire absence of ribs, and the strongly imbricated surface. The growth of the shell has been a little oblique, making the striæ, especially of the upper valve, somewhat excentric. It wants entirely, however, the spiral form of *Exogyra*.

Conrad's characterization of *O. tuomeyi*:

The rock of this county [Jasper], in which the fossils occur, is stated by Hilgard to be of the Jackson Group (Upper Eocene). The species are *O. tuomeyi*, Con., *Mortonia turgida*, Con., *Pecten poulsoni*, Morton, *P. perplanus*, Morton, *Carcharodon angustidens* Agass., *Orbitolites Mantelli*, Morton. The former of these I suppose to be the shell which Tuomey found so common in the Basilosaurus limestone in Alabama, and which he referred to *Pycnodonta vesicularis* (*Gryphæa mutabilis*, Morton). It is very different, however, and may be distinguished by the following characters:

Ostrea tuomeyi.—Ovate, sublobate, lower valve deep, umbo narrow, rough and unequal in surface, with rough lines of growth, not distinctly plicate; upper valve convex above, slightly convex below, with a rough and unequal surface; concentric lamination very prominent when weathered. It differs from *P. vesicularis* especially in wanting the inner plications about the upper submargins of the interior, and the umbo is much narrower; it is also a true *Ostrea* whilst the *vesicularis* is the type of the genus *Pycnodonta*, Fischer, and characterizes the cretaceous era.

Aldrich (see synonymy) makes the following remarks regarding Gabb's *pandæformis*:

This fossil was described as cretaceous, because it was received from a black prairie near Yazoo City, Miss. This locality is not Cretaceous but Tertiary, and a part of the Jackson group. We also have it from Shubuta, Miss., and it is rather common in the strata holding Zeuglodon bones. It closely resembles an old and large *O. mortonii*, Gabb (*panda, pars*). Specimens in my cabinet are six inches broad from beak to ventral margin. It seems to have been known to Professor Tuomey, and was called *Gryphæa mutabilis* by him. *Ostrea tuomeyi*, Con. (Proc. Acad. Nat. Sci., p. 184, 1865) is evidently the same form. It is quite probable that all three names will have to be placed in the synonymy of *Ostrea mortonii*, Gabb (*panda, pars*).

Dall (1898, p. 682) takes a rather broad view of this species as will be seen by the following remarks:

The original figure of Conrad is very poor. The species is wide-spread and recognized by its flat upper valve, few ribbed lower valve, straight hinge-line, flat hinge-area, with excavated central channel and the peculiar vermicular sculpture of the submargin on each side near the hinge-line. It is not improbable that *O. percrassa* Conrad is a peculiar local race of this species and that *O. mortonii* Gabb and *O. vicksburgensis* Conrad are young pebble-grown shells of the same species as the large, well grown specimens which I regard as normal *trigonalis*. The differences are, however, so marked that it is probably best to keep them separate for the present until more is known. *O. subtrigonalis* Evans and Shumard is a Cretaceous species. Varieties of *O. compressirostra* approach very closely to this species.

Dall gives his species a range from the Jacksonian Eocene of Louisiana to the Miocene of North Carolina and even the Pliocene of Florida.

Localities.—This is the large, characteristic oyster of the Jackson beds of the Mississippi Embayment area. It may be expected from central Louisiana to Alabama in both the Garland Creek and zeuglodon horizons. On the Ouachita, it shows immature forms, while at Montgomery, La., larger specimens are noted, seemingly of more *virginica*-like outline, but with beginnings of "vermicular" lines in the umbonal region and with fine radii on the outward slope of the "submarginal" carination as noted by Conrad. Town Creek, at Jackson, furnishes excellent large specimens, while those between the city water works and the city are apt to be less ponderous. Fair specimens are obtained from the athletic grounds of Millsaps College, at Jackson, Miss. Sims Siding north of Yazoo City, Miss., and other localities about this town, as indicated above, have furnished good examples of this species. Prairies south of Newton, Miss., often show large specimens at the roadside. Garland Creek and the high bluff one and a half mile above Shubuta yield specimens in a fair state of preservation. Heavy ones may be found at ten feet above water level at low stage in the east bank of the Chickasawhay Creek, one-quarter mile below the old road bridge south of Shubuta. In the old fields two miles east of Shubuta, this ponderous species is found associated with the more delicate *O. plicatella* and varieties of *vicksburgensis,* together with zeuglodon fragments in abundance. It is common south of the highway near the site of the old Cocoa Post Office.

Specimens figured.—As noted under *Explanation of Plates,* the specimens figured are from Jackson and Shubuta, Miss., and show various stages of development. They are in the Paleontological Research Institution.

Genus **PLICATULA** Lamarck, 1801
(Système des Animaux sans Vertèbres, p. 132)

Genotype.—*Spondylus plicatus* Linné, *fide* Gray, Zoöl. Soc. London, Proc., pt. 15, 1847, p. 201.

Plicatula plicata Forskal, *fide* Stoliczka, Palæont. Indica Cretaceous Fauna S. India, vol. 3, 1871, p. 440.

Plicatula gibbosa Lamarck=*P. ramosa* Lamarck, *fide* Gardner, U. S. Geol. Survey, Prof. Paper, No. 142A, 1926, p. 51.

Illustration.—*Spondylus plicatus* Chemnitz, Conch. Cab., vol. 13, pl. 47, figs. 479-481b; *Plicatula ramosa,* Tryon, Structural and Systematic Conchology, vol. 3, 1884, pl. 131, fig. 69.

Plicatula (?) **louisiana**, n. sp. Plate 5, figs. 5, 5a

Characterization.—General form and size as indicated by the illustrations; very young shell inflated and narrow, but soon rapidly and broadly flattening as in *Ostrea anomiæformis* Roemer, Coquand (1869, pl. 4, fig. 14); exterior nearly smooth, but with indications of faint radii; margin noncrenulate; muscular impression large, nearly circular; hinge broken and imperfect, but giving the impression of consisting of two strong hinge teeth, quite different from any cardinal growths in *Ostrea;* left valve only known.

Viewed exteriorly, this shell looks decidedly like a rather smooth *Crepidula.* The nearly circular muscular scar and the indications of strong cardinal teeth have caused us to refer this specimen, at least temporarily, to *Plicatula,* although the typical plicæ are missing.

Occurrence.—Upper layer in bluff at Montgomery on the Red River, La.

Holotype and specimen figured.—From Montgomery, La.; Paleontological Research Institution.

Plicatula filamentosa ? Conrad Plate 6, fig. 1

The *Plicatula* herewith figured is of the general *filamentosa* stock, though exact determinations cannot be made from such imperfect specimens. Its height is 18 mm. It was obtained west of Silas and perhaps one mile east of the site of old Fail Post Office.

Paleontological Research Institution.

Plicatula filamentosa Conrad Plate 6, fig. 1a

So far as the fragment here illustrated goes, there would seem to be little doubt as to the identity of this with the Claiborne form so named. Height of shell fragment 16 mm. From Bunker Hill, Ouachita River, La. Other similar specimens are from Montgomery, La.

Specimen figured.—Paleontological Research Institution.

Genus **SPONDYLUS** Linné, 1758
(Systema Naturæ, 10th ed., p. 690)

Genotype.—*Spondylus gædcropus* Gray (*S. gædcropus* Linné), Zool. Soc. London, Proc., pt. 15, 1847, p. 201.

Illustration.—*Spondylus gædcropus* Chemnitz, Conch. Cab. 1795, pl. 45, figs. 466, 467; *S. gædcropus* Reeve, Conch. Icon., vol. 6, 1856, *Spondylus,* pl. 3, fig. 13.

Spondylus dumosus (Morton) Plate 6, figs. 2, 2a

Plagiostoma dumosum Morton, 1834, Synop. Organic Remains Cretaceous Group U. S., p. 59, pl. 16, fig. 8, text fig. p. 60.

Morton's description.—Shell obovate, slightly ventricose, with nine or ten slightly elevated ribs, armed with long spines on each valve; spines flattened with a longitudinal groove beneath; intervals between ribs, with two or three slightly prominent longitudinal lines . . . Largest specimen "from beak to base, three inches . . ." Mr. Conrad observed a stratum of this species, in company with *Ostrea panda* near low water mark, in the interesting bluff at St. Stephens, on the Tombecke; and it is a characteristic species of the newer Cretaceous deposits of the southern states.

Dall (1898, p. 758) notes the occurrence of this species as follows:

Eocene of the Jacksonian horizon, St. Stephens, Clarke County, Cocoa Post-Office, Choctaw County, &c., Alabama; Red Bluff, Wayne County, Carson's Creek, near Shubuta, and Chickasawha River, Wayne County, Mississippi.

This would seem to be a most characteristic species of the Red Bluff Oligocene, especially if the *Spondylus* bed at the base of St. Stephens bluff is regarded as of this horizon. The alleged occurrences in the lower portion of Claiborne bluff seem to be due to mistaken stratigraphic relations of the various beds as primarily interpreted by Morton and Conrad. (See section, p. 87, of Morton's Synopsis as cited above.)

Dall's reference to Cocoa Post Office would suggest that this species may occur in upper Jacksonian beds. The numerous fragments scattered over the weathered surface in an old field south of Melvin in company with zeuglodon remains suggest either a former occurrence of Red Bluff beds in that vicinity or a Jacksonian age for this *Spondylus*. Red Bluff relationship here is suggested by the presence of *Astarte triangulata* Meyer.

Aldrich's statement (1885, vol. 30, p 305) that he found this species 25 feet below the Buhrstone at Hatchetigbee is noteworthy. Our specimens from there as described and figured in these Bulletins (1897, vol. 2, p. 234, pl. 12, fig. 11) seem scarcely determinable specifically; hence their identity with *dumosus* is in doubt.

After following the meandering of Little Stave Creek some distance above the Claiborne-Jackson contact, one finds whitish cliffs with *Spondylus* fragments, Pectens and large Lepidocyclinas, but exact formational delimitations have yet to be made.

Specimens figured.—The fragments shown are associated with zeuglodon remains from south of Melvin, Ala. Paleontological Research Institution.

Genus PECTEN Mueller, 1776
(Zoölogiæ Danicæ Prodromus, p. 248)

Genotype.—*Ostrea maxima* Linné, by Schmidt, Versuch. Conch.-Samml., 1818, p. 67; *P. maximus* Children (1823, p. 40).

Illustration.—Brown, Illus. Recent. Conch. Gr. Britain and Ireland, 1842, pl. 25, fig. 1; Reeve, Conch. Icon., 1852, *Pecten*, pl. 9, fig. 38.

Pecten perplanus Morton Plate 7, figs. 5-11

Pecten perplanus Morton, 1833, Amer. Jour. Sci., vol. 23, p. 293, pl. 5, fig. 5.

Pecten perplanus Morton, 1834, Synop. Organic Remains Cret. Group. U. S., p. 58, pl. 5, fig. 5; pl. 15, fig. 8.

This seems to be but one of the many forms assumed by the species listed by most modern writers under the name of *Pecten poulsoni*. It is very abundant on top of the black clay just beneath the white limestone layers in the large quarry below the cement plant at St. Stephens Bluff, Ala. Its horizon is presumably Red Bluff Oligocene. Some left valves are flat or even slightly concave about the umbo; some right valves are gibbous as described by Morton for *poulsoni* (see his pl. 19, fig. 2), but for the most part, there is not that disparity of valves so characteristic in later forms. *Poulsoni* ranks properly as a varietal name under *perplanus*. Though the types of *poulsoni* and *perplanus* now seem lost, Morton's illustrations are quite sufficient to indicate what forms he had in hand in describing both these species. The flat valves he described first under the name of *perplanus* (very flat), a name certainly not applicable to the species *spillmani* that has, for four score years, been called "*perplanus*" by nearly all writers.

Subgenus CHLAMYS Bolten, 1798
(Museum Boltenianum, *pars* 2, p. 161)

Subgenotype.—*Ostrea islandica* Linné, by Herrmannson, Indicis Generum Malacozoörum, vol. 1, 1846, p. 231.

Illustration.—Reeve, Conch. Icon., 1853, *Pecten*, pl. 14, fig. 52; Dekay, Nat. Hist. New York State, Zoöl., pt. 5, 1843, pl. 11, fig. 206; Gould, Rept. Invert. Massachusetts, 1841, fig. 89; ed. 1870, p. 198, text fig. 495.

Chlamys spillmani Gabb Plate 6, figs. 3-8

Pecten spillmani Gabb, 1860, Acad. Nat. Sci. Philadelphia, Jour., vol. 4, p. 402, pl. 68, fig. 3.

Pecten spillmani Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 14.

Pecten perplanus Heilprin, 1881, Acad. Nat. Sci. Philadelphia, Proc., p. 417.

Pecten (*Aequipecten*) *perplanus* Dall, 1895, Wagner Free Inst. Sci., Trans., vol. 3, p. 732.

Chlamys (*Aequipecten*) *perplanus* Tucker-Rowland, 1938, Mus. roy. hist. nat. Belgique, Mem., 2 ser., fasc. 13, p. 29, pl. 6, fig. 12.

Gabb's original description is as follows:

Equivalve, orbicular; surface marked by about twenty-two radiating ribs, each with one or two very small ones on each side, and with the crests of all minutely granulous; alations ? (both ears are broken in the specimen before me). *Locality,* Eocene, Alabama. Dr. Spillman.

Though this description is imperfect, the telling features of the species are apparent from it and the figure. The species seems to be a fairly well-defined form of the *nupera* stock. In some cases, the distinctions are slight as will be seen by examining the illustrations herewith given. But in the Shubuta-Grove Hill region, the remarkable costal ornamentation makes this a highly valuable guide species. It is an upper Jacksonian form, found often with zeuglodon remains, while *nupera* characterizes the Garland Creek—Moodys Branch formations from Garland Creek to Montgomery, La.

It would seem that Heilprin (see synonymy) was the first to confuse *spillmani* with *perplanus* when he stated, "The original specimen of *spillmani* in the Academy's collection agrees thoroughly with *P. perplanus* and is marked as its equivalent in Gabb's handwriting." But did Heilprin, or Gabb, have in hand the actual specimens Morton figured and described as "*perplanus*"? Certainly Morton's figures and descriptions show nothing in common with Gabb's *spillmani.* Specimens from St. Stephens in the Academy's collection labelled *perplanus* are in part *spillmani* and in part left valves of "*poulsoni*" (*perplanus*).

Morton's original description as published in 1833, based evidently on the specimen given as figure 5, plate 5, reads as follows (p. 293):

Depressed, with about twenty simple costæ, transversely striated. Diameter less than an inch. Found with the preceding species [*i. e., anatipes* from the "overlying limestone of Claiborne, Ala."].

Apparently having more material to draw on in 1834, he slightly modified his description and adds figure 8 on plate 15. The modified description reads:

Orbicular, somewhat flattened, with about twenty small, simple costæ, transversely striated.

Diameter from three-fourths of an inch to an inch and a quarter.

Note here that "simple costae transversely striated" agrees precisely with this type of "*poulsoni*" of authors and has nothing in common with the characteristics of *spillmani* as defined by Gabb. The specimen labelled "*Pecten perplanus* Morton, type" in the Philadelphia Academy's collection shows clearly the *spillmani* characteristics. It differs markedly in size from either of Morton's figures, especially the early type, his plate 5, figure 5, and the chances are it came from quite a different locality and horizon. For some details of *perplanus-poulsoni* see Plate 7, figures 5-11 of this work.

Occurrence.—In argillo-calcareous beds from Shubuta, Miss., to Oak Grove, Ala.

Figured specimens.—Figures 3-7, three miles east of Shubuta, Miss. ; fig. 8a, about one mile east of the site of the old Fail P. O., west of Silas, Ala.

Chlamys nupera (Conrad) Plate 7, figs. 1-4

Pecten nuperus Conrad, 1854, Wailes, Rept. Agric. and Geol. Mississippi, pl. 14, fig. 11; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 259.
Pecten (*Chlamys*) *nuperus* Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 739.
Chlamys (*Chlamys*) *nuperus* Rowland, 1936, Amer. Midland Nat., vol. 17, p. 1000, pl. 10, fig. 6.
Pecten nuperus Conrad, Reprint, 1939, Bull. Amer. Paleont., vol. 24, p. 345, pl. 23, fig. 11.

Conrad's description.—Suborbicular, ventricose, with about twenty-three angular prominent ribs, crossed by fine, closely arranged wrinkled lines; ears finely striated obliquely.

The holotype of this species came from Jackson, Miss., and is now in the collection of the Academy of Natural Sciences of Philadelphia. It measures 30x30x9 mm. Its ears, for the most part, are gone. The pencil sketch made of the surface markings (enlarged) by Meyer for Aldrich shows precisely the characteristics herewith shown on Plate 7, figure 3. *Nupera* and *spillmani* are of the same general stock, but *nupera* usually has about 21 ribs while *spillmani* may have 24. Perhaps the most striking characteristic of *spillmani* is the acute ornamentation of primary and secondary ribbing on very well-preserved specimens, while on *nupera*, this feature is much more subdued, and one notices more clearly evenly spaced concentric lines. The ornamentation of ribbing on the earlier stages of growth of both species is of the same general character. The intercostal spaces in both are more or less v-shaped, while in *perplanus* (*poulsoni auct.*) they are flat bottomed.

As stated under the preceding species, *nupera* is characteristic of the Moodys Branch horizon.

Specimens figured.—Figs. 1, 1a, from Jackson, Miss. (from Dr. Sullivan, Millsaps College); fig. 2, Jackson, Miss., one mile south of water works railroad cut; fig. 3, Montgomery, La.; fig. 4, same locality as fig. 2. Paleontological Research Institution.

Chlamys beverlyi Tucker Plate 8, figs. 1-5

Pecten (*Chlamys*) *gilbertharrisi* Tucker [Rowland], 1931, Indiana Acad. Sci., Proc., vol. 40, p. 243, pl. 1, fig. 1.

Chlamys (*Chlamys*) *beverlyi* Tucker [Rowland] 1934, Amer. Midland Nat., vol. 15, p. 614.

Chlamys (*Chlamys*) *beverlyi* Tucker-Rowland, 1936, Amer. Midland Nat., vol. 17, p. 997, pl. 8, figs. 7, 8.

Tucker's description.—Shell ovate; small, rather thin, somewhat gibbous, radial sculpture well developed over general surface of the disk; ten to twelve abruptly elevated, broad, flat ribs, which in the umbonal region appear to be beaded and towards the periphery show distinctly bipartite marking. The type has only one or two scaly, radial threads in the interspaces while specimens of apparently the same species from the Jackson of the Sabine River, La., show three or six, one of which, in some cases, is much better developed than the others. The ribs of one specimen from this locality increase by dichotomy. Submargins narrow, plain, or ornamented with very fine, obsolete, radial threads. Beak narrow, quite pointed. Ears unequal, sculptured with fine, scaly radial threads. Right anterior byssal ear the larger, corrugated near the cardinal margin. Cardinal margin of the right valve over that of the left valve. Fasciole well marked. Byssal notch deep, conspicuous. Ctenolium consists of about three or four denticles. Cardinal crura well developed. Provinculum retained in the form of obsolete, fine lines normal to the cardinal margin. Height 18, length 15.5 mm.

This variety is distinguished from *wautubbeanus* by its fewer, broader, ribs, more oval outline, stronger development of sculpture, shape of its ears and the retention of the provinculum.

Holotype.—Harris collection, Cornell University.

Range.—Jackson Eocene.

Localities.—Lisbon, Ala., Sabine River just below Robinson's Ferry, La. [Texas.]

These remarks were modified by Tucker (Mrs. Rowland) in 1936 (p. 998) as follows:

Dimensions.—Holotype, a right valve, height 18, width 15.5 mm. Hypotype, height 18, width 16 mm.

Localities.—Lisbon, Ala. (type); Sabine River, below Robinson's Ferry, La. [Tucker].

Holotype and Hypotype.—Collection H. I. Rowland.

Horizon.—Jackson (Eocene).

Later correspondence with Mrs. Rowland failed to clear up the inconsistencies herein involved.

We are including here illustrations of a beautiful form of *Pecten* from the Sabine River; evidently the same as that referred to above as from "Sabine River, below Robinson's Ferry, La.," though quite probably coming from a station somewhat higher up the river. Over forty years have elapsed since the collections were made and we mistrust some confusion in labeling. They seem to represent a somewhat large form of the *wautubbeana*-stock and show clearly the costal characteristics of this species and varietal forms as illustrated on plate 14, volume 6 of these Bulletins. Mrs. Rowland uses, as types of her *beverlyi*, specimens collected at Lisbon, Ala., assigning them, evidently by mistake, to the Jackson Eocene. So far as can be judged from her illustrations, they correspond closely to the Sabine River forms now illustrated, although of only two-thirds the size of the latter. Future Claibornian studies will doubtless establish the true status of these interesting forms.

Specimens illustrated.—Paleontological Research Institution.

Chlamys corvina, n. sp. Plate 8, fig. 6

Characterization.—Shell small, thin, very fragile and of general outline as figured; ribs about thirty-five anteriorly rather indistinct, with vertical sides, rather wider than interspaces, no tendency to bifurcate nor to show lateral riblets; anterior ear (in only specimen at hand) with four radii.

The costation in this species is of the simple *greggi* type with nothing in common with the elaborate decorations of *spillmani* or even *danvillensis*. The imperfect nodulation of the ribs calls to mind similar appearances in members of the genus *Arca*.

Occurrence.—Crow Creek, near Forrest City, Ark.

Holotype and specimen figured.—Paleontological Research Institution.

Chlamys danvillensis Weisbord Plate 8, figs. 7-9

Pecten (Chlamys) danvillensis (Weisbord MS.)

Chlamys (Chlamys) danvillensis Tucker-Rowland, 1936, Amer. Midland Nat., vol. 17, p. 999, pl. 6, figs. 4, 6, 12.

Weisbord's MS. *description as copied by Tucker-Rowland.*—Shell thin, suborbicular; compressed, with steeply sloping umbonal margins; valves sculptured by 36-40 ribs which are subequal, quadrangular and flat-topped umbonally, but more triangular and terraced ventrally; intercostal sulci channeled, slightly narrower than the ribs; on adult specimens a series of concentric lamellæ cross the whole, imbricating the ribs. Hinge line straight, with about six radiating riblets and crossed by rather fine incremental lamellæ.

The rather thin shell, fairly numerous ribs which pass from a simple construction umbonally to a terraced, imbricated structure ventrally, serve to characterize this species. It appears to have developed from some such stock as *P. choctavensis* Aldrich from the Sabine Eocene of Alabama.

Mrs. Rowland adds:

Dimensions.—Syntypes; young right valve, height 10.5, width, 11 mm.; left (?) valve, height 15.5, width, 15 mm.

Localities.—Danville Landing (type), and Tullos, La. [Weisbord.]

Horizon.—Jackson (Eocene).

Syntypes.—Paleontological Research Institution.

The "syntypes" seem never to have been returned to our collections, so we have had to rely, for illustration, on a decorticated specimen from Tullos, which, though showing shape and general costation, gives no idea as to the finer surface sculpturing.

Chlamys cocoana Dall Plate 8, fig. 10

Pecten (Chlamys) cocoanus Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 738, pl. 34, fig. 23.

Chlamys (Chlamys) cocoanus Rowland, 1936, Amer. Midland Nat., vol. 17, p. 1001, pl. 7, figs. 7, 8.

This species was defined by Dall as follows:

Jacksonian Eocene of Red Bluff, Mississippi, and Cocoa Post Office, Choctaw County, Alabama; Burns.

Shell small, thin, flattish, oblique, produced behind, with about 25 small, low entire ribs, rounded above, and about fourteen interstitial single smaller threads, the tops of all of which are somewhat sparsely concentrically imbricated, the interspaces showing only incremental lines; ears quite unequal, small, the posterior smaller, each with five or six low, hardly scaly radii; inside of the valve obsoletely channeled, the cardinal crura developed. Alt. 23, lat. 23, mm.

The shell differs from *P. membranosus* by its entire and less numerous ribs, and from *P. wahtubbeanus* by its greater obliquity, its entire less conspicuous, and less densely imbricated ribs.

Mrs. Rowland's remarks (1936, p. 1001) under this species beginning: "Specimens from Heidelberg," etc., were evidently written as a primal draft for remarks under *anatipes* (p. 1004) and do not at all apply to *cocoana*; hence they should be deleted from Tertiary literature.

We do not have in hand any specimen of this species from the site of old Cocoa Post Office. Fragments of Pectens from Red Bluff in our collections show relationships with both *perplana* and *spillmani*, but not with *cocoana*. We are copying herewith (Pl. 8, fig. 10) Dall's figure of the holotype. It suggests relationship with the Claibornian *deshayesi*.

Subgenus **EBURNEOPECTEN** Conrad, 1865
(Amer. Jour. Conch., vol. 1, p. 140, pl. 10, fig. 4)

Subgenotype.—*Pecten* (*Eburneopecten*) *scintillatus* Conrad, Amer. Jour. Conch., vol. 1, 1865, p. 140.

Illustration.—Conrad, *vid. sup.*, pl. 10, fig. 4; *Pecten claibornensis* Conrad, Harris, Acad. Nat. Sci. Philadelphia, Proc., 1895, pl. 18, figs. 1, 2; Bull. Amer. Paleont., vol. 6, 1919, pl. 15, fig. 14.

Conrad's description of *Eburneopecten*, very brief and unsatisfactory, is as follows:

Description.—Smooth, polished, thin, of an ivory-like substance.

This subgenus is common in Eocene strata, but I have not met with it in later formations.

Eburneopecten scintillatus Conrad — Plate 9, figs. 1-9

Pecten (*Eburneopecten*) *scintillatus* Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 140, 190b, pl. 10, fig. 4.

Camptonectes scintillatus Conrad, 1866, Smithsonian Misc. Coll., vol. 7, No. 200, p. 23.

Camptonectes claibornensis Conrad, 1866, Smithsonian Misc. Coll., vol. 7, No. 200, p. 23.

Pecten claibornensis Harris, 1894, Arkansas Geol. Survey, Rept. for 1892, vol. 2, p. 145.

Pecten (*Pseudamusium*) *scintillatus* Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 752.

Pecten scintillatus Harris, 1919, Bull. Amer. Paleont., vol. 6, pl. 15, fig. 14.

Amusium (*Pseudamussium*) *scintillatus* Tucker-Rowland, 1938, Mus. roy. hist. nat. Belgique, Mem., ser. 2, fasc. 13, p. 66, pl. 5, fig. 12.

Eburneopecten scintillatus Gardner, 1939, Jour. Paleont., vol. 13, p. 341.

Conrad's original description of this species reads:

Ovate, very thin in substance; umbo ventricose, narrow, apex acute; anteriorly the larger valve is marked with minute fine lines, having a shagreen-like character.

The smaller valve of this species is unknown.

The general characters of this species are shown on Plate 9. In strong, oblique light, there appear obscure traces of faint radii on certain specimens as seen in figures 1 and 2. Occasionally there are indications of 3-5 extremely low radial undulations, as faintly indicated in figure 2. There is no trace of crenulation on the margins of either valve. In general, the valves seem more or less translucent some distance from the margins, but are whitish and opaque centrally and within the umbonal area. This feature is roughly indicated by figure 5. Rarely the whitish matter seems to radiate out from the umbo to near the shell margin. The byssal notch is well defined, giving this part of the shell a *Chlamys*, rather than an *Amusium*, aspect. Ctenolium with usually 3 to 5 teeth, though, when auricle is broken away, such teeth form a serrate series approaching the beak. The chondrophore is wide, with margins above rather protruding. The resilium occupied only the central portion of the pit as shown in figure 6. There is but one pair of cardinal cruræ or cardinal ridges extending out from the beak parallel to, and just below, the ligamental groove. Usually only on the upper flank of the proximal ends of these cruræ does provincular cross-etching appear. The hinge line of the right valve is slightly angulated, depressed, at the umbo, whereas in the left valve, it is very nearly rectilinear. The hinge margins of both valves are slightly infolded; angle of posterior auricle obtuse.

In this species there seems not to be that discrepancy in ornamentation of the two valves so frequently noted in somewhat similar forms. In "*Pecten pseudamussium*" of Sowerby and Reeve and *Cyclopecten pustulosus* Verrill, this trait is well illustrated. Unworn surfaces generally show very fine camptonectes markings.

So far as camptonectes markings are concerned, *scintillatus* somewhat resembles *groenlandicus* Sowerby (1847, p. 57, pl. 13, fig. 40); Sars (1878, p. 23, pl. 2, figs. 4a-c), but the latter is more circular in outline, with greater length of hinge line. Neither of these seems closely related to *Camptonectes* proper with *lens* as its genotype.

Woodring (1925, p. 72, pl. 8, figs. 13-16) has referred Dall's *Pecten* (*Pseudamusium*) *guppyi* to *Chlamys*, subgenus *Palliolum*?, but the latter name, if applicable here, dates only from 1884. Conrad's *Eburneopecten* dates, as we have seen, from 1865, though later in the same year he regarded it as synonymous with *Camptonectes* Agassiz. A year later, *scintillatus* is referred (1866, p. 23) to *Camptonectes* along with his MS. species *claibornensis*.

Regarding Agassiz's MS. name *Camptonectes*, Meek (1864, p. 59) says:

The name *Camptonectes* has been adopted by Professor Agassiz for a group of Jurassic and Cretaceous species, several of which have been confounded under the name of *Pecten lens*. These shells are subequivalve, compressed, lenticular, and closed all around. They have generally small compressed ears, and a short edentulous hinge; byssal sinus under the anterior ear of the right valve deep, well defined. Surface ornamented with fine, very regular, closely arranged, often subpunctate, radiating or subdivaricate striæ, which curve gracefully outward on each side.

The intimate relationship of the Jurassic *P. lens*[1]—often thick and sometimes three inches in diameter, with its well-marked, ex-curving striæ separated by punctate lines—to the thin, microscopically striate *scintillatus* may well be doubted. The feasibility of referring *scintillatus* to *Pseudamussium* Mörch (1853, pt. 2, p. 59;—*ex* Klein) depends largely whether we assume, as does Stewart (1930, p. 122), that *P. septemradiatus* Müller (1776, p. 248=*P. danicus* Chemnitz, 1795, pl. 207, fig. 2043) is the genotype of *Pseudamussium*, or whether like Verrill (1807, p. 60), Dall (1898, p. 751) and others, we regard "*Ostrea*" *hybrida* Gmelin (=*P. exoticus* Chemnitz) as the type species. Both are well shown on Plate 207 of Chemnitz already referred to. It is evident that *scintillatus* does not belong to the *septemradiatus* section, practically the subgenus *Peplum* of Bucquoy, Dautzenberg, and Dollfus (1889, p. 67). It is nearer the *hybridus-exoticus* section, but differs in being more equivalve, with more pointed umbones, larger auricles—especially the right anterior—and lack of discrepancy in surface markings of right and left valves. Its camptonectes markings are very fine, microscopic and more or less irregular.

Verrill (1897, p. 70, fig. 1) has given the name *Cyclopecten* to forms typified by *C. pustulous*, a deep-sea form with small discrepant valves, and the name *Placopecten* (*ibid*, p. 69) to the large *clintonius* stock.

Eburneopecten is, according to Stewart (1930, p. 122), "apparently the first valid name for smooth Pectens which lack the long internal rays."

[1] For a good illustration, see Quenstedt (1885, pl. 59, fig. 25x).

Occurrence.—Small, smooth pectinoid forms may be expected to occur in almost any of the later Eocene deposits of the Embayment Region, but the particular type here under discussion seems to be prevailingly from Jackson horizons. As noted in the synonymy it occurs in Arkansas (Cleveland Co.) and is particularly common in Mississippi about Jackson and Garland Creek, near Shubuta. It is also found farther east at the roadside about one mile east—southeast of the site of old Fail Post Office, and in a bed just above the "*Scutella*" layer at Gopher Hill above St. Stephens, Ala. Plate 9, figures 5 and 9 show differences in auricles and outlines between typical *scintillatus* and representatives from lower horizons.

Holotype.—Probably lost.

Specimens figured.—Figs. 1, 2, 3, 6, 7, 8 from Garland Creek; figs. 4 and 5 from Moodys Branch, Miss. Paleontological Research Institution.

Genus **PTERIA** Scopoli, 1777
(Introductio ad Historiam Naturalem, p. 397)

Genotype—*Mytilus hirundo* Linné, Systema Naturæ, 10th ed. 1758, p. 706; by monotypy, Scopoli, 1777.

Illustration.—Bucquoy, Dautzenberg, and Dollfus, Les Mollusques Marins de Roussillon, 1890, pl. 22, figs. 1-4.

This type of shell has been long and well known under the name *Avicula* (Brug. 1792, Enc. Met.; Lamarck, 1799, p. 82). This was originally Klein's designation, but it apparently was not used in accordance with the rules of binomial nomenclature until 1792, *i. e.*, fifteen years after Scopoli's name was introduced. (See Meek, 1876, pp. 28-31.)

Owing to a general lack of internal, or especially hinge, characters in very similar-appearing Paleozoic forms, the propriety of referring such representatives to *Avicula* or *Pteria* seems doubtful. There appears to be a remarkable blending of aviculoid and pectinoid characteristics in our upper Devonian formations as well shown in Hall's Reports on the paleontology of New York. This tendency seems less well marked in the Mesozoic and still less so in Cenozoic and Recent representatives.

Of the three living sections of *Pteria*, *i. e.*, (1) the winged, (2) the pearl oyster, and (3) the thin, small, wingless long forms, only the first occurs in our southern Tertiaries; the others appear to be more recent developments of tropical seas.

The Jackson form doubtless stems directly from the Claibornian *limula* of Conrad (Claiborne sand horizon), but we have obtained quite similar forms from the older mid-Eocene beds of Texas, and *linguiformis* Evans and Shumard from the Pierre and Fox Hill beds of the Upper Missouri Cretaceous as figured by Meek (1876, p. 32, pl. 16, figs. 1, a, b, c, d) bears a striking resemblance to our Eocene specimens. The Claiborne sand *limula* generally shows a thickened, heavy hinge margin[2], in fact, so much so that De Gregorio (1890, p. 184) gave a special name (*carainerassa*) to specimens showing this development. The dentition of our Eocene species is weak, consisting of a somewhat raised anterior margin of the ligamental pit, occasionally appearing bifid and hanging slightly below the cardinal margin. The disposition of the main ligamental mass in its oblique, shallow channel (with also, doubtless, a thin, marginal section) appears very similar to modern developments as seen, for example, in "*Avicula lotorium*" Reeve (Conch. Icon., 1857, *Avicula*, pl. 3, fig. 3). The torsion brought about by the opening and closing of the valves along the hinge line tends to break up the ligamental mass into more or less equal sections—as may be seen in specimens of *Pteria* or in Reeve's figure just cited—and doubtless led in the past to *Perna*-like "dentition." This tendency is displayed conspicuously by representatives styled *Aviculoperna* (section of *Avicula*) by Cossmann (1887, p. 164; type, *Perna aviculina* Deshayes). (See Deshayes, 1864, pl. 77.) So far no such development has been recorded from American Tertiary deposits. In general form there is a marked resemblance between the American Jackson variety and the one described by Vincent (1893, p. 2 and text fig. p. 2) as *Avicula proxima* from the middle Eocene (Bruxellien).

Pteria limula, var. vanwinkleæ, n. var. Plate 10, figs. 1-4

Characterization.—Fragments of a form of *Pteria* intermediate in general obliquity of form between Claiborne *limula* and the

2 A very similar development may be seen in the variety of *Avicula hirunda* figured by Schaffer (1910, pl. 23, figs. 1, 2, 3).

Vicksburg *argentea* are not uncommon in the Moodys Branch marl of Jackson, Miss. We have found no thick valves like those occurring at Claiborne (these Bulletins, vol. 6, pl. 16, figs. 3-7) showing extreme thickening of the hinge platform (the *cardincrassa* of De Gregorio). In the Jackson specimens, the line of demarcation between the ear and main shell is generally well shown, and beak tips are well defined. Neither our specimens from Claiborne nor from Jackson show hinge "teeth" so well developed as indicated by Lea for *claibornensis*. The curvature in the lines of growth on the wing in Jackson specimens corresponds more nearly to that shown on *limula* rather than on *argentea*. Variety *vanwinkleæ* is nearest akin, in general make-up, to that we designated "*Avicula*, sp." from the Sabine stage at Woods Bluff, Ala. (these Bulletins, vol. 2, 1897, p. 238, pl. 13, figs. 7, 7a.).

Occurrence.—Jackson beds on the Sabine River, but especially Moodys Branch, Jackson, Miss., and Montgomery, La. Also on the Ouachita River at Gibson Landing.

Holotype.—From Moodys Branch (Pl. 10, fig. 1).

Specimens figured.—Fig. 2, Gibson Landing; figs. 3, 4, Montgomery, La.

Paleontological Research Institution.

Genus PINNA Linné, 1758
(Systema Naturæ, 10th ed., p. 707)

Genotype.—*Pinna rudis* Linné, by Children, Quart. Jour. Sci. Lit. and Arts, vol. 15, 1823, p. 34, pl. 2, fig. 80.
Illustration.—Reeve, Conch. Icon. 1858, *Pinna*, pl. 10, fig. 19.

The long, pointed, curved Pinnas with medial angulation, hence quadrangular cross section, seem to form the prevailing type of this genus from later Paleozoic throughout the Mesozoic era. Since Tertiary specimens are usually fragmentary, we cannot feel sure of the propriety of referring any of our material to this genus, *s. s.* Dall (1898, p. 660, pl. 29, fig. 7), however, seems to have found a representative of this type in his *Pinna quadrata* from the Ocala limestone of Florida. A few others have been recorded from later American Tertiaries. Such specimens as we have, appear to fall in with subgenus *Atrina* as indicated below.

Subgenus ATRINA Gray, 1842

Subgenotype.—*Pinna nigra* Chemnitz; see Gray, Zoöl. Soc. London, Proc.

pt. 15, 1847, p. 199; also Iredale, Malacol. Soc. London, Proc., vol. 10, 1913, p. 303.
Illustration.—Chemnitz, Conch. Cab., vol. 8, 1785, pl. 88, fig. 774.

In Iredale's quotation from Gray, we read:—"The *Pinna* have an elongated shell with a longitudinal crack filled with a cartilage in the middle of each valve, and *Atrina* are shorter shells without such a crack."

For the historic development of *Pinna*-like forms, see Stoliczka (1871, vol. 3, p. 381 *et seq.*).

Fragments of Pinnas belonging to this subgenus are often met with in our Eocene marine deposits, but rarely do they show details for specific characterization. In volume 6 of these Bulletins (p. 30, pls. 16, 17) we have ventured to name two lower Claibornian types, while Dall has given the name *Atrina jacksoniana* to a Jacksonian form common in the Embayment area.

Pinna (Atrina) jacksoniana Dall Plate 10, figs. 5, 6

Atrina jacksoniana Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 662.

Dall gives as a representative of this form, "Lesueur, Walnut Hill Fossils, pl. 5, fig. 5, 1829." He defines *jacksoniana* as follows:

In the Jacksonian Eocene of Green's marl bed, at Jackson, Mississippi, and Garland's Creek, near Shubuta, Clarke County, Mississippi, Burns; and at Creole Bluff, Grant Parish, Louisiana, Vaughan and Johnson.

Shell thin, fragile, rapidly widening, somewhat compressed along the ventral border; sculpture of near the beaks numerous, feeble, more or less wavy, longitudinal elevated lines which become less distinct ventrally, and are obsolete over the greater portion of the shell, which appears from the numerous fragments to have been nearly smooth posteriorly or with a few feeble concentric wavelets, most prominent ventrally. A fragment (including the beaks), forty-five millimeters long, has a dorso-ventral maximum diameter of thirty-four, and a transverse diameter of about twenty millimeters. The valves are evenly arched, and become more convex behind.

The material is abundant but very fragmentary, yet sufficient to establish the identity of the species at these localities and its distinctness from the others mentioned.

If markings are shown at all on the representatives of this species they consist mainly of low, concentric undulations on the lower margin of the shell. However, some specimens, generally small, show from six to a dozen not prominent radii from ligamental margin to center of the shell. These are finer than similar radii in *gravida* of the St. Maurice, and the shell seems not to attain the turgidity of that species. The species, however, must be regarded as closely related.

Occurrence.—Besides the localities listed above by Dall, attention may be called to the Bayou Toro region in western Louisiana, where at Wooley's Bluff (SE. side of small creek behind the Wooley homesite, about 100 yards from the highway, NW. ¼ sec. NE. ¼ sec. 4, Tp. 3 N., R. 12 W, Sabine Parish) these shells occur in great abundance, though rather fragmentary.

Type.—See Dall's statement above.

Specimens figured.—From Wooley's Bluff.

Paleontological Research Institution.

Genus **MYTILUS** (Linné, 1758) Bolten-Röding, 1798
(Systema Naturæ, 10th ed., p. 704; Museum Boltenianum, p. 157)

Genotype.—*Mytilus edulis* Gray, Zoöl. Soc. London, Proc., pt. 15, 1847, p. 198.

Illustration.—Dall. U. S. Nat. Mus., Bull., No. 37, 1889, pl. 71, fig. 2. Typical, Bucquoy, *et al.*, Les Mollusques Marins du Roussillon, Plates, vol. 2, 1890, pl. 26, figs. 1-4; also Jeffreys, British Conchology, vol. 5, 1869, pl. 27, fig. 1.

Specimens of the general form of this genus occur from Devonian times on. But the hinge characters of early forms seem to indicate relationship with *Myalina* rather than with *Mytilus*. The Mesozoic forms become more normal mytiloids; especially is this the case with the Cretaceous specimens from India, Europe, and America. In Tertiary and Recent deposits, *Mytilus* seems rather intimately associated with *Ostrea* wherever reefs of the latter are found. Strange to say, we have found no *Mytilus*, *s. s.*, in the Embayment Eocene and only one species of the subgenus *Hormomya* as given below.

Subgenus **HORMOMYA** Mörch
(Catalogus Yoldi, 1853, p. 53)

Type.—*Mytilus exustus* Linné. Designated by Dall, Wagner Free Inst. Sci., Trans., vol. 3, 1898, p. 787.

Accessible illustration.—*Mytilus exustus* Perry, Bull. Amer. Paleont., vol. 26, pl. 7, fig. 35.

Mytilus (Hormomya) hamatoides Call — Plate 10, figs. 7-9

Mytilus hamatoides Call, 1891, Arkansas Geol. Survey, Rept. for 1889, vol. 2, p. 202, text fig.

Call's description.—Shell moderate in size, thin, equivalve, somewhat convex; lines of growth well marked and numerous, becoming crowded near the posterior margin; impressed lines departing from the umbones and bifurcating at each growth line, the crenulations thus caused furnishing a characteristic sculpturing; hinge margin nearly straight, or but slightly curved, little more than one half the total length of the shell; ventral border flattened and sulcate, indicating byssiform attachment in life; posterior margin much curved, resembling closely its modern congener.

Position and location.—Claiborne beds, Eocene Tertiary; Little Crow Creek, St. Francis County, Arkansas.

Call's reference of this species to Claiborne Eocene was due to misinterpretation of associated species. Typical *Basilosaurus cetoides* remains and other characteristic horizon markers place the Little Crow Creek beds in the Jackson Eocene.

This species is represented by many fragments and some fairly perfect specimens in place, but the nature of the soft shelly matrix is such that it is exceedingly difficult to secure and preserve even fragments of any considerable size. Our specimens do not indicate the extreme narrowness of the anterior moiety of the shell shown by Call's restoration. That this divaricately sculptured form belongs to some section of *Mytilus* near *Hormomya* there can be no doubt. The unusual dental development herewith illustrated may, perhaps, be pathologic, but if not, it would seem to demand a new sectional division in the genus *Mytilus*.

Occurrence.—As *Mytilus hamatus* is found among oyster shells along the Atlantic Coast today, so this form is found among the Eocene oysters of Crow Creek, Arkansas. Of a surprisingly similar form, *Mytilus dutemplei* Deshayes, from near Epernay, France, Deshayes (1864, p. 30, pl. 71, fig. 22) says:

One frequently finds this beautiful and interesting species in the lignites about Epernay; but, crushed in the clayey layers, it is difficult to find individuals sufficiently well preserved for determining its characteristics.

Here, too, Crow Creek fragments are abundant as well as what appears to be nearly entire specimens, but they are too tender and too much fractured to be removed and shipped. Call evidently drew his original sketch of the species from a somewhat distorted specimen (or specimens).

Type.—Unknown.

Specimens figured.—Below the highway bridge, two miles east of Forrest City, Ark.

Paleontological Research Institution.

Genus **VOLSELLA** Scopoli, 1777
(Introductio ad Historiam Naturalem, p. 397)

Genotype.—*Mytilus modiolus* Linné, Systema Naturæ, 1758, 10th ed., p. 706, designated by Gray, Zoöl. Soc. London, Proc., pt. 15, 1847, p. 198.
Illustration.—Jeffreys, British Conchology, vol. 5, 1869, pl. 27, fig. 2, Dall, U. S. Nat. Mus., Bull., No. 37, 1889, pl. 54, fig. 4.

In accordance with the usage of Gray, Meek, and Stewart, we are employing the name *Volsella* in place of the more usual term *Modiolus* of Lamarck. Although the name *Volsella* primarily included species subsequently referred to *Modiolus* and *Mytilus,* after the latter were removed there still remained the forms referred to *Modiolus* Lamarck, 1799. For such, *Volsella* has a priority of 22 years. Regarding this matter, Meek (1876, p. 71) aptly quotes the rule laid down by the "British and American Associations".

A generic name, when once established, should never be canceled in any subsequent subdivision of the group, but retained in a restricted sense for one of the constituent portions.

Very primitive pelecypod species in the early Paleozoic seas if moving forward by the action of their hatchet-shaped foot or if anchored in a current by means of their byssus would naturally become pointed and expanded posteriorly. Many subdivisional names have been given to early pelecypods based on the word *modiolus*—little measure or drinking cup. But their relationship to later modioloid forms seems rather obscure. However, there is little room for doubting the direct relationship, for example, of a number of Muschelkalk (Trias) species to modern representatives.

What we notice particularly in our studies of older Tertiary species is the preponderance of plicate forms, belonging mainly, doubtless, to *Brachidontes* Swainson. Conrad early described a *Modiola cretacea* from the white limestone of Clarke County, Ala., which is herewith illustrated—a cast of a large right valve showing little surface sculpture. A smaller specimen (borrowed from the U. S. National Museum) which was regarded by Dall as *M. cretacea* Conrad shows, however, no indication of external radii (Pl. 10, fig. 11). It appears rather gibbose; length 25, height 18, thickness 7 mm Its posterior portion is broken away, and this rather extended area represented by Conrad's figure of the species is left in doubt.

Volsella (Arcoperna) filosa (Conrad) Plate 10, fig. 13

Arcoperna filosa Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 140, pl. 10, fig. 14.

Modiolus filosus Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 792.

Conrad describes his genus *Arcoperna* as follows:

Oval or oblong, inflated; beaks terminal; hinge edentulous; ligament internal; muscular impressions marginal.

The species *A. filosa* is thus described:

Suboval, inflated, thin, pearly; radiated with minute, closely-arranged lines; disk somewhat flattened behind the umbonal slope; posterior margin subtruncated above, extremity rounded; basal margin rounded posteriorly; beak terminal.

This genus appears to me quite distinct from *Modiola*, and is characteristic of the Eocene period. *M. radiolata* Desh. is congeneric, and the peculiarities of the species described by Deshayes are, I think, of generic value.

Dall (*op. cit.*) remarks regarding *Arcoperna*:

Shell oval, general form like *Botula*, but the surface finely striated or reticulated and the margin, except over the ligaments crenulated. Type *M.* (*A.*) *filosus* Conr., Jacksonian and Parisian Eocene.

This section resembles *Modiolaria*, except in the absence of the medial unstriated impressed area, and the more oval outline of many of the species. The umbones are swollen and conspicuous.

The holotype of this species in the collection of the Academy of Natural Science, Philadelphia, is, according to Meyer's careful pencil drawing, in a very bad state of preservation.

We have not observed this species, so far, in our Jacksonian collections.

It may be compared with *Lithophaga carolinensis* (Conrad) Stephenson, from the Upper Cretaceous of North Carolina (North Carolina Geol. and Econ. Survey, vol. 5, 1923, p. 243, pl. 62, figs. 4-9).

Volsella ? tenuis Meyer Plate 10, fig. 12

Modiola tenuis Meyer, 1887, Sond. Abd. Ber. Senckenberg. Naturf. Gesell., p. 10, pl. 2, fig. 7.

Meyer's description (translated).—Longish oval, gibbous, fairly regularly arched, thin, shining mother-of-pearl. Beak small, located anteriorly, directed forward. Hinge toothless, with a swelling beneath the beak. Surface with concentric striation.

I have found only the damaged specimen figured.

Type.—From Jackson, Miss.

Dall (1898, p. 803) regarded this as synonymous with *Crenella latifrons* Conrad, considering it as both Claibornian and Jacksonian in age.

Volsella (Brachidontes ?) cretacea (Conrad) Plate 10, figs. 10, 11

Modiola cretacea Conrad, 1835, Geol. Soc. Pennsylvania, Trans., vol. I, p. 340, pl. 13, fig. 2.
Perna cretacea Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 10.
Modiola cretacea Aldrich, 1886, Alabama Geol. Survey, Bull., No. 1, p. 43.
Modiolus cretaceus Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 792.

Conrad's description.—Shell inflated, narrowed inferiorly; umbonal slope angulated. This species is remarkable for its inflated form, which gives it a rounded contour. It is a cast from the upper division of the cretaceous series of Clark county, Alabama, whence it was received by Dr. Harlan, to whom I am indebted for the opportunity to describe and figure it.

Occurrence.—This upper Jacksonian (zeuglodon horizon) species is given in Aldrich's lists as coming from "The Rocks," Clarke Co., Ala., while Dall notes its occurrence near Fail Post Office in the zeuglodon bed as determined by Schuchert, and possibly from Oak Grove and elsewhere in Florida.

On Plate 10, figure 10, we have a copy of Conrad's figure of this species. It is somewhat more slender posteriorly than that of Meyer (presumably of the same specimen) drawn for Aldrich from the Philadelphia Academy's collection.

Figure 11 is of a specimen loaned for study and illustration by the Cenozoic Division of the U. S. National Museum.

Genus **BARBATIA** Gray, 1842
(Synopsis of the Contents of the British Museum, ed. of 1840, p. 81; Iredale, Malacol. Soc. London, Proc., vol. 10, 1913, p. 303)

Genotype.—*Arca barbatia* Linné, Systema Naturæ, 10th ed., 1758, p. 693, designated by Gray, Zoöl. Soc. London, Proc., pl. 15, 1847, p. 197.
Illustration.—Sheldon, Palæont. Amer., vol. 1, 1917, pl. 2, figs. 4-6; Reeve, Conch. Icon., 1844, *Arca*, pl. 13, fig. 83; Bucquoy, *et al.* Les Mollusques Marins du Roussillon, vol. 2, 1891, pl. 32, figs. 1-5.

The preponderance of Cucullæas in Cretaceous and early Eocene times gave way in middle and late Eocene to *Arca*-like forms, especially of the genus *Barbatia*. It is true that, in the Claiborne "sand," we find *Arca rhomboidella*, which Sheldon says lies between *Barbatia* and *Scapharca;* in the Jackson, *Navicula aspera* Conrad, referred to by Dall as *Barbatia* (*Arca*) *reticulata* (1898, p. 629); while, from the upper Sabine in Alabama, we have collected *Arca* (*s. s.*) *hatchetigbeensis* (these Bulletins, vol. 2, 1897, p. 239, pl. 13). Nevertheless, it is *Barbatia* and its subgenera that, as we have said, predominate in later Eocene times in the Embayment region under discussion. Among these, most generally noticeable, is the subgenus *Cucullæarca* described below.

Subgenus **CUCULLÆARCA** Conrad, 1865
(Amer. Jour. Conch., vol. 1, 1865, p. 11)

Type.—*Byssoarca lima* Conrad (=*cuculloides*), 1847, Acad. Nat. Sci. Philadelphia, Proc., p. 295; its Jour., vol. 1, 2d ser., 1848, p. 125, pl. 13, fig. 23.

Illustration.—See above; also Palæontogr. Amer., vol. 1, 1917, pl. 2, figs. 8-12 (*cuculloides*); Bull. Amer. Paleont., vol. 6, 1919, pl. 22, fig. 17 (for type specimen).

Barbatia (Cucullæarca) cuculloides (Conrad) Plate 11, figs. 1-3

For synonymy and general discussion of this species, see Sheldon (1917, p 13, pl. 2). A discussion of earlier forms is given in volume 6 of these Bulletins (1919, p. 54), and figure 17, plate 22 shows the type specimen in the museum of the Academy of Natural Sciences of Philadelphia. The figures herewith given show most typical Jacksonian forms. Though most common in the Jacksonian of Louisiana and Mississippi, it occurs also in the Oligocene at Vicksburg, Miss.

Occurrence.—This species may be expected from the Sabine River to Claiborne, but it is best exhibited at Montgomery, La., and Jackson, Miss. It occurs on the Ouachita at Bunker Hill and in the Yazoo Valley at Sims Siding rather frequently. Really good, perfect large specimens are by no means common anywhere.

Holotype.—Academy of Natural Sciences of Philadelphia.

Figured specimens.—Figs. 1, 2, 3, Jackson, Miss.

Paleontological Research Institution.

Subgenus **JACKSONARCA**, new subgenus

Type.—*Barbatia (Jacksonarca) scraperta*, n. sp.

This subgenus is characterized by its elliptical outline; dentition along the whole hinge line; smooth cardinal area in front of the beak not defined sharply, nor grooved; but, posterior to the beak, showing two or three oblique, comparatively deep ligamental grooves; exterior recalling *Arca glacialis* Gray as figured by Sars (1878, pl. 4, fig. 1) or by Sheldon (1917, pl. 16, figs. 12-14) though *glacialis* is far more inflated.

Barbatia (Jacksonarca) seraperta, n. sp. Plate 11, figs. 4, 5

Characterization.—Size and general appearance as shown by the figures; beaks small, prosogyrate, sharply incurved; not quite reaching the plane separating the two valves; ligamental area broad and very indistinct anterior to the beak, but posteriorly narrow and transversed by two or three very oblique channels; muscular scars not conspicuous; basal margin without crenulations except postero-basally; hinge teeth large and oblique anteriorly, becoming small and irregular centrally, but oblique and more obvious posteriorly.

In general this species seems to be somewhat akin to the Paris Basin Eocene forms, such as *Arca caillati* Cossmann and Pissarro (vol. 1, pl. 37, figs. 110-64), but probably should be assigned a subgeneric place near *Bathyarca ? glacialis* of more recent date from the northern Atlantic.

Occurrence.—The figured specimen, the only one in hand, came from the cut on the G. M. and M. R. R., just beyond the northern limit of the freight yard, Jackson, Miss.

Paleontological Research Institution.

Barbatia ludoviciana Harris Plate 11, figs. 6-8

Arca (cuculloides?) var. *ludoviciana* Harris, 1919, Bull. Amer. Paleont., vol. 6, p. 54, pl. 22, figs. 8-14.

The specimens herewith illustrated seem to belong to a *Barbatia* group with superficial appearances like *cuculloides*, especially when somewhat irregular in form. But as the postumbonal ridge and smooth area above are missing, one might say we are dealing with *mississippiensis.* Yet *mississippiensis* is a larger form lacking the rhomboidal outline of *ludoviciana* and having anteriorly located umbones. In fact, a kinship with the Claibornian *rhomboidella* might be suspected.

Using figure 9, plate 22 (Bull. Amer. Paleont., vol. 6) as holotype for *ludoviciana*, then the forms here under discussion may be regarded as constituting a large, gibbous variety.

Specimens figured.—Figs. 6, 7, Montgomery, La.; fig. 8, from Danville Landing on the Ouachita River, La.

Paleontological Research Institution.

Barbatia corvamnis, n. sp. Plate 11, figs. 9-11

Characterization.—Size and general appearance as indicated by the illustrations; ribs on old specimens posteriorly obsolescent, on young specimens few, interrupted by growth lines; medial ribbing prominent basally even when smooth dorsally; ligamental furrows few, deep and well defined; teeth very fine and vertical centrally, large and oblique terminally.

Old specimens when viewed from above have a decidedly *Modiolus* aspect. *A. modioliformis* Deshayes of the Paris Basin has a somewhat similar form but has finer ribbing, and is much smaller. Perhaps that author's *A. rigaulti* from the Bartonian of the same Basin approaches our form most closely.

Occurrence.—The only locality where this species is known beyond a doubt is Crow Creek, below the highway bridge east of Forrest City, Ark. One-fourth mile below where a small lateral stream approaches the creek, a fine vertebra of *Basilosaurus cetoides* was found. A fragment of an *Arca* from White Bluff, Ark., is probably of this species.

Holotype.—Pl. 11, fig. 9. Other specimens figured from the locality just described.

Paleontological Research Institution.

Subgenus **ACAR**, Gray, 1857

(Annals and Magazine of Natural History, 2d ser., vol. 19, p. 369)

Type.—*Arca gradata* Broderip and Sowerby, Zoöl. Jour., vol. 4, 1829, p. 365; so designated by Woodring, Carnegie Inst. Washington, Publ., No. 366, 1925, p. 36.

Illustration.—*Arca gradata* Reeve, Conch, Icon., 1844, *Arca*, pl. 14, fig. 92.

Barbatia (Acar) aspera (Conrad) Plate 11, figs. 12, 13

Navicula aspera Conrad, 1854, Wailes, Rept. Agric. and Geol. Miss., p. 298, pl. 14, fig. 5; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 258.

Barbatia (Calloarca) cuculloides Dall, *partim*, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 625.

Barbatia (Acar) reticulata Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 629.

Arca reticulata Sheldon, 1917, Palæont. Amer., vol. I, p. 20, pl. 4, figs. 8-12.

Barbatia jacksonensis Cooke, 1916, Washington Acad. Sci., Jour., vol. 16, p. 137, figs. 13.a, b

Arca (Acar) reticulata Harris, 1919, Bull. Amer. Paleont., vol. 6, p. 55, pl. 22, figs. 18, 19.

Conrad's description.—Trapezoidal, disc contracted behind the middle, cancellated; concentric lines distant, imbricated; radial lines largest towards the umbonal slope, subspinous; umbonal slope acutely angulated; posterior slope excavated; series of cardinal teeth uninterrupted; inner margins crenulated.

This was described by Conrad from Jackson, Miss., but the same general form also occurs at a lower horizon as noted in volume 6 of these Bulletins (1919, p. 55).

It differs from the modern *reticulata* to such an extent as to make it desirable, doubtless, to give it a different specific designation. By comparing the specimens herewith figured with typical *reticulata* (Sheldon, 1917, pl. 4, figs. 8-12), it will be seen that the Eocene specimens are much more angulated, posteriorly, and comparatively longer, with smaller and less elevated beaks.

Occurrence.—Aside from the mid-Eocene localities already mentioned for this species—Wautubbee, Hickory, Miss., and Smithville, Tex.—we know of no other but the type locality, Jackson, Miss.

Specimen figured.—Jackson, Miss.

Paleontological Research Institution.

Genus **GLYCYMERIS** da Costa, 1778

(Historia Naturalis Testaceorum Britanniæ, p. 168)

Genotype.—*Arca glycymeris* Linné, Systema Naturæ, 10th ed., 1758, p. 695.

Illustration.—Lister, Historiæ sive Synopsis Methodicæ Conchyliorum, etc., ed. Altera, 1770, pl. 247, fig. 82; Reeve, Conch. Icon., 1843, *Pectunculus*, pl. 3, figs. 12 a, b; H. and A. Adams, Genera of Recent Mollusca, vol. 3, Plates, 1858, pl. 126, figs. 1, a, b.

Since Dall's substitution of Da Costa's *Glycymeris* for Lamarck's *Pectunculus* (1898, p. 571) practically all American conchologists have followed his example. Jukes-Browne of England early approved of this change (1904, p. 101), and in Thiele (1931, p. 794) it is accepted without comment.

The genus seems first well developed in Cretaceous times, showing plicate and nearly smooth forms, as in modern times. The dentition of *Pseudocucullæa* Solger from the Upper Cretaceous of Cameroon, east Brazil, Venezuela, and Peru (Harris and Hodson, 1927, p. 1, pls. 1, 2; Olsson, 1933, p. 22, pl. 3) strongly suggests a *Cucullæa*-like ancestry for this genus. In form, *Pseudocucullæa* strongly suggests *Protarca* affinities (Stephenson, 1923, p. 104, pl. 19), and in the latter quite *Glycymeris*-like dentition is developed.

While in a way the *Glycymeris* fauna of the Jackson resembles that of the Claibornian, it seems wholly lacking in the vast number of *trigonella* forms so characteristic of the latter horizon.

Glycymeris filosa (Conrad) Plate 12, figs. 1-3

Glossus filosus Conrad, 1854, Wailes, Rept. Agric. and Geol. Mississippi, p. 289, pl. 14, fig. 8; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 259; See also reprint, 1939, Bull. Amer. Paleont., vol. 24, p. 345, pl. 23, fig. 8.

Axinaea inequistria Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 139, pl. 10, fig. 12.

?*Axinea duplistria* Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 139, pl. 10, fig. 19.

Glycymeris filosa Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 607.

Conrad's description of filosa.—Orbicular, ventricose, with radiating lines unequal, medially flattened, and towards the ends angulated; concentric lines microscopic; series of cardinal teeth uninterrupted, generally large and prominent.

Allied to *G. staminens* Con., but very distinct.

As regards *inequistria, duplistria* of Conrad, Dall states (*loc. cit.*) the "names were given to mutations which intergrade completely according to the large series I have studied."

Glycymeris filosa differs from *staminea* in several ways. The latter, so far as we are aware, is found only in the Claiborne sand. It is a heavier, thicker shell with deeper umbonal region, but with beaks more incurved and less elevated. It is wider dorsally when young, and when old assumes a quadrangulate form due principally to the widely truncate posterior. The principal ribs are far apart and become effaced in old age; marginal crenulations are somewhat finer than in closely related forms. *G. filosa* maintains its more circular form, high beak, and its ribs varying in strength are retained throughout life. *G. idonea* of the Claiborne sand is smaller, more oblique, with more even costation which practically disappears in old specimens.

Occurrence.—This is the large, conspicuous *Glycymeris* of the Jackson beds of Mississippi and Louisiana. We note it especially along Garland Creek and at Jackson, Miss., as well as at Montgomery and Gibson Landing on the Ouachita River in Louisiana.

Specimens figured.—Figs. 1, 2, Town Creek, Jackson, Miss., fig. 3, Montgomery, La.

Holotype.—Academy of Natural Sciences, Philadelphia, Pa.

Glycymeris idonea (Conrad) Plate 12, figs. 4-12

Pectunculus idoneus Conrad, 1833, Fossil Shells of the Tertiary Formations, p. 39; see also, 1893, Harris' Reprint p. [65].

We have already called attention in these Bulletins to forms of *idonea* stock from horizons ranging from Midway to Claiborne Eocene. Lea seems never to have recognized this shell; even De Gregorio and Cossmann seem to have missed it, and this, doubtless because Conrad did not figure it in his "Fossil Shells," in 1833. In volume 6 of these Bulletins (1919, pl. 20) we figured topotypes of this species. It is generally a smaller form than *staminea*, less quadrangular, more oblique, and with much more obscure radial sculpturing. Jacksonian varieties seem to be more oval in outline, with deeper umbones and more pointed beaks. A noticeable posterior angle is usually shown in older and larger topotypes of *idonea*, but this is practically obliterated in Jackson specimens. However, in the latter, fine but readily discernible radii are present.

Occurrence.—Small, almost equilateral, distinctly radiate forms with a tendency to show distantly spaced growth lines are very common at Montgomery on the Red River. Small, nearly smooth specimens occur at Bunker Hill on the Ouachita River. Along the creek bed from two to three miles below the bluff on Garland Creek furnishing the majority of shells from "Garland Creek," a considerably larger form occurs. At Sims Siding about eight miles above Yazoo City, Miss., a slightly more oblique variant is abundant, in fact dominates the fauna.

Specimens figured.—Figs. 4 and 9, Sims Siding, north of Yazoo City, Miss.; figs. 5, 6, 7, 8 Montgomery, La.; fig. 10, Garland Creek, Miss.; fig. 11, Burleson Shell Bluff, Brazos River, Tex. (St. Maurice Eocene); fig. 12, typical form, Claiborne sand, Claiborne, Ala.

Genus **LIMOPSIS** Sasso, 1827

(Giornale Ligustico di Scienze, Lettere ed Arti, fasc. 1, p. 476)

Genotype.—*Pectunculus auritus* (Brocchi, as *Arca aurita*, Conchilogia Fossile Subappennina, 1843, p. 289, pl. 11, fig. 9); Deshayes, Description des Animaux sans Vertèbres, vol. 1, 1860, p. 825; Stoliczka (Palaeontographica Indica, 1871, p. 334) and Meek (U. S. Geol. Terr. Rept., 1875, p. 96) regard *Arca multistriata* Forskal as the type species.

Illustration.—*Arca aurita* Brocchi (*vide supra*); *Limopsis aurita* (Brocchi) Fischer (Manuel de Conchyliologie, 1887, pl. 17, fig. 17).

The circumstances under which Nyst and Galeotti (1835, p. 289) renamed this genus *Trigonocœlis*, while D'Orbigny (1844, p. 183) gave it still another name, *Pectunculina*, are well stated by Deshayes (*loc. cit.*). Sasso's name, it will be noticed, antedates these by from eight to seventeen years.

The re-installation of *Pectunculina* by Sacco for the more highly sculptured limopses may, in certain instances, seem desirable (Woodring, 1925, p. 54), but in our later Eocene specimens reliable differentiating characteristics seem wanting.

Limopsis radiata Meyer Plate 12, figs. 13-15; Plate 13, figs. 1, 2

Limopsis radiatus Meyer, 1885, Amer. Jour. Sci., vol. 29, p. 459.

Limopsis radiatus Meyer, 1886, Geol. Surv. Ala., Bull. 1, p. 80, pl. 3, figs. 17, a.

?*Limopsis radiatus* deGregorio, 1890, Mon. Fau. Eoc. de l'Ala., p. 194, pl. 24, figs. 15, 16.

Limopsis radiatus Cossmann, 1893, Notes Compl., p. 16.

Limopsis radiatus Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 605.

Meyer's characterization (*of* 1885).—In Jackson occurs a species, *Limopsis radiatus*, n. sp., agreeing with *Limopsis obliquus* Lea sp., from Claiborne, but somewhat larger and having radiating ribs. The latter difference is so striking, that I should not have related the two species to each other, except perhaps by a [ ], had I not a specimen of *L. obliquus*, which shows the same ribs. Though they are less distinct they are formed in the same manner as in the Jackson form by nodules on the concentric striæ.

This characterization Meyer modifies somewhat in his publication of 1886 (*sup. cit.*). He remarks: "Rounded, quadrangular; solid, hinge teeth, diminishing in size near the pit; surface covered by alternating, radiating ribs, crossed by equal closely set, elevated concentric lines; the points of crossing are thickened by nodules; margin crenulate within.

"Locality.—Jackson, Miss. Common."

The type specimen of *L. obliquus* (Conrad's *aviculoides*) was from the Claiborne sand at Claiborne, Ala. Lea's figure of the same leaves no doubt as to its identity. It is probably No. 5377 of the Academy's collection. The specimen labelled *Limopsis aviculoides* Con., is seemingly Conrad's type.

If we assume *aviculoides* (*obliquus* Lea) to be the typical form of this stock, we find in the St. Maurice stage, especially at St. Maurice a variety which may be called *mauricensis* characterized by a nearly smooth exterior, cut by fine concentric lines. If these lines widen out, in some instances a punctate appearance becomes evident. Further widening shows the punctate appearance to be caused by the presence of partially submerged radii. This development may take place in the St. Maurice stage, but it is in the Claiborne stage where concentric smooth bands and the channels with radii are of equal breadth. Some small specimens in the Claiborne may show traces of radii attempting to cross the smooth concentric bands, but it is in the Jackson stage that the radii dominate the surface ornamentation. To the Jackson form Meyer has given the name *"radiatus,"* regarding the same of specific rank. There is another form showing a remarkably coarse dentition of the lower margin of the shell, within. This has already been figured in these Bulletins (vol. 6, 1919, pl. 18, fig. 2) from the St. Maurice stage at Hickory, Miss. If this large form by further study, proves to be nonpathologic it will doubtless receive a special name with proper characterization.

Holotype of aviculoides.—Phila. Acad. Nat. Sci.

Type of radiatus.—Aldrich Coll., Johns Hopkins Univ.

Holotype of var. mauricensis.—Specimen shown as fig. 4, pl. 18, Bull. Amer. Paleont., vol. 6, 1919, from St. Maurice, La. Paleontological Research Institution.

Occasionally forms from Mongtomery, La., seem to hark back nearly to the *mauricensis* type.

Occurrence.—Besides its Jackson occurrence this species is well represented at Gibson Ldg., Bunker Hill on the Ouachita River, La., and 1 mile below Robinson's Ferry, Sabine R., Tex.

Genus TRINACRIA Mayer, 1868

(Vierteljahreschrift der Naturforschenden Gesellschaft in Zürich, vol. 13, p. 81)

Genotype.—*Trigonocœlia crassa* Deshayes, Description des Animaux sans Vertébres, etc., vol. 1, 1860, p. 841, pl. 65, 1-4, *fide* Gardner, U. S. Geol. Survey, Prof. Paper, No. 142 A., 1926, p. 21.

Illustration.—See Deshayes, *supra*.

By examining plate 34 of Cossmann and Pissarro's "Iconographie," it will be noted that, in form, the trinacrids vary from acutely triangular to roughly quadrangular and oval in outline (see No. 107-4, *inaequilateralis* d'Orbigny and No. 107-9, *baudoni* Mayer). We have an even greater range in form and size in the Eocene formations of the Southern States. (See these Bulletins, vol. 6, pl. 18, fig. 8 for *cuneus*; pl. 19, fig. 10 for *perplana*.) Their gibbosity and thickness of shell likewise are subject to great variations. *T. crassa* Deshayes of the Paris Basin shows a medium general outline, but an unusual thickness of shell. Of the more *crassa*-like forms found in our Eocene formations, we note "*Trigonarca pulchra* Gabb" from the Sabine Eocene (Harris, 1897, pl. 14); *Trinacria decisa* and *declivis* from the Lisbon beds; *T. pectuncularis* and *ledoides* from the Claiborne "sands," and *T. corvamnis*, n. sp., from the lower Jackson beds of Crow Creek (Pl. 13, figs. 3, 4). Dall (1898, p. 658) refers the more cuneate forms only, to *Trinacria*, the more oblong to "*Trigonoarca*"; and incorrectly makes Gabb's *Noetia pulchra* the equivalent of "*Trinacria decisa*."

Taking *Noetia pulchra* as the type, Stewart (1930, p. 78) erects a new genus, *Halonanus*, to embrace the common St. Maurice species of this group. To embrace the more elliptical members, as *perplana* and *ellipsis*, MacNeil proposes a new subgenus *Trinaciella* (1937, p. 456) unfortunately twice preoccupied in zoological nomenclature.

Trinacria is best exhibited in upper St. Maurice beds, less developed in the Claiborne "sands," and rarely found in the Sabine and Jackson horizons.

Trinacria corvamnis, n. sp. Plate 13, figs. 3, 4

Characterization.—The general form and size of this little species is indicated by the illustrations. It is more nearly equilateral than Mayer's *ledoides* and higher proportionally than Deshayes's *me ia*. It appears to be devoid of all surface radii, thus contrasting strongly with Gabb's *pulchra*, as well as *ledoides*. Its general appearance, as will be seen by consulting the illustrations, is decidedly *Spisula*-like (especially externally).

We are not aware that the genus has been reported from the Jackson Eocene, though it is well represented in the Claiborne and St. Maurice Eocene below. Apparently most abundant in the Lutetian of western Europe, its occurrence in the Bartonian is by no means rare.

Holotype and specimen figured.—From Crow Creek, two miles east of Forrest City, Ark.

Paleontological Research Institution.

Genus **NUCULANA** Link, 1807
(Beschreibung der Naturalien-Sammlung der Universitäi zu Rostock, p. 155.)

Genotype.—*Arca rostrata* (Gmelin-Linné, Systema Naturæ, 13th ed., 1791, p. 3308).

Illustration.—*Leda pernula* Sars, Mollusca Regionis Arcticæ Norvegiæ, 1878, pl. 5, figs. 1a-d. Also Reeve, Conch. Icon., 1871, *Leda*, pl. 2, fig. 5a-c (as *L. pernula*).

Nuculanas, generally under the name *Leda*, go back to the Paleozoic in forms differing not greatly from certain species found in the oceans of today. They seem to have lived in about the same ecologic conditions throughout these vast periods of time. Certain traits in external ornamentation have appeared and disappeared throughout these ages, and one is at a loss to find marked traces of evolutionary advancement. The Embayment Jackson beds contain several sections of this genus that have received special names. Perhaps, in fragmentary form, *regina-jacksonis* is the most conspicuous species. This, along with *pharcida* of the Sabine and *opulenta* of the Claiborne, has been referred to a new genus *Calorhadia* by Stewart in "that the internal ligamental pit is wide, and almost symmetrically placed between the two rows of teeth, while on *Nuculana, s. s.*, this pit is narrow and curves posteriorly away from the umbo, being asymmetrical."

Section **CALORHADIA** Stewart, 1930
(Academy of Natural Sciences of Philadelphia, Special Publications, No. 3, p. 51)

Type.—*Leda pharcida* Dall. Wagner Free Inst. Sci., Trans., vol. 3, 1898, p. 587, pl. 32, fig. 8.

Illustration.—See Dall, *supra*, and Harris, Bull. Amer. Paleont., vol. 2, 1897, pl. 14, fig. 13 (as *L. protexta* Conrad).

Nuculana regina-jacksonis Harris — Plate 13, figs. 5-7, 10, 11

Leda regina-jacksonis Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., p. 470, pl. 18, fig. 3.

Leda regina-jacksonis Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 587.

Original characterization.—This fine species is the Jackson representative of *L. opulenta* Con. of the Claiborne sand. It differs, however, from that species (a) in having finer, rounder and not depressed concentric striae; (b) in having directly below the umbo a peculiar, straight, ventral margin for some distance; (c) in being less nasute posteriorly and (d) in having the concentric lines in the post-umbonal slope less strongly marked and less distinctly interrupted and deflected by a radiating depression.

Locality.—Jackson, Miss.

This species and its close relatives may be spoken of as the *opulenta* stock, which, so far as our present knowledge goes, has its earliest representatives in the Sabine Eocene of Alabama and has usually been referred to as *Leda protexta* Conrad. As this name has been so promiscuously used by Conrad and Gabb in Tertiary and Cretaceous literature, Dall (1898, p. 587) has proposed for this form the name *pharcida*. It is somewhat more slender than subsequent representatives; has growth lines appearing very prominently on both anterior and posterior dorsal slopes; has a rather broad, though well-marked, radial depression from beak to anterior basal margin; and shows practically no trace of a radial channel bisecting the postumbonal slope. (See Dall, *op. cit.*, and Harris, these Bulletins, vol. 2, 1897, p. 244.)

In the St. Maurice form, *hammetti*, the shell is broader, more recurved, with faint anterior radiating depression, but without much strengthening of lines near the anterior-dorsal margin. The concentric striæ end abruptly at the umbonal ridge and there form fairly well-defined nodules. Starting from a radial depression just behind the row of nodules, clearly marked concentric lines pass directly to the posterio-dorsal margin of the shell. Gabb's *compsa* of the St. Maurice stage of Texas has a wide posterio-dorsal area with ornamentation as in *hammetti*, but with a much more acute posterior angle (Harris, 1919, pl. 24, figs. 1, 2).

In *opulenta* (Pl. 13, fig 8), the postumbonal area shows strong concentric lines of growth, each line divided in two unequal parts by a radiating channel (Harris, 1919, pl. 23, figs. 20, 21). In *regina-jacksonis*, the postumbonal striæ are but slightly modified by a radiating furrow. In the upper Jackson beds at Danville Landing on the Ouachita River a varietal form of this type shows very fine concentric striation even on the posterio-dorsal area (Pl. 13, fig. 10). The very strong anterior concentric lines of *pharcida*, less obvious in *opulenta* are much subdued in *regina-jacksonis*. Specimens from the type locality of the latter show some differences in the modification of the strong concentric lines on the postumbonal area but in no case are they severed completely as in *opulenta*. A fragment from White Bluff, Ark. (Pl. 13, fig. 9) seems referable to this stock, as does *L. potomacensis* of Virginia. (Maryland Geol. Survey, Eocene, 1901, p. 200, pl. 56, figs. 9, 10.)

Holotype.—Lea Memorial Collection, Academy of Natural Sciences, Philadelphia, from Jackson, Miss.

Specimens figured.—Figs. 5, 6, Moodys Branch, Jackson, Miss., figs., 7, 10, 11, Danville landing, Ouachita River, La.; fig. 8, Claiborne sand, Claiborne, Ala.; fig. 9, a fragment evidently belonging to this stock from White Bluff, Arkansas River, Ark.

Nuculana mater (Meyer) Plate 13, figs. 12-14

Leda mater Meyer, 1885, Amer. Jour. Sci., vol. 129, p. 460.

Leda mater Meyer, 1886, Alabama Geol. Survey, Bull., No. 1, p. 79, pl. 3, fig. 20.

Leda mater Harris, 1894, Arkansas Geol. Survey, Ann. Rept. for 1892, vol. 2, p. 147.

Leda mater Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 578.

Calorhadia mater Gardner, 1939, Jour. Paleont., vol. 13, p. 341.

First characterization by Meyer.—In Jackson a species is not rare which may be called *Leda mater*. I have also a specimen of it from Claiborne. This species has the inequilateral form of *L. plicata*: the position of the beak however is not quite constant and is sometimes a little more medial. It is inflated like *L. media*, but some specimens are more compressed. The folds on the surface continue generally over the anterior portion, but become less distinct there and sometimes even vanish. A slight furrowing of the anterior portion may be noticed in most specimens, but not in all. In short, *Leda mater* in Jackson stands between *L. plicata* and *L. media*; it varies in certain features, and the same features constitute in a developed form the differences between the two species in Claiborne. From these facts the conclusion might be deduced, that the two species are also derived from *L. mater*.

Second characterization by Meyer.—Elliptically transverse, convex; produced and truncate behind; strongly inequilateral; covered with concentric ribs and posteriorly with three radiating ribs; teeth diminishing in size towards the fosset; channel interrupted by a callus; margin entire.

Locality.—Jackson, Miss. Not rare.

The concentric ribs are quite regular on the umbonial part of the shell; on the ventral part, however, about half of them vanish rather suddenly posteriorly, and the rest of them increase in size, so that the posterior part is covered by fewer but larger ribs. Many of the specimens have one or two distinct radiating furrows on the anterior part. In some, the concentric ribs become erased like on the anterior part (see *loc. cit.*).

It is interesting to note that the name *mater* (mother) was applied by Meyer supposing that Jackson beds underlie Claibornian and hence this species gave rise to *plicata* and *media*.

Occurrence.—Well preserved and best known from Jackson, Miss., but found in various localities in Cleveland County, Ark.

Specimens figured.—Moodys Branch, Jackson, Miss.

Paleontological Research Institution.

Nuculana albirupina (Harris) Plate 13, figs. 15, 16

Leda albirupina Harris, 1894, Arkansas Geol. Survey, Ann. Rept. for 1892, vol. 2, p. 148, pl. 6, fig. 1.

Leda albirupina Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 578.

Original characterization.—The general outline and appearance of this species can be seen by consulting Pl. VI, fig. 1. This is an adult specimen. When young, the form is slightly more arcuate and gibbous.

Specific characters: Presence of fine concentric striæ on the posterior portion of the shell which bifurcate anteriorly and vanish entirely upon reaching a well marked sulcus which radiates from the umbo to the anterior basal margin; anterior portion, as well as posterior dorsal slope smooth and polished, the latter is traversed by a faint radiating fold.

This species has much the same general outline as *L. plicata* Lea, the surface of its anterior portion recalls that of *L. media*, Lea.

Localities: White Bluff, Arkansas River, Arkansas; Wadsworth's well, Long Prairie, Drew County.

The specimens from the type locality, White Bluff, are very fragile, and it is with considerable difficulty that a fair series may be obtained. Additional material collected since 1892 proves that there is no general "bifurcating anteriorly" of the striæ as noted in the original description, nor is the "radiating sulcus" so obvious as the description implies.

In form, this species seems close to *mater*, but it lacks the strong, transverse striæ of that species over the postumbonal slope. The surface sculpture is close to that of *media* Lea, yet the postumbonal furrows and ridges of that species are but faintly represented in this species, and the location of the beaks in these two species is decidedly different—likewise the general curvature of the shell form.

Occurrence.—Besides the localities in Arkansas referred to above, this species has been found on the Ouachita River one-half mile below Gibson Landing.

Specimens figured.—White Bluff, Arkansas River, Ark.

Paleontological Research Institution.

Holotype.—U. S. National Museum.

Yoldia (Nuculana ?) psammotæa Dall, vars. Plate 13, figs. 17-20

Yoldia psammotæa Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3,

p. 596, pl. 34, fig. 20.
Yoldia psammotæa Harris, 1919, Bull. Amer. Paleont., vol. 6, p. 72, pl. 25, figs. 25-31.
Orthoyoldia, psammotæa Stewart, 1930, Acad. Nat. Sci. Philadelphia, Spec. Publ., No. 3, p. 61.

We have discussed the characteristics and occurrence of this St. Maurice species in volume 6 of these Bulletins referred to in the synonymy. In the Jackson Eocene there are several forms with very thin shells and, so far as our collections are concerned, always in a very imperfect state of preservation. At White Bluff, Ark., there are many crushed, fragmentary specimens; at Montgomery, La., there are scattered fragments of the *psammotæa* type; and likewise in Little Stave Creek, Ala.; in the limy beds probably fifty feet above the Claiborne sand bed. These fragments generally show a more slender posterior, terminating more pointedly than in *psammotæa.* We have no specimens of this species with quite so broad a swing in the posterior lines of growth as shown in Dall's figure of the type. A good photograph of this, however, might give a slightly different impression. We have inserted (Pl. 13, fig. 20) a photograph of *psammotæa* as a standard with which to compare Jackson material.

Specimens figured.—Paleontological Research Institution.

Yoldia psammotæa ? var. rubamnis, n. var. Plate 14, fig. 1

At Montgomery, Bayou Toro, and elsewhere in the Jackson Eocene beds, there are numerous fragments of a nuculanoid form with very thin, porcelaneous *Yoldia*-like shell, but with beaks not so centrally located as in the genus. Between beak and base the shell is apt to be rather gibbous and broad, with posterior somewhat elongate and narrow. Taking figure 1, Plate 14 as typical for this variety, these characteristics show out clearly when compared with figure 20 of Plate 13, *Yoldia psammotæa* Dall. It seems quite possible that specimens like figure 18 of the same plate, from Little Stave Creek, Ala., some distance above the Claiborne sand bed, may belong to this variety. The imperfect specimen shown by figure 19 closely approaches *Y. psammotæa.*

Holotype and specimen figured.—White Bluff, Ark.

Paleontological Research Institution.

Subgenus **HILGARDIA** new subgenus

Subgenotype.—*Leda multilineata* Conrad, Acad. Nat. Sci. Philadelphia, Proc., 1855, p. 258, and Wailes, Rept. Agric. and Geol. Mississippi, 1854, pl. 14, fig. 4.

Illustration.—As above, also copied in Bull. Amer. Paleont., vol. 24, 1939, pl. 23, fig. 4. See also these Bulletins, vol. 6, 1919, pl. 23, figs. 11, 12; Wagner Free Inst. Sci., Trans., vol. 3, 1898, pl. 25, fig. 11

The pointed posterior, the pseudo-concentric lines turned abruptly upwards at the anterior margin, the escutcheon with pouting ligamental margin, and radiating smooth ridges, the post-umbonal slope with its crenulated radii (three of which are generally stronger than the others), and the frequent occurrence of radii over the whole surface—all tend to produce a very marked type of *Nuculana*. The name is given in honor of Dr. Eugene W. Hilgard, father of Mississippi geology.

Nuculana (Hilgardia) multilineata (Conrad) Plate 14, figs. 2-6

For a copy of the original description and notes on this species, see volume 6 of these Bulletins (1919, p. 58). In its typical form, this species must be considered as one of the most important Jackson stage markers. Since the more general of its characteristics were fairly well developed in the upper beds of the St. Maurice stage, and since it is so well developed and generally distributed in the Jackson stage, we have often wondered at its seeming absence in the Claiborne sand. Neither Conrad, Aldrich, DeGregorio, Cossmann, nor Dall have listed it as occurring in the Claiborne sand bed. But we have found one specimen in the upper part of the Gopher Hill beds near St. Stephens Bluff, which proves that somewhere in the offing, during Claiborne times, this species was carrying on, ready to assume its important rôle in the oncoming Jackson invasion.

Occurrence.—We have observed this species in Jackson beds from the Sabine River, to the Tombigbee. Dall (1898, p. 588) reported it from "nummulitic beds near Martin Station, Florida." So far we have not observed it at Crow Creek or White Bluff, Ark., in fact, nowhere north of Cleveland County. It seems most abundant in the Jackson-Garland Creek district, Mississippi.

Holotype—Unknown.

Specimens figured.—Figs. 2-6, Moodys Branch, Jackson, Miss. Paleontological Research Institution.

Nuculana linifera ? Conrad Plate 14, fig. 8

Nuculana linifera Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 139, pl. 10, fig. 8.

Leda linifera Dall ?, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 591.

Conrad's description.—Elliptical, ventricose, equilateral, concentrically ribbed; ribs obsolete posteriorly, and remote; each side has a slight furrow or fold radiating from the beak; anterior extremity acute; ventral margin rounded.

This small species is very perfect, with both valves connected. The figure is much enlarged.

Dall remarks (*vide supra*); "The shallow radiating furrow on the rostral end of Conrad's shell is misrepresented as a rib on his figure. The shell is subrhomboidal and compressed with the concentric lines sparse, obsolete anteriorly and on the rostrum."

Conrad's specimen was from his "Enterprise" (Garland Creek) material, but so far we have not obtained anything corresponding closely to his or Dall's descriptions. Some forms of the young of *multilineata* (Pl. 14, figs. 5, 6) have very much the general outline as figured by Conrad for his *linifera*, but all our specimens show traces of radiate, crenulate lines on the postumbonal slope. A large, imperfect specimen (fig. 8) from near the mouth of Garland Creek, and from a horizon slightly higher than the main Garland Creek fauna, has more subdued ornamentation and may possibly be an adult of Conrad's minute *linifera*. As the figure of his type specimen is very imperfect, we herewith introduce as figure 8a a copy of Meyer's pencil drawing of the same.

Holotype.—Museum, Acad. Nat. Sci. Phila.

Section **LEDINA** Dall, 1898

(Wagner Free Institute of Science, Transactions, vol. 3, p. 580)

Type.—*Leda eborea* Conrad, 1860 (not 1846) (*L. smirna* Dall). Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, 1860, p. 295, pl. 47, fig. 26.

Illustration.—Bull. Amer. Paleont., vol. 1, 1896, pl. 14, fig. 7.

Nuculana, sp. Plate 14, figs. 9-11

Characterization.—Size and general form as indicated by the illustrations; surface when young, smooth and shining, later with faint folds corresponding with incremental lines over the medial portion of the shell; very faintly striate anteriorly, posterior third always smooth; teeth very long, v-shaped, breaking when valves are pulled apart; umbonal ridge faintly defined, one obscure radiating ridge between it and the ligamental margin. We know of no species with which this is closely related, but there is a general resemblance between this and *eborea=smirna* Dall of the Midway stage.

Occurrence.—We have no proof that the two specimens we have of this species came from a Jackson horizon. They are labelled simply, "Sour Lake well, 1500 ft." But they may be met elsewhere and may serve for correlating the well material.

Specimens figured.—The larger specimen may be taken as the holotype.

Paleontological Research Institution.

Section **SACCELLA** Woodring, 1925

(Carnegie Inst. Washington, Publ. No. 366, p. 15)

Type.—*Arca fragilis* Chemnitz, Conch. Cab., vol. 7, 1784, p. 199, pl. 55, fig. 546.

Illustration.—See above, also Reeve, Conch. Icon., 1871, *Leda*, pl. 8, fig. 53; "*L. commutata* Philippi" Sowerby, Thesaurus, vol. 3, 1866, p. 131 of "Nuculidæ," pl. 228, figs. 80, 81.

Nuculana, sp. Plate 14, figs. 12-14

Characterization.—Size and general form as indicated by the illustrations; surface marked supra-centrally by four to six heavy, rather sharp, folds while peripherally the markings become less prominent; umbonal angle marked by a row of beading, each bead representing the posterior termination of a concentric fold; a slight radiating sinus extending from beak to anterior basal margin and posteriorly from beak to posterior basal margin just below line of beading; area behind umbonal ridge concave with no sign of a ridge limiting the escutcheon, teeth v-shaped and long; no siphonal ridge or fold within.

This little shell is of the *parva* Rogers stock and is perhaps more nearly related to *robusta* Aldrich than to any other species described from our Tertiary formations. That species is without the surface markings described above and has a lunule and escutcheon defined by a well-marked radiating fold as will be seen by consulting Aldrich, plate 6, figure 1 (1895, p. 69). The same remarks may be applied to *catasarca* Dall.

Types.—Exact locality and horizon not given. Associated with, but not labelled, Jackson material from Louisiana.

Paleontological Research Institution.

Genus **NUCULA** Lamarck, 1799

(Société d'Histoire Naturelle de Paris, Mémoires, p. 87)

Genotype.—*Arca nucleus* Linné, Systema Naturæ, 10th ed., 1758, p. 695.
Illustration.—Reeves, Conch. Icon., vol. 19, 1871, *Nucula*, pl. 1, figs. 2a, b; Sowerby, Thesaurus, vol. 3, 1866, pl. IV, figs. 121, 122; Grant and Gale, San Diego Soc. Nat. Hist., Mem., vol. 1, 1931, pl. 1, figs. 4, 5.

This, like *Nuculana*, is a very old genus going back to the Paleozoic and showing quite modern-appearing forms—in mid-Devonian horizons, for example.

Nucula magnifica Conrad, vars. Plate 14, figs. 17, 18-21

For a reprint of Conrad's original description, together with references to the literature. see volume 6 of these Bulletins (1919, p. 73).

There is little difficulty in separating the true *magnifica* from the Jackson representatives when placed in juxtaposition. The latter appear more extended anteriorly, not so gibbous, less developed umbonally, but with sharper beak. In these respects they seem to stand halfway between the typical *magnifica* and the variety *mauricensis*, from the St. Maurice beds below the Claiborne sand. Since a varietal name will be convenient in discussing the relationship of the several forms of this species, we may call this var. *yazooënsis*. Taking as lectotype for *mauricensis* the specimen represented by figure 5, plate 26 (vol. 6, these Bulletins already referred to) and figured again here as figure 21, Plate 14, its relationship with subsequent variations can be readily observed (see Pl. 14).

Occurrence.—The Jacksonian variety *yazooënsis* is very conspicuous in the yellow sands at Sims Siding eight miles north of Yazoo City, Miss. It is fairly well represented in collections from Danville on the Ouachita and at Montgomery, La. Specimens from the Wooley's Bluff locality, though rather small, seem clearly referable to this variety. The small, thin specimens obviously of the *magnifica* stock found farther north in Arkansas—at White Bluff and Crow Creek, for example—may deserve a separate specific name.

Specimens figured.—Fig. 17, Claiborne sand at Gosport, Ala., showing form of typical *magnifica* with heavy umbonal development. (See also these Bulletins, vol. 6, pl. 26, figs. 1-3, 8.)[3] Fig. 18, Claiborne sand at Gosport, showing unusual anterior development, closely approaching var. *yazooënsis*. Figs. 19, 20, syntypes of *yazooënsis* from Sims Siding, eight miles north of Yazoo City, Miss., showing longer, more rectilinear posterior margin, less inflated umbo and more pointed beak than seen in fig. 17. Fig. 21, holotype, var. *mauricensis*, St. Maurice Eocene horizon, base of bluff, upper landing, Claiborne, Ala. Fig. 22, the small unnamed *magnifica*-like form of *Nucula* occurring at White Bluff, Ark.

Paleontological Research Institution.

Nucula ovula Lea Plate 14, figs. 23, 31

For a copy of the original description and references to the literature, see these Bulletins, vol. 1, 1896, p. 168; vol. 2, 1897, p. 242; vol. 6, 1919, p. 75.

With further study on more material it is evident that many modifications of this general form will be delimited and perhaps named from sub-Claiborne Eocene material. The standard stock for comparison naturally comes from the Claiborne sand, Claiborne, Ala. Plate 26, figures 12-14 (these Bulletins vol. 6) illustrate topotypes. Varieties occur in the Jackson beds above the Claiborne horizon—as at Garland Creek—that seemingly may well be intermediate between *ovula* and *spheniopsis* Conrad. In the Jackson district we have seen only variants of *spheniopsis*.

Specimens figured.—Figs. 23 and 31 are from the Claiborne sands at Claiborne, Ala., and show typical forms of this species. They are here introduced for comparison with specimens of *spheniopsis*.

Nucula spheniopsis Conrad Plate 14, figs. 24-30

Nucula spheniopsis Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 140, pl. 10, fig. 13.

Nucula meridionalis Aldrich and Meyer, 1887, Sonder-Abdr. Ber. Senckenberg. Naturf. Gesell., p. 10, pl. 2, fig. 2.

[3] Erroneously listed as figs. 4, 5, and 6 under *N. magnifica*, *s. s.*, in work cited.

Conrad's original description.—Obliquely ovate-triangular, slightly ventricose; posterior side cuneiform, extremity acutely rounded; inner margin minutely crenulated.

His figure leaves much to be desired. However, the locality we understand now to be Garland Creek from which his specimens were derived, and the "obliquely ovate-triangular form," etc., of his description admit of little doubt as to the species he was describing. Here, as in general in describing Nuculas, he uses "posterior" for "anterior" and *vice versa* About Jackson, Miss., this species exhibits its *spheniopsis*-form to best advantage. In fact, Meyer and Aldrich gave the name *meridionalis* to a decidedly oblique triangular form. A copy of their figure is herewith given as figure 28, Plate 14.

This species in some of its forms approaches very closely, or perhaps blends with, *ovula*, but in this latter the lunular area is generally a little longer than the same area in *spheniopsis*, perhaps a little more sharply defined, and its marginal pouting is greatest higher up towards the beak. For comparison with figures 24-30, showing various specimens and forms of *spheniopsis*, consult figures 23 and 31 of the same plate and also figures 12-14, plate 26 of volume 6 (these Bulletins) illustrating topotypes of *ovula*.

Genus **VENERICARDIA** Lamarck, 1801
(Système des Animaux sans Vertèbres, p. 123)

Genotype.—*Venericardia imbricata* Lamarck; see Stewart, Acad. Nat. Sci. Philadelphia, Spec. Publ., No. 3, 1930, p. 150.

Illustration.—Mus. Hist. Nat. Genève, Catalogue Illustré, Collection Lamarck, Dimyaires, 1914, pl. 24; Cossmann and Pissarro, Iconographie Complète, etc., vol. 1, 1904, pl. 31, figs. 97-4; Chemnitz, Conch. Cab., vol. 6, 1782, p. 315, pl. 30, figs. 314, 315.

Since the publication of preliminary discussions of earlier Eocene Mollusca of the Southern States (Harris, 1896, 1897, 1899, and 1919), two important articles have appeared relating to the venericarids of America (Stewart, 1930, pp. 150-173; Gardner and Bowles, 1939). These bring into the literature a very considerable number of new names, especially specific and subgeneric, the desirability of which time alone can determine. There seems to be a tendency among modern writers to assume that specimens from diffierent levels or distant localities must of necessity belong to different "species." How far this tendency should be carried depends largely on one's idea as to what constitutes a "species." The same writer may have different views at different times; as for example Cossmann. In his "Notes" of 1893 (p. 14) he finds the Claiborne *Cardita planicosta* "identique aux individus du bassin de Paris," but in 1901, he writes a "note" for the sole purpose "de confondre irréfutablement cette légende." (1901, p. 653.)

Venericardia planicosta Lamarck, vars. Plate 15, figs. 1-11
Plate 16, figs, 1-9

(Section *Venericor* Stewart, Acad. Nat. Sci. Philadelphia, Spec. Publ. No. 3, 1930, p. 153.)

By consulting these Bulletins (vol. 1, No. 4, 1896; vol. 2, No. 9, 1897; vol. 3, No. 11, 1899; and vol. 6, No. 31, 1919) it will be seen that a number of varieties of this stock occur in the Embayment Eocene. These have even been given specific names by Gardner and Bowles. As we recede from this area, especially to the West Coast of North and South America, representatives do occur deserving of separate specific designation (Olsson, 1928, p. 71). This is less obviously true when applied to east American and west European areas.

It would seem that one of the rugged branches of the planicostid stock is that represented by *"Cardita densata"* Conrad, found typically developed in the St. Maurice Eocene beds at the base of Claiborne Bluff just below the bridge. Many of the specimens here are rather small, but some among them are decidedly good-sized and have characteristics closely allied to typical *planicosta* of western Europe. (See these Bulletins, vol. 6, 1919, pl. 27, fig. 2.) This branch, we believe, gave rise to all the planicosti forms of the Claiborne sand and Jackson formations. Those from Jackson are listed below and illustrated on Plates 15 and 16 of this work. For the reader's convenience Conrad's description of *densata* is herewith given.

Venericardia planicosta, var. densata Conrad (Bull. Amer. Paleont., vol. 6, 1919, pl. 27, figs. 1, 2)

Cardita densata Conrad, 1848, Acad. Nat. Sci. Philadelphia, Jour., vol. 1, p. 130, pl. 14, fig. 24.

See also references to this variety in our Bulletins referred to above.

Conrad's original description of densata reads:—Obliquely cordate, ventricose, thick, with about twenty-five flattened costæ obsolete towards the base, narrow, profound, elevated and crenulated on the umbo; umbo very prominent at the apex; anterior basal margin obliquely subtruncated, direct; cardinal area very thick and dilated, the teeth oblique. Height 1 5/8 inch. Length the same.

Locality.—Claiborne, Alabama.

The pretty species abounds in entire specimens in the argillaceous stratum near low water mark in the Claiborne Bluff. I found none in the upper beds. Compared with *C. planicosta*, it is much smaller, comparatively shorter, thicker, and may always be readily distinguished by the crenulated ribs on the umbo.

During Jackson times this virile branch developed slight modifications at different localities. In one district, Yazoo-Danville, the modification seems sufficient to warrant a special designation, as already noted by Gardner and Bowles. New localities will naturally show further modifications. For the present we note the following:

1. A variant (Pl. 15, figs. 1, 2) combining characters of *densata*, "*claiboplata*" and "*apodensata*"; Crow Creek, Ark., also Sims Siding, above Yazoo City, Miss.

2. Slightly less circular forms than "*claiboplata*," distinguished often with great difficulty from *densata*, styled *Venericardia* (*Venericor*) *apodensata* by Gardner and Bowles (1939, p. 192). Somewhat smaller specimens are herewith illustrated (Pl. 15, figs. 3, 4) from Moodys Branch, Jackson, Miss. Closely allied forms are found at Montgomery, La., also at Garland Creek, Miss. These gradually shade into the following variant.

3. Smaller, more erect or less oblique forms with intercostals more clearly defined, found characteristically at White Bluff on the Arkansas River, Ark. (Pl. 15, figs. 5-9).

4. Specimens showing a tendency to increase in relative height; decrease in number of ribs; increase in cross-grooving of ribs; transitional towards the following variety *klimacodes* Gardner and Bowles; occurs at Montgomery, Myatt Landing, and especially at Bunker Hill bluff on the Ouachita River, La. Such transitional forms are illustrated here by figures 10 and 11, Plate 15 and figures 1-6, Plate 16.

Venericardia planicosta var. klimacodes Gardner and Bowles

Plate 16, figs. 1-9

Venericardia (Venericor) klimacodes Gardner and Bowles, 1939, U. S. Geol. Survey, Prof. Paper, No. 189F, p. 193, pl. 37, figs. 9, 10.

It would seem that the extensive transgression of the sea during Jacksonian times produced in the Embayment area great differences in type and place of sedimentation. Such differences naturally were reflected in the amount and kind of life inhabiting various localities at various times. These differences are reflected in the *planicosta* stock, the variants referred to above. That they all stem from one and the same stock seems quite evident. The emerging of the somewhat elevated *klimacodes* form is well under way at Montgomery, less evident at Myatt Landing and Grand View, and reaches its typical stage at Bunker Hill and Danville, La., and one mile east of Yazoo City, Miss. (Gardner and Bowles).

The figures shown on Plates 15 and 16 will serve to indicate some of the varying characteristics of the *planicosta* stock in the Embayment area during Jacksonian times.

Specimens figured.—Plate 15, figs. 1 and 2, Crow Creek, Ark.; figs. 3 and 4, Moodys Branch, Jackson, Miss.; figs. 5-9, White Bluff, Ark.; figs. 10, 11, Montgomery, La. Plate 16, figs. 1-9 from Bunker Hill, Ouachita River, La.

Types.—For the present, we can perhaps do no better than assume that the specimens figured in the Catalogue Illustré, Collection Lamarck (1914, Dimyaires, pl. 23, fig. 126a-c) represent Lamarck's idea of this species (*planicosta*) since one specimen at least bears the inscription "*Venericardia planicosta*" in his handwriting (*fide* this publication). Note, however, in his original description (see these Bulletins, vol. 1, 1895, p. 172) he finds only smaller specimens, var. *beta*, about Paris, while the fully developed, figured specimen is from an Italian Piedmont or Florentine area. The figure in the Annales du Musée (1807, pl. 31, fig. 10 a, b) shows a remarkably pointed and hooked beak for typical *planicosta* from Grignon. So far as Lamarck's Italian localities are concerned, Deshayes (1824, p. 149) was not able to find any proof of such occurrences and concludes, "je présume que M. Lamarck aura été trompé dans cette indication."

The subgenotype of *Venericardia* (*Venericor*) *planicosta* is the specimen figured by Gardner and Bowles (1939, pl. 35, figs. 1, 2; pl. 36, figs. 5, 6). U. S. Nat. Mus. 12704, from Grignon, France.

Holotype of "Venericardia (Venericor) klimacodes."—Gardner and Bowles (1939, pl. 37, figs. 9, 10), U. S. Nat. Mus. 372693, one mile south of Yazoo City, Miss.

Typical and variant representatives of *klimacodes* are herewith figured on Plate 16, from Bunker Hill on the Ouachita River, north Lousiana.

THE ROTUNDA-ALTICOSTATA STOCK

In general outline and costal ornamentation, this stock seems quite distinct from planicostid developments. True, the latter sometimes show considerable costal crenulation, but, in general, it is confined to the umbonal region of young specimens. Locally, at least, this stock was as well established and diversified in the Midway Eocene of America as was the planicostid. In this connection, note the characters of such species as *willcoxensis, bulla, crenæa, eoa,* etc. (Gardner, 1933, pp. 163-170, pls. 13-15) and, also, note the longer, *alticostata* outline in figure 3, plate 15 (vol. 1 of these Bulletins). The gravid umbonal development presaging *tetrica* characteristics is well established in Sabine Eocene times by *greggiana,* from Gregg's Landing horizon. Extreme umbonal development and funginate costal development occurred in a Woods Bluff form as shown in these Bulletins (vol. 6, pl. 31, figs. 1-4). The St. Maurice (lower Claiborne) stage furnishes a wealth of intermediate *rotunda-alticostata* forms. *V. trapaquara* from Texas and *perantiqua* of New Jersey may closely approach, in some specimens, the *alticostata* of the Claiborne sand. Varieties *coloradonis* (these Bulletins, vol. 6, pl. 29, fig. 9) and *texalana* (Gardner, 1927, p. 381, figs. 24-27) diverge through forms represented by figures 6 and 7, plate 29 (*loc. cit.*) towards what Plummer has called *V. rotunda* (1932, pl. 8, fig. 7). It is, however, not till we reach the Claiborne sand that typical *rotunda* and *alticostata* are encountered. Here *alticostata* reaches its zenith of development and disappears, while *rotunda* passes on, in a somewhat modified form, into the Jackson or upper Eocene.

In the Jackson there seems to be something of a recrudescence of Sabine umbonal development, while costal ornamentation follows closely the various lines of Clabornian representatives. In the Paris Basin, while rotundid outlines and costal ornamentation closely follow American analogues, neither the *alticostata* quadrangularity nor the *greggiana*-like umbones seem to have been developed.

The young, short forms of *alticostata* described by Lea as *V. sillimani* are sometimes taken for *rotunda*, but the flattening of the postumbonal area of the former and the more quadrangular form serve to differentiate the two. Yet in some specimens of *rotunda* there still remain traces of these characters sufficient to show a common, though distant, ancestry. Such traces have not been observed in the subsequent Jacksonian *diversidentata* development. Still higher, in the Red Bluff beds, though the *rotunda* type of costal ornamentation may survive, the number of ribs has become notably less than in Jackson representatives. This is Dall's species *carsonensis* illustrated here as Plate 17, fig. 9a. (See also Dall, 1903, pl. 56, fig. 9.)

Venericardia diversidentata Meyer, and vars. Plate 16, fig. 10
Plate 17, figs. 1-3, 5-9; 10-17a

Cardita tetrica Conrad, 1854, Wailes, Rept. Geol. and Agric. Mississippi, p. 289 (name only).
Venericardia diversidentata Meyer, 1885, Amer. Jour. Sci., 3d ser., vol. 29, p. 460.
Venericardia rotunda var., Harris, 1894, Arkansas Geol. Survey, Rept. for 1892, vol. 2, p. 149.
Venericardia tetrica Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1424.

The nomenclature of the venericarids of the *rotunda* stock in the Embayment area will doubtless be continually modified for some time to come. *V. rotunda* itself is very close to *V. imbricata* of the Paris Basin and hence is a *Venericardia, s. s.*

Its representative in Jackson beds was listed by Conrad as *Cardita tetrica* as noted above. No doubt he had the same species in mind when compiling his Check List, No. 200 (Smithsonian Inst. Misc. Coll. 1866, p. 23) and used the name *jacksonensis*. We have used Conrad's name *tetrica* as noted by Dall (1903, p. 1424), but, since this and *jacksonensis* are clearly *nom. nud.* and Meyer has given a short diagnosis and name (*diversi-*

dentata) to this form, we are under obligation to continue its usage. Meyer says (see above reference):

In Jackson occurs *Venericardia diversidentata*, n. sp., similar to *Vener. rotunda* Lea, but with a larger beak, and the tooth of the left valve horizontal, while in the Claiborne species it rises obliquely. Though one of the Claiborne specimens has also a large beak, the difference appears to me to be of such importance as to require a new specific name. The relation to *Vener. rotunda* is so obvious, that for instance in Hilgard's Geology of Mississippi it is enumerated under this name. In the young specimens of the Claiborne species the tooth has nearly, or perhaps entirely, the same form as in the Jackson species.

Meyer's type specimen is preserved in the Alabama State Museum and is herewith illustrated (Pl. 16, fig. 10). It is clearly a good-sized, somewhat worn Jackson specimen. Regarding this species Aldrich remarks (1885, p. 307). : "*Venericardia diversidentata* Mr., from Jackson, is nothing more or less than *V. rotunda* Lea. Conrad at one time evidently considered it new, as he gives a name in Wailes (Geol. of Miss.) '*Cardita tetrica*' but afterwards abandons it."

Regarding the significance of subdivisional names to be applied to the *diversidentata* representatives in the Jackson beds, it may be noted that in the Paris Basin Lamarck's *imbricata* specimens, as labelled in the Geneva Museum, are separable into groups with few ribs, coarsely ornamented, and those with more ribs, more finely ornamented. To these groups names like *squamosa* and *elegans* have been applied (Catalogue Illustré, 1914. Dimyaires, pl. 25, figs. 131-138). Somewhat analogous varieties of *rotunda* from the Claiborne sand we have styled var. *fungina* and *funiculata*. Dall found similar conditions in the Jackson and Red Bluff beds and gave two new specific names, *præcisa* and *carsonensis* (1903, p. 1427, pl. 56, figs. 7-9).

By examining our Plate 17, figures 1-17, a fair idea may be gathered of the characteristics of the *diversidentata* Jackson forms. It is the fullness of the umbonal region that serves most readily to distinguish it from the *rotunda* Claibornian analogues. This Meyer has already pointed out.

The costal ornamentation is generally more evenly distributed over the whole surface of the valves in *diversidentata* than in *rotunda*. The beaks in *diversidentata* stand up high and give the shells a cordate form, while they are more subdued and the general outline is more or less quadrate in *rotunda*. When ribs are comparatively few in number and conspicuously serrate (Pl. 17, figs. 8 and 9) the *carsonensis* type is adumbrated. This harks back, perhaps, to *texalaña* Gardner (1927, p. 370, figs. 24-27) of Cook Mountain Eocene horizon. As ribs become more numerous and costal ornamentation broadens (Pl. 17, figs. 1-3) the typical *diversidentata* form is reached. With a greater increase in width of costal ornamentation a *flabellum* type (these Bulletins, vol. 6, p. 80, pl. 29, fig. 8) is produced. This is a common Weches formation type at Smithville, Tex.

Ribs, may, however, become more numerous and the costal crenulation become very fine, producing the *præcisa* aspect (Dall, 1903, p. 1427, pl. 56, figs. 7, 8). Plate 17, figures 7, 10, 11, and 14 show *præcisa* characteristics. The form represented by figures 12, 13 has few ribs with *præcisa* ornamentation. It comes from the same Jackson locality in Arkansas as figure 14 with more ribs. Passing from this through a Gibson Landing Jackson form, figure 15, we come to a Garland Creek type of small size, but remarkedly gibbous and so formed that, if suspended by the beak, it would appear almost equilateral (see figs. 16, 17, 17a). This may be referred to as var. *symmetrica* Dall.

On comparing the figures referred to above with the representatives of *rotunda-alticostata* as shown on plates 28-30 of volume 6 of these Bulletins, it will be noticed at once how thoroughly the *alticostata* characteristics have all disappeared. There seems to be not even a suggestion of transitional forms as noted in *coloradonis* and *trapaquara* from St. Maurice horizons.

For convenience in further studies of Jacksonian types Dall's descriptions of *præcisa* (1903, p. 1427) and *carsonensis* are herewith inserted.

Venericardia præcisa Dall Plate 17, fig. 14

Jacksonian Eocene of Cleveland County, Arkansas, at Station 2232, S. 32, T. 10, R. 11 W. G. D. Harris.

Shell thick, small, rounded, with small, rather anterior not elevated beaks; sculptured with about thirty-four narrow, uniform, articulated ribs, with a T-rail section, separated by about equal V-shaped interspaces with no accompanying threads or riblets; the articulation of the ribs is close, even, fine, and squarely nodular, flat and polished above; the posterior slope has the nodules more elevated and longer with their short slopes ventrally directed; there are on the average three to five articular nodes in a millimetre's length of rib; lunule small, convex; beaks situated about the anterior third; hinge heavy, inner margins elaborately and deeply fluted Length 13.0, height 12.5, diameter 8.5 mm.

This differs from *V. tetrica* in having lower and more compact ribbing, with the tops of the ribs flattened, widened and polished. In *tetrica* the beaks are higher, more prominent, more anterior, and the sculpture more rasplike.

Specimens similar to those from Cleveland County, Ark., (Pl 17, figs. 11-14) rarely show the numerous costæ as described by Dall. In fact, most specimens appear intermediate between our figures 12 and 14. Figure 7 shows how at Moodys Branch, Jackson, Miss., multicostate forms occur.

This form is very close to *V. elegans* of the Paris Basin.

Venericardia carsonensis Dall

Well figured by Dall (1903, pl. 56, fig. 9), his description is as follows (*op. cit.*, p. 1427):

Carson's Creek and Red Bluff Eocene of Wayne County, Mississippi; Burns.

Shell somewhat squarish, rounded, moderately inflated, thin, with about nineteen to twenty-one very narrow, elevated radial ribs, separated by much wider interspaces; sculpture imbricate-nodulous, the nodules in perfect specimens becoming irregularly spinose in the posterior third of the shell; the nodules are not so close to each other as in *V. tetrica* and *V. praecisa* as a rule, especially in the young; lunule small and impressed; the beaks are lower and the whole form less oblique than in *V. tetrica;* hinge normal and more delicate than in the other species mentioned. Length of a moderate-sized specimen 17.0, height 16.5, diameter 11.0 mm.

While the spinosity of the posterior ribs is frequently worn away in adult individuals it is quite noticeable in the younger perfect ones, and the relative sparseness of the ribs with their wide interspaces immediately distinguishes it from *V. tetrica* and other near allies. It reaches, judging by fragments, a length of twenty or twenty-two millimetres when fully grown.

According to our present knowledge all specimens from Carson Creek and Red Bluff should be regarded as Oligocene.

Our figures 8 and 9, Plate 17 of specimens from Moodys Branch foreshadow this Red Bluff species.

This type of development is very close to the Paris Basin *V. squamosa* Lamarck and *V. alticostata* Wood (*non* Conrad) of S. England.

Occurrence.—*V. diversidentata* is one of the most common and widely distributed fossils of the Embayment area. At Robinson's Ferry on the Sabine River, specimens of the type shown here as figures 8 and 9 are found. The various occurrences of this species in Cleveland County, Ark., we formerly referred to under *V. rotunda* var. (Harris, 1894, vol. 2. p. 149). Dall's finely ribbed *præcisa* is from this district. Most accessible collecting is along the east bank of the Saline River near Vince Bluff. The nodules on the ribs are, however, frequently worn off, giving the ribs a peculiarly narrow appearance. Strangely enough we have as yet collected no specimens of this species at White Bluff on the Arkansas. From similar beds on Crow Creek near Forrest City several normal forms have been found. In Tancock Prairie and especially in the Bunker Hill bluff on the Ouachita River, numerous well-preserved specimens may be quickly obtained. They resemble most closely those found at Montgomery on the Red River. Both at Montgomery and in the vicinity of Jackson, Miss., great variations are shown in size, outline, and ornamentation (see Pl. 17, figs. 1, 2, 7-10). The small, very rotund form shown by figures 16 and 17 from Garland Creek, north of Shubuta, we are referring to *garlandia*, n. var.

Types.—Of *diversidentata*, Alabama State Museum
Of *carsonensis*, U. S. National Museum
Of var. *præcisa*, U. S. National Museum
Of var. *garlandia*, Paleont. Res. Institution

Specimens figured.—Figs. 1, 2, Jackson, Miss.; fig. 3, Bunker Hill, La.; fig 4, Gosport, Ala.; fig. 5, Jackson, Miss.; fig. 5a, Claiborne, Ala.; fig. 6, Jackson, Miss.; fig. 6a, Claiborne, Ala.; fig. 7, Jackson, Miss.; fig. 8, Jackson, Miss.; fig. 9, Jackson, Miss.; fig. 9a, Hiwannee, Miss.; fig. 10, Jackson, Miss.; figs. 11, 12, Montgomery, La.; fig. 14, Vince Bluff, La.; fig. 15, Gibson Landing, La.; figs. 16, 17, Garland Creek, Miss.

All specimens in the Paleontological Research Institution.

Venericardia parva Lea

General Remarks.—For Lea's description and Dall's remarks on a variety of *symmetrica*, see these Bulletins, volume 6, 1919, p. 88. Lea's description is excellent and his figure, though small, is well drawn. The crenulation on the 22-24 ribs, in Claiborne sand specimens, when not eroded, is very distinct. The typical form from this horizon is about 5 or 6 mm. in length. Very closely allied or conspecific forms are found in the Lisbon horizon at the base of the Claiborne bluff and at Woods Bluff in the Sabine.

Jackson specimens from Vince Bluff on the Saline River, Arkansas, are about one-half the dimensions of the Claiborne sand specimens and have fewer ribs (about 18). Uneroded specimens show the typically heavy crenate costation. The beak is comparatively high and somewhat curved. This seems to be close to what Meyer has styled *Venericardia parva*, var. *jacksonensis*, and to the *V.* (*Pleuromeris*) *leonensis* from the St. Maurice Eocene of Texas. Of like dimensions (3, 5 mm.) is a *Pleuromeris*-like form with about 14 ribs, from the Sabine River, which may be called *ludvia*. Very small shells with comparatively great thickness and gibbosity are found on the Sabine, on Garland Creek and at Jackson, Miss. These appear to be what Meyer has called *V. inflatior*, var. *jacksonensis*. *V.* (*Pleuromeris*) *tortidens* Harris from Lisbon, Ala. is a thin-shelled form with coarse ornamentation.

Typical *parva* is twice the dimensions of other forms here discussed. Its lunule is but little pouting, and its ligament partially external. In others the ligament seems to be anchored on the interior escutcheon margin.

Subgenus **PLEUROMERIS** Conrad, 1867
(American Journal of Conchology, vol. 3, p. 12)

Subgenotype.—Pleuromeris decemcostata Conrad (=? *Cardita tridentata* Say). Say's *tridentata* is a Recent form on the Atlantic Coast of the United Staes; *decemcosata* Conrad was evidently a name intended to be applied to that East Coast Miocene form at first regarded by Conrad (1838, p. 76) as *tridentata* Say, but later separated. Dall would have them one and the same (Conrad, Reprint, 1893, p. [127]).

Conrad's characterization of *Pleuromeris* is as follows:

Equivalve, triangular, radially ribbed; hinge in the right valve with one broad, nearly direct concave or broadly furrowed recurved tooth, the upper extremity acute and opposite or above the apex of the shell; hinge in the left valve with three teeth, the anterior one small and fitting into a cavity in the opposite valve.

Venericardia (Pleuromeris) parva, var. jacksonensis Meyer

Plate 17, figs. 19-21

Venericardia parva, var. *jacksonensis* Meyer, 1885, Amer. Jour. Sci., vol. 29, 3d ser., p. 460.

The very brief diagnosis of Meyer without a figure leaves one in doubt as to just what he had in hand in describing this variety. Figures 19-21 correspond fairly well to his description, which reads:

> *Venericardia parva* Lea occurs in Jackson in a small form with straighter lateral margins. These two qualities are not constant in Claiborne, and the distinction is properly made by a varietal name, var. *Jacksonensis*.[4]

Occurrence.—Meyer's words, though not clear, would seem to imply that this form occurs in Claiborne beds as well as Jackson. Our specimens are from the Sabine River.

Type.—*V. parva*, var. *jacksonensis*, the Johns Hopkins University Museum.

Specimens figured.—One mile below Robinson's Ferry, Sabine River, Texas.

Venericardia (Pleuromeris) parva Lea, var. Plate 17, figs. 25, 26

Small, rather thin, multicostate form; beak, though slightly eroded, showing concentric sculpture without costæ. Compare markings on beak of *Pleuromeris aldrichi* Harris (1919, pl. 32, fig. 26).

Specimen figured.—Vince Bluff, Saline River, Ark.

Venericardia (Pleuromeris) inflatior Meyer Plate 17, figs. 18, 18a, 18b

Venericardia inflatior Meyer, 1885 Amer. Jour. Sci., vol. 29, 3d ser., p. 460.

Venericardia parva, var. *symmetrica* ? Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1432.

Cardita (*Venericardia*) *transversa*, var. *juvenis*? de Gregorio, 1890, Monographie de la Faune Eocénique de l'Alabama, pl. 31, fig. 20.

Meyer's description of this species is very inadequate for identification purposes. It is as follows:

> A specimen from Claiborne resembles *Venericardia parva* Lea, but is very distinct by being still smaller, very much inflated, having a much larger beak and less nodulous ribs. It may be called *Venericardia inflatior* The same form is also rare in Jackson in a variety with straighter lateral margins, var. *Jacksonensis*.

Since our specimens (figs. 18, 18a) are from the Jackson locality, Garland Creek, and seem to correspond with typical *inflatior*, the slightly higher specimen from Jackson, Meyer's type

[4] Not to be confused with Conrad's *V. jacksonensis* (1866, No. 200, p. 23).

for *Jacksonensis* (fig. 18b) would scarcely seem worthy of even varietal designation. And, as Meyer in a previous paragraph on the same page names a variety of *parva*, *Jacksonensis*, this varietal name cannot be applied to a form of *inflatior*.

Type.—*V. inflatior*, var., "*jacksonensis*." Fig. 18b. Alabama State Museum.

Specimen figured of inflatior.—Fig. 18, 18a, from Garland Creek.

Paleontological Research Institution.

Genus **ASTARTE** Sowerby, 1816

(Mineral Conchology, vol. 2, p. 85)

Genotype.—*Venus scotica* (Maton and Rackett) so designated by Sowerby (p. 85 *sup. cit.*); name synonymous with the older *sulcata* da Costa (British Conchology, 1778, p. 192). See E. A. Smith, Jour. Conch., vol. 3, 1881, pp. 196-232, for general discussion of *Astarte* and allies; also Dall, Wagner Free Inst. Sci., Trans., vol. 3, 1903, pp. 1485-1496.

Illustrations.—Fischer, Man'l de Conch., 1887; DeKay, Zoology of New York, 1843, pl. 28, fig. 281; Sowerby, Thesaurus, 1855, vol. 2, Plates, pl. 167, figs. 1-3—all given as *sulcata* da Costa.

For elaborate synonymy, see Dautzenberg and Fischer in Résultats des Campagnes Scientifiques, Albert 1, Prince de Monoco, Fasc. 37, 1912, pp. 412-416.

Astarte triangulata Meyer Plate 18, figs. 11-14

Astarte triangulata Meyer, 1886, Alabama Geol. Survey, Bull. No. 1, p. 80, pl. 3, figs. 21, 21a.

Astarte triangulata Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1488.

Meyer's description.—Trigonal, solid; pedal scar of anterior adductor distinct; lunule long and flat; surface covered with concentric ribs; margin crenulate.

Locality.—Red Bluff, Miss. Common.

The concentric ribs vary in size, in different specimens, and in some become obsolete toward the ventral margin.

Occurrence.—This species is generally regarded as a good marker for the Red Bluff Oligocene horizon, but it evidently was on the scene in latest Jacksonian Eocene times. This is indicated by the specimens herewith figured from western Alabama, which were found associated with the regular zeuglodon fauna.

Type.—Aldrich Collection, the Johns Hopkins University.

Specimens figured.—Figs. 11, 12, three miles west of Grove Hill, Ala.; fig. 13, about one mile south of Melvin, Ala.; fig. 14, Red Bluff, south of Shubuta, Miss.; Oligocene specimen inserted here for comparison with uppermost Eocene forms.

Subgenus LIRODISCUS Conrad, 1869

(American Journal of Conchology, vol. 5, p. 46 [as *n. gen.*])

Subgenotype.—*Astarte tellinoides* Conrad, Amer. Jour. Sci., vol. 23, 1833, p. 342.

Illustrations.—*A. nicklini* and *sulcata* Lea, Contribution to Geology, 1833, pl. 2, figs. 35, 36. Also, *Lirodiscus tellinoides* Harris, Bull. Amer. Paleont., vol. 6, 1919, pl. 32, figs. 4-11.

By consulting Bulletins of American Paleontology, vol. 6 (*sup. cit.*) it will be seen that there are several Eocene astartid species with flattened early stages of growth in the Embayment area. These the present writer as well as Dall (1903, p. 1483 *et seq.*) have classed as *Lirodiscus*. The peculiar posterior marginal sulcation of *tellinoides* seems not to be a constant character of even this type species. The flattening of the beak in juvenile stages seems to be a character of subgeneric importance. Conrad queries the possible assignment of D'Orbigny's Cretaceous *A. sinuata* to *Lirodiscus;* but the posterior sinuosity of that shell is somewhat higher, and there is no trace of flattening of the beak (D'Orbigny, vol. 3, Atlas, pl. 264, figs. 1-3).

Lirodiscus jacksonensis Meyer Plate 18, figs. 1-5, 8-10

Astarte parilis Conrad, 1854, Wailes Rept. Agric. and Geol. Mississippi, p. 289, pl. 14, fig. 2; not *A. parilis* Conrad, 1853, Acad. Nat. Sci. Philadelphia, Jour., vol. 2, p. 276, pl. 24, fig. 16.

Astarte sulcata, var. *jacksonensis* Meyer, 1885, Amer. Jour. Sci., 3d ser., vol. 29, p. 460.

Lirodiscus wailesii Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1483, pl. 57, fig. 21.

Meyer's characterization of this form, though very incomplete, is quite sufficient to determine this species. It is as follows:

Astarte sulcata Lea occurs in Jackson with more numerous concentric ribs and seems to be generally stouter than in Claiborne; this may justify a varietal name var. *Jacksonensis.*

For a more complete description we quote Dall.

Dall's characterization.—Jacksonian Eocene of Jackson, Mississippi, Vince's Bluff, Arkansas, and Montgomery, Louisiana; Burns, Harris, Vaughan.

Shell subovate, with high, flat, nearly smooth beaks, the remainder of the disk finely, concentrically ribbed with narrow, rather elevated ridges and wider interspaces; beaks pointed, prosogyrate; lunule smooth, sublanceolate, rather deeply excavated; escutcheon longer, narrower, and less impressed; posterior end hardly rostrate; hinge normal, basal margin finely crenate; adductor scars slightly raised; length 18.0; height 15.2, diameter 8.0 mm.

The nepionic shell in this species is smaller and smoother and the ribbing of the disk less coarse than in the other species. The rostration, which is so marked a feature in *L. tellinoides,* is not found in this or the lower Eocene species.

Dall's description applies to the common, or more normal, form as represented by figures 1, 2, and 5 of Plate 18 of this work. The concentric ribbing may form undulations of a higher order as shown somewhat in figure 8, but more especially in figure 4. Some specimens are without marginal crenulation within. For the normal form of the Clalbornian *tellinoides*, see volume 6 of these Bulletins (pl. 32, figs. 4-7).

Figure 6 of our present plate is a *tellinoides* from the Claiborne sand at Claiborne showing a remarkably short form. It is the same specimen illustrated in volume 6 as figure 9, plate 32 and is inserted to suggest distant relationship with *jacksonensis* and *smithvillensis*. Figure 7 is a *tellinoides* from the "*Scutella*" bed above the "sand" and shows an interesting variety, *scutellaria*, n. var.

Occurrence.—This is a typical Jacksonian species, occurring from the Sabine River on the west, through Cleveland County, Ark., along the Ouachita River (Gibson, Bunker Hill, and Grand View landings) and Montgomery, La., to Jackson and Garland Creek, Miss.

Type of jacksonensis.—Aldrich Coll., the Johns Hopkins Univ.

Specimens figured.—Figs. 1, 2, from Moodys Branch, Miss.; figs. 3, 4, Vince Bluff, Cleveland Co., Ark.; fig. 5, Gibson Landing, Ouachita River, La.; fig. 6, Claiborne sand, Claiborne, Ala.; fig. 7, "*Scutella* bed," above Claiborne sand at Claiborne, Ala.; fig. 8, Vince Bluff, Ark.; figs. 9, 10, Sabine River, Texas side.

Micromeris senex Meyer Plate 18, fig. 19

Micromeris senex Meyer, 1886, Alabama Geol. Survey, Bull., No. 1. p. 81, pl. 3, fig. 22.

Meyer's brief description of this species has already been referred to in these Bulletins (vol. 6, 1919, p. 95). Dall (1903, p. 1480) says of it; "Meyer's *M. senex* does not appear to differ appreciably from a very young *Venericardia*. The species is also reported from the Jacksonian."

So far as we are aware there is no definite proof of the Jackson age of this ill-defined form except that Meyer says it comes from his bed "g" of the section at Claiborne. This section as given in the American Journal of Science, vol. 30, 1885, p. 69, reads as follows:

k. Diluvium ? red loam and pebbles	
i. Mostly limestone	33 feet
h. Glauconitic sands and clays	11 feet
g. Gray sandy stratum with fossils	6½ feet
f. Red sand, fossils badly preserved, similar to e, but *Scutella* very common.	
Highest Claibornian	
e. Ferruginous sand with Claibornian fossils	17 feet
Lowest Claibornian	
d. Color a bluish gray	26 feet
c. Mostly limestone with large ferruginous concretions	8 feet
b. Calcareous limestone with green sand, *Ostrea, Pecten, Scalpellum, Scutella*	30? feet

Since the specimen Meyer described came from the bed "g", and since it came from the sandy stratum above the well-known "*Scutella*" layer at Claiborne, there can be little doubt about its Jacksonian age.

Holotype.—Not located. Meyer (1887, p. 16) says it is but a young *Venericardia*, "und ziehe ich hiermit die Art *Micromeris senex* ganz zurück."

Genus **CRASSINELLA** Guppy, 1874
(Geological Magazine, vol. 1, 2d dec., p. 442)

Genotype.—*Crassinella martinicensis* (d'Orbigny) by monotypy.

For discussion of synonymy, see: Stewart, Acad. Nat. Sci. Philadelphia, Spec. Publ., No. 3, 1930, p. 146; Keen, Malacol. Soc. London, Proc., vol. 23, 1938, p. 30; Chavan, Mus. Roy. Hist. Nat. Belgique, vol. 15, No. 34, 1939, p. 1.

Illustration.—Sagra, Historia Fisica, Politica y Natural dela Isla de Cuba, pt. 2, vol. 5, Moluscos, 1845, p. 325, pl. 27, figs. 21-23.

Crassinella pygmæa (Conrad) Plate 18, figs. 17-18

Gouldia pygmæa Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 139, pl. 21, fig. 5.

Crassatellites (Crassinella) pygmæa Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1475.

Conrad's description.—Triangular, equilateral, with eight distinct concentric ribs; posterior hinge-margin very slightly curved, the anterior straight, but slightly angular at the umbo; anterior extremity angular and situated medially to the height of the valves.

Occurrence.—Conrad's specimen (among the lot described by him from "Enterprise, Miss.," now regarded as mainly from the Garland Creek locality) was evidently very minute, scarcely a millimeter in length as he figures it. Our specimen of about twice that size is from Moodys Branch, Jackson, Miss. However, there seems to be no valid reason for supposing the two are distinct species.

Holotype.—Acad. Nat. Sci. Philadelphia.

Specimen figured.—Moodys Branch, Jackson, Miss.

Genus **CRASSATELLA** Lamarck 1799?, 1801
(Prodrome d'une Nouvelle Classification des Coquilles, Société d'Histoire Naturelle, Mémoires, p. 85)

Illustration.—Lamarck, Ann. Mus. Nat. Hist. Nat., vol. 9, 1807, pl. 20, figs. 7a, b; Sowerby, Genera of Recent and Fossil Shells, 1822, *Crassatelia*, fig. 1; Deshayes, Description des Coquilles des Environs de Paris, vol. 1, Atlas, 1837, pl. 3, figs. 10, 11; Muséum d'Histoire Naturelle de Genève, Catalogue Illustré de la Collection Lamarck, 1914, Dimyaires, pl. 2, fig. 16 and pl. 3, figs. 17- 18.

The genus *Crassatella* (*crassus*, thick, dense) was briefly characterized by Lamarck in 1799. By some *lapsis* he gave "*Mactra cygnea* Chemnitz (vol. 6, pl. 21, fig 207) as sole representative, although his description clearly indicates that he had other specimens in hand while writing the same. In 1801 (Système des Animaux sans Vertèbres, p. 119) he had referred Chemnitz's *Venus plumbea* to "*gibba*", and in 1805 (Ann. Mus. Hist. Nat., Paris, vol. 6, p. 408), he questions the propriety of including "*Mactra cygnea*" Chemnitz under *Crassatella*, showing by his description and species referred to that he had attained to practically the modern conception of the genus *Crassatella*. For genotype, he would seem to have made it clear by stating, regarding his *tumida*, "*gibba*" Lamarck=*plumbea auct.*; "C'est d'après cette belle crassatelle que j'ai établi le caractère du genre." (Ann. Mus. Nat., Paris, vol. 6. 1805, p. 408). Regarding the history and significance of the name *plumbea*, see Deshayes, volume 1 of his Animaux sans Vertèbres (1860, pp. 737-738).

On account of the initial instability of the name *Crassatella*, Dall (1903, vol. 3, p. 1468) has proposed making use of Krüger's name *Crassatellites* (Arch. Neuest Entd. Urwelt, vol. 2, 1823, p 466). Type *C. sinuatus*. But *Crassatellites* cannot be regarded as taking the place of *Crassatella* as Krüger refers various species to "*Crassatella*." Would he include any other species under *Crassatellites* besides *sinuatus*, and what is *sinuatus*? His description reads:

(a) Crassatellites sinatus. Crassatelle bossue. Mit sehr dicken Schaalen, riefen Müskeleindrücken und einzelnen Querrelfen, welche auf der Oberfläche mit dem untern Rande der Schaalen gleichlaufen.—Häufig bei Grignon. (From notes furnished Miss L. M. Schoonover, Thesis, 1936, by Dr C. Davies Sherborn of the British Museum.)

The probabilities are that this *sinuatus* is Lamarck's *tumida*. For a discussion of the generic name *Crassatella* and the more recently given subgeneric terms see Stewart (1930, pp. 134-140).

JACKSONIAN CRASSATELLÆ

A glance at the *Crassatella* illustrated in volume 6 of these Bulletins will suffice to show that in the St. Maurice stage three definite groups or stocks of this genus were well represented: (1) the quadrangular (*e. g. texanus*), (2) the high and circular (*texaltus*), and (3) the elongate (*clarkensis*). Of these the second and the third groups hold over into the Claiborne stage, while only the last is represented in the Jacksonian Embayment area. Practically all, up to 2-3 mm. in length, have similar characteristics—a nearly circular form becoming elongate as size increases and showing concentric undulations spreading farther and farther apart postero-basally. The shell surface soon becomes practically smooth in the St. Maurice representatives, but shows a tendency toward increasing corrugation in the Claiborne, reaching a maximum in the Jackson stage. Among such forms, however, are many reversions to the earlier, smooth types. Note the similarity in figure 30, Plate 18 and figure 4, Plate 19. Plates 18 and 19 illustrate all the above-mentioned characteristics.

Crassatella flexura Conrad Plate 18, figs. 22-29, 35-38; Plate 19, figs. 1-4

Crassatella flexura Conrad, 1854, Wailes, Rept. Agric. and Geol. Mississippi, pl. 14, fig. 7; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 259 (Reprinted: Bull. Am. Paleont., vol. 24, pp. 343-359, pls. 23, 26).

Crassatella producta Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 139, pl. 10, fig. 6.

Conrad's description.—Trapezoidal, inequilateral; ventricose medially; slightly contracted anteriorly, and more so posteriorly; umbonal slope angulated and prominent; whole surface with concentric prominent lines, some of which bifurcate anteriorly; inner margin crenulated.

Approaches *C. protexta* Con., but has the striæ over the whole disk, the cardinal teeth more compressed; inner margin with larger crenulations, etc.

Conrad's figure, in the Wailes report, shows a shell (exterior view) with beak rather anteriorly located, though the interior view does not emphasize that character. A fair representative of average *flexura* characteristics is shown by figure 35, Plate 18, from Jackson, Miss. The short anterior and strong ribbing is shown by figure 37, while the pointed beak of "*productus*" is shown by figure 36 (from Garland Creek). The young of the latter is shown by figure 29 with unusually strong crimp in the postumbonal slope. This is present in common young forms as figures 24-28, but not so noticeable as in the Garland Creek representatives. For ready comparison with the *flexura* Jackson forms, figures 32-34 of *protexta* from the Claiborne sand beds have been inserted. Here, it will be observed, strong plication continues over the surface of the shell for at least 10 mm. from the apex, thence the anterior and basal portions become nearly smooth. By consulting plate 35, volume 6 of these Bulletins, it will be seen that, for the most part, Claiborne specimens have little exterior corrugation. It will be noted that where the surface is corrugated in figure 34, Plate 18, the shell is somewhat inflated and the lower margin is bowed down, while in Jackson forms these characters are absent, *i. e.*, the basal submargin is straight. Not all Jacksonian forms are strongly corrugated. Various stages of this type of ornamentation are shown as figures 1-3, Plate 19. Many forms appear smooth (Pl. 19, fig. 4.) and assume a decidedly *clarkensis* appearance. Such specimens we called "*postclarkensis*" on p. 100, volume 6 of these Bulletins.

Occurrence.—The forms we must regard as most typical come from the vicinity of Jackson, Miss., and are shown on Plate 18, figures 35 and 37. Figure 37 has a somewhat wider posterior than the specimen figured by Conrad, while figure 35 shows an antero-superior margin a little too concave. Figure 36 is very close to the form described as "*producta*" by Conrad from the Garland Creek locality. It is not always distinguishable from *flexura*. Various phases are obtainable from Montgomery, La., as shown by figure 38, Plate 18 and figures, 1, 2, of Plate 19. Bunker Hill on the Ouachita River, La., and Vince Bluff on the Saline River in Arkansas show forms like Plate 19, figure 4, suggestive of the St. Maurice *clarkensis.* We have designated them as "*postclarkensis.*" While most of the specimens at Bunker Hill are smooth exteriorly, a few are as highly corrugated as typical *flexura.* On rare occasions specimens from Garland Creek are nearly smooth, with abnormally coarse umbonal corrugation (Pl. 19, fig. 4) reminding one of *ferrocarolina.* (See Bull. Amer. Paleont., vol. 6, 1919, pl. 34, fig. 7).

Fragments of seemingly nearly typical *flexura* were found on the old Fail road perhaps three miles west of Silas, Ala., in a ferruginous ledge in the road ditch.

Genus **ALVEINUS** Conrad, 1865

(American Journal of Conchology, vol. 1, p. 138, pl. 10, fig. 2)

Genotype.—*Alveinus minutus*, Conrad, by monotypy, *vid. sup.*

Illustrations.—Palæont. Amer., vol. 1, 1920, pl. 17, figs. 11-15; Bull. Amer. Paleont., vol. 6, 1919, pl. 37, fig. 15.

Alveinus minutus Conrad Plate 19, figs. 5, 5a

For synonymy and characterization of this species, see references to Bulletins of American Paleontology cited above and also Dall in the Transactions of the Wagner Institute (1900, vol. 3, p. 1166).

Occurrence.—This species ranges from the Sabine River on the west, Gibson Landing on the north, through Jackson and Garland Creek, Miss. (as a Jackson form), and occurs sparingly in the Claiborne sand at Claiborne, Gopher Hill, and Little Stave Creek, Ala.

Type.—Not found.

Specimens figured.—See Palæont. Amer., vol. 1, p. 112, pl. 17, figs. 11, 12.

Genus **KELLIELLA** Sars, 1865

(Förh. Vidensk. Selsk. Christiana, p. 198, *fide* Neave)

Genotype.—*Kelliella abyssicola* Sars (=*miliaria* Philippi)

Illustration.—Sars, Mollusca Regionæ Arcticæ Norvegiæ, 1878, pl. 19, figs. 15a, b, c.

"*Venus miliaria*" was described in a fossil state by Philippi (1844, p. 36, pl. 14). It is found living from Norway to the Mediterranean (Dautzenberg and Fischer, 1912, p. 431). Cossmann and Pissarro cite one species of this genus from the Paris Basin (1887, pl. 29). Dall remarks (1900, p. 1167); "A recent species *K.* [*K*] *nitida* Verrill, is known from the Atlantic coast in deep water, and we may expect that other Tertiary horizons when thoroughly searched will prove to include this genus."

Kelliella bœttgeri Meyer Plate 19, figs. 6, 6a

Kelliella ? bœttgeri Meyer, 1886, Alabama Geol. Survey, Bull., No. 1, p. 83, pl. 3, fig. 15.

Kelliella bœttgeri Dall, 1900, Wagner Free Inst. Sci., Trans., vol. 3, p. 1167.

Kelliela bœttgeri Harris, 1920, Palæont. Amer., vol. 1, p. 114, pl. 17, figs. 16-18.

By referring to the last citation, it will be seen that this species has much in common in hinge characteristics with the genus *Lutetia* (established by Deshayes five years before Sars described *Kelliella*). Text figures 2 and 7 (opp. p. 114) show the hinge characters of the two to be fundamentally the same. Exterior markings and lunule, however, are more like those of *Kelliella*. Meyer's description, together with a much more detailed characterization of this species, may be found on page 114 of Palæontographica Americana.

Meyer cites this "from Jackson, Miss., common," but we have found it only at this locality, and rarely.

Genus **ERYCINA** Lamarck, 1805
(Annales du Muséum d'Histoire Naturelle, Paris, vol. 6, p. 413)

Genotype.—*Erycina pellucida* (Lamarck) Récluz, Rev. Zoöl. Soc. Cuvierienne, Paris, 1844, pp. 291, 325; Cossmann, Cat. Illus. etc., in Ann. Soc. Roy. Malacol., vol. 22, 1887, p. 52, pl. 2, figs. 32, 33; Dall, Wagner Free Inst. Sci., Trans., vol. 3, 1900, p. 1140.

Illustrations.—Lamarck, Ann. Mus. Hist. Nat., vol. 9, 1807, pl. 19, figs. 2a, b; Cossmann, *supra cit.*, pl. 2, figs. 32, 33; Deshayes, Description des Coquilles des Environs de Paris, vol. 1, Atlas, 1837, pl. 6, figs. 19-21.

Récluz (*op. cit. supra*) cites 18 living representatives of this genus of wide distribution (from the Antilles to New Holland) and 11 fossil forms; Cossmann discusses 26 species in the Paris Basin, from lower to upper Eocene, and is in doubt as to the true representatives in modern seas.

Erycina whitfieldi Meyer Plate 19, fig. 7

Meyer's description is quoted in volume 6 of the Bulletins of American Paleontology (1919, p. 107), which see. In his Sonder-Abdruck (Ber. Senckenberg. Naturf. Gesell., 1887, p. 11) he states:

Das Original exemplar von Claiborne (linke Klappe) ist anscheinend ein etwas junges Stück. Von Jackson besitz ich nun beide erwachsens Klappen; Taf. 2, fig. 8 stellt die rechte Klappe dar.

Dall remarks regarding this species (*op. cit.*, p. 1143):

From the Jackson Meyer has described . . . a form which he refers to *E. whitfieldi*, but which if his figure is reliable is more likely to be a variety of *E. zitteli* or even a distinct species.

Erycina zitteli Meyer Plate 19, fig. 8

Erycina zitteli Meyer, 1887, Sond.-Abdr. Ber. Senckenberg. Naturf. Gesell. p. 11, pl. 2, fig. 9.

Erycina zitteli Dall, 1900, Wagner Free Inst. Sci., Trans., vol. 3, p. 1143.

Meyer's description.—Queroval, sehr ungleichseitig und bauchig. Wirbel hinten gelegen, obsolet. Hinterrand abgestumpft. Rechte Klappe mit einem horizontalen lamellaren Hauptzahn, vom Wirbel aus nach vorn gelegen, und zwei kräftigen, leistenformigen Seitenzähen. Muskeleindrücke oval. Manteleindruck ganz. Oberflache glatt, mit Anwachsstreifen.

We are refiguring herewith as figures 7 and 8, Plate 19, Meyer's type specimens, kindly loaned from the Aldrich type collection at the Johns Hopkins University, by Dr. C. T. Berry.

Genus **DIPLODONTA** Bronn, 1831

(Ergebnisse meinen Naturhist-ökonomischen Reisen, vol. 2, p. 484)

Genotype.—*Venus lupinus* Brocchi, Conchologia Fossile Subapennina, vol. 2, 1843, p. 369, pl. 14, fig. 8; by Herrmannsen, Indicis Generum Malacozoörum, vol. 1, 1846, p. 392.

Illustration.—Brocchi (*vid. sup.*, pl. 14, fig. 8). For details of hinge, Lamy, Jour. Conch., vol. 65, 1920, p. 336.

Regarding the possible substitution of *Taras,* Dall remarks (1901, p. 791):

> The genus *Taras* Risso, from the figure and description, would seem to be a *Diplodonta,* in which the delicate posterior cardinal of the left valve had been broken away and the corresponding tooth of the right valve mistaken for an adjacent lateral. It was founded on *T. antiquatus* Risso, a fossil of La Trinité (Tertiary). If this identification proves correct, the name *Taras* will supersede *Diplodonta,* being five years earlier in date. It was placed next to *Loripes* by Risso. I do not make the substitution, hoping that some Italian naturalist may be able to examine Risso's type species, and thus arrive at certainty before upsetting an old and familiar name.

The same hesitation about making so drastic a change seems to have been felt by Lamy (1920, p. 335) about a score of years later, but Stewart (1930, p. 193) accepts the change with little hesitation. We are not aware that the type specimen has recently been examined.

Diplodonta ungulina Conrad, var. **yazoocola**, n. var.

Plate 19, figs. 9, 10, 10a

For Conrad's description, synonymy and general discussion of *ungulina*, see Bull. Amer. Paleont., vol. 6, 1919, p. 127, pl. 40, figs. 10-14.

The specimens referred to this new variety seem close to *ungulina* in some respects, but are more circular in outline and not quite so solid in general make-up. In fact, they suggest in outline some similarity to Lea's *inflata,* but are not so gibbous. Some variants in the Claiborne sand hint at relationship with this variety.

Occurrence.—We have collected this form only at the escarpment in the pasture lot behind the buildings on the east side of the railway at Sims Siding some eight miles north of Yazoo City, Miss. It appears there quite abundantly with comparatively little variation in size and outline. The horizon represented is probably early Jacksonian.

Syntypes.—Paleontological Research Institution.

Subgenus **TIMOTHYNUS**, new subgenus

Type.—*Sphærella bulla* Conrad, Amer. Jour. Conch., vol. 1, 1865, p. 138, pl. 10, fig. 9.

Illustration.—See Conrad, *supra;* Harris, Bull. Amer. Paleont., vol. 6, 1919, pl. 40, fig. 9.

Following Conrad, we have usually referred the species *bulla* to *Sphærella* Conrad (1838). This genus was described by its author for a Miocene form (*S. subvexa*) from the East Coast Miocene. He refers, however, to a Recent Pacific Ocean species. In 1860, (vol. 4, p. 280) he writes:

> The first appearance of this genus is in the Cretaceous formations as indicated by the species herein described. In the Eocene of Alabama, or of the other Southern States, I have never found a species, but I obtained four species of *Diplodonta*. In the Miocene there are two species of *Diplodonta* and only one of *Sphærella*.

In his Eocene, Oligocene Check-List of 1866 (Smithsonian Misc. Publ., No. 200, p. 24) he gives the Jacksonian *S. bulla* Conrad, 1865, along with *S. turgida* (formerly *Loripes turgida* from the Vicksburg beds).

Dall (1900, p. 1179) would limit *Sphærella* to the Miocene type species and a few Recent forms, remarking in fine: "It is evident, therefore, that *Sphærella* can be regarded at most as a section of *Diplodonta*, closely allied to the typical form of the genus."

However, since Sommerfelt employed *Sphærella* for a protozoan (*fide* Neave) in 1824, Conrad's usage of the term in 1838 should be discontinued. To what extent the Miocene and Cretaceous forms heretofore referred to *Sphærella* Conrad should be relegated to *Diplodonta* or referred to the new subgeneric name here proposed remains for the future to decide.

Timothynus bulla (Conrad) Plate 19, figs. 12-16

Sphærella bulla Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 138, pl. 10, fig. 9.

Diplodonta turgida (Dall) *partim*, 1900, Wagner Free Inst. Sci., Trans., vol. 3, p. 1181.

Sphærella bulla Harris, 1919, Bull. Amer. Paleont., vol. 6, p. 125, pl. 40, fig. 9.

Conrad's description.—Equilateral, orbicular, subspheroidal; surface with distant, shallow concentric furrows.

This description was included in Conrad's "Enterprise" paper, and hence we conclude that the type specimen figured was from somewhere on Garland Creek. Note that he gives no internal characteristics. But in his revised diagnosis of *Sphærella* in the American Journal of Conchology (vol. 6, 1871, p. 200) he says:

> Hinge of the right valve with three cardinal teeth, the two anterior teeth small, entire; posterior tooth rather elongated, parallel with the hinge margin and slightly grooved.

These characters he evidently derived from a study of his genotype species, *S. subvexa*, from the East Coast Miocene.

In *Timothynus*, it would seem that the posterior section of the central cardinal represents, or serves the function of, the "posterior tooth rather elongated, parallel with the hinge margin" in "*Sphærella.*" The globular form of this subgenus allows for the growth of the hinge teeth of each valve far into the cavity of the opposite valve, thus producing strong articulation without extensive lateral teeth or long ligament. Though the outline of the Jackson forms may approach that of the St. Maurice *T. anteproducta*, we have yet to find the dental apparatus of *bulla* so extravagantly developed as in that earlier form. See figures 8a, 8b, volume 6, plate 40, and figures 14, 16, Plate 19 of the present work.

Occurrence.—The occurrence of representatives of these globular forms with both valves locked together and filled generally with hard, limy substances renders the study of interior characters very difficult We have yet to see traces of pallial line or muscular scars. We assume, however, that the Jackson representatives belong to one and the same species from Texas to Alabama. Perhaps they are most abundant in Toro Bayou outcrops, especially in hard, almost cherty calcareous layers. As will be noted in our Arkansas Tertiary report (Arkansas Geol. Survey Rept. for 1892, vol. 2, p. 152) localities are numerous in Cleveland County, Ark., from Vince Bluff to Kingsland. Other occurrences are: Danville on the Ouachita River, Tullos, La., as well as Moodys Branch and Town Creek in Jackson, and Garland Creek, Miss. Great care must be exercised in studying the Mississippi examples as the material is often not consolidated, the shell substance is very thin and fragile, and the finer dental characteristics are generally destroyed.

Holotype.—Acad. Nat. Sci. Philadelphia. Badly broken.

Specimen figured.—Figs. 12-14, Vince Bluff, Saline River, Ark.; fig. 15, Moodys Branch, Jackson, Miss.; fig. 16, exact locality not known.

Timothynus deflatus, n. sp. Plate 19, figs. 17, 18

Characterization.—Among the smaller bivalves from Jackson, Miss., is this thin and fragile left valve having much the shape of *Diplodonta ungulina* with the hinge of *Timothynus* type. It is less than one-half the linear dimensions of Lea's "*Egeria inflata*" and lacks the tendency towards the quadrangular outline of that species.

Holotype and specimen figured.—Paleontological Research Institution.

JACKSON LUCINACEA

On referring to volumes 2 and 6 of the Bulletins of American Paleontology, one can observe how the three stocks of Jackson lucinids have developed from lower (Sabine) to upper (Jackson) Eocene times. The following table indicates this development.

	Sabine vol. 2	Claiborne vol. 6	Jackson vol. 30
Myrtid	Pl. 20, figs. 5, 6	Pl. 38, figs. 18-21	Pl. 19, figs. 20-23
Milthid	Pl. 20, figs. 2, 4	Pl. 39, figs. 8-9	Pl. 20, figs. 9-13
Loripid	Pl. 20, figs. 7a, b	Pl. 39, figs. 1-5a	Pl. 20, figs. 6-8

Note how the abundant, virile stock of *pomilia*-like forms, as well as the huge loripids and milthids, is absent from Embayment Jackson beds.

Genus **LUCINA** Bruguière, 1797

(Encyclopédie Méthodique, Vers Testacées [Atlas], 1797, pl. 284)

Genotype.—*Venus pensylvanica* Linné, Systema Naturæ, 12th ed. 1767, p. 1134; *Lucina pensylvanica* Schumacher, Essai d'un Nouveau Systéme . . . Vers Testacés [Atlas] 1817, p. 165, pl. 16, figs. 2a, b.

Illustration.—"*Pectunculus albus,*" etc. Lister, Synopsis Conchyliorum, 1770, pl. 305, fig. 138; *Venus pensylvanica* Chemnitz, Conch. Cab. vol. 7, 1784, pl. 37, figs. 394-396; *Lucina pensylvanica* Schumacher, *sup. cit.*; *Lucina pensylvanica* Reeve, Conch. Icon., 1850, *Lucina*, pl. 6, fig. 29.

Genus **MYRTEA** Turton, 1822

(Conchylia Dithyra Insularum Britannicarum, p. 133)

Genotype.—*Venus spinifera* Montagu, Testacea Britannica, 1803, p. 577;

Myrtea spinifera Turton, *sup. cit.*
Illustration.—Montagu, *op. cit.*, pl. 17, fig. 1; Reeve, Conch. Icon., 1850, *Lucina*, pl. 7, fig. 39.

To what extent it may prove advisable in the future to refer certain of our small Eocene lucinids to the genus *Myrtea* cannot now be foretold. Because of the size to which the British genotype, the modern *M. spinifera*, may attain (one inch plus, *fide* Forbes and Hanley, 1850, vol. 2, p. 51), because of its plastic form, its greater length compared to height, and the greater regularity in its surface markings, one hesitates to assign American Eocene species to this genus. The general type of dentition, however, would not seem against such assignments. Dall (1903, p. 1358) has referred Conrad's *Cyclas curta* to "*Myrtæa*," quite probably on account of the serrate dorsal projections. They are not regular, comblike, as in *spinifera*, and often are practically absent. *Myrtea curta* ties in rather closely with *Lucina papyracea*, which in turn is not far removed from the *pomilis* stock. For the present, we regard *curta* as a *Lucina* with some myrtid characteristics.

Lucina (Myrtea?) curta (Conrad) Plate 19, figs. 19-23

Cyclas curta Conrad, 1865, Amer. Jour. Conch., vol. 1, pp. 139, 212, pl. 20, fig. 14.
Lucina curta Conrad, 1866, Smithsonian Misc. Coll., vol. 7, Check List, No. 200, p. 24.
Myrtaea Curta Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1358.
Conrad's description.—Equilateral, suborbicular, ventricose, concentrically finely striated, posterior end truncated, direct; dorsal margin each with two or three pointed tubercles; beaks slightly prominent, acute.
Length 3/8 inch; height the same.

The figures herewith given show main characteristics, internal as well as external.

Occurrence.—Most abundant at Jackson, though occurring at Garland Creek, Miss., Vince Bluff, Saline River, Ark.; and on the Sabine River, Texas side at Jackson outcropping.

Holotype.—Acad. Nat. Sci. Philadelphia.

Specimens figured.—All from Jackson, Miss.

Lucina (Myrtea?) subcurta, n. sp. Plate 20, figs. 1-5

Specific characterization.—Size and general appearance as illustrated; well-marked concentric striation increasing in strength from beak to basal margin; posterior truncation well defined and showing from either obtuse angle exteriorly, to the beak, series of irregularly raised, knife-edged projections (well indicated in fig. 2); one cardinal tooth in right valve, with anterior and posterior lateral sockets; two cardinals with shell margins answering for weak laterals in left valve; peripheral crenulation well developed; lunule large and well defined.

In some respects this species recalls *smithi* Meyer, but it has not the low, *Corbis*-like appearance as shown by Meyer's illustration (Alabama Geol. Survey, Bull. No. 1, 1886, pl. 1, fig. 23; Bull. Amer. Paleont., vol. 6, pl. 38, fig. 1). The Woods Bluff (Sabine Eocene) forms approach this species, but are too broad and low beaked, with coarser lirations, and seem not yet to have developed the series of knife-edged posterior projections as mentioned above. Only occasionally is there developed that concentric, billowy surface so characteristically shown by the Claibornian *pomilia* and *alveata*.

Occurrence.—The species is found most abundantly at Jackson, Miss., though it is not rare at Garland Creek.

Specimens figured.—Fig. 3 is from Garland Creek, Miss.; all others from Jackson, Miss.

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Subgenus **EOPHYSEMA** Stewart, 1930
(Academy of Natural Sciences of Philadelphia, Special Publications, No. 3, p. 186)

Subgenotype.—*Lucina subvexa*[5] Conrad, Fossil Shells of the Tertiary Formations, 1833, p. 40; *Loriphinus (Eophysema) subvexa* Stewart, *vid. sup.*

Illustration.—*Lucina subvexa* Conrad, Amer. Jour. Sci., vol. 1, 1846, pl. 4, fig. 14; copied Bull. Amer. Paleont., vol. 6, 1919, pl. 39, fig. 1. See also this Bulletin, vol. 30, pl. 20, fig. 8.

Lucina (Eophysema) ozarkana ?, var. Plate 20, figs. 6, 7

The proper name to be applied to the Jackson representatives of this group of shells will depend on what is assumed to be Conrad's *Lucina subvexa*. Conrad speaks of *subvexa* as being "without teeth" (these Bulletins, vol. 6, 1919, p. 119). *L. ozarkana* is fairly well provided with lucinid cardinal teeth (see these Bulletins, vol. 2, 1897, pl. 20 figs. 7a,b). The interior of the fragmental holotype in the Philadelphia Academy is sketched herewith as figure 8. The Jackson specimens we have in hand

[5] It seems rather unfortunate that a species so imperfectly defined as "*subvexa*" should be used as a genotype.

agree as to exterior markings with *ozarkana* but have the teeth less lucinid in appearance. seemingly small, oblique, and compressed vertically. Had we better knowledge of *subvexa*, it is quite possible the Jackson form might be regarded as a variety of that species.

Specimens illustrated.—Fig. 6, Gibson Landing, Ouachita River, La.; figs. 6a, 7, Jackson, Miss.

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Subgenus **PLASTOMILTHA** Stewart, 1930
(Academy of Natural Sciences of Philadelphia, Special Publications, No. 3, p. 191)

Subgenotype.—*Cyclas claibornensis* Conrad. Amer. Jour. Conch., vol. 1, 1865, p. 146; *Miltha* (*Plastomiltha*) *claibornensis* Stewart, *op. cit.*, p. 191.

Illustration.—*Phacoides* (*Miltha*) *claibornensis*, Dall, Wagner Free Inst. Sci., Trans., vol. 3, 1903, pl. 50, fig. 18; *Lucina claibornensis* Harris, Bull. Amer. Paleont., vol. 6, 1919, pl. 39, figs. 8, 9.

This type of shell is separated from the more common, more *Miltha*-like, *pandata* shells by its higher, more circular form; narrower, long anterior adductor scar, greater thickness and slight tendency to show traces of anterior laterals. The truncation of the posterior margin is decidedly pronounced.

Lucina (Plastomiltha) gaufia, n. sp. Plate 20, figs. 9-13

The characteristics of the material we have in hand are shown by the figures here referred to. The anterior muscular scar is moderately long and narrow; ligamental socket is long, deep and practically internal; area behind the umbonal ridge very broad, giving the posterior margin a remarkably broad truncation; anterior cardinal margin tending to become alate and showing within a faint trace of an anterior lateral; surface marked by sharp-edged concentric lirations.

Specimens figured.—Figures 9 and 10, Gopher Hill (Baker's Bluff) Ala; figs. 11 and 12, Montgomery, La.; fig. 13, Garland Creek, Miss.

Paleontological Research Institution.

Genus CHAMA (Linné, 1758) Bruguière, 1789
(Systema Naturae, 10th ed., p. 691)

Genotype.—*Chama lazarius* Linné *fide* Children, Quart. Jour. Sci. Lit. and Arts vol. 15, 1823, p. 28; Gray, Zoöl. Soc. London, Proc., 1847, p. 193; Grant and Gale, San Diego Soc. Nat. Hist., Mem., vol. 1, 1931, p. 279.

Illustration.—Rumph, D'Amboinsche Rariteitkamer Schaalvisschen, 1741, pl. 48, fig. 3; Chemnitz, Conch. Cab., vol. 7, 1784, pl. 51, figs. 507-508; Reeve, Conch. Icon., 1846, *Chama*, pl. 2, figs. 4a, b.

An excellent account of the early history of *Chama lazarius* is given by Chemnitz (*op. cit.*, pp 141-144) and the accompanying illustrations are good.

Chama mississippiensis Conrad? Plate 20, figs. 14, 15

Chama mississippiensis Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc. p. 294; 1848, its Jour., vol. 1, p. 124, pl. 13, figs. 21, 27.

Chama mississippiensis Dall, 1903, Wagner Free Inst. Sci., Trans., p. 1397.

Conrad's description.—Suboval, irregular, adhering; larger valve ventricose, with numerous irregular, radiating lines, squamose inferiorly; upper valve with numerous concentric lines, with numerous small scales. Length 3/4. Height 6-10.

Rare, and occurs on Dr. Smith's plantation, 6 miles N.E. of Vicksburg.

Dall remarks concerning this species:

Vicksburgian Oligocene at Vicksburg and at Red Bluff and other localities in Wayne County, Mississippi; in Louisiana, near Mt. Lebanon; Vaughan.

More material must be collected from the Jackson formation to make sure of the identity of the specimen herewith figured with *mississippiensis.* At any rate the relationship seems close.

Specimen figured.—Montgomery, La.

Paleontological Research Institution.

Genus **PROTOCARDIA** Beyrich, 1845

(Zeitschrift für Malacozoölogie, p. 17)

Genotype.—*Cardium hillanum* (Sowerby) Herrmannsen, Indicis Generum Malacozoörum, vol. 2, 1847, p. 336.

Illustration.—*Cardium hillanum*, Sowerby, Mineral Conchology of Great Britain, vol. 1, 1812, p. 41, pl. 14.

Subgenus **NEMOCARDIUM** Meek, 1876

Subgenotype.—*Cardium semi-asperum* (Deshayes) Meek, U. S. Geol. Survey Terr., Rept., vol. 9, 1876, p. 167.

Illustration.—*Cardium semi-asperum* Deshayes, Description des Animaux sans Vertèbres, vol. 1, 1860, p. 573, pl. 55, figs. 1, 2.

Protocardia (Nemocardium) nicolletti (Conrad) Plate 20, figs. 16-19

Cardium nicolletti Conrad, 1841, Acad. Nat. Sci. Philadelphia, Proc., vol. 1, p. 33; 1842, its Jour., 1st ser., vol. 8, p. 190; 1854, Wailes, Rept. Agric. and Geol. Mississippi, pl. 14, fig. 6; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 258.

Protocardia lima Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 139, pl. 10, fig. 3.

Not *Cardium nicolletti* Aldrich, 1886, Alabama Geol. Survey, Bull., No. 1, p. 48.

Protocardia nicolletti Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, p. 1113.

Protocardia nicolletti Harris, 1897, Bull. Amer. Paleont., vol. 2, p. 251; 1919, vol. 6, pl. 42, fig. 4.

Conrad's original description.—Cordate, ventricose, polished, with crowded minute, impressed radiating lines; beaks central; summits very prominent; posterior margin nearly direct, slightly emarginate; posterior slope with larger striæ than the disk, and muricated with radiating rows of approximate, rather obtuse, slender and prominent tubercles. Length $2\frac{1}{2}$ inches. Height the same.

For this splendid *Cardium*, I am indebted to my distinguished friend J. N. Nicollet. It was found in green clay at 50 feet in height on the right bank of the Washita river, Monroe county, Louisiana.

One naturally marvels at the dimensions assigned by Conrad for this species ($2\frac{1}{2}$x$2\frac{1}{2}$ inches) as found on the Ouachita River, Louisiana. However, in 1855 (*loc. cit.*) he says of the Jackson, Miss., representative: "This shell agrees except in size with the specimen originally described from the Washita, and doubtless the beds of that locality will prove to be of synchronous origin with those of Jackson. A species of *Cardium* very nearly allied to this, I formerly believed to be the same; but it accompanies a different group, and presents variations entitling it to be a specific distinction. It is from Pamunkey river, Virg.

"Compared with *C. nicolletti;* umbo less inflated, posterior margin oblique, shell proportionally longer, and the radiating lines *22*; in the other *25*. The posterior cardinal tooth larger, etc. It may be named *C. lene.*"

Of the representatives of this type of shell we have thus far examined, it would appear that the form illustrated in volume I of these Bulletins (pl. 16, fig. 2) is the nearest to *Protocardia, s. s.* as its posterior costæ appear at first sight, smooth aud flat-topped. A closer examination reveals the probability of slight pustular growth on the anterior side of some costæ, and hence its closer relationship to the *gambrina* (*harrisi*) group of species rather than with the *nicolletti* forms as indicated in volume I (*loc. cit.*). Gardner states (Univ. Texas, Bull., No. 3301, 1935, p. 181), that her *Protocardia actia* "is quite certainly the precursor of *Protocardia nicoletti,* so conspicuous in the late Eocene fauna." But there does not seem to be that abrupt change in surface marking from posterior to lateral areas so characteristic of *nicolletti* and the Naheola species just referred to, nor are we yet aware of the character of spine growth it may have possessed. Although the immediate ancestry of *nicolletti* may be obscure, it nevertheless serves well as a characteristic Jackson species in the Embayment area.

Occurrence.—Though first found and described from the Ouachita River, La., this seems most abundantly developed at Jackson, Miss. The Garland Creek (Miss.) specimens named *Protocardia lima* by Conrad would, as Dall remarks, appear in reality to be *nicolletti*. Montgomery, La., specimens show very narrow ribs with elongate pustules.

Holotype.—Acad. Nat. Sci. Philadelphia.

Specimens figured.—Figs. 16-19, Jackson, Miss.; figs. 20, 21, Vicksburg, Miss.; fig. 22, Woods Bluff, Ala.

Paleontological Research Institution.

Genus **PITAR** Römer, 1857

(Kritische Untersuchung . . . Venus, p. 15)

Genotype.—*Venus tumens* Gmelin—Linné, Systema Naturæ, 1791, p. 3292.
Illustration.—Palmer, Palæont. Amer., vol. 1, 1929, pl. 32, figs. 1, 4-7.

Pitar securiformis (Conrad) Plate 21, figs. 1-3

Dione securiformis Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 137, pl. 10, fig. 1.

Pitaria (*Pitaria*) *securiformis* (Conrad) Palmer, 1929, Palæont. Amer., vol. 1, p. 225, pl. 33, figs. 14-16.

Conrad's description.—Subcordate, ventricose, with concentric recurved ribs; anterior margin acutely rounded; posterior extremity subtruncated; lunule cordate, defined by a slightly impressed line; right valve—cardinal teeth approximate, curved, direct.

This is one of the Garland Creek forms referred by Conrad to "Enterprise, Miss." Though closely allied to several middle or lower Eocene forms, its tendency to have a posterior somewhat truncated, its basal margin rather straight, its anterior slightly protruding, and its concentric markings rather even and well developed, make this a fairly well-defined species. It is in the formations below the Claiborne sands that its nearest allies are found. (See Palmer's discussion of this subject, *loc. cit.*)

Occurrence.—This is the common, rather large venerid in the Jacksonian beds of the Mississippi Embayment. It is most abundantly displayed in the Jackson-Garland Creek area of Mississippi but is not rare on the Ouachita River from Danville northward to Bunker Hill. Rather large, thin specimens seemingly of this species are found at Sims Siding north of Yazoo City, Miss., and representatives appear as far north as Vince Bluff on the Saline River, Cleveland, Co., Ark.

Holotype.—Acad. Nat. Sci. Philadelphia; Conrad Collection.

Specimens figured.—Jackson, Miss.

Paleontological Research Institution.

Pitar trigoniata (Lea) Plate 21, figs. 4, 5

For synonymy, see Bull. Amer. Paleont., vol. 5, 1919, p. 146; Palæont. Amer., vol. 1, 1927, p. 249.

Occurrence.—This species though not rare in the Claiborne sand can scarcely be termed abundant. In comparison with other veneroids it may be called abundant in Cleveland County, Ark., also at White Bluff on the Arkansas River and Crow Creek, near Forrest City. We have found it at Montgomery, La., as well.

Syntypes.—Probably Nos. 5248-49 of Lea Collection, though the former is scarcely so pointed as figured by Lea.

Specimens figured.—From Crow Creek, near Forrest City, Ark.

Paleontological Research Institution.

Genus **CALLISTA** (Poli, 1791) Mörch, 1853
(Poli, Testacea Utriusque Siciliæ, vol. 1, p. 30; Mörch, Catalogus Yoldi, fasc. 2, p. 27)

Genotype.—*Venus chione* (Linné, Systema Naturæ, 10th ed., 1758, p. 686) Meek, U. S. Geol. Survey, Terr., 1876, vol. 9, p. 178.

Illustration.—Palmer, Palæont. Amer., vol. 1, 1929, pl. 42, figs. 1, 4-6.

Callista annexa (Conrad) Plate 21, figs. 6-9

Dione annexa Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 137, pl. 10, fig. 5.

Callista annexa Palmer, 1929, Palæont. Amer., vol. 1, p. 283, pl. 45, figs. 17, 20.

Conrad's description.—Ovate, convex; posteriorly cuneate, abruptly rounded at the extremity; substance thick; anterior side short, obtusely rounded; ventral margin rounded; umbo broad; anterior cardinal tooth robust in the left valve, pyramidal.

One valve only is in the collection, and is water-worn, but otherwise entire. It differs from *D. perovata* in being a smaller species, less in diameter through the umbones, and less produced posteriorly. It has some resemblance to *D. silicea*, C., but is shorter anteriorly, and proportionally longer in outline.

This is one of Conrad's "Enterprise, Clark Co., Miss." fossils, evidently coming from Garland Creek. Though the Claiborne sand is the happiest hunting ground for *perovata* and its relatives, near and remote, the Moodys Branch-Garland Creek beds are scarcely less inviting. The typical form of *annexa* is represented fairly well by the valve Conrad figured. Specimens of this character show relationships to both *perovata* and thick forms of *æquorea*. But there are longer forms bearing the same relation to *annexa* that var. *aldrichi* does to typical *perovata* (Pl. 21, fig.

7). These we described—perhaps rashly—as "*pearlensis*, n. sp." in 1896 (p. 470, pl. 18, figs. 4, 5). Our characterization of this form runs as follows:

> The general characters of the species are shown by the figures. The concentric striation is precisely that of *Meretrix perovata*, var., *aldrichi* (Bull. Amer. Paleont., No. 1, p. 48, pl. 1, fig. 1), and the young of these two forms sometimes approach each other closely in outline, yet there is always noticeable in *pearlensis* a tendency to become elongate, like *M. lævigata* of the Paris Basin.

Instead of making this a new species, we might speak of it as a marked variety of *aldrichi*, which is, itself, a variety of *perovata* Conrad. It seems to us, however, better to designate it by a new name. A variety of this species shows concentric liræ over its entire outer surface.

More and better material causes us to believe that this variety stems more directly through *annexa* which in turn has *perovata* and *æquerea* relationships. Ancestral *annexa* and *securiformis* stocks seem to be represented in lower Eocene times by "var. *fulva*" and *nuttalliopsis* as illustrated on plate 18, figs. 5-10 (Bull. Amer. Paleont., vol. 2, 1897).

Occurrence.—Though found at Garland Creek, this form is most characteristically developed about Jackson, Miss. It is well developed at Montgomery, La., showing especially strongly undulate and *pearlensis*-like forms. On the Ouachita, it occurs at Bunker Hill, Gibson Landing, and Danville Landing.

Holotype.—Acad. Nat. Sci. Philadelphia.

Specimens figured.—Figs. 6-8, Garland Creek; fig. 9, Jackson, Miss.

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"Venus" jacksonensis Meyer Plate 21, fig. 9a

Venus jacksonensis Meyer, 1887, Sonder-Abdruck. Ber. Senkenberg. Naturf. Gesell., p. 12, pl. 2, fig. 4.

Venus jacksonensis, Palmer, 1929, Palæont. Amer., vol. 1, p. 403, pl. 64, fig. 9.

We are not aware that another specimen of this small, doubtful form has been found since the date of Meyer's original description. Meyer's description, translated, reads:

> Fairly thick-shelled, slightly convex, triangular-oval. Pallial impression with shallow sinus. Margin crenulate within. Exterior smooth, with growth lines. Lunule not pronounced, linguloid. I have only the illustrated specimen.

Meyer's specimen was from Jackson, Miss.

We have copied his illustration, holotype, from the Johns Hopkins University.

Genus **GARI** Schumacher, 1817

(Essai d'un Nouveau Systéme Vers Testacés, p. 131, pl. 9, fig. 2)

Genotype.—*Tellina gari* Linné (*Gari vulgaris* Schumacher) Systema Naturæ, 10th ed., 1758, p. 674.

Illustration.—*Gari vulgaris*, Schumacher, *vid. sup.;* Chemnitz, Conch. Cab., 1782, vol. 6, pl. 10, fig. 92.

Gari[6] jacksonense, n. sp. Plate 21, figs. 12-14

Characterization.—Fragmentary, *Gari*-like specimens are by no means rare in the Embayment Jackson beds and would seem at first sight to be referable to "*Psammobea*" *eborea* of the Claiborne Eocene. The shell matter is very thin and fragile, and only rarely can the hinge structure be worked out in detail. Beaks are a little higher and the posterior a little shorter than in *eborea.* In the right valve teeth are flatter and more sickle-shaped than in *eborea.* In the left valve the difference is striking as will be seen by comparing figure 11, plate 48 (these Bulletins, vol. 6) and figure 13, Plate 21 of the present work. Such teeth do not arise from a simple hinge plate, as in genera like *Venus* and *Venericardia,* but come out from the shell under the beak and curve into the cavity of the opposite shell as would seem to be illustrated by Turton's figure of *Psammobia scopula* (1848, pl. 6, fig. 12) or by Hoernes' *Psammobia lombardi* Basterot (1870, pl. 9, figs. 5a-d). Regarding such dentition, Cossmann (1893, p. 6) remarks (translation):

> These two teeth are rarely preserved; and on most valves it is seldom that more than the cicatrices are to be seen so that one might believe he was dealing with two species with entirely distinct hinge. But I have found the same among living *Solenocurtus;* in individual valves, the teeth appear almost lacking; on the contrary, when both valves are present, the teeth are tightly fitted together, and when the valves are opened, the teeth are broken.

We have long felt uncertain as to just where this and allied species should be placed among the old-time genera of modern species. Lea described his short *Solenocurtus blainvillii* from the Claiborne sands in 1833 (Contributions to Geology, p. 39); Conrad in the same year described—among others—a *Psammobia eborea* (Fossil Shells of the Tertiary Formations, p. 42). As

[6] If Dall's derivation of "Garum" is correct, authors should use neuter adjective endings instead of the feminine which seem generally prevalent.

Lea's species seems exceedingly scarce, we have little doubt but that the hinge fragments figured and described by Cossmann (1893, p. 5, pl. 1, figs. 2, 3) belong to "*Psammobia*" *eborea*, which, in a fragmentary state, is not rare. Cossmann's illustrations are fairly accurate for *P. eborea*, though in describing the left valve dentition he interchanges *postérieure* and *antérieure*, and refers the species to *Solenocurtus*. In this reference he may not be far wrong, as the dentition, especially in the right valve, seems more solenid than psammobid (Plate 21, fig. 11). Dall refers these forms to "*Psammobia*. (1900, p. 976).

We have only the one (left) valve of *ozarkana* from the Sabine Eocene of Alabama. This agrees fairly well, in dentition, with the left valve of *eborea* as illustrated in volume 6, plate 48, figure 11 of these Bulletins. (See Pl. 21, fig. 13a). This, too, agrees with Lea's illustration of the hinge of *blainvillii*. The latter and *eborea* are very distinct species in the Claiborne sand, but in some respects *ozarkana* shows vague similarities to both. In this species, there are faint traces of radii extending from beak to posterior basal margin, somewhat as seen, though less obviously, in figure 10, Plate 21. The earliest incremental growth lines indicate a form approaching *lamarcki* Deshayes, yet by no means so short and broad as *blainvillii*. This broadening and shortening of the posterior, though slight, is in marked contrast to Claiborne and Jackson forms. The dentition of *jacksonensis* is far more specialized, especially in the left valve, than in any of the earlier species.

Occurrence.—It is very difficult to obtain specimens of this species showing details for illustration. Those figured are from Montgomery, La. Somewhat similar specimens may be had at Jackson, Miss.

Holotype.—Fig. 12, Pl. 21, Montgomery, La.

Paleontological Research Institution.

Genus **TELLINA** Linné, 1758

(Systema Naturæ, 10th ed, p. 674)

Genotype.—*Tellina radiata* Linné, so designated by Children, Quart. Jour. Sci. Lit. and Arts, vol. 14, 1823, p. 306.

Illustrations.—*Tellina radiata* Bruguière, Encyclopédie Méthodique, Vers Testacées [Atlas] 1797, pl. 289, fig. 2; Sowerby, Genera of Recent and Fossil Shells, vol. 2, *Tellina*, fig. 3; Chenu, Manuel de Conchyliologie, 1862, p. 66, fig. 272; Rogers, Shell Book, 1908, p. 338, fig. 5.

Subgenus **TELLINELLA** Gray, 1852 (MS)

Subgenotype.—*Tellinella virgata* (Linné, Systema Naturæ, 10th ed., 1758, p. 674) Mörch, Catalogus Yoldi, 1853, p. 13; Stoliczka, Palæontologia Indica, vol. 3, 1871, p. 116.

Illustrations.—*Tellinella virgata* (Linné), Chenu, *op. cit.*, p. 67, fig. 273; Bruguière, *op. cit.*, pl. 288, fig. 2.

Tellina (Tellinella) linifera Conrad Plate 21, figs. 15-18

Tellina (*Tellinella*) *linifera* Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 138, pl. 10, figs. 16, 18.

Tellina linifera Harris, 1894, Arkansas Geol. Survey Rept. for 1892, vol. 2, p. 154.

Tellina linifera Dall, 1900, Wagner Free Inst. Sci., Trans., vol. 3, p. 1015.

Conrad's description.—Oblong, fold distinct, but not profound; concentric lines acute anteriorly, and angulated over the fold. Two left valves, imperfect, the outlines of which have been restored in the figures. The outline of fig. 18 is incorrectly drawn; it should be nearer the proportion of fig. 16.

This is one of Conrad's "Enterprise, Miss.," species, *i. e.*, from Garland Creek.

We have already suggested (Bull. Amer. Paleont., vol. 6, 1919, p. 161) the relationship of this species to *cynoglossa* Dall, of the Sabine Eocene, and *cynoglossula* Harris, of the Claibornian. *Tellina cynoglossa* is wider; *cynoglossula* has a more upward-curved posterior dorsal margin and less emargination posteriobasally. The beak in *linifera* is comparatively sharply pointed.

Occurrence.—This with fragmentary specimens of other species occurs in the Jackson Eocene beds in Cleveland County, Ark., and Montgomery, La., but it is about Jackson and Garland Creek, Miss., where it may be called fairly abundant. It also occurs in the zeuglodon beds on the top of the bluff one and one-half mile above Shubuta on the Chickasawhay. We have never obtained it further eastward. Gardner reports it from Little Stave Creek north of Jackson, Ala. It may attain a length of 20 mm., and have a rather pointed posterior, but when less than half that length the posterior is more rounded.

Types.—The two specimens in the Philadelphia Academy of Sciences are evidently the ones Conrad described and figured. As Conrad remarks, the smaller specimen is incorrectly drawn.

Specimens figured.—Moodys Branch, Jackson, Miss.; figs. 16, 17, Montgomery, La.; fig. 15, fig. 18, Garland Cr., Miss.

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Tellina eburneopsis Conrad Plate 21, figs. 19, 20

Tellina (*Angulus*) *eburneopsis* Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 138, pl. 10, fig. 17.

Tellina (*Arcopagia*) *eburneopsis* Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1015.

Tellina eburneopsis Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., pl. 18, fig. 6.

Conrad's description.—Subovate, inequilateral, thin in substance, compressed, white, polished; apex slightly prominent, acute, fold submarginal, distinct; anterior margin regularly rounded; posterior margin very oblique, subtruncated at the end, and angular at tip.

One right valve only in the collection, very distinct from any other fossil species I have seen from the American Tertiaries.

This is one of Conrad's "Enterprise" species, seemingly from Garland Creek, Miss.

As viewed from the rear, the posterior of this shell is flexed a little to the right as in many of the tellinid forms. Whereas the surface of this shell is generally smooth and shining, the posterior area radiating from beak to basal margin shows concentric lines more clearly and irregularly. Passing radially through this area in the right valve there is a faint fold; in the left, a slight channel. Hinge characters of the left valve are as indicated by figure 20; those of the right valve not yet determined. Lateral teeth seem wanting; the posterior flexure suggests *Macoma* affinities.

Occurrence.—We have definitely recorded this species only from Jackson and Garland Creek, Miss., and Bunker Hill, on the Ouachita River, La., but tellinid fragments from other localities, as Cleveland County, Ark., would suggest a fairly wide range for it in the Jackson Embayment area.

Holotype.—Acad. Nat. Sci. Philadelphia.

Specimens figured.—Fig. 19, Bunker Hill, La.; fig. 20, Jackson, Miss.

Tellina trumani var. garlandica, n. var. Plate 22, figs. 1, 2, 3

For description of *trumani*, see these Bulletins, vol. 2, 1897, p. 265.

The variety *garlandica* differs from typical *trumani* in being smaller, more elongate, with deeper pallial sinus, less distinct and regular growth lines, longer and more obliquely directed resilifer. But, since the differences are of degree and not of kind, and as we have but the type specimen of *garlandica*, the two forms can now scarcely be separated specifically. Here, again, we have a striking resemblance between a Woods Bluff and a Jackson type.

Along this same line of development we find in the St. Maurice Eocene *Tellina talicheti*, but here the elliptical form is more elongate. All seem referable to the subgenus *Arcopagia sensu lato*.

Occurrence of specimen figured, the holotype.—Garland Creek, near Shubuta, Miss.

Tellina vicksburgensis, var. moodiana Cooke Plate 22, figs. 4-8

Tellina vicksburgensis var. *robusta* Meyer, 1885, Amer. Jour. Sci., 3d ser., vol. 29, p. 461 (not *Tellina robusta* Hanley, 1844).

Tellina vicksburgensis Aldrich, *partim*, 1885, Amer. Jour. Sci., 3d ser., vol. 30, p. 72.

Tellina vicksburgensis, var. *moodiana* Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, p. 137, figs. 15a, b.

Conrad described *Tellina vicksburgensis* (1847, p. 292) as follows:

Triangular, small, with regular minute concentric lines; anterior end rounded; posterior submargin angular or obscurely carinated, the end obliquely truncated; posterior side shortest, and slightly bent or waved; lateral teeth in the right valve only. Length 3-10. Height ¼.

Before 1885, both Meyer and Aldrich seem to have agreed in calling the Jacksonian specimens *Tellina vicksburgensis*. Then Meyer instituted the var. *robusta*.

A rather common *Tellina* in Jackson is a larger and stouter variety, var. *robusta*, of a Vicksburg species, which I determined as *Tellina Vicksburgensis* C. A young Jackson specimen has the same form as one of the stouter Vicksburg specimens.

Cooke, in 1926, describing var. *moodiana*, wrote:

The variety at Jackson differs from the typical form at Vicksburg in its larger size, proportionately greater altitude, and slightly stronger sculpture. Longitude 11½ mm; altitude 8 mm.; semidiameter 2½ mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353, 951.

Further descriptive details regarding the interior of this form are as follows: Pallial sinus deep, angulate above, coalescing for the most part with the pallial line below. Articulation, right valve, passing anteriorly; lower half posterior margin plain, broadening above into lower and upper lamina with channel or dental socket between; halfway to beak, socket is replaced by ligamental support of nymph, coming to a point at beak, dividing long ligament above from a very short and inconspicuous internal portion; internal or submerged portion often showing a faint supporting lamella below; next prominent feature anteriorly is the large bifid tooth, still further a deep socket, then a low lamellar tooth quite obvious at the beak but soon dying down to a low ridge continuing for a third the distance to the extreme anterior of the shell, where its recrudescence appears as a lamellar anterior lateral tooth; channel above tooth limited by lamellar margin of the shell; lunular depression narrow, indistinct. Left valve, passing anteriorly: lower half posterior margin thin, simple; upper half, with narrow ligamental platform above, reaches near the beak where it divides, showing an internal ligamental scar in the fork, the lower limb of same forming a very thin posterior cardinal tooth; anteriorly, a deep socket, directly under the beak; this is followed by a large tooth, tending to become bifid, and this in turn is followed by a deep tooth socket, lunule scarcely defined. A general conception of the above described features may be had by referring to figures 5-8, Plate 22.

Our specimens from Vicksburg seem to indicate that at that locality there is considerable variation shown in this species (see figs. 9, 10, Pl. 22). None of our specimens from Jackson shows the rather pronounced nasute posterior flexure indicated by Cooke's figures, but there seems to be little room for doubt that this rather common Jacksonian form is the one he named *moodiana*.

Figures 9-12 show typical *vicksburgensis*. Figure 6 is an enlargement of var. *moodiana* to show concentric striation more clearly. The Jacksonian forms vary somewhat but would seem as a whole to be a little higher than the Vicksburgian.

Occurrence.—Most abundant at Moodys Branch and in the R. R. cut at northern end of the freight yard of the G. M. & N. R. R., Jackson, Miss. Other specimens are recorded as coming from the Ouachita River at Bunker Hill and Gibson Landing, La.

Tellina vaughani Cooke Plate 22, figs. 13-16

Tellina vaughani Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, p. 138, figs. 16a-b.

Cooke's description.—Shell subelliptical, beaks slightly anterior, moderately inflated; anterior end somewhat more acute than the posterior; surface covered with close, flat, concentric threads which are fewer, narrower, and farther apart on the dorsal slopes. Longitude $11\frac{1}{2}$ mm.; altitude 8 mm.; semidiameter 3 mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353, 952.

In reply to an inquiry regarding the above diagnoses, Mr. H. A. Rehder of the National Museum, writes (July 30, 1941):

The description of *Tellina vaughani* should read:

The beaks slightly posterior to the center and the posterior end somewhat more acute than the anterior. The concentric grooves seem to be of the same distance apart over the whole shell, although on the dorsal slopes they show a tendency to unite as is plainly shown in certain of the paratypes. The measurement of the types are as follows: *Tellina vaughani*, length 11.5 mm.; height 7.6 mm. *Tellina vicksburgensis moodiana*, length, 11.6 mm.; height, 8.6 mm.

This species sometimes attains a length of 15 mm. and a height of 10 mm.

In locating it among the many conflicting, overlapping subgenera and sections of the tellinids, the following facts must be taken into consideration: shell rather thin, gibbous; no posterior flexure; concentric markings not pronounced; pallial sinus deep, extending nearly to the anterior abductor scar, but not so broad as in *trumani;* not confluent with pallial line below; lunule and escutcheon very narrow; lateral teeth variable in strength in right valve but always present, scarcely developed in left valve by shell margin; ligamental area very narrow and extending from beak to lateral teeth; resilifer oblique, extending from beak backward just behind the bifid, posterior cardinal in the right valve and just posterior to the central socket of the left valve. In general appearance this species is close to some of the species enumerated by Cossmann and Pissarro in their Iconographie Complète des Coquilles Fossiles de l'Eocène, under *Mœrella* and *Macaliopsis*; see especially plates 6 and 7.

Occurrence.—We have found this species common at Jackson, Miss. It occurs in a comparatively large form at Garland Creek; and a very closely allied, if not identical, form is not rare in the uppermost Claiborne beds at Gopher Hill (Baker Bluff), Ala.

Types.—In the U. S. Nat. Mus. as stated above.

Specimens figured.—Paleontological Research Institution.

Tellina vaughani, var. Plate 22, fig. 17

In Moodys Branch, Dr. Day's place, a specimen (herewith shown as figure 17) was found that is far more regularly elliptical in outline than typical *vaughani*. Anteriorly it resembles Cooke's figure of *vaughani,* but posteriorly it lacks the angulation there shown. It is gibbous, with depressed beaks and with surface marking fine, though two or three stoppages of growth with more pronounced incised lines are evident. The specimen figured is the only one found with the above-mentioned characteristics.

Paleontological Research Institution.

Tellina pearlensis Meyer Plate 22, fig. 18

Tellina pearlensis Meyer, 1887, Sonder-Abdruck, Ber. Senckenberg. Naturf. Gesell., pl. 2, fig. 3.

In the explanation of Meyer's plate 2, he gives figure 3 as *Tellina pearlensis* without reference to any description. From the figure alone its status is uncertain; but it may be presumed to have come from Jackson, Miss.

The reference of the species to the genus *Aligena* in the Meyer type collection at the Johns Hopkins University must be incorrect if Meyer's drawing (with deep pallial sinus) is correct. The dentition appears like that of some species of *Aligena.*

Tellina (Arcopagia) raveneli var. weisbordi, n. var. Plate 22, fig. 19

A somewhat imperfect specimen in our collections, enclosing a rather hard, calcareous matrix, and having very much the appearance of *Semele linosa* of the lower Claiborne or Lisbon horizon (Bull. Amer. Paleont., vol. 6, 1910, p. 171) proves on excavation of the hinge character to be very closely allied to *Tellina raveneli* Conrad. Its smooth surface makes its relationship with this species very evident. It is a little more elongate than *raveneli* and is only about two-thirds the dimensions of that species. For convenience in future reference, it may be given the above varietal designation.

For a discussion of *Tellina raveneli,* see this publication, volume, 6, 1919, p. 167.

Occurrence.—This occurs as a thin shell filled with hard calcareous rock, at Montgomery, La.

Holotype and specimen figured.—Montgomery, La.

Paleontological Research Institution.

Tellina spillmani Dall Plate 22, fig. 20

Tellina (Angulus) albaria Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 138, pl. 11, fig. 7.

Tellina (Arcopagia?) spillmani Dall, 1900, Wagner Free Inst. Sci., Trans., vol. 3, p. 1015. (Not *albaria* Conrad, 1849.)

Conrad's description: 1865.—Oblong, inequilateral, thin in substance, compressed, white, with traces of one or two concentric bands; fold obsolete.

One left valve, very distinct from the preceding, or any other American species known to me.

Conrad was here comparing the species to *eburneopsis* with which it was associated. It is another of his "Enterprise" species, presumably from Garland Creek, Miss.

The holotype is in the Academy of Natural Sciences of Philadelphia and is less perfect than indicated by Conrad's figure, here reproduced as figure 20 on Plate 22. The apex and posterior seem a little less pointed than illustrated.

Tellina (Arcopagia) spillmani, var. corvia, n. var. Plate 22, fig. 21

The nearest approach we have found to this species is shown by an imperfect specimen collected at Crow Creek, Ark., in lower Jacksonian beds. The area behind the umbo extending towards the posterior basal margin is apparently a little more definitely marked off from the main surface of the shell than Conrad's figure and description of *albaria* would indicate.

Holotype and specimen figured.—At the bridge (Highway No. 70) over Crow Creek, two miles east of Forrest City Ark.

Paleontological Research Institution.

Genus **ABRA** Leach (MS.)

(Mentioned in synonymy under *Amphidesma tenuis* Lamarck, Animaux sans Vertèbres, vol. 5, 1818, p. 492,)

Genotype.—*Mactra tenuis* Montagu, Testacea Britannica, 1803, p. 572, pl. 17, fig. 7.

Illustration.—Montagu, *vid. sup.;* Brown, Illustrations of Recent Conchology, Great Britain and Ireland, 2d ed., 1842, pl. 42, fig. 2, as "*Amphidesma tenue*".

Abra nitens (Lea), var. jacksonica, n. var. Plate 22, figs. 22-24

For general discussion of *Abra nitens,* see these Bulletins, volume 6, 1919, p. 173, pl. 52, figs. 11-13.

The Jackson variety agrees fairly well with the typical Claiborne representatives, though it is rather large, more pointed posteriorly, with a more sharply defined postumbonal ridge and slope and with a slight *Tellina*-like twist to the right of the posterior extremity.

Holotype and specimen figured.—Dr. Day's premises, Moodys Branch, Jackson, Miss.

Paleontological Research Institution.

Genus **MACTRA** Linné, 1767

(Systema Naturæ, 12th ed., vol. 1, pt. 2, p. 1125)

Genotype.—*Mactra stultorum* (Linné) Fleming, 1818, *fide* Stewart, Acad. Nat. Sci. Philadelphia, Spec. Publ., No. 3, 1930, p. 206.

Illustration.—Chemnitz, Conch. Cab., 1782, vol. 6, pl. 23, figs. 224, 225; Reeve, Conch. Icon, 1854, *Mactra*, No. 15; Fischer, Man'l de Conch. 1887, pl. 21, fig. 1.

For the general discussion of the Mactridæ, see Dall, in the Transactions of the Wagner Free Institute of Science (vol. 3, 1898, p. 873, *et sec.;* also Gray, Mag. Nat. Hist., vol. 1, new ser., p. 372.

Subgenus **SPISULA** Gray, 1837
(Mag. Nat. Hist., new ser., vol. 1, pp. 335 and 372)

Subgenotype.—*Mactra solida* Linné, Gray, Zoöl. Soc. London, Proc., 1847, p. 185.

Illustrations.—Chenu, Manuel de Conchyliologie, 1862, vol. 2, p. 56, fig. 232; Brown, Illus. Rec. Conch., 1844, pl. 41, fig. 3.

Spisula prætenuis Conrad — Plate 23, fig. 1

For synonymy and discussion of this species, see this series volume 6, 1909, p. 175.

We have yet to find a specimen showing the length in comparison to height indicated by Conrad's type specimen.

Occurrence.—The fairly well-preserved specimen figured herewith (fig. 1) is from Montgomery, La.; other specimens are from Crow Creek and White Bluff, Ark.

Spisula mississippiensis (Conrad) — Plate 23, fig. 2

Mactra mississippiensis Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc., p. 290; 1848, its Jour. p. 121, pl. 12, fig. 14.
Mactra mississippiensis Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., p. 471, pl. 18. fig. 7.
Spisula mississippiensis Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 896.

Among Johnson's collections for the Lea Memorial Collection of the Philadelphia Academy, there was a specimen from Jackson, Miss., that seemed to agree with Conrad's *mississippiensis* from Vicksburg, and we so identified it in 1896. McConnell's pen and ink drawing of this specimen is reproduced here (Pl. 23, fig. 2).

Spisula parilis (Conrad) — Plate 23, figs. 3-6

For synonymy and discussion of this Claiborne species, see these Bulletins (vol. 6, 1919, p. 174, pl. 53, figs. 2-4).

It is here again referred to and figured for ready comparison with the several closely related forms occurring in the Jackson beds of the Embayment area.

Typically, *parilis* and its relatives show, in the main, smooth surfaces. On the dorsal slopes, however, there is a strengthening of the concentric striation. Close to the anterior ridge, extending from beak to anterior basal margin, a fine depressed radiating line may separate smooth from striated areas. A trace of a fold radiating from beak to posterior basal margin may often be detected. Such features are greatly magnified in the var. *bistriata* shown as figure 4 on plate 53 referred to above. Both hinge structure and typical outline of *parilis* are well shown as figures 3, 4 on the same plate. Note that the margin at the termination of the posterior lateral tooth may be slightly arched, thus giving the posterior margin a somewhat truncated appearance. The pallial sinus is occasionally visible and shows that it is deep, extending practically to the middle of the shell. (See Pl. 23, fig. 3.) The anterior element of the cardinal tooth of the right valve is well developed, curved, with its lower portion aimed at the center of the shell. The comparatively long ventral margin gives this type a broad-based triangular appearance. The anterior portion of the shell is narrower than the posterior. This species seems to be restricted to the Claiborne sand horizon in Alabama.

Specimens figured.—Claiborne sand, Claiborne, Ala.

Paleontological Research Institution.

Spisula jacksonensis Cooke Plate 23, figs. 7-10

Spisula jacksonensis Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, p. 137, figs. 14a, b, c.

Cooke's description.—Shell small, subovate, moderately inflated; beaks central, adjacent; surface smooth except the dorsal areas, which are wrinkled; anterior dorsal area slightly depressed; base arcuate; pallial sinus little longer than wide, rounded in front; hinge with strong ventral lateral laminæ, adjacent sides of laminæ striated; arms of cardinal tooth of left valve forming a right angle.

Longitude 8.2 mm; altitude 6.2 mm.; semidiameter 2 mm.

Station 6458, Moodys Branch, Jackson, Miss. U. S. N. M., No. 353,950.

The type of *Spisula jacksonensis* is a left valve. This very abundant species differs from *S. funerata* (Conrad) from Vicksburg in its central beaks, more rounded base and shoulders, and in the symmetrical position and rectangular shape of its left cardinal tooth, which in *funerata* is twisted forward and forms an acute angle.

This little Jackson mactrid has been compared with Claiborne and Vicksburg forms for the last half century. Meyer remarked in 1885 (vol. 29, p. 461):

In Jackson occurs a species of *Mactra*, which is almost equilateral, but otherwise does not differ from *Mactra pygmæa* Lea, from Claiborne. As the forms vary in both localities they are most probably to be related. The

Jackson specimens are very similar or identical with a species in Vicksburg, which is perhaps what Conrad called *Mactra funerata*.

Under *Mactra* sp., Harris wrote in the Report for 1892 of the Arkansas Survey (1894, p. 154):

> A small very common species about the size of *M. parilis* though very different otherwise. It is identical with an undescribed species from Bailey's marl bed, Jackson, Miss.

Its occurrence at nine different localities in Cleveland County, Ark., is noted.

Dall, referring to the Vicksburg Spisulas (1895, p. 896) commented: "There is another form which differs barely, if at all, from *funerata* in the Jacksonian."

As regards *Spisula parilis* Conrad (*pygmæa* Lea), there need be no confusion with the other small forms already mentioned. The long, triangular form, the suggestion of an oblique posterior truncation, the dental characteristics, and the deep pallial sinus, all furnish trustworthy criteria for specific determination.

Spisula jacksonensis Cooke has a somewhat plumper appearance, with more nearly centrally located beaks, with a more highly curved basal margin, and with dentition, especially of the right valve, corresponding more clearly with *albirupina* Harris than with *parilis* Conrad.

Though we do not see the difference between the shape of the central tooth of the left valve and that in *funerata* mentioned by Cooke, it does appear perhaps relatively smaller in *funerata*. The latter has a higher, sharper beak, and a posterior tending to lengthen, but in no way so conspicuously as in *albirupina*. The outline of *jacksonensis* is more elliptical, the umbones fuller and the basal margin more slightly curved. *S. funerata* has a somewhat corbuloid aspect as Conrad's original drawing shows (1848, pl. 12, fig. 13).

Occurrence.—This species is best known from Jackson, Miss., but it also occurs at Garland Creek. In seemingly the same horizon, it is common in Cleveland County, Ark. What appears to be the same species is not rare in the uppermost Claiborne bed at Gopher Hill, north of St. Stephens, Ala.

Type.—As given by Cooke, see above.

Specimens figured.—Figs, 7-8, Jackson, Miss.; figs. 9-10, Garland Creek, Miss.

Spisula albirupina (Harris) Plate 23, figs. 11, 12

Mactra albirupina Harris, 1894, Arkansas Geol. Survey, Rept. for 1892, p. 155, pl. 6, fig. 2.

Spisula albirupina Dall, 1895, Wagner Free Inst. Sci., Trans., vol. 3, p. 896.

Harris' description.—For the size and general features of this species, see Pl. VI, fig. 2. This is a thin and rather fragile shell resembling in a superficial way *Mactra parilis* Conrad, though in reality it is very different. The exterior markings in both species are similar, but in that species the anterior end is produced, in this the posterior.

Locality.—White Bluff, Arkansas.

This species is at once separated from *parilis* by its general outline (see figs. 11, 12); by its small, short pallial sinus; and by the small, short, direct, anterior portion of the hinge tooth

Occurrence.—This shell cannot be regarded as scarce at White Bluff, Ark., but so far, we have found it nowhere else.

Holotype.—U. S. Nat. Museum.

This is possibly the species referred to by Meyer in the American Journal of Science (1885, vol. 29, p. 461) as follows:

> A new species, *Mactra inornata,* occurs in Jackson. It is small, somewhat flattened, inequilateral and has a rather solid shell. The margin is entire, the lower margin rather straight. Concentric striæ on the extremities are seldom noticeable, because the surface is mostly water-worn. In a specimen from Claiborne, I cannot find any difference. A specimen from Vicksburg is relatively higher.

Genus **PERIPLOMA** Schumacher, 1817
(Essai d'un Nouveau Système, Vers Testacés, p. 115)

Genotype.—*Periploma inæquivalvis* Schumacher, *vid. sup.*
Illustration.—*Op. Cit.*, pl. 5, fig. 1.

Periploma claibornensis, var. parva ? Meyer Plate 23, figs. 16-18

The mid-Eocene occurrence of Lea's *Anatina claibornensis* has already been referred to in this series (volume 6, p. 180).

Meyer described from Claiborne what appears to be a pathologic form of this type (Alabama Geol. Survey, Bull., No. 1, 1886, p. 85) as *P. complicata.* In his Sonder-Abdruck (Ber. Senckenberg. Naturf. Gesell., 1887, p. 16) he lists it from Jackson, Miss. This may have been the basis for Dall's referring *complicata* to the Jacksonian.

Meyer, however, did note the occurrence of fragments of a small form from the Jacksonian beds, "Which seem to differ merely in size from *Periploma claibornensis* Lea sp. . . . . The Jackson form may be called var. *parva.*" (Amer. Jour. Sci., vol. 129, 1885, pp. 461, 467). The relationship of *complicata* and *parva* seems rather obscure. But, that there is a small *Periploma* in the Jackson beds is proven by the more satisfactory material collected by the late C. W. Johnson and illustrated in an article, "New and Interesting Eocene Mollusca from the Gulf States" (1896, pl. 18, figs. 8 a, b). This is quite probably Meyer's *parva*, but as that variety was founded on mere fragments the correctness of the identification is in doubt.

Periploma complicata Meyer Plate 23, fig. 18a

Periploma complicata Meyer, 1886 Alabama Geol. Survey Bull., No. 1 p. 85, pl. 1, fig. 22.

Periploma complicata Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1529.

Meyer's characterization.—The only specimen found is of the same fragmentary shape as that in which *Periploma claibornensis* Lea, sp., a species not rare, constantly occurs. The fissure of the beak and the pearly nacre of the inside are well seen; the hinge with the spoon-shaped process is much more complicated than in *P. claibornensis*. as the figure shows, the process consisting mainly of two concentric spoons.

Locality.—Claiborne, Ala.

Reference to this form should have been made in volume 6 (these Bulletins) in discussing Claiborne material. But it is most likely that it is only a pathologic specimen of *claibornensis*. Mention of this "species" is made here solely because Dall, in discussing the genus (*loc. cit.*), says:

Another species described from similarly inadequate material is *P. complicata* Meyer from the Jacksonian.

We have found no specimens with the peculiarity mentioned by Meyer in either Claiborne or Jackson horizons.

Periploma collardi var. turgida, n. var. Plate 23, figs. 19-21

For synonymy and discussion of the relationship of *collardi* to other mid-Eocene forms, see these Bulletins, vol. 6, 1919, p. 180, pl. 55, figs. 2-5.

In the Jackson beds at White Bluff, Ark., occur crushed specimens and fairly well-preserved chondrophores, clavicular ribs and lithodesma of a larger form than that referred to above, but scarcely in a condition to render specific description or identification desirable. Still larger forms are found preserved in a hard iron-clay matrix at Crow Creek, Ark., showing the true form of the shell before fossilization. The specimen here figured is 51 mm. in length, though the posterior margin is incomplete, thus indicating a shell of greater size than any other of this genus known to us in our Gulf Coast Eocene. As viewed from above, there is a tendency to show a slight twist to the left in the anterior part of the shell, and to the right in the posterior. The depth of the two valves may be 18 mm.; and the concentric undulations seem well marked, especially basally. So far we have found no trace of the fine radiating lines on these specimens so characteristic of many examples from the base of the bluff at Claiborne, Ala., and referred by us to the Texan species *collardi*.

Specimen figured and holotype of the variety.—Crow Creek, near Forrest City, NE. Arkansas.

Paleontological Research Institution.

Genus **VERTICORDIA** Wood (in Sowerby), 1844[7]

(Mineral Conchology, vol. 7, Suppl., p. 67, pl. 639, figs. a, b, c, d)

Genotype.—*Verticordia cardiiformis* J. Sowerby, *vid. sup.*

Illustration.—*Verticordia cardiiformis* Wood, Fischer, Manuel de Conchyliologie, 1887, pl. 17, fig. 26.

JACKSONIAN VERTICORDIA

Langdon noted and described a *Verticordia eocensis* from our southern Eocene in 1886 (Amer. Jour. Sci., vol. 41, p. 208) as already stated in volume 6 of these Bulletins (1919, p. 182). It was figured by Aldrich the same year in Bulletin No. 1 of the Alabama Geological Survey (pl. 6, fig. 13).

Langdon gives as localities, Claiborne, Ala., and Jackson, Miss. His description and figure would seem to indicate that he regarded as the type form a *Verticordia, s. s.*, with little difference in size of ribs over the surface of the valve. We are figuring such a specimen from the Claiborne "sand" (Pl. 23, fig. 24), the same specimen used in volume 6 (pl. 55, fig. 13).

Just what type of *Verticordia* Meyer may have had in mind in cataloguing *Verticordia eocensis* Langdon, var. from Jackson, Miss., (1887, p. 16) is a question. However, Cossmann states in his Notes Complémentaires, 1893 (p. 7) that Meyer sent him specimens of *eocensis* (emend. by Cossmann to *eocaenensis*) from Jackson, Miss. One specimen is illustrated. He also proceeds to describe it as follows:

Coquille assez déprimée, arrondie, ornée de 12 à carène rayonnantes, subgranuleuses du côté postérieur, courbées et séparées par de larges intervalles au fond desquels on distingue quelques lamelles d'accroissement; crochets un peu gonflés, fortement contournés du côté antérieur; valve

[7] For discussion of this genus see Dall, U. S. Nat. Mus., Proc. vol. 17, 1895, pp. 687-697.

gauche (la seule que je connaisse) portant sous le crochet une profonde cavité, destinée à recevoir la dent cardinale de la valve opposée, et en avant de laquelle le bord cardinal forme une sorte de cuilleron, produit par la profonde dépression de la lunule; mais il ne faut pas confondre cette disposition avec une véritable dent cochléariforme. Intérieur des valves bien nacré; bord palléal muni de digitations pointues, formées par les prolongements des côtés; impression de l'adducteur postérieur subtrigone placée assez bas.

Dall is evidently quite right in referring Cossmann's *cocæncnsis* to the *Trigonulina* section of *Verticordia,* and giving it a new name, *cossmanni.* A copy of Cossmann's figure is shown herewith as figure 23, Plate 23. Dall gives on plate 42, figures 13 and 14 of his Wagner treatise, vol. 3, 1900, good illustrations of what presumably is true *cocensis.*

It seems from the above discussion that *Vericordia cocensis* is not yet certainly known from the Jackson stage.

Verticordia (Trigonulina) cossmanni Dall Plate 23, fig. 23

Verticordia cocæncnsis Cossmann, 1893, Notes Complémentaires, p. 7, pl. 1, fig. 6.

Verticordia (*Trigonulina*) *cossmanni* Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1512.

For discussion of this species, see above references.

Holotype.—Cossmann's cabinet.

Locality.—Jackson, Miss.

Verticordia (Trigonulina) dalliana Aldrich Plate 23, figs. 25, 26

Verticordia dalliana Aldrich, 1903, Nautilus, vol. 16, p. 100, pl. 4, fig. 18.

Aldrich's description.—Shell small, rather flat, surface ornamented with sharp curved ribs, in the present specimen thirteen in number, nine on the anterior, then a concave space as if one rib was missing, two more ribs about the middle of the shell, then a wide concave space and then two more ribs, the last one almost at the margin. Ribs serrating the ventral margin. Cardinal tooth strong, erect; lateral tooth long and curved.

Breadth 2.5 mm., height from beak to base 2 mm.

Only one valve found; it is about the same size as *V. cocense* Langdon. The muscular scars are slightly impressed. Pallial line not perceptible.

Locality.—Red Bluffs, Miss. (*File* letter from Aldrich, March 10, 1911.)

Holotype.—The Johns Hopkins University.

We have in our collection an imperfect specimen, which, so far as can be judged, is very close to this species. The rather remarkable spacing of the ribs seems to agree well with this species, though the duplicate character of the more or less centrally placed rib cannot be determined. The broad interspace just anterior to this double rib is clearly defined.

Occurrence.—Though the horizon of the holotype of this species (Red Bluff) would seem to be somewhat higher than the Bunker Hill bluff where our specimen was found, the shells seem very similar.

Genus **CORBULA** Bruguière, 1797
(Encyclopédie Méthodique [Atlas] pl. 230)

Genotype.—*Corbula sulcata* Lamarck, Syst. Animaux sans Vertèbres, 1801, p. 137.

Illustration.—Bruguière, *op. cit.*, pl. 230, figs. 1a-e; Reeve, Conch. Icon. 1843, *Corbula*, pl. 1, fig. 2; Chenu, Manuel de Conchyliologie, vol. 2, 1862, p. 32; Fischer, Manuel de Conchyliologie, 1887, pl. 23, fig. 2.

For discussion of generic synonymy, see Grant and Gale (1931, p. 419), Stewart (1930, p. 286), and Gardner (1926, p. 41).

Corbula wailesiana Harris (MS) Dall — Plate 23, figs. 27, 28; Plate 24, figs. 1, 3, 4, 5, 7, 8

Corbula bicarinata Conrad, 1854, Wailes, Rept. Agric. and Geol., Mississippi, p. 289, pl. 14, fig. 3; 1855, Acad. Nat. Sci. Philadedphia, Proc. vol. 7, p. 258.

Corbula wailesiana Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 846.

Corbula bicarinata Conrad (Reprint) 1939, Bull. Amer. Paleont., vol. 24, p. 344, pl. 23, fig. 3.

Noticing that *bicarinata* was preoccupied by Sowerby, 1833, we gave, in our museum work at the Smithsonian Institution in the early '90s, the name *wailesiana* to this corbulid form. Dall recognized the name in his Wagner paper cited above, and hence it may be considered as fully established in paleontological literature.

Conrad's description.—Elevated, triangular, slightly oblique, thick in substance, profoundly ventricose, with robust reflected concentric lines; umbo profoundly prominent and the beak incurved; posterior slope biangulated; space between the angles flattened, direct.

Resembles *C. oniscus* Con., but is thicker, more elevated, not rostrated, and its slight obliquity is the reverse of that in the former species. I have not seen the smaller valve.

We have already compared this form with *Corbula murchisoni* Lea (*C. oniscus* Conrad) in volume 6, p. 192 of these Bulletins.

Meyer stated in 1885 (vol. 29, p. 462): "*Corbula bicarinata* C. from Jackson differs from *C. Murchisoni* Lea in having the concentric ribs somewhat more numerous and the umbonal carination less distinct, but this variation is slight."

Placed side by side, specimens from Claiborne (*murchisoni*) and from Jackson, Miss. (*wailesiana*) are quite readily distinguished; figures 7 and 8, plate 58 (vol. 6) are considerably different from figures 27 and 28, Plate 23 of the present volume of the Bulletins. Conrad did not have a left valve, but we have already shown this in volume 6, plate 57, fig. 23. Postumbonal slopes (right valves) of the two species are shown herewith as figures 1 and 2, Plate 24.

In very young stages, the two valves appear very similar as shown by figure 3, but this juvenile stage is nearly always broken off or eroded away as shown by figure 28, Plate 23 (left valve). Dwarf forms of this species are readily separated from equally small Red Bluff types by the dissimilarity of their left valves. The latter have been referred to *Corbula perdubia* de Gregorio. (See Casey, Acad. Nat. Sci. Philadelphia, Proc., 1903, p. 261; Dall, Wagner Free Inst. Sci., Trans., vol. 3, 1898, p. 844). Both valves are illustrated on Plate 24, figures 9 and 10.

Occurrence.—This form, with various close approaches to *Corbula murchisoni*, is common throughout the Embayment area. It is most characteristically developed about Jackson, Miss. Vince Bluff on the Saline River, Cleveland County, Ark., furnishes small specimens. Abundant, but less sharply differentiated, specimens are common along the Ouachita River, La., from Gibson Landing to Danville. The same may be said of many specimens at Montgomery, La. Small specimens are not rare on Bayou Toro, Wooley's Bluff and on the Sabine River, Texas, below Robinson's Ferry. Representatives from the uppermost Claiborne sand bed at Gopher Hill, near St. Stephens, usually referred to *Corbula murchisoni* Lea (Aldrich, Smith, Gardner), we believe could with equal propriety be assigned to *Corbula wailesiana*.

Specimens figured.—Plate 23: fig. 27, Town Creek, Jackson, Miss.; fig. 28, Montgomery, La. Plate 24: fig. 1, posterior margin of fig. 27, Pl. 23, Town Creek, Jackson, Miss.; fig. 2 posterior margin of *murchisoni* from Claiborne, Ala.; fig. 3, undecorticated umbones, *wailesiana*, Montgomery, La.; fig. 4, Montgomery, La.; fig. 5, *wailesiana* approaching *murchisoni*, Bunker Hill, La; fig. 6, typical *murchisoni* from Claiborne, Ala.; fig. 7, var. *wailesiana* showing slight carination, ravine back of Bunker Hill, La.; fig. 8, *wailesiana*, var. from Bayou Toro, east bank. S. 5, T. 3 N., R. 11 W., Vernon Parish, La.

Paleontological Research Institution.

Subgenus **CARYOCORBULA** Gardner, 1926
(The Nautilus, vol. 40, p. 46)

Subgenotype.—*Corbula alabamiensis* Lea, Contributions to Geology, 1833, p. 45, pl. 1, fig. 12.

Illustration.—Lea, *op. cit.*, pl. 1, fig. 12; Harris, Bull. Amer. Paleont., vol. 6, 1919, pl. 56, figs. 16-26

Corbula densata Conrad Plate 24, figs. 11-15, 17-21

Corbula densata Conrad, 1854, Wailes, Rept. Geol. and Agric. Mississippi, p. 289, pl. 14, fig. 9; 1855, Acad. Nat. Sci. Philadelphia, Proc., p. 258.
Corbula filosa Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 137, pl. 10, fig. 7.
Corbula densata Meyer, 1885, Amer. Jour. Sci., vol. 29, 3d ser. p. 462.
Corbula densata Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 842.
Corbula densata Conrad (Reprint) 1939, Bull. Amer. Paleont., vol. 24, p. 344, pl. 23, fig. 9.

Conrad's description.—Triangular, subequilateral, very thick in substance; surface undulated and having angular concentric striæ; umbonal slope submarginal and acutely carinated, posterior extremity angular.

The various lines of development in the *Corbula alabamiensis* stock are as difficult to disentangle as those of the *Venericardia planicosta* stock already discussed in this work. As to *densata*, regarded generally as a distinct specific form, Meyer has this to say:

> *Corbula densata* C. from Jackson has indeed, as Conrad says, a shorter form and more rounded base than *C. alabamiensis* Lea, but there are quite a number of specimens of almost the same appearance in Claiborne, which I tried in vain to separate specifically from the elongated forms. So the stout specimens can be considered only a variety.

Dall says of *densata*:

> This is a large irregular, coarse, and strong species, more common in the Claiborne sands than in the Jacksonian, from which it was first described. It is more coarsely sulcate and much more trapezoidal than *C. alabamiensis* with which it is usually associated.

One has only to glance at the struggling of De Gregorio in his Faune Eocénique de l'Alabama, as evidenced by his illustrations and numerous varietal names, to appreciate the various aspects assumed by *alabamiensis* in the Claiborne "sand" horizon alone. Jackson deposits show other forms. The same remark applies to earlier Eocene deposits.

Occurrence.—Corbula densata occurs in its large "dense" form most typically in the vicinity of Jackson, Miss.; less abundant at Garland Creek, in adult form, but well represented at Sims Siding above Yazoo City, Miss. It is likewise found at Gibson Landing on the Ouachita River, and Montgomery on the Red River, La.

Small, presumably young, and more elongate forms occur commonly at Garland Creek, Miss., with concentric plicæ well developed. (See Pl. 24, figs. 17 and 18). Others, still smaller and appearing smooth and shining, with less sharp umbonal keel, are probably the very young of *densata*. (See Pl. 24, fig. 21, from Montgomery, La.)

Holotype of densata.—Unknown, presumably lost.

Specimens figured.—Figs. 11, 12, 14, 19, Jackson, Miss.; figs. 13, 16, Claiborne, Ala.; fig. 15, Crow Creek, Ark.; figs. 17, 18, Garland Creek, Miss.; figs. 20, 21, Montgomery, La.

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Corbula willistoni Meyer Plate 24, figs. 22-25

Corbula alabamensis Owen, 1860, 2d Rept. Geol. Recon., Arkansas, pl. 9, figs. 8, 8a.

Corbula willistoni Meyer, 1885, Amer. Jour. Sci., 3d ser., vol. 29, p. 462.

Corbula alabamensis Call, 1891, Arkansas Geol. Survey, Rept. for 1889, vol. 2, p. 8.

Corbula nasuta Harris (*partim*), 1894, Arkansas Geol. Survey, Rept. for 1892, vol. 2, p. 156.

Among the more common specimens of *densata* of the Embayment area, are comparatively longer forms resembling some varieties of *alabamiensis* of the Claiborne sand. The pointed posterior of some suggests a *gibbosa* relationship. Meyer wrote (1885):

A *Corbula* in Jackson differs from the *Corbula gibbosa* Lea in having less distinct concentric ribs and a much smaller beak. The last difference is important enough to justify a new name, *Corbula willistoni*, but otherwise the details are alike.

Harris (1894) remarked:

This is by no means a typical *nasuta* and may prove to be a distinct species.

The larger valves labelled as type specimens from the Alabama State Museum very closely resemble our figures 24 and 25, with some characteristics of figure 26. Another smaller specimen is more elongate—*alabamiensis*-like. The former may be regarded as "types."

Occurrence.—Jackson and Sims Siding north of Yazoo City, Miss.; Crow Creek, Ark.; Wyatt's Bluff, and Danville on the Ouachita River, La.

Types.—Jackson, Miss., Alabama State Museum, Univ. Alabama.

Specimens figured.—Figs. 22, 24, 25, Sims Siding, Miss.; fig. 23, Crow Creek, Ark.

Corbula willistoni, var. arkansia, n. var. Plate 24, figs. 26-28

Corbula nasuta Harris (*partim*), 1894, Arkansas Geol. Survey, Rept. for

1892, vol. 2, p. 156.

The figures herewith given show the characteristics of this variety. A somewhat similar form was described by Morris in 1854 (Geol. Soc., London, Quart. Jour., vol. 10, p. 157) from the lower Eocene of Reculvers, southeast England, under the name of *regulbiensis*. In 1860, Deshayes (Animaux sans Vertèbres, Atlas, pl. 12, figs. 7-9) illustrated Morris's species more fully.

Occurrence.—Found most characteristically at White Bluff, Ark., but also occurs at Crow Creek, Ark., as well as Bayou Toro, (Fig. 28) west Louisiana.

Holotype.—Figs. 26 and 27, White Bluff, Ark.

Paleontological Research Institution.

Subgenus **BIOCORBULA** Fischer, 1887
(Manuel de Conchyliologie, p. 1123)

Subgenotype.—*Corbula gallica* Lamarck, Ann. Mus. Hist. Nat., Paris, vol. 8, 1806, p. 466.

Illustration.—Deshayes, Description des Coquilles Fossiles, etc., 1837, pl. 7, figs. 1-3; Cossmann and Pissarro, Icon. Complète, etc., 1904, pl. 3 figs. 20-2.

Corbula pearlensis Meyer Plate 25, figs. 1, 2

Corbula pearlensis Meyer, 1886, Alabama Geol. Survey, Bull., No. 1, p. 83, pl. 3, figs. 16, 16a.

Corbula pearlensis Cossmann, 1890, Notes Complémentaires, p. 7.

Corbula ? pearlensis Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 846.

Meyer's description.—Rather small, rounded, inflated; margin rounded anteriorly, truncated posteriorly; beaks very small, turned anteriorly; surface of both valves smooth on the umbonal part, covered with rounded concentric ribs on the ventral part.

Locality.—Jackson, Miss., rare.

The dangers besetting guesswork in paleontology are well illustrated in many of Cossmann's remarks about American forms discussed in his "Notes." Here, *pearlensis* is referred to as, "certainly not a *Corbula* and besides is probably not from the Eocene." In the same sentence, it may be of interest to note he says *C. texana* Gabb, "ne doit pas être une forme éocénique."

Dall remarks (*loc. cit.*) : "*C. pearlensis* Meyer . . . may prove to belong to some other genus, as the figure certainly has not the aspect of a *Corbula*."

The beaks of this species are rather high and twisted, but we see no special reason for not referring it to *Corbula* (*s. l.*).[8]

Occurrence.—Jackson, Miss.

Holotype.—The Johns Hopkins University.

Specimens figured.—Town Branch, Jackson, Miss. Paleontological Research Institution.

Genus **POROMYA** Forbes, 1844

(Report on the Mollusca of the Aegean Sea, p. 143, Report of the British Association (Cork, 1843) vol. 13, p. 191: see Neave.)

Type.—*Poromya anatinoides* Forbes=*Corbula granulata*, Nyst and Westendorp, Nouvelles Recherches sur les Coquilles Fossiles d'Anvers, 1839, No. 10, p. 6, pl. 3, fig. 3. (Bull. Ac. Roy. Brux., vol. 6, p. 398)

Illustration—Nyst, 1845. Descrip. des Coquilles et des Polypiers Fossiles des Terrains Tertiares de la Belgique, pl. 1, figs. 6a-d; Fischer, Manuel de Conchyliologie, 1887, p. 1172, fig. 886; Thiele, Handbuch der Systematischen Weichtierkunde, pt. 3, 1934, p. 946, fig. 865.

Poromya mississippiensis Aldrich and Meyer Plate 25, figs. 3-5

Poromya mississippiensis Meyer, 1887, Sonder-Abdruck, Ber. Senckenberg. Naturf. Gesell., 1887, p. 10, pl. 2, figs. 1, a, b.

Poromya mississippiensis Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, p. 1508.

Meyer's description from Aldrich and Meyer MS.—Rounded gibbous, rather thin, quite equivalve, within with mother-of-pearl sheen. Right valve with a flattened-out conical tooth. Left valve with a posterior lateral tooth. Surface thickly bedecked with granular elevations which are radially arranged. Beak turned forward, smooth. Posterior scarcely keeled. Mantel and muscle impressions not evident.

The above is a literal translation of Meyer's description. His specimens were derived from Jackson, Miss.

Dall remarks regarding this species (*loc. cit.*):

A single species of this group [Poromyacea] has been described from our Tertiary. This is marvelously like the recent and typical species, but differs in having the granules arranged quincunxially instead of a direct radial series.

He cites Jackson and Garland Creek as localities for *mississippiensis*.

Holotype.—The Johns Hopkins University.

Specimens figured.—From our old Jackson collection, locality not definitely stated.

Genus **PANOPE** Ménard, 1807

(Mémoire sur un Nouveau Genre de Coquille, 1807)

Genotype.—*Panope glycimeris* Born, Testacea Musee Cæsarei Vindobonensis, 1780; See Dall, Malacol. Soc. London, Proc., vol. 10, 1912, p. 34.

8 For a somewhat similar twisting of the beak, see *Corbula exarata* Deshayes (1837, Atlas, pl. 7, figs. 4-7).

Illustration.— Lister, Historiae sive Synopsis Conchyliorum. 2d ed., 1770, pl. 414, fig. 258; Martini, Conch. Cab., 1777, pl. 3, fig. 25.

For a discussion of this generic name, see Dall, *loc. cit.*

Panope oblongata Conrad Plate 25, fig. 6

Panopaea oblongata Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc. p. 290; 1848, its Jour., 2d ser., vol. 1, p. 121, pl. 13, fig. 12.

Panopea oblongata Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 828.

Conrad's description.— Elongated, very inequilateral, ventricose; extremities rounded; umbo prominent, undulated; valves slightly contracted at base in a line with the umbones; valves gaping at both ends. Length 3½ [inches].

Occurs in its original vertical position generally with connected valves, but it is extremely friable and difficult to obtain.

Conrad described this species from the Vicksburg Oligocene beds. The figure he gives is of a rather large, broad specimen, but others from the same locality show a variety of forms and sizes. Both here and in the Jackson beds there are specimens showing somewhat less curved ventral margins and less depth of valves, but such modifications are largely due to distortion.

A narrow form from the lower Eocene of Alabama we have given the name *alabama.* (These Bulletins, vol. 2, 1897, p. 261, pl. 19, fig. 16). Aldrich's species *porrectoides* from the Claiborne sand at Baker's Bluff (Gopher Hill), Ala., is quite a different form. (See Alabama Geol. Survey, Bull., No. 1, 1886, p. 37, pl. 4, fig. 3.)

Occurrence.—In softer material where original shell matter is retained, specimens are usually in a broken and very imperfect condition. In harder, especially limy, material, the general shape of the species can be correctly observed. Well-preserved shell fragments are fairly common in the exposures about Jackson, Miss., and in the river bluff at Montgomery, La. Fairly well-preserved fragments and casts occur on the Sabine, below Robinson's Ferry, and internal casts are found in the white limestone layers in the river bluffs about two miles above Shubuta, Miss. Small specimens occur likewise at Danville Landing, Ouachita River, La.

Holotype.—Not found.

Specimen figured.—Town Branch, Jackson, Miss.

Paleontological Research Institution.

Genus **GASTROCHÆNA** Spengler, 1783
(Nye Samling af det K. Danske Videnskabers Selskabs Skrifter, vol. 2, p. 174, figs. 8-11)

Type.—*Mya dubia* Pennant, British Zoology, vol. 4, 1777, p. 69, pl. 44, fig. 19; see Dall, Wagner Free Inst. Sci., Trans., vol. 3, 1898, p. 823.
Illustration.—Bucquoy *et al*, Les Mollusques Marine du Roussillon, vol. 2, Atlas, 1896, pl. 85, figs. 36-40; Fischer, Manuel de Conchyliologie, 1887, pl. 23, fig. 15.

Gastrochæna mississippiensis, n. sp. Plate 25, figs. 7-11

Characterization.—Shell moderately large and of shape and general characters indicated by the figures; a faint umbonal ridge passing from beak to posterior lower margin, while below this ridge the valves are slightly depressed; beaks somewhat anteriorly located; valves anteriorly widely gaping; posterior rather pointedly rounded.

This shell is much more rugged and five times the dimensions of Conrad's *larva* of the Claibornian, and twice as large as Aldrich's *striatula* from the Sabine of Alabama. In general appearance it seems most close to *ovata* Sowerby, a Recent East Coast form. It is not quite so broad medially as the last-mentioned species, and the beaks are more anteriorly located; it has, moreover, twice the dimensions of *ovata*.

Occurrence.—Town Creek, Jackson, Ala., in hard clay limestone concretions.

Holotype and specimen figured.—From Town Creek, as stated above.

Paleontological Research Institution.

Teredo mississippiensis Conrad Plate 25, fig. 12

Teredo mississippiensis Conrad, 1854, Wailes, Rept. Agric. and Geol. Mississippi, p. 289, pl. 16, fig. 6.
Teredo mississippiensis Dall, 1898, Wagner Free Inst. Sci., Trans., vol. 3, p. 812.

Since this "species" is as yet known only by tube fragments, it cannot be considered of any importance in Jacksonian literature. Such fragments are common about Jackson, Miss., Montgomery on the Red River, and various outcrops along the Ouachita River, La.

The whereabouts of Conrad's figured specimen is unknown.

Specimens figured herewith.—Town Creek, Jackson, Miss.

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PLATES

PLATE I

16. **Ostrea vicksburgensis** Conrad 17
 Left valve; length 45 mm.; highly plicate and gibbous; Jackson Eocene, Shubuta, Miss., Pal. Res. Inst., No. 4129.

Explanation of Plate 1

Figure | Page

1, 2. **Gryphæaostrea "vomer"** (Morton) 15
1. Left valve; length 21 mm. Cretaceous; Delaware and Chesapeake Canal, Del.; Maryland Geological Survey, Cretaceous, 1916.
2. Right valve; length 20 mm.; Cretaceous, Prince George Co., Maryland, 1916.

3, 4. **Gryphæostrea vomer** (Morton) 15
Both valves; length 38 mm.
3. New Egypt ?, New Jersey, from Morton's original figure, Amer. Jour. Sci., vol. 18, 1830, pl. 3, fig. 1.
4. Side view of fig. 3.

5-13. **Gryphæostrea vomer, var. plicatella** (Morton) 16
5. Left valve; length 8 mm., Eocene "overlying limestone of Alabama"; from Morton's figure, 1830.
6. Both valves, length 55 mm.; specimen in Phila. Acad. Nat. Sci., labelled *Ostrea vomer* Mort. New Egypt, N. J. and probably the specimen used by Morton in illustrating *Gryphæa vomer* in his "Synopsis", 1834, pl. 9, fig. 5.
7,8. Left valve; length 42 mm.; showing postsuperior adhering alations and exogyroid beak; Shubuta, Miss., Jackson Eocene; Pal. Res. Inst., No. 4123.
9. Left valve; length 29 mm., gryphæa-like umbonal region with minute beak distinctly exogyroid; attachment not well developed; Shubuta, Miss. Jackson Eocene, Pal. Res. Inst., No. 4124.
10. Left valve; length 43 mm.; posterior attachment alation well developed; beaks exogyroid, hidden by alation; Shubuta, Miss. Jackson Eocene, Pal. Res. Inst., No. 4125.
11. Right valve; length 18 mm.; showing concentric plicæ and radial folds; Jackson Eocene, Shubuta. Miss. Pal. Res. Inst., No. 4126.
12. Right valve; length 25 mm.; elongate form; Jackson Eocene; Shubuta, Miss. Pal. Res. Inst., No. 4127.
13. Right valve; length 23 mm.; surface concave; beak exogyroid; Jackson Eocene, Shubuta, Miss. Pal. Res. Inst., No. 4128.

14. **Ostrea crista-galli** Morton 17
From Morton's illustration, Amer. Jour. Sci., vol. 18, 1830, pl. 3, fig. 22, afterwards figured in his "Synopsis", 1834, as *Ostrea panda* Mort.; regarded as Cretaceous, "Chiefly found at St. Georges, Del."

15. **Ostrea vicksburgensis** Conrad, var. **mortoni** Gabb 18
From Morton's illustration of *Ostrea panda* Mort., "Synopsis", 1834, pl. 19, fig. 10, characterized in explanation of this figure as "*Ostrea panda* var. from Ala." Gabb's type of *mortoni*, Phila. Acad. Nat. Sci.

(*Continued on previous page*)


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PLATE 2

EXPLANATION OF PLATE 2

Figure Page

1-7. Ostrea vicksburgensis Conrad, vars. 17

1. Side view of specimen shown as fig. 16, Pl. 1. Note gibbosity and extent of fixation; Jackson Eocene; Shubuta, Miss., Pal. Res. Inst., No. 4130.
2. Left valve; greatest diameter 63 mm.; attachment here great but by no means so extensive as in many instances; Jackson Eocene, Shubuta, Miss. Pal. Res. Inst., No. 4131.
3. Interior of fig. 2; anterior and posterior alation slight in comparison with the same in *plicatella*.
4. Right valve of a panciplicate form; length 30 mm.; Jackson Eocene, Shubuta, Miss. Pal. Res. Inst., No. 4132.
5. Exterior, right valve; length 40 mm.; showing plicæ more plainly than in fig. 4; Jackson Eocene, Shubuta, Miss. Pal. Res. Inst., No. 4133.
6. Interior of fig. 5.

6a. A more normally plicate form; length 32 mm.; Oligocene, St. Stephen's Bluff, Ala. Pal. Res. Inst., No. 4134.

7. *O. vicksburgensis*, var. *ludoviciana*, n. var. . . Left valve; length 35 mm.; elongate with few plications; Jackson Eocene, Bunker Hill on the Ouachita River, La. Pal. Res. Inst., No. 4135.

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PLATE 3

EXPLANATION OF PLATE 3


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PLATE 4

EXPLANATION OF PLATE 4

Figure Page

1-6. Ostrea trigonalis Conrad 21

1,a. Conrad's type; width 30 mm., Jackson, Miss.; Phila. Acad. Nat. Sci., No. 13184.

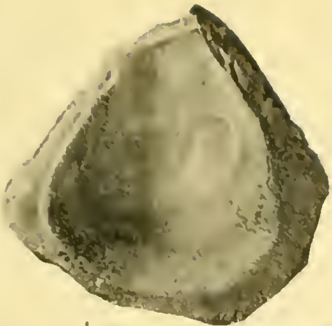
2. Right valve; young; greatest diameter 28 mm.; showing traces of radial striæ; Jackson Eocene, Shubuta, Miss. Pal. Res. Inst., No. 4141.

3. Interior of fig. 2; showing peripheral plicæ.

4. Right valve; length 90 mm.; showing the usual shape and depth of a left valve also "vermicular sculpture on hinge termini"; Jackson Eocene, near city water works, Jackson, Miss. Pal. Res. Ins., No. 4142.

5. Portion of a right valve showing exterior etched radii as in *Gryphæa vesicularis;* Jackson Eocene, Shubuta, Miss. Pal. Res. Inst., No. 4143.

6. Right valve; greatest diameter 75 mm.; showing hinge sculpturing and peripheral geniculation; Jackson Eocene, Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4144.



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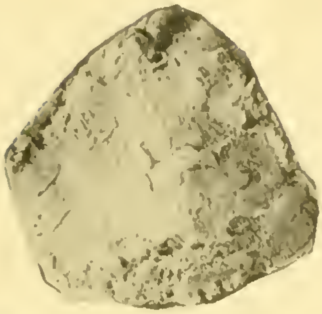

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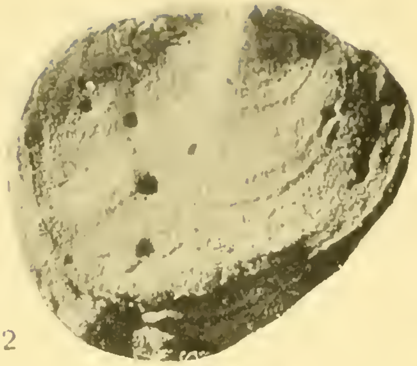

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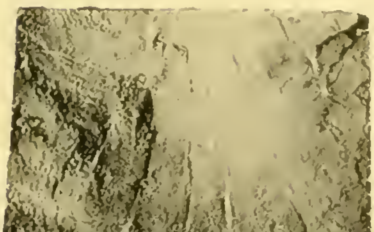

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PLATE 5

EXPLANATION OF PLATE 5


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PLATE 6

EXPLANATION OF PLATE 6

Figure Page

1. **Plicatula filamentosa** ? Conrad 25
   Left valve; length 18 mm.; Jackson Eocene, west of Silas and east of old Fail P. O. site about 1 mile; Jackson, Miss. Pal. Res. Inst., No. 4150.

1a. **Plicatula filamentosa** Conrad 25
   Left valve; length 16 mm.; showing portions of an anterior very similar to fig. 6, pl. 12, vol. 6 of these Bulletins (from Claiborne); Jackson Eocene, Bunker Hill, Ouachita River, La. Pal. Res. Inst., No. 4151.

2,a. **Spondylus dumosus** (Morton) 25
   Fragments 40 and 45 mm. in length; associated with *Chlamys spillmani*, zeuglodon bones, etc.; Jackson Eocene, 1 mile south of Melvin, Ala. Pal. Res. Inst., No. 4152,

3-8a. **Chlamys spillmani** Gabb 27
   3,a. Right valve; length 27 mm.; showing interior and exterior of average size specimen; Jackson Eocene; Shubuta, Miss. Pal. Res. Inst., No. 4153.
   4. Specimen 32 mm. in length, showing equivalve characteristics; from the same locality as fig. 3. Pal. Res. Inst., No. 4154.
   5. Specimen 20 mm. in length; showing coarse sculpturing; found with fig. 3. Pal. Res. Inst., No. 4155.
   6. Specimen from same locality showing typical surface magnified. Pal. Res. Inst., No. 4156.
   7. Specimen from same locality showing duplicate lateral lobing of fimbriate lamellæ on each rib. Photographed from left valve of fig. 4.
   8. Specimen showing somewhat unusually complex ornamentation (magnified) of a right valve from a locality west of Silas and perhaps 1 mile east of old Fail P. O. site. Pal. Res. Inst., No. 4157.
   8a. Hinge margin of specimen shown by fig. 8 exhibiting unusually coarse ornamentation on posterior ear.

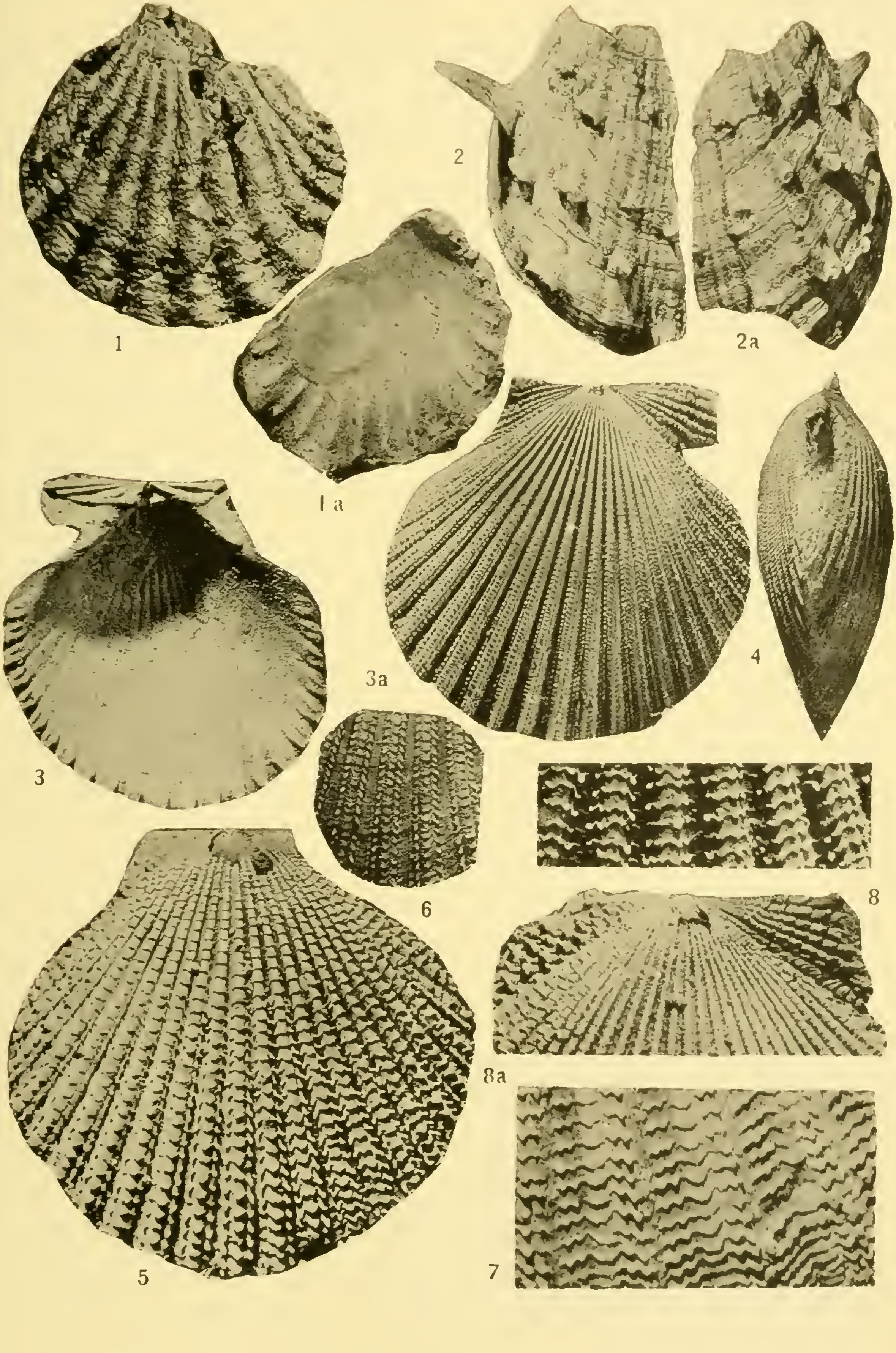
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PLATE 7

EXPLANATION OF PLATE 7

Figure Page

1-4. **Chlamys nupera** (Conrad) 29

1,a. Right valve; length 21.5 mm.; showing the usual subdued type of ornamentation; specimen furnished by Dr. Sullivan of Millsaps College; figured by Rowland (Amer. Midl. Nat., vol. 17, 1936, pl. 10, fig. 6); Jackson Eocene at Jackson, Miss. Pal. Res. Inst., No. 4158.

2. Specimen ×4; showing details of uneroded ornamentation; R. R. cut 1 mile south of city water works; Jackson Eocene, Jackson, Miss. Pal. Res. Inst., No. 4159.

3. Specimen ×7; showing ornamentation on a specimen from Montgomery, La.; Jackson Eocene. Pal. Res. Inst., No. 4160.

4. Specimen 32 mm. from beak to base; showing surface characteristics like the type specimen in the collection of the Phila. Acad. Nat. Sci.; found with fig. 2, Jackson Eocene. Pal. Res. Inst., No. 4161.

5-11. **Pecten perplanus** Morton 27

5. Area magnified from near the base of a very gibbous right valve showing depth and breadth of interspaces and characteristic markings; probably Red Bluff Oligocene; top of blue clay 1/4 mile below cement plant at St. Stephen's Bluff, Ala. Pal. Res. Inst., No. 4162.

6. Specimen showing broad costal crests; Oligocene; top of Gopher Hill quarry, above St. Stephen's Bluff, Ala. Pal. Res. Inst., No. 4163.

7. Specimen showing ornamentation of narrow costal crests; locality as for fig. 5. Pal. Res. Inst., No. 4164.

8. Left valve; 16 mm. from beak to base; flat valve of Morton's typical *perplanus* (not Gabb's *spillmani* generally called *perplanus*); locality and horizon as for fig. 5. Pal. Res. Inst., No. 4165.

9. Specimen × 4; from a comparatively shallow right valve, showing modifications toward the mature stage called *poulsoni* by Morton (Synop. Org. Rem., 1835, p. 59, pl. 19, fig. 2); locality and horizon as for fig. 5. Pal. Res. Inst., No. 4166.

10, 11. Final stages in *perplanus-poulsoni* development; left valve (fig. 10) flat; right valve (fig. 11) very gibbous; Oligocene of Byram, Miss. Pal. Res. Inst., No. 4167.

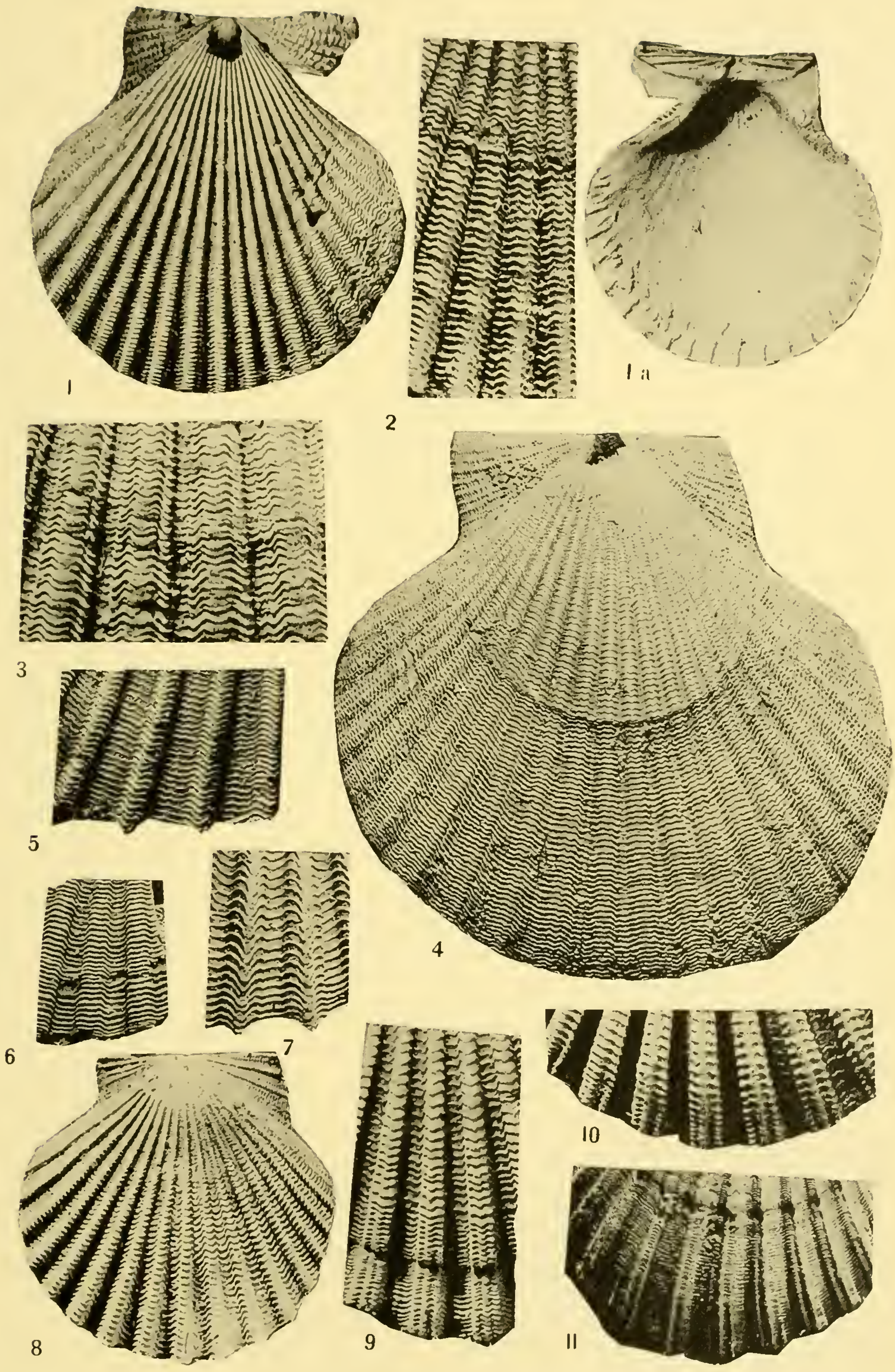
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PLATE 8

EXPLANATION OF PLATE 8

Figure	Page

1-5. Chlamys beverlyi Tucker 30

1, 2. Right valve; length 23 mm.; showing division of primary ribs at an early stage; presumably St. Maurice Eocene, Sabine River, Tex. Pal. Res. Inst., No. 4168.

3, 4. Left valve; length 23 mm.; showing broad ribbing as in *wautubbiana* var. *canei* extending over the greater part of the shell before subdividing; location and horizon as in fig. 1. Pal. Res. Inst., No. 4169.

5. Young shell; length 10 mm.; showing adult costation about the periphery; horizon and location as in fig. 1. Pal. Res. Inst., No. 4170.

6. Chlamys corvina, n. sp. 31

6. Right valve; length and width 12 mm.; showing narrow, vertically sided riblets somewhat varying in size, with unusually wide interspaces; Jackson Eocene, Crow Creek, Ark. Pal. Res. Inst., No. 4171.

7-9. Chlamys danvillensis Weisbord 31

7. Left valve; length and width 17 mm.; showing riblets varying in size; decorticated and not showing surface ornamentation; Jackson Eocene from Tullos, La. Pal. Res. Inst., No. 4172.

8. A small specimen (10 mm.) but showing general surface features; also from Tullos, La. Pal. Res. Inst., No. 4173.

9. Portion of surface of fig. 8, × 4 showing details of surface ornamentation; likewise from Tullos, La.

10. Chlamys cocoana Dall 32

Left valve; copy of Dall's figure; length 23 mm.; Old Cocoa P. O. site, Choctaw Co., Ala.; holotype, U. S. Nat. Mus., No. 141,025.

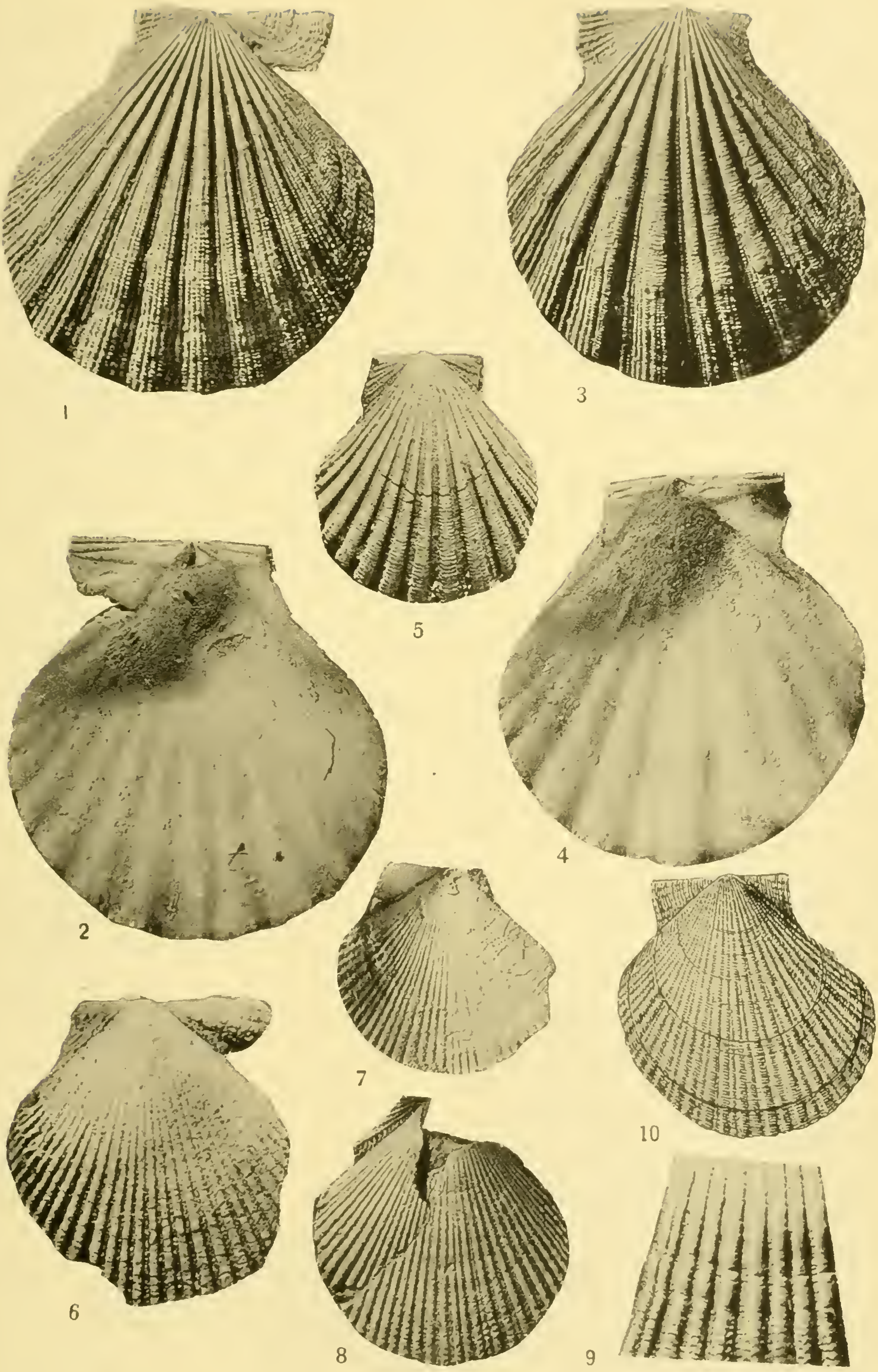
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PLATE 9

EXPLANATION OF PLATE 9

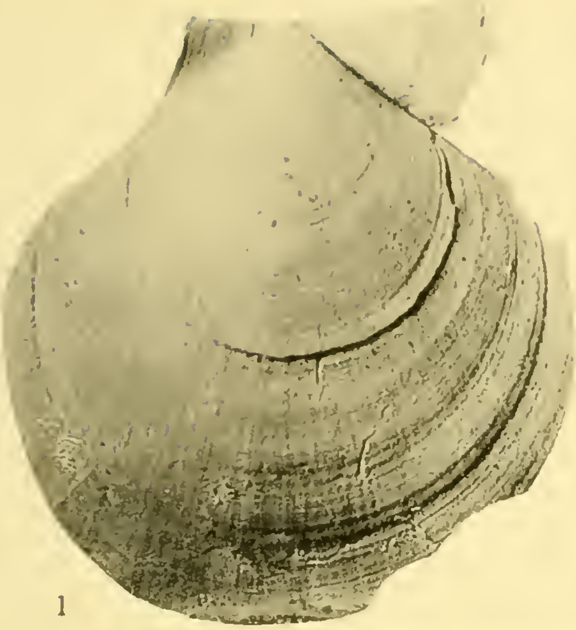
Figure	Page
1-8. Eburneopecten scintillatus Conrad	33

1. Right valve; length 17 mm.; showing indications of fine costæ; from the cliff near the old bridge on Garland Creek above Shubuta, probably Conrad's type "Enterprise" locality; Jackson Eocene. Pal. Res. Inst., No. 4174.
2. Left valve; length 15 mm.; showing traces of slight undulations causing broad costations distantly resembling those on fig. 11, pl. 15, vol. 6 of these Bulletins from the upper Sabine horizon at Hatchetigbee Bluff, Ala.; Jackson Eocene on Garland Creek, Miss. Pal. Res. Inst., No. 4175.
3. Umbonal area × 10; showing details of markings on umbonal areas; camptonectes markings clearly shown on posterior areas; occurrence as in fig. 1. Pal Res. Inst., No. 4176.
4. Umbonal area × 10; occurrence as in fig. 5. Pal. Res. Inst., No. 4177.
5. Right valve, exterior; × 1½; showing light coloration as noted by Conrad. Jackson Eocene at Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4178.
6. Hinge structure of right valve × 6½; occurrence as in fig. 1. Pal. Res. Inst., No. 4179.

7, 8. Hinge structure, right and left valves; × 3½; occurrence as in fig. 1. Pal. Res. Inst., Nos. 4180, 4181.

9. Eburneopecten scintillatus var. corneoides Harris ... 33

Here introduced to shew modifications of the *scintillatus* type of *Pecten* in lower Eocene horizons; also described and figured in these Bulletins, vol. 2, p. 235, pl. 13, fig. 1. (Upper Sabine at Hatchetigbee Bluff, Ala.). Pal. Res. Inst., No. 185.



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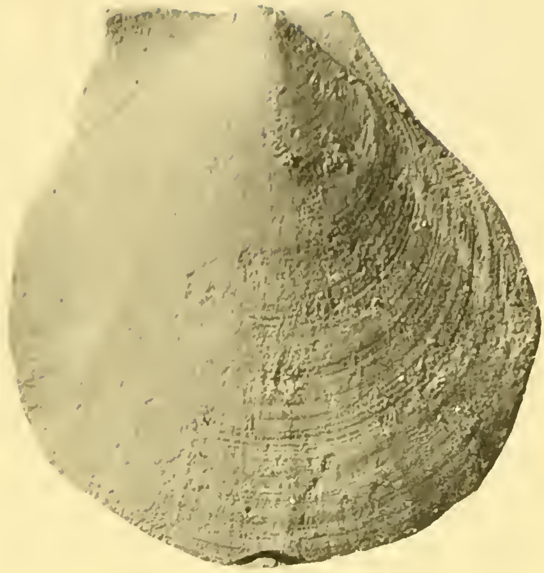

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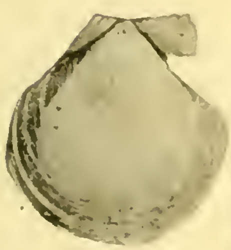

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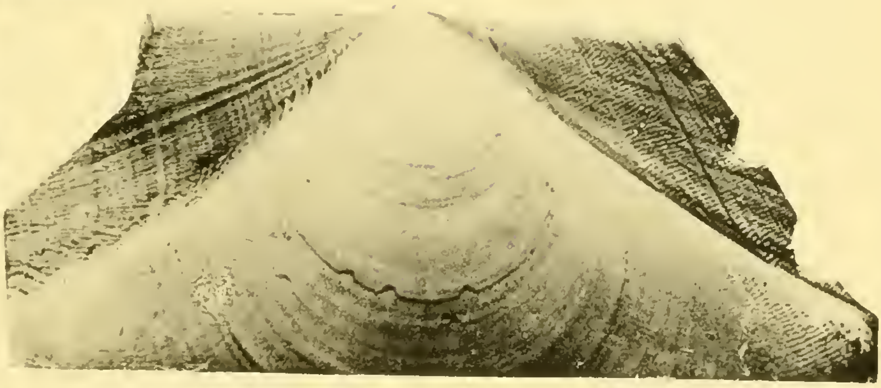

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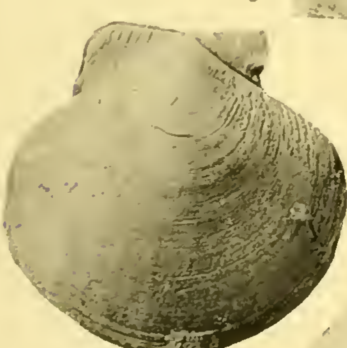

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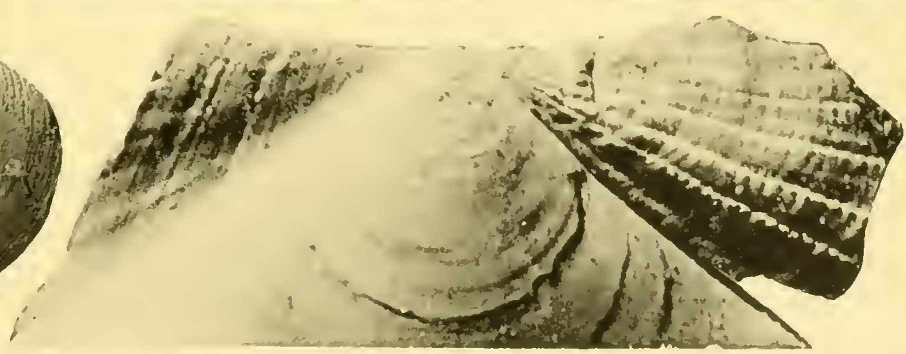

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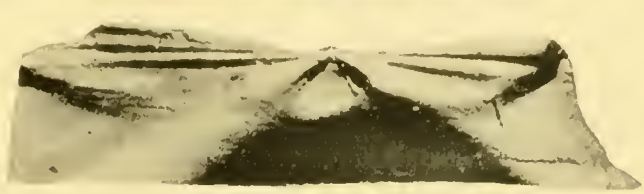

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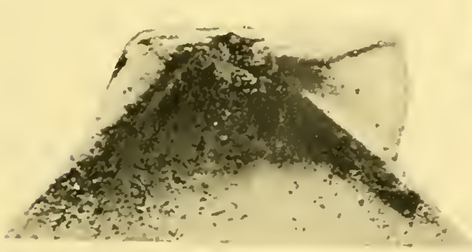

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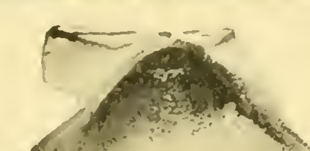

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PLATE 10

Explanation of Plate 10

Figure	Page

1-4. Pteria limula var. vanwinkleæ, n. var. ... 37

1. Right valve; length 25 mm., height 31 mm., thickness 8 mm. Jackson Eocene of Moodys Branch. Jackson, Miss. Pal. Res. Inst., No. 4182.
2. Right valve; length 20 mm., height 15 mm., thickness 4 mm.; Jackson Eocene of Gibson Landing, Ouachita River, La. Pal. Res. Inst., No. 4183.
3. Left valve; length 30 mm., height 26 mm.; thickness 10 mm.; Jackson Eocene, Montgomery, La. Pal. Res. Inst., No. 4184.
4. Same specimen as fig. 3, showing hinge features.

5,6. Atrina jacksoniana Dall ... 39

5. Both valves, showing right only; length 75 mm.; height 60 mm.; thickness 15 mm.; Jackson Eocene, Wooley's Bluff, Bayou Toro region, Sabine Co., La. Pal. Res. Inst., No. 4185.
6. Anterior portion of shell; length 31 mm.; height 18 mm.; thickness 9 mm.; occurrence as in fig. 5. Pal. Res. Inst., No. 4186.

7-9. Mytilus hamatoides Call ... 40

7. Right valve; length 63 mm.; height 36 mm.; thickness 7 mm.; showing general shape of shell and surface markings; Jackson Eocene, Crow Creek, Ark. Pal. Res. Inst., No. 4187.

7a. Fragment, slightly magnified showing correct outline of juvenile specimen; occurrence as in fig. 7. Pal. Res. Inst., No. 4188.

8. Umbonal fragment; × 3; showing tooth, slightly bifid; occurrence as in fig. 7. Pal. Res. Inst., No. 4189.

8a. The same fragment viewed anteriorly showing cardinal areas and ligamental groove.

9. Specimen viewed from above, exterior exfoliated; length 55 mm.; height 25 mm.; thickness (both valves) 18 mm.; specimen indicating that the ligament was largely internal; occurrence as in fig. 7. Pal. Res. Inst., No. 4190.

10,11. Volsella cretacea (Conrad) ... 42, 44

10. Cast of right valve copied from Conrad's original illustration; length 100 mm.; (here somewhat reduced); "from the upper division of the Cretaceous series of Clarke County, Ala." (See Conrad, 1835, p. 340).
11. A specimen 25 mm. in length from Sta. 2809, U. S. Nat. Mus., Jacksonian of Choctaw Co., Ala.

12. Modiola tenuis Meyer ... 43

Left valve; length 4 mm.; Jackson, Miss. Copy of Meyer's illustration.

13. Volsella (Arcoperna) filosa (Conrad) ... 43

Copy of Conrad's original illustration; one of his "Enterprise" (Garland Creek) Jackson types. See Conrad, Amer. Jour. Conch., vol. 1, pl. 10, fig. 14.

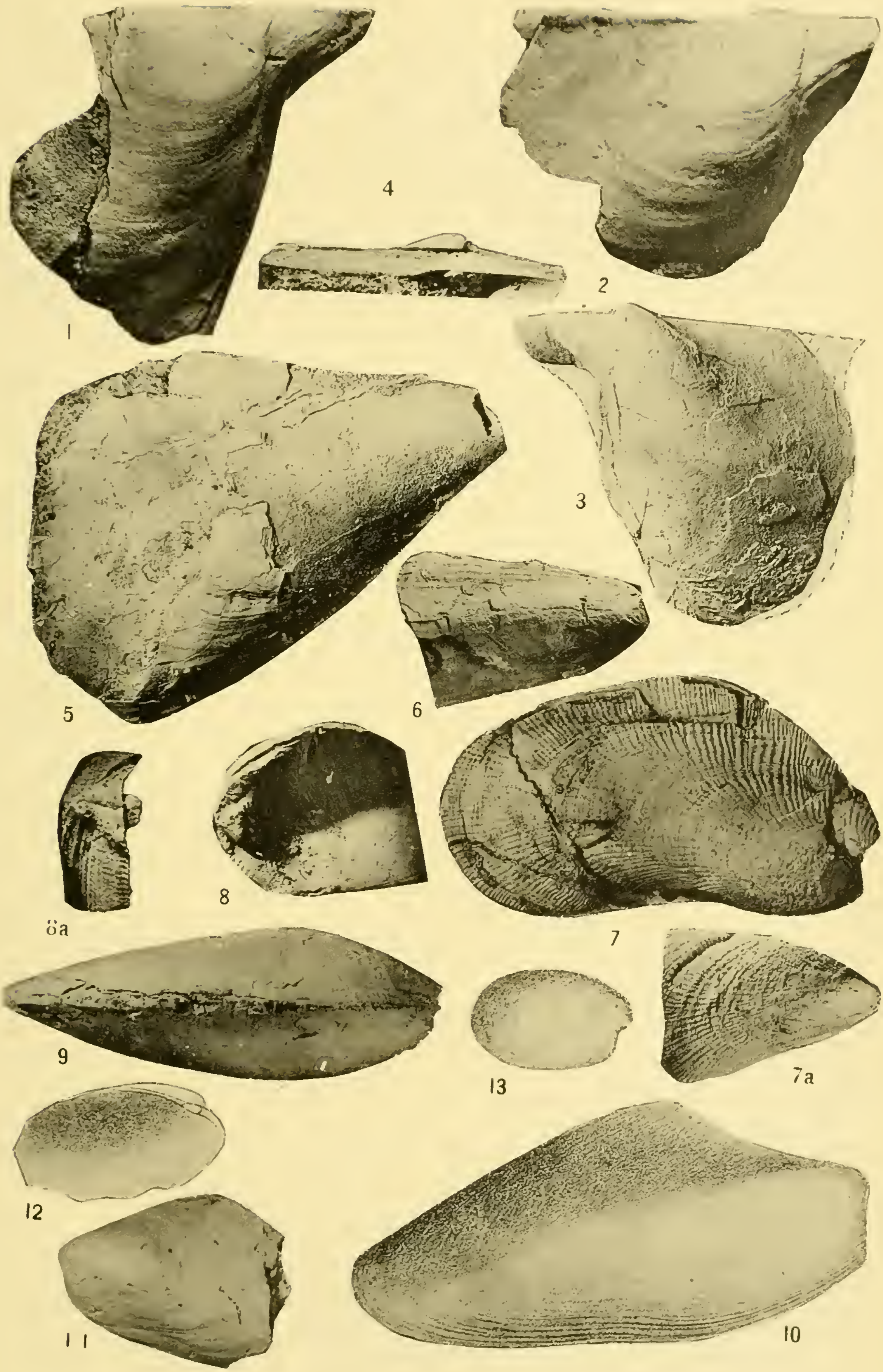
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PLATE 11

EXPLANATION OF PLATE 11

Figure		Page
1-3.	**Barbatia (Cucullæarca) cuculloides** (Conrad)	45
	1. Right valve; length 75 mm.; showing undistorted form and markings; Jackson Eocene, Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4191.	
	2. Left valve; length 56 mm.; Jackson, Miss. Pal. Res. Inst., No. 4192.	
	3. Left valve; length 66 mm.; Jackson, Miss. Pal. Res. Inst., No. 4193.	
4-5a.	**Barbatia (Jacksonarca) seraperta**, n. subg. and sp.	46
	4. Left valve; length 9 mm.; height 6 mm.; depth 2 mm.; Jackson, Miss. Pal. Res. Inst., No. 4194.	
	5. Interior of fig. 4.	
	5a. Magnification of ligamental area of fig. 4.	
6-8.	**Barbatia ludoviciana** Harris	46
	6. Right valve; length 25 mm.; undistorted form; Jackson Eocene; Montgomery, La. Pal. Res. Inst., No. 4195.	
	7. Left valve; length 21 mm.; slightly distorted; occurrence as in fig. 6. Pal. Res. Inst., No. 4196	
	8. Left valve; length 25 mm.; distorted; Jackson Eocene at Danville, La. Pal. Res. Inst., No. 4197.	
9-11.	**Barbatia corvamnis**, n. sp.	46
	9. Right valve; length 15 mm.; showing sparse, interrupted radii anteriorly and posteriorly, more numerous and sharply defined medially, and generally worn appearance superiorly; Jackson Eocene, Crow Creek, near Forrest City, Ark. Pal. Res. Inst., No. 4198.	
	10. Dorsal view; length 21 mm.; showing gibbosity of valves and deletion of costæ; occurrence as in fig. 9. Pal. Res. Inst., No. 4199.	
	11. Interior view; length 24 mm.; showing dentition and ligamental area; occurrence as for fig. 9. Pal. Res. Inst., No. 4200.	
12,13.	**Barbatia (Acar) aspera** (Conrad)	47
	12. Right valve; length 13 mm.; showing hinge characters; Jackson, Miss. Pal. Res. Inst., No. 4201.	
	13. Exterior of same specimen as shown in fig. 12.	
14.	**Barbatia (Scapharca?) rhomboidella** Lea	44
	Right valve, length 9 mm.; showing characters of young specimen from the upper Clabornian horizon at Gosport, Ala. Compare type of ribbing with that of Jacksonian species. Pal. Res. Inst., No. 4202.	


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PLATE 12

EXPLANATION OF PLATE 12

Figure | Page

1-3. Glycymeris filosa Conrad 49

1. Left valve; width 31 mm.; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4203.
2. Interior of fig. 1.
3. Right valve; width 34 mm.; Jackson Eocene at Montgomery, La. Pal. Res. Inst., No. 4204.

4-12. Glycymeris idonea Conrad 49

4. Both valves; depth of both, 16 mm.; var. from Sims Siding north of Yazoo City, Miss.; regarded as of lower Jackson Eocene. Pal. Res. Inst., No. 4205.
5. Left valve; height 18 mm.; Montgomery, La. Pal. Res. Inst., No. 4206.
6. Interior view; height 19 mm.; Montgomery, La.
7. Exterior of right valve; height 23 mm. showing distant, strong growth-lines often seen in this species in Jackson horizons; Montgomery, La. Pal. Res. Inst., No. 4207.
8. Right valve; height 18 mm.; showing a cuneate form with subdued ribbing; Montgomery, La. Pal. Res. Inst., No. 4208.
9. Right valve; height 28.5 mm.; showing typical form and ornamentation of specimens from Sims Siding north of Yazoo City, Miss. See also fig. 4. Pal. Res. Inst., No. 4208a.
10. Left valve; height 28 mm.; showing coarse costation for this species; Garland Creek above Shubuta, Miss. Pal. Res. Inst., No. 4209.
11. Right valve; height 22 mm.; showing marked umbonal development; St. Maurice Eocene, Burleson Shell Bluff, Brazos River, Tex. Pal. Res. Inst., No. 4210.
12. Right valve; height 29.5 mm.; showing typical form of this species as developed in the "sand" at Claiborne, Ala. Costæ practically obliterated except posterobasally. Pal. Res. Inst., No. 4211.

13-19. Limopsis radiata Meyer 51

13. Right valve; height 8 mm.; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4212.
14. Left valve; height 10 mm.; northern terminus of freight yard, one mile from city water works, Jackson, Miss. Jackson Eocene. Pal. Res. Inst., No. 4213.
15. Left valve; height 3 mm.; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4214.
16. Surface of fig. 15 magnified.
17. Surface of a Claiborne *Limopsis aviculoides* Con. same specimen as figured in vol. 6, these Bulletins, pl. 18, fig. 7. Pal. Res. Inst., No. 495.
18. Surface of a St. Maurice specimen. See these Bulletins, vol. 6, pl. 18, fig. 3. Pal. Res. Inst., No. 491.
19. Surface of the St. Maurice specimen shown in vol 6, pl. 18, fig. 4. Pal. Res. Inst., No. 492.

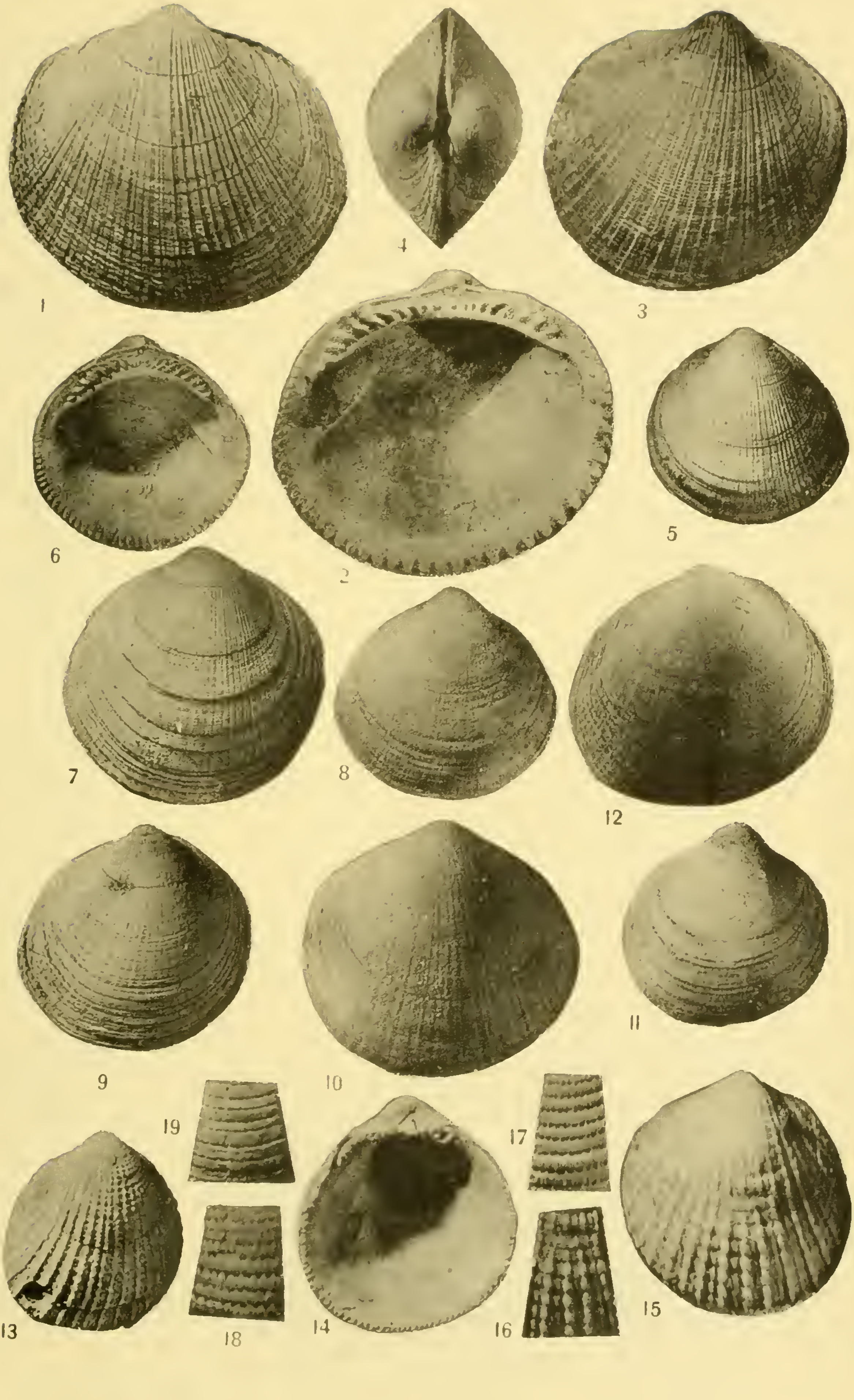
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PLATE 13

19. **Yoldia** ?, sp. 58
Right valve; length 12 mm.; White Bluff, Ark. Pal. Res. Inst., No. 4230.

20. **Yoldia psammotæa** Dall 57
Left valve, length 18 mm.; a Lisbon Eocene species from the base of the bluff at the upper landing at Claiborne, Ala. Same specimen as figured in vol. 6, these Bulletins, pl. 25, fig. 29.

21. So far as observed no Jackson forms of this general type show the long ridges and channels on the escutcheon as indicated in the Bulletin just referred to or as shown here by fig. 21.

EXPLANATION OF PLATE 13

Figure Page

1-2. **Limopsis radiata** Meyer 51

1. Right valve; height 8 mm.; showing the somewhat quadrangular outline of Meyer's type figure; Jackson Eocene near Gibson Ldg., Ouachita River, La. Pal. Res. Inst., No. 4216.
2. Exterior; height 6 mm.; showing the usual exterior characteristics of a well-developed form; Jackson Eocene at Bunker Hill, Ouachita River, La. Pal. Res. Inst., No. 4217.

3-4. **Trinacria corvamnis**, n. sp. 53

Left valve; length 4 mm.; Jackson Eocene of Crow Creek, near Forrest City, Ark. Pal. Res. Inst., No. 4218.

5-7. **Nuculana regina-jacksonis** Harris 54

5. Right valve; length 44 mm.; showing typical form and details of surface ornamentation; Jackson, Miss. Pal. Res. Inst., No. 4219.
6. Cardinal view; same specimen as fig. 5.
7. Umbonal fragment showing markings in early stage of growth; × 1½; Danville, La. Pal. Res. Inst., No. 4220.

8. **Nuculana opulenta** Conrad 55

Umbonal fragment introduced for comparison with fig. 7; × 2; from Claiborne sand at Claiborne, Ala. Pal. Res. Inst., No. 4221.

9. Fragment of an *opulenta*-like form from White Bluff, Ark. Pal. Res. Inst., No. 4222.

10-11. **Nuculana regina-jacksonis Harris**, var. 54

10. Right valve; length 36 mm.; a rather narrow, thick varietal form; Danville, La. Pal. Res. Inst., No. 4223.
11. Showing the interior of fig. 10. Note deep sinus and wide pit.

12-14. **Nuculana mater** Meyer 56

12. Adult left valve; length 11 mm.; showing outline and characteristic markings; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4224.
13. Young right valve; length 5½ mm.; showing umbonal markings; occurrence as in fig. 12. Pal. Res. Inst., No. 4225.
14. Right valve; length 7 mm. showing siphonal deposits; occurrence as in fig. 12. Pal. Res. Inst., No. 4226.

15-16. **Nuculana albirupina** Harris 57

15. Left valve; length 8 mm.; showing smooth anterior and posterior; Jacksonian, White Bluff, Ark. Pal. Res. Inst., No. 4227.
16. Interior of fig. 15; showing siphonal characters.

17. **Yoldia** ?, unidentified fragment 58

Left valve; length 14 mm.; Jackson Eocene of Montgomery, La. Pal. Res. Inst., No. 4228.

18. **Yoldia** ?, sp. 58

Right valve; length 22 mm.; Jackson Eocene at Little Stave Creek, Ala., near Jackson, Ala. Pal. Res. Inst., No. 4229.

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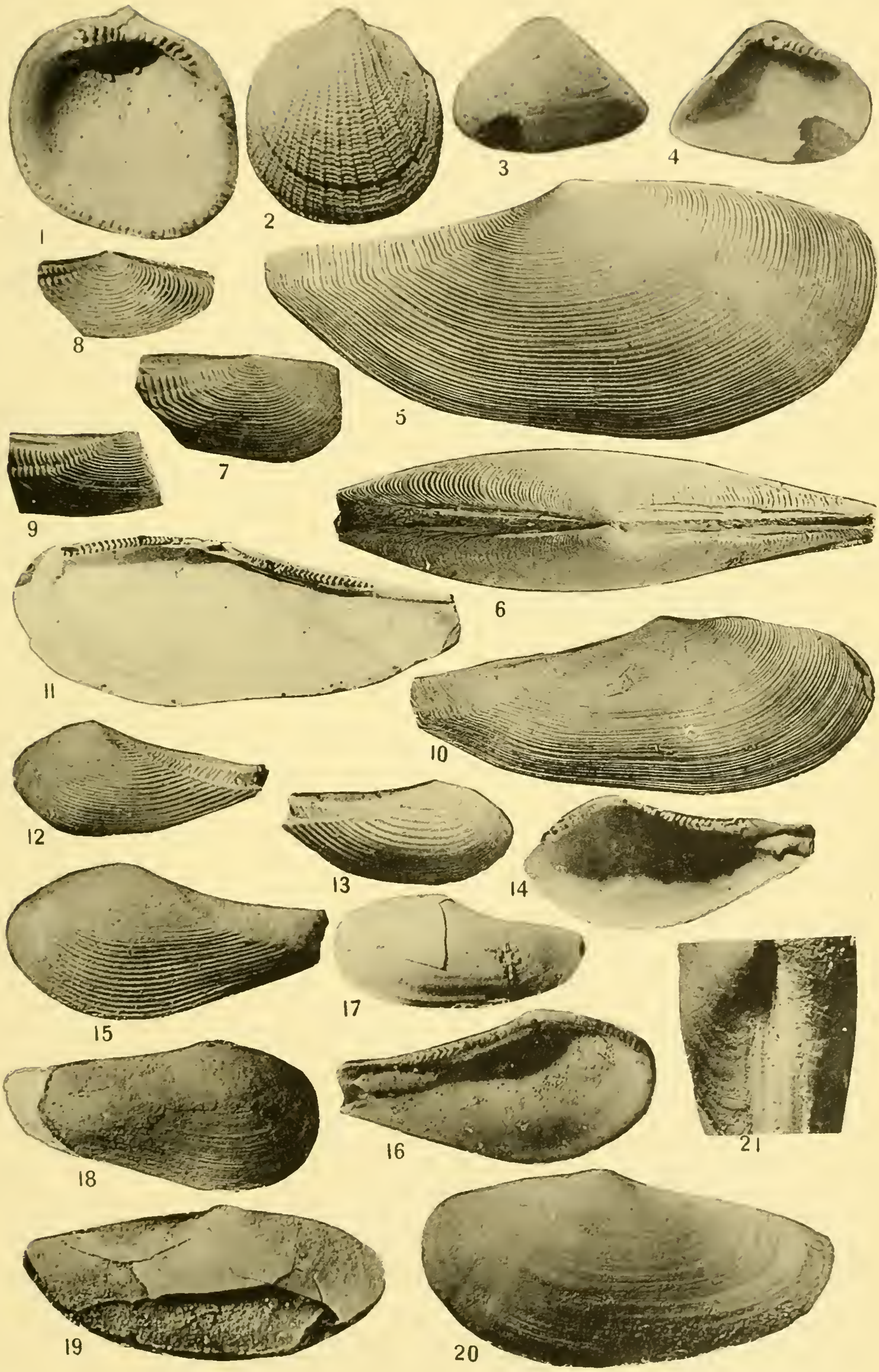
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PLATE 14

18. **Nucula magnifica**, var. 62
Right valve; length 24 mm.; showing a form approaching *yazooënsis*; Claiborne sand, Gosport, Ala. Pal. Res. Inst., No. 4244.

19. **Nucula magnifica**, var. **yazooënsis**, n. var. 62
Left valve; length 20 mm.; showing typical form of the variety from Sims Siding, 8 miles north of Yazoo City, Miss. Pal. Res. Inst., No. 4245. Type.

20. **Nucula magnifica**, var. 62
Right valve; length 22 mm.; umbo somewhat more pointed than in fig. 19; occurrence as in fig. 19. Pal. Res. Inst., No. 4246.

21. **Nucula magnifica**, var. **mauricensis** Harris 62
Right valve; length 15 mm.; St. Maurice Eocene at base of bluff, Claiborne, Ala.; same specimen as shown in fig. 5, pl. 26, vol. 6 of these Bulletins; here inserted for comparison with later developments. Pal. Res. Inst., No. 620.

22. **Nucula**, sp. 62
Left valve; length 5 mm.; small form of undetermined relationship to other Jackson Nuculas from White Bluff, Arkansas River, Ark. Pal. Res. Inst., No. 4247.

23, 31. **Nucula ovula** Lea 63
23. Right valve; length 9 mm.; from the Claiborne sand horizon, Claiborne, Ala.; here inserted for comparison with *N. spheniopsis*. Pal. Res. Inst., No. 4248.
31. Right valve; length 10 mm.; occurrence as in fig. 23. For other *ovula* for comparison see these Bulletins, vol. 6, pl. 26, figs. 12-14. Pal. Res. Inst., No. 4249.

24-27. **Nucula spheniopsis** Conrad 63
24. Right valve; length 8 mm.; Jackson Eocene at Garland Creek, Miss. Pal. Res. Inst., No. 4250.
25. Left valve; length 4 mm.; showing a small, thick form from Jackson, Miss. Pal. Res. Inst., No. 4251.
26. Left valve; length 10 mm.; from Jackson beds near the mouth of Garland Creek, Miss. Pal. Res. Inst., No. 4252.
27. Right valve; length 18 mm.; freight yard, Jackson, Miss.; unusually large for this species. Pal. Res. Inst., No. 4253.

28. **Nucula "meridionalis"** Aldrich and Meyer 64
Left valve; height 5 mm.; Jackson, Miss. Pal. Res. Inst., No. 4254.

29,30. **Nucula spheniopsis ?** vars. 63
Right valves; length 9 mm.; Garland Creek, Miss. showing *ovula* relationship. Pal. Res. Inst. No. 4255.

EXPLANATION OF PLATE 14

(*Continued on previous page*)


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PLATE 15

EXPLANATION OF PLATE 15

Figure Page

1-11. **Venericardia planicosta** Lamarck, vars. 65

1. Left valve; height 72 mm.; showing relationship to other Claiborne and Jackson variants of "*densata*"; Crow Creek, Jackson Eocene. Pal. Res. Inst., No. 4256.

2. Both valves; length 57 mm.; occurs with fig. 1. Pal. Res. Inst., No. 4257.

3,4. Right valve; height 45 mm.; form (topotype) styled *Venericardia* (*Venericor*) *apodensata* by Gardner and Bowles; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4258.

5,6. Right valve; height 33 mm.; a small form showing rather heavy umbones, clear-cut ribbing and pointed beak; White Bluff, Ark. Pal. Res. Inst., No. 4259.

7. Right valve; height 38 mm.; showing a somewhat broader umbo than fig. 5; White Bluff, Ark. Pal. Res. Inst., No. 4260.

8,9. Left valve; height 22.5 mm.; comparatively narrow ribs; White Bluff, Ark. Pal. Res. Inst., No. 4261.

10,11. Right valve; height 22 mm.; with pointed beak, broad ribs, and heavy incised concentric lines anterio-basally; Montgomery, La. Pal. Res. Inst., No. 4262.

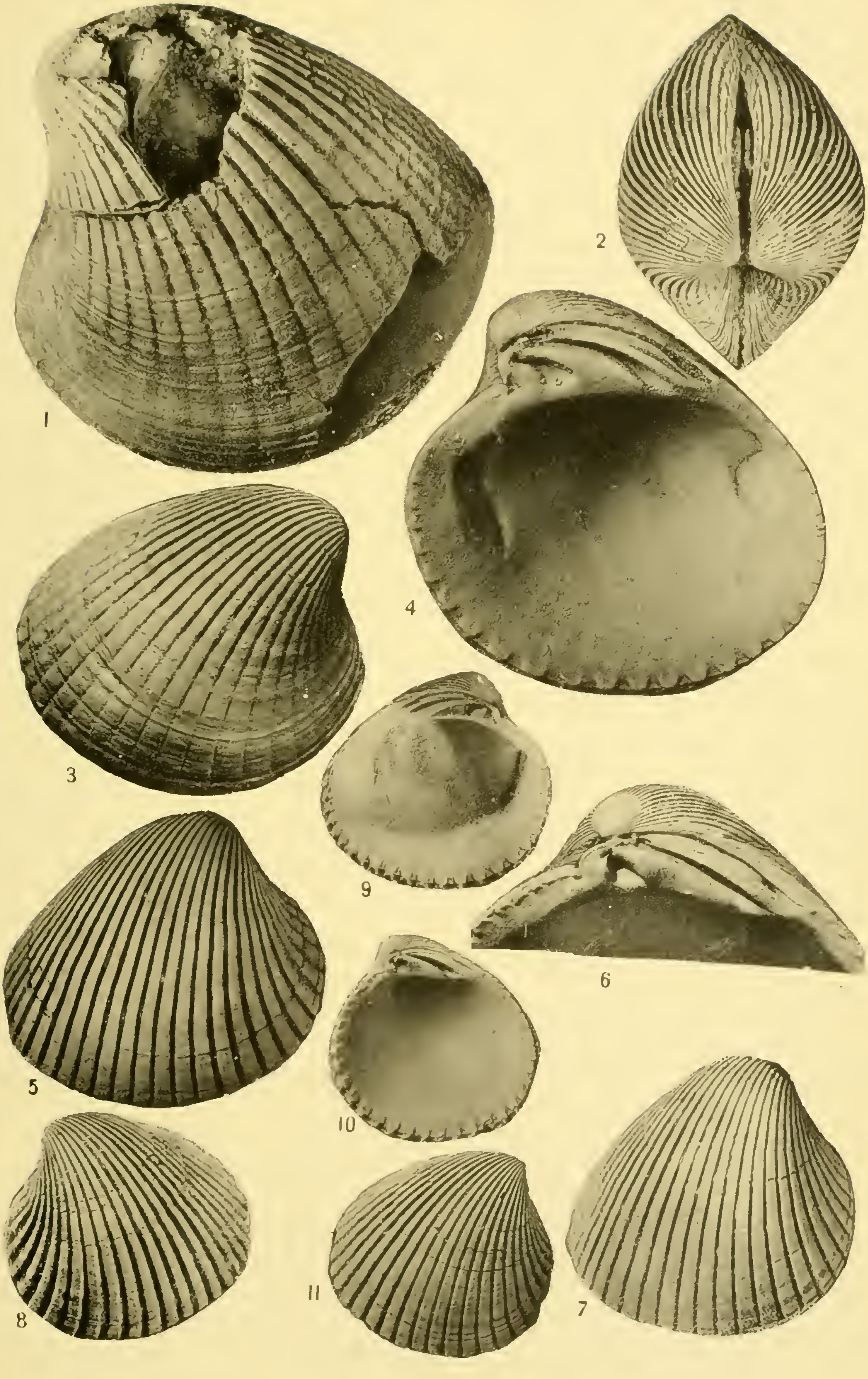
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PLATE 16

Explanation of Plate 16

Figure Page

All specimens from Bunker Hill, La.
1, 2. Left valve; height 21 mm.; showing low beak, and narrow ribs especially anteriorly. Pal. Res. Inst., No. 4263.
3, 4. Right valve; height 44 mm.; increasing height and marked channelling of rib tops. Pal. Res. Inst., No. 4264.
5, 6. Right valve; height 38 mm.; less channelling of rib tops, broader costæ. Pal. Res. Inst., No. 4265.
7, 8. Left valve; height 51 mm.; typical *klimacodes* form. Pal. Res. Inst., No. 4266.
9. Right valve; height 55 mm.; showing hinge and internal characteristics. Pal. Res. Inst., No. 4267.

Right valve; height 17 mm.; depth of one valve 6 mm.; type; Jackson, Miss.; Alabama State Museum.

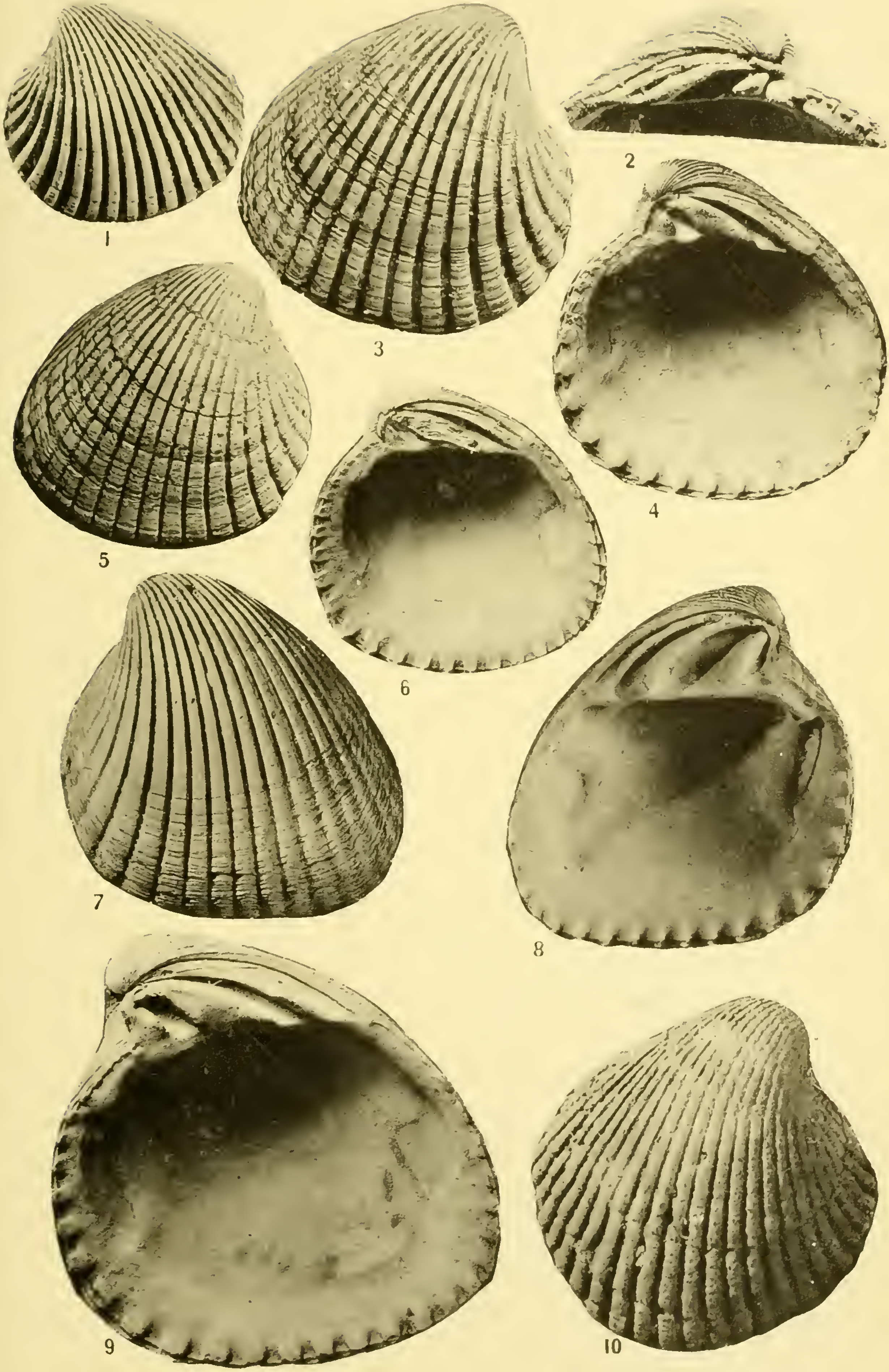
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PLATE 17

fig. 8). Pal. Res. Inst., No. 4281.

15. Right valve; height 18 mm.; solid, high form, var. *garlandia*, n. var.; Gibson Ldg., La. Pal. Res. Inst., No. 4282.

16a. Left valve; height 6 mm.; var. *garlandia* 73
Holotype: Garland Creek, Miss. Pal. Res. Inst., No. 4283.

17a. Right valve; height 5 mm.; var. *garlandia*, Garland Creek, Miss. Pal. Res. Inst., No. 4284.

18,18a. **Venericardia inflatior**, Meyer 75
Left valve; height 3.2 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4285.

18b. **Venericardia inflatior**, var. **"jacksonensis"** Meyer 75
Left valve; height 17 mm.; Jackson, Miss.; Alabama State Museum. (Holotype.)

19-21. **Venericardia (Pleuromeris) parva**, var. **jacksonensis** Meyer 75

19. Right valve; height 4 mm.; Sabine River, Tex. Pal. Res. Inst., No. 4286.
20. Right valve; 3.5 mm.; Sabine River, Texas. Pal. Res. Inst., No. 4287.
21. Right valve; height 2 mm.; Sabine River, Tex. Pal. Res. Inst., No. 4288.

22,23. **"Venericardia (Pleuromeris) leonensis"** Gardner 74
Right valve; height 1.7 mm.; south of Jewett, Leon Co., Tex. (See Wash. Acad. Sci., vol. 17, 1927, p. 371, figs. 38, 39); here inserted for comparison with Jackson forms.

25,26. **Venericardia parva**, var. 75
Right valve; height 3.5 mm.; more circular in outline than *parva*, *s. s.* (See these Bulletins, vol. 6, pl. 31, figs. 13-16); Vince Bluff, Ark. Pal. Res. Inst., No. 4289.

24,27,28,29. **Venericardia tortidens** Harris 74

24,27. Right valve; height 4 mm.; Lisbon, Ala. form for comparison with small Jackson forms. Pal. Res. Inst., No. 672.

28,29. Left valve; height 5.2 mm.; Lisbon, Ala. Pal. Res. Inst., No. 672a.

EXPLANATION OF PLATE 17

Figure Page

1-3. **Venericardia diversidentata** Meyer 69
1. Left valve; height 22 mm.; a typical, large specimen; north end of freight yard, Jackson, Miss. Pal. Res. Inst., No. 4268.
2. Right valve; height 20 mm.; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4269.
3. Both valves; length 18 mm.; Bunker Hill, La. Pal. Res. Inst., No. 4270.

4, 5a, 6a. **Venericardia rotunda** Lea 69
4. Both valves; length 27 mm.; showing form less gibbous than fig. 3, Claiborne sand at Gosport, Ala. Pal. Res. Inst., No. 4271.
5a, 6a. Right and left hinge; × 2. Claiborne sand, Claiborne, Ala. Pal. Res. Inst., No. 4272.

5, 6. **Venericardia diversidentata** Meyer 69
Right and left hinge; × 2; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4273.

7-9. **Venericardia diversidentata**, vars. 69
7. Right valve; height 16 mm.; a funginid representative of this species (see these Bulletins, vol. 6, pl. 28, fig. 4); Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4274.
8. Right valve; height 16 mm.; a funiculid variety of this species (*ibid.* pl. 28, fig. 6); Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4275.
9. Right valve; height 15 mm.; a funiculid variety suggesting relationship with *carsonensis* as figured by Dall (1903, pl. 56, fig. 9); Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4276.

9a. **Venericardia carsonensis** Dall, var. 69
Left valve; height 15 mm.; showing somewhat thicker ribs than indicated by Dall's figure; Red Bluff Station, Miss.; Oligocene. Pal. Res. Inst. No. 4277.

10-17a. **Venericardia diversidentata**, var. 69-71
10. Right valve; height 20 mm.; representing a form intermediate between fig. 1 and 7; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4278.
11. Right valve; height 14 mm.; a funginid variety approaching *præcisa* Dall. Montgomery, La. Pal. Res. Inst., No. 4279.
12,13. Left valve; height 17 mm.; var. *præcisa* Dall. Montgomery, La. Pal. Res. Inst., No. 4280.
14. Right valve; height 12 mm.; Vince Bluff, Ark. nearly typical *præcisa*. See Dall (1903, pl. 56,

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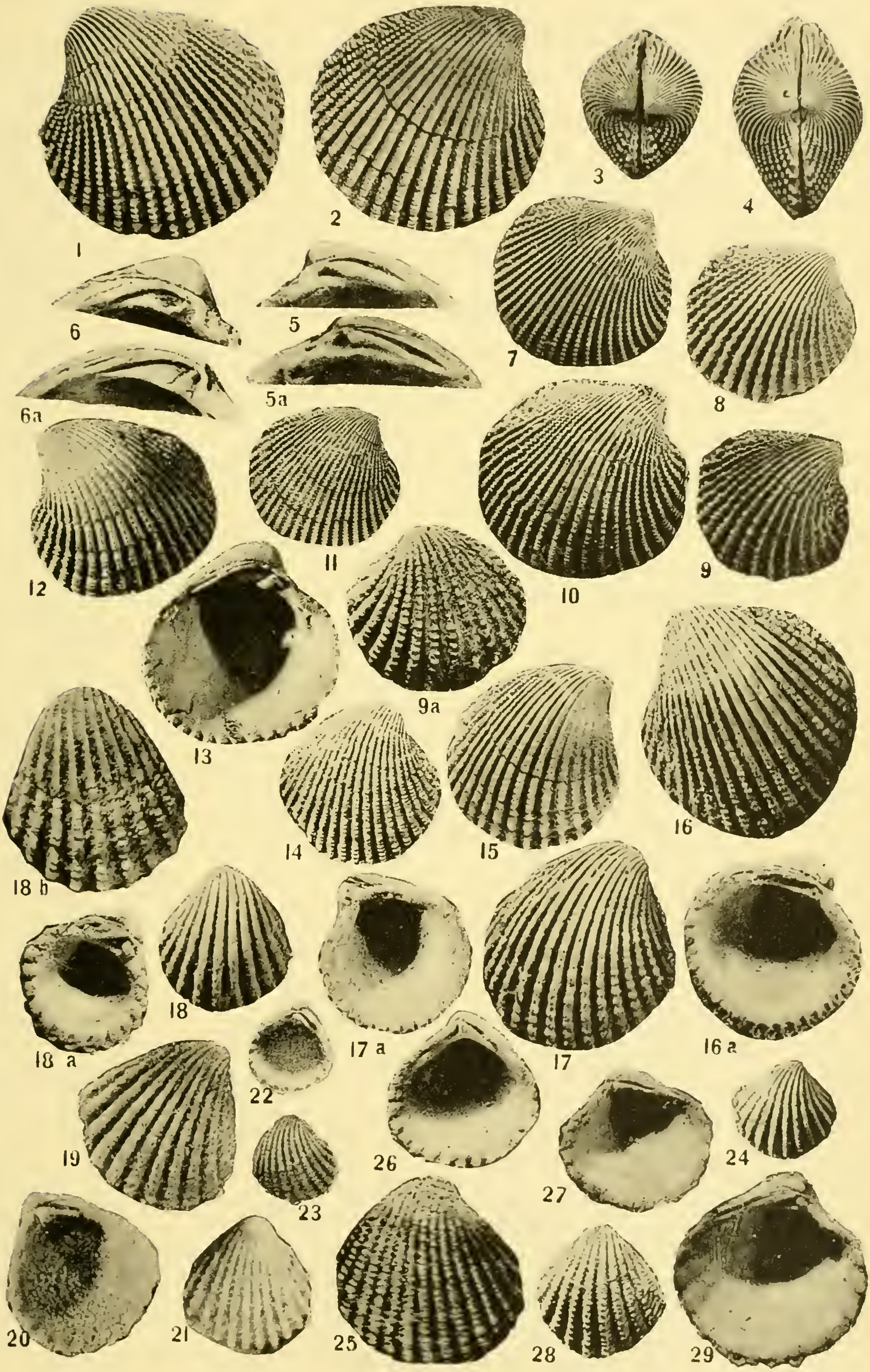
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PLATE 18

22-29. **Crassatella flexura** Conrad ... 81

22,23. Left valve; height 1.8 mm.; young; Sabine River, Robinson's Ferry ?, Tex. Pal. Res. Inst., No. 4302.

24,25. Right valve; height 3 mm.; occurs with 22. Pal. Res. Inst., No. 4303.

26,27. Right valve; height 3.5 mm.; occurs with 22. Pal. Res. Inst., No. 4304.

28. Right valve; height 4.3 mm.; Montgomery, La. Pal. Res. Inst., No. 4305.

29. The variety *producta* Conrad. Left valve, height 8 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4306.

30,31. **Crassatella clarkensis** Dall ... 82

Left valve; height 16 mm.; St. Maurice, La., here inserted for comparison with Jackson forms. Pal. Res. Inst., No. 4307.

32-34. **Crassatella protexta** Conrad ... 82

32. Left valve; height 6 mm.; from the Claiborne "sand" at Gosport 4 miles below Claiborne Bluff, Ala. Pal. Res. Inst., No. 4308.

33. Left valve; height 5 mm.; occurs with 32. Pal. Res. Inst., No. 4309.

34. Right valve, height 20 mm.; adult valve; occurs with 32 and 33. These figures show how the Claiborne sand species are early corrugated but become smooth, especially basally and anteriorly. Many become smooth throughout. Pal. Res. Inst. No. 4309a.

35. **Crassatella flexura** Conrad ... 81

Right valve; height 18 mm.; freight yard, one mile below water works, Jackson, Miss. Specimen with average specific characteristics: beaks less inrolling and less centrally located than in *protexta* but with more general corrugation, beaks less pointed than in *producta* (fig. 36) and less anteriorly located than in some flexuras, (fig. 37). Pal. Res. Inst., No. 4310.

36. **Crassatella flexura, var. producta** Conrad ... 82

Left valve; height 18 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4311.

37. **Crassatella flexura** Conrad ... 82

Right valve; height 21 mm.; Town Branch, Jackson, Miss. Pal. Res. Inst., No. 4312.

38. **Crassatella flexura** Conrad variant ... 82

Both valves; length 35 mm.; Montgomery, La. Pal. Res. Inst., No. 4313.

EXPLANATION OF PLATE 18

Figure	Page
1-5,8-10. Lirodiscus jacksonensis Meyer	77

1,2. Right valve; height 10 mm.; showing flattened, smooth beak, close-set and rather regular ribbing, crenate margin and rather prominent muscular scars; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4290.

3,4. Left valve; height 7.5 mm.; showing lack of marginal crenulation, with ribs broad centrally; Vince Bluff, Saline River, Ark. Pal. Res. Inst., No. 4291.

5. Left valve; height 12 mm.; interior of typical form like fig. 1; Gibson Ldg., Ouachita River, La. Pal. Res. Inst., No. 4292.

8. Right valve; height 9 mm.; showing furrowed beak with typical concentric marking below; Saline River, Ark. Pal. Res. Inst., No. 4293.

9,10. Left valve; height 5 mm.; smooth beak with typical concentric marking below; Robinson's Ferry, Sabine River, Tex. Pal. Res. Inst., No. 4294.

6,7. Lirodiscus tellinoides Conrad ... 78

6. Left valve; height 11 mm.; exterior of same shell shown as fig. 9, pl. 32, vol. 6 these Bulls.; showing how some short forms of the Claiborne sand superficially resemble *jacksonensis* as well as *smithvillensis*; Claiborne, Ala. Pal. Res. Inst., No. 686.

7. Right valve; height 11.5 mm.; var. *scutellaria*, n. var.; "*Scutella* bed" just above the Claiborne "sand," Claiborne, Ala. Pal. Res. Inst., No. 4295.

11-14. Astarte triangulata Meyer ... 76

11,12. Left valve; 9 mm. high; 3 miles west of Grove Hill, Ala; uppermost Jackson horizon. Pal. Res. Inst., No. 4296.

13. Left valve; height 10 mm.; variety, large, thin and not strongly corrugated; 1 mile south of Melvin, Ala. Pal. Res. Inst., No. 4297.

14. Left valve; height 8 mm.; Red Bluff, above R. R. bridge north of Hiwannee Station; typical Red Bluff Oligocene. Pal. Res. Inst., No. 4298.

15,16. Astarte, sp.

Right valve; height 5 mm.; from Montgomery, La. Pal. Res. Inst., No. 4299.

17,18. Crassinella pygmæa Conrad ... 79

Left valve; height 2.4 mm.; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4300.

19. **"Micromeris senex"** Meyer ... 78

Left valve; height 1.8 mm.; doubtful Jackson form; see page 78.

20,21. Crassatella, sp. indent.

Left valve; height 6 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4301.

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PLATE 19

19-23. **Lucina curta** Conrad 89

19. Right valve; height 7.3 mm.; showing obliquely truncated posterior and fine, concentric markings; Jackson, Miss. Pal. Res. Inst., No. 4325.
20. Right valve; height 6 mm.; showing postumbonal marginal serration; Jackson, Miss. Pal. Res. Inst., No. 4326.
21. Exterior of fig. 20, enlarged, showing details of markings.
22. Hinge of left valve, enlarged; Jackson, Miss. Pal. Res. Inst., No. 4327.
23. Cardinal view enlarged, showing position of spinose growths; Jackson, Miss. Pal. Res. Inst., No. 4328.

EXPLANATION OF PLATE 19

Figure Page

(*Continued on previous page*)

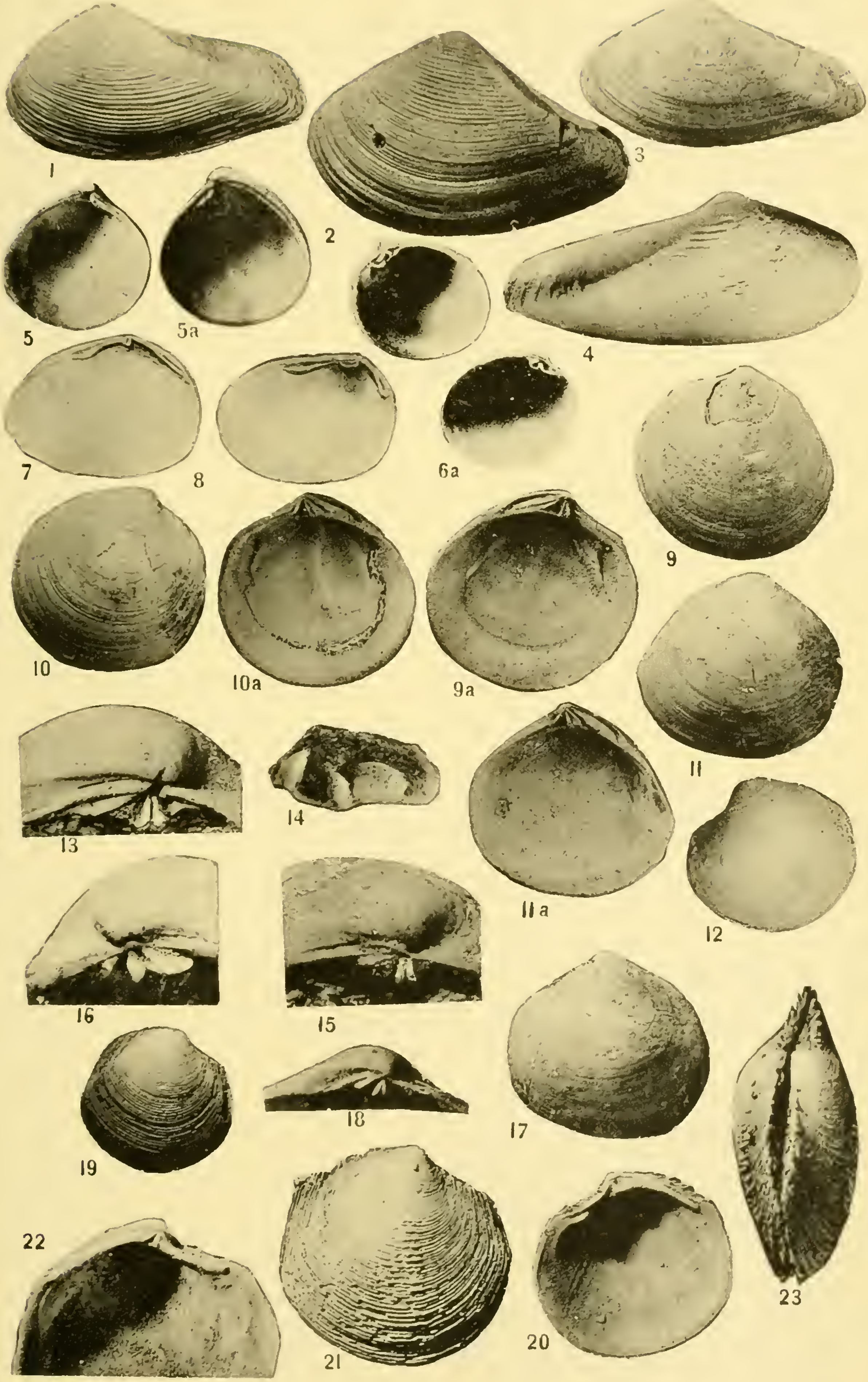
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PLATE 20

20,21. **Protocardia diversa** Conrad

20. Left valve; about natural size; slightly distorted but showing different form and markings from *nicolletti;* Vicksburg Oligocene. Pal. Res. Inst., No. 4344.

21. Figure showing markings on lower portion of umbonal ridge of fig. 20. Compare with the St. Maurice fig. 22 and the Jackson fig. 19.

22. **Protocardia harrisi** Dall 93

Small area corresponding with figs. 19 and 21 of the specimen shown, same specimen as shown by fig. 6, pl. 42, vol. 6, Bull. Amer. Pal. Pal. Res. Inst., No. 1174.

EXPLANATION OF PLATE 20

Figure Page

1-5. **Lucina (Myrtea ?) subcurta**, n. sp. 89

1. Left valve; height 5.2 mm.; holotype; Jackson, Miss. Pal. Res. Inst., No. 4329.
2. Right valve; height 5.5 mm.; Jackson, Miss. Pal. Res. Inst., No. 4330.
3. Right valve; height 3 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4331.
4. Left valve; height 2.9 mm.; Jackson, Miss. Pal. Res. Inst., No. 4332.
5. Both valves; young, × 8; Jackson, Miss. Pal. Res. Inst., No. 4333.

6-7. **Lucina (Eophysema) ozarkana** ? Harris 90

6. Left valve; height 9 mm.; Gibson Landing, Ouachita River, La. Pal. Res. Inst., No. 4334.

6a. Hinge of the right valve, magnified; Jackson, Miss. Pal. Res. Inst., No. 4335.

7. Hinge of the left valve, magnified; Jackson, Miss. Pal. Res. Inst., No. 4336.

8. **Lucina subvexa** Conrad, type of s. gen. **Eophysema** 90

Collection of the Phila. Acad. Nat. Sci.; Claiborne. Ala. Pal. Res. Inst., No. 4337. (pencil sketch)

9-13. **Lucina gaufia**, n. sp. 91

9. Right valve; height 17 mm.; holotype; showing remarkable area behind umbonal ridge and lunular alation; hereby differing from *claibornensis* Con. (pl. 39, fig. 8, these Bulletins, vol. 6); uppermost Claiborne sand horizon at Gopher Hill, above St. Stephen's Bluff, Ala. Pal. Res. Inst., No. 4338.

10 Interior of fig. 9, less enlarged.

11,12. Right valve; height 16.5 mm.; Montgomery, La. Pal. Res. Inst., No. 4339.

13. Left valve; height 29 mm.; large eroded valve probably of this species; Garland Creek, Miss. Pal. Res. Inst., No. 4340.

14,15. **Chama mississippiensis** ? Conrad 92

Attached valve; height 12 mm.; quite probably of this species; Montgomery, La. Pal. Res. Inst., No. 4341.

16-19. **Protocardia nicolletti** (Conrad) 92

16,17. Right valve; height 38 mm.; typical specimen; Jackson, Miss. Pal. Res. Inst., No. 4342.

18. Left valve; height 32 mm.; showing perfect pustules at base of umbonal ridge, as shown (magnified 8 times) in fig. 19. Pal. Res. Inst.. No. 4343.

19. Magnified portion of fig. 18.


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PLATE 21

15-18. **Tellina linifera** Conrad 99

15. Right valve; length 19 mm.; adult; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4357.

16. Left valve; length 19 mm.; Montgomery, La. Pal. Res. Inst., No. 4358.

17. Right valve; length 16.5 mm.; Montgomery, La. Pal. Res. Inst., No. 4359.

18. Left valve; length 11 mm.; showing blunt posterior end and clear-cut markings on young individual; Garland Creek, Miss. Pal. Res. Inst., No. 4360.

19,20. **Tellina eburneopsis** Conrad 100

19. Right valve; length 40 mm.; Bunker Hill, La. Pal. Res. Inst., No. 4361.

EXPLANATION OF PLATE 21

Figure	Page

1-3. Pitar securiformis (Conrad) 94

1. Right valve; height 34 mm.; typical form; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4345.
2. Right valve; height 28 mm.; showing dentition and pallial sinus; Jackson, Miss. Pal. Res. Inst., No. 4346.
3. Left valve; height 29 mm.; Jackson, Miss. Pal. Res. Inst., No. 4347.

4-5. Pitar trigoniata (Lea) 95

Right valve; height 32 mm.; rather large robust specimen from Crow Creek, near Forrest City, Ark. Pal. Res. Inst., No. 4348.

6-9. Callista annexa (Conrad) 95

6. Left valve; height 23 mm.; topotype; Garland Creek, north of Shubuta; Miss. Pal. Res. Inst., No. 4349.
7. Left valve; height 20 mm.; showing form of pallial sinus; Garland Creek, Miss. Pal. Res. Inst., No. 4350.
8. Right valve; height 22 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4351.
9. Left valve; height 18 mm.; var. *pearlensis* Harris. Pal. Res. Inst., No. 4352.

9a. "Venus" jacksonensis Meyer 96

Right valve; length 4.5 mm.; a form of uncertain affinities; figure from Meyer; said to be from Jackson, Miss.

10-11. Gari eboreum (Conrad) 97

Claiborne sand specimen, the same as figured in vol. 6, these Bulls., pl. 48, figs. 8 and 10 showing some additional details; here inserted for comparison with Jackson specimens. Pal. Res. Inst., No. 1204, 1206.

12-14. Gari jacksonense, n. sp. 97

12. Left valve; length 30 mm.; slightly wider than Claiborne specimens; Montgomery, La. Pal. Res. Inst., No. 4353.
13. Left valve hinge; × 6; Montgomery, La. Pal. Res. Inst., No. 4354.

13a. Left valve hinge enlarged; *G. ozarkanum* Harris. Sabine Eocene. Pal. Res. Inst., No. 4355.

14. Right valve hinge; × 6; Montgomery, La. Pal. Res. Inst., No. 4356.

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PLATE 22

22-24. **Abra nitens** Lea, var. **jacksonica**, n. var. 105
22. Right valve; length 11.6 mm.; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4380.
23. Hinge of fig. 22 magnified.
24. Hinge of a left valve, magnified, Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4381.

EXPLANATION OF PLATE 22

Figure	Page

1-3. Tellina trumani, var. garlandica, n. sp. 100
Left valve; length 9 mm.; exterior, interior, and hinge enlarged, Garland Creek, Miss. Pal. Res. Inst., No. 4363.

4-8. Tellina vickburgensis, var. moodiana Cooke 101
4. Left valve; length 10 mm.; typical form; Jackson, Miss. Pal. Res. Inst., No. 4364.
5. Right valve; length 6 mm.; Jackson, Miss. Pal. Res. Inst., No. 4365.
6. Right valve; length 9.5 mm.; enlarged to show surface markings; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4366.
7. Left valve; × 5; Jackson, Miss. Pal. Res. Inst., No. 4367.
8. Right valve; × 6; Jackson, Miss. Pal. Res. Inst., No. 4368.

9-12. Tellina vicksburgensis Conrad 102
9. Right valve; length 5 mm.; typical small, low form of the species; Oligocene of Vicksburg, Miss. Pal. Res. Inst., No. 4369.
10. Interior of fig. 9.
11. Left valve; length 6 mm.; higher form, Oligocene of Vicksburg, Miss. Pal Res. Inst., No. 4370.
12. Interior of fig. 11.

13-17. Tellina vaughani Cooke 102
13. Left valve; length 13 mm.; Moodys Branch, Miss. Pal. Res. Inst., No. 4371.
14. Interior of fig. 13.
15. Hinge of fig. 13 enlarged.
16. Hinge of right valve. × 5; uppermost Claiborne sand, Gopher Hill, above St. Stephens, Ala. Pal. Res. Inst. No. 4372.
17. Right valve; length 15 mm.; a varietal form with broadly rounded posterior; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4377.

18. Tellina ? pearlensis Meyer 104
Left valve; length 4 mm.; copy of Meyer's figure; Moodys Branch, Jackson, Miss.

19. Tellina raveneli, var. weisbordi, n. var. 104
Both valves; showing left only; length 29 mm.; Montgomery, La. Pal. Res. Inst., No. 4378.

20. Tellina spillmani Conrad 105
Copy of Conrad's illustration; Am. Jour. Conch., vol. I, pl. 11, fig. 7. Conrad's "Enterprise" locality, Miss.

21. Tellina spillmani Conrad, var. **corvia,** n. var. 105
Right valve; length 18 mm.; Crow Creek, near Forrest City, Ark. Pal. Res. Inst., No. 4379.

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PLATE 23

19-21. **Periploma collardi**, var. **turgida**, n. var. 110

19. Both valves, length 51 mm.; cast, slightly distorted; Crow Creek, near Forrest City, Ark. Pal. Res. Inst., No 4393.

20. Dorsal view of fig. 19.

21. Ventral view, fig. 19; curvature of ventral line due to slight distortion.

22. **Periploma collardi ?** var. 110

View from within, both valves, magnified, showing clavicular ribs, and large lithodesma; White Bluff, Ark. Pal. Res. Inst., No. 4394.

23. **Verticordia (Trigonulina) cossmanni** Dall 112

Interior of left valve; length 1.5 mm.; reproduction from Cossmann; from Jackson, Miss.; Cossmann's cabinet.

24. **Verticordia eocensis** Langdon 111

Exterior of the specimen figured in Bull. Amer. Pal., vol. 6, pl. 55, fig. 13 showing imperfectly preserved ribbing which indicates that in well-preserved specimens the ribs are serrately carinate; Claiborne sand, Ala. Pal. Res. Inst., No. 4395.

25. **Verticordia (Trigonulina) dalliana** Aldrich 112

Reproduction of Aldrich's figure; length 2.5 mm.; lower Oligocene, Red Bluff, Miss. Specimen at Johns Hopkins Univ. Mus.

26. **Verticordia (Trigonulina) dalliana** var. 112

Interior of an imperfect specimen, 2 mm. in length; showing characteristic large subcentral rib and broad interspaces; Bunker Hill on Ouachita River, La. Pal. Res. Inst., No. 4396.

27. **Corbula (Aloidis) wailesiana** (Harris in Dall) 113

Right valve; length 14 mm.; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4397.

28. Reverse of fig. 27; shell inclined forward, towards the observer, hence left valve vertically foreshortened; beaks decorticated; Montgomery, La.

EXPLANATION OF PLATE 23

Figure Page

1. **Spisula prætenuis** (Conrad) 106
   Right valve; height 27 mm.; Montgomery, La. Pal. Res. Inst., No. 4382.

2. **Spisula mississippiensis** (Conrad) 106
   Reproduced from fig. 7, pl. 18, Acad. Nat. Sci. Phila., Proc. 1896; specimen from Jackson, Miss. now in the Academy's collection.

3-6. **Spisula parilis** (Conrad) 106
   3. Right valve; height 8 mm.; Claiborne sand species here introduced for comparison with Jackson specimens. Pal. Res. Inst., No. 4383.
   4. Hinge of fig. 3 enlarged.
   5. Left valve; height 6.2 mm.; Claiborne sand. Pal. Res. Inst., No. 4384.
   6. Hinge of left valve enlarged; Claiborne sand. Pal. Res. Inst., No. 4385.

7-10. **Spisula jacksonensis** Cooke 107
   7. Left valve; height 6 mm.; Jackson, Miss. Pal. Res. Inst., No. 4386.
   8. Right valve. Enlarged hinge. Pal. Res. Inst., No. 4387.
   9. Left valve; height 7 mm.; Garland Creek, Miss. Pal. Res. Inst., No. 4388.
   10. Hinge of fig. 9 enlarged.

11,12. **Spisula albirupina** (Harris) 109
   11. Right valve; length 7.2 mm.; showing pallial sinus and hinge characters; White Bluff, Ark. Pal. Res. Inst., No. 4389.
   12. Right valve; length 9 mm.; showing common form of adult specimen; White Bluff, Ark. Pal. Res. Inst., No. 4390.

13-15. **Spisula funerata** (Conrad) 108
   13. Left valve; length 7 mm.; showing general characters of this Vicksburg Oligocene species for comparison with Jackson forms. Pal Res. Inst., No. 4391.
   14. Hinge of fig. 13 enlarged.
   15. Exterior of Vicksburg *funerata* showing triangular outline and corbuloid appearance. Pal. Res. Inst., No. 4392.

16-18. **Periploma claibornensis, var. parva** ? Meyer 109
   16. Right valve; natural size; showing exterior markings; reprint from fig. 8, pl. 18, Acad. Nat. Sci. Phila., Proc., 1896, in Academy collection; from Jackson, Miss.
   17. Interior of fig. 16.
   18. Enlargement of hinge of fig. 17.

18a. **"Periploma complicata"** Meyer 110
   Length 8 mm.; seemingly a pathologic specimen of uncertain specific relationship; Claiborne sand, Claiborne, Ala.

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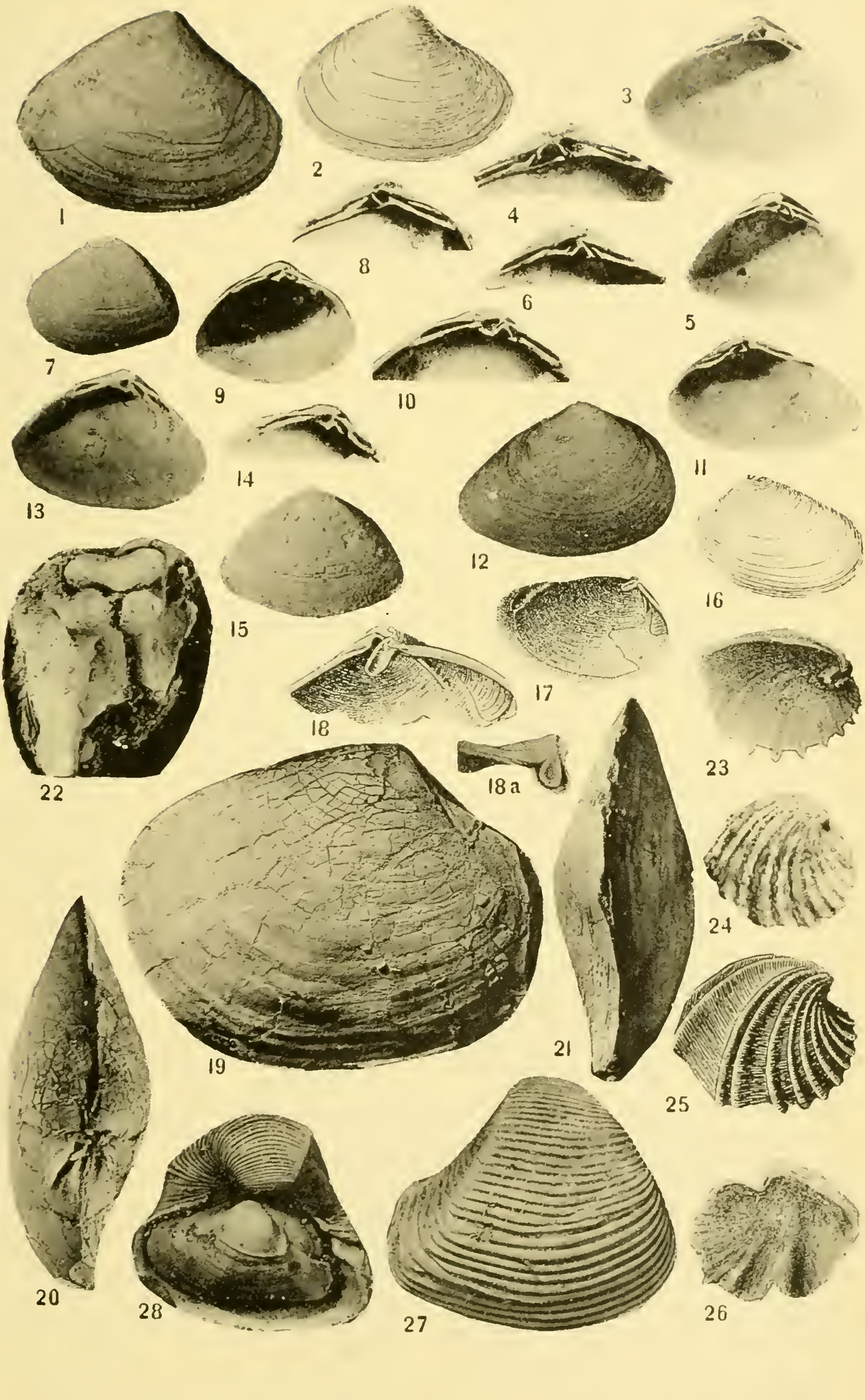
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PLATE 24

16. **Corbula alabamiensis** Lea 115
Left valve; length 8 mm.; here introduced to show relationship to *densata*. Claiborne sand, Claiborne, Ala. Pal. Res. Inst., No. 4412a.

17-21. **Corbula densata** Conrad 115
17. Left valve; length 6.5 mm.; young; more common at Garland Creek than larger specimens but seemingly of the same species. Pal. Res. Inst., No. 4413.
18. Left valve; length 8 mm.; remarks as under fig. 17. Pal. Res. Inst., No. 4414.
19. Right valve; length 9 mm.; medium size; somewhat eroded; Jackson, Miss. Pal. Res. Inst., No. 4415.
20. Both valves; showing right only; length 13 mm.; liræ well preserved; Montgomery, La. Pal. Res. Inst., No. 4416.
21. Right valve; length 4.5 mm.; young; Montgomery, La. Pal. Res. Inst., No. 4417.

22-25. **Corbula willistoni** Meyer 116
22. Right valve; length 11 mm; short form from Sims Siding above Yazoo City, Miss. Pal, Res. Inst., No. 4418.
23. Right valve; length 14.5 mm.; typical form; Crow Creek, Ark. Pal. Res. Inst., No. 4419.
24. Right valve; length 11 mm.; pointed form; Sims Siding, Miss. Pal. Res. Inst., No. 4420.
25. Left valve; length 11 mm.; Sims Siding, Miss. Pal. Res. Inst., No. 4421.

26-28. **Corbula willistoni arkansia,** n. var. 116
26. Both valves; length 14 mm.; with general *densata* aspect but more gibbous and with posterior extension of right valve; White Bluff on the Arkansas River, Ark. Pal. Res. Inst., No. 4422.
27. Dorsal view of fig. 26.
28. Right valve; length 12 mm.; posterior extension broken off; Bayou Toro, western La. Pal. Res. Inst., No. 4423.

EXPLANATION OF PLATE 24

Figure — Page

1,3-5,7,8. **Corbula wailesiana** Harris in Dall 113

1. Right valve; × 4; showing umbonal characteristics; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4398.
3. Dorsal view of both valves, × 4; left valve not decorticated in young stage as is usually the case as is shown by fig. 28 of the preceding plate; Montgomery, La. Pal. Res. Inst., No. 4399.
4. Left valve; length 8 mm.; elongate form with indistinct radial markings; Montgomery, La. Pal. Res. Inst., No. 4400.
5. Left valve; length 8.2 mm.; form approaching left valve of *murchisoni;* Montgomery, La. Pal. Res. Inst., No. 4401.
7. Right valve; length 5 mm.; small variety showing slight umbonal carination; ravine back of Bunker Hill Bluff, La. Pal. Res. Inst., No. 4402.
8. Both valves; length 6 mm.; showing characters of this small variety; Bayou Toro, La. Pal. Res. Inst., No. 4403.

2,6. **Corbula murchisoni** Lea 114

2. Claiborne sand specimen from Claiborne, Ala. here introduced for comparison with fig. 1, Jackson *wailesiana*; note heavy liration, sharp carination, but without down-dipping of liræ over umbonal ridge, and with faint liræ postumbonally. Pal. Res. Inst., No. 4404.
6. Left valve; length 6 mm.; Claiborne sand specimen here introduced for comparison with figs. 4 and 5. Pal. Res. Inst., No. 4405.

9,10. **Corbula "perdubia"** of authors 114

9. Both valves; length 4 mm.; here introduced to show the difference between this and the small variety of *wailesiana* (fig. 8); Red Bluff, Oligocene. Pal. Res. Inst., No. 4406.
10. Right valve; length 4.5 mm.; Hiwannee (Red Bluff Sta.) Miss. Compare with fig. 7, small form of *wailesiana*, Jacksonian. Pal. Res. Inst., No. 4407.

11-15,17-21. **Corbula densata** Conrad 115

11. Right valve; length 17.4 mm.: a characteristic adult form; Jackson, Miss. Pal. Res. Inst., No. 4408.
12. Left valve; length 16 mm.; typical adult, Jackson, Miss. Pal. Res. Inst., No. 4409.
13. Both valves; length 18 mm.; valves never disunited; Claiborne sand, Claiborne, Ala. Pal. Res. Inst., No. 4410.
14. Right valve; length 16 mm.; thickening somewhat pathologic. giving meaning to the term "*densata*"; Moodys Branch, Jackson, Miss. Pal. Res. Inst., No. 4411.
15. Right valve; length 15 mm.; thin, elongate form; Crow Creek, Ark. Pal. Res. Inst., No. 4412.

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PLATE 25

EXPLANATION OF PLATE 25

Figure | Page

1,2. Corbula pearlensis Meyer 117

1. Left valve; height 3.7 mm.; showing smooth umbo and faint lirations below; Town Creek, Jackson, Miss. Pal. Inst., No. 4424.
2. Umbo of fig. 1 enlarged 4 diameters.

3-5. Poromya mississippiensis Aldrich and Meyer 118

3. Right valve; height 6 mm.; Jackson, Miss. Pal. Res. Inst., No. 4425.
4. The same, left hinge magnified. Pal. Res. Inst., No. 4426.
5. The same, right hinge magnified.

6. Panopea oblongata Conrad 119

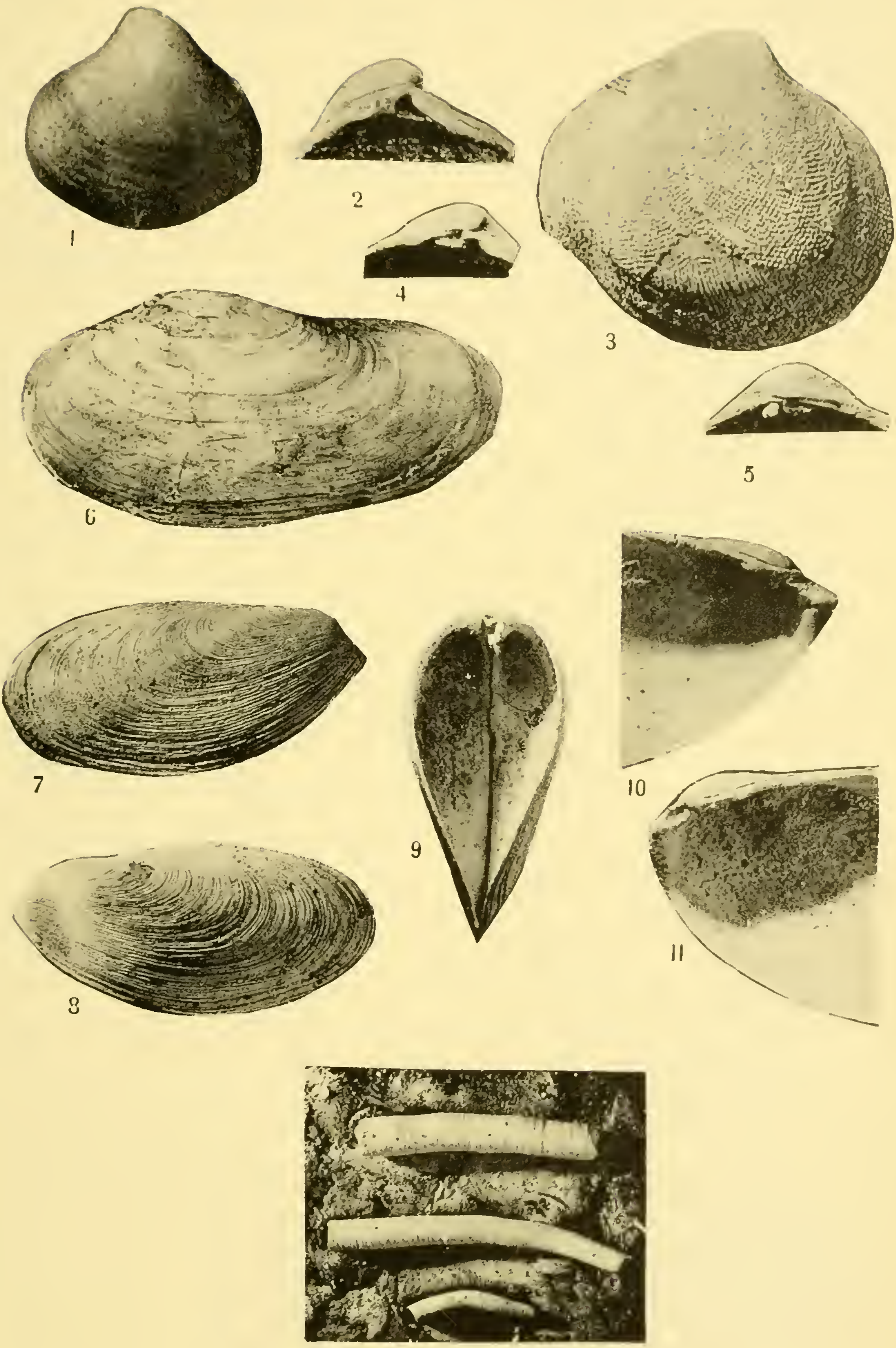
Left valve; length 71 mm.; specimen showing nearly the true form of the species; specimens generally considerably distorted; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4427.

7-11. Gastrochæna mississippiensis, n. sp. 120

7. Right valve; length 32 mm.; Town Creek, Jackson, Miss. Pal. Res. Inst., No. 4428.
8. The same, left valve. Pal. Res. Inst., No. 4429.
9. The same viewed from below.
10. Left beak, enlarged.
11. Right beak, enlarged.

12. Teredo mississippiensis Conrad 120

Tubes from Town Creek, Jackson, Miss. of lengths 19, 35, and 43 mm. respectively. Pal. Res. Inst., No. 4430.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THE MOLLUSCA OF THE JACKSON EOCENE OF THE MISSISSIPPI EMBAYMENT (SABINE RIVER TO THE ALABAMA RIVER)

By

Gilbert D. Harris
and
Katherine VanWinkle Palmer

SECOND SECTION

INCLUDING PART II, UNIVALVES AND INDEX

February 6, 1947

Palæontological Research Institution
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NOTE

The discussion of *Teinostoma* and its two species (pp. 221-223) should be placed between *Tornus* and *Circulus* (Cyclostrematidæ) p. 231.

PART II. UNIVALVES

By

KATHERINE VAN WINKLE PALMER

SYSTEMATIC DESCRIPTIONS

Phylum **MOLLUSCA**

Class **SCAPHOPODA**[1]

Family **DENTALIIDÆ**

Linnæus, Systema Naturæ, ed. X, 1758, p. 785.

Genus **DENTALIUM**[2] Linnæus, 1758

Genotype by subsequent designation, Montfort (Conchyliol. Syst., 1810, t. 2, p. 23). *Dentalium elephantinum* Linnæus (*loc. cit.*) Living. Amboyna and Philippine Islands. Pilsbry and Sharp, Manual Conch., vol. XVII, 1897, pl. 1, figs. 1-7.

Subgenus **ANTALIS** H. and A. Adams, 1854

(*Entalis* Gray, 1847: *Entaliopsis* Newton and Harris, 1894)

H. and A. Adams, Genera Recent Mollusca, vol. 1, 1854, p. 457. See Pilsbry and Sharp, Manual Conch., vol. XVII, 1897, pp. 37, 42, pl. 8, fig. 25.

Subgenotype by subsequent designation, Pilsbry and Sharp (*op. cit.*, p. 37), *Dentalium entalis* Linnæus (1758, p. 785). Recent. Spitzbergen, Iceland, Scandinavia, and Atlantic Coast of Europe.

Many of the Claibornian and Jacksonian Dentalia which I have placed in *Antalis* are more coarsely sculptured than typical and suggest in appearance *Dentalium, s. s.* The specimens exhibit apical notches the character of which has influenced me in placing the species in *Antalis*. Probably they do not belong, strictly speaking, in that group.

Dentalium (Antalis) vincense, n. sp. Plate 26, figs. 29-31

Shell medium, slightly ovate; tapering, somewhat curved; shape of the aperture presents the impression that they are round; surface with microscopic sharp longitudinal striations, interspaces equal to or slightly less than the striations.

The longitudinal striations are so fine that they may become obliterated, hence, there are many smooth shells belonging to this species. Many such shells if found by themselves would be determined as representatives of a smooth-shelled form. The collection from the type locality includes over 100 fragments so that different stages between striated and worn shells may

[1] Pilsbry, H. A., and Sharp, B.: Manual Conch., vol. XVII, 1897-98 true dates of publication, p. 348; Henderson, J. B., U. S. Nat. Museum, Bull. 111, 1920.

[2] *Dentalium* placed on Official List of Generic Names, Sum. Opinion Rend., No. 94, Inter. Rules Zool. Nomen., Smithsonian Misc. Coll., vol. 73, No. 4, 1926, p. 12; Schenk and McMasters, Procedure in Taxonomy, [1936], p. 53.

be observed. Because of the similarity in size and general shape of the smooth specimens found at White Bluff, Arkansas, I have included them under this species. Some of the White Bluff individuals, when examined under the microscope, show obliterated striations.

This species may be differentiated from *D. minutistriatum* Gabb (1860, p. 386, pl. 67, fig. 46; Palmer, 1937, p. 17, pl. 2, figs. 33-36, 38, 41) of the lower Claiborne Eocene by the finer striations with larger interspaces. *D. vincense* does not show the microscopic annulations which are seen commonly on specimens of *D. minutistriatum*. Only one specimen in over 100 shells of *D. vincense* possessed the annulations.

Dimensions.—Length, 17 mm.; greatest diameter, 2.5± mm. (fragment).

Types.—Holotype, No. 4468; paratypes, No. 4469, 4470, Paleontological Research Institution.

Occurrence.—Jackson of Arkansas, localities 897 (type); 896.

Dentalium (Antalis) minutistriatum Gabb Plate 26, fig. 28

Dentalium minutistriatum Gabb, 1860, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. IV, p. 386, pl. 67, fig. 46.

For synonymy and discussion see Palmer, 1937, Bull Amer. Paleont., vol. VII, No. 32, p. 17, pl. 2, figs. 33-36, 38, 41.

This species is a widely distributed and characteristic lower Claiborne form. Mention has been made by the author in the Claiborne bulletin of the meagre data regarding its occurrence in the Gosport sand.

In the Veatch collection from Montgomery, Louisiana, there are several typical specimens of *D. minutistriatum*. There is the possibility that the collection may have been mixed and the specimens belong in a lower horizon than the Jackson.

Dimensions.—Greatest diameter, 2.5 mm. (fragments).

Occurrence.—Lower Claiborne, Crockett (Cook Mountain) formation, Wheelock, Texas (type). Gosport sand. Jackson, Moodys Branch marl, locality ? 10.

Dentalium (Antalis) danvillense, n. sp. Plate 26, figs. 23-27

Shell medium in size; apical end with nine, sharp longitudinal, primary ribs with wide interspaces; several millimeters anteriorly, varying with individuals, a set of secondary ribs occurs irregularly, such ribs increase anteriorly, becoming equal in size with the primary ribs; about midlength of the shell tertiary ribs develop which extend irregularly both in size and length. The longitudinal ribs have a tendency to become obscure or obsolete in the last stages of growth so that the anterior end of mature and senile specimens is usually smooth. An immense sheath is present and there is an apical notch on the convex side. The outer layer of shell is thick but this species does not shed the outer layer, leaving a smooth inner tube which is a common structure of *D. thalloides* Conrad of the Claibornian. Only two or three examples of the worn tube of specimens of *D. danvillense* have been found.

This species is very abundant in the slumped bank at Danville Landing, Ouachita River, Louisiana, and occurs commonly at Carter Landing on the same river. The collection studied represents over 590 fragments of A. C. Veatch's collection of 1899 from Danville Landing and over 625 of the Harris and Palmer material of 1938 from the same locality. In a group of over 60 apical points all had nine primary ribs, except three specimens which had 8, 10, 11 primary ribs, respectively, indicating that a certain allowance must be made for some variation.

The species may be separated from *D. thalloides* Conrad of the Claibornian by *D. danvillense* having nine apical ribs instead of eight and by the ribs becoming more equalized in size anteriorly. In *D. thalloides* the ribs tend to remain differentiated in size.

D. danvillense differs from *D. mississippiense* Conrad of the Vicksburg Oligocene and probably Jackson Eocene in that *D. mississippiense* has commonly 12 primary ribs instead of 9, and the ribs on *D. mississippiense* do not die out in the anterior-most part of the shell in mature and old age specimens. *D. danvillense* does not attain the large size of *D. mississippiense*. Large specimens of *D. mississippiense* commonly have an anterior diameter of 6 mm. and may be 10 to 20 mm. longer than *D. danvillense*. The shell of *D. danvillense* has a slender appearance. However, isolated fragments of the midregion of the shells of the two species may be readily confused. Both have in that area about the same number of ribs which tend to equalize but which include ribs irregular in size.

Dimensions.—Length (chord subtending the arc), 38 mm.; apical diameter, 1 mm.; anterior diameter, 4 mm.

Types.—Holotype, No. 4472; paratypes, Nos. 4473-76, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 1051. Danville Landing beds, localities Nos. 6 (type), 886; 20; 1020.

Dentalium (Antalis) mississippiense jacksonense, new var.

Plate 26, figs. 20-22

Shell large; a thin inner sheath present with an apical notch on the convex side; apical end with 9 to 12 primary ribs; anteriorly, a secondary and tertiary set of ribs are intercalated which tend to equalize, but the primary ribs usually, as in *D. danvillense*, are slightly the most conspicuous. In old specimens the ribs may become obscure and the surface smooth. In that respect the form is more like *D. danvillense* than *D. mississippiense* but it shows a greater relationship with the Vicksburg species in size and in the tapering of the shell. In the *D. mississippiense* stock, the increase in diameter is greater in proportion to the length.

This form has not been found in the quantity of individuals as was *D. danvillense* at its type locality. The geographic extent of *D. jacksonense* is greater than *D. danvillense*. Probably on account of its large size and the equalization of the ribs in some specimens, though not typically, the shells have been given in lists as *D. mississippiense*.

D. mississippiense Conrad[3] was described from the Vicksburg Oligocene where it is abundant. The development of the species apparently began in the Jackson Eocene. It occurs in the Red Bluff Oligocene at Red Bluff, Mississippi, associated with a species which bears a close affinity to the *D. thalloides-danvillense* group. Casey[4] described four species of *Dentalium* from the Oligocene. These species as yet have never been figured.

Dimensions.—Length (chord subtending the arc), 63 mm.; apical diameter, 2 mm.; anterior diameter, 6.75 mm.

[3] Conrad, T. A.: Acad. Nat. Sci. Philadelphia, Proc., vol. III, 1847, p. 282; *ibid.*, Jour., 2d ser., vol. I, 1848, p. 112, pl. 11, fig. 1.

[4] Casey, T. L.: Acad. Nat. Sci. Philadelphia, Proc., vol. LV, 1903, pp. 266-267.

Types.—Holotype, No. 4477; paratypes, No. 4478 and 4479, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities, Jackson, Miss., 693 (type), 785, 786, 787, 879, 881 921, 1051; 900; 883; 1121; 1, 1119; 7, 8, 912. Lower Yazoo clay, locality 915.

Dentalium, sp. Plate 26, fig. 19

Fragments of a *Dentalium*, which bear a resemblance to *D. danvillense* in that the primary ribs remain slightly differentiated from the remainder of the ribs after the surface of the shell becomes covered with intercalated ribs, have been found at several localities. On this form the longitudinal ribs become obsolete more rapidly than on *D. danvillense* so that most of the shell is smooth with patterns of decoration microscopically developed. The sculpture differs from *D. minutistriatum* in that the primary ribs are conspicuous. In *D. minutistriatum* the ribs are microscopic but equally developed. Both forms commonly become smooth. In the Red Bluff Oligocene there is a species which also has the prominent primaries. The shell of the Red Bluff species may become smooth with senility.

Dimensions.—Length, 26.4 mm.; greatest diameter, 3.4 mm.

Specimen figured.—No. 4480, Paleontological Research Institution.

Occurrence.—Jackson Eocene of Arkansas, locality 807; Jackson Eocene, St. Stephens Bluff, Lone Star Cement Corp. quarry, Tombigbee, R., Ala.

Subgenus **LÆVIDENTALIUM** Cossmann, 1888

Cossmann, Ann. Soc. roy. malac. Belgique, t. XXIII, 4th. ser., t. III, 1888, p. 7 as a section.

Subgenotype by original designation, *Dentalium incertum* Deshayes (Anat. et Mon. genre Dentale, 1825, p. 42, pl. 3, fig. 17). Eocene. Paris Basin. Deshayes, Desc. An. sans Vert., t. II, 1864 [1861], p. 202, pl. 1, figs. 26, 27; Cossmann and Pissarro, Icon. comp. Coq. foss. Eocene Env. Paris, t. 2 1910-13, pl. 1, figs. 1-3.

Dentalium (Lævidentalium) danai Meyer Plate 26, figs 12, 13, 18

Dentalium Danai Meyer, 1885, Am. Jour. Sci., vol. XXIX, pp. 462, 468; Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 64, pl. 3, figs. 2, 2a; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, pp. 438, 439 (*partim*); Pilsbry and Sharp, 1898, Manual Conch., vol. XVII, p. 202; de Gregorio, 1890, Ann. Géol. Paléont., 8 liv., p. 172 under ? *D. turritum* Lea; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 19 *Lævidentalium*.

Non Dentalium danai Martin, 1904, Maryland Geol. Survey, p. 272, pl. LXIV, fig. 4.

Smooth, section circular; smaller aperture with additional tube; margin distinctly notched on the convex side of the shell; slightly emarginate on the concave side.

Locality.—Jackson, Miss.

The preceding species [*D. leai*] is notched distinctly on both sides of the margin of the aperture.—[Meyer, 1886.]

There are in the Jackson Eocene many specimens of a smooth *Dentalium* with a round aperture which may not be accounted for as the smooth interior of a sculptured species. Whether they should be included under *D. danai* is still a question, for the specimens of Dentalia in our collections are medium-sized individuals while the types of the three Lævidentalia described by Meyer (as *Dentalium*) are very small.

Dentalium arciforme Conrad (*D. leai* Meyer; see Palmer, 1937, p. 16) may be a representative in the Gosport sand of *Lævidentalium* with a round aperture.

The *Dentalium* in the Maryland Miocene which Martin (1904) identified as *D. danai* Meyer can be readily distinguished from the Jackson species. *D. danai* is a smooth form and smaller than the *Dentalium* at Plum Point, Maryland. The latter requires a new name.

Dimensions.—Length, 5 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type): localities ? 699; ? 10. Lower Yazoo clay, locality ? 910.

Dentalium (Lævidentalium) subcompressum Meyer Plate 26, figs. 6, 15

Dentalium subcompressum Meyer, 1885, Am. Jour. Sci., vol. XXIX, pp. 462, 468; Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 64, pl. 3, figs. 3, 3a; Meyer, 1887, Acad. Nat. Sci. Philadelphia, Proc., vol. 39, p. 54, pl. III, figs. 13, 13a; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 439; Cossmann, 1893, Ann. Géol Paléont., 12 liv., p. 19; Pilsbry and Sharp, 1898, Manual Conch., vol. XVII, p. 216.

Shell small, smooth, somewhat polished; section ovate.

Locality.—Jackson, Red Bluff and Vicksburg, Miss. The figured type-specimen is from Jackson.—[Meyer, 1886.]

The Jackson Eocene sediments yield fragments of medium-sized smooth Dentalia which are difficult to place specifically. Meyer made three species respectively based on very small specimens to include those forms with a round aperture (*D. danai*), those with an ovate aperture (*D. subcompressum*), and some which he described as having a tubular aperture (*D. bitubatum*).

There does seem to be a species with a somewhat compressed form and one with a round aperture. For lack of further evidence Meyer's names are used to classify the individuals we have found.

Dimensions.—Length, 6.5 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 699.

"Dentalium bitubatum" Meyer Plate 26, fig. 7

Dentalium bitubatum Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 64, pl. 3, fig. 1; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 438; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 20; Pilsbry and Sharp, 1898, Manual Conch., vol. XVII, p. 200.

Smooth, rapidly increasing in size; section suborbicular; aperture with a long additional tube.

Locality.—Jackson, Miss.

I have only one specimen of this species, which in its long tube of the aperture resembles *Dentalium duplex*, Def.† from the Paris basin.—[Meyer, 1886].

† Desh., An. s. vertèb., II, p. 203, pl. 1, figs. 36-39.

The species is known only from the type. The holotype has straight tapering sides. What Meyer took to be bitubular may be only a condition where a smaller specimen has been caught inside of a larger one as frequently happens with some straight Dentalia. The condition of the type suggests such an explanation but the shell was too fragile for a rigid, critical examination. There is also the possibility that the specimen is the broken apical end of a *Cadulus*.

Dimensions.—Length, 3.5± mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Nomen Nudum

Under the discussion of the Jackson Eocene, Fayette formation of Texas, Plummer (Univ. Texas Bull. No. 3232, 1933, p. 693) included a list of mollusks identified by Dumble (Univ. Texas Bull. No. 1869, 1920, p. 171) from the vicinity of Caddell, Texas. *Dentalium dumblei* Harris is given. This name is a *nomen nudum* as has been pointed out by Palmer (1937, p. 21). The fauna is a lower Claiborne assemblage with some Jackson representatives. "*Haminea grandis*" Aldrich occurred but that species has been found in Texas in the lower Claiborne so that its stratigraphic status is still a problem. See further discussion of that species in this work under *Lithophysema grande*.

The locality, according to the fauna as listed, is not typically Jackson but has more lower Claiborne affinities. It may be that the list of species needs revision, or there is a mixture in the fauna, and a clarification of the stratigraphy, from which the fossils were collected, is necessary.

Family **SIPHONODENTALIIDÆ**

Genus **CADULUS** Philippi, 1844

Philippi, Enumeratio Molluscorum Siciliæ, vol. 2, App. I, 1844, p. 209, pl. XXVII, fig. 21; Pilsbry and Sharp, Manual Conch., vol. XVII, 1897-98, pp. 112, 156, pl. 32, figs. 40-41.

Genotype by monotypy. *Dentalium ovulum* Philippi (*loc. cit.*). Recent Mediterranean and Bay of Biscay. Miocene and Pliocene of Italy.

Cadulus (Cadulus) juvenis Meyer Plate 26, fig. 14

Cadulus juvenis Meyer, 1886, Geol. Survey Alabama Bull., No. I pt. II, p. 66, pl. 3, fig. 4; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 444; Pilsbry and Sharp, 1898, Manual Conch., vol. XVII, p. 237.

Gadus juvenis (Meyer), Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 20.

Cadulus [cf.] *juvenis* Meyer, Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 157.

Small; inflation near the middle; slender, not compressed; smaller aperture forming an ellipse, one side of which is flattened.

Locality. Jackson, Miss.: not rare.—[Meyer, 1886.]

Dimensions.—Length, 2+ mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Subgenus **POLYSCHIDES** Pilsbry and Sharp, 1898

Pilsbry and Sharp, Manual Conch., vol. XVII, 1897-98, pp. 142, 146 as a section.

Subgenotype by original designation. *Cadulus* (*Polyschides*) *tetraschistus* (Watson). Recent. Anchorage, Fernando Noronha off Brazil. 25 fathoms (*Challenger*). Watson *Challenger*, Rept., Zoöl., vol. XV, 1886, p. 15, pl. 2, fig. 8; Pilsbry and Sharp, *ibid.*, p. 148, pl. 23, fig. 1; Henderson, U. S. Nat. Mus., Bull. 111, 1920, p. 97, pl. 17, fig. 1.

Cadulus (Polyschides) jacksonensis Meyer Plate 26, figs 1-5

Cadulus jacksonensis Meyer, 1885, Am. Jour. Sci., vol. XXIX, pp. 462, 468; Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 65, pl. 3, figs. 8, 8a, 8b; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 444.

Cadulus newtonensis Meyer and Aldrich, Dall, 1892, *loc. cit.*, *partim;* Pilsbry and Sharp, 1898, Manual Conch., vol. XVII, p. 237 (*Polyschides*) *partim.*

? *Siphonodentalium jacksonense* (Meyer), Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 20.

Cadulus [cf.] *jacksonensis* Meyer, Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 157.

Rather large; inflation faint near the end, very slightly compressed; smaller aperture elliptical; margin by notches divided into four appendages; the two appendages on the smaller side of the ellipse are slender, simple and equal to each other; the two other opposite ones are broad, emarginate in the middle, and unequal in size, that one situated on the convex side of the shell being the largest.

Locality.—Jackson, Miss.—[Meyer, 1886.]

This species is common at Jackson, Mississippi, and the shells are usually preserved well enough to show the four apical slits. The species is associated with another abundant form of equal size, which in 1937, I identified as *C. quadriturritus* Meyer of the Oligocene at Red Bluff, Mississippi. To the Jackson specimens of that determination, I am now applying a new name, *C. margarita*, which see.

Dall and Pilsbry and Sharp included *C. jacksonensis* under the lower Claiborne species, *C. newtonensis*. Dall also extended the range of *C. newtonensis* into the Chipola and Chesapeake Miocene. Martin (Maryland Geol. Survey, Miocene, 1904, p. 273, pl. LXIV, fig. 7), following Dall, identified specimens from Jones Wharf, Maryland, as *C. newtonensis*. Although in general the Miocene species may appear close to the Eocene form, I doubt that they are the same and the Jones Wharf *Cadulus* requires a new name. *C. newtonensis* is narrower apically and the apex tapers less gradually than the Miocene species.

Dimensions.—Length (chord subtending the arc), 9+ mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, localities 921; 10, 883.

Cadulus (Polyschides) margarita, n. sp. Plate 26, figs. 8-11

Cadulus (*Polyschides*) *quadriturritus* Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 23 *partim* (Jackson Eocene specimen); *non* Meyer, 1886, Geol. Survey Alabama, Bull. I, pt. II, p. 65, pl. 3, figs. 7, 7a.

Shell small; curved slightly; compressed; localized swelling anterior to the middle to about one-fourth the distance from the anterior end; apical aperture with four slits.

This species differs from *C. jacksonensis*, with which it is associated and equally abundant, in having a localized bulbous area. *C. jacksonensis* is more gradually tapering. *C. margarita* bears a resemblance to *C. quadriturritus* under which its representatives were included by me in 1937. *C. margarita* has a greater swelling than *C. quadriturritus*. The apical slits as represented by Meyer differ from any I have seen. The holotype of *C. quadriturritus* was reserved for study elsewhere and not available at the time of my comparison with Jackson specimens, hence present and additional revisions in its study have not been added herein.

Dimensions.—Length (chord subtending the arc), 10 mm.; greatest diameter, 1.5 mm. (holotype).

Types.—Holotype, No. 4483; paratype, No. 4484, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 699 (type), 921; 912; 922; 1121.

Class **GASTROPODA**

Subclass **PROSOBRANCHIATA**

Family **FISSURELLIDÆ**

Genus **DIODORA** Gray, 1821

(*Diadora* Gray, 1847)

Gray, London Medical Repository, vol. XV, 1821, Mar. 1, p. 233; Iredale, Malacol. Soc. London, Proc., vol. XI, 1915, p. 331.

Genotype by monotypy, *Patella apertura* Montagu (immature *Fissurella græca auct.*, *non* Linnæus, 12 ed., 1767, p. 1262). Living. British Isles. Montagu, Testacea Britannica, vol. II, 1803, p. 491, pl. XIII, fig. 10; Iredale, *loc. cit.*; Lowe, Zoöl. Jour., vol. III, 1827, p. 77.

Diodora tenebrosa antica, n. var. Plate 27, figs. 11-13

Diodora tenebrosa (Conrad), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 28, *partim*, pl. 3, figs. 2, 9.

Shell medium; posterior slope slightly less convex than the anterior; apical perforation large, includes area of beak; beak eliminated; interior margin of apical hole with heavy callus and posterior pit; sculpture consists of coarse radiating ribs of alternating strength, the radiating ribs are crossed by concentric fine lines which give a cancellate appearance; radiating ribs predominate. The radiating ribs tend, with age, to equalize in strength, the ribs become wider and the interspaces narrower. Such is typical of large specimens of *D. tenebrosa* of the Gosport sand.

When discussing *D. tenebrosa* (Conrad), differences between lower Claiborne specimens and the typical form from the Gosport sand were pointed out. A specimen from Hickory, Mississippi, was figured. That specimen becomes the holotype of this new variety. It is a young shell. The strength of the ribs changes with age. In the earlier work the author did not wish to name the lower Claiborne form from few specimens because the sculpture is decidedly of the same pattern as that of *D. tenebrosa*. In working the Jackson Eocene material a young specimen reveals sculpture of the *D. tenebrosa* stock having the coarser character of the ribs such as that developed in the lower Claiborne. The Jackson derivative, however, has the beaklike apex of typical *D. tenebrosa*. This suggests that the lower Claiborne product, which even in the young stage has lost the apical point, represents greater difference than was formerly thought. It is possible that the apparent similar sculptural pattern is superficial and that the presence or absence of the beak is of greater value than varietal rank.

Dimensions.—Height, 2 mm.; length, 6 mm.; width, 4 mm.

Types.—Holotype, No. 2661; paratypes Nos. 4488, 4489, and 4490, Paleontological Research Institution.

Occurrence.—Lower Claiborne Eocene. Cook Mountain formation, Hickory, Miss. (locality 728, type); Wautubbee, Miss. (locality 731); Hammett's Branch, La. (locality 730).

Diodora tenebrosa veatchi, n. var. Plate 27, figs. 15, 16

? *Fissurella claibornensis* Meyer and Aldrich, 1886, Cincinnati Soc. Nat. Hist., vol. IX, No. 2, p. 47 *partim* (Jackson reference); *non F. claibornensis* Lea, 1833.

For synonymy and discussion of *Fissurella tenebrosa* Conrad see, Palmer, Bull. Amer. Paleont., vol. VII, No. 32, p. 27, pl. 3, figs. 7, 10, 12, 13 *non* figs. 2, 9.

Shell small; posterior slope less convex than the anterior; posterior margin slightly broader than the anterior; apical perforation medium; apical tip present, beaklike; anterior margin crenulated; interior margin of apical perforation with heavy callus; transverse septum with posterior pit behind; sculpture coarse, consists of radiating primary ribs with a secondary and tertiary series of radiating ridges. All have narrower interspaces and are crossed by coarse concentric lines.

Perfect but probably young specimens from Gibson Landing, Ouachita River, Louisiana, and Town Creek, Jackson, Mississippi, have the typical sculptural pattern of *D. tenebrosa* but the ribs are coarser on the Jackson specimens. A similar development of the species occurs in the lower Claiborne Eocene (see *D. tenebrosa antica*, n. var.). The Jackson shells resemble the representatives of the species in the Gosport sand in that the apical beak is retained.

Stratigraphically and biologically the varietal form in the lower Claiborne with the apical perforation large represents the initial growth of the species. In the Gosport sand conditions were apparently favorable for the species as the shells are fairly abundant. The individuals are large with the ribs on the younger portion of the adult specimens enlarged and flattened with no interspaces.

Dimensions.—Height, 3.5 mm.; length, 7.5 mm.; width, 5.5 mm.

Holotype.—No. 4491, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 9 (type); 881.

Addendum

Fissurella mississippiensis Conrad, 1847 (Acad. Nat. Sci. Philadelphia, Proc., vol. III, No. 10, p. 282; 1848, Acad. Nat Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 113), listed as Eocene by Pilsbry and Johnson, "Catalogue of Fissurellidæ of the United States" (Nautilus, vol. V, No. 9, 1892, p. 106) is Oligocene. The type came from Vicksburg, Mississippi.

Genus **PUNCTURELLA** Lowe, 1827

Lowe, Zoöl. Jour., vol. 3, 1827, pp. 77, 78; Dall, Mus. Comp. Zoöl. Harvard, Bull., vol. IX, 1881, p. 74; Pilsbry, Manual Conch., XII, 1890, p. 228, pl. 27, figs. 69, 70.

Genotype by original designation, *Patella noachina* Linnaeus (Mantissa, 1771, p. 551). Circumpolar. Forbes and Hanley, Hist. British Moll., vol. II, 1850, p. 174, pl. LXII, figs. 10, 11, 12; pl. B.B., figs. 4, 5, 6.

Puncturella jacksonensis Meyer Plate 27, fig. 14

Puncturella jacksonensis Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 6, pl. 1, fig. 15; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 428; Pilsbry and Johnson, 1892, Nautilus, vol. V, No. 10, p. 113; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 31.

Spalt elliptisch, etwas vor dem Wirbel gelegen. Innen unter dem Wirbel ein Septum. Oberfläche mit starken concentrischen und mit abwechselnden Radialrippen. Die Kreuzungspunkte derselben sind verdickt.—[Meyer, 1886.]

This species has not been reported since the original discovery. The illustration does not depict the sculpture authentically. The longitudinal ribs are sharp, crenulated, and alternate in size. The concentric ribs are well developed. The radiating ribs are irregular in size and it is difficult to determine which are the primary and which are the secondary series. The ribs are most pronounced posteriorly.

Dimensions.—Height, 2 mm.; greatest diameter; 4 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **TEINOSTOMA** H. and A. Adams, 1853

H. and A. Adams, Genera of Recent Mollusca, vol. I, 1853, August, p. 122; A. Adams, Zoöl. Soc. London, Proc., pt. XXI, 1853 [1855], p. 183 (as n. g.)

Genotype by subsequent designation, Cossmann (Ann. Soc. roy. malac. Belgique, t. XXIII, 1888, 4th. ser., t. III, p. 44); monotype, A. Adams (*loc. cit.*), *Tinostoma* [=*Teinostoma*] *politum* A. Adams. Living. "Sancta Elena, 8 fathoms" (A. Adams). H. and A. Adams, 1853, *op. cit.*, pl. 12, fig. 9; Tryon, Manual Conch., vol. X, 1888, pl. 34, figs. 46, 47.

Teinostoma moodiënse, n. sp. Plate 28, figs. 1, 3

Nucleus minute, exposed, smooth, consists of about 2½ whorls; the postnuclear whorls begin with the surface completely covered with microscopic but distinct, punctate spiral lines which are present for nearly a whorl, the remainder of the surface, from where the lines end distinctly to the posterior area of the aperture, has the punctate lines faintly developed; remainder of the shell, smooth except for very faint lines just beyond the parietal callus and above the umbilical callus. The shell would be considered smooth but the presence of the well-defined lines on the postnuclear whorl shows that the ancestral form of the species was sculptured. The umbilicus is sunken but completely covered. The body whorl is rounded.

This species resembles *T. texanum* Palmer (1937, p. 46, pl. 2, figs. 20-22) somewhat in shape of the unenveloped spire. It differs from that species in having a greater sunken umbilical area as well as larger whorls of the spire. *T. moodiense* differs from *T. texanum* by the presence of spiral punctate lines on the Jackson species. In this respect it is like *T. subrotundum* Meyer (Geol. Survey Alabama, Bull., 1, pt. II, 1886, p. 66, pl. II, figs. 26, 26a) of the Gosport sand. It has a less enveloped spire and greater depressed umbilical area than *T. subrotundum*.

Dimensions.—Height, 2 mm.; greatest diameter, 3.7 mm.

Holotype.—No. 4498, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, "first bluff below the first bridge east of the institution for the blind, Jackson, Mississippi.

Section IDIORAPHE Pilsbry, 1922

Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., vol. LXXIII, pt. II, 1922, p. 398.

Type by original designation, *T. angulatum* (Gabb), (Am. Philos. Soc., Trans., vol. XV, 1873, p. 214 as *Cyclops*). Miocene. Santo Domingo. Pilsbry, *ibid.*, pl. XXXVII, figs. 1, 1a, 1b.

Teinostoma verrilli Meyer — Plate 28, figs. 2, 4

Teinostoma Verrilli Meyer, 1885, Am. Jour. Sci., vol. XXIX, pp. 463, 468; Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 66, pl. II, figs. 27, 27a; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 412, section *Pseudorotella*; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 46, section *Idioraphe*.

Discoid; umbilical region covered and thickened by callus; margin angular, though not carinated, polished; suture entirely indistinct, so that the number of whorls can not be counted; base regularly rounded; aperture trigonal-elliptical.

Locality.—Jackson, Miss.—[Meyer, 1886.]

There is a great deal of variation in the degree to which the nuclear whorls are exposed. Some have the nucleus completely covered, its position shown by the irregular line of the suture and the slightly raised area; in others the nucleus is the minute apical point; while some have the nucleus well exposed showing about two whorls.

The species is fairly common in the Moodys Branch marl.

Dimensions.—Height, .5± mm.; greatest diameter, 2+ mm. (holotype). Height, 1.5 mm.; greatest diameter, 2.5 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); first bluff below the first bridge east of the institution for the blind, Jackson, Miss.

Family **MELANELLIDÆ**

Genus **MELANELLA** Bowdich, 1822

(*Balcis* Leach, Ann. Mag. nat. Hist., vol. XX, 1847, p. 271, *non Melanella* Swainson, 1840)

Bowdich, Elements Conch., pt. I, 1822, p. 27, pl. 6, fig. 17; Bartsch, U. S. Nat. Mus., Proc., vol. 53, 1917, p. 302.

Genotype by monotypy, *M. dufresnii* Bowdich (*loc. cit.*). Living. Indo-Pacific.

In modern nomenclature *Melanella* Bowdich is being used generally but not universally as synonymous with *Eulima* Risso. The chief difference between the two genera is that of the character of the spire. In *Melanella* the spire is extremely curved while in *Eulima* the shell is straight, or nearly so. Unfortunately Bartsch (1917, p. 302) overlooked Bowdich's type figure, which is of a shell decidedly curved, and he characterized *Melanella, s. s.*, as including the specimens with straight shells. *Balcis*[5] was employed for the Melanellas with flexed shells. Since *Melanella, s. s.*, should be applied to the curved forms, *Balcis* becomes synonymous with it. If the straight and curved shells are separated generically, then *Eulima* Risso (Hist. Nat. Europe merid., 1826, p. 123) would be employed for the straight forms. However, Bartsch, from his monographic studies of the family, decided that there was a transition between the straight and flexed forms. Iredale (Jour. Conch., vol. 14, 1915, p. 344, footnote) was at one time of the same opinion. Others still separate the two. The Jackson species belongs to *Eulima*.

A minor point on which authors are at variance is the name of the family to which these genera belong. Iredale in 1915 (Malacol. Soc. London, Proc., vol. XI, p. 293) revived and gave a type designation to *Strombiformis* da Costa (British Conch., 1778, p. 107). According to older usage, Da Costa's

5 Subsequent designation of type, Bartsch (1917, p. 319), *Balcis arcuata* Leach, 1847 (=*Melania distorta* Philippi, Enum. Moll. Siciliæ, vol. 1, p. 158 *fide* Jeffreys, British Conch., vol. IV, 1867, pp. 205, 207).

name being the oldest in the family had precedent over other names. Hence the name Strombiformidæ is frequently employed for the family. But by Opinion 141, Int. Com. Zool. Nomen., vol. 2, 1943, p. 57, the oldest generic name need not be employed as the type genus; therefore, the use of Da Costa's name as the root for the family name is not necessary.

The name *Melanella* has been given to groups in other phyla of invertebrates but Bowdich's designation has priority.

Melanella jacksonensis (de Gregorio) Plate 26, fig. 16

Eulima aciculata (Lea), Meyer, 1887, Acad. Nat. Sci. Philadelphia, Proc., vol. XXXIX, p. 54, pl. III, fig. 5. *Non Pasithea aciculata* Lea, 1833, Cont. Geology, p. 102, pl. 4, fig. 82.

Eulima aciculata var. *jacksonensis* de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 161, pl. 16, fig. 4.

Cf. *Eulima extremis* Aldrich, 1911, Bull. Amer. Paleont., vol. V, No. 22, p. 8, pl. III, fig. 4.

Cf. *Melanella extremis* (Aldrich), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 65, pl. 6, figs. 8, 9, 13, 14, 15, 21.

Shell slender; nucleus of about two whorls; postnuclear whorls nine; sides of whorls microscopically convex, sides appear straight in general view; suture linear, distinct, whorl slightly sunken just below the suture indicated by Meyer with a second obscure line; anterior portion of inner lip, flaring with a slight concavity back of it.

This species is more needlelike than *M. aciculata* (Lea) of the Gosport sand (see type figure, Palmer, 1937, p. 63, pl. 6, figs. 18, 19; pl. 78, fig. 8). *M. jacksonensis* is fairly common in the Moodys Branch marl, represented by specimens of various stages of growth.

There is in the lower Claiborne a widely distributed slender *Melanella* which was called in the Claiborne work the same as that which Aldrich described from the Gosport sand. The Claibornian and Jacksonian shells bear such a close resemblance that for practical purposes I have tentatively included them under the same name. The first name was that of De Gregorio for the Jackson form. In such genera as *Melanella* where the validity of similarly appearing small fossil species may rest on shades of differences in shape their specific determination may always be in doubt. Species which are made on slight differences in degrees of convexity are not practical to use for stratigraphic purposes. Neither their separation nor their aggregation is of great practical value.

Dimensions.—Height, 8 mm.; greatest diameter, 2 mm.

Holotype.—Not found.

Occurrence.—Lower Claiborne and Gosport sand (*M. extremis* Aldrich) Jackson, Moodys Branch marl, Jackson, Miss. (type); first bluff below the bridge east of the institution for the blind, Jackson, Miss.

Genus **NISO** Risso, 1826

Risso, Hist. Nat. Europe merid., vol. 4, 1826, pp. 218, 219, pl. 7, fig. 98.

Genotype by monotypy, *Niso eburnea* Risso. Pliocene (Plaisancian). Trinité, vicinity of Nice, France. Plaisancian and Astian. Italy.

Niso umbilicata (Lea) Plate 26, fig. 17

Pasithea umbilicata Lea, 1833, Cont. Geology, p. 103, pl. 4, fig. 85.

For synonymy and description see, Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 66, pl. 6, figs. 22-25.

Dimensions.—Height, 14 mm.; greatest diameter, 6 mm.

Lectotype.—No. 5506, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Sabine (Wilcox), lower Claiborne, Gosport sand (type), and Jackson Eocene. Jackson, Danville Landing beds, locality 6.

Family **PYRAMIDELLIDÆ**

Genus **PYRAMIDELLA** Lamarck, 1799

Lamarck, Soc. Hist. nat. Paris., Mem., 1799, p. 76.

Genotype by monotypy, *Trochus dolabratus* Linnæus (12 ed., 1767, p. 1231). Living. Southern Florida and West Indies. Tryon, Manual Conch., VIII, 1886, p. 300, pl. 72, figs. 71-74.

Subgenus **SYRNOLA** A. Adams, 1860

A. Adams, Ann. Mag. nat. Hist., 3d ser., vol. V, 1860, p. 405.

Subgenotype by monotypy, *S. gracillima* A. Adams. Living. Korea. Tryon, Manual Conch., vol. VIII, 1886, p. 307, pl. 73, fig. 13.

Pyramidella (Syrnola) meyeri (Cossmann) Plate 28, fig. 7

Syrnola Meyeri Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 23, pl. 1, fig. 27; Cossmann, 1921, Essais Paléont. comp., 12 liv., p. 228; Chavan in Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 76.

Testa minuta, perangusta, polygyrata, lævigata; apice heterostropho; anfractibus 10, subulatis, planis sutura lineari et profunda discretis; ultimo ad peripheriam obsolete subanguloso; apertura minima; columella recta, valde uniplicata.

Petite coquille, très étroit, composée d'un grand nombre (10) de tours lisses, subulés, plans, séparés par une suture linéaire et profonde; le sommet hétérostrophe forme une petite crosse globuleuse, obliquement déviée par rapport à l'axe de la coquille. Dernier tour peu élevé faiblement anguleux à la circonférence de la base qui est dénuée d'ombilic; overture très petite, arrondie, columelle portant un fort pli peu oblique.

Longeuer, 5 mill.; diamètre, 0,75 mill.

Beaucoup plus etroite que la précédente, elle ressemble à *S. polygyrata*, Desh., quoiqu'elle ait les tours moins convexes; les six individus que j'en possède m'ont été envoyés sous le nom *Pyramidella larvata*, par M. Meyer il est bien évident qu'on ne peut les rapporter à l'espéce de Conrad, et que c'est une forme distincte de toutes celles qu'on a décrites de l'Eocéne d'Amérique.

Loc. Jackson (Miss.), ma coll. (pl. 1, fig. 27).—[Cossmann, 1893.]

André Chavan, who examined the holotype of this species, stated that it belonged to *Syrnola, s. s.*

Dimensions.—Height, 5.5 mm.; greatest diameter, 1.5 mm.

Holotype.—Laboratoire de Géologie de la Faculté des Sciences, Université de Paris (Sorbonne).

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 921.

Subgenus **MONOTIGMA** Gray in Sowerby, 1839

(*Actæopyramis* Fischer, 1885; *non Monoptygma* Lea, 1833)

Gray, in Sowerby, Conchological Manual, 1st ed., 1839, p. 66, fig. 371; *ibid.*, 2d ed., 1842, p. 192, fig. 371; *ibid.*, 3d ed., 1846, p. 192, fig. 371; Gray, Zoöl. Soc. London, Proc., pt. XV, 1847, p. 159 *Monotygma, non* p. 140 ? *Monoptygma.*

Subgenotype by monotypy, fig. 371 = *M. striata* Gray (designated by Gray, 1847, p. 159). Recent. Philippines. Tryon, Manual Conch., vol. VIII, 1886, p. 313, pl. 74, fig. 39 as *Actæopyramis.*

As there seems to be a great deal of confusion in regard to this generic name, and Fischer's name has been given preference in most works on the subject, a brief explanation of the literature will not be amiss.

Authors have assumed, following Fischer (Man. Conchyliol., 1885, p. 787), that Gray in writing *Monotigma* and *Monotygma* made a typographical error for *Monoptygma*, and hence the name would be preoccupied by that of Lea, 1833. However, in reviewing the references of *Monotigma* (*Monotygma*) previous to Fischer, one finds that the name was given by Gray in Sowerby (1839, 1842, 1846) as distinct in spelling and represented by a monotype. Both *Monotigma* Gray and *Monoptygma* Lea are defined respectively. Iredale has pointed out (Nautilus, vol. XXIV, No. 5, 1910, p. 52; Malacol. Soc. London, Proc., vol. X, 1913, p. 297) that *Monotygma* Gray, 1840, is a *nomen nudum.* The name of that date requires no consideration. Whether Gray's 1840 reference (which is the one Fischer gave) is a typographical mistake cannot be ascertained but because of its invalidity it does not influence the status of the preceding or succeeding names.

In the first, second, and third editions of Sowerby's Conchological Manual, *Monotigma* is defined with a figure of a shell which Gray in 1847 (*loc. cit.*) designated as *M. striata* spelling the name *Monotygma.* In the first three works, *Monoptygma* Lea is presented with no connection with *Monotigma.* Therefore, in the three earliest dates for the genus it is not true that *Monotigma* is a typographical error for the name of Lea's genus. In 1847 (pp. 140, 159) Gray was somewhat confused. He said on p. 159 that *Monotygma* was not that of Lea (meaning *Monoptygma* Lea) and in this reference he established the name of the monotype of *Monotigma, M. striata* Gray. However, on page 140 (1847) he stated *Monotigma* G. Sowerby was ? *Monoptygma* Lea, missaying that *M. elegans* Lea was the species that Sowerby gave for *Monotigma.* Sowerby referred *M. elegans* to *Monoptygma* Lea. This confusion is later than the original description of *Monotigma* and therefore should not influence the original status of the generic name.

A. Adams (in Sowerby, Thes. Conch., vol. II, [1855 for vol.], p. 816) incorrectly placed *M. striata* under *Monoptygma* Lea. Fischer gave the name *Actæopyramis* as a substitute for *Monotygma* thinking Gray had made a typographical error. Fischer's name has become entrenched (see Tryon, 1886; Dall and Bartsch, 1904; 1909; Thiele, 1929; Wenz, 1940) and the misstatement as to its origin carried through literature.

Pyramidella (Monotigma) crassispirata (Meyer) Plate 27, fig. 19

Odostomia crassispirata Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 6, pl. 1, fig. 13.

Der links gewundene Nucleus ist etwas im ersten erwachsenen umgang verborgen. Die erwachsenen Windungen sind ziemlich flach, an der Sutur ausgehöhlt und mit ungleichen, ziemlich starken Spiralen bedeckt. Columella mit einer deutlichen Falte. Mündung oval.—[Meyer, 1886.]

As far as one can determine from the illustration, *A. crassispirata* (Meyer) seems to fit better into the group of *Monotigma* [*Actæopyramis*] than it does in *Odostomia.* Lack of material prevents a definite classification.

Dimensions.—Height, 2.5 mm. (type).

Holotype.—Not found.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **TURBONILLA** Leach in Risso, 1826

Risso, Hist. Nat. Europe merid., 1826, t. 4, p. 224.

Genotype by subsequent designation, Hermannsen (Ind. Gen. Malac., Supp. et Corr., 1852, p. 136), *T. costulata*[6] Risso (*loc. cit.*). Fossil. Saint Jean. Risso, *op. cit.*, fig. 72.

Risso listed three species: *T. plicatula* Risso, fossil from Trinité; *T. costulata* Risso, fossil from Saint Jean; *T. gracilis* Brocchi, fossil from Trinité; and a supplementary species (p. 394), *T. humboldti* Risso, living, Mediterranean. He did not designate a type for the genus.

Since the type designation must be one of the above or its equivalent, the designations of Gray (1847, p. 160) and Monterosato (1884, p. 91) of *Turbo elegantissima* Montagu (1803, pt. 2, p. 298), the British living species, are valid only if one of the species mentioned by Risso is regarded as synonymous with that of Montagu. Monterosato questionably put *T. costulata* Risso as equivalent to *T. elegantissima*. If Monterosato were in doubt as to the exact identity of the fossil, *T. costulata*, with a living form of the Mediterranean and Britain, then the genotypic designation based on that inductive method is not a clear-cut definition of type. Such is particularly true when modern writers (Winckworth, Jour. Conch., vol. 19, 1932, p. 227) restrict *T. elegantissima* Montagu to a northern distribution.

Subgenus **STRIOTURBONILLA** Sacco, 1892

Sacco, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. XI, Torino, 1892, p. 94; *ibid.*, Boll. Mus. Zoöl. Anat. comp., Torino. vol. VII, No. 121, 1892, p. 55.

Subgenotype by original designation, *S. sigmoidea* (Jeffreys) = *Odostomia sigmoidea* Jeffreys (Zoöl. Soc. London, Proc., 1884, p. 354). Recent. Algiers, Palermo; 163½ fms. Jeffreys, *ibid.*, pl. XXVI, fig. 9.

Dall and Bartsch (1904; 1909) stated that the type of *Strioturbonilla* Sacco is *T. alpina* Sacco. They have been followed by such authors as Cossmann (Essais Paléoconch. comp., 12 liv., 1921, p. 281) and Thiele (1929). Sacco definitely designated as type *S. sigmoidea* (Jeffreys) in both of his 1892 descriptions

[6] *Non T. costulata* Verrill, 1873, Rep. U. S. Comm. Fish., pt. 1, p. 658= *T. mighelsi* Bartsch, 1909, Boston Soc. Nat. Hist., Proc.

hence other designations of type have no status.

Turbonilla (Strioturbonilla) major Meyer Plate 28, figs. 6, 11

Turbonilla major Meyer, 1887, Acad. Nat. Sci. Philadelphia, Proc., vol. XXXIX, p. 51, pl. III, fig. 3.

Nucleus sinistral, its axis horizontal, its volutions separate. Adult whorls many, subconvex, covered with strong transverse ribs and densely spirally striated. The spirals do not extend over the ribs. Mouth subquadrangular. Inner lips with a strong oblique fold. Base spirally striated. Jackson, Miss. Rare.

The more common *Turbonilla* in Jackson is a form which I should rather put to *Turbonilla neglecta* Mr. than to the above species. Compared with *T. major* it is much smaller and more slender and the spiral striæ are scarcely distinct, otherwise it is very similar.—[Meyer, 1887.]

A fragment which probably belongs in this species has been found in the Moodys Branch marl. The specimen has more longitudinal ribs than illustrated on the type figure.

Dimensions.—Height, 6 mm. (from type figure).

Holotype.—Not found.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 921.

Family **TROCHIDÆ**

Genus **SOLARIELLA** S. Wood, 1842

Wood, Ann. Mag. nat. Hist., vol. IX, 1842, p. 531, pl. V, figs. 7, 10.

Genotype by monotypy, *S. maculata* S. Wood. Pliocene. England. Wood. Palæont. Soc., 1848, Mon. Crag Moll., vol. 1, p. 135, pl. XV, fig. 3.

Solariella cancellata jacksonia, n. var. Plate 27, figs. 8-10

For complete synonymy and description of *Solarium cancellatum* Conrad, 1833, see, Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 36, pl. 4, figs. 9, 13, 17; pl. 78, fig. 13.

Nuclear whorls about 2½; smooth or the last portion may have incipient spiral ribs; conspicuous sculpture begins on the postnuclear whorls. The longitudinal ribs are coarse and are sharply nodose just below and above the suture along a spiral rib, the combination produces an excavated appearance along the suture. The longitudinal ribs predominate on the penultimate whorl and upper part of the body whorl. Between the upper and lower rows of nodes, one or two spiral lines occur, with three or four striæ on the body whorl. A fine cord may be present above and below the suture. The umbilicus is large, coarsely sculptured with spiral ribs which on the margin are nodose. The basal portion of the body whorl is covered with close-set spiral ribs which vary in the amount of nodosity. Between the base and the nodose shoulder of the body whorl there are three prominent spiral ribs with wide interspaces which may or may not contain a fine spiral cord. The shell is small, composed of three nacreous whorls.

The form in the Jackson shows its relationship to the species in the Gosport sand and is probably the representation upon which Dall (1892, p. 407) listed the species from the Jackson Eocene.

The Jackson shells exhibit differences which are consistent enough for one to be able to distinguish a species and subspecies. *S. cancellata, s. s.*, has three prominent, nodose spiral ribs over the whorls and upper region of the body whorl. *S. cancellata jacksonia* has only two. On some specimens a third may occur but it is obscure compared with the typical form. The longitudinal ribs are well developed on *S. cancellata*, almost equal in strength to the spiral, hence the name of the species. In *S. jacksonia* the longitudinal ribs are subordinated with growth. A conspicuous difference between the two forms is the sculpture of the basal area of the body whorl. On *S. cancellata, s. s.*, that area is smooth or the spiral ribs are obscure. The ribs develop with age until on adult shells they are coarse with wide interspaces. In the stratigraphically younger shells of the Jackson Eocene the growth of the basal spiral ribs is accelerated. The spiral ribbing on young shells is well developed with the interspaces narrower.

In restudying *S. cancellata* Conrad, I am not sure of the number of nuclear whorls. Where the demarcation of the nucleus is not clear it is difficult to give an exact number. Probably 2½ whorls is a better estimate than three as I gave in the Claiborne bulletin.

Dimensions.—Height, 4 mm.; greatest diameter, 4 mm.

Holotype.—No. 4492, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Jackson, Miss; the first bluff below the first bridge east of the institution for the blind; SW. ¼ sec. 35, T. 6 N., R. 1 E.

Family CYCLOSTREMATIDÆ

Genus TORNUS Turton and Kingston, 1830
(*Adeorbis* S. Wood, 1842)

Turton and Kingston, Guide to the Watering Places, vol. II, Nat. Hist. of the District, 1830 [no pagination]; Iredale, Malacol Soc. London, Proc., vol. XI, 1914, p. 171.

Genotype by subsequent designation, Sacco (Boll. Mus. Zoöl. Anat. comp., Torino, vol. XI, No. 267, 1896, p. 88), *Tornus subcarinatus* (Montagu) (as *Helix*, Testacea Britannica, pt. 2, 1803, p. 438, tab. 7, fig. 9). Living. British Isles. Eastern Atlantic Coast and Mediterranean. Fossil. Miocene-Pleistocene. Europe. Harmer, Palæont. Soc., LXXV, 1923, p. 756, pl. LX, fig. 20.

Tornus infraplicatus (Johnson) Plate 27, figs. 17, 18

Adeorbis infraplicatus Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 81, pl. II, figs. 13, 14.

Shell small, spire depressed, nucleus smooth, whorls three, with two prominent revolving ridges, one at the periphery and one midway between the periphery and the suture, both are very minutely crenulated, between the two ridges smooth or with very fine revolving lines, from the smooth nucleus radiate fine raised lines that increase in size on the body whorl, these are crossed by fine revolving lines, base of the shell with numerous fine revolving lines, umbilicus of moderate size, margin smooth, nearly half-way across the base from the margin of the umbilicus extend numerous radiating plications, crossed by very fine revolving lines. Alt. 1½ mm., greatest diam. 3 mm.

Four specimens from the material collected by Thomas A. Morgan, at Jackson, Miss.—[Johnson, 1899.]

Two specimens which we have of this species show that the fine details of sculpture are variable. On one individual the radiating ribs of both the dorsal and ventral surfaces are large; on the other shell, the ribs on those surfaces are fine. The major characters of the species are so distinct that such a minor difference though conspicuous is due probably to individual variation.

This species is unique.

Dimensions.—Height, 1 mm.; greatest diameter, 2.5 mm.

Holotype.—No. 7472, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **CIRCULUS** Jeffreys, 1865

Jeffreys, British Conchology, vol. III, 1865, p. 315, *ibid.*, 1869, vol. V, pl. LXII, fig. 5.

Genotype by monotypy. *Delphinula Duminyi* Requien = *Valvata ? striatus* Philippi, 1836. Living. Sicily to Ireland. Also fossil. Harmer, Palæont. Soc., vol. LXXV, 1923, p. 759, pl. LX, fig. 25.

For further references in regard to *Circulus*, see, my report, 1937, p. 52.

Circulus ottonius, n. n. Plate 27, figs. 3, 4

Solarium delphinuloides Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 4, pl. 1, figs. 3, 3a; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 347.

Non Solarium delphinuloides d'Orbigny, 1845, in Sagra, Hist. fis. pol. y nat. Cuba, tome V., Mol., p. 189, pl. XIX, figs. 21, 24; *Non* Heilprin, 1881, Acad. Nat. Sci. Philadelphia, Proc. for 1880, vol. XXXII, p. 375, pl. 20, fig. 13 = *Architectonica sabinia* Palmer, 1944, Bull. Amer. Paleont., vol. XXVIII, No. 112, p. 17.

Circulus delphinuloides (Meyer), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 54.

Die convexen Windungen liegen nahezu in einer Ebene. Der Teil der Umgänge, welcher sich Sutur herabsenkt, ist mit sehr dicht neben einander liegenden Spiralen bedeckt. Auf dem nach aussen fallenden, grösseren Teil der Windungen sind die Spiralen grösser und weiter von einander entfernt. Der letzte Umgang ist durch eine aufgesetzte Carina gekielt. Die Basis ist ebenfalls gekielt und mit schwachen Spiralen gleichmässig bedeckt; der weite Nabel aber ist glatt. Mündung gerundet-vierseitig.

Aehlich aussehend, jedoch nicht unbeträchtlich verschieden ist *Solarium planum* Lea *sp.* von Claiborne.—[Meyer, 1886.]

This species was thought by Dall (1892, p. 347) to be synonymous with *C. exacuus* (Conrad) of the Claibornian. The forms are distinct as was pointed out in the Claiborne gastropod bulletin. The differences were given there and will not be repeated here.

Dimensions.—Height, 2.5 mm.; greatest diameter, 5 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **SOLARIORBIS** Conrad, 1865

Conrad, Am. Jour. Conch., vol. I, 1865, p. 30.

Genotype by subsequent designation, Dall (Wagner Free Inst. Sci., Trans., vol. 3, pt. II, 1892, pp. 412, 414), *Delphinula depressa* I. Lea. Claibornian Eocene. Southern United States. Palmer, Bull. Amer. Paleont., vol. VII, No. 32, p. 50, pl. 2, figs. 6-8; pl. 78, fig. 14.

Solariorbis quadrangularis (Meyer) Plate 27, figs. 1, 2

Adeorbis quadrangularis Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 4, pl. 1, figs. 1, 1a.

Teinostoma quadrangulare (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 414, section *Solariorbis*.

Solariorbis quadrangularis (Meyer), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 51.

Von den drei und ein halb Umgängen ist der letze von trapezförmigem Querschnitt und hat eine scharf abgeplattete Seite. Die Oberseite ist wenig convex und, mit Ausnahme eines schwieligen Bandes an der Sutur, Spiral gestreift. Die Basis ist abgeplattet und auf dem Marginalteile spiral gestrieft. Nebelgegend und Innenlippe schwielig verdickt, eine tiefe Nabelspalte überdeckend.—[Meyer, 1886.]

Shell small; nucleus minute, about 2½ whorls, smooth; postnuclear whorl and early part of body whorl completely covered with fine spiral punctate lines; middle of last part of body whorl smooth; body whorl biangulate with a wide smooth area between the angles; the surface of the body whorl, above the superior angulation and on the upper part of whorl just below a narrow smooth area below suture, has fine spiral punctate lines which also occur from the inferior angle about halfway over the surface of base; remainder of base to umbilicus smooth; umbilicus may be more open than revealed on type; aperture large and nearly quadrangular.

Dimensions.—Height, 1± mm.; greatest diameter, 3 mm. (holotype). Height, 1.5 mm.; greatest diameter, 3 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type): the first bluff below the first bridge east of the institution for the blind, Jackson, Miss.

Solariorbis subangulatus (Meyer) Plate 27, figs. 5, 6, 7

Adeorbis subangulatus Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 67, pl. 2, fig. 28; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 25.

Teinostoma subangulatum (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 414, section *Solariorbis*.

Tornus subangulatus (Meyer), Cossmann, 1918, Essais Paléoconch. comp., 11 liv., p. 99.

Discoid; whorls five, rapidly increasing in size; margin somewhat angular; basal part of margin rounded; umbilicus deep; suture distinct; surface with revolving lines, indistinct near the margin; aperture irregularly elliptical.

Locality.—Jackson, Miss.

Adeorbis depressus, Lea,, sp. (Teinostoma rotula, Heilpr.) from Claiborne has the umbilicus nearly closed, a regularly rounded margin, a more developed ornamentation, and is larger.—[Meyer, 1886.]

Shell small; nucleus large, composed of 2½ whorls with a minute first whorl, others narrow on a large spiral; smooth; postnuclear whorls begin abruptly and are covered completely with microscopic spiral lines; suture well defined; body whorl rounded, base covered with microscopic lines so fine that in some cases the surface appears smooth; umbilicus large for size of the shell, deep.

Some specimens have a decided carination along the convex margin of the body whorl. Many show the carination faintly and more do not show it. For such a reason the character does not seem to warrant a separation of the forms. The carination is similar to that figured for *S. planulatus* (H. C. Lea) (see Palmer, 1937, pl. 78, fig. 4) of the Gosport sand. It is probably that feature which suggested to Dall (1892) that *S. subangulatus* was synonymous with *S. planulatus*. However, *S. planulatus* is smooth, and *S. subangulatus* is microscopically but decidedly sculptured.

Prof. G. D. Harris[7] and Mr. Aldrich[8] discriminated varieties of the species from the Sabine (Wilcox). It is difficult to say whether the Aldrich specimen from Bell's Landing, Alabama, named *smithi,* is the same as the form Harris had from the same locality. The Gregg's Landing, Alabama, and Sabinetown, Texas, types have been lost so further examination could not be made.

Dimensions.—Height, 1.5 mm.; greatest diameter, 3+ mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); the first bluff below the first bridge east of the institution for the blind, Jackson, Miss.

Family MATHILDIDÆ

Genus MATHILDA Semper, 1865

Semper, Jour. Conchyliol., 1865, vol. XIII, p. 330.

Genotype by original designation, *Turbo quadricarinatus* Brocchi (Conch. Foss. subap., vol. II, 1814, [reprint 1843], p. 160, tab. VII, fig. 6). Pliocene. Italy. Tryon, Manual Conch., vol. VIII, 1886, p. 211, pl. 65, fig. 38 [as *quadricincta*].

Mathilda regularis (Meyer) Plate 28, fig. 9

Eglisia regularis Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 63, pl. 2, fig. 3.

Mathilda regularis (Meyer), Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 5, pl. 1, fig. 12; Dall, 1892. Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 320; Aldrich, 1897, Bull. Amer. Paleont., vol. II. No. 8, p. 6, pl. 1, figs. 1a, b, c; Cossmann, 1912, Essais Paléoconch. comp., 9 liv., p. 10 *Mathildia;* Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 89, pl. 9, fig. 7.

The species was described from the Red Bluff Oligocene. Meyer identified a Jackson specimen as belonging to the species. The shell retained a protoconch similar to *Mathilda*. Aldrich (1897) found the form at Vicksburg (Oligocene) and stated

[7] Harris, G. D.: Bull. Amer. Paleont., vol. III, No. 11, 1899, p. 101, pl. 12, figs. 20-22 as *Teinostoma*.

[8] Aldrich, T. H.: Bull. Amer. Paleont., vol. IX, No. 37, 1921, p. 11, pl. 1, figs. 19, 20 as *Teinostoma subangulata Smithii*.

in a letter, May 31, 1931, to the author that he had obtained a specimen in the Gosport sand. It was upon this authority that the species was included in the Claiborne fauna.

Dimensions.—Height, 3.5 mm.; greatest diameter, 1+ mm. (Meyer's Jackson specimen).

Holotype and figured Jackson specimen.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Gosport sand to Vicksburg Oligocene (Aldrich). Red Bluff, Miss. (type).

Genus **GEGANIA** Jeffreys, 1884

Gegania Jeffreys, Zoöl. Soc. London, Proc., 1884, p. 365, pl. XXVII, fig. 10.

Tuba Lea, 1833, Cont. Geology, p. 127; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 89. Genotype by subsequent designation, Cossmann, 1888, p. 312. *Non Tuba* Renier, 1804, Tavole, VI; *nec Tuba* Oken, 1815, Lehrb. Nat., 3 (1), p. 383; *nec Tuba* Fabricius, 1823, Fortegnelse, 80; *nec Tuba* Barrande, 1848, in Verneuil, Bull. Soc. géol. France, (2), 5, 376; *nec Tuba* Duchassaing and Michelotti, 1864, Natuurk. Verh. Wet. Haarlem, (3), 21, No. 3, 44.

Genotype by monotypy, *G. pinguis* Jeffreys. Living. Atlantic.

The generic name, *Tuba,* which is so familiar in the literature of Eocene Mollusca, has been preoccupied many times. A new name for that of Lea is not required because the term is synonymous with *Gegania* Jeffreys[9], 1884, which was proposed for a Recent Atlantic species. The fossil forms are typical of the living genotype. As well as being widely distributed in the Eocene, *Gegania* (*Tuba*) is found in the Oligocene of Peru (Olsson, Bull. Amer. Paleont., vol. XVII, No. 62, p. 69, pl. 12, figs. 9, 10), Miocene of Florida (Dall, *op. cit.*, p. 319, pl. 18, fig. 4a), France, and Italy (Cossmann, 1912, p. 14), and perhaps in the Cretaceous (Wenz).

No species of *Gegania* have been found so far in the Jackson but there are several in the Claibornian (Palmer, 1937, pp. 89-94 as *Tuba*).

[9] Dall, W. H.: Wagner Free Inst. Sci., Trans., vol. 3, pt. II, 1892, p. 318; Wenz, W., Handbuch Paläozoologie, Bd. 6, Teil 3, 1939, p. 663, fig. 1891.

Family **EPITONIIDÆ**

Genus **EPITONIUM** Roeding in Bolten, 1798

(*Scala* Humphrey, 1797[10]; *Scalaria* Lamarck, 1801)

Roeding in Bolten, Museum Boltenianum, 1798, pt. 2. p. 91.

Genotype by subsequent designation, Suter (Manual New Zealand Moll., 1913, p. 319), *Turbo scalaris* Linnæus (12 ed., 1767, p. 1237) = (*Scalaria pretiosa* Lamarck, Hist. nat. An. sans Vert., t. VI, pt. 2, 1822, p. 226.) Living. Western Pacific. Tryon, Manual Conch., vol. IX, 1887, p. 54, pl. 11, fig. 31; Durham, Jour. Paleont., vol. 11, No. 6, 1937, pl. 56, fig. 1.

Genus **ACIRSA** Mörch, 1857

Mörch, Mollusca Grondlandica, 1857, in H. Rink, Grønland geographisk og statistisk beskrevet, Andet Bd., p. 77.

Genotype by monotypy, *Scalaria* (*Acirsa*) *borealis* Beck (*Turritella?* Lyell, Phil. Trans., CXXV, 1835, p. 37, pl. II, figs. 11-12, *non* "1838" as given by Harmer; in Lyell, Geol. Soc. London, Proc., vol. III, 1839, p. 120 not described [*non* Gould] = *A. eschrichti* (Holböll) in Möller, Ind. Moll. Grœnlandiæ, 1842, p. 10) = *A. costulata* (Mighels and Adams) (Boston Jour. Nat. Hist., IV, 1842, p. 50) *fide* Tryon. Living. Greenland. Circumboreal. Harmer. Palæont. Soc., vol. LXXII, 1920, pl. XLIX. figs. 6, 7. Tryon, Manual Conch., vol. IX, 1887, pl. 16, figs. 10, 12, 18 *A. costulata* (Mighels and Adams).

Since the author's work on the Claiborne Eocene the original description of this genus has been examined, and the type of the genus has been found to be monotypic.

Genus **TENUISCALA** de Boury, 1887

De Boury, Étude sur les sous Genres de Scalidæ du Bassin de Paris, Paris, 1887, p. 25.

Genotype by original designation, *T. Laubrierei* de Boury. Eocene. Paris Basin. Cossmann, Essais Paléoconch. comp., 9 liv., 1912, pl. IV, figs. 25-26.

Tenuiscala aspersa (Meyer) Plate 28, fig. 10

Eglisia aspersa Meyer 1886, Bericht Senckenberg. naturf. Gesell., p. 5, pl. 1, fig. 11.

Zwei und ein halb glatten embryonischen Windungen folgen sieben erwachsene Umgänge mit starker Skulptur. Von den fünf erhabenen Spiralen sind die drei unteren die deutlichsten. Die zahlreichen Transversalrippen sind dünne Lamellen, welche wellig über die Spiralen und deren Zwischenräume hinweg schreiten. Sie stehen schräg nach links (Stellung der Schale wie in der Figur). Die Basis mit derselben, aber obsoleten Ornamentation. Mündung oval.

Das Hauptkennzeichen dieser Art sind wohl die schuppigen, welligen Transversalen.—[Meyer, 1886.]

The longitudinal lines on the type are more crenulated than shown in the illustration by Meyer.

Dimensions.—Height, 5 mm., greatest diameter, 1.5± mm. (holotype).

[10] Names in Museum Calonnianum, 1797, (Humphrey) are not accepted by Int. Rules of Zool. Nomen., Opinion Rendered No. 51.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **CIRSOTREMA** Mörch, 1852

Mörch, Catalogus Conch. . . Yoldi, fasc. 1, p. 49.

Genotype by monotypy, *Scalaria varicosa* Lamarck (Hist. nat. An. sans Vert., t. 6, pt. 2, 1822, p. 227). Recent. Indo-Pacific. Tryon, Manual Conch., vol. IX, 1887, p. 81, pl. 17, figs. 23, 27.

Subgenus **CORONISCALA** de Boury, 1909

De Boury, Jour. Conchyliol., vol. LVII, 1909, p. 255.

Subgenotype by original designation, *S. coronalis* Deshayes. Eocene. Paris Basin. Deshayes, Desc. An. sans Vert., t. II, 1864, [1861], p. 337, pl. 11, figs. 7, 8; Cossmann and Pissarro, Icon. comp. Coq. Foss. Eocène Env. Paris, t. 2, 1910-1913, pl. VII, fig. 52-19.

Cirsotrema (Coroniscala) ranellinum (Dall) Plate 28, fig. 19

Scala ranellina Dall, 1896, Nautilus, vol. IX, No. 10, p. 111; Dall, 1900, Wagner Free Inst. Sci., Trans., vol. 3, pt. V, pl. XLI, figs. 8, 9; Schuchert, etc., 1905, U. S. Nat. Mus., Bull., No. 53, pt. I, p. 583, type No.

Scala (Coroniscala) ranellina Dall, de Boury, 1912, Jour. Conchyliol., vol. LX, p. 315.

Cirsotrema (Coroniscala) ranellina (Dall), Cossmann, 1912, Essais Paléoconch. comp., 9 liv., p. 54.

Shell of five or more whorls, rather rapidly increasing, spirally ribbed with ten or twelve rather feeble flattish ridges which are obsolete or absent above the shoulder; basal area projecting, strongly marked, overrun by the varices which are angulated and prominent over the keel; varices of two sorts, one set large, thin, wide set at the half whorl, continuous up the spire on each side like the varices of *Ranella pulchra*, their profiles rounded, the aperture circular, the axial edge narrower, not perceptibly angular; the other varices are much smaller and less prominent, about seven to twelve on each half whorl between the larger series, sharp edged and subequal. Height of (decollate) shell 33, max. diameter 23 mm.

Zeuglodon bed of Jacksonian, near Cocoa P. O., Alabama, Burns and Schuchert.

This fine species is related to *S. octolineata* Conrad, which is found in the same horizon, but has the large varices less conspicuous and irregularly distributed. *S. octolineata* is also a smaller, more cylindrical shell. The present species is readily recognized by its peculiar flattened aspect recalling *Ranella*.—[Dall, 1896.]

Dimensions.—Height, 21 mm. (fragment, 2 whorls); greatest diameter, 15 mm.

Syntypes.—No. 130038, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, locality 883. Yazoo clay, locality 794. Upper Jackson, near Cocoa P. O., Alabama (type).

Cirsotrema octolineatum (Conrad)

Scala octolineata Conrad, 1860, Acad. Nat. Sci. Philadelphia, Jour.,2d ser., vol. IV, p. 294.

Scala (*Cirsotrema*) *octolineata* Conrad, 1865, Am. Jour. Conch., vol. I, p. 28.

? *Scalaria octolineata* (Conrad), Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., vol. VIII, p. 153, pl. 3, fig. 22; Aldrich, 1886, Geol. Survey Alabama, Bull., No. 1, pt. 1, p. 34, pl. 1, fig. 22 = *S. Spillmani* Aldrich, 1885, *op. cit.*, p. 154; Dall, 1896, Nautilus, vol. IX, p. 112.

? *Scala octolineata* Conrad, Aldrich, 1897, Bull. Amer. Paleont., vol. II, No. 8, pl. 4, figs. 6, 6a = *C. danvillense*, n. sp.

Cirsotrema (*Coroniscala*) *octolineata* (Conrad), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 100 *partim.*

Turrited; whirls [whorls] longitudinally costate; ribs distant, very prominent, laminar; revolving lines distant, prominent, continued over the right sides of each varix, the other side rugose; varices very prominent; base with a carina.

Length about 1½ inches.

Locality.—Mississippi. Dr. Spillman.—[Conrad, 1860.]

When writing the notes on this species in the Clabornian work, the author did not identify the specimens as above with assurrance for the origin of the species was in doubt, and additional notes by Aldrich only added further confusion to the problem.

Because, (1) Conrad's original description is not definite and might apply to various southern Eocene species of *Cirsotrema;* (2) the holotype is lost, and the species was never originally figured; (3) the original locality is ambiguous and might be either lower Claiborne or Jackson depending on where in "Mississippi" the original specimen came from, the author feels it would be best to abandon the name *"octolineata"* for a southern Eocene *Epitonium.*

Any neotype that could be selected would be based on an arbitrary decision and hence would not be proof as to what the original species was. The name establishes a form in the group with eight spiral lines but hardly limits it specifically.

The name *spillmani* by Aldrich is available for the lower Claiborne species which Aldrich figured from Enterprise, Mississippi, (Aldrich, 1885, pl. 3, fig. 22; 1886, pl. 1, fig. 22) and those figured by the writer (1937, pl. 10, figs. 17, 20, 24) from the lower Claiborne and Gosport sand.

Why Aldrich made the statement in 1897 that the specimen from "The Rocks," Clarke County, Alabama, was from the "same vicinity where Conrad is said to have obtained his shell" is not clear for it does not agree with the original data nor Aldrich's discussion of 1885. Aldrich may have meant age for vicinity. Conrad originally gave Mississippi as the type locality, and Aldrich in 1885 and 1886 thought he had typical material from Enterprise, Mississippi. The specimen from "The Rocks," Alabama, would be Jacksonian or Vicksburgian.[11] If Conrad obtained his shell from the Jackson of Mississippi then the specimen which Aldrich had from Alabama would be of the same age if the shell came from the lower horizon at "The Rocks." Dall, 1896, certainly believed that *"S." octolineata* was a Jackson species.

The specimens figured by Aldrich under this name are apparently not in existence for they are not on record in the list of type and figured specimens in the Alabama Museum of Natural History, Geology Deparment, the Johns Hopkins University, or the Paleontological Research Institution.

The dimensions as given by Conrad, "length about 1½ inches," adds further doubt as to later authors knowing what specific shell Conrad had. The only known species in the Claiborne-Jackson formations which attain such large size are *C. ranellinum* Dall and *C. linteum* (Conrad). Dall made a comparison of *C. ranellinum* with *C. octolineatum*. Other than Dall referring to a Jackson shell, one is puzzled as to what Dall was using as type for *"S." octolineata*. The incomplete holotype of *C. linteum* is 28 mm. in height. That species has a broader body whorl in comparison to its height than related species have.

The history of the knowledge in regard to *"S. octolineata"* may be outlined as follows:

1. *S. octolineata* Conrad, 1860. Mississippi. Type lost. No original figure given. Horizon or description not definite enough for specific determination. Suggest name be abandoned.

2. *"S. octolineata"* Aldrich, 1885. Enterprise, Mississippi.

[11] Smith, E. A., Johnson, L. C., and Langdon, D. W. Jr.: Geol. Survey Alabama, 1894, p. 639.

Lower Claiborne. No definite proof that it is the same as that of Conrad. This is *Cirsotrema spillmani* (Aldrich), 1885.

3. "*S. octolineata*" Aldrich, 1897. "The Rocks," Alabama. Jackson Eocene or Vicksburg Oligocene (probably the Jackson horizon). Figured specimens probably lost. No certainty that it is the same as *S. octolineata* Conrad or of Aldrich, 1885. This is referred to *C. danvillense*, n. sp.

Cirsotrema (Coroniscala) spillmani (Aldrich)

Scalaria octolineata Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., vol. VIII, p. 153, pl. 3, fig. 22; Aldrich, 1886, Geol. Survey Alabama, Bull. No. 1, pt. I, p. 34, pl. 1, fig. 22. *Non* Conrad, 1860, *loc. cit.*

Scalaria Spillmani Aldrich, 1885, *op. cit.*, p. 154.

Cirsotrema (*Coroniscala*) *octolineata* (Conrad), Palmer, *partim*, pl. 10, figs. 17, 20, 24.

The type locality of this species would be Enterprise, Mississippi. The age is Cook Mountain, lower Claiborne Eocene and not Jackson as suggested by Aldrich. The type is not available. A neotype would have to be selected from the type locality. The specimen figured by the author from Wautubbee, Mississippi, is from the same horizon but not the same locality.

Cirsotrema (Coroniscala) danvillense, n. sp. Plate 28, figs. 8, 16

Scala octolineata Aldrich, 1897, Bull. Amer. Paleont., vol. II, No. 8, p. 7, pl. 4, figs. 6, 6a. *Non* Conrad, 1860, *loc. cit.*; *nec* Aldrich, 1885, *loc. cit.*; *nec* Aldrich, 1886, *loc. cit.*

Total nuclear whorls unknown; portion of last nepionic whorl small, marked from the postnuclear whorl by a definite line; postnuclear whorls with longitudinal lamellæ and fine spiral ribs. The width of the interspaces between the spiral ribs increases with age and becomes filled with microscopic spiral lines which cover the whole surface of the whorls and right side of the varices. The strength of the primary spiral ribs decreases with age but the ribs may be seen obscurely on adult shells without the aid of the microscope. Whorls about seven, a complete adult shell not available; longitudinal ribs irregularly varicose; aperture circular, outer (basal) margin enlarged into a varix; basal cord conspicuous; lamellæ scalariform; to the right and just below the suture the margin is drawn into a spinulose condition. Perfect shells probably had the spinose character accentuated. The number of longitudinal lamellæ range from 13 to 20 with the greatest number of specimens having from 14 to 16.

The species differs from *C. spillmani* from the Claiborne in having the varices more irregular. Commonly *C. danvillense* has varices only on the right side extending on one or more whorls. The varices are not limited to a particular side or whorl. *C. danvillense* has the varices extended out from the suture into a backward curved flare or incipient spine. The varices of *C. spillmani* are more rounded although such differences in appearance may be due to the excellent preservation of the Danville Landing material of the species compared with the shells of the Claiborne species. A specimen from the Gosport sand figured by me (1937, pl. 10, fig. 18) as *C. nassulum* shows similar flaring or spinose character of the varices as on *C. danvillense*.

A difference which appears conspicuous between specimens of *C. danvillense* and related species from the Claiborne is the microscopic structure of the surface. Under the binoculars, the primary spiral ribs predominate over the microscopic lines, but the specimens of the Claiborne species show only the microscopic threads. I do not believe that such an appearance represents a natural difference but merely that the preservation of the Danville Landing shells are less worn, and the primary ribs are strong enough so that the slight elevation between rib and hollow is not levelled with magnification. The basis for this conclusion is that a few Danville specimens have the primary ribs so weak that they too do not show under strong power. The presence of primary ribs may be observed without the use of the microscope on specimens of species of this group from both the Claiborne and Jackson beds.

This species is represented in our collection by over 200 specimens from Danville Landing, Louisiana. So far this is the most abundant species of *Epitonium* in the southern Claiborne-Jackson material and is unusual in its proliferation.

Dimensions.—Height, 21+ mm. (incomplete); greatest diameter, 11 mm.

Types.—Holotype, No. 4502; paratype, No. 4503. Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10. Danville Landing beds, localities 6 (type), 886.

Cf. Cirsotrema (Coroniscala) nassulum (Conrad) Plate 28, fig. 14

Scalaria nassuta Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XVI, fig. 6, typographical error for *nassula*. Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, p. 19, pl. 3, fig. 6.

Scalaria nássula Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 261. Reprint, *op. cit.*, p. 7. *Non S. nassula* Conrad, 1833, 1834.

Cirsotrema (Coroniscala) nassula (Conrad), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, pl. 10, fig. 23, copy of Conrad.

The original *C nassulum* was described from the Gosport sand at Claiborne, Alabama. Conrad later figured a specimen from Jackson, Mississippi, as belonging to the same species The specimen Conrad figured from Jackson is probably lost as it has not been found to date. For synonymy and discussion of *C. nassulum* (Conrad) see Palmer, 1937, p. 97.

The figure given by Conrad of his Jackson shell is that of a specimen with 11 or 12 longitudinal costæ between the varices. This number, though larger than for typical *C. nassulum*, may not exclude the specimen from belonging to *C. nassulum*. There is considerable variation in the number of longitudinal ribs between varices in the *C. nassulum* group even on the same whorl. Such a difference may be seen on the types.

Our collections do not afford any individuals which compare with Conrad's figured shell from Jackson. We have one specimen, Plate 28, figure 17, which belongs to a similar group as *C. nassulum* but differs from the typical form in having fewer longitudinal costæ This shell has therefore varied in the opposite extreme from Conrad's Jackson individual.

Future collecting may yield specimens from Jackson which may reveal whether the form belongs within the limits of *C. nassulum.*

Dimensions.—Height, 34 mm.; greatest diameter, 11 mm. (taken from Conrad's figure, 1854, may be only approximate).

Figured specimen (*Conrad*).—Not found.

Occurrence.—Moodys Branch marl, Jackson, Miss. (Conrad).

Cirsotrema (Coroniscala) nassulum creolum, n var. Plate 28, fig. 17

Known only by the holotype; shell medium; apical whorls broken, eight whorls preserved; whorls rounded, sculptured with strong longitudinal lamellæ, 13 on the body whorl; the lamellæ are not continuous at the suture but each rib extends forward so that its place of origin at the suture is in line with the rib ahead on the previous whorl and not with the costa which is directly above it. Spiral ribs conspicuous but not strongly developed; varices large, irregular; peristome round, strong; well-developed basal cord; microscopic spiral striæ present.

This form belongs in the general group of *C. nassulum*, the Claibornian species. It is separated subspecifically because of the smaller number of longitudinal costæ, 13 as compared to 20 and more. The only other illustrated Jackson specimen of this form is that called *S. nassula* by Conrad which had more longitudinal ribs than typical. It may be that with more specimens a continuous series may be found between this variation and that of *C. nassulum, s. s.*

Dimensions.—Height, 23.6 mm.; greatest diameter, 10 mm. (holotype).

Holotype.—No. 4504, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10.

Genus **PLICISCALA** de Boury, 1887

De Boury, Étude sur les sous Genres de Scalidæ du Bassin de Paris, Paris, 1887, p. 19.

Genotype by original designation, *P.* "(*Scalaria*)" *Gouldi* (Deshayes). Eocene. Paris Basin. Deshayes, Desc. An. sans Vert., t. II, Atlas, 1866 [1861], pl. 11, figs. 15, 16.

Pliciscala pearlensis (Meyer) Plate 28, figs. 15, 18

Scalaria pearlensis Meyer, 1886, Bericht Senckenberg, naturf. Gesell., p. 4, pl. 1, fig. 9.

Pliciscala pearlensis (Meyer), Cossmann, 1912, Essais Paléoconch. comp., 9 liv., p. 83.

Embryonische Windungen vier. Erwachsene Umgänge mit starken, geraden Rippen, ungefähr zehn auf jeder Windung die sich über die Basis erstrecken. Die älteren Umgänge und die Mündung mit starken Endwülsten. Die Oberfläche ist dicht bedeckt mit feinen, vertieften, punktierten Spiralen, welche ähnlich solchen sind, wie man sie häufig bei *Actaeon* und *Bulla* findet.—[Meyer, 1886].

A single specimen of this species has been found at Jackson, Mississippi.

Dimensions.—Height, 4+ mm.; greatest diameter, 1 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Pliciscala cribrum (Cooke) Plate 28, fig. 13

Epitonium cribrum Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 137, fig. 11.

Subulate, apical angle about 25°. Nucleus small, of at least 4 smooth convex whorls (broken in type); 10 succeeding whorls moderately convex. Entire surface (including base and varices) covered by fine, close-set, reticulating threads which produce a punctate or sievelike appearance under the microscope. Axial sculpture of low, rounded, retractive ribs which become fainter on the larger whorls; strong, round, cordlike varices on fourth and seventh whorls and at the aperture; base with one strong cord. Altitude 23 mm.; latitude 8 mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,947. —[Cooke, 1926].

There is the possibility that this species may be the same as *P. pearlensis* (Meyer). Their general appearance, with the presence in both of the microscopic punctations, suggests a similarity. *P. cribrum* has a strong basal cord which is absent in *P. pearlensis*. The two specimens known of *P. pearlensis* are tiny and it may be that they are young specimens, while *P. cribrum* may represent an adult of the same species. In such a case the basal spiral rib would develop with age.

Due to the war, it was not feasible in regard to the above question to examine the type specimen in Washington, D. C.

Holotype.—No. 353,947, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **ACRILLA** H. Adams, 1860

Adams, H., Zööl. Soc. London, Proc., pt. XXVIII, 1860, p. 241.

Genotype by original designation, "*Aclis acuminata* H. and A. Adams (*Scalaria acuminata*)" = *Acrilla acuminata* (Sowerby) (Zoöl. Soc. London, Proc., XII, 1844, p. 31). Living. East Indies. Sowerby, Thes. Conch., *Scalaria*, vol. I, 1847, p. 106, pl. XXXV, fig. 130; Tryon, Manual Conch., vol. IX, 1887, p. 83, pl. 17, figs. 30, 35; Durham, Jour. Paleont., vol. 11, No. 6, 1937, pl. 56, fig. 3.

Acrilla unilineata (Heilprin) Plate 28, figs. 5, 12, 20

Scalaria unilineata Heilprin, 1880, U. S. Nat. Mus., Proc., vol. 3, p. 150, fig. 5.

Scala unilineata (Heilprin), Aldrich, 1897, Bull. Amer. Paleont., vol. II, No. 8, p. 5, pl. 3, figs. 5, 5a (type).

Whorls about nine in number, convex, with numerous very faint, almost invisible, revolving lines, and much more prominent transverse ones (about 24 on the body-whorl); two very distinct revolving lines on the last volution, the upper one placed at about the middle, the lower one subcarinating it (only the upper of these two lines is seen on the remaining whorls, appearing there as a central line); base striated by revolving lines, and radially by the continuations of the transverse lines; aperture elliptical,

somewhat produced distally.
Length, ¾ inch. (No. 8920.)
Jackson, Miss.—[Heilprin, 1880.]

This species is unique in the Jackson Eocene. Specimens of the species are rare. The only specimen we have is imperfect, about 3.5 mm. in height, and the exact locality from which it came is unknown (Plate 28, figure 5). Aldrich published a good illustration of the type, the original drawings of which are herein included.

Wade Hadley[12] determined this species in collections from the upper Danville horizon, Danville Landing, Ouachita River, Louisiana. This would extend the range from the lower to the upper Jackson.

Aldrich (1897, p. 5) wrote that the specific name was preoccupied but it seems that he must have been confused in names for the appellation of *Scala* or *Scalaria unilineata* has not been found to have been used previously.

Holotype.—No. 8920, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type). Danville Landing beds, Danville Landing, La. (Hadley).

Addendum

Scalaria elegans H. C. Lea, 1841, Am. Jour. Sci., vol. XL, p. 95, pl. 1, fig. 6 (*non S. elegans* Risso, 1826, Hist. nat. l'Europe Merid., IV, p. 113) was renamed *S. leai* by Nyst in 1871 (Ann. Soc. roy. malac. Belgique, VI, p. 116). Nyst's new name was unnecessary because *S. elegans* of Lea is the young of *S. sessilis* Conrad and therefore synonymous with that species (Palmer, 1937, p. 106).

Family NATICIDÆ
Subfamily NATICINÆ
Genus NATICA Scopoli, 1777

Scopoli, Introductio ad Historiam Naturalem . . ., 1777, p. 392.
Genotype by subsequent designation, Harris (Cat. Tertiary Mollusca British Mus. (Nat. Hist.). pt. I, 1897, p. 255), *Nerita vitellus* Linnaeus (1758, p. 776). Recent. Indo-Pacific. Tryon, Manual Conch., vol. VIII, 1886, pl. 8, fig. 60.

[12]Chawner, W. D.: State Louisiana Dept. Conser., Geol. Bull., No. 9, 1936, p. 89.

Subgenus **NATICARIUS** Dumeril, 1806

Dumeril, Zool. Analytique. 1806, p. 164. Substitute name for *Natica* Lamarck, 1799, p. 77 *non* Scopoli, 1777.[13]

Subgenotype by monotypy, *Nerita canrena* Linnæus (1758, p. 776[14]). Living. North Carolina to the West Indies and Gulf of Mexico. Palmer, 1937, pl. 11, fig. 15; Perry, Bull. Amer. Paleont., vol. XXVI, No. 95, 1940, pl. 24, fig. 165a, b.

Key to Jackson Naticinæ

A. Umbilicus with funicle .... *N. permunda*

AA. Umbilicus without funicle

B. Sides of whorls of spire rounded and shouldered above .... *E. jacksonensis*

BB. Sides of whorls of spire in an almost continuous straight line from body whorl to apex (polinician shape)

C. Umbilical callus with cross furrows .... *P. weisbordi*

CC. Umbilical callus without cross furrows .... *P. eminulus*

Natica (Naticarius) permunda Conrad Plate 29, figs. 3-6

Natica permunda Conrad, 1854, Wailes, Rept. Agr. and Geol. Mississippi. p. 289, pl. XVI, fig. 2; Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, p. 6. pl. 3, fig. 2; Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 26; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Dall. 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 365 *partim*; Cossmann, 1925, Essais. Paléoconch. comp., 13 liv., p. 113 section *Nacca*, error in placing in Miocene; typ. error Missouri for Mississippi; Stewart, 1927. Acad. Nat. Sci. Philadelphia, Proc., vol. LXXVIII, p. 323.

Suborbicular; body whorl somewhat excavated near the suture; spire very short; umbilicus very long, profound, with a central broad rounded ridge, and the lower margin subcarinated; columella subrectilinear.—[Conrad, 1855.]

Nuclear whorls minute, flattened, about 2 or 2½ whorls, not demarcated from the postnuclear whorls. A faint groove occurs just below the suture. The lines of growth may be more conspicuous as they radiate from the suture but no furrows exist comparable to those in the living *N. canrena* (Linnæus) or *N. magno-umbilicata* Lea of the Gosport sand.

This species is abundant and widely distributed geographic-

[13]Iredale, T.: Malacol. Soc. London, Proc., vol. XII, 1916, pp. 81, 83; Woodring, W. P., Carnegie Inst. Washington, Pub. No. 385. 1928, p. 378.

[14]According to Hanley, Ipsa Linnæi Conchylia, 1855, p. 392, at least six species were confused by Linnæus under *N. canrena*.

ally and stratigraphically in the Jackson Eocene.

It was first described from the lower Jackson in the Moodys Branch marl at Jackson, Mississippi, and it also occurs commonly in the Danville Landing beds on the Ouachita River, Louisiana. The only difference noted between the Danville Landing specimens and those from collections of the lower beds is that the Danville Landing shells are smaller. This may not be a valid difference but true only of the collections studied.

N. permunda is more like *N. canrena*, type of *Naticarius*, than it is like *Natica*, *s. s.*,[15] in that *N. permunda* has the large funicle with a large notch in the margin of the columellar callus which is developed between the funicular and parietal calli. In *Natica*, *s. s.*, not only is the funicle small but the parietal callus spreads low and wide over the posterior portion of the umbilicus. *N. permunda* lacks the radiating furrows which occur below the suture in *N. canrena*. The funicle occurs on young specimens so that the size of such a feature does not depend on the age of the specimen.

Opercula (localities 10 and 921) have been found associated with *N. permunda* and *Euspira jacksonensis* but not in place in shells of either species so they cannot be identified specifically.

However, a very interesting fact is that *Natica maculosa* Lamarck, an eastern Pacific living species with similar umbilical characters as *N. permunda*, has the same type of operculum. Probably therefore, the operculum figured herein (Plate 3, figs. 1, 2) belongs to *N. permunda*. *N. permunda* is the only species of the Jackson Naticidæ so far known which has the same generic characters as *N. maculosa*. For characters of the operculum of *N. canrena* see Perry, 1940, pl. 24, fig. 165a.

Dimensions.—Height, 18.7 mm.; greatest diameter, 18.2 mm. (holotype). Height, 12.1 mm.; greatest diameter, 12.7 mm. (type material).

Holotype.—No. 13214, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, localities 693, 785, 879.

[15]For illustration of the difference mentioned see Tryon, Manual Conch., vol. VIII, 1886, pl. 4, fig. 58; pl. 8, fig. 60.

880, 881, 921, 1051; 000; 922, 883, 10, 11, 15, 1052; 7, 8, 9; 16; 1; 1119. Yazoo clay, locality 2. Danville Landing beds, localities 6, 886; 14.

Genus **POLINICES** Montfort, 1810
(*Uber* Humphreys, 1797[16])

Montfort, Conchyliol. Syst., t. 2, 1810, p. 222.
Genotype by original designation, *Polinices albus* Montfort (=*N. mammillaris* Lamarck (Hist. nat. An. sans Vert., Deshayes and Milne Edwards, VIII, 1838, p. 628). *Non Nerita mammilla* Linnæus as cited by Montfort. Woodring, Carnegie Inst. Washington, Pub. 385, 1928, p. 385. Living. West Indies. Tryon, Manual Conch., vol. VIII, 1886, pl. 18, fig. 74.

Previously I (1937, p. 121) inserted *P. eminulus* and *P. weisbordi* under the section *Mammilla* Schumacher (Essais nouveau Système Hab. Vers Testacés, 1817, p. 190) because the Eocene species lacked the large funicle of *Polinices, s. s.* However, *M. fasciata* Schumacher (Chemnitz, Neues Syst. Conchyl. Cab., Bd. V, p. 284, pl. 180, figs. 1936, 1937) does not have any suggestion of the notches on the columellar callus which are so characteristic of *P. weisbordi.* Until more detailed study of the whole family of Naticidæ is done no attempt is made to define these species in a subdivision of *Polinices.* The umbilical callus in *P. eminulus* is nearer to that of *Mammilla* than is that of *P. weisbordi* because *P. eminulus* is also destitute of callus furrows.

Polinices weisbordi Palmer Plate 29, figs. 7-11

Polinices weisbordi Palmer 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 122, pl. 12, figs. 7, 10.

This species is widely distributed in the Jackson and except at Montgomery, Louisiana, is not represented by a large number of specimens from a locality. At Montgomery, the type locality, it must have been prolific, for our collections contain over 700 specimens from that place. They have been referred, in collections and in lists of species, to "*Natica eminula*" Conrad as has been pointed out in the original description. Although this species and *P. eminulus* might be confused by shape, they may be readily separated by the two grooves on the columellar callus in *P. weisbordi. P. weisbordi* differs from *P. aratus* (Gabb) of the lower Claiborne in that *P. aratus* has three

[16]Int. Rules Zool. Nom. Opinion 51, Biol. Soc. Washington, Proc., vol. 39, 1926, p. 97 (or Schenk and Mc Masters, Proc. in Taxonomy, 1936, p. 46); Hedley, C., Rec. Australian Mus., vol. 14, No. 3, 1924, p. 154; Findley, H. J., New Zealand Inst., Trans., vol. 57, 1926, p. 395 *Uber.*

grooves in place of two. Cossmann[17] in Martin (1914) made a section *Pliconacca* on the presence of the three grooves. The type came from the upper Eocene of Java. Perhaps the importance of the presence of grooves on the columellar callus in making groups above specific rank is over emphasized in using such a section as *Pliconacca.* For practical determination in the southern Eocene the character is useful. *P. eminulus* (Gosport sand and Jackson of Arkansas) lacks the grooves, *P. aratus* (lower Claiborne) has three furrows, and *P. weisbordi* (Jackson) has two In *P. aratus* the grooves develop three strong folds. The presence of the furrows is a feature persisting from the youngest stage of the conch. Shells less than one mm. in height show them well developed. In *P. aratus* the grooves and ridges are strongly manifested in the young, and in *P. weisbordi* (including variations) they are more conspicuous in immature shells.

If one were not aware of the great variation in the amount of individual depression of the spire of the living *Neverita duplicata* (Say) of the Atlantic and Gulf coasts of United States and that gradations exist between short- and long-spired specimens of *Polinices weisbordi*, a varietal name would be designated for the depressed shells of this Jackson species. High-spired shells were taken for the holotype and paratype of this species. At the same localities and in the same beds, individuals with a short spire occur which as extreme members may be easily differentiated from the typical form. However, there are gradations which complicate a separation. A measure of the total height to the greatest diameter in this species does not give a true comparison of the variations. The difference between the extremes may be judged by the ratio of the height of the spire to the height of the body whorl. On many specimens with an elevated spire there is a slight concavity to the surface of the body whorl below the suture. A trace of such sulcus may be seen on the intermediate shells To denote the lack of stratigraphic value in segregating the short-spired individuals, those localities in which the short

[17]See, Cossmann and Pissarro in bibliography. Reference should be under Cossmann only. Line is misplaced.

extreme has been identified are indicated by an asterisk after the locality number. The intermediate forms are grouped with the species, *s. s.* The absence of short-spired shells at other localities than indicated does not mean that they might not occur there but that probably our collections contain too few specimens to reveal much variation.

At Danville Landing and Wyant Bluff, Ouachita River, Louisiana, where a fairly large representation of the species has been found, the shells with a spire of intermediate height are most common, consisting mostly of immature individuals.

At locality 915, Jackson, Mississippi, an extremely large specimen, 27 mm., height and 25 mm., greatest diameter, related to this species was found. Because it shows no difference from *P. weisbordi* except in size and no other specimens were discovered to form a series and indicate more completely the unit characters the shell is identified by this specific name.

At Montgomery the species does not display a large size, for, out of 700 specimens, about ten reached a height of 18 to 20 mm.

Dimensions.—Height, 18 mm.; greatest diameter, 15 mm.

Types.—Holotype, No. 2785; paratype, No. 2784, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 921, 881, 10* (type), 11*, 15*, 1054*, 883*; 8*, 912*; 1*, 1118, 923. Yazoo clay, localities 915; 2*, 913. Danville Landing beds, localities 6*, 886*; 14. Jackson of Arkansas, locality 897.

Polinices eminulus (Conrad) Plate 29, figs. 12-15

Natica eminula Conrad, 1833, Nov., Fos. Shells Tert. Form., p. 46; Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 171.

For synonymy, discussion, and copy of originad description, see, Palmer, 1937, p. 121, pl. 12, figs. 2, 4, 9, 13; pl. 80, fig. 14. *Polinices* takes the masculine gender.

Although the common *Polinices* in the Jackson is *P. weisbordi*, a species which has been confused by shape with *P. eminulus* of the Gosport sand (see Plate 29, fig. 15), nevertheless *P. eminulus* does occur in the Jackson Eocene in the Crow Creek and White Bluff beds in Arkansas. So far, the collections have not yielded the species from Jackson localities elsewhere. Although the two species have a general polinician shape they may be separated readily by the character of the umbilical callus. *P. eminulus* has a slightly less thickened and spreading umbilical callus, the margin of which is thinner and it lacks the characteristic furrows of *P. weisbordi*.

Dimensions.—Height, 18 mm.; greatest diameter, 13 mm.

Occurrence.—Gosport sand (type). Jackson of Arkansas. Localities 894, 1046, 896, 1049.

Genus **EUSPIRA** Agassiz, 1839

Agassiz, in Desor, French translation of Sowerby's Min. Conch. Great Britain, 1839, pp. 14, 15, 16 (finest print), pl. 5, figs. 1, 2, 3; pl. 479, fig. 3; Sherborn, C. D., Index Animalium, pt. 1, 1922, p. CXVIII under Sowerby, J. de C.; Neave, Nomen. Zool., gives *Euspira* Agassiz, 1838, Germ. ed. of Sowerby, Min. Conch., 14, 320.

Genotype by subsequent designation, Dall (U. S. Nat. Mus., Bull. 90, 1915, p. 106), *Natica glaucinoides* Sowerby. Eocene. England. Sowerby, Min. Conch. Great Britain, vol. 1, 1812, p. 19, pl. 5, three upper figures.

Euspira jacksonensis, n. sp. Plate 29, figs. 16-19

Natica "(*Naticarius*)" *semilunata leana* Palmer, 1937, pp. 117, 119 Jackson shells only.

Lunatia minima Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 370, *partim* Jackson reference.

Shell medium; spire somewhat elevated, whorls flattened just below the suture giving a shoulder to the whorls; umbilicus large, no funicle; parietal and umbilical calli narrow; furrow in the posterior margin of the umbilical callus.

This species differs from the Gosport sand and Sabine (Wilcox) species, *E. leana* (=*N. semilunata leana*), with which I included the form during the Claibornian work, by having a slightly higher spire, more elevated nuclear whorls, and a greater angle to the slope of the whorls.

E. jacksonensis does not have the spire elevated so much as *E. sabina*, and the Jackson species has a larger umbilical opening.

Attention has been called to this form by various authors,[18] and it has been labelled in collections as *N. minima*, *N. semilunata*, and *N. vicksburgensis*. Deceived by the apparent resemblance to *N. semilunata*, I (1937) let that factor outweigh the *Euspira* characters which are developed on the shell, and I included the

[18]Stewart, R. B.: Acad. Nat. Sci. Philadelphia., Proc., vol. LXXVIII, 1927, p. 323; Vaughan, T. W., U. S. Geol. Survey, Bull. No. 142, 1896, p. 50 possibly *L. vicksburgensis* as I have seen other collections so labelled.

forms *leana* and *sabina* as varieties of *N. semilunata* Lea which is a *Natica* (*Naticarius*). After additional study of the Jackson material it seems that the abundance of the shells with the *Euspira* characters indicates that the absence of the funicle and the notched columellar callus are distinct and generic characters. As pointed out in 1937, *N. semilunata* has an umbilicus with a funicle as in *Naticarius*. It lacks the radiating wrinkles from the suture but I believe the umbilical characters are of greater generic importance than the striæ. The umbilical characters are developed in the young, hence they are very good features upon which to differentiate the shells of the Naticidæ. In small and broken specimens the genus may be ascertained if the umbilical area is available.

Although this species may be readily separated from *N. semilunata* of the Gosport sand by the lack of an umbilical rib in *E. jacksonensis*, its discrimination from *E. leana* of the Gosport sand and Sabine Eocene is not so easily rendered. The differentiation from *E. leana* is based on a difference in shape which is more difficult to use in diagnosing unknown stratigraphic material. The associated fauna should be considered.

The species differs from *E. vicksburgensis* (Conrad) in having the whorls of the spire decidedly more shouldered than those of that form.

Dimensions.—Height, 21 mm.; greatest diameter, 20 mm.

Types.—Holotype, No. 4517; paratypes, Nos. 4518, 4519, 4520, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 693, 785 (type), 880, 881, 921; 900; 10, 11, 15, 883, 1054; 8, 9; 12; 1; 922; 1121.

Euspira sabina (Palmer)

"*Natica*" *semilunata sabina* Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 118, pl. 11, figs. 8, 9.

This species is the most elevated of the *E. sabina-leana-jacksonensis* stock.

Geologic occurrence.—Sabine (Wilcox) Eocene

Euspira leana (Palmer)

"*Natica*" *semilunata leana* Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 118, pl. 11, figs. 4-7.

Under this species I have included individuals from the Gosport sand and the Sabine (Wilcox) Eocene. Contrary to reasoning that the Sabine and Claiborne forms are probably not the same species they are grouped together because their differences in shape are so immeasurable that specific separation is not practical so far as stratigraphic work is concerned.

The *E. sabina-leana-jacksonensis* stock is a group in which differentiation is based on shape. *E. sabina*, representing the extreme of an elevated spire, is the most readily determined. To *E. jacksonensis* may be attributed an intermediate position of spire height. Some specimens from Woods Bluff, Alabama, Sabine Eocene, resemble the Jackson specimens.

Geologic occurrence.—Sabine. Gosport sand (type).

Subfamily SININÆ

Genus SINUM Roeding in Bolten, 1798
(*Sigaretus* Lamarck, 1799, p. 77)

Roeding in Bolten, Museum Boltenianum, 1798, pt. 2, p. 14.

Genotype by subsequent designation, Dall (U. S. Nat. Mus., Bull. 90, 1915, p. 109), *Helix haliotoidea* Linnæus (12 ed., 1767, p. 1250). Recent. Western Pacific ? (*fide* Woodring, 1928, p. 389). Hanley, Ipsa Linnæi Conchylia, 1855, p. 390, pl. IV, fig. 7. Not Mediterranean as originally stated (Hanley).

Sinum danvillense, n. sp. Plate 30, figs. 6, 7

Shell medium; nuclear whorls worn in all specimens; postnuclear whorls bear microscopic spiral striations which increase rapidly and conspicuously and cover the whole surface of the shell as in the case of the other species of *Sinum* in the southern Eocene. The umbilical callus does not completely conceal the umbilicus but leaves a narrow opening.

This species differs from *S. bilex* of the Claibornian and *S. vicksburgense* of the Vicksburg in being more flattened. The spire is more enlarged in those two species than in *S. danvillense*. This species is nearer in shape to *S. arctatum* of the Claiborne but differs from that species in having the margin of the umbilical callus elongate. In *S. arctatum* the umbilical callus is thickened across the umbilicus with its lower margin concave producing a tunnel-like effect of the umbilical opening.

Dimensions.—Height, 13 mm.; greatest diameter, 13 mm. (holotype).

Types.—Holotype, No. 4521; paratype, No. 4521A, Paleontological Research Institution.

Occurrence.—Danville Landing beds, localities 6 (type); 20.

Sinum, sp. Plate 30, figs. 3, 4

Shell small; flattened; nuclear whorls smooth; postnuclear whorls covered with fine spiral striations; umbilicus well defined.

Known only from one small specimen which therefore forbids designation with a new name. The parietal and umbilical calli are not well developed but this may be due to immaturity. Lack of material also limits our knowledge of the amount of variation that might exist in such a character. The shell is of the general type of *S. beatricæ* of the Claibornian with which it is comparable in flatness of the body whorl and character of the umbilical and parietal areas. *S. beatricæ* has the umbilical callus well extended.

Dimensions.—Height, 2 mm.; greatest diameter, 4.5 mm.

Figured specimen.—No. 4522, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10.

Family AMPULLOSPIRIDÆ

Cox, Pal. Indica, Geol. Survey India, Mem., n. ser. vol. XV, pt. VIII, 1930, p. 170; Roy. Soc. Edinburgh, Trans., vol. LVII, No. II, 1931, p. 38.

The degree of generic importance to place on the amount of umbilical covering would best be solved by studying a large suite of related species from the Eocene of the Paris Basin and English area. Deshayes (Desc. Coq. fos. Env. Paris, t. 2, 1824 [1832], p. 170, pl. 21, figs. 5, 6) stated that the columellar callus covers a part of the umbilicus on *Natica sigaretina* but in his later writings (Desc. An. sans Vert., t. III, 1866 [1864], p. 63) under *N. sigaretina* and *N. semipatula*, he described the umbilicus as closed and gave distinctions between the umbilical opening in the three species, *G. sigaretina* (Lamarck), *G. patula* (Lamarck), and *G. semipatula* (Deshayes). *G. morgani* would be included in the perforated *G. patula-semipatula* group. With a fairly large number of specimens of the Paris Basin species such as *G. parisiensis* (d'Orbigny) and *Crommium willemeti* (Deshayes), which I have examined, one sees that the umbilical opening varies from none to 1 mm. in width in *C. willemeti* and from none to 1.5 mm.

in *G. parisiensis.* I do not believe it is correct to give generic or even specific characters in either *Crommium* or *Globularia* to include the umbilical perforation completely closed by the callus. Specimens are figured herein to illustrate a few variations.

The Ampullospiridae, with certain variations in the diagnostic features of the family, is an important family in the Eocene. The proper arrangement of the forms is only approached as yet.

Genus **GLOBULARIA** Swainson, 1840

Swainson, Treatise on Malacology, 1840, p. 345.

Genotype by subsequent designation, Herrmannsen (Ind. Gen. Malac., 1, 1846, p. 480), *Natica sigaretina* (Lamarck). Eocene. Paris Basin. (Lamarck, Ann. Mus. nat. Hist. nat., t. 5, 1804, p. 32). Plate 30, fig. 13.

Globularia morgani (Johnson) Plate 30, figs. 11, 12

Ampullina morgani Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 80, pl. II, fig. 12.

Globularia morgani (Johnson), Stewart, 1927, Acad. Nat. Sci. Philadelphia, Proc. for 1926, vol. LXXVIII, p. 330.

Shell globose, spire prominent, whorls convex, somewhat flattened below the suture, smooth, with numerous, very close, fine lines of growth, and obsolete revolving raised lines on same portion of the shells, umbilicus of moderate width surrounded by a reflected polished callus, that extends to the anterior portion of the aperture, pillar-lip thin not reflected over the umbilicus. Length 31 mm., greatest diam. 27 mm.

Two specimens collected by Thomas A. Morgan, at Jackson, Miss.

This species is distinguished from *A. streptostoma* Heilp. by the more prominent spire, flattened area below the suture, larger umbilicus and *non*-reflected pillar-lip.—[Johnson, 1899.]

One specimen of this species was found at Town Creek, Jackson, Mississippi. The umbilicus on the shell is fairly large. This is true also of the type although it is not so shown on the original illustration.

The apical 4 or 4½ whorls, including the nucleus, are small, pyramidal and sharply pointed; the succeeding whorls become increasingly flattened below the suture. This shape is typical of *G. patula* (Lamarck) of the Barton beds, upper Eocene, of England.

Holotype.—No. 7440, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Mississippi (type), locality 785.

Genus **CROMMIUM** Cossmann, 1888

(*Lupia* Conrad, 1865 *non* Robineau-Desvoidy, 1863)

Cossmann, Ann. Soc. roy. malac. Belgique, t. XXIII, 4th ser., t. III, 1888, p. 173.

Genotype by original designation, *Ampullina Willemeti* (Deshayes) (Desc. Coq. foss. Env. Paris t. 2, 1824, p. 141, pl. XVII, figs. 11, 12). Eocene. Paris Basin. Plate 30, figs. 10, 14.

Crommium jacksonense (Harris) Plate 30, fig. 5

Amauropsis jacksonensis Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 474, pl. XIX, fig. 3; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 138.

Size and general form as shown by the figure; whorls 10, the upper 4 to 5 small, the other increasing in size rapidly and becoming shouldered; body whorl large, shouldered; umbilicus none or entirely hidden by a labial callosity. This differs from *A. perovata* Con. by its greater height, the well-defined shoulder on each whorl, and the absence of an umbilicus.

Locality.—Jackson, Miss.—[Harris, 1896.]

Prof. Harris pointed out the differences between this Jackson species and *C. perovatum* of the Claiborne to which it bears a similarity in shape. Both differ from typical *Crommium* in having a more elevated spire. However, the two species seem to agree more closely with *Crommium* in the character of the umbilical area than they do with that of *Pachycrommium*, the genus in which *C. perovatum* was segregated by Woodring. (See Palmer,[19] 1937, p. 137.)

The difference between the slight perforated umbilicus in *C. perovatum* and the nonperforation in *C. jacksonense* can hardly be of generic importance when a greater gap in that area may be seen in specimens of the genotype of *Crommium*, see Plate 30, figs. 10, 14.

The base of the body whorl of the holotype is broken. Obscure spiral folds show through on the shell where the surface is worn.

Dimensions.—Height of spire, 15 mm.; greatest diameter, 21.5 mm. (holotype).

Holotype.—No. 7445, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Mississippi (type).

Genus **AMPULLELLA** Cox, 1931

Cox, Roy. Soc. Edinburgh, Trans., vol. LVII, pt. 1, 1931, p. 38.

[19]Under *Crommium perovatum* in the work referred to, a typographical error is present, p. 137. In the next to the last sentence, first paragraph, the word "not" obviously should be deleted to conclude the statements in the preceding sentences.

Genotype by original designation, *Ampullaria depressa* Lamarck (Lamarck, Ann. Mus. nat. Hist. nat., 1806, t. 8, pl. 61, figs. 3a, 3b). Eocene. Paris Basin. Cossmann and Pissarro, Icon. comp. Coq. foss. Eocenè Env. Paris, 1910-1913, t. 2, pl. X, fig. 64-7.

In the Claiborne work, I retained the use of *Ampullina* Bowdich, 1822, for *A. recurva* and *A. recurva dumblei* of the lower Claiborne. *Ampullina* Bowdich (Elements of Conchology, p. 31, pl. 9, fig. 2) was illustrated by a single unnamed species. Authors[20] have interpreted the figure given by Bowdich as that of *A. depressa* Lamarck. However, more recently Cox (Pal. Indica, n. s., vol. XV, 1930, p. 170; 1931, *op. cit.*, p. 38) doubted the identity of the Bowdich figure as *A. depressa*. He made the real *A. depressa* the type of a new genus, *Ampullella*, and suggested that the illustration in Bowdich might be *N. labellata* Lamarck. If that were true *Ampullina* Bowdich would be more *Euspira*-like and would be synonymous with *Labellinacca* Cossmann (in Cossmann and Peyrot, Act. Soc. Linn. Bordeaux, t. LXX, 1918, p. 188) of which *N. labellata* Lamarck is the genotype. Until the species figured in Bowdich can be determined with greater certainty than supposition, it would seem that *Ampullina* Bowdich would have to be abandoned in any strict sense.

Ampullella recurva (Aldrich) with its probable variety, *A. dumblei* (Heilprin) (Palmer, 1937, pp. 133-134, and its initial variety in the Sabine (Wilcox) Eocene (Harris, Bull. Amer. Paleont., vol. III, No. 11, 1899, p. 92, pl. 12, fig. 1) may present characters beyond the boundary of *Ampullella*. Although *A. depressa* may exhibit a perforate condition, it is more frequently covered in the umbilical area. Typically *A. recurva* is umbilicated but the form in the Sabine suggested by Harris as a variety of *A. recurva* is imperforate. Also, if *A. dumblei* (Heilprin) is a bona fide variety of *A. recurva*, it would represent a less perforate variety of the stock than *A. recurva*. However, *A. dumblei* may have an umbilicus regardless of the original description. It remains to be seen in the case of the Claibornian forms mentioned how much separation should be made on the degree of

[20]Dall, W. H.: U. S. Geol. Survey, Prop. Paper, 59, 1909, p. 89; Stewart, R. B., Acad. Nat. Sci. Philadelphia, Proc., vol. LXXVIII, 1927, p. 330; Cox. L. R., Rept. Paleont. Zanzibar Protectorate, Mollusca, 1927, p. 20 *nomen dubium*.

perforation. Certainly such a character is of minor importance in the family.

Family XENOPHORIDÆ

Genus XENOPHORA Fischer de Waldheim, 1807

Fischer de Waldheim, Muséum-Demidoff, Moscou, vol. 3, 1807, p. 213.[21]

Genotype by subsequent designation, Gray (Zoöl. Soc. London, Proc., pt. XV, 1847, p. 158), *Trochus conchyliophorus* Born, 1780, = *T. trochiformis* Born, 1878 (Index Musei Cæsarei Vindobonensis, p. 355) (=*X. laevigata* Fischer de Waldheim). Living. North Carolina to Brazil. Fossil. Eastern America. Clench and Aguayo, Johnsonia, 1943, No. 8, pl. 1, figs. 1-2.

Xenophora trochiformis (Born) Plate 30, figs. 15-18

Turbo trochiformis Born, 1778, Index Musei Cæsarei Vindobonensis, p. 355.

Trochus conchyliophorus Born, 1780, Testacea Musei Cæsarei Vindobonensis, p. 333, tab. XII, figs. 21-22.

Phorus reclusus Conrad, 1854, Wailes, Rept. Agr. and Geol. Mississippi, p. 289, pl. XVII, figs. 6a, 6b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262, Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 8, 19, pl. 4, figs. 6a, 6b.

Onustus reclusus Conrad, 1865, Am. Jour. Conch., vol. 1, p. 33.

Xenophora reclusa Conrad, sp. dub., de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 144.

Xenophora humilis Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. I, pl. 4, figs. 10, 10a *non* Conrad, 1848.

Xenophora conchyliophora (Born), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 360 *partim*; Harris, 1899, Bull. Amer. Paleont., vol. III, No. 11, p. 85, pl. 11, fig. 17.

Cf. *Xenophora*, sp. Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 143, pl. 14, figs. 1, 2, 6.

Testa imperforata, convexo-conica, anfractibus, plicato-rugosis, basi concava, apertura falcata.—[Born, 1780.]

The Eocene members of this species displayed a preference for bivalves in cementing bits to the surface of their shells. However, the material so used was not limited to the shells of pelecypods nor to a particular genus or species. The attached fragment was connected by its convex surface. The umbilical area was imperforate or partially perforate.

Dall was the first to identify the common Tertiary fossils of eastern and southern America *Xenophora* as equivalent to the living species of eastern United States and the Antilles.[22] He also included the Cretaceous *X. leprosus* of Morton. Later authors have retained Morton's name for the Cretaceous shells. Many of the Cretaceous specimens occur as casts, therefore, it

[21] Fischer, Paul: Jour. Conchyliol., t. 5, 1857, pp. 251-253, reprint of pp. 213, 214 on *Xenophora* of Fischer de Waldheim.

[22] See, Clench, W. J., and Aguayo, C. G.: Johnsonia, No. 8, 1943, pp. 1-2.

is difficult to be certain of their specific identity. The material so far discussed[23] from the Midway (Paleocene) has been in the form of casts, and hence the determination must be limited.

The Miocene, Recent, etc., synonymy is not included in the present report.

Dimensions. Height, 17.8 mm.; greatest diameter, 30 mm. (lectotype, *X. reclusa*).

Lectotype.—(*X. reclusa*) No. 13195, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Sabine (Wilcox) and probably Claibornian Eocene. Jackson: Moodys Branch marl, localities 785, 881, 1051, 10; 7, 8; 1, 1119—Yazoo clay, locality 915. [*X. reclusa.*]

Xenophora humilis (Conrad) Plate 30, fig. 2

Phorus humilis Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc., vol. III, p. 285; Conrad. 1848, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. I, p. 116, pl. 11, fig. 46.

Onustus humilis Conrad, 1865, Am. Jour. Conch., vol. 1, p. 33; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25.

Xenophora humilis (Conrad), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, Pt. II, p. 361; *non* Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, pl. 4, figs. 10, 10a.

Xenophora humilis (Conrad), Vaughan, 1896, U. S. Geol. Survey, Bull. 142, p. 50.

Depressed; volutions five, with comparatively large shells and fragments adhering; body whorl very wide, much depressed; base flat; near the periphery concave. Width 8-10. Height ¼.

I found but one specimen of its shell, which seems to be less elevated than the other species.—[Conrad, 1847; 1848.]

This species was described from Vicksburg, Mississippi, Oligocene. Jacksonian specimens of the species were reported by Dall from the "White limestone" at Claiborne Bluff, from Jackson, Mississippi, and from the Ocala limestone in Florida. Vaughan listed the species from Montgomery, Louisiana. I have not found specimens in our collections and due to the war have not been able to examine the shells at the U. S. National Museum identified by Dall and Vaughan.

Dimensions.—Height, 8 mm.; greatest diameter, 20 mm. (lectotype).

Lectotype.—No. 13521, Academy of Natural Sciences, Phila-

[23] Harris, G. D.: Bull. Amer. Paleont., vol. 1, No. 4, 1896, p. 117, pl. 12, figs. 12, 13; Gardner, Julia, Univ. Texas Bull., No. 3301, 1935, p. 299.

delphia, Pa.

Occurrence.—Jackson Eocene (Dall and Vaughan). Vicksburg Oligocene (type).

Family **CALYPTRÆIDÆ**

Genus **CALYPTRÆA** Lamarck, 1799[24]

Lamarck, Soc. Hist. Nat. Paris, Mem., 1799, tab. facing p. 70, *Calyptraea;* No. 54, p. 78 *Calyptræa.*

Genotype by monotypy, *Patella chinensis* Linnæus (1758, p. 781). Recent. England through the Mediterranean. Fossil. Tryon, Manual Conch., vol. VIII, 1886, pl. 34, figs. 56, 57.

Section **TROCHITA** Schumacher, 1817

(*Trochatella* Lesson, Voy. "Coquille," Zool. 2, p. 389)

Schumacher, Essai d'un nouveau Système des Habitations des Vers Testacés, 1817, p. 184.

Type by subsequent designation, Dall, (1909, U. S. Geol. Survey, Prof. Paper, 59, p. 81), *T. radians* Lamarck=*Trochita spiralis* Schumacher=? *Patella trochiformis* Gmelin, 1791 (*non Calyptraea trochiformis* Lamarck, 1802 = *C. aperta* (Solander), 1766).[25] Panama to Peru. Recent. Tryon, Manual Conch., vol. VIII, 1886, pl. 35, figs. 84-88.

After examining the genotypes of *Calyptræa* and *Trochita* and comparing them with the variation of character as seen in *C. aperta*, an agreement with Dall and Thiele is reached that *Trochita* is not of more than sectional value. Other authors separate the two into distinct genera or subgenera. *C. aperta* is an intermediate form, resembling *Calyptræa* in typical sculpture, but affiliating more with *Trochita* by the umbilical area. The perforated area with the labium is usually broken in the fossil shells. In a collection of 18 specimens of the high conical variation of *C. aperta* from Ver, France, nearly every specimen has that region perfectly preserved. The shape of the columella and inner lip is typical of *Trochita.* Amongst the 18 shells are individuals showing variation from lack of an umbilical opening to where the overlap of columellar callus extends about one-third the length of labium or apertural shelf. On other specimens of *C. aperta* with a more flattened shape, the overlap is increased. None seen has reached the stage as occurs in typical *Calyptræa.*

Calyptræa aperta (Solander) Plate 31, figs. 2, 4-12

Trochus apertus Solander, 1766, in Brander, Fossilia Hantoniensia, p. 9, pl. 1, figs. 1, 2.

[24]Sum. Opinion Rend., No. 94, Int. Rules Zool. Nomen., Smithsonian Misc. Coll., vol. 73, No. 4, 1926, p. 12, *Calyptraea* Lam., 1799, mt., *Patella chinensis* L., placed in the Official List of Generic Names.

[25]*Fide* Deshayes, G. P., and Milne Edwards, H.: Hist. nat. An. sans Vert., 2d ed., tome 7, 1836, p. 627.

Trochus opercularis Solander, *op. cit.*, fig. 3.
Calyptræa trochiformis Lamarck, 1802, Ann. Mus. nat. Hist. nat., t. 1, p. 385; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 352. *Non* Gmelin, 1790.
Calyptræa aperta (Solander), Harris, 1899, Bull. Amer. Paleont., vol. III, No. 11, pt. II, p. 84, pl. 11, figs. 13-16; Maury, 1912, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. XV, p. 99, pl. XIII fig. 5 Midway (Paleocene), Trinidad; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 145, pl. 16, figs. 1, 2, 3, 5; Olsson, 1944, Bull. Amer. Paleont., vol. XXVIII, No. 111, p. 90, pl. 9, figs. 10-13.
Calyptræa (Trochatella) aperta (Solander), Olsson, 1928, Bull. Amer. Paleont., vol. XIV, No. 52, p. 62, upper Eocene, Peru.

The complete Eocene synonymy and original description were given in my Claiborne report, hence they are not repeated here. For further references to synonymy of the species see, Dall, Harris, and Palmer. I am not sure that *Calyptræa alta* (Conrad) is the same as *C. aperta* and hence have ceased to follow Dall in uniting the two names.

The nucleus is composed of 2½ to 3 whorls, the first whorl minute, with the following whorls greatly enlarged and flared hornlike; the apical whorls are elevated but there is no distinct demarcation between the nuclear shell and the postnuclear whorls. Often there are microscopic widely spaced radiating lines over the enlarged portion of the nucleus. Following the protoconch, there is a more or less smooth stage consisting of a whorl which is smooth except for coarse lines of growth. In general, the stage succeeding the smooth period has the surface of the shell covered with microscopic, wavy or irregular radiating striations. These may be retained throughout the remainder of the shell growth and be conspicuous on adult shells. The illustrations of the Claiborne shells (Palmer, 1937, pl. 16, figs. 1, 5), as well as the Jackson, bespeak this feature. Superimposed over the fine radiating lines, hooked nodes or spines, or frilled lines of growth occur. The growth of the shell may be accelerated so that the intermediate stage of radiating lines is crowded, and the coarse puckered lines of growth predominate as in figures 11, 12, Plate 31. In some young stages, the radiating lines are omitted. The described stages have been followed through in both the Claiborne (Gosport sand) and Jackson specimens. Orangeburg, South Carolina, McBean formation, lower Claiborne and Claiborne Bluff, Gosport sand, shells include similar high-coiled elongate-spinose forms as do specimens from Ver, France, Auversian Eocene. Spinose individuals were probably as abundant elsewhere in the Claibornian but the preservation of the Orangeburg shells is unique. Delicate parts were destroyed in a less favorable environment for preservation.

No new data or points of view have been established which will enable one to separate specifically the English, French, and American migrants of *Calyptræa aperta* (Solander). If the European and American synonymies of the species are examined, the attempts of authors in the past to separate from the parent stock some of the numerous variations, are obvious. I have not examined Oligocene and Miocene collections to verify Dall's and Martin's determinations that the species extends into the Chesapeake Miocene. The specimen figured by Martin (1904, pl. LIX, fig. 1) is similar to typical *C. aperta*. The individual of figure 3b, plate LIX is merely a young shell of the species called *C. aperta*. It was named a new species, *Calyptræa greensboroënsis*,[26] by Martin, the specimen, figs. 3a, 3b, being the holotype. This is not a valid species. The shell is immature as can be determined from the figure, consisting of 1 or 1½ whorls beyond the protoconch and bearing the fine radiating striations This is typical of the corresponding third or striated stage of the Eocene *Calyptræa aperta* as illustrated (Plate 31, fig. 9). The shell being young, indicates that the Miocene *Calyptræa* passes through a similar evolution in species development.

A. A. Olsson (1944) has collected and figured specimens from the Cretaceous of Paita, Peru, that appear to be typical representatives of the species.

Dimensions.—Height, 9 mm.; greatest diameter, 18 mm. (medium-sized specimen). The species varies so much in dimensions, that these measurements of one specimen should be used only as a criterion of the average growth.

Type.—British Museum (Natural History).

Occurrence.—Sabine. Lower Claiborne. Gosport sand. Jack-

[26]Martin, G. C.: Maryland Geol. Survey, Miocene, 1904, p. 248, pl. LIX, figs. 3a, 3b.

son: Moodys Branch marl, localities 921, 785; 1100, 900; 883, 10, 11, 15; 1121; 912; Yazoo clay, localities 2, 913; Danville Landing beds, locality 6.

Calyptræa alta (Conrad) Plate 31, figs. 1, 3

Trochita alta Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XV, figs. 3a, 3b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 259; Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 5, 19, pl. 2, figs. 3a, 3b; Conrad, 1865, Am. Jour. Conch., vol. 1, p. 33; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 24. *Non Trochita alta* Hutton, 1885.

Conic, elevated, with three or four transverse undulations; radii prominent, rounded, very irregular, interrupted, somewhat tuberculated; vertex central, spiral, somewhat prominent.—[Conrad, 1855.]

Dall in 1892 (p. 352) included this species under *C. trochiformis* (=*aperta*) Conrad. I, in the Claiborne work, on Dall's authority, inserted *C. alta* in the synonymy of *C. aperta*.

The two species are distinct and only the apical end, if broken and isolated from the remainder of the shell, could be confused in the two forms.

The nuclear whorls are minute, spiral, pointed and smooth, consisting of probably 1½ whorls with the following whorls enlarged and smooth; the coarse radiating ribs begin on the following whorls and cover the whorl of the remaining portion of the shell. It may be that all of the smooth apical end is the protoconch.

Dimensions.—Height, 14.5 mm.; greatest diameter, 21.1 mm., (lectotype).

Lectotype.—No. 13194, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, localities 785, 881; 883, 11. Yazoo clay, locality 915.

Family **CAPULIDÆ**

Genus **CAPULUS** Montfort, 1810

Montfort, Conchyliol. Syst., t. 2, 1810, p. 54.

Genotype by original designation, *Patella hungaricus* Linnæus (*ungarica*, 1758, p. 782). Living. Iceland to Aegean. Greenland to Florida. Fossil, Miocene-Pliocene. Europe. Harmer, Palæont. Soc., vol. LXXV, 1923, p. 763, pl. LXI, figs. 1, 2; Tryon, Manual Conch., vol. VIII, 1886, p. 131, pl. 39, figs. 72-74.

Capulus americanus Conrad Plate 32, figs. 8, 12-15

Capulus Americanus Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XV, figs. 1a, 1b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 259, Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 5, 19, pl. 2, figs. 1a, 1b; Conrad, 1865, Am. Jour. Conch., vol. I, p. 33; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 24.

Amalthea americana Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 358.

Obliquely ovate, longitudinally contracted on one side; lines of growth profound; summit very oblique; apex profoundly prominent, acute, curving towards the base and projecting far beyond the basal margin; aperture obtusely oval or suborbicular.—[Conrad, 1855.]

Nucleus minute, dextral, spiral, consisting of about 2½ whorls, elevated and distinctly marked from the postnuclear whorls; postnuclear whorls not coiled, horn-shaped, convex above, concave below the beak, the convexity often increasing with age, the umbo becomes hooked; shell smooth, wrinkled; muscle scars prominent; apertural margin thickened with age, irregular in outline, depending on the character of the attachment.

The nucleus and young shells of this species may be distinguished from the same stage in *Calyptræa* (*Trochita*) *aperta* in that the protoconch of *C. americanus* is raised above the surface of the postnuclear shell, the whorls of the spire of the nucleus are elevated, and the whole appears helicoid, while in *Calyptræa* the nucleus is sunken, and the body whorl is flared like a horn. There is not the sharp demarcation between nuclear and postnuclear stages in *Calyptræa aperta* as in *Capulus americanus*.

Iredale[27] described the nepionic stage of *Capulus ungaricus* (*hungaricus*) as consisting "of a regularly coiled smooth helicoid of one and a-half whorls succeeded by a varix."

This is a common Jackson species Langdon[28] reported finding it associated with Vicksburg Oligocene shells at Byram station, Mississippi. Such an occurrence does not seem to have been verified by later authors.

Dimensions.—Height, 30 mm.; greatest diameter of aperture, 19 mm. (large specimen).

Holotype.—No. 13193, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, localities 693, 879, 921, 785, 1051; 922; 1121; 10, 11, 15, 883, 1054; 7, 8, 9, 912; 16; 923, 1119. Yazoo clay, locality 2. Danville Landing beds, lo-

[27] Iredale, T.: Mem. Queensland Museum, vol. IX, 1929, p. 277.
[28] Langdon, D. W., Jr.: Am. Jour. Sci., 3d ser., vol. XXXI, 1886, p. 205.

calities 6; 14.

Family **HIPPONICIDÆ**
Genus **HIPPONIX**[29] Defrance, 1819
(*Amalthea* Schumacher, 1817 *non* Rafinesque, 1815)

Defrance, J. Physique, Chimie, Hist. nat., t. 88, 1819, Jan., p. 217, figs. 1, a-f.

Genotype by subsequent designation, Gray (Zoöl. Soc. London Proc., pt. XV, 1847, p. 157), *Patella cornucopiæ* Lamarck (Ann. Mus. nat. Hist. nat., t. 1, 1802, p. 311). Eocene. Paris Basin. Cossmann and Pissarro. Icon. comp. Coq. foss. Éocène Env. Paris, t. 2, 1910-1913, pl. XII, figs. 74-1.

As far as fossil shells are concerned the most reliable criterion for separating *Capulus* and *Hipponix* is the spirality of the nuclear whorls. This differentiation may be elucidated by figures 1, 12, 14, Plate 32, showing representatives of the two genera in the Jackson. The shape cannot be depended upon because superficially some gerontic shells of *C. americanus* assume a shape which could easily be confused with that of *H. cornucopiæ*, the type of *Hipponix*. All authors are not consistent in characterizing the nuclear whorls of the two genera. The genotypes of both genera have fine radiating lines and both have the well-defined horseshoe-shaped cicatrix.

Hipponix pygmæus Lea Plate 32, figs. 1-3

Hipponix pygmæa Lea, 1833, Cont. Geology, p. 95, pl. 3, fig. 75.

For complete synonymy, original description, and figures see. Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 149, pl. 13, figs 1-4, 8, 9; pl. 82, figs. 13, 14; Bull. Amer. Paleont., vol. XXVIII, No. 112, 1944, p. 7.

Shell small, conical with the apex overhanging; apex knoblike, not spiral, smooth; postnuclear whorls entirely covered with fine radiating striations, the size of the interspaces varies from less than the width of the rib to at least twice the size of the rib. Irregular concentric growth stages are conspicuous.

The species can be distinguished readily from the young of *Capulus americanus* by the presence of radial striations and the absence of the helicoid nucleus in *H. pygmæus*.

This species is abundant in the Moodys Branch marl at Jackson, Mississippi. It is also common in the Gosport sand at Claiborne Bluff. The same differences in the size of the interspaces

[29]The original spelling is *Hipponix*. *Hipponyx* Defrance, Blainville, Bull. Soc. Philom., 1819. p. 9 is only a notice of the original article, *fide* Smith, 1906, p. 123.

between the ribs and the shape of the shell exist at both places. The greatest diameter measured for a Claiborne shell of *H. pygmæus* was 5 mm., and 4 mm. for a Jackson individual. *H. sylværupis* Harris of the Sabine (Wilcox) Eocene attains a size of 11 mm., greatest diameter. *H. vagus* Palmer (Bull. Amer. Paleont., vol. XXVIII, No. 112, 1944, p. 6), known by a single specimen from the Gosport sand, is the largest form of the genus so far known from the southern Eocene. The shell of that species is 22 mm., greatest diameter. That measurement is comparable to that of the genotype in the Paris Basin.

Dimensions.—Height (greatest convexity), 1.5 mm.; greatest diameter, 3+ mm.

Lectotype.—No. 5451, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Lower Claiborne. Gosport sand. Jackson, Moodys Branch marl, localities 921, 785; 900; 883; 1055.

Family **RISSOINIDÆ**

Genus **RISSOINIA** d'Orbigny, 1840

D'Orbigny, Voy. dans l'Amer. Merid., t. 5, 1840, p. 395, pl. 53, figs. 11-16.

Genotype by monotypy, *Rissoina inca* d'Orbigny. Living. Peru. Chile. Tryon, Manual Conch., vol. IX, 1887, pl. 55, fig. 15.

Rissoina mississippiensis Meyer Plate 30, fig. 8

Rissoina Mississippiensis Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 69, pl. 2, fig. 17; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II. pp. 342, 343.

The only specimen found has four smooth, embryonic whorls; the first two of which form a disk, thus making the apex blunt; then four adult whorls follow which are slightly convex, and are densely covered by indistinct, rounded oblique, transverse ribs; base with faint revolving lines; aperture semilunar, faintly channeled anteriorly; receding posteriorly, thus giving a strongly sigmoid appearance to the outer lip.

Locality.—Jackson, Miss.—[Meyer, 1886.]

So far this species is known only from the holotype. It has a typical rissoinoid aperture and thickened lips. The species does not belong to *Rissoina, s. s.* It is nearer to those species such as *R. expansa* Carpenter,[30] 1865, living, Mazatlan (Bartsch, U. S. Nat. Mus., Proc., vol. 49, 1915, p. 46, pl. 28, fig. 5). The longitudinal ribs do not extend over the whole of the body whorl, and

[30] Name preoccupied by *R. expansa* Deshayes, An. sans Vert., vol. II, 1861, p. 396 now *Cossmannia expansa* (Deshayes).

there are fine revolving lines on the base.

Dimensions.—Height, 3± mm.; greatest diameter, 1.5± mm

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **OTTOINA**, new genus

Genotype, *Scalaria kinkelini* Meyer. Jackson Eocene. Jackson, Mississippi.

Small, elevated; nucleus smooth, composed of about two whorls; smooth base; surface with strong longitudinal ribs which are strongly curved, forming a deep sinus at the posterior area of the aperture and producing a twisted flaring anterior margin to the aperture.

The distinctive feature of the genus is the reflected posterior margin of the aperture, resembling this character in the Rissoinidæ, especially *Leaella* Cossmann (*L. cossmanni* Aldrich, Palmer, 1937, pl. 6, fig. 4) of the Claiborne Eocene. *Ottoina* differs from that genus in being coarsely sculptured by longitudinal costæ. *Leaella* is smooth. *Ottoina* differs from most of the genera in the Rissoinidæ, particularly *Rissoina* d'Orbigny, in the lack of a varicose labrum or thickened labium.

Ottoina kinkelini (Meyer) Plate 30, fig. 9

Scalaria Kinkelini Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 5, pl. 1, fig. 14.

Klein. Zwei aufgeblasene glatte Windungen bilden den Nucleus. Erwachsene Umgänge mit scharfen Rippen bedeckt, ungefähr zwölf auf jeder Windung. Diese Rippen stehen ziemlich gerade auf den jüngeren Umgängen, werden auf den älteren aber schräger und schliesslich, S-förmig gebogen. Basis glatt, Mündung oval.

Die Art ist nach Herrn Dr. F. Kinkelin in Frankfurt a. M. bennant. [Meyer, 1886.]

Dimensions.—Height, 2 mm.; greatest diameter, 1 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Family **ARCHITECTONICIDÆ**

Genus **ARCHITECTONICA** Roeding in Bolten, 1798

(*Solarium* Lamarck, 1799)

Roeding in Bolten, Museum Boltenianum, pt. 2, 1798, p. 78.

Genotype by subsequent designation, Gray (Zoöl. Soc. London, Proc., pt. XV, 1847, p. 151, "*Architectoma*"), *Trochus perspectivus* Linnæus, (1758, p. 757). Living. Indo-Pacific. Tryon, Manual Conch., vol. IX, 1887, pl. 2, figs. 18, 19.

Architectonica (Architectonica) bellistriata Conrad Plate 32, figs. 16-19

Architectonica bellistriata Conrad, 1854, Wailes, Agr. Geol. Rept. Mississippi, p. 289, pl. XVII, figs. 2a, 2b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 261, Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 9, 19, pl. 4, figs. 2a, 2b; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 158, pl. 17, figs. 10, 11, 14.

Solarium bellistriatum Conrad, Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 327; Meyer, 1886, Bericht Senckenberg. naturf. Gesell., pl. 1, figs. 18, 18a, 18b.

Discoidal, with radiating impressed lines, which frequently bifurcate and are most profound at the suture; whorls of the spire carinated below near the suture; periphery acutely carinated, margined above by two approximate raised lines, and below by a prominent line which is slightly marked by a microscopic impressed line; base with three impressed lines, that nearest the umbilicus profound; radiating striæ interrupted by the revolving lines; base convex towards the periphery and concave towards the umbilicus.—[Conrad, 1855.]

On the apical whorls of adult shells and on young specimens, the radiating lines extend the width of the whorl. They lose their strength with age and become obsolete away from the suture. The suture is deeply excavated. Sometimes the middle of the three basal impressed lines mentioned by Conrad is absent. Figure 16, Plate 32 is included to show an absolescence of the mid-furrow on the basal area. A number of Jackson specimens have the basal impressed line nearest the umbilicus deeply cut but not widened. By the presence of the three impressed basal lines with the inner one profound, the specimen figured in Bull. Amer. Paleont., vol. VII, No. 32, pl. 17, figs. 10, 11, 14, from the lower Claiborne of Texas, is typical.

The type material consists of two specimens. The original illustration does not show the radiating lines extending so far over the width of the whorls as they actually do on the lectotype. On that specimen the lines extend across the width of the whorl. Also on the lectotype, sharp spiral lines on the young whorls cut the longitudinal folds below the suture just above the middle area of the whorl. Such lines become obsolete on the last two whorls of the shell.

Dimensions.- Height, 8.8 mm.; greatest diameter, 19.6 mm. (lectotype).

Lectotype.—No. 13211, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Lower Claiborne. Jackson Eocene: Moodys Branch marl, Jackson, Miss. (type); localities 921, 786; 883; 1—Danville Landing beds, locality 886— Jackson of Arkansas, locality 897.

Architectonica (Architectonica) trilirata (Conrad), var. Plate 32, figs. 4-7

Solarium triliratum Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc., vol. III, p. 282; Conrad, 1848, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. I, p. 113, pl. 11, fig. 4; Meyer, 1886, Bericht Senckenberg. naturf. Gesell., pl. 1, figs. 17, 17a, 17b.

Architectonica trilirata Conrad, 1865, Am. Jour. Conch., vol. I, p. 30; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 29; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 159.

Solarium bellistriatum triliratum Conrad, Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 327 *partim.*

Discoidal, with three thick approximate ridges on the periphery; suture channelled; volutions with oblique impressed lines, and 2 fine revolving lines on each whorl; base convex with three revolving impressed lines that near the umbilicus profound, and with coarse rugose transverse lines. Diameter 7-10. Not common.—[Conrad, 1847.]

The two fine revolving lines on the upper surface of the whorls mentioned by Conrad are distinct and sharp but may become obscure on large mature specimens. That portion of whorl below the lower line and the suture is nodose and elevated above the level of the remainder of the whorl. The base is completely sculptured by the oblique radiating ribs which are crossed by three revolving furrows. The species may be distinguished from *A. bellistriata* by the points just enumerated.

The type material consists of two specimens which are not exactly alike in detail. The Jackson specimen figured herein is closer in appearance to the second of the two specimens than it is to the specimen which had been chosen as the lectotype. The forms of the *A. trilirata* stock which occur in the Jackson may not be typical of that which is present in the Vicksburg. I have, therefore, left the naming indefinite until the species is discussed and analyzed in work on the Vicksburg for without such data naming of the Jackson shells would be premature.

Dall (1892, p. 327) stated that the species was found in the lower Claiborne and Gosport sand. I have not seen the species in collections of Claibornian material.

Dimensions.—Height, 12 mm.; greatest diameter, 21 mm. (Jackson specimen).

Lectotype.—No. 13519, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Jackson, Moodys Branch marl, localities 693, 785; 10; 9. Vicksburg (type).

Subgenus **GRANOSOLARIUM** Sacco, 1892[31]

(*Non Solariaxis* Dall, December, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, pp. 323, 324, genotype, *S. elaboratum* Conrad)

Sacco, Boll. Mus. Zool. Anat. comp., vol. VII, April, 1892, p. 56; I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. XII, June, 1892, p. 59.

Subgenotype by original designation, *Solarium millegranum* Lamarck (Hist. nat. An. sans Vert., VII, 1822, p. 6). Miocene. Pliocene. Italy. Sacco, June, 1892, *op. cit.*, pl. II, fig. 18.

Architectonica (Granosolarium) ornata jacksonia, n. var.

Plate 33, figs. 2-4, 13

Solarium elaboratum variety Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 324.

Shell medium, high; nucleus about two whorls, smooth; postnuclear whorls with two prominent nodose revolving ribs, one rib just below and the other rib just above the suture; conspicuously excavated below the lower spiral rib and the suture. A revolving nodose rib begins faintly on the early whorls between the lower of the two original primary ribs and the suture. This third ridge accelerates and after the first or one and a half turns becomes equal in prominence with the biprimary ribs, and the sculpture is thereafter triprimate. The largest of the three principal ridges is the lower of the original two primaries. The whorl is furrowed above the peripheral carina and below on the base. There are three or four secondary, with sometimes tertiary ribs or threads, between the first and second primaries. The base is convex with five or six nodose spiral ribs, the largest on the umbilical margin. Finer intervening threads may occur. All are crossed by radiating striations.

This is the variety which Dall spoke of as the "most elevated form of *S. elaboratum.*" But tracing the fundamental pattern of sculpture from the nucleus through that of the adult whorls, this form, as well as *A. ornata* (Lea) of the Gosport sand and

[31]Palmer, K. V. W.: Bull. Amer. Paleont., vol. XXVIII, No. 112, 1944, pp. 8, 9.

A. sabinia Palmer (=*delphinuloides* Heilprin) of the Sabine, do not belong to the *A. elaborata* group as Dall segregated them. They seem to be of the stock of *A. meekana* Gabb, *A. sabinia* representing the oldest form. This grouping is based on the biprimate-triprimate pattern of sculpture and the presence of the conspicuous longitudinal striations.

A. ornata in the Jackson differs from typical *A. ornata* (cf. Palmer, 1937, pl. 18, figs. 15, 16, 19) in having the fundamental features of its shell intensified. If one tries to separate the Claiborne and Jackson specimens, the only distinction seems to be that the characters on the Jackson individuals are more pronounced. The shells are larger, the revolving ribs are bigger, and the excavated area between the two lower primaries is larger. A young shell of *A. jacksonia*, Plate 33, figure 13, may be compared with the young of typical *A. ornata* on Plate 33, figure 12. The ornamentation of the Gosport sand specimens is more subdued than that of the Jackson development. Part of such difference may be due to the fact that the Gosport sand specimens studied are small, and the Jackson shells are at least twice the size of those from the "sand."

Dimensions.—Height, 11 mm.; greatest diameter, 18 mm.

Types.—Holotype, No. 4552; paratype, No. 4553, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 1; 10 (type).

Architectonica (Granosolarium) meekana subsplendida, n. var.
Plate 33, figs. 1, 5-8

Shell medium; periphery acute; nuclear whorls smooth, separated from the postnuclear whorls by a distinct line where the highly sculptured postnuclear whorls begin; postnuclear whorls begin with two strong revolving ribs with a minor thread just above the suture, shortly the third row increases until there are three conspicuous, nodose revolving ribs with a pronounced sunken area between the middle rib and the lower; finer beaded revolving threads are displayed between the primary ribs, those in the excavated part are finer. The number of secondary ribs varies with age, increasing with maturity. The whole surface is crossed by fine radiating divaricating threads which cut the spiral ribs, producing the delicate character of the sculpture. Fine beads or nodes are formed at the intersections of the two series of ribs. The ventral surface is ornamented with about five coarse nodose revolving ribs with alternating finer ones. Between the crenulated, acute periphery and the first spiral rib below, there is a wide excavated area with fine spiral threads. The tripartite pattern of sculpture is reflected in the sculpture within the umbilicus. A strong medial rib occurs, the area below (looking into the umbilicus) is cavelike, area above is extended into a broad shelf. The latter area has one or more fine revolving ribs.

The general pattern described above is that typical of the group, represented in the southern Eocene, at least, in the lower Claiborne by *A. meekana*, *A. meekana splendida*, *A. texcarolina* and other probable varieties, and *A. ornata* of the Gosport sand and its Jackson variety.

A. meekana subsplendida belongs more with *A. meekana* (Plate 65, figs. 3, 4, 6, 7) and *A. splendida* of the lower Claiborne than with *A. ornata*. In fact, this variety is so close to *A. splendida* Palmer (Bull. Amer. Paleont., vol. XXVIII, No. 112, 1944, p. 14) that it is difficult to express definite distinctions. The separation is made to call attention to the Jackson and lower Claiborne varieties rather than to be of practical aid in using the two in stratigraphic differentiation.

The holotype of *A. subsplendida*, an adult, has six spiral ribs between the periphery and the medial primary, but on the whorls of the spire the spiral threads of the corresponding area become less conspicuous and the radiating lines almost predominate over them. Medium-sized specimens have only two or three fine spiral ribs in the same area and they may become obsolete in spots. In *A. splendida*, the spiral threads in the similar area are fine but distinct and coarsely beaded. Ventrally, typical *A. splendida* does not have any secondary spiral rib between the primaries in the umbilicus. Typically on *A. subsplendida*, one large rib and sometimes a finer thread is between the primary ribs on the shelflike area. There are specimens in the collections of the variety that are like *A. splendida* in that no secondary ribs are present. More commonly, however, there is a rib. Rarely a fine thread is present on *A. splendida* in the same area.

Dimensions.— Height, 8 mm.; greatest diameter, 16.6 mm. (holotype).

Types.— Holotype, No. 4555; paratypes No. 4556 and No. 4557, Paleontological Research Institution.

Occurrence.— Moodys Branch marl, localities 10 (type), 883; 785, 881, 921. Yazoo clay, locality 915. Danville Landing beds, localities 6; 20.

Subgenus SOLARIAXIS Dall, 1892

Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, 1892, pp. 323, 324.
Subgenotype by original designation, *Solarium elaboratum* Conrad (Am. Jour. Sci., vol. 23, 1833, p. 344). Claiborne Eocene. Southern United States. Palmer, 1937, pl. 18, figs. 13, 14, 17, 18; pl. 81, figs. 13, 14.

Architectonica (Solariaxis) elaborata (Conrad)

Solarium elaboratum Conrad, 1833, Jan., Am. Jour. Sci., vol. 23, p. 344.

For complete synonymy, type measurements, and copy of the original description see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p 164, pl. 18, figs. 10-14, 17, 18; pl. 81, figs. 13, 14. The synonymy given there includes *A. ornata* (Lea), 1833, which is here segregated. Plate 81, figs. 9-11 in Palmer, 1937, are of the lectotype of *A. ornata.* Figures 15, 16, 19. plate 18, same reference, are of *A. ornata* (Lea) not *A. elaborata, s. s.*

The lectotype of *A. ornata* is a small shell, 8.5 mm., greatest diameter, and the specimens range small in size in the Gosport sand compared to *A. elaborata, s. s.* I was under the impression previously that *A. ornata* was the young of *A. elaborata.* When the development of *A. elaborata* in the Gosport sand and *A. ornata jacksonia* in the Jackson is studied one becomes aware that *A. ornata* represents more than a stage in the growth of *A. elaborata* and does not even belong to the same stock. For further discussion of *A. ornata,* see, Palmer, Bull. Amer. Paleont., vol. XXVIII, No. 112, p. 9.

A. elaborata and *A. meekana* represent two prolific stocks, which by the characters of each, *sensu stricto,* may be distinguished readily. Both, in conducive environments of the Claibornian, particularly lower Claiborne stages, developed varieties or affiliated species which may exhibit some feature of both or either, *A. elaborata* or *A. meekana*. It seems as though a description of *A. elaborata* in its strict sense, to use for a basis of comparison or control, would be more useful than that of a looser grouping. Therefore the localities of *A. elaborata, s. s.,* given in Palmer, Claiborne report should be limited to No. 103, Lisbon formation, base of bluff at Claiborne, Alabama; No. 727, Crockett formation (Cook Mountain), Little Brazos River (note Palmer, 1944, p. 17); No. 758, Cook Mountain formation, H. W. Berryman Place, 2½ miles from Linwood, 11 miles from Rusk, Angelina County, Texas, and No. 104, Gosport sand, Claiborne Bluff, Alabama (type). Certain specimens from localities 727 and 136 were described as *A. texcarolina* (Palmer, 1944, p. 15). Those from loc. 766 have been segregated under *A. ornata* (Lea).

On individuals, at least as immature as 9 mm. in greatest diameter, there are five crenulated spiral ribs on the whorls of the spire On the first whorls of the postnuclear region, the revolving lines are fine and are about equal in size. The spiral ribs increase in size with age; the sutural line becomes sunken or the first rib below the suture overhangs, this presents the appearance of an excavated surface. On the body and penultimate whorls, the interspace between the fourth and fifth revolving ridge widens, and the radiating lines of growth become conspicuous (under the lens). There may be incipient fine revolving threads between the major ribs. The fine intervening threads on adult shells become an integral part of the sculpture. The basal angle is carinated by the bounding rib; the base is convex at the umbilical edge and concave near the periphery. There are six basal spiral ribs in adolescense, the first and second at the umbilicus are crenulated. The third develops nodosity with age.

The sculpture on the mature shells is essentially the same as that of the young except that between the five primary revolving ribs there may be one or more fine spiral lines, depending on the age of the specimen. The revolving ridges tend, with maturity, to become irregular in size and frequently the sculpture decreases over parts of the upper surface, tending to affect a smoother appearance. Intervening ribs or lines develop on the base. (Gosport sand.)

A. elaborata was in existence in the lower Claiborne. The collections studied have not yielded abundant specimens. In the Gosport sand the species is well established. In the Jackson the stock is represented by *A. acuta*.

Architectonica (Solariaxis)[1] acuta Conrad

Plate 33, figs. 9-11, 14-19; Plate 65, figs. 1, 2

Architectonica acuta Conrad, 1854, Wailes, Agr. Geol. Rept. Mississippi, p. 289, pl. XVII, figs. 1a, 1b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 261; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 7, 19, pl. 4, figs. 1a, 1b; Conrad, 1866, Smithsonian Misc. Coll., vol VII, No. 200, p. 25.

Solarium acutum (Conrad), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 324 *partim;* Cossmann, 1915, Essais Paléoconch. comp., 10 liv., p. 170 section *Solariaxis*.

Non Architectonica acuta Conrad, Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 167, pl. 20, figs. 12, 14-17. Only synonymy and copy of original description apply to *A. acuta* Conrad.

Non Solarium acutum Tenison-Woods, 1879, Linnean Soc. New South Wales, Proc., vol. 3, p. 236 = *Architectonica balcombensis* Findley, 1927, New Zealand Inst., Trans., vol. 57, p. 501.

Much depressed, very thin and acutely carinated on the margin; convex above, lower half of the whorls somewhat excavated; revolving striæ linear, crenulated, with a minute intermediate crenulated line, and a still finer line or two in some of the interstices; base convex, flattened and somewhat excavated towards the periphery, revolving striæ linear, alternated with a medial smaller line and two minute ones, nearly smooth, except four from the umbilical margin, which rapidly increase in size towards the inner margins; the marginal line profoundly crenulated; a carinated beaded line on the middle of each whorl within the umbilicus, which is profoundly scalariform.—[Conrad, 1855.]

Early postnuclear whorls with five close-set crenulated spiral ribs, the first is the largest and overhangs the suture presenting an excavated sutural area. The general pattern of five or six primary revolving ribs is persistent and characteristic. The ribs enlarge, become more strongly nodose, and have finer intervening spiral lines; on younger whorls, there is one interstitial rib, fine and smooth; on later whorls, there may be more ribs. The peripheral margin is acute. There is variation in the elevation of the spire as is shown by two examples, figures 17, 18, Plate 33. The walls of the umbilicus recede on the base of the preceding whorl so that a crenulated spiral rib other than the marginal is exposed.

After obtaining pictures of the lectotype of *A. acuta* Conrad, I find that various factors misled me in identifying *A. acuta*

Conrad incorrectly in the Claiborne Bulletin. The species called *A. acuta* in 1937 is not that form and was since named by me *A. meekana splendida* (Bull. Amer. Paleont., vol. XXVIII, No. 112, 1944, p. 14). *A. acuta* Conrad is a Jackson derivative of the Claibornian *A. elaborata* stock. The form may be easily confused with *A. elaborata* as may be seen by comparing the figures given herein of *A. acuta* with the illustrations of *A. elaborata* Conrad in Palmer, 1937, plate 18. *A. acuta* reveals the general pattern of five primary revolving ribs dorsally. In *A. elaborata* the ribs become irregular in size while in *A. acuta* they retain a more or less equality in size. *A. acuta* has a more acute margin and usually has more of the spiral ribs outward from the umbilical margin more heavily crenulated. The walls of the umbilicus recede more in *A. acuta* than in *A. elaborata*.

The variation in the spiral ribbing in *A. acuta* at some localities trends toward typical *A. elaborata* in the inequality of dorsal ribbing in mature and older specimens. The umbilical area on such specimens will be similar to that of *A. acuta*. Some specimens of *A. acuta* present a close resemblance to *A. elaborata*.

Through the courtesy of Horace G. Richards, of the Academy of Natural Sciences at Philadelphia, the type of *A. acuta* was made available so that an enlarged illustration could be made to show the pattern and ornamentation.

Dimensions.—Height, 8.5; greatest diameter, 22.6 (lectotype)

Lectotype.—No. 13212, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, localities 785, 879; 881; 10, 15, 883, 1054; 912, 8; 16; 1, 1119. Danville Landing beds, localities 6, 886.

Subgenus STELLAXIS Dall. 1892

Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, 1892, pp. 323, 326 as section.

Subgenotype by original designation, *Solarium alveatum* Conrad (Foss. Shells Tert. Form., 1833, p. 31). Eocene. Southern United States. Plate 32, figures 9-11.

Architectonica (Stellaxis) alveata (Conrad) Plate 32, figs. 9-11

Solarium alveatum Conrad, 1833, Sept., Fossil Shells Tert. Forms., p.

31; Conrad, 1835, Fossil Shells Tert. Forms., p. 47, pl. 17, fig. 3.
Architectonica alveata (Conrad), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 173, pl. 19, figs. 8-18.

For copy of the original description and complete synonymy see, Palmer, 1937, p. 173. A series of pictures of the species from the lower Claiborne and Gosport sand, illustrating the protoconch, young to adult stages with various views, was given in the Claiborne bulletin. Since the species extends into the Jackson without modification, a suite of figures is not repeated.

The two spiral ridges on the upper surface of the whorls just above the suture may become obscure with age. Frequently the outer layer of the surface is peeled or broken and only one spiral ridge is visible.

Dimensions.—Height 11± mm.; greatest diameter, 22 mm. (medium).

Lectotype.—No. 15372, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Lower Claiborne and Gosport sand. Jackson: Moodys Branch marl, localities 10, 15, 883; 1—Danville Landing beds, localities 886; 20; 1120.

Family THIARIDÆ (MELANIIDÆ)

Genus HEMISINUS Swainson, 1840

(*Semisinus* em. Fischer, 1885, p. 701)

Swainson, Treatise on Malacology, 1840, pp. 199, 200, 341.
Genotype by original designation, *Melania lineolata* Gray (*lineata sic*, error in Swainson, p. 200, for *lineolata* in Griffith [and Pidgeon], Cuvier, pl. 13, fig. 4). Living in streams of northern South America. Reeve, Conch. Icon., *Hemisinus*, vol. 12, 1860, pl. 1, figs. 4a, 4b.

Hemisinus jacksonius, n. sp. Plate 35, figs. 7-9

Shell large, plump; sutures distinct, sides of whorls straight; body whorl convex, sloping gradually to the aperture; labrum with posterior notch and probably an anterior notch to the aperture; surface smooth or with slight revolving ribs; spiral ribs over the base of the body whorl.

All the specimens of this species, so far found, are badly worn, and the outer portion of the aperture is missing. As the species has not as yet been found outside of the Jackson in the Eocene of the southern area the form warrants description. It is very characteristic of beds on Crow Creek, near Forrest City, Arkansas. *Hemisinus* is a fresh-water genus The presence of these shells adds further data that the strand line of the Jackson sea was in the vicinity, with streams emptying into the embayment near this point. In the same sediments are thick layers of oyster shells with abundant remains of barnacles and an associated and probably predatory gastropod. The position and assemblage in the oyster beds are typical of flats at tide level along coasts today. A zeuglodont, *B. cetoides* (*Owen*),[32] vertebra was found in this area.

H. jacksonius also occurs at Creole Bluff, Montgomery, Louisiana.

Dimensions.—Height, 49+ mm.; greatest diameter, 20 mm. (holotype). Greatest diameter, 25 mm. (of largest specimen).

Types.—Holotype, No. 4574; paratype, No. 4575, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 883. Jackson of Arkansas, localities 894, 1046 (type).

Family **CÆCIDÆ**

Genus **CÆCUM** Fleming, 1813[33]

Fleming, Brewster's Edinburgh Encyclopædia, vol. VII, 1813, p. 67, [*fide* Neave and Sherborn]; *ibid*, American ed., vol. 6, pt. 2, 1815, p. 689.

Genotype by subsequent designation, Gray (Zoöl. Soc. London, Proc., 1847, p. 203), *Dentalium trachea* Montagu. (Testacea Britannica, Pt. 2, 1803, p. 497, pl. 14, fig. 10). Living. European seas. Harmer, Palæont. Soc., vol. LXXV, 1923, p. 847, pl. LXIV, fig. 32.

Subgenus **MICRANELLUM** Bartsch, 1920

Bartsch, Washington Acad. Sci., Jour., vol. X, 1920, p. 568.

Subgenotype by original designation, *Cæcum crebricinctum* Carpenter (California Acad. Sci., Proc., 3, 1864, p. 215; Oldroyd, Stanford Univ. Pub., Geol. Ser., vol. II, pt. 3, p. 45). Living. Monterey, California, to Lower California, in shallow water. Tryon, Manual Conch., vol. VIII, 1886, pl. 67, fig. 71.

C. alterum Meyer of the Jackson appears to be a typical *Micranellum*. This would lower the range of the subgenus as given by authorities (Wenz, p. 683, Miocene-Recent).

Micranellum was proposed by Dr. Bartsch as a genus of the *Cæcidæ*. Theile and Wenz limit the group to subgeneric rank.

[32]Palmer, K. V. W.: Bull. Amer. Assoc. Pet. Geol., vol. 23, No. 8, 1939, pp. 1228-1229.

[33]Sherborn, C. D.: Jour. Sci. Bib. Nat. Hist., vol. 1, pt. 4, 1937, p. 112.

Cæcum (Micranellum) alterum Meyer Plate 35, fig. 6

Cæcum alterum Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 6, pl. 1, fig. 8; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. 11, p. 297 *partim.*

Regelmässig gekrümmt, an der Mündung verengt. Querschnitt und Mündung kreisförmig. Oberfläche mit Ringen bedeckt, welche nach der Mündung zu undeutlicher werden.

Cæcum solitarium Mr. von Vicksburg ist glatt.—[Meyer, 1886.]

This species is known from the type only. The ribs are more irregular in strength than would appear from the illustration. The ribs are more even on the side shown in the figure than they are on the opposite side.

Dimensions.—Length (chord subtending the arc), 2 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Family TURRITELLIDÆ

Genus TURRITELLA Lamarck, 1799

Lamarck, Soc. Hist. nat. Paris, Mem., ser. 1, t. 1, 1799, p. 74.

Genotype by monotypy, *Turbo terebra* Linnæus (1758, p. 766). Living. China and East Indies.[34] Tryon, Manual Conch., *op. cit.*, p. 195, pl. 59, figs. 32, 33.

In a study of extensive material of the Turritellidæ, it readily becomes apparent that the sculptural pattern of the shell may pass through a series of changes from the nepionic stage to that of the adult. A fundamental transformation is in the number and size of the revolving ribs Such a factor must be accounted for in the description of each species, including the progressive changes in the ontogeny. Fragments taken from different parts in the length of the shell, unless fitted into the total pattern, may seem to belong to different species. The change of ornamentation in the ontogeny of gastropods is universal but such a process is particularly accelerated and profusely developed in the Turritellidæ. After studying the Claibornian Turritellas a plan was devised by the author, based on the fundamental pattern of their sculpture, which would serve as a practical grouping of the species. Independently Chas. W. Merr-

[34]Hanley, S.: Ipsa Linnæi Conchylia, 1855, p. 348; Bucquoy, E., Dautzenberg, Ph., and Dollfus, G., Mollusques marins du Roussillon. Gastropodes, t. 1, 1884, p. 225; Tryon, G., Jr., Manual Conch., vol. VIII, 1886, p. 197. The European *T. terebra* = *T. communis* Risso.

iam, monographing the Turritellidæ of the Pacific Coast, had conceived a similar basis for classification. Curiously he used the root "costate" for his groups and I used "carinate"—both combining such prefixes as "uni," "bi" and "tri." The terminology devised in my Claiborne work (1937) has priority in naming and since the two classifications are founded on similar rudiments, I shall continue to use the terms which I proposed.

In regard to the more applicable terminology of the roots "costate" and "carinate," it seems that the grouping we emphasize in this scheme is not so much the total costation of the whorls but the modification of that costation by carination. It is the carinæ that one refers to in using the combinations as "uni," "bi," and "tri." This is unconsciously inferred by Bowles (see p. 276 and elsewhere) in using the words "carina" and "bicarinate."

Bowles inserted Dr. Merriam's grouping, adding a serviceable "multicostate" group, in his monograph of the "Eocene and Paleocene Turritellidæ of the Atlantic and Gulf Coastal Plain of North America" (Jour. Paleont., vol. 13, No. 3, 1939, pp. 267-336) but that was not until two years after the Claiborne Turritellas had been discussed and fitted into the carinate classification. Merriam's monograph was published in 1941 (Univ. California Pub. Bull. Geol. Sci., vol. 26, No. 1).

The factor of change enumerated in the first paragraph of this discussion is not accounted for in the Bowles-Merriam grouping. A species may be unicarinate on the nepionic or postnepionic whorls, becoming bicarinate and later multicarinate on the mature whorls. Other changes may occur as shown in the outline herein. There is no rigidity in their carination over the entire length of their shell. Therefore a qualifying statement must accompany any outline as to what part of the shell the "type carination" may occur.

Key to Carination of the Apical Whorls of Jackson Turritellidæ

I. Nepionic (first 3 or 4 whorls)

A. Unicarinate

T. arenicola

T. arenicola branneri

T. creola
T. alveata (Obscure unicarinate stage, followed by short bicarinate stage, succeeded by a tricarinate stage.)

B. Bicarinate
T. arenicola danvillensis
T. rivurbana

C. Tricarinate
T. clevelandia
T. perdita
T. perdita jacksonensis

II. First postnepionic whorls

A. Unicarinate
T. arenicola branneri
T. arenicola danvillensis

B. Bicarinate
T. creola

C. Tricarinate
T. alveata
T. clevelandia
T. perdita
T. perdita jacksonensis
T. rivurbana (Short stage followed by bicarination.)

Turritella arenicola (Conrad) Plate 34, figs. 8-11

M. ? arenicola Conrad, 1865, Am. Jour. Conch., vol. 1, p. 141, pl. 10, fig. 11.
Turritella arenicola (Conrad), Bowles, 1939, Jour. Paleont., vol. 13, No. 3, p. 275, pl. 31, figs. 5-7. Includes *T. branneri* Harris.
Turritella arenicola Stenzel and Turner, [1942], Type Invertebrate Fossils of North America, Eocene, Gastropoda 17, Card No. 45, figs. 11, 1-3.

Volutions thirteen? convex, penultimate, and two contiguous volutions, each with seven acute, prominent, revolving lines; the two inferior lines remote, and the third more prominent and distant than the remainder; towards the apex this line is not more prominent than those above it but the second becomes large and carinates the volutions, giving them an angular appearance; one, and occasionally two, very fine lines alternate with the others.—[Conrad, 1865.]

Early postnuclear whorls smooth, unicarinate with only a faint suggestion of a spiral rib below the carina. Gradually the trace of the revolving lines, one below the carina and three above, are discernible. The secondary spirals, within the length of two whorls, increase in size as the primary carina is reduced, resulting in the presence of five revolving ribs on medium-aged specimens. With increased growth of the shell, intervening lines develop in prominence making the spiral pattern irregular in size and increasing the number of the enlarged ribs on the adult, so that the group of ribs is difficult to discriminate and as many as seven larger ribs may be present. A revolving rib is initiated just above the suture. There is a wide and conspicuous space between the lowermost enlarged rib or carina and the sutural rib. The two lines above that space may frequently be more pronounced than the other ribs on the whorl. The upper of the two most prominent liræ is the reduced original carina. Microscopic lines may occur between the major spirals, particularly between the suture and the lowermost prominent rib.

Edgar Bowles, in his excellent monograph, has given details of description and localities of this species. He has, with good reason, included the variety *T. branneri* with the typical form. Subsequent to Bowles's work, Stenzel and Turner differentiated the sharper rib development in the upper Jackson Eocene at Danville Landing, Louisiana, by a subspecific name. Since the varietal names are in literature, I am using them to tabulate the characters of extreme forms so that such may be used as criteria for judging other variations and the value of named units.

With a species as prolific as *T. arenicola*, it would be expected to find environmental phases. Although the form is abundant in the Garland Creek strata, it is rare at Moodys Branch and Town Creek, at Jackson, Mississippi.

This species, as many other Turritellas do, frequently seals the aperture of the posterior end of the shell with a thin septum, convex toward the apex (Plate 34, fig 9). Numerous specimens so closed have been found among the typical form and among *T. branneri* and *T. danvillensis*. One of the types (No. 15536, A. N. S.) has such a septum.

Dimensions.—Height, 34.6 mm.; greatest diameter, 10 mm. (larger of types).

Lectotype.—No. 15536, Academy of Natural Sciences, Philadelphia, Pa. (2 specimens).

Occurrence.—Garland Creek, Clarke County, Miss. (type), not Enterprise, Miss. as given by Conrad, see, Aldrich, Am. Jour. Sci., 3d ser., vol. XXX, 1885, p. 307. Moodys Branch marl, localities 900, 1099, 1100, 1111; 879, 881; 1127; 9; 10. Yazoo clay, locality 2. Danville Landing beds, locality 20.

Turritella arenicola branneri Harris Plate 34, figs. 2, 3, 6, 7

Turritella arenicola branneri Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 169, pl. VI, fig. 7; Stenzel and Turner, [1942], Type Invertebrate Fossils of North America, Eocene, Gastropoda, 21, Card No. 49, figs. 5-7.

This variety differs from true *arenicola* in having fewer revolving lines, less rounded whorls, and in being of considerably smaller size.

Localities:

White Bluff, Arkansas River.

Station 2331, 2413 and 2423, Rison.

2420, Cross Roads Church, 5 miles northwest of Kingsland.

2403, three quarters of a mile above Vince Bluff, Saline River.

2404, Hammaker's well, 12S., 9W., section 8.

2408, Wadsworth's well, Long Prairie, Drew county.—[Harris, 1894.]

The synonymy and description of this form are given in the Claibornian report, Bull. Amer. Paleont., vol. VII, No. 32, p. 197, pl. 23, figs. 1, 2 and will not be repeated here. At that time the White Bluff sediments were designated by the author as Claibornian or Jacksonian for the reason that a complete study had not been made of the Jackson fauna of Arkansas. Since the publication of the Claiborne paper, additional collections have been made and the Jacksonian age of the beds confirmed. The finding of a zeuglodont bone (*Basilosaurus cetoides*)[35] in the exposure in Crow Creek near Forrest City, Arkansas, substantiated a Jacksonian correlation for the White Bluff-Crow Creek Eocene.

Typical *T. branneri* differs from *T. arenicola, s. s.*, in having a more slender, tapering shape, and fewer revolving ribs. *T.*

[35]Palmer, K. V. W.: Bull. Amer. Assoc. Pet. Geol., vol. 23, No. 8, 1939, pp. 1228-1229.

branneri on adult whorls has five spiral costæ. The type locality for such variation is White Bluff, Arkansas. Subsequent collections have yielded fairly abundant material from that bluff.

Dimensions.—Height, 39 mm.; greatest diameter, 11 mm.

Holotype.—No. 135141, United States National Museum, Washington, D. C.

Occurrence.—Jackson of Arkansas, localities 896; 894; 897. Moodys Branch marl, locality 922. Danville Landing beds, localities 20; 4, 1120.

Turritella arenicola danvillensis Stenzel and Turner

Plate 34, figs. 1, 4, 5; Plate 35, fig. 1

Turritella arenicola danvillensis Stenzel and Turner, 1940, Univ. Texas Pub. 3945, p. 841, pl. 47, figs. 4, 5; Stenzel and Turner, [1942], Type Invertebrate Fossils of North America, Eocene, Gastropoda, 30, Card No. 58, figs. 4, 5.

Apical angle 24° juvenile, 14° adult; shell profile slightly convex. First two apical whorls smooth; two median, equal, and closely spaced primary revolving ribs appear on third whorl; as the anterior of these two ribs becomes gradually weaker and disappears on seventh or eighth whorl the other primary forms a prominent carina situated a little anterior to the median of the whorl; anterior primary reappears on ninth or tenth whorl and increases gradually in size until it becomes equal to the other on the adult whorls; 3 to 4 accessory ribs are added between the primaries and the posterior suture; a few fine threads arise between the ribs. Adult whorls convex with the greatest diameter at the level of the 2 primaries; ornamentation consists of 5 or 6 sharply raised spirals, of which the 2 anterior ones are most conspicuous, and a few scattered fine spiral threads; area just behind the suture excavated. Base of body whorl set off by a sharp spiral rib, which is hidden by the suture on the spire whorls. Incrementals most advanced at posterior suture, less so at anterior suture, to which they descend at a steep angle; sinus centers posterior to the primary rib.

This subspecies differs from typical *T. arenicola* Conrad by the usually more sharply raised spiral ribs, the smaller number of ribs and threads, the greater convexity of the adult whorls, and the short bicarinate stage on the apical whorls which precedes the usual unicarinate stage usual in the *T. arenicola* group.

Type data.—Syntypes in Stenzel Collection, Austin, Texas.

Type locality.—Bluff on right bank of Ouachita River at Danville Landing on boundary between Caldwell and Catahoula parishes, Louisiana; Bureau of Economic Geology locality No. La-9.

For exact location, compare Chawner, W. D., Geology of Concordia and Catahoula parishes: Louisiana Geol. Surv., Geol. Bull. 9, 1936.

Geologic horizon.—Danville Landing beds, upper Jackson group, upper Eocene.

Distribution.—Known at present only from type locality.—[Stenzel and Turner, 1940.]

The appearance of the *T. arenicola* at Danville Landing on the Ouachita River, Louisiana, is conspicuous because of the sharpness of the spiral ribs and the smaller number of ribs than occur on the typical form. In this respect, *T. danvillensis* is closer to the characters displayed in *T. branneri. T. branneri* is more slender than either *T. arenicola, s. s.,* or *T. danvillensis.*

In regard to the short postnuclear bicarinate stage described for this subspecies, if adequate material were available one might find that such occurs in the typical form. It so happens that *T. danvillensis* is prolifically preserved in the Danville Landing beds. The collections from that locality studied by the writer consist of over 1,000 specimens (fragments). Perfect apical material is abundant, and one has opportunity to determine the minute details. Although *T. arenicola* is abundant at the type locality and occurs at other localities, the quantity and preservation of the shells do not equal that of the variety at Danville Landing. Therefore, the apices are not available in an amount to enable one to determine accurately what variation the first postnuclear whorls of the typical form might display.

T. apita de Gregorio of the Gosport sand is also a bi-unicarinate species in its postnuclear development. It and *T. arenicola danvillensis* are the only two Turritellas of the Claiborne-Jackson Eocene which belong in such a group. *T. apita* passes into the unicarinate stage and retains it throughout life, while in *T. arenicola,* the unicarinate stage is a transitional phase, developing five and more spiral ribs, depending on the locality of its occurrence. There are fine details which distinguish the young unicarinate stage of *T. apita* and the unicarinate period of growth in *T. arenicola.* However, the identification of apical fragments of the two species from localities, the age of which is not known, should be done with caution, particularly if the microscopic details are worn.

Since the original description was written, the form has been identified by the author from Carter Landing, Ouachita River, and from two miles north of Rosefield, Louisiana.

Occurrence.—Danville Landing beds, Danville Landing, La. (type); localities 6, 886; 18; 20.

Turritella creola, n. sp. Plate 35, figs. 2, 4, 5, 11

Shell slender, whorls convex anteriorly and concave posteriorly; nucleus consists of about one whorl; early four postnuclear whorls unicarinate with a faint suggestion on the early three whorls of a revolving line above and below the submedial carina. The secondary ribs increase rapidly until on the fourth whorl they are readily seen under the microscope. On the fifth whorl and thereafter for several whorls the basal spiral rib is equivalent in size to the original primary carina. At the same time the first secondary costa above the medial carina is followed by another so that during the period of growth, in which the prominent ribs are in a basal bicarinate stage, two and then three revolving ribs of lesser importance occur on the posterior surface of the whorl. On medium-sized specimens there are therefore a suite of five spiral ribs, the two anterior being largest and sharpest. Interstitial lines develop between the major ribs, the one between the two anterior major costæ increases more rapidly so that on mature shells, six or more revolving lines of primary importance occur. Incremental microscopic striæ are present. The space between the suture and the primary rib above is wider and excavated. In this respect the species is similar to *T. arenicola* and *T. alveata*. *T. creola* is like the varietal phases of *T. arenicola* in the conspicuousness of the two anterior revolving ribs. The species may be differentiated from *T. arenicola* in that the bicarinate feature has been formed as a definite character by the stage of the fifth whorl and the unicarinate phase is shortened and limited to the first four postnuclear whorls. In this respect *T. creola* seems to be more of a derivative of *T. dutexata* and allies of the lower Claiborne, than related directly to *T. arenicola*. The unicarinate stage is the conspicuous feature of the youth of *T. arenicola*, and the inception of the bicarinate stage is retarded longer in that species. *T. creola* differs from *T. arenicola danvillensis* in having a fine revolving thread between the two anterior prominent ribs.

T. creola bears an aspect resembling *T. femina* Stenzel[36] of

[36]See Stenzel, H. B., and Turner, F. E.: Univ. Texas Pub. 3945, 1940, p. 830, pl. 46, figs. 11-13; Type Invertebrate Fossils of North America, Eocene, Gastropoda 36, Card No. 64 [1942], figs. 11-13.

the Weches formation, Clabornian of Texas, but differs most conspicuously in the absence on *T. creola* of a larger revolving rib between the suture and the lower of the two major anterior liræ. The wider basal interspace above the suture in *T. creola* remains smooth except for lines of growth or obscure microscopic threads. The illustrations of *T. femina* reveal the development of a revolving rib in that area.

T. creola is apparently the Jackson representative of the *T. cutexrata* Harris stock of the lower Claiborne.

The species is seemingly not abundant but is persistent at Creole Bluff near Montgomery, Louisiana. Each of the various trips made by ourselves or associates, including A. C. Veatch's first over 40 years ago, have yielded specimens.

Broken individuals have been found which have the aperture of the posterior part of the whorl sealed with a convex thin septum.

Dimensions.—Height, 33 mm. (not complete); greatest diameter, 11 mm.

Types.—Holotype, No. 4579; paratypes, Nos. 4577, 4578, 4580, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Creole Bluff, Montgomery, La. (type); localities 11, 10, 15, 883, 1054; 922.

Turritella bunkerhillensis, n. sp. Plate 35, figs. 3, 10

Shell medium in size; apical whorls unknown; adult whorls ornamented with a strong revolving rib or carina posterior to the suture with a concave wide space between the carina and suture. A spiral rib may develop on the posterior margin of the suture. This rib may enlarge and project giving the whorl a bicarinate appearance just above the suture. Neither the single nor the bicarinate condition of the anterior ribbing is specific for both may be seen on the same specimen (Plate 34, fig. 3). Such a change in ribbing occurs in *T. rina* of the Clabornian. The middle of the whorl is concave in varying degrees. There may be four or five revolving ribs above the primary rib. Alternating finer spiral threads occur in the interspaces. One of the characteristic features of this species is the crenulation of the revolving ridges.

This species is like *T. cælatura* Conrad (Acad. Nat. Sci. Philadelphia, Jour., 2d ser., I, 1848, p. 114, pl. 14, fig. 16), described from the Vicksburg Oligocene, in that they both have conspicuous crenulated or beaded revolving ribs. *T. bunkerhillensis* differs from *T. cælatura* in having an excavated area above the suture with the spiral rib above stronger than the others, slightly carinating the whole at that position. There are about five spiral ribs above the carinated one, the number depending on the age of the whorl. There are about five in all crenulated ribs on *T. cælatura*. Conrad described *T. cælatura* with Vicksburg shells but in later publications he does not include it among the Vicksburg species but does list it as from the Eocene of South Carolina.

One hesitates to describe a *Turritella* with the apical whorls lacking, because without that portion of the shell the change in ontogenetic development and the basic group into which the species may fall cannot be determined.

Because the adult whorls are different from the known Jackson species, and because there are available four specimens from two different collecting trips, it seems attention should be drawn to the form.

Dimensions.—Height, 28 mm.; greatest diameter, 10 mm. (fragment).

Types.—Holotype, No. 4581; paratype, No. 4582, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Bunker Hill, Ouachita River, Caldwell Parish, La.; localities 1, 1119.

Turritella alveata Conrad Plate 36, figs. 7-12

Turritella alveata Conrad, 1854, Wailes. Rept. Agr. Geol. Mississippi, pl. XVII, fig. 7; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 263; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, 1939, p. 9, pl. 4, fig. 7; Harris, 1894, Ann. Rept. Geol. Survey Arkansas, 1892, vol. II, pp. 120, 169, 181; Bowles, 1939. Jour. Paleont., vol. 13, No. 3, p. 306, pl. 32, fig. 1; Stenzel and Turner, [1942], Type Invertebrate Fossils of North America, Eocene, Gastropoda 15, Card No. 43, figs. 7, 1, 2.

Mesalia alveata Conrad, 1865, Am. Jour. Conch., vol. I, p. 33; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25.

Turritella (Haustator) alveata Conrad, Cossmann, 1912, Essais Paléoconch. comp., 9 liv., p. 118.

Elongated; whorls about nineteen; revolving lines prominent, about six in number alternated by a minute line; volutions excavated at base and minutely striated.

Allied to *T. obruta*, Con., (*T. lineata*, Lea) of Claiborne, but greatly more elongated.—[Conrad, 1855.]

Nucleus consists of about 1 or 1½ whorls, smooth, not demarcated definitely from the following whorls; earlier two postnuclear whorls carinated with an obscure incipient revolving rib suggested above and below the carination. The lower spiral costa is recognizable on the third whorl; on the fourth whorl three revolving ribs or carinæ occur which continue for several whorls. Secondary spiral lines are present. Gradually the posteriormost secondary line just below the suture assumes a size equal to the primaries and the ribbing for several whorls consists of four ribs of major size, in pairs anteriorly and posteriorly with a slightly weaker fifth rib in a central position on the whorl. The middle rib increases in size until there is a period on adult whorls where there are five prominent spiral ribs. As more incrementals enlarge with age there may be six or seven dominant ribs on the mature whorls. Typically there are six. The number varies on individuals at the same and at different localities. Microscopic spiral threads occur between the ribs. Typically the whorls are compressed, some may have the whorls slightly convex. The whorls are excavated below the first anterior rib so that the sutural area is conspicuous but not deep. The shell is slender with many whorls. The figured type specimen has 19 whorls and it is not complete. The fragment, in the collections studied, with the greatest diameter (16 mm.), is from Bunker Hill Landing on the Ouachita River, Louisiana. Conrad's illustration gives the impression of greater narrowness and tapering than actually exists on the type.

The apical and immature whorls of this species and *T. arenicola* can be differentiated because *T. arenicola* has a unicarinate pattern of early sculpture while that of *T. alveata* is predominately tricarinate. Adult whorls of the two species may have a similar number of revolving ribs on certain whorls but *T. arenicola* has a tendency for the two anterior liræ to be more pronounced than those posteriorly. *T. alveata* is more slender and has a greater number of whorls than *T. arenicola*.

Four or five coarse spiral ribs occur on the basal area in *T. alveata*.

This species is characteristic of the Jackson Eocene. Stenzel[37] identified it, as well as *T. perdita*, in the Claiborne Yegua, nine feet below the Moodys Branch marl in his section at Creole Bluff, Montgomery, Louisiana.

Dimensions.—Height, 48 mm.; greatest diameter, 11.6 mm. (lectotype); height, 45 mm.; greatest diameter, 11.6 mm. (paratype).

Types.—No. 13213, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 880, 693, 786, 921, 881, 879; 900, 1111, 1098; 10, 883, 1054, 9, 7, 8, 912; 16; 1, 1119. Danville Landing beds, locality 6. Jackson of Arkansas, locality 897.

Turritella clevelandia Harris Plate 36, figs. 1-6

Turritella perdita ? Dall, 1891, in Call, Ann. Rept. Geol. Survey Arkansas for 1889, vol. II, p. 8 *fide* Harris, 1894, p. 92.

? *Turritella mortoni* Call, 1891, Ann. Rept. Geol. Survey Arkansas for 1889, vol. II, p. 8 *fide* Harris, 1894, p. 92.

Turritella clevelandia Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 176, pl. VI, fig. 9; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 202, pl. 26, figs. 6, 7; Bowles, 1939, Jour. Paleont., vol. 13, No. 3, p. 308, pl. 31 figs. 9, 12; Stenzel and Turner, [1942], Type Invertebrate Fossils N. America, Eocene, Gastropoda 28, Card No. 56, figs. 1, 9, 12.

Specific characteristics: Size and general form as indicated by the figure; whorls 13 or 14; generally ornamented by about three prominent revolving lines and a few subordinate ones; from the uppermost and lowest of the revolving lines the whorls slope abruptly to the suture, while between these lines the sides of the whorls are straight.

Localities: White Bluff, Arkansas River. Rison. Toledo, Orton place. Above Vince Bluff, Saline River.—[Harris, 1894.]

Shell slender and small for the genus; nucleus probably smooth. The third whorl and perhaps the second have three cordlike primary carinæ with the two anterior the stronger. The whorls appear conspicuously tricarinate throughout the growth of the shell. On the later whorls, secondary ribs may develop between the suture and the posterior carina and between the two posterior liræ. The secondary ribs remain slightly smaller in size than the primaries but on old specimens they may ob-

[37]Stenzel, H. B.: Univ. Texas Pub. No. 3945, 1940, p. 877.

scure the original tricarinate pattern. Fine, irregular in size, revolving lines cover the space between the larger ribs. Base of body whorl smooth or striated by microscopic spiral lines. The sides of the whorls slope with the greatest width anteriorly. The sutures are linear, sharp, and the whorl projects above.

Since the publication of the work on the Clabornian gastropods, we have collected many specimens of this species from the type locality and elsewhere. Young and immature material is abundant but the individuals have the first whorl broken or worn.

The form in the Sabine Eocene which Prof. Harris (Bull. Amer. Paleont., vol. III, No. 11, 1899, p. 74, pl. 10, fig. 2) suggested might be a variety of *T. clevelandia,* Bowles (1939, Jour. Paleont., vol. 13, No. 3, p. 302, pl. 32, fig. 16) named *T. gilberti* and discussed its relationships.

This species is common at Danville Landing, Louisiana, a fact which has not been previously reported. The form in the Danville Landing beds attains a larger size, coarser ornamentation and slight variation in the slope of the revolving ribs.

The shells may be considerably worn when collected which leads to much puzzling as to their identity. Although the decorticated specimens may have most of the details of sculpture eliminated the anterior carina remains evident. A series, from ornamentation through partial obliteration of the outer shell layer to a stage of more complete surface erosion, is illustrated herein (Plate 36, figs. 1-6). Such will assist in the identification of the species as it frequently occurs.

According to Harris's original synonymy of *T. clevelandia,* this is the *T. perdita* ? which Dall reported from White Bluff, Arkansas. Bowles's (1939, pp. 307, 308) statement that Harris recorded and erroneously identified *T. perdita* from Arkansas is confounding as to the facts in the matter and leads to unnecessary confusion in the distribution of *T. perdita.* Harris[38] merely listed Dall's identification of "*T. perdita* ?" The record as given by Harris (1894, p. 92) definitely stated Dall as the authority for *T. perdita* ? and the same species is not given under Harris's heading. Later in the same work (p. 170) Prof.

[38]Harris, G. D.: Ann. Rept. Geol. Sur. Arkansas for 1892, vol. II, 1894, pp. 89, 92, 170.

Harris differentiated the *T. perdita* ? Dall as new under the appellation, *T. clevelandia*.

The finding of this species at Sims Siding, Mississippi (locality 1050), appears to be the first record of the species in Mississippi.

Dimensions.—Length, 30 mm.; greatest diameter, 7 mm. (medium size at type locality).

Types.—Lectotype, No. 498010, United States National Museum (Bowles). Syntypes, United States National Museum, No. 135142 (Bowles).

Occurrence.—White Bluff, Jefferson County, Arkansas (type). Jackson of Arkansas, localities 896, 1049; 897; 894, 1048. Moodys Branch marl, locality 1, 1050. Danville Landing beds, localities 6, 886; 18; 20.

Turritella perdita Conrad Plate 37, figs. 1-3, 6, 8-11

Turritella perdita Conrad, 1865, Am. Jour. Conch., vol. 1, p. 141, pl. 10, fig. 10; Bowles, 1937, Jour. Paleont., vol. 13, No. 3, p. 307, pl. 32, fig. 11 *partim;* Stenzel and Turner, [1942], Type Invertebrate Fossils North America, Eocene, Gastropoda 62, Card No. 90, figs. 1-3, 10.

Broad at base; volutions thirteen or fourteen, laterally flattened, and having five prominent revolving lines on each, with an intermediate fine line; the two inferior volutions of the spire slightly projecting near the base; body volution angulated; base finely striated; lines on the volutions, towards the apex, crenulated.—[Conrad, 1865.]

Shell medium in size; elongate. Complete specimens may include one or two whorls more than given by Conrad. Nucleus unknown; early apical whorls contain three primary carinations, the anterior two, the sharper. The tricarination stage continues for several whorls, followed by the development just below the suture of a revolving rib which increases in size, making four primary ribs. A spiral rib, in about the middle part of the whorl, as well as another just above the suture, is gradually added. Hence, as the shell matures, five primary ribs occur with six or more on old specimens. Microscopic spiral threads are present between the primary ribs. The primary costæ of the apical whorls are crenulated. Many retain the crenulations on mature whorls. The suture is deeply impressed on the apical whorls. The posterior whorls are "laterally flattened" on adult shells, with the volutions "projecting near the base" on the later whorls. The base of the body whorl is sculptured with microscopic revolving lines, close-set and uniform in size.

The lines differ from those on the variety *T. jacksonensis* in having the lines of equal strength. In the latter the threads are composed of a larger series with finer striæ between.

There is a variation of *T. perdita* (Plate 37, fig. 8) which is elongate with the apical whorls attenuated, the narrowness begins with about the middle whorls of the spire There are in specimens of equivalent age, four or more whorls on the variation than on the typical form. The sculpture has a tendency to become obsolete. Such partial smoothness, together with wear, produces decorticated apical ends which are conspicuous in a collection of the species from the type locality. The sutural area is not so deeply impressed as on the typical shells and the later few volutions do not project. The whorls, except the body whorl and penultimate, have the appearance of slightly overlapping the volution above.

T. perdita displays, at the type locality on Garland Creek, which is probably lower than typical Moodys Branch marl, and elsewhere in the Moodys Branch marl, extreme modifications. Bowles (1939) did not figure a typical shell when illustrating the species in his monograph. His figure, plate 32, figure 11, represents the variety, *T. jacksonensis* Cooke, and his description does not cover the typical form. The type locality is Garland Creek, Mississippi, and there occurs the slender shell figured by Conrad as *T. perdita*. At Garland Creek occurs also the modification of the typical form (an example, Plate 37, fig. 8) which is distinct in its extreme features but transitional stages occur linking it and the *T. perdita, s. s.*

At Moodys Branch, Jackson, Mississippi, the species is represented by the short, abruptly tapering variety, *T. jacksonensis* Cooke, (including probably *T. lowei* Cooke) a discussion of which is given under a separate heading.

Dimensions. Height, 41 mm.; greatest diameter, 12.6 mm. (lectotype). Height, 40 mm.; greatest diameter, 10 mm. (paratype). Height, 39.4 mm.; greatest diameter, 10 mm. (paratype).

Lectotype.—No. 13232 (three specimens), Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—"Moodys Branch marl," (probably lower than) Garland Creek, Miss (type) not Enterprise, Miss. (See Aldrich, Am. Jour. Sci., vol. XXX. 1885, p 307); localities 900, 1100, 1111, 1098, 1099. Moodys Branch marl localities 10, 11, 883; 1127.

Turritella perdita jacksonensis Cooke Plate 37, figs. 4, 5, 7, 12, 13

Turritella jacksonensis Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 136, fig. 8.

Turritella lowei Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 136, fig. 9.

Turritella perdita Conrad, Bowles, 1939, Jour. Paleont., vol. 13, No. 3, p. 307, pl. 32, fig. 11.

Turritella perdita jacksonensis Cooke, Stenzel and Turner, [1942], Type Invertebrate Fossils North America, Eocene, Gastropoda 44, Card No. 72, figs. 1, 8, 11.

Turritella perdita lowei Cooke, Stenzel and Turner, [1942], Type Invertebrate Fossils North America, Eocene, Gastropoda 48, Card No. 76, figs. 1, 9.

Shell rapidly expanding; apical angle 25°. Suture impressed. Whorls postero-medially constricted, twice as broad as high, ornamented with faintly nodular spiral threads which continue over the base. Growth lines deeply sinuated on the constriction and gently flexed on the periphery. Altitude 20 mm.; latitude 7 mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,944. —[Cooke, 1926, *T. jacksonensis*.]

Shell small, short for the genus, abruptly tapering; whorls 10 to 12. Nucleus broken or worn on all specimens examined, hence, it is difficult to determine the nature of the ornamentation. Probably two carinations exist on the first whorl, three appear on the second whorl and continue. The sculpture may be designated as tricarinate for three or four whorls. Secondary lire develop so that the later whorls have four or five primary ribs with finer secondaries and microscopic intervening threads. The spiral lines may be conspicuously crenulated over part or all of the surface of the shell including the body whorl. The base of the body whorl has fine spiral lines with intervening smaller threads. The suture is deeply excavated over the shell Some specimens have a tendency to be more elongate than others, and such individuals have the sculpture less pronounced hence with wear the shells are commonly smooth. The tendency for the species to have the shell elongate posteriorly in the variety of *T. perdita* is apparently paralleled by the same inclination in the typical form at Garland Creek. The elongated individuals do not seem to be restricted enough from the short forms to warrant a new name. *T. lowei* named by Cooke, probably represents merely the attenuated variation of *T. jacksonensis.* So far I have not found *T. jacksonensis* or *T. lowei* at Garland Creek.

At Moodys Branch, a common and conspicuous *Turritella* is that called *T. jacksonensis* by Cooke and figured as *T. perdita* by Bowles. Cooke's type of *T. jacksonensis* is a young shell and specimens occur longer than that figured by Bowles. Since the Garland Creek specimens must represent the typical *T. perdita* and an apparent relationship seems to exist between *T. perdita, s. s.,* and *T. jacksonensis, T. jacksonensis* is classified as a variety of *T. perdita. T. lowei* is included as merely a modification of *T. jacksonensis.*

Dimensions.—Height, 29 mm.; greatest diameter, 12 mm.

Types.—Holotype, *T. jacksonensis* Cooke, No. 353,944, U. S. Nat. Mus. Holotype, *T. lowei* Cooke, No. 353,945, U. S. Nat. Mus.

Occurrence.—Moodys Branch, Jackson, Miss. (type). Moodys Branch marl, localities 785, 881, 879, 921, 693, 1051; 11, 883 (one worn specimen each); 1; 923. Lower Yazoo clay, locality 915.

Turritella rivurbana Cooke Plate 38, figs. 6-9

Turritella rivurbana Cooke, 1926, Washington Acad. Sci. Jour., vol. 16, No. 5, p. 136, fig. 10; Bowles, 1939, Jour. Paleont., vol. 13, No. 3, p. 283; Stenzel and Turner, [1942], Type Invertebrate Fossils of North America, Eocene, Gastropoda 71, Card No. 99, fig. 10.

Apical angle about 20°. Whorls carinated, slightly constricted medially, suture depressed; spiral sculpture of one strong thread on the carina and several finer, widely spaced threads. Altitude of a fragment of 5 whorls 17 mm.; latitude 8 mm.

Station 6466, Town Creek, Jackson, Miss., U. S. N. M. No. 353,946.

In form, this species resembles *T. carinata* Lea from Claiborne, but lacks the crowded, microscopic, spiral threads, its suture is more depressed, and it differs also in the direction of its growth lines. In front of the carina the growth lines of *T. rivurbana* are strongly protractive (bent clockwise to the axis), making an obtuse angle with the lines behind the carina, but in *T. carinata* they are retractive and make an acute angle.—[Cooke, 1926]

Shell small; nucleus probably with two strong carinations, one anteriorly and one about the middle of the whorls. On about the second or third whorl, an incipient third carina appears posteriorly and rapidly increases in strength. For about three whorls, the whorls are tricarinate. As the posterior lira enlarges, the middle carina decreases in size, until it is an obscure thread. The adult whorls are bicarinate with the anterior rib the larger. A smaller spiral rib develops between the suture and the posterior primary rib. The carinæ are finely crenulated. The whole surface of the whorls is covered with microscopic revolving lines. The sutures are sharp.

The species is distinct from the other species of Jackson Turritellas but it is not an abundant form. Not enough specimens of adult whorls are found so that one can say with assurance what the extreme growth would be. The apical whorls and the bicarinate pattern of the immature sculpture are typical of *T. rina* and varieties (Palmer, 1937, p. 192, pl. 22; Palmer, Bull. Amer. Paleont., vol. XXVIII, No. 112, p. 17). It may be found that *T. rivurbana* is the end member of the *T. rina* stock and that there are only varietal differences between the two. In that case *T. rivurbana* the earlier name has priority and such takes precedency over biologic development. The lower Claiborne names would be varietal names of the Jackson designation. Due to the fact that under the present emergency it has been impossible to study the type and supplementary material of *T. rivurbana* which are in Washington, D. C., I do not feel justified in definitely uniting *T. rina* and *T. rivurbana.*

T. rina and varieties represent a prolific stock in the lower Claibornian. The early tricarinate, later bicarinate, sculptural design becomes modified along different trends as may be seen in such variations as *T. rina subrina* and *T. rina carolina. T. cortezi* Bowles and *T. rina wechesensis* Bowles (1939, pl. 31, figs. 8, 14). For discussion of *T. wechesensis* Bowles see Palmer, 1944, *loc. cit.*, pl. 1, figs. 12-16. There is a remarkable similarity between the character of the spiral whorls of *T. rina wechesensis* (Bowles, 1939, pl. 31, fig. 8) and those of *T. rivurbana* (Plate 38, figs. 6-9). In fact, I do not see any differences. The same similarity in the apical whorls appears between those of *T. rina, T. subrina,* and *T. cortezi.* Stenzel and Turner (1942, Card 57) remark, "Young specimens of *T. cortezi* can hardly be distinguished from those of *T. rina subrina*." Yet in the extreme adult stage *T. rina*, *T. subrina*, and *T. cortezi* have robust, distinct sculpture. The shells with the obsolete sculpture in the adult as in *T. wechesensis* may merge in a transitional series of specimens with certain variations of *T. rina*. I believe *T. rivurbana* probably represents the last of the line (or remnant in the Jackson Eocene) of the *T. rina* lower Claiborne species-stock. The stock had a dominant youthful uniformity but a virile potentiality for extreme change with maturity.

Dimensions.—Complete specimens are not available. See dimensions of figured shells.

Holotype.—No. 353,946, United States National Museum, Washington, D. C.

Occurrence.—"Moodys marl, Town Creek, Jackson, Miss." (type). Moodys Branch marl, locality 785. Lower Yazoo clay, locality 915.

Genus **MESALIA** Gray, 1842; 1847

Gray, Synop. Cont. British Museum, 44 ed., 1842, p. 60 (see, Iredale, Malacol. Soc. London, Proc., vol. X, 1913, p. 306); Gray, Zoöl. Soc. London, Proc., pt. XV, 1847, p. 155; Smith, E. A., Ann. Mag. nat. Hist., 8th ser., vol. XV, 1915, p. 367.

Genotype by subsequent designation, Gray, 1847 (*loc. cit.*), *Cerithium Mesal* Adanson, 1757, = *Turritella brevialis* Lamarck (Hist. nat. An. sans Vert., t. 7, 1822, p. 58). Living. Goree, Senegal, and Leone. Tryon, Manual Conch., vol. VIII, 1886, p. 209, pl. LXV, figs. 27-29.

Mesalia vetusta (Conrad) Plate 38, figs. 1-5

Melania ? vetusta Conrad, Sept. 1833, Fos. Shells Ter. Form., vol. 1, No. 3, p. 35.

Mesalia vetusta Conrad, 1865, Am. Jour. Conch., vol. 1, p. 33 *M. venusta* [error in spelling]; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 205, pl. 27, figs. 7, 8, 13-15; Bowles, 1939, Jour. Paleont., vol. 13, No. 3, p. 331, pl. 34, fig. 1; Stenzel and Turner, [1942], Type Invertebrate Fossils of North America, Eocene, Gastropoda 93, Card No. 121, fig. 1.

For complete synonymy and notes see Palmer, 1937; Bowles, 1939; Stenzil and Turner, 1942. Omit *Mesalia lintea* Conrad from Bowles's synonymy (see Palmer, 1937, p. 209 and Bowles, 1939, p. 291). Palmer and Stenzel and Turner include a copy of the original description.

This species is very abundant in the Gosport sand at Claiborne, Alabama. It is a variable form at the type locality. In

1919, Cooke (U. S. Geol. Sur., Prof. Paper 120, 1919, p. 43) reported the species from the basal Jackson at Sims Siding, Yazoo County, Mississippi. In 1891-92, Prof. G. D. Harris collected a specimen of *M. vetusta* from the Jackson at White Bluff, Arkansas, for the U. S. Geol. Survey, and it was deposited in the U. S. National Museum. A picture of the specimen made by Harris many years later (1940) is included herein. The whorls are rounder than the whorls of common Claiborne specimens of the species. However, the whorls of species at the type locality vary from rounded to straight-sided whorls. Dr. Julia Gardner (Jour. Paleont., vol. 13, No. 3, 1939, p. 342) identified the form from Sims Siding, about 1½ miles south of Eden, Yazoo County, Mississippi, as well as at six localities in Alabama. Gardner regarded Sims Siding material as a transitional fauna between the Gosport sand and the Jackson. Our collections include numerous specimens of the species from Little Stave Creek and Sims Siding. Four specimens of this species have been identified by the author from material from Creole Bluff, Montgomery, Louisiana, from two different collecting trips, two years apart. Such discoveries reveal that the species, while not abundant in the deposits, is persistent, if it can be picked up after different periods of erosion. Specimens from some of the respective localities mentioned are illustrated on Plate 38. Additional figures of the shells from the Gosport sand are given in Palmer, 1937, plate 27. These supplementary localities rule out *Mesalia vetusta* as a diagnostic Gosport sand fossil. It probably was sparsely represented in the lower Jackson fauna.

Occurrence.—Gosport sand, Claiborne, Alabama (type); 1062. See also, Gardner, 1939, p. 342. Jackson Eocene, localities Sta. 2402, U. S Geol. Survey (White Bluff, Ark.). Basal Jackson, locality 1050. Moodys Branch marl, localities 883, 1054.

Family **VERMETIDÆ**

Genus **SERPULORBIS** Sasso, 1827

(*Lemintina* of authors)[39]

[39] Chavan, A.: Bull. du Mus. 2d ser., t. XVI, No. 5, 1944. *Lemintina* determined as *nomen dubium*.

Sasso, Giornale Lig. Sci. Lett. Art., Fas. 1, 1827, p. 183.

Genotype by subsequent designation, Gray (1847, p. 156), *Serpula arenaria* Linnaeus (Systema Naturae, 1758, p. 787; 12 ed., 1767, p. 1266) = *Serpulorbis polyphragma* Sasso *fide* Bucquoy, Dautzenberg, and Dollfus, 1884, p. 236; Chavan, 1944, *op. cit.*, p. 332. Living. Mediterranean. Bucquoy, Dautzenberg, and Dollfus, 1884, p. 236, pl. XXIX, figs. 1-3.

Serpulorbis chavani, n. sp. Plate 38, figs. 10-12

Cf. *Lemintina major* Chavan, 1937, in Palmer, Bull. Amer. Paleont., vol. VII, No. 32, p. 210, pl. 28, figs. 1, 6 *non Vermetus gigas major* Monterosato, 1878, Giornale Sci. Nat. Econ. publicata per cura Soc. Sci. Nat. Econ. Palermo, vol. XIII, p. 88 *nomen nudum; non L. arenaria major* Sacco, 1896, I Molluschi dei Terreni terziarii del Piemonte e della Liguria. pt. XX, p. 12, pl. 1, fig. 26.

Shell large, contorted, the irregular convolutions in contact. The surface is irregularly covered with rough medium longitudinal striations; alternating with the primaries is a series of smaller ribs with a narrow interspace between. The size and character of the sculpture vary with the age and condition of growth. On some places on the same specimens the ribs will be crowded, on other portions a narrow space intervenes between primaries and secondaries. Transverse concave septa may be present. Irregular transverse undulations may occur.

This form, large and fairly common near Montgomery and Bunker Hill, Louisiana, has been labeled in collections as *Serpulorbis granifera* (Say),[40] the species from the Chesapeake Miocene, Oak Grove (middle Miocene) of Florida, Gurabo (middle Miocene) of San Domingo, Duplin, and upper Miocene of Florida.

This species may be the same as that which Cossmann[41] listed as *Lemintina major* but did not describe from the Gosport sand at Claiborne. André Chavan kindly sketched Cossman's specimen and inserted a description in my Claibornian gastropod work. The name *Serpulorbis major* (as *Lemintina*) is probably preoccupied by Sacco, 1896, who first made valid the name originally used by Monterosato. Therefore the Gosport species may require a new name. The Jackson shells appear similar to the figures of M. Chavan. Because of world conditions it is impossible to request M. Chavan to compare

[40] Say, T.: Acad. Nat. Sci. Philadelphia, Proc., vol. IV, 1824, p. 154, pl. 8, fig. 4. Reprint, Bull. Amer. Paleont., vol. 1, No. 5, 1896, p. 60, pl. 8, fig. 4.

[41] Cossmann, M.: Essais Paléoconch. comp., 9 liv., 1912, p. 139, *nomen nudum*.

the Jackson material with Cossmann's type or rename the Claiborne species. If the Claibornian and Jackson forms prove to be the same, the name for the Jackson species will cover the preoccupied name of Chavan. If the Jackson and Claiborne individuals belong to separate species or subspecies, M. Chavan will be able to rename the Claibornian form at some later date.

Dimensions.—Greatest diameter, 10 mm. (inside measurements).

Types.—Holotype, No. 4612; paratypes, Nos., 4611, 4613, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 10, 11 (type), 15, 883, 1054; 1, 16.

Family LITIOPIDÆ

Genus LITIOPA Rang, 1829

(*Bombyxin* Bélanger in Lesson, 1831)[42]

Rang, Ann. Sci. Nat., vol. 16, 1st ser., 1829, p. 306.

Genotype by subsequent designation, Nevill (Handlist Moll. Indian Mus., pt. II, 1884, p. 177), *L. melanostoma* Rang. Recent. Pelagic. Martha's Vineyard[43] to West Indies. Southern California and Gulf of California. Tryon, Manual Conch., vol. IX, 1887, pl. 53, figs. 72-75.

The designation of Gray, 1847, (p. 155) may have priority if *L. bombix* Kiener is approved as synonymous with *L. melanostoma* entirely, *i. e.*, that *L. maculata* is also the same as *L. melanostoma* Rang. (See Palmer, Nautilus, vol. LV, No. 4, 1942, pp. 128-130.)

Litiopa spirata (Meyer) Plate 30, fig. 1

Cerithioderma spirata Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 8, pl. 1, fig. 7.

Litiopa spirata (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, pp. 292, 293.

Drei und ein halb embryonische Windungen bilden einen Nucleus, der deutlich von der ersten erwachsenen Windung abgesetzt ist. Die vier rewachsenen Umgänge sind etwas convex. Sie sowohl, wie die Basis, sind mit spiralen gleichmässig bedeckt.—[Meyer, 1886.]

Specimens of this species have not been found. The type apparently is not in existence, as it is not with the majority of the Meyer types at the Johns Hopkins University. The figure given by Meyer corresponds in characters to those displayed by the

[42] Bélanger, in Lesson, R. R.: Illustrations de zoologie, [1831], no pagination, Appendix.

[43] Palmer, K. V. W.: Nautilus, vol. LVIII, No. 2, 1944, pp. 70, 71.

genotype and allied species of *Litiopa*.

Dimensions.—Height, 4- mm., measurement given with type drawing.

Holotype.—Unknown.

Occurrence.—Moodys Branch marl, Jackson, Miss. (Meyer).

Family **CERITHIIDÆ**

Genus **BITTIUM** Leach in Gray, 1847

Leach in Gray, Ann. Mag. nat. Hist., vol. XX, 1847, p. 270.

Genotype by subsequent designation, Gray (Zoöl. Soc. London, Proc., pt. XV, 1847, p. 154), *Murex reticulatus* Montagu (Testacea Britannica, 1803, p. 272) = *B. reticulatum* (da Costa) (British Conch., 1778, p. 117, pl. 8, fig. 13). Living. Europe. Harmer, Palæont. Soc. (for 1916), LXX, 1918, p. 414, pl. XLI, figs. 1-3.

Bittium kœneni Meyer Plate 39, figs. 7-9

Bittium koeneni Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 70, pl. 2, fig. 12; Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, 1892, pp. 275, 276; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., 1893, p. 30.

Four spirally striated, embryonic whorls without ribs are followed by four transversely ribbed whorls with three spirals, the uppermost of which is the smallest. On the following older whorls, three more spirals appear between them. All the whorls are convex; aperture effuse anteriorly, but without proper canal; base spirally striated. Many of the specimens have varices.

Localities.—Jackson, Miss., common; Red Bluff, Miss., not rare.

The type-specimen is from Jackson; in the specimens from Red Bluff the canal is more distinct. Named after Prof. v. Kœnen, who has successfully worked up the German Tertiary.—[Meyer, 1886.]

Shell small; earlier two embryonic whorls smooth, the two following have two sharp spiral microscopic ribs. Where the transverse ribs cross the revolving ridges, sharp nodes are produced. The spiral ribs may develop corresponding ridges on the interior of the aperture. The outer lip is thin, such ridges, mentioned as being internal, are not always apparent. The labrum is fragile and usually broken. A perfect specimen shows the labrum arched medially forward, making a broad sinus posteriorly.

The species is abundant in the Moodys Branch marl at Jackson, Mississippi.

Dimensions.—Height, 4 mm.; greatest diameter, 1 mm.

Holotype.—Unknown. Not recorded at the Johns Hopkins University, where most of the Meyer types are.

Occurrence.—Moodys Branch marl, Jackson Eocene, Jackson, Miss. (type), locality 921. Red Bluff, Mississippi, Oligocene, occurrence not verified.

Family ? **CERITHIIDÆ**

Subfamily ? **POTAMIDINÆ**

Genus **HARRISIANELLA** Olsson

Olsson, Bull. Amer. Paleont., vol. XV, No. 57, 1929, p. 20, pl. 8, fig. 7. Genotype by original designation, *H. peruviana* Olsson. Upper middle and upper Eocene of Peru.

The genus is a unique group, restricted so far to the later formations of the Eocene. Three species are known as yet, respectively from Peru, Panama, and Texas. It bears a similarity in sculpture to *Aurelianella* Cossmann (Ann. Soc. roy. malac. Belgique, t. XXVIII, 1893, p. 11) of the upper Eocene of France. At present the two genera are placed in different families. Future research may either unite the two genera or show that the pattern of ornamentation is only an example of parallelism. The complete nature of the anterior canal of *Harrisianella* is not known so that the absolute classification as to family is indefinite.

Harrisianella plicifera (Heilprin) Plate 39, figs. 11, 12

Terebra plicifera Heilprin, 1880, U. S. Nat. Mus., Proc., vol. III, p. 151, fig. 8 included in 1882, Smithsonian Misc. Coll., vol. XXII, p. 151, Heilprin, 1884, Cont. Tertiary Geol. Paleont. United States, p. 38 footnote; Heilprin, 1891, Acad. Nat. Sci. Philadelphia, Proc. for 1890, vol. XLII, p. 398; Aldrich, 1897, Bull. Amer. Paleont., vol. II, No. 8, p. 4, pl. 3, figs. 2, 2a, suggested ceritholoid affinity.

Harrisianella plicifera (Heilprin), Olsson, 1929, Bull. Amer. Paleont., vol. XV, No. 57, p. 20.

"*Clava*" *plicifera* (Heilprin), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 218, pl. 29, fig. 12.

Turreted; whorls ? in number, flattened, rapidly decreasing in size from the base upwards, and ornamented by numerous broad and prominently defined plicæ, having a sigmoidal flexure; an impressed line on the upper portion of each volution produces a subsutural ring or band, over which the plicæ and corresponding sulci are continued, and which occasionally tends to become double from the presence of a second impressed line. Body-whorl with two elevated revolving lines on its basal angulation; base radiatey and longitudinally striated; aperture ? (broken in all specimens).

Length ? (No. 8919).

Atascosa County, Texas.—[Heilprin, 1880.]

Aldrich examined the types of the species in the U. S. National Museum and figured one of them. The Harris Collection in the Paleontological Research Institution includes two specimens of a ferruginous sandstone containing several imprints of this species. The material came from Peeler's Ranch in Atascosa

County, Texas, collected during the days of the Texas Geological Survey. The specimens do not reveal the nature of the aperture and base of the body whorl so that Aldrich's figure of one of the types gives the only evidence known of that portion of the shell.

The figures of the sculptured apical whorls of *H. plicifera* bear a remarkable resemblance to the type of the genus *Harrisianella* of the upper middle and upper Eocene of Peru, described by A. A. Olsson (1929). There are more longitudinal ribs on *H. peruviana.* The axial sculpture on the Texas species may not be so pronounced as on the genotype.

Harrisianella exhibits a similarity to *Aurelianella* Cossmann,[45] type, *A. mutabilis*, from the upper Eocene of the Paris Basin. The longitudinal sculpture in *Aurelianella* dies out anteriorly which is also true of the ornamentation in *H. plicifera.* (See Palmer, 1937, pl. 29, fig. 12.) Cossmann placed *Aurelianella* in the family Diastomidæ because of the lack of the anterior canal. Olsson thought *Harrisianella* probably should be classed in the Potamidinæ subfamily of the Cerithiidæ. However, the base of the aperture in the holotype of *H. peruviana* is broken so that the true nature cannot be determined.

The nature of the impressions of *H. plicifera* makes it difficult to determine the definite nature of the canal. From the standpoint of the nature of the sculpture, the species seems to belong more with *Aurelianella* than with *Harrisianella.*

However, in the Paleogene of Panama there is a new species of *Harrisianella* which is typical of the genus. On the holotype of the Panama species the columellar area, including the callus, is preserved and shows a similar slight fold on that area such as is on the genotype and as Aldrich illustrated for *H. plicifera.* (Aldrich, 1897, pl. 3, fig. 2a.) If *H. plicifera* belongs to *Harrisianella* (of which there seems to be little doubt) then the generic description must be modified to include forms, such as *H. plicifera*, in which the sculpture on the adult whorls may become obsolete.

[45]Cossmann, M.: Ann. Soc. roy. malac. Belgique, t. XXVIII, 1893, p. 12, fig. 10; Essais Paléoconch. comp., 7 liv., 1906, p. 184, pl. X, figs. 15-17, pl. XI, fig. 11; Cossmann, M., and Pissarro, G., Icon. comp. Coq. foss. Eocené Env. Paris, t. 2, 1910-1913, pl. XXVI, figs. 139 bis 1.

This character brings the relationship of *Harrisianella* closer to *Aurelianella* of the Paris Basin. The major difference between the two genera is then the size of the anterior sinus.

Dimensions.—Height, 21 mm.; greatest diameter, 9 mm. (fragment).

Types.—No. 8919, United States National Museum, Washington, D. C.

Occurrence.—Fayette formation, Atascosa County, Texas, (type); Peeler's Ranch, Atascosa County, Texas.

Family CERITHIOPSIDÆ

Genus SEILA A. Adams, 1861

A. Adams, Ann. Mag. nat. Hist., 3d ser., vol. VII, 1861, p. 131.

Genotype by subsequent designation, Dall, (Mus. Comp. Zoöl. Harvard, Bull., vol. XVIII, 1889, p. 250), *Triphoris dextroversus* Adams and Reeve (Voyage *Samarang*, 1850, Mollusca, p. 45, pl. XI, fig. 31 a, b). Living. China Sea. Tryon, Manual Conch., vol. IX, 1887, p. 190, pl. 39, fig. 58.

Seila constricta (H. C. Lea)

Terebra constricta H. C. Lea, 1841, Am. Jour. Sci., vol. 40, p. 100, pl. 1, fig. 18.

For synonymy, original description, illustrations, and notes see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 222, pl. 30, figs. 5, 12, 13.

This species was described from the Gosport sand, Claiborne, Alabama. Meyer[44] reported finding the form at Jackson, Mississippi. We have not been able to verify the identification.

Genus CERITHIELLA Verrill, 1882

Lovenella Sars, 1878 *non Lovenella* Hincks, 1869 in Hydroidea; *Newtonia* Cossmann, 1891 *non Newtonia* Schlegel, 1866; *Newtoniella* Cossmann, 1893, n. n. for *Newtonia; Cerithiolinum* Locard, 1903, n. n. for *Lovenella* Sars.

Verrill, Connecticut Acad. Arts and Sci., Trans., vol. 5, pt. 2, 1882, p. 522, to replace the preoccupied name of *Lovenella* Sars.

Genotype by original designation, *Cerithium metula* Lovén (Ind. Moll. Scandinaviae, 1846, p. 23). Living. Western Europe. Tryon, Manual Conch., vol. IX, 1887, p. 175, pl. 36, fig. 68.

Cerithiella aldrichi (Meyer)

Cerithiopsis Aldrichi Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 71, pl. 2, fig. 14.

For synonymy and description see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 226, pl. 29, fig. 2.

Meyer listed originally Red Bluff, Mississippi, Jackson, Mississippi, and Claiborne, Alabama, as localities for the occur-

[44]Meyer, O.: Bericht Senckenberg. naturf. Gesell., 1886, p. 15.

rence of this species. The holotype in the Geology Department, the Johns Hopkins University, is from Red Bluff, Mississippi, Oligocene.

Meyer and Aldrich (Cincinnati Soc. Nat. Hist., Jour., vol. IX, No. 2, 1886, p. 48) listed the species from Newton and Wautubbee, Mississippi, Claiborne, Alabama, and Jackson, Mississippi, as well as Red Bluff. Supplementary material is not available for me to verify whether the specimens from the different localities belong to the same species.

Cerithiella jacksonensis (Meyer) Plate 39, figs. 5, 6

Cerithiopsis Jacksonensis Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 71, pl. 2, fig. 13.

Non Cerithiopsis (Lovenella) Jacksonensis (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. II, p. 270.

Newtoniella Jacksonensis Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 31.

Cerithiella jacksonensis (Meyer), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 225.

Whorls regularly rounded, covered by four elevated, longitudinal lines, crossed by numerous transverse ribs of smaller size; the points of crossing are thickened. Base covered with minute elevated, revolving lines, the outermost of which is larger; canal reflected.

Locality.—Jackson, Miss.

On the last whorl of the type-specimen a fifth spiral line appears near the suture, and in a much larger specimen this fifth spiral is fully developed. Differs from the preceding species in having more rounded whorls.—[Meyer, 1886.]

I do not agree with Dall that *C. jacksonensis* is the young of *C. nassula* (Conrad). *C. nassula* has three spiral ribs on each whorl. *C. jacksonensis* has four spiral ribs with the number of revolving ribs increasing with age. Therefore the more mature whorls would have more revolving ribs instead of less. It would be impossible for *C. jacksonensis* with more spiral ribs to be the tip of an individual of *C. nassula* as Dall postulated. Meyer mentioned a fifth revolving ridge, and in a fragment of a large specimen figured herein five definite spiral ribs are present on the body whorl and on the penultimate whorl. No other specimens are available in our collections but the data known are sufficient to show the distinction between *C. jacksonensis* and allied species.

Dimensions.—Greatest diameter, 7.5 mm. (fragment). Height of type (indicated by type figure), 9 mm.

Holotype.—Not found.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 8.

Cerithiella ouachitensis, n. sp. Plate 39, fig. 10

Shell small, probably young; postnuclear whorls seven; whorls convex; first whorl of nucleus unknown, the last with microscopic longitudinal striations, convex to the right. The nuclear sculpture ends abruptly. The postnuclear ornamentation consists of four prominent sharp spiral ribs crossed by pronounced longitudinal ridges with fine nodes at the intersection. The base of the body whorl is carinated, below which, are microscopic spiral lines only. There is a fine spiral cord at the suture.

The nuclear whorls of this species are similar to those on *C. aldrichi* figured by Meyer. This species has the same number of revolving ribs as *C. jacksonensis* Meyer but differs from that species in having the longitudinal striations less developed in strength and many less in number. The form has a similar number of longitudinal ridges as *C. aldrichi* Meyer but is distinct from that species in having more spiral ribs on specimens of the same stage of ontogeny.

Dimensions.—Height, 5.3 mm.; greatest diameter, 1.5 mm.

Holotype.—No. 4617, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 8.

Family TRIPHORIDÆ

"*Triforis*" *Americanus* Aldrich (Cincinnati Soc. Nat. Hist., Jour., vol. VIII, 1885, p. 151) is the genotype of *Sinistrella* Meyer (Bericht Senckenberg. naturf. Gesell., 1886, pp. 17, 18). The form belongs in the Turridæ, which see.

No representatives of the Triphoridæ have so far been found in the Jackson, although species are described from the Claibornian.

Family STROMBIDÆ

Genus STROMBUS Linnæus, 1758

Linnæus, 1758, Systema Naturæ, ed. X, p. 742.

Genotype by subsequent designation, *Strombus pugilis* Linnæus (1758, p. 744), Montfort (Conchyliol. Syst., t. 2, 1810, p. 515). Recent. Southeastern Florida. West Indies to southern Brazil. Clench and Abbott, Johnsonia, No. 1, 1941, p. 5, pl. 4.

Strombus albirupianus Dall Plate 40, figs. 1, 2

Strombus albirupianus Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 174, pl. 12, figs. 2, 10.

Upper Eocene (Jackson) white limestone overlying the Claiborne sands at Claiborne Bluff, Alabama.

Shell of six or more whorls; nuclear part lost; whole surface spirally sculptured with feeble, elevated ridges, with wider interspaces; the ridges or threads coarser in front of the suture and near the canal; transverse sculpture on the early whorls of obscure ribs, chiefly apparent as stout tubercles, which on the later whorls are more or less vertically flattened and may number ten to fourteen or more on the last whorl; whorls turrited by the shoulder, which on the last whorl is subcarinate, with the tubercles on the carina, behind which the shell is somewhat excavated, the surface rising and somewhat appressed at the suture, which is very distinct; aperture narrow, not extended behind the carina of the body-whorl, toward which the expanded lip rises a little from the line of the shoulder, which last angulates the aperture; outer lip hardly reflected, somewhat thickened internally; inner lip lightly coated with callus, lirate behind, with small but distinct liræ; pillar a little twisted, with a faint siphonal fasciole; genital sulcus of the outer lip distinct, small and rather deep, quite anteriorly placed. Max. lon. of shell somewhat exceeding 55.0; max. lat. 26.0 mm.

This interesting form is remarkable for its narrow form, which gives to the molds by which we know it somewhat the appearance of those of *Conus*. The molds give a deceptive look of height to the spire; when gutta-percha casts are taken, it is seen to be of about the usual height in *S. pugilis* and other allied species. It is intimately related, as will be seen, to the Lower Miocene species which succeed it, through which its kinship to the recent species may apparently be traced.

The type-specimens in the National Museum were received from the American Museum of Natural History at New York, through Prof. R. P. Whitfield, and specimens of the species are undoubtedly contained in the New York collection.—[Dall, 1890.]

This form seems extraneous to the Jackson fauna. It is suggestive that the specimens probably did not come from the limestone overlying the Gosport sand at Claiborne Bluff but may have come from stratigraphically higher limestones in the area of Claiborne Bluff. The species may be Oligocene instead of Jackson Eocene.

Syntypes.—No. 11431, United States National Museum, Washington, D. C.

Genus ECTINOCHILUS Cossmann, 1889

Cossmann, Ann. Soc. roy. malac. Belgique, t. XXIV, 4th ser., t. IV, 1889, p. 87.

Genotype by original designation, *Strombus canalis* Coquebert and Alex. Brongniart (1793)[46] [=Lamarck, 1803]. Lutetian. Paris Basin;

[46]Coquebert, Roman, and Brongniart, Alex.: Bull. Soc. Philom., Paris, vol. 1, 1793, p. 56, pl. V, fig. 5; Lamarck, J., Ann. Mus. nat. Hist. nat., t. 2, 1803, p. 219; *op. cit.*, t. 6, 1805, pl. III, figs. 2a, 2b.

Sables de Wemmel, Tongrian, Belgium; Vicentin, Italy. Cossmann, Essais Paléonch. comp., 1904, 6 liv., pl. III, figs. 17-18.

Subgenus VADEROS Clark and Palmer, 1923

Clark and Palmer, Univ. California Pub., Geol. Sci., vol. 14, No. 7, 1923, pp. 281, 282, pl. 51, figs. 7, 8.

Subgenotype by original designation, *Rimella elongata* Weaver (Geol. Survey Washington, Bull., No. 15, 1912, p. 37, pl. 2, fig. 19). Upper Eocene. State of Washington, U. S. A. Weaver, Univ. Washington Pub. Geol., vol. 5, pt. II, p. 391; pt. III, pl. 76, fig. 22.

Ectinochilus (Vaderos) stenzeli, n. sp. Plate 40, figs. 5-7

Nucleus consists of three and possibly more smooth whorls, first minute; apex pointed. It is difficult to determine the limit of the nucleus, as few specimens retain the apical whorls and many shells are worn. The postnuclear whorls bulge from the small nucleus. Sides of whorls are straight, obscurely convex, and slightly excavated at the suture. The three or four postnuclear whorls are smooth, the next whorl is covered with microscopic flat even spiral lines. The lines gain strength anteriorly so that the remainder of the whorls of the spire are completely covered with the fine revolving ribs. The interspaces are linear and punctate. The spiral ribs are most conspicuous over the basal area of the body whorl where they are slightly elevated, the interspaces are larger and more strongly dissected by hair-like longitudinal striations. Fine longitudinal folds occur over the penultimate whorl and body whorl, stronger on the body whorl. The aperture has a strong basal notch anteriorly with sharp margins. Varices have not been noticed on the specimens studied.

The Jackson *E. stenzeli* differs from *E. laqueatum* (Conrad)[47] of the Gosport sand (Plate 40, figs. 3, 4, 8) by the accentuation of the spiral sculpture, a greater extension of the posterior callus, and in the character of the basal notch. In *E. laqueatum* the apical whorls have definite longitudinal folds and only microscopic spiral lines. In *E. stenzeli* spiral sculpture covers the body whorl and most of the spire with the longitudinal folds limited to

[47]Conrad, T. A.: Fos. Shells Tert. Form., 1833, p. 41; *op. cit.*, 1835, p. 38, pl. 15, fig. 4 *non* 5; Palmer, K. V. W., Bull. Amer. Paleont., vol. VII, No. 32, p. 244, pl. 33, figs. 1, 2, 5-7.

the body whorl and penultimate whorl.

In the Claiborne report, I regarded the Jackson form as a variety of *E. laqueatum*. On additional study the two species reveal different lines of development although superficially a relationship is suggested. Not only is the ornamentation dissimilar but the basal notch of each represents two different trends of growth. *E. laqueatum* has the margin of the labrum turned forward. In *E. stenzeli* the margin of the labrum is reflected with a concavity or groove just back of the edge. The inner margin of the parietal callus on *E. laqueatum* extends posteriorly on to the inner callus of the posterior canal. On *E. stenzeli* the parietal callus and inner callus of the posterior canal are continuous. This may be a minor point and not of anatomical value. The posterior canal and callus extend higher on the spire in *E. stenzeli* than they do on *E. laqueatum*. Such features are much shorter in *E. laqueatum* than on typical *Ectinochilus*.

E. stenzeli seems to bear a closer resemblance to the pattern of *E. elongatum* (Weaver) of the Cowlitz, upper Eocene of the State of Washington, than to other known species of the group.

Dimensions.—Height, 23 mm.; greatest diameter, 10 mm.

Types.—Holotype, No. 4624; paratype, No. 4625, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 10 (type). Yazoo clay, locality 2.

Genus **DIENTOMOCHILUS** Cossmann, 1904

Cossmann. Essais Paléoconch. comp., 6 liv., 1904, p. 38.

Genotype by original designation, *Strombus ornatus* Deshayes (Descrip. Coq. foss. Eocène env. Paris, t. II, 1835, p. 628, pl. 85, figs. 3-5). Lutetian Eocene. Paris Basin. Cossmann, *loc. cit.*, pl. III, fig. 21.

D. bartonense (J. Sowerby, 1819)[48] of the Bartonian of England is very close to and may be the same species as the Parisian, *D. ornatum*. The appelation used then for the genotype would be *bartonense* (Sowerby) because of priority.

Subgenus **DASYOSTOMA** Stewart, 1927

Stewart. Acad. Nat. Sci. Philadelphia, Proc. for 1926, vol. LXXVIII, 1927, p. 368.

Subgenotype by monotypy, *Rimella rugostoma* Johnson. Jackson Eocene. United States. Plate 42, figs. 4, 5.

[48]Wrigley, A.: Malacol. Soc. London, Proc., vol. XXIII, pt. II, 1938, p. 74.

Dientomochilus (Dasyostoma) rugostomum (Johnson) Plate 42, figs. 4, 5

Rimella rugostoma Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 79, pl. II, fig. 10.

Ectinochilus (Dasyostoma) rugostoma (Johnson), Stewart, 1927, Acad. Nat. Sci. Philadelphia, Proc., vol. LXXVIII, p. 368; Wenz, 1940, Handbuch Paläozoölogie, Bd. 6, Gastropoda, Teil 4, p. 933, fig. 2730.

Dientomochilus rugostoma (Johnson), Wrigley, 1938, Malacol. Soc. London, Proc., vol. XXIII, pt. II, p. 75.

Shell subfusiform, whorls eight, slightly convex, the two apical whorls smooth, the others beautifully reticulated as follow: The three spiral whorls below the smooth apical whorls, have seven equidistant, flat, revolving ridges, which are crossed by small interrupted longitudinal ribs, obsolete on the upper of the three whorls. The body whorl above the periphery and the first and second spiral whorls have revolving ridges that are divided by a small groove into five pairs, on the body whorl below the periphery are twenty single revolving ridges, which become gradually small toward the base, just above the suture one of the single revolving ridges is also exposed on the first and second spiral whorls; longitudinal ribs prominent, about twenty to each whorl, becoming nodulose where they cross the revolving ridges. Aperture narrow, ovate, outer lip thick, and deeply notched, lobe acute, inner margin crenulated by about twenty short ridges; inner lip thin, expanded, bearing a rugose callous ridge which curves gradually downward toward the posterior end of the aperture, above which, at the posterior commissure is a small rugose triangle, the posterior canal extending to the base of the fourth spiral whorl. Length 20 mm., greatest diam. 9 mm.

One specimen from the material collected by Thomas A. Morgan, at Jackson, Miss.—[Johnson, 1899.]

There are three smooth apical whorls instead of two, as originally described. Such a number occurs on the specimen figured herein and was present on the holotype. The crenulations on the labium of the holotype extend the full length of the lip and are well developed. However, variation must be considered for on the specimen in our collection the labial crenulations are coarse only posteriorly and are partially developed anteriorly.

In a similar manner the absence of varices is not a definite character in this form. The holotype lacks varices but the specimen of the species which I have observed and illustrated has conspicuous but not strong varices. If, one or two chance specimens have varices and the others not, then the presence or absence of varices cannot be diagnostic even specifically. The presence or absence of varices in the rimellids, as I have noted before (1937, p. 245), and as Stewart (1927 [typ. error bibliography, 1937], p. 368) has deduced, are factors not to be relied upon. Therefore, the comment by Stewart (1927, p. 368) and continued in Wenz (1940, p. 933) as to the lack of varices in

D. rugostomum for the generic or even specific description should be modified.

Dasyostoma is certainly allied more with *Dientomochilus* than with *Ectinochilus*. *D. rugostomum* has the notch in the labrum located about medially, *i. e.*, more posteriorly than in *Dientomochilus*, *s. s.*, and there is a narrow groove which enters the posterior canal posteriorly from the notch in the labrum. There is also a pit in the parietal callus. There is a strong longitudinal fold back of the labrum, in juxtaposition to the thickened margin.

Dimensions.—Height, 18 mm.; greatest diameter, 9 mm.

Holotype.—No. 9683, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 10.

Genus **CALYPTRAPHORUS** Conrad, 1857

Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. IX, 1857, p. 166.

Genotype by subsequent designation, Cossmann, 1904 (Essais Paléoconch. comp., 6 liv., p. 25), *Rostellaria velata* Conrad (Fos. Shells Tert. Form., 1833, p. 31). Claibornian Eocene. United States. Palmer, 1937, pl. 32, figs. 4, 6, 7, 10-12.

Calyptraphorus velatus stamineus (Conrad) Plate 41, figs. 5-12

Rostellaria velata Conrad, 1833, Sept., Fos. Shells Tert. Form., p. 31; Conrad, 1835, Fos. Shells Tert. Form., p. 38, pl. 15, fig. 5 *non* 4. For complete synonymy, copy of original description, and discussion of the species see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 240, pl. 32, figs. 4, 6, 7, 8, 10-13.—[*Calytraphorus* typ. error.]

Rostellaria velata Conrad, 1854, Wailes, Rept. Agr. Geol. Misissippi, p. 289, pl. XV, figs. 7a, 7b [*vellata sic*]; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 260; Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 6, 19, pl. 2, figs. 7a, 7b. Jackson form.

Rostellaria staminea Conrad, 1854, *loc. cit.*, pl. XVI, fig. 9; Conrad, 1855, *loc. cit.*, Reprint, *op. cit.*, p. 6, pl. 3, fig. 9.

Calyptraphorus stamineus Conrad, 1865, Am. Jour. Conch., vol. 1, p. 31 Jackson.

Calyptrophorus stamineus Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25.

Calyptrophorus eburneus Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25 *nomen nudum;* Aldrich, Geol. Survey Alabama, 1894, p. 245.

Fusiform, spire elongated, subulate above; whorls fifteen; body whorl slightly concave with fine closely-arranged revolving lines and obsolete longitudinal undulations; three upper whorls with curved longitudinal acute ribs; the remainder covered with a polished calcareous deposit, and excavated at the suture; body whorl angular on a line with the upper margin of the aperture; labrum thin; beak slightly curved.

This species occurs at Claiborne in great abundance.—[Conrad, 1855.]

This species is one of the most abundant forms in the Jackson Eocene. The species-stock was developed in the lower Claiborne, was well established in the Gosport sand, but reached its greatest fulfillment of growth in number of individuals in the Jackson Eocene. Hundreds of specimens may be easily obtained in the Moodys Branch marl at Jackson, Mississippi. Specimens in the Gosport sand at Claiborne Bluff are badly broken. Particularly fragile are the anterior canal and the callous covering of the groove which spreads over the back of the whorls. However, better preserved specimens from the same horizon may be collected at Little Stave Creek and Gopher Hill, Alabama.

The Jackson shells differ from typical *C. velatus* of the Gosport sand in having finer revolving striations, fewer longitudinal ribs, and present more irregular varices. The calloused apical tip seems to be shorter in the Jackson form and does not extend in a long narrow projection as is common amongst specimens of typical *C. velatus*.

There are several specimens in the Conradian Collection in the Academy of Natural Sciences at Philadelphia labelled "*C. eburneus*," "B. L. C. Wailes" and "Jackson, Miss." That name was listed by Conrad in 1866 but it is a *nomen nudum*. Although Conrad included both *C. eburneus* and *C. stamineus* in his checklist of 1866, the specimens labelled *C. eburneus* seem to be the same form as that figured in Wailes as *C. stamineus*.

Dimensions.—Height, 58 mm.; greatest diameter, 20.5 (medium-sized).

Type.—*C. stamineus* Conrad, not found. Nos. 15062, 15063, 15064 specimens labelled *C. eburneus* Conrad, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Lower Claiborne, Gosport sand (*C. velatus* type). Jackson: Moodys Branch marl, localities 785, 870, 881, 921, 693, 1051; 900., 1098, 1100, 1111; 883, 1054, 10, 15; 912, 7, 8, 9; 1, 1119; 16; Danville Landing Beds, localities 6, 886; Jackson of Arkansas, localities 897; 1046, 894.

Genus **PLATYOPTERA** Conrad, 1855

Platyoptera Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 260, Reprint, 1939 Bull. Amer. Paleont., vol. XXIV, No. 86, p.

6, pl. 3, fig. 3; Conrad, 1865, Am. Jour. Conch., vol. 1, p. 31; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Stoliczka, 1868, Palæont. Indica, Mem. Geol. Survey India, Cretaceous Fauna of S. India, vol. II, p. 448.

Genotype by monotypy, *P. extenta* Conrad. Jackson Eocene. Southern United States. Plate 41, figs. 1-4.

This genus is known so far from the type species. Unfortunately the distinct characters of the genus are poorly known in consequence of the compilation of authors following the dictum of Tryon in 1883 whereby the genus was relegated to synonymy of *Rostellaria* (Struct. Syst. Conch., vol. II, p. 191). In the Manual of Conchology, vol. VII, 1885, p. 143, index, the name is given as synonymous with *Rostellaria* referring to p. 102 in the text, but no note of *Platyoptera* is given in the text. Cossmann (Essais Paléoconch. comp., 6 liv., 1904, p. 19) noted the omission in Tryon, but he did not find the original figure of *Platyoptera extenta*, or he would not have continued to place the form as equal to *Rostellaria*. The illustration of Conrad is not adequate in revealing the complete details of the species, but it does show that the genus is not typically rostéllaroid. *Platyoptera* was retained under *Tibia* (= *Rostellaria*) in 1940 by Wenz (Handbuch der Paläozoologie, Bd. 6, Gastropoda, Teil 4, p. 933).

Platyoptera may belong in the Strombidæ with *Tibia* Bolten (= *Rostellaria* Lamarck), but it does show well-marked affinities with such genera, of the family Aporrhaidæ, as *Malaptera* Piette[49] (= *Phyllocheilus* Gabb,[50] 1868) in the Jurassic and *Maussenetia* Cossmann (*op. cit.*, p. 71, pl. IV, figs. 8, 9; Wenz, *op. cit.*, p. 920) in the Paleocene.

Platyoptera has a stout, medium-height spire with regular well-developed spiral striations as in *Malaptera* Piette or *Harpagodes* Gill (Am. Jour. Conch., vol. V, 1870, p. 138). Not many complete specimens of *Platyoptera extenta* are available to determine whether it had spines projecting from the large wing at one or more points as in the genera herein compared with it.

[49] Piette, Ed.: Note sur les Coquilles ailées des Mers jurassiques, 1876, p. 5. *Malaptera*, in accordance with Int. Rules Zool. Nomen., Arts. 35, 36, is not preoccupied by *Malapterus* Curvier and Valenciennes, 1839, Pisces, as considered by Cossmann, *op. cit.*, p. 68 and Wenz, *op. cit.*, p. 919.

[50] Gabb, Wm. M.: Am. Jour. Conch., vol. IV, 1868, p. 140, pl. 13, fig. 6; Wenz, W., *op. cit.*, p. 919, fig. 2696.

The spiral lines at the boundary of the wing and the body proper are bent sharply downward or obliquely. This feature is also noted on *Malaptera* (*Phyllocheilus*). (See Cossmann, *loc. cit.*, pl. IV, fig. 4.)

The genus, however, has a curved or arched posterior sinus which descends anteriorly in a manner similar to *Ectinochilus* and allied genera of *Calyptraphorus* of the Strombidæ. Conrad placed the genus with *Aporrhais*.

Platyoptera extenta (Conrad) Plate 41, figs. 1-4

Rostellaria extenta Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XVI, fig. 3, Reprint, 1939, Bull. Amer. Paleont., vol. XXIV, No. 86, p. 19, pl. 3, fig. 3.

Aporrhais (*Platyoptera*) *extenta* Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 260, Reprint, *op. cit.*, p. 6.

Platyoptera extenta Conrad, 1865, Am. Jour. Conch., vol. 1, p. 31; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Stoliczka, 1868, Palæont. Indica, Mem. Geol. Survey India, Cretaceous Fauna S. India, vol. II, p. 448.

Hippochrenes extenta (Conrad), Gabb, 1868, Am. Jour. Conch., vol. IV, p. 141.

Rostellaria (*Hippocrenes*) *extenta* Conrad, Aldrich, 1894, Geol. Survey Alabama, p. 244.

Shell independent of labrum fusiform, with prominent revolving rounded lines and intermediate fine lines, from one to three, and longitudinal microscopic lines; volutions rounded, covered towards the apex with a polished calcareous deposit; labrum within with impressed radiating lines, becoming well marked furrows towards the base.—[Conrad, 1855.]

Shell large, body stout, spire medium, nucleus unknown; whorls rounded or angulated above the middle of the whorl; whole surface of whorls covered with regular spiral ribs with interspaces equal to or wider than the rib; microscopic longitudinal striations; revolving ribs may project through the parietal callus as plications.

The labrum is expanded into a large wing which extends beyond the body whorl, above and over the spire, as well as below and over the canal. The full extent of the wing is not known. The revolving ribs of the body whorl continue onto the wing, bending obliquely on the outer flare. Between the spiral ribs on the body whorl, fine secondary threads may occur. These may also extend onto the wing. The apical whorls are covered with callus. A posterior sinus curves over the spire and extends anteriorly opposite the wing.

The genus is known from the one species, *P. extenta* Conrad, from the Jackson Eocene of the Mississippi embayment area. Since the form has no close relatives in the lower or higher horizons, it is an excellent guide to Jackson strata.

Mausseneetia cossmanni Trechmann[51] from the Yellow limestone (Eocene) of Jamaica, is generically related, but the preservation of the specimens are too poor to be able to give definite affinities.

The body of the Jackson species shows the same characteristics in shape and sculpture as *Mausseneetia dimorphospira*[52] Cossmann and Pissarro, from the upper Ranikot series of Sind, India, lower Eocene.

Dimensions.—Height, 43+ mm.; greatest diameter, 31 mm. (lectotype).

Lectotype.—No. 13210, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 1056; 1, 7. Lower Yazoo clay, locality 915.

Family CYPRÆIDÆ

Genus CYPRÆA Linnæus

Linnæus, Systema Naturæ, 10th ed., 1758, p. 718.

Genotype by subsequent designation, Montfort (Conchyliol. Syst., t. 2, 1810, p. 631), *Cypraea tigris* Linnæus (1758, p. 721; Hanley, 1855, p. 187). Living. Indo-Pacific. Tryon, Manual Conch., vol. VII, 1885, pl. 11, figs. 49, 50.

Cypræa healeyi Aldrich Plate 39, figs. 13-17

Cypraea Dalli Aldrich, 1894. Nautilus, vol. VII, No. 9, p. 98, pl. 4, figs. 2, 2a; Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 474, pl. XIX, figs. 5a, 6a; fig. 6a renamed *C. conradi* by Schilder, 1932, Fossilium Catalogus, Animalia I, Pars 55, p. 223.

Non Cypræa dalli Cossmann, 1893, Ann. Soc. roy. malac. Belgique, IV ser., t. XXVIII, p. 13, fig. 11.

Cypræa (*Cypræovula*) *Dalli* Aldrich, Cossmann, 1903, Essais Paléoconch. comp., 5 liv., p. 169, pl. IX, figs. 6-7.

Cypræa healeyi Aldrich, 1923, Biol. Soc. Washington, Proc., vol. 36,

[51]Trechmann, C. T.: Geol. Mag., vol. LX, No. 710, 1923, p. 354, pl. XIV, fig. 3.

[52]Cossmann, M., and Pissarro, G.: Palæont. Indica, Geol. Survey India, n. ser., vol. III, Mem., No. 1, 1909, p. 51, pl. IV, figs. 26-28; pl. VIII, figs. 4, 4a.

p. 199[53] n. n. for *C. dalli* Aldrich, 1894 *non C. dalli* Cossmann, 1893; Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 14, pl. 2, figs. 1-4.

Eocypræa conradi Schilder, 1927 [1925 Jahrgang], Archiv Naturgesch., 91, Abt. A, Heft 10, p. 74 n. name for *dalli* Harris, 1896, pl. XIX, figs. 6, 6a.

Sulcocypræa healeyi (Aldrich), Schilder, 1927, *op. cit.*, p. 81.

Sulcocypræa lintea healeyi (Aldrich), Schilder, 1932, *loc. cit.*

Shell ovate, moderately elevated, surface highly polished, crossed above by a number of lines not closely set, dividing the surface into a series of facets, base ventricose; labrum very much thickened, profoundly striated but the striations do not extend up over the whole surface. Teeth on outer lip alternate. The smaller ones half the length of the others; aperture narrowed in some specimens in the centre, in others regular and strongly denticulated. Length 15 mm.; width 12 mm.; alt. 9 mm.

This shell is also found at Jackson, Miss. It resembles *C. lintea* Con., and has been considered as that species. It is however, larger, with a more thickened labrum on which the striations do not reach the body of the shell as in Conrad's species, but stop half way; the surface of this shell is very different. In *C. lintea* the surface is completely covered with close-set, very fine lines, while this species has but few, and they are not impressed, some specimens being smooth. The type retains some color, showing the shell to be chocolate brown above with the lip white; *C. lintea* Con. is figured in my *Preliminary Report*, Pl. V, fig. 2, p. 32, 1886.

Conrad's original description contains a misprint which seems to have been perpetuated in later publications. It should read "with *fine* approximate equal impressed lines," instead of "*four* . . . lines." Type in National Museum; examples in my collection.—[Aldrich, 1894.]

The holotype of this species comes from Red Bluff, Mississippi, Oligocene. Ingram (1942) figured, in addition to the holotype, an immature specimen. The illustrations of specimens of Jackson Eocene shells given by Harris (1896) are like the holotype and the Oligocene immature individual respectively, figured by Ingram. The figures included herein of shells from near Montgomery, Louisiana, are between, in stage of growth, the immature shells illustrated by Harris and Ingram and the fully matured *Cypræa* represented by the holotype.

Dimensions.—Height, 19 mm.; greatest diameter, 12 mm. (medium).

Holotype.—No. 135157, United States National Museum, Washington, D. C.

Occurrence.—Oligocene, Red Bluff, Wayne County, Mississ-

[53]The reference to Cossmann, 1893, given by Aldrich should read Ann. Soc. roy. malac. Belgique, IV ser., t. 28, p. 13 and not "Essais de Pal., 5 liv., p. 169, pl. 9, f. 6, 7, Dec., 1893." The date of Essais Paléoconch. comp., 5 liv., is 1903 (not 1893) and the Cossmann's reference is to Aldrich's *C. dalli*. See synonymy above.

ippi (type). Jackson, Moodys Branch marl, localities 10, 883; 1.

Cypræa jacksonensis Johnson Plate 39, fig. 18

Cypræa jacksonensis Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc. LI, p. 77; Schilder, 1927, [1925 Jahrgang], Archiv Naturgesch., 91, Abt. A, Heft 10, p. 162 ? *Luponovula;* Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 14, pl. 2, fig. 7.

?*Eocypræa* (*Sphærocypræa*) *jacksonensis* (Johnson), Schilder, 1932, Fossilium Catalogus, Animalia 1, Pars 55, p. 218.

This is the largest species of *Cypræa* from the Eocene of North America. It is represented only by parts of perhaps three individuals (five specimens). The part of the outer lip measures 68 mm. A perfect specimen would probably exceed 90 mm. A specimen representing the dorsal surface has a diameter of 55 mm. Shell smooth and polished, lip thick, reflected, teeth large and occasionally bifurcate.

Collected by Mr. Thomas A. Morgan and the writer at Jackson, Miss.—[Johnson, 1899.]

A broken smooth specimen from near Montgomery, Louisiana, which measures about 65 mm. in height, probably belongs to this species.

Holotype.—No. 7120, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 10.

Cypræa ludoviciana Johnson Plate 39, figs. 3, 4

Cypræa ludoviciana Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 77, pl. 11, fig. 6; Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 15, pl. 2, figs. 10, 11.

Cypropterina (*Jenneria*) *ludoviciana* (Johnson), Schilder, 1927 [1925 Jahrgang], Archiv Naturgesch., 91, Abt. A, Heft 10, p. 72.

Cypropterina (*Cypropterina*) *ludoviciana* (Johnson), Schilder, 1932, Fossilium Catalogus, Animalia 1, Pars 55, p. 205.

Shell ovate, somewhat flattened, sligatly prolonged at the extremities, smooth with a prominent broad medial dorsal groove. Aperture narrow, having on each side 21 teeth, toward the ends these extend entirely across the base. Represented by four specimens, three of which measure as follows:

Largest, length 17 mm., greatest diam. 12 mm.
Specimen figured, length 15 mm., greatest diam. 10 mm.
Smallest, length 13 mm., greatest diam. 9 mm.

Collected by the writer from the Jacksonian Eocene at Montgomery, Grant Parish, La.—[Johnson, 1899.]

Lectotype.—No. 13538, Academy of Natural Sciences, Philadelphia, Pa.

Genus **CYPRÆORBIS** Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 31.

Genotype by monotypy, *C. sphæroides* Conrad. Oligocene. Vicksburg, Miss. Plate 40, figs. 13, 14.

Conrad listed, in 1866 (Smithsonian Misc. Coll., vol. VII, No. 200, p. 25), *C. sphæroides* from the Jackson Eocene of Mississippi. The species, however, has not been reported since from the Jackson. The lectotype of the species was figured by Ingram (1942) and through his courtesy the illustration is included in this report. It is supplied here merely so that cognizance may be taken of it in identifying Jackson species.

Cypræorbis ventripotens (Cossmann) Plate 40, figs. 11, 12, 15, 16

Cypræa pinguis Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, pl. XVII, p. 289 [*penguis*], figs. 3a, 3b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 8, 19, pl. 4, figs. 3a, 3b; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. I, p. 164 *partim; non* pl. 11, figs. 1, 1a, *non* Miocene.

Non Cypræa pinguis Bonelli, 1827, Cat. Mus. Tor., No. 3706 *fide* Cossmann, 1922; *nec C. annulus pinguis* Grateloup, 1827, Bull. Soc. Linn. Bordeaux, t. VI; 1840, Conchyl. foss. terrains tertiaires du bassin d'Adour, Atlas, pl. 41, *Cypræa*, pl. II, fig.; Cossmann and Peyrot, 1922, Actes Soc. Linn. Bordeaux, t. LXXIV, p. 301.

Cypræa (*Luponia*) *ventripotens* Cossmann, 1903, Essais Paléoconch. comp., 5 liv., p. 161 new name.

Cypræorbis (*C.*) *ventripotens* (Cossmann), Schilder, 1927 [1925 Jahrgang], Archiv Naturgesch., 91, Abt. A, Heft 10, p. 98; Schilder, 1932, Fossilium Catalogus, Animalia 1, Pars 55, p. 124.

Cypræa tumulus Dall, 1915, U. S. Nat. Museum, Bull. 90, p. 84 *partim, non* pl. 3, figs. 1, 12; *non C. tumulus* Heilprin, 1887, Tampa Miocene.

Cypræa pinguis Conrad, Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 15; Shimer and Shrock, 1944, Index Fossils North America, p. 500.

Obtusely ovate, rounded at base, but obliquely flattened towards the aperture which is very narrow and denticulato-striate on both sides; columella deeply indented near the base, and a dentate line on the margin; labrum excavated towards the base.

Allied to *C. sphæroides*, Con., of Vicksburg, but must less ventricose and very distinct.—[Conrad, 1855.]

The original name of this species is preoccupied and therefore that of Cossmann must be used.

This species is fairly common and well preserved at Jackson Eocene localities. Dall included Miocene specimens under the species but there are qualified differences between the Eocene and Miocene species.

Through courtesy of the Academy of Natural Sciences, Philadelphia, illustrations of the lectotype are included herein.

Dimensions.—Height, 26 mm; greatest diameter, 17.6 mm. (lectotype).

Lectotype.—No. 13198, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 880; 10, 883. Yazoo clay, locality 2.

Genus SULCOCYPRÆA Conrad, 1865

Conrad, Am. Jour. Conch., 1865, vol. 1, p. 31.

Genotype by monotypy, *Cypræa lintea* Conrad. Oligocene. United States. Plate 39, figs. 1, 2.

Sulcocypræa lintea (Conrad) Plate 39, figs. 1, 2

Cypræa lintea Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc. vol. III, p. 282; Conrad, 1848, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. I, p. 113 [*liftea*, correctly spelled on p. 133], pl. 11, fig. 7; pl. 13, fig. 4; Aldrich, 1886, Geol. Survey Alabama, Bull., No. 1, pt. I, p. 32, pl. 5, fig. 2; Aldrich, 1894, Nautilus, vol. VII, No. 9, p. 98.

Sulcocypræa lintea Conrad, 1865, Am. Jour. Conch., vol. 1, p. 31; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. I, p. 165; Schilder, 1927, Archiv Naturg., 91, Abt. A, Heft 10, pp. 81, 133 includes *C. kennedyi* Harris; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 235, pl. 30, figs. 31, 32; Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 18, pl. 3, figs. 12, 13; Shimer and Shrock, 1944, Index Fossils North America, p. 500, pl. 205, figs. 7, 8.

Cypræa (*Cypræovula*) *lintea* Cossmann, 1903, Essais Paléoconch. comp., 5 liv., p. 170 section *Cyprædia*.

Cypræa (*Sulcocypræa*) *lintea* Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25

Sulcocypræa lintea (Conrad), Schilder, 1927, [1925 Jahrgang], Archiv Naturgesch., 91, Abt. A, Heft 10, p. 81, *partim*, age wrong; not equal to *C. kennedyi*.

Ovate, elevated, ventricose, with four [fine] approximate equal impressed lines; base ventricose, profoundly striated; labrum margin much thickened, profoundly striated; summit of the labrum prominent; base slightly produced. Length 6-19. Rare.—[Conrad, 1847 and 1848.]

As was brought out by Aldrich (see under *C. healeyi*), the typographical error of four in place of fine in the original description (described in 1847, repeated in 1848) of this species was confusing as regards the true nature of the shell.

Conrad's illustration of the type was poor but Aldrich figured in 1886 a specimen of the species from Vicksburg. Ingram (1942) illustrated the holotype. Through the courtesy of Dr. Ingram the same illustration is included herein.

The species was listed from the Jackson Eocene by Conrad in 1866. Conrad's reference was the basis of my mention (1937) of the species as a Jackson fossil. However, I have not found representatives of the species in the Jackson collections. Dall's reference to "later Eocene" in 1890 may have been based on Conrad's statement.

Holotype.—No. 13510, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Oligocene. Vicksburg, Miss. (type).

Genus **CYPRÆDIA** Swainson, 1840

Swainson, Treatisé on Malacology, 1840, p. 325; Iredale, Malacol. Soc. London, Proc., vol. XI, 1914, p. 178, "in or before May, 1840" exact date of Swainson.

Genotype by monotypy, *C. cancellata* Swainson (=*C. elegans* Sowerby, 1825[54] Genera Rec. Fos. Shells, *Cypræa*, fig. 7 *non C. cancellata* Gmelin (13 ed., 1791, p. 3414). Eocene. Paris Basin. Cossmann and Pissarro, Icon. complete Coq. Foss. Éocene Env. Paris, t. 2, 1910-1913, pl. XXXIII, figs. 162-13.

The equivalency of *C. cancellata* Swainson and *C. elegans* Sowerby or Defrance was discussed in Palmer, 1937, p. 233.

Cyprædia is a genus represented by beautifully sculptured shells confined to the Eocene and Oligocene. Three species are so far known in the Eocene of the Mississippi embayment area, *C. subcancellata* Johnson, lower Claiborne, *C. gilberti* Palmer, Gosport sand, and *C. fenestralis* Conrad from the Moodys Branch marl of the Jackson.

Cyprædia fenestralis Conrad — Plate 40, figs. 9, 10, 17, 18

Cypræa (*Cyprædia*) *fenestralis* Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XVII, figs. 5a, 5b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 8, 19, pl. 4, figs. 5a, 5b.

Cypraedia fenestralis Conrad, 1865, Am. Jour. Conch., vol. 1, p. 31; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 59 "M. Bocks" = "The Rocks," Ala. misquoted from Aldrich, 1886, Geol. Survey Alabama, Bull., No. 1, pt. 1, p. 43; Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 19, pl. 4, figs. 2, 3.

Cypræa (*Cypraedia*) *fenestralis fenestralis* Conrad, Schilder, 1927 [1925 Jahrgang], Archiv Naturgesch., 91, Abt. A, Heft 10, p. 68; Schilder, 1932, Fossilium Catalogus, Animalia I, Pars 55, p. 210 repeated "M. Bocks" of De Gregorio.

[54]Newton, R. B.: Syst. List. British Oligocene and Eocene Moll., 1891, p. 322 for true dates of Sowerby.

Ovate, ventricose, decussated with acute, prominent, distant lines, the transverse ones alternated in size; interstices with microscopic lines parallel to the transverse ones; aperture narrow, much curved above; columella with four or five plaits.

This beautiful species is nearly allied to *C. elegans*, Desh., but is much broader, and has microscopic regular lines which are not mentioned in the description of the former, and it is probably destitute of them. The plaits on the columella of the Jackson shell are much larger than in its European relative. These two shells are so different from any in the more recent formations that they appear to be entitled to a generic distinction, and they are peculiar to the Eocene period.—[Conrad, 1855.]

This species may be differentiated from *C. gilberti* Palmer (1937, p. 234, pl. 30, figs. 27, 28), which approaches it in size and character, by the transverse ribs alternating in size and their being more closely spaced in *C. fenestralis*.

There is a typographical error in the description of *C. gilberti* Palmer (p. 235) which obviously will be corrected. The word "species reveals" should read "specimens reveal."

The shell of this form is fragile and complete specimens are difficult to find.

Dimensions.—Height, 40 mm.; greatest diameter, 26.7 mm. (lectotype).

Lectotype.—No. 13197, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 10, 883; 8; 1109.

Family FICIDÆ

Genus FICUS Roeding in Bolten, 1798
(Pyrula Lamarck, 1799; *Pirula* Montfort, 1810)

Roeding in Bolten, Museum Boltenianum, 1798, pt. 2, p. 148.

Genotype by monotypy,[55] *F. communis* Roeding, Bolten = *F. variegata* Roeding, Bolten = *Bulla ficus* Linnæus (12 ed., 1767, p. 1184.[56] or genotype by subsequent designation, Dall (Jour. Conch., vol. 11, 1906, p. 296), *Bulla ficus* Gmelin (Syst. Nat., ed. XIII, 1791, p. 3426). Recent. East Indies. Tryon, Manual Conch., vol. VII, 1885, pl. 6, fig. 36.

A striking contrast may be noted in the distribution of the Ficidæ in the Mississippi embayment area in Claiborne and Jackson times. *Ficopsis* is the predominant genus with *Ficus* in a

[55]Of the three species mentioned by Bolten, *F. communis* and *F. variegata* are synonymous, and *F. picta* is a *nomen nudem*. *Fide* Gardner, U. S. Geol. Survey, Prof. Paper 193-B, 1939, p. 34.

[56]Smith, E. A.: Jour. Malacol., vol. III, 1894, p. 65.

minor rôle.[57] In the Jackson *Ficopsis* is not known so far and its place is taken by *Ficus*, foreshadowing the presence of that genus in the Oligocene. In the Pacific Coast Eocene *Ficopsis* persisted into the upper Eocene where the type species[58] occurs. *Ficus* is also present.

Ficus mississippiensis Conrad Plate 43, figs. 1-3

Ficus mississippiensis Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc., vol. III, p. 286; Conrad, 1848, Acad. Nat. Sci. Philadelphia, Jour. 2d ser., vol. I, p. 117; Gardner, 1939, U. S. Geol. Survey, Prof. Paper 193-B, p. 35, pl. 7, fig. 22.

Sycotypus Mississippiensis Conrad, 1865, Am. Jour. Conch., vol. 1, p. 26.

Ficopsis mississipiensis [*sic*] Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 29.

Pyrula mississippiensis (Conrad), Smith, B., 1907, Acad. Nat. Sci. Philadelphia, Proc., vol. LIX, pp. 214, 215, 216, pl. 17, fig. 5.

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 entire; large volution flattened at top. Length 1¼.—[Conrad, 1847 and 1848.]

Neither the type of this species nor any specimen from the type locality has heretofore been figured. Dr. Gardner illustrated a specimen from Mexico which she believed to be *F. mississippiensis*, and her figure does illustrate a shell of the characters of the species.

In the Jackson, there is a species which is fairly common particularly near Montgomery, Louisiana, which bears a resemblance to *F. mississippiensis*, if it does not belong to the same species-stock. It is therefore desirable that the type of *F. mississippiensis* be illustrated, and the species as it occurs in the Oligocene be more carefully described than the general notes of Conrad. Burnett Smith figured the nuclear whorls of *F. mississippiensis*. The drawing of one of the original Conradian specimens made by Otto Meyer is included herein. Recently a better specimen of the lot, No. 13508, Academy of Natural Sciences, has been selected as the lectotype.

[57]Gardner, J.: U. S. Geol. Survey, Prof. Paper, No. 193-B, 1939, p. 34, pl. 7, figs. 21, 23, *Ficus amichel* Gardner, Mexico and Texas, Cook Mountain Eocene.

[58]Stewart, R. B.: Acad. Nat. Sci. Philadelphia, Proc., vol. LXXVIII, 1927, p. 375. See also Weaver, C.: Washington Geol. Survey, Bull., No. 15, 1912, p. 15, pl. 1, figs. 1, 4; Univ. Washington Pub. Geol., vol. 5, pt. III, pl. 77, figs. 8, 9 for *F. cowlitzensis*.

Shell medium; nucleus composed of three smooth whorls, flattened on top, the first minute, the third whorl enlarged; the nuclear and postnuclear whorls merge gradually. Postnuclear sculpture is initiated by fine spiral lines on the anterior portion of the whorl. By the time revolving lines are present on the posterior region, axial striations begin, covering the whole surface and producing a microscopic cancellated ornamentation. The revolving ribs predominate over the longitudinal lines. Between the primary ribs on the body whorl are usually three, sometimes four or five (one on the spire) spiral threads, the medial one of which is the stoutest. The primary spirals, over the area of greatest convexity on the body whorl become exaggerated in size and have a slight tendency to multicarinate the whorl. The shape of the slope of the posterior angle of the body whorl is not constant but the contour is frequently flattened above and does not slope directly from the penultimate whorl. At the intersections of the axial and spiral sculpture there are microscopic or incipient nodes.

Dimensions.—Height, 22.5 mm.; greatest diameter, 13.5 mm. (lectotype).

Lectotype.—No. 13508, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Oligocene, Vicksburg, Miss. (type). Numerous localities in Nuevo León and Tamaulipas, Mexico (Gardner).

Ficus filia (Meyer) Plate 43, figs. 7-10

Fulgur filius Meyer, 1885, Am. Jour. Sci., 3d ser., vol. XXIX, No. 174, pp. 465, 468; Aldrich 1885, Am. Jour. Sci., vol. XXX, p. 308.

Ficus filia Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 8, pl. 1, fig. 10.

Non ? Pyrula filia (Meyer), Smith, B., 1907, Acad. Nat. Sci. Philadelphia, Proc., vol. LIX, pp. 210, 214, 215, pl. XVII, fig. 6, see *F. merita*, n. sp.

Ficus filia (Meyer), Gardner, 1939, U. S. Geol. Survey, Prof. Paper, No. 193-B, p. 35.

In Jackson occurs a species, *Fulgur filius*, n. sp. which has the form of *F. Mississippiensis* C. from Vicksburg. The coarse part of the sculpture is also similar, but the surface is covered with fine, closely set, elevated revolving lines. In the largest of my Vicksburg specimens the following can be seen: In the youngest reticulated whorl there are only the large revolving lines, then a small line appears in the middle of the large ones and finally one more line appears in the interstices. If we imagine this process repeated twice more, we obtain the finely striated surface of *F. filius*, and indeed this same process can be traced along the whorls of the Jackson form, so that we can say, the young *F. filius* repeats the old *F. Mississippiensis*.—[Meyer, 1885.]

Die Figure ist eine Abbildung des Originalexemplars. Die Art unterscheidet sich von *Ficula mississippiensis* Conr. von Vicksburg, abgesehen von der dichten Spiralstreitung, mehr noch durch ihre walzenförmige, weniger kugelige Form. Ich wiederhole, dass die jungen Exemplare sowohl in Form wie Skulptur die Vicksburger Art repräsentieren.

Das (einzige?) Exemplar, welches Herr T. H. Aldrich in Jackson gefunden hat, besitzt die walzenförmige Gestalt von *F. filia*, aber die einfachere Spiralstreifung von *F. mississippiensis*, steht also zwischen beiden obwohl ich es wegen seiner Form eher noch zu *F. filia* stellen würde. Ich habe speciell auf jedes Bruchstück in meinem Material von Jackson geachtet, aber niemals etwas anderes gesehen, als die fein gestreifte Oberfläche der typischen *F. filia*. Vielleicht entstammt das Exemplar des Herrn Aldrich einem Horizont, der nicht ganz genau parallel ist mit dem, aus welchem meine Stücke herrühen.—[Meyer, 1886.]

Although Meyer[59] was using an erroneous hypothesis as to the stratigraphic sequence of the Claiborne, Jackson, and Vicksburg at the time of his original remarks on this species, the description of the fine spiral lines on the shell are pertinent. His theories as to derivation are not to be considered since they were based on the stratigraphic section in reversed order.

Shell medium in size; nucleus composed of 2½ whorls, flattened on top; the first whorl is minute, the last whorl enlarged. There is no abrupt line between the nuclear and postnuclear whorls, the spirals originate first, beginning anteriorly. Very shortly axial lines are initiated, establishing the well-developed microscopic cancellate sculpture which is present over the whole surface of the shell.

Under the microscope the cancellate sculpture may be seen to be definite, particularly on the whorls of the spire, but the revolving ribs predominate. With the naked eye, the cancellate character appears inconspicuous so that the body whorl would not be described as such.

Between the primary revolving ribs on the body whorl are many fine spiral threads, well seen with the lens. Such lines are absent on the first nuclear whorl, one begins on the second whorl, and more lines are gradually inserted so that there may be several

[59]Meyer, O.: *The genealogy and the age of the species in the southern old-tertiary*, Am. Jour. Sci., vol. XXIX, 1885, pp. 457-468.

on the last of the second and penultimate whorls. The intersection of the axial and spiral ribs may be microscopically nodose.

The numerous fine intermediate spiral lines over the body whorl readily separate this species from *F. mississippiensis* Conrad of the Vicksburg and its relative in the Jackson Eocene. Meyer's figure of 1887 plainly depicts the fine sculpture. The presence of the large number of secondary spiral threads facilitates the practical identification of *F. filia*. The species may be determined from fragments of the body whorl of adult shells provided the external surface is not too badly worn. Young individuals will not have shells provided with the increased number of threadlets.

F. mississippiensis and allies have from one to three minor spiral threads, the midline, the sharpest. I believe Dr. Gardner (1939, p. 35) has placed the lower figure of the interprimary threads in *F. filia* too high. On the holotype of the species there are from 10 to 14 or more spiral threads but apparently the number varies considerably and does decrease to a smaller number than "10," for the specimen from Jackson, Mississippi, of *F. filia*, Plate 43, figures 9, 10, does not have a constant number of threadlets, and there may be as few as seven in many interprimary spaces. Such a number Dr. Gardner found on "a western lower Jackson species."

Further differences between *F. filia* and *F. mississippiensis* will be brought out under *F. merita*, n. sp.

Through the courtesy of Dr. Charles Berry of the Geology Department, the Johns Hopkins University, the holotype of *F. filia* was loaned to the writer. An illustration of the holotype is included herein.

Dimensions.—Height, 31.3 mm.; greatest diameter, 20 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type), localities 693, 921; 1.

Ficus merita, n. sp. Plate 43, figs. 4-6

? *Pyrula filia* "Meyer," Smith, B., 1907, Acad. Nat. Sci. Philadelphia, Proc., vol. LIX, pp. 210, 214, 215, pl. XVII, fig. 6 nucleus. *Non F. filia* Meyer, 1885.

Shell large; nucleus composed of 2½ and sometimes less, smooth whorls, flattened on top, the first whorl minute, the last of nucleus enlarged; no sharp line separates the nuclear from the postnuclear whorls; spiral threads initiate the postnuclear area, begin anteriorly, and shortly cover the whole of the whorls. Fine axial lines are introduced where the revolving ribs cover the full length of the whorl. The longitudinal lines occur over all the shell, secondary in size to the spiral ribs and give the surface a microscopic cancellate ornamentation and an initial nodose condition at the intersections. The interspaces on the first of the postnuclear whorls may be smooth or there may be a single spiral thread. With the growth of the shell through that of the penultimate whorl, the intermediate spiral becomes dominant between all of the primaries with sometimes a second finer thread initiated. Three threadlets occur between the primany spiral ribs on the body whorl of adults, the middle of the three is the strongest. On the basal area of some specimens, one or two more finer spiral lines may be present. One specimen associated with numerous other shells from the same locality has the primary revolving rib reduced in size over the lower area of the body whorl so that one must make certain allowances for variation.

By the number of fine intercostal spiral threads, this species is like *F. mississippiensis*. The primary revolving ribs over the convex region of the body whorl are more uniform in size in *F. merita* and do not enlarge to the extent that is displayed in *F. mississippiensis*. The body whorl is more elongate in *F. merita* than in the latter species.

F. merita and *F. mississippiensis* are both distinguished from *F. filia* by having fewer and nonuniform revolving ribs.

The specimen, No. 7092, Academy of Natural Science at Philadelphia, of which Dr. Burnett Smith illustrated the nucleus in his paper on the morphology of *Pyrula*, is an individual of the species, *F. merita*, rather than typical *F. filia*. Dr. Smith doubted that his specimens belonged to *F. filia* Meyer.

F. merita is common at Creole Bluff, Montgomery, Louisiana.

Dimensions.—Height, 27 mm.; greatest diameter, 16.5 mm. (medium); greatest diameter, 29 mm. (crushed specimen).

Types.—Holotype, No. 4644; paratypes, Nos. 4643, 4645, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Creole Bluff, Montgomery, La. (type); 10, 883; 1051; 1118.

Genus **FUSOFICULA** Sacco, 1890

Sacco, Boll. Mus. Zool. Anat. comp. Torino, vol. V, No. 86, 1890, p. 26. Genotype by monotypy, *F. appeninica* Sacco[60] (*loc. cit.*). Tongrian (Oligocene), Liguria. Sacco, 1891, I Molluschi terreni terziarii del Piemonte e della Liguria, pt. VIII, 1891, p. 39, pl. 1, fig. 50, a, b.

Fusoficula angelinensis Harris — Plate 42, fig. 3

Fusoficula angelinensis Harris, 1919, Bull. Amer. Paleont., vol. VIII, No. 33, p. 18, pl. 2, fig. 15; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 258, pl. 34, fig. 6.

This species was described by Harris from Angelina River, two miles above Marion, Angelina County, Texas, (Coll. A. C. Veatch), and attention was called to the assemblage of lower Claiborne and Jackson species in the collection in which they were found. Among the species was "*Haminea*" *grandis*, a supposedly Jackson Eocene guide. Modifying this opinion, however, is the collection of "*H.*" [*Lithophysema*] *grandis* by Charles L. Baker from "near the top of the south side of Angelina River bank at Marion Ferry, on the north line of Angelina County, Texas," in what he regarded as lower Claiborne Eocene. A previous discussion of this was made by Palmer, 1937, p. 485.

Whether the collection studied by Harris contained a mixture of specimens from two horizons or whether the age of the formation may be assigned definitely to the lower Claiborne is a problem still unsettled.

Family **CASSIDIDÆ**

Genus **PHALIUM** Link, 1807

(*Bezoardica* Schumacher, 1817)

Link, Beschr. Nat. Samm. Univ. Rostock, 1807, 3d abt., p. 112. Genotype by subsequent designation, Herrmannsen (Indicis gen. Malac.,

[60]My footnote of 1937 should be revised to read that Sacco, I Molluschi terreni terziarii del Piemonte e della Liguria, pt. 30, 1904, p. 101 stated that Roverto identified Sacco's species as equal to *F. subelegans* (d'Orbigny), 1850.

Sup., 1852, p. 104), *Cassis glauca* (Linnæus) (1758, p. 737). Recent. Indo-Pacific. Schenck, Univ. California Pub., Bull. Geol. Sci., vol. 16, No. 4, 1926, pl. 13, fig. 1.

Phalium brevicostatum creolum, n. var. Plate 42, figs. 7, 8

For complete synonymy, copy of original description, figure of lectotype, and additional illustration of *Phalium brevicostatum* (Conrad) see Palmer, 1937, pp. 248-251, pl. 31, figs. 4, 9-11; pl. 83, fig. 9.

Due to an oversight by Dall of Conrad's species of *Phalium*, Dall gave the name *globosum* to two forms from two localities of different horizons. There was also a mistake in the citation of the locality from which Dall obtained *P. brevicostatum*. An outline of the confusion and rectification of the data was given by Palmer, 1937, pp. 249, 250, who limited Dall's *P. globosum* to the Ocala limestone, Florida, Jackson Eocene. One specimen of *Phalium* was found from the Jackson Eocene near Montgomery, Louisiana, which resembles *P. brevicostatum* more than *P. globosum* does. The specimen is crushed but the sculpture of the shell is available. The surface is covered with the typical coarse flat spiral ribs. Just below the suture is a nodose revolving shelf with another wider shoulder below it. The margin of the lower shoulder or carina is nodose. The single row of nodes is followed on the body whorl, first obscurely and later conspicuously, by a double row of nodes.

In *P. brevicostatum, s. s.*, the spiral ribs above and below the nodose rows are uniform in size. In *P. creolum*, the revolving ribs alternate in size on the whorls of the spire and between the rows of nodes on the body whorl.

Associated with *P. creolum* is *Athleta haleana jacksonia*. Both varieties exhibit a marked relationship with their respective species-stock of the lower Claiborne.

Dimensions.—Height, 20.5 mm.; width distorted (holotype).

Holotype.—No. 4638, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10, Montgomery, La.

Phalium taitii johnsoni, n. var. Plate 42, figs. 12, 13

Cassis (*Phalium*) *taitii* (Conrad), Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 77, pl. II, fig. 5. *Non* Conrad, 1834, Acad.

Nat. Sci. Philadelphia, Jour., vol. VII, p. 145.

As Mr. Johnson pointed out the Jackson representative of *P. taitii* (Conrad)[61] differs from the typical form in the Claiborne by lacking the double row of nodes on the body whorl.

Phalium taitii is known from one specimen, the type. Apparently the stock or species with characters of somewhat similar aspect occurs in the Jackson Eocene but individuals are rare and in most cases the shells are fragmentary. Johnson and Morgan found two specimens at Jackson, Mississippi, one of which is well preserved. A remnant consisting of the labrum of the shell was found at Montgomery, Louisiana, and is figured herein as probably belonging to *P. taitii johnsoni.* An imperfect but more complete specimen was found at Bunker Hill, Louisiana. It is more like typical *P. taitii* in that there are two spiral rows of strong nodes above on the upper area of the body whorl. Regular revolving tiers of noticeable but more subdued nodes are over the body whorl, stronger than appear in *P. taitii.* So far the specimens are too few for determining the variation in sculpture which may occur in this stock of *Phalium.*

Dimensions.—Height, 35.1 mm.; greatest diameter, 23.7 mm. (holotype).

Holotype.—No. 7083, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Genus **GALEODEA** Link, 1807

(*Morio* Montfort, 1810; *Cassidaria* Lamarck, 1822)

Link, Beschr. Nat.-Samml. Univ. Rostock, 1807, 3d abt., p. 113.

Genotype by monotypy, *G. echinophora* (Linnæus), (1758, p. 735). Recent. Mediterranean. Schenck, Univ. California Pub., Geol. Sci., Bull., vol. 16, No. 4, 1926, pl. 14, fig. 2; Durham, Jour. Paleont., vol. 16, No. 2, 1942, pl. 29, figs. 1, 3.

Galeodaria Conrad (Am. Jour. Conch., vol. 1, 1865, p. 26), monotype, *G. petersoni* Conrad, differs in minor details from *Galeodea.* The differences do not seem to warrant the retention of Conrad's name for a separate group.

Galeodea petersoni Conrad Plate 42, figs. 1, 2, 6

Morio Petersoni Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p.

[61]Palmer, K. V. W.: Bull. Amer. Paleont., vol. VII, No. 32, p. 251, pl. 83, fig. 10.

289, pl. XVII, figs. 9a, 9b; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, p. 19, pl. 4, figs. 9a, 9b.

Galeodia Petersoni Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262; 1939, Reprint, *op. cit.*, p. 348.

Galeodia (*Galeodaria*) *Petersoni* Conrad, 1865, Am. Jour. Conch., vol. 1, p. 26; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25 *Galeodea.*

Cassidaria Petersoni (Conrad), Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 168; Cossmann, 1893, Essais Paléoconch. comp., 5 liv., p. 131.

Galeodea petersoni (Conrad), Schenck, 1926, Univ. California Pub., Geol. Sci., vol. 16, No. 4, p. 81, pl. 14, figs. 3, 4 section *Galeodaria;* Gardner, 1939, U. S. Geol. Survey, Prof. Paper, No. 193-B, pp. 21, 23.

Doliopsis quinquecosta Conrad, 1865, Am. Jour. Conch., vol. 1, p. 141, pl. 10, fig. 15; Tryon, 1885, Manual Conch., vol. VII, p. 258, pl. 5, fig. 32 (Doliidæ); Dall, 1909, U. S. Geol. Survey, Prof. Paper, No. 59, p. 70.

Galeodea (*Galeodaria*) *quinquecostata* Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, pp. 25, 37.

Obtusely ovate, spire short, scalariform; body whorl with three distant revolving lines much larger than the others which are alternated, suture margined by a prominent acute line; inferiorly three revolving lines larger than the others; lower whorl of the spire carinated in the middle; longitudinal wrinkled lines very fine: labrum margin thickened, somewhat reflected; inner margin denticulato-striate, with a prominent tooth near the upper extremity; labrum reflected; columella striated, inferiorly tuberculato-striate.

Approaches *G. funiculosa* (*cassidaria*) Desh. but very distinct.—[Conrad, 1855.]

Subglobose, slightly beaked; body whorl ornamented with five distinct, acutely angular, revolving ribs, the inferior rib smallest and approximate; spire short, whorls angular at the top and flattened; aperture narrow; beak sinuous.—[Conrad, 1865, *D. quinquecosta.*]

Nuclear whorls smooth, elevated, about 2½ whorls; first whorl minute, last enlarged; nuclear and postnuclear whorls merge without an abrupt line. Spire elevated, consisting of three or four whorls, early whorl rounded, penultimate whorl carinated above with a sloping shoulder; body whorl with four strong carinations; entire shell covered with fine spiral threads, which may or may not alternate in size. On some specimens the alternation in size of the revolving ribs is distinct, the intermediate thread is very fine. The spiral ribs are closely spaced on the primal postnuclear whorls, the interspaces increasing in width anteriorly. Nodes do not develop in this species. In this respect *G. petersoni* differs from the genotype and typical species. The varix is terminal, with heavy denticulate outer lip; callus of inner lip spread over the body whorl, lower portion denticulate; anterior canal short, curved backward.

The shell of this species is fragile. An internal mold may be identified by the four or five well-impressed carinæ on the body whorl.

I think that there is little doubt but that the *Doliopsis quinquecosta* which Conrad described from Garland Creek (erroneously ascribed to Enterprise, Mississippi) is an internal mold of *G. petersoni*. A similar five-carinated mold from Garland Creek which we have in our collections is illustrated herein to show the possibility of what Conrad's shell might be. Our specimen has the anterior canal broken. The type of *D. quinquecosta* is not extant but there are eight well-preserved specimens in one collection of *G. petersoni*, No. 7089, at the Academy of Natural Sciences, Philadelphia. One of the eight shells shows five costæ on the front and back of the body whorl as in *D. quinquecosta*. Another reveals five costæ on the back of the specimen. Hence five-carinated individuals of *G. petersoni* are not uncommon and do not represent a specific distinction.

Conrad (1866, p. 37) noted a relationship of *D. quinquecosta* with *G. petersoni* and abandoned his genus *Doliopsis*.

Dimensions.—Height, 21.8 mm.; greatest diameter, 16.2 mm. (lectotype).

Lectotype.—No. 13199, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 881, 879, 1051; 1111; 1121.

Section[62] MAMBRINIA Gardner, 1939

Gardner, 1939, U. S. Geol. Survey, Prof. Paper, No. 193-B, p. 23, pl. 7, figs. 1, 2, 10, 15.

Type by original designation, *Cassidaria planotecta* Meyer and Aldrich (Cincinnati Soc. Nat. Hist., Jour., vol. IX, p. 43, pl. 2, fig. 14). Lower Claiborne Cook Mountain and Lisbon formations. Eocene. Gulf province, United States.

Galeodea planotecta jacksonia, n. var. Plate 42, fig. 14

Morio planotecta Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 77, pl. 1, fig. 12 *non* Meyer and Aldrich, 1886.

Galeodea planotecta (Meyer and Aldrich), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 252 *partim*.

[62]On p. 23 of Gardner, *loc. cit.*, referred to a section. On p. 27 referred to as subgenus.

Shell large; spire low; nucleus smooth, elevated, consisting of two whorls and part of a third. The first minute and flattened, second enlarged; a sharp, oblique demarcation between the nuclear and postnuclear whorls; postnuclear whorls ornamented with fine spiral striations which continue over the remainder of the shell; sutural line sunken; body whorl bicarinated, the posterior carination with 18, moderate spines, those on the anterior carination less developed. There is a posterior fold on the outer lip with a corresponding fold opposite on the parietal callus. The outer lip has serrations extending from the posterior tooth to the anterior constriction of the aperture. A finer and shorter series of teeth characterize the umbilical callus The parietal callus and varicose outer lip are widely spread or extended as in the species. The anterior canal is long and produced obliquely to the plane of the body.

The Jackson representative of the species differs from the typical in having more nodes on the posterior carination and in having the outer and inner lip serrated.

The species is abundant in the lower Claiborne, Cook Mountain-Lisbon formations of the Mississippi embayment area. The shell is fragile and rarely exhibits the unique elongated anterior canal Dr. Julia Gardner called attention to that character by differentiating a new section, *Mambrinia,* with *G. planotecta* Meyer and Aldrich as type. The Jackson Eocene should be included in the range and occurrence given of the section by Dr. Gardner.

Charles Johnson figured a perfect specimen from the Jackson Eocene from Jackson, Mississippi.

Because the single specimen in the collection which I have studied is not complete, I designate the specimen, No. 7084, in the Academy of Natural Sciences of Philadelphia, figured by Johnson, *op. cit.,* pl. 1, fig. 12, as the holotype of *G. planotecta jacksonia.*

Dimensions.— Height, 61.2 mm.; greatest diameter, 46.5 mm. (holotype).

Types.—Holotype, No. 7084, Academy of Natural Sciences, Philadelphia, Pa. Paratype, No. 4641, Paleontological Research

Institution.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 785.

Subgenus **GOMPHOPAGES** Gardner, 1939

Gardner, U. S. Geol. Survey, Prof. Paper, No. 193-B, 1939, p. 25.
Subgenotype by original designation, *Galeodea* (*Gomphopages*) *turneri* Gardner, (*op. cit.*, pl. 8, figs. 1, 4). Mount Selman formation, lower Claiborne Eocene. Texas.

Since publication of the original designation of this group, Durham (Jour. Paleont., vol. 16, No. 2, 1942, p. 184) tentatively placed in the subgenus four species from the Eocene of the West Coast of United States.

Galeodea (Gomphopages?) millsapsi Sullivan and Gardner
Plate 42, figs. 9-11

Galeodea (*Gomphopages?*) *millsapsi* Sullivan and Gardner, 1939, in Gardner, U. S. Geol. Survey, Prop. Paper, No. 193-B, p. 26, pl. 8, figs. 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 being 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 rugosites 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, 40.0 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.—[Sullivan and Gardner, 1939.]

Nomina Nuda

Doliopsis tricarinatum Conrad, 1865, Am. Jour. Conch., vol. 1, p. 26 is a *nomen nudum*. It was the monotype of *Doliopsis* Conrad, *loc. cit.* Since the monotype of the genus is a *nomen nudum*, the name of the genus would automatically become a nude name. Conrad used *Doliopsis* in the same volume on p. 141 with *D. quinquecosta* Conrad and on p. 150, same reference, listed two species from the West Coast of United States. If the name in the first reference (being a *nomen nudum*) does not invalidate the second, *D. quinquecosta* Conrad would be the monotype for the name *Doliopsis*. Since *D. quinquecosta* Conrad is probably synonymous with *G. petersoni*, *Doliopsis* Conrad would be synonymous with *Galeodea* Link.

The name, *Doliopsis* Conrad, 1865, is preoccupied by Vogt, 1852, Act. Soc. Helvét. (Sion), p. 137 (Tunicata). Considering the status of the name, *Doliopsis* Conrad, there is no justification for renaming the genus. Conrad in 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 37, states that he abandoned the genus.

Family **CYMATIIDÆ**

Genus **DISTORSIO** Roeding in Bolten, 1798

Roeding in Bolten, Mus. Boltenianum, 1798, pt. 2, p. 133.

Genotype by subsequent designation, Gray[63] 1847, *Murex anus* Linnæus (1758, p. 750). Recent. Indo-Pacific. Tryon, Manual Conch., vol. III, 1881, pl. 17, fig. 173.

Subgenus **PERSONELLA** Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 21.

Subgenotype by monotypy, *Distorsio septemdentata* Gabb (Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. IV, 1860, p. 380). Eocene. Southern United States. Palmer, 1937, pl. 34, figs. 10, 11.

Dall[64] placed *Sassia* Bellardi,[65] 1872, under *Personella* Conrad but Wrigley[66] applied *Sassia* to English Eocene and Oligocene fossils which had previously been assigned to *Lampusia* or *Triton* and doubted the propriety of including *Sassia* with the American *Personella*. The separation of *Sassia* seems to be justified because those species which can be assumed to be typical of *Sassia* do not display the amount of distortion of the whorls as is seen in *P. septemdentata* of the lower Claiborne. However, the presence in the Jackson Eocene of a variation of *P. septemdentata* with slight distortion indicates that *Personella* probably had short-ranged descendants which simulated the shape of *Sassia*. *Sassia* extends in Europe from the Upper Cretaceous through Miocene. *Personella*, so far known, is limited to the middle and upper Eocene of the Mississippi embayment region.

[63]Gray, J. E.: Zoöl. Soc. London, Proc., 1847, p. 133 under *Persona* Montfort. This designation antedates that of Pilsbry, 1922, Acad. Nat. Sci. Philadelphia, Proc., vol LXXIII, p. 357, usually cited as the first designation.

[64]Dall, W. H.: Smithsonian Misc. Coll., vol. 47, No. 1475, p. 1904, pp. 130, 141.

[65]Bellardi, L.: Moll. terreni terziarii del Piedmonte e della Liguria, pt. I, 1873 [1872], p. 219. Genotype *Triton appenninicum* Sassi. Miocene. Europe.

[66]Wrigley, A.: Malacol. Soc. London, Proc., vol. XX, Pt. II, 1932, p. 135.

Distorsio (Personella) septemdentata jacksonensis (Meyer)

Plate 44, figs. 7-9

Distortrix Jacksonensis Meyer, 1885, Am. Jour. Sci., vol. XXIX, 3d ser., pp. 464, 468; Meyer and Aldrich, 1886, Cincinnati Soc. Nat. Hist., Jour., vol. IX, No. 2, p. 50 footnote, var. *D. septemdentata* Gabb.

For illustration, synonymy, copy of original description, and additional notes on *D. septemdentata* Gabb, see Palmer, 1937, p. 260, pl. 34, figs. 10, 11.

In Jackson occurs a species nearly allied to *Distortrix septemdentata* Gabb from Texas. It differs in having the canal somewhat reflected, being more callous on the inner lip, having more prominent varices and more distinct transverse ribs. It may be called *Distortrix Jacksonensis*. This species is probably to be related to *Distortrix crassidens* C. from Vicksburg.—[Meyer, 1885.]

Nuclear whorls 3½ in number, smooth; first whorl minute and flattened above, others enlarged; the change from the nuclear to postnuclear whorls is abrupt, and the postnuclear whorls begin with the heavy well-developed sculpture characteristic of the species.

Earlier three postnuclear whorls of the spire have three coarse transverse ribs crossed by longitudinal folds which form a strong node at the intersection. An additional spiral rib develops on the penultimate whorl. There are seven revolving ribs on the body whorl with several small ribs on the basal portion of that whorl. There are several microscopic spiral lines in the interspaces between the ribs. Seven denticulations occur on the interior of the labrum.

The above notes were described from the holotype, an immature specimen. The holotype is figured herein. Through the courtesy of Dr. Chas. Berry of the Johns Hopkins University Geological Department, the holotype was loaned for illustrating and examination. Two smaller individuals were available in our collections.

The Jackson form differs from the species as it occurs in the lower Claiborne in being less distorted in shape. Possibly the shell is more consistently elongated and has a sharper demarcation between the nuclear and postnuclear whorls.

D. septemdentata is a widely distributed and an abundantly developed species in the lower Claiborne of the Mississippi embayment so that one can obtain an adequate idea of its variation. Although frequently the species has a short canal there are many individuals from the same localities as those with the blunt beak which have longer and strongly reflected beaks. Hence such a distinction as pointed out by Meyer between the lower Claiborne and Jackson specimens does not hold. There are also specimens of the species with elevated spires in the lower Claiborne. The feature between *D. septemdentata* and *D. jacksonensis* which differs to the greatest extent is the character of the nuclear whorls. While the nuclear whorls of both forms are alike in general shape, the line between nuclear and post-nuclear whorls in *D. jacksonensis* is sharp with the nuclear whorls smooth. Both transverse and axial sculpture originate abruptly and are sharp and strong. In *D. septemdentata,* while there is a line marking where the coarse sculpture of the conch starts, the spiral lines begin earlier on about the second or second and a half whorl, gradually increase in size and are continuous with the revolving ribs of the later whorls.

Larger collections of the species in the Jackson may reveal greater variation of the form than only three specimens can reveal. So far, the small number found would indicate that the variety was rare.

This *Distorsio* in the Jackson Eocene is more nearly related to *D. septemdentata* of the lower Claiborne than to *D. crassidens* (Conrad)[67] of the Vicksburg.

Dimensions.—Height, 12 mm.; greatest diameter, 7 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 10 (fragments).

Family MURICIDÆ

Genus MUREX Linnæus, 1758

Linnæus, Syst. Nat., 10th ed., 1758, p. 746.

[67]Conrad, T. A.: Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, 1848, p. 118, pl. 11, fig. 40; Acad. Nat. Sci. Philadelphia, Proc., vol. VII, 1854, p. 31; Am. Jour. Conch., vol. 1, 1865, p. 20.

Genotype by subsequent designation, Montfort (Conchyliol. Syst., t. 2, 1810, p. 619), *Murex pecten* Montfort = *M. tribulus* Linnæus (1758, p. 746). Living. Indo-Pacific. Tryon, Manual Conch.. vol. II, 1880, pl. 9, figs. 107, 109.

"Murex" angulatus Meyer Plate 44, fig. 6

Murex angulatus Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 74, pl. 11, fig. 18; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 148 "Young *Eupleura* or *Urosalpinx*."

Ovate; nucleus consisting of four smooth, embryonic, rounded whorls, which rapidly increase in size; adult whorls angular, with edged, transverse ribs, which, on the angles, are produced into spines—on the body whorl they number ten; a few distinct, elevated revolving lines cover the lower part of each whorl; canal slightly curved.

Locality.—Jackson, Miss.—[Meyer, 1886.]

The canal is long and is curved more than originally illustrated. The species is known only from the holotype.

Dimensions.—Height, 10± mm.; greatest diameter, 6± mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Murex vanuxemi Conrad Plate 44, figs. 10-13

Murex Vanuxemi Conrad, 1834, App. in Morton, Synopsis Cret. Group, p. 5; Conrad, 1865, Am. Jour. Conch., vol. 1, pp. 16 [typ. error], 210, pl. 20, fig. 4.

For complete synonymy, copy of the original description, and additional notes see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 263, pl. 35, figs. 2, 5, 9, 12; pl. 84, fig. 1.

This species, described from the Claiborne Eocene at Claiborne Bluff, Alabama, is apparently rare in the Gosport sand. While not common, it is widely distributed in the lower Claiborne and occurs in the Jackson. Our collections yield the most specimens from the Jackson on the Ouachita River, Louisiana, particularly at the Bunker Hill locality. Specimens from the lower Claiborne at Newton, Mississippi, and the Jackson shells are similar.

There are from six to eight varices on the body whorl of the specimens from the Jackson localities.

Typically in the Gosport sand, the intermediate revolving ribs are finer and more squamose than on the Jackson specimens. The squamose character of the ornamentation of the Jackson shells is revealed more where longitudinal lines crowd at the varices. The Jackson specimens seem like gerontic individuals of the species. Although there are minor differences between the Claiborne and Jackson shells they apparently do not represent changes worthy of a special name.

Dimensions—Height, 22 mm.; greatest diameter, 14 mm.

Specimens figured.—Nos. 4648 and 4649, Paleontological Research Institution.

Occurrence.—Lower Claiborne. Gosport sand, Claiborne, Alabama (type). Jackson, Moodys Branch marl, localities 785; 1; 912; 7, 8.

Subgenus **PHYLLONOTUS** Swainson, 1833

Swainson, Zool. Illust., 2d ser., vol. III, 1833, p. 109.

Subgenotype by monotypy, *Murex imperialis* Swainson (1831-32, *ibid.* vol. II, pl. 67) = *M. pomum* Gmelin (ed. XIII, 1791, p. 3527). Living. North Carolina to Venezuela. Perry, Bull. Amer. Paleont., vol. XXVI, No. 95, pl. 30, fig. 214.

Murex (Phyllonotus) engonatus marksi Harris Plate 44, figs. 14-17

Murex marksi Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 167, pl. VI, fig. 10; Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 473, pl. XVIII, fig. 15.

For the synonymy, copy of original description, and notes on *M. engonatus* Conrad, see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 267, pl. 36, figs. 9, 10, 13; pl. 84, fig. 6. In the discussion of the species by Palmer, the labrum is given as probably smooth within. Judging by the Jackson specimens of the varieties of the species such a description may not always be true. The labrum of the Jackson varieties is dentate within.

Specific characteristics: Size and form as indicated by the figure; whorls 6; ornamented by, (a) six rather narrow and high costæ on each whorl (not continuous from one whorl to another), and by, (b) strong revolving lines, about ten on the penultimate whorl and thirty on the body whorl; umbilicus small; canal nearly closed in front; labrum thickened within and bearing about ten teeth.

On the humeral region there is a slight tendency to carination. Between this faint carina and the suture the revolving lines are comparatively obscure.

This species is closely allied to Conrad's *Murex engonatus* from the Claiborne sands, from which it differs however in having a much smaller umbilicus, a trace of a carina, and ribs on varices non-continuous from whorl to whorl.

Locality.—From a well one mile northeast of Pansy post-office, Cleveland county, Ark. Mr. Parkman, collector.—[Harris, 1892.]

This, as well as typical *marksi* from the Eocene of Arkansas, approaches very closely to *M. engonatus*, and, when specimens enough shall have been collected, the two will doubtless be proven identical. This has seven costæ instead of six.

Locality, Jackson, Miss.—[Harris, 1896.]

Nuclear whorls consist of about 4½ smooth whorls, the initial whorl minute, others enlarged, the whole pyramidal; the suture of the third and fourth whorls well excavated; a sharp spiral rib begins at the base of the fourth whorl and extends to the demarcation of the postnuclear whorls. The postnuclear whorls are initiated with curved longitudinal ribs, one or two or several, crowded, and curved more convexly than the following ribs. The spiral rib of the nucleus continues beyond the line of the axial ribs, thus extending their connection more to the right at the suture. After the first few longitudinal ribs are present, revolving ribs are initiated and extend over all of the whorls of the spire. The axial folds become nodose or spinose just above the middle of each whorl. The area above the nodes to the suture is smooth in young specimens but on adult shells that area contains spiral ribs, less conspicuous than those on the lower part of the whorl. The axial costæ may bear well-developed spines and be exfoliated along the length of the rib. The umbilical area is closed in the young stages. On large adult shells a false umbilicus is conspicuous.

The number of longitudinal ribs or folds varies and the number seems to bear some relation to the age of the horizon from which the specimens may be obtained.

Prof. Harris first found a representative of the species in Arkansas. This specimen, the holotype of the variety of *M. marksi,* has only six axial costæ. Later he pointed out that the shells from Jackson, Mississippi, had seven longitudinal costæ. The form is common at Jackson Eocene localities, particularly young specimens may be found at Jackson, Mississippi, Montgomery, at Bunker Hill and Gibson Landing, Ouachita River, Louisiana. At those localities there are seven axial costæ on the body whorl, occasionally eight, with eight or nine on the penultimate whorl, while at higher Jackson horizons, such as Danville Landing and Carter Landing on the Ouachita River, and Bayou Toro, Louisiana, there are usually nine, sometimes eight, axial costæ on the body whorl and nine or ten on the penultimate whorl. Consistently with this apparent stratigraphic significance in the number of longitudinal ribs in the species is the fact that the type of the species from Gosport sand was described by Conrad as having six varices on the body whorl. Also significant is the observation that the few lower Claiborne specimens found have a smaller number of varices. While there may be individual exceptions to the general number of axial ribs at a certain locality, given a fairly large number of specimens the rule may be applied. There are exceptions, because one specimen from Jackson, Mississippi, has eight costæ with 10 on the penultimate whorl.

The relationship with *M. engonatus* Conrad of the Claiborne is readily seen, especially when examining young and medium-sized specimens. Harris was aware of such identity and suggested that *M. marksi* might prove to be the same as *M. egonatus*. Since there is an increase in the number of varices, it seems convenient to retain *M. marksi* for the lower Jackson variety. In applying the same criterion in separating the forms from the upper Jackson beds, the name *supernus* is given to the variation from the higher horizon.

Young shells of the species are slender, with the beak[68] narrow and elongate, while in the large adults the beak including the false umbilicus is wide and foliated. The channel remains contracted. The spire is elevated and the young individuals therefore have a *Trophon*-like appearance.

Dimensions.—Height, 38 mm.; greatest diameter, 23 mm. (large).

Holotype.—No. 135148, United States National Museum, Washington, D. C.

Occurrence.—Jackson of Arkansas, one mile northeast of Pansy, Cleveland County, Ark. (type). Moodys Branch marl, Jackson, Miss.; localities 921, 785; 900; 10, 15, 883; 1, 1118, 8.

Murex (Phyllonotus) engonatus supernus, n. var. Plate 44, figs. 1-5

This variety differs from typical *M. engonatus* in having eight to nine longitudinal costæ or varices on the body whorl with nine

[68]"Beak" is a term applied here to differentiate the calcareous rostrum around the channel of the anterior siphon. The usage is not original but was employed by Conrad and early writers and by some modern writers. The expression "canal" as usually used is ambiguous because it is applied by most authors for both the channel and the calcareous walls. In many gastropods it is not imperative to differentiate between the wall and the open space. In such groups as the Muricidæ where the beak becomes widened and roughened the word canal is not adequate.

to ten on the penultimate whorl. *M. engonatus, s. s.*, has six similar costæ. *M. engonatus marksi* has seven to eight axial costæ on the body whorl with eight to nine on the penultimate whorl. The relationship of the species and varieties is discussed under *M. engonatus marksi.*

Although we have numerous specimens of *M. supernus* and *M. marksi*, most of the shells of *M. supernus* are young, shorter than 20 mm. while nearly all of the collection of *M. marksi* are large, more than 25 or 30 mm. in height. The difference is probably due to the fortuitousness of preservation and not to a factor of growth.

Dimensions.—Height, 20.5 mm.; greatest diameter, 11 mm. (holotype).

Types.—Holotype, No. 4653; paratypes, Nos. 4654, 4655, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 785 (1 specimen). Danville Landing beds, localities 1120 (type), 14; 6, 886; 20.

Subgenus **PTEROPURPURA** Jousseaume, 1880

(*Pterynotus* (p. 100), *Pteronotus* (p. 122) Swainson, 1833)

Jousseaume, Le Naturaliste, 2d Année, vol. 1, No. 42, 1880, p. 335; Revue Magasin Zool., 3d ser., t. 7, 1879 [1882], p. 334.[69]

Subgenotype by original designation, *Murex macropterum* [*macropterus*] Deshayes (Rev. Zool., 1839 [1840], t. II, p. 360). Recent. Cape Hatteras. North Carolina to Key West. Maxwell Smith, Rock Shells, 1939, pl. 11, fig. 8.

Pteronotus Swainson[70] is not available for use for a group of trivaricate Muricidæ because the name is preoccupied. As indicated by Wrigley (Malacol. Soc. London, Proc., vol. XIX, pt. III, 1930, p. 99) the first spelling Swainson used was *Pterynotus.* Wrigley also pointed out the introduction by Harris (Cat. Tert. Moll. British Mus., Pt. I, 1897, p. 172) of *Triplex* Perry (Conchology, 1811, pl. VII) as a substitute for *Pteronotus* selecting *T. flexuosa* Perry as the genotype. The *T. flexuosa* of Perry is considered to be *M. triqueter* of Born (Test. Mus. Cæsarei Vindobonensis, 1780, p. 291, pl. XI, figs. 1, 2) which

[69]Iredale, T.: Linn. Soc. New South Wales, Proc., vol. XLIX, 1924, pp. 271-272.

[70]Swainson, Wm.: Zool. Illus., 2d ser., vol. 3, 1832-33, pp. 100, 122, pl. 122; Treatise on Malacology, 1840, p. 296. *Non Pteronotus* Rafinesque, 1815.

had been selected by Jousseaume in 1881 as the type of *Naquetia.* Perry had reviewed *Triplex*, a name originally used by Humphrey in the Museum Calonnianum, 1797, a work which has been ruled as invalid by the International Zoological Congress (Sum. Opinions Rend., No. 51). Therefore, Gray's Zoöl. Soc. London, Proc., pt. XV, 1847, p. 133) selection of the genotype of Humphrey's name ought not to have status. *Pteropurpura* Jousseaume is used here for the trivaricate muricid species. This usage follows the procedure of Cossmann and the suggestion of Wrigley.

Murex (Pteropurpura) weisbordi, n. sp. Plate 45, figs. 19-21

Shell slender, spire elevated; nuclear whorls worn; postnuclear whorls, probably first and second, have longitudinal folds extending the length of the whorl; on the third whorl, three of the longitudinal folds become continuous from whorl to whorl forming varices of a trivaricate pattern. The remaining intervening longitudinal folds of the third whorl develop into blunt nodes between the varices on the whorls. The varices are flangelike. The surface of the shell is covered with fine spiral ribs with wide interspaces. Canal is long; outer lip crenulated; inner lip smooth.

This species conforms to the *M. tricarinatus* Lamarck (Wrigley, Malacol. Soc. London, Proc., vol. XIX, pt. III, 1930, pp. 93-96, pl. 9) stock of the Lutetian of the Paris Basin and upper Bracklesham beds and Barton beds of England.

The varices are too broken and worn to determine the limit that spines may have extended beyond the margin of the varix. Judging from the best preserved varices on the specimen of figure 19, Plate 45, spines were formed to some extent. The varices differed from those of *M. tricarinatus* and varieties in being more flangelike.

M. weisbordi differs from its closest relative, *M. veatchi* Palmer (1937, p. 266, pl. 36, figs. 7, 11, 12), from the lower Claiborne, in having the whorls of the spire larger. The spiral ribs are finer on *M. weisbordi.* The few specimens available of *M. veatchi* are small, while two of the four shells obtained of *M. weisbordi* are large. Whether the difference in size is specific or merely due to fortuitous collecting remains to be solved.

M. matthewsensis Aldrich[71] of the Midway Eocene is a trivaricate species, but it lacks the nodes between the varices, and hence the species seems to belong to a different development than does *M. veatchi* and *M. weisbordi*. *M. grandispinosa* Aldrich[72] (= *M. burnsi* Aldrich) from the Oligocene at Red Bluff, Mississippi, may be a descendant of the same line as the Claiborne and Jackson species.

Dimensions.—Height, 33.5 mm.; greatest diameter, 15 mm. (holotype).

Types.—Holotype, No. 4657; No. 4656, paratype, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 11, 1054 (type); 7, 8.

Genus TYPHIS Montfort, 1810

Montfort, Conchyliol. Syst., t. 2, 1810, pp. 614-615.

Genotype by original designation, *Purpura tubifer* Bruguière (J. Hist. nat. (Paris), 1792, vol. 1, p. 28, pl. 2, figs. 3, 4) =*Murex pungens* Solander[73] (in Brander, Foss. Hant., 1766, p. 35, pl. III, fig. 81). Eocene Paris Basin. Cossmann and Pissarro, Icon. comp. Coq. foss. Eocène Env. Paris, t. 2, 1910-13, pl. 36, fig. 172-1. *M. pungens* Solander. Eocene. England; Oligocene of Belgium and Germany.

Subgenus TYPHINA Jousseaume, 1880

Jousseaume, Le Naturaliste, vol. 1, No. 42, 1880, p. 335 (see Keen, 1944, p. 53).

Subgenotype by original designation, *Typhis belcheri* Broderip (Zoöl. Soc. London, Proc. for 1832, 1833, p. 178). Recent. West Africa. Sowerby (Reeve), Conch. Icon., vol. 19, *Typhis*, 1874, pl. II, fig. 9; Tryon, Manual Conch., vol. II, 1880, pl. 30, fig. 300.

Typhis (Typhina) dentatus Johnson Plate 45, fig. 25

Typhis dentatus Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 76, pl. 1, fig. 13.

Typhis (*Typhina*) *dentatus* Johnson, Keen, Jour. Paleont., vol. 18, No. 1, pp. 55, 64.

Shell with seven whorls, including the two smooth apical whorls, each whorl with four varices or ribs, those of the body whorl serrated with six, partly open, teeth-like projections, the one at the shoulder large and irregular, the varices in all cases extend more than half-way up the spiral

[71]Aldrich, T. H.: Geol. Survey Alabama, Bull., vol. 1, pt. I, 1886, p. 18, pl. 3, fig. 15; Harris, G. D., Bull. Amer. Paleont., vol. I, No. 4, 1896, p. 101, pl. 10, fig. 2.

[72]Aldrich, T. H.: Nautilus, vol. VII, No. 9, 1894, p. 98, pl. 4, figs. 4, 4a; Aldrich, T. H., Bull. Amer. Paleont., vol. I, No. 2, 1895, p. 14 new name.

[73]Wrigley, A.: Malacol. Soc. London, Proc., vol. XIX, pt. III, 1930, p. 112, fig. 39. Keen (Jour. Paleont., vol. 18, No. 1, 1944, p. 53) regards the two species as distinct.

whorls, the large tubular spine at the shoulder midway between the varices extends outward and slightly forward, aperture ovate. Length 16 mm., greatest diam. 10 mm.

One adult and three young specimens, from the material collected by Thomas A. Morgan, at Jackson, Miss.—[Johnson, 1899.]

Holotype.—No. 7049, Academy of Natural Sciences, Philadelphia, Pa.

Indefinite Form

Odontopolys triplicata Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 7, pl. 1, fig. 6; Harris, 1895, Acad. Nat. Sci. Philadelphia. Proc., vol. XLVII, p. 75; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 273, described from the Jackson Eocene is a young volute and does not belong in *Odontopolys.*

The type is at the Geology Department, the Johns Hopkins University, Baltimore, Maryland.

Family **COLUMBELLIDÆ (PYRENIDÆ)**

Genus **METULA** H. and A. Adams, 1853

Henry and Arthur Adams, The Genera of Recent Mollusca, vol. 1, 1853, p. 84.

Genotype by tautonomy[75] *Buccinum metula* Hinds (Voyage Sulphur, 1844, Mollusca, vol. II, No. VII, p. 31, pl. XVI, figs. 13, 14) (=*M. Hindsii* H. and A. Adams). Living, Pacific Coast of Panama. Tryon, Manual Conch., vol. III, 1881, pl. 72, fig. 240.

Metula subgracilis Johnson Plate 45, figs. 7, 8

Metula subgracilis Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 75, pl. II, fig. 2.

Shell similar to the preceding, but with 6½ whorls, only 1½ of the apical whorls being smooth, slightly convex and showing a slight angle below the sutures, spiral whorls showing 8 and the body whorl about 24 revolving ridges, the first two below the suture more prominent than the others, longitudinal ribs of uniform size about 40 in number, anterior canal much shorter, lip thickened, interior with 16 teeth-like ridges. Length 11 mm., greatest diam. 5 mm.

From the material collected by Mr. Thomas A. Morgan at Jackson, Miss. Two specimens.—[Johnson, 1899.]

The number of revolving ribs, as given originally, must be qualified, otherwise the determination of the species may be confusing. The number of spiral ribs depends on the whorl of the spire examined and the age of the individual. There are two revolving ribs below the suture. Between the most anterior one and the following spiral rib, there is a wider interval or channel. Above the channel and suture, there are two revolving

[75]Woodring, W. P.: Carnegie Inst. Washington, Pub. No. 385, 1928, p. 285.

ribs. Below the groove the number of spiral ribs varies with the whorl. There are four or five ribs below the channel on the early whorls, with seven to ten below that area on the later whorls including the penultimate whorl. The number is increased over the convex portion of the body whorl. Terminal varix is wide and prominent. The remnant of the varix on the preceding whorls is obscure. The species may become large as evidenced by the specimens in our collection.

Dimensions.—Height, 24 mm.; greatest diameter, 11 mm. Another specimen (broken), height, 26+ mm.; greatest diameter, 12 mm.

Holotype.—No. 9684, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 883.

Metula gentilicia, n. sp. Plate 45, figs. 12, 13

Nuclear whorls about 2½ in number, first one large and bulbous, all smooth; postnuclear whorls begin with longitudinal ribs which override microscopic striations; the strength of the spiral lines increases until on the later whorls of the spire and body whorl such ribs are legible and form fine nodes where they transverse the long axial ridges. Below and close to the suture, there is one nodose revolving rib. Between that rib and the following spirals there is a conspicuous groove or channel. There are eight revolving ribs below the channel on the penultimate whorl, and six spiral ribs below the channel on the whorl above. Varix is terminal and broad. Labrum is dentate within.

This species differs from *M. subgracilis* in having only one transverse rib above the channel on the whorls. In *M. subgracilis* there are two ribs in that area. The spiral ribs are closer in *M. gentilicia*. There seems to be some variation in the character of the nuclear whorls in these species of *Metula*. Johnson stated that the holotype of *M. subgracilis* has 1½ smooth apical whorls. The large specimen we have, which corresponds in other characters to *M. subgracilis*, has about 2½ or 3 smooth apical whorls, somewhat elongate. *M. gentilicia* has 2½ smooth apical whorls but they are more bulbous than on the large specimen of *M. subgracilis*.

Dimensions.—Height, 10.5 mm.; greatest diameter, 4.5 mm. (holotype).

Holotype.—No. 4666, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 921.

Metula johnsoni (Vaughan) Plate 45, fig. 9

Phos johnsoni Vaughan, 1896, U. S. Geol. Survey, Bull., No. 142, p. 36, pl. 3, fig. 3; Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 75.

Form and size indicated by the figure. The embryonic whorls are so worn that they cannot be described. Whorls, about 8, excepting the embryonic, they are regularly and rather coarsely cancellate. On the short beak the revolving lines are alternated in size.

Locality.—Montgomery, La. (Vaughan).

Geological horizon.—Jackson.

Type in the United States National Museum.—[Vaughan, 1896.]

Holotype.—No. 147036, United States National Museum, Washington, D. C.

Family NASSARIIDÆ

Genus BULLIA Gray, 1834

(*Ancillopsis* Conrad, 1865, Am. Jour. Conch., vol. 1, p. 22.)

Gray,[74] in Griffith and Pidgeon, Griffith-Cuvier, An. Kingdom, Mollusca and Radiata, vol. XII, pl. 37, fig. 8 (p. 596 *Bullæa non Bullæ* Lamarck, 1801).

Genotype by monotypy, *Bullia semiplicata* Gray in Griffith (*loc. cit.;* Gray, Zoöl. Capt. Beechey's Voyage, 1839, Mollusca, p. 127). Living. Habitat unknown.

The first mention of this generic name is in Griffith and Pidgeon (*loc. cit.*) where it is applied to the illustration of *B. semiplicata.* Credit is given by Neave (Nomen. Zoöl., vol. 1, 1939, p. 500) to Griffith. However, Agassiz intimates that Gray was the real author. Gray in Beechey's Voyage *Blossom* (p. 125), proposed the genus as new. He earlier (Philos. Trans. Roy. Soc. London, 1835, pt. I, p. 305) claimed the genus.

Bullia altilis (Conrad) Plate 45, figs. 22, 23

Ancillaria altile Conrad, 1832, Fos. Shells Tert. Form., vol. 1, No. 1, p. 24, pl. 10, fig. 2.

For complete synonymy, original description, illustrations, and further discussion of the species see Palmer, 1937, Bull. Amer.

[74]Gray, J. E.: The inedited species of shells figured in Griffith, Animal Kingdom, 1834, XII, p. 595. *Fide* Agassiz (Strickland), Bib. Zoöl. Geol. vol. III, 1852, p. 119.

Paleont., vol. VII, No. 32, p. 287, pl. 39, figs. 7-9.

The variety, *Bullia altilis subglobosa*, was figured by Owen and reported from Crow Creek, Arkansas; by Cox in 1860. Call listed *B. subglobosa* from White Bluff. Neither Harris (1894) nor we in our later collecting found the species at White Bluff but we have a considerable number of specimens of both *B. altilis* and *B. subglobosa* which we unearthed on Crow Creek. The specimens found do not attain the size of those in the Gosport sand, and the Crow Creek shells tend to be more typically developed. Several young shells are extremely slender (see fig. 23, Plate 45).

Dimensions.—Height, 20+ mm.; greatest diameter, 10+ mm.

Occurrence.—Lower Claiborne (rare); Gosport sand, type; through Jackson Eocene. Jackson localities, 894, 1046.

Bullia altilis subglobosa (Conrad) Plate 45, fig. 24

Ancillaria subglobosa Conrad, 1832, Fos. Shells Tert. Form., vol. 1, No. 1, p. 25, pl. 10, fig. 3 *partim*. For copy of original description, illustrations, and additional notes see Palmer, 1937, Bull. Amer. Paleont., vol. VII. No. 32, p. 289, pl. 39, figs. 1, 4, 5, 6, 11, 12; pl. 40, figs. 1-3, 5.

Ancillaria subglobosa Conrad, Owen, 1860, 2d Rept. Geol. Recon. Arkansas, p. 417 (Cox), pl. IX, fig. 9; Call, 1891, Ann. Rept. Geol. Survey Arkansas for 1889, p. 8; Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 161.

A few specimens of *B. altilis* from Crow Creek, Arkansas, approach the globosity of *B. subglobosa* but the majority of the specimens are typical *B. altilis*. Call reported *B. subglobosa* from White Bluff, but we have so far only found it in Arkansas on Crow Creek, St. Francis County.

Dimensions.—Height, 28 mm.; greatest diameter, 20 mm.

Occurrence.—Jackson of Arkansas, locality 894.

Family ? NASSARIIDÆ

Genus TRITIARIA Conrad

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 21.

Genotype by monotypy, *Buccinum mississippiensis* Conrad (Acad. Nat. Sci. Philadelphia, 2d ser., vol. I, p. 116). Oligocene. Mississippi. Plate 45, fig. 18.

This genus is represented in the Oligocene of Peru. *T. chira* and *T. sullana* have been described by Olsson (Bull. Amer. Paleont., vol. XVII, No. 63, 1931, pp. 99, 100, pl. 21, figs. 8, 15, 16).

Tritiaria albirupina (Harris) Plate 45, figs. 3-5

Phos albirupina Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 166, pl. VI, fig. 5.

General form and markings as shown in the figure; longitudinal ribs sharp, about 22 on the body whorl; whorls 7, in adult specimens upper two or three quite destitute of ornamentation; spiral lines alternating in size, not so prominent as the ribs; lower columellar margin defined by a sharp fold; labrum denticulations about 10 in number.

The specimen figured is from White Bluff, and is the most perfect one obtained, though it is not quite full grown.

Localities:

White Bluff, Arkansas River.

Station 2413, Rison.—[Harris, 1894.]

About 3½ or 4½ nuclear whorls, first minute, pointed, later whorls enlarged; earlier whorls smooth, after about the third whorl (fourth on larger specimens) longitudinal folds develop, obscurely and very obliquely inclined at first, becoming more pronounced and vertically extended, at the same time microscopic spiral threads begin and soon merge into the sculpture of the postnuclear stage. The siphonal fasciole is bounded above by coarser lines, with finer threads below continuing to the columellar callus; canal moderate with a notch; interior of labrum is coarsely denticulate, the labium may have three teeth, one at the margin of the columellar callus and the canal, another just above, and one on the parietal callus. Any or all of these may be present and they may vary in strength. The presence or absence of all of the labial teeth is not generic or specific for they vary on individuals from the same locality. The columellar basal fold is the one which is the most constant.

The number of longitudinal folds must be used with caution when differentiating species of the *T. hilli-albirupina* group. The number of ribs depends on the stage of development of the individual as much as that of the species. In some specimens of *T. albirupina,* figure 3, Plate 45, it is apparent that on the whorls of the spire the axial folds may be wide and few as in *T. hilli* with the number on the body whorl greatly increased and the strength of each rib decreased. The young stage in the ontogeny of such specimens has an appearance like *T. hilli* and if one had a lone specimen which represented such a stage, the shell probably would be classified as that species, which might or might not be its true identity.

In differentiating the species of the *T. hilli-albirupina* species-stock, it is necessary to have adult shells for comparison. The difference in the strength of the longitudinal folds is the most satisfactory character to distinguish the two species. The axial ribs on *T. albirupina* are finer and sharper than on *T. hilli.* Although the number of such ribs typically is greater in *T. albirupina,* yet the number varies in both forms so that a smaller number of axial folds in *T. albirupina* might be confused with a larger number in *T. hilli.*

Dimensions.—Height, 8.5 mm.; greatest diameter, 4 mm. (medium). Height, 14 mm.; greatest diameter, 6+ mm. (specimen loc. 13, Prairie Home, La.).

Syntypes.—No. 135146, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, locality 10. Yazoo clay, locality 2. Jackson of Arkansas, White Bluff, Ark. (type), 1049, 897. Jackson, loc. 13., Prairie Home (Tancock Prairie), Winn Parish, La.

Tritiaria hilli (Harris) Plate 45, fig. 6

Phos hilli Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 167, pl. VI, fig. 6.

Phos (*Tritiaria*) *hilli* (Harris), Stewart, 1927. Acad. Nat. Sci. Philadelphia, Proc., vol. LXXVIII, p. 391.

Tritiaria hilli (Harris), Woodring, 1928, Carnegie Inst. Washington, Pub. No. 385, p. 259.

Specific characteristics: General proportions as shown in the figure; surface ornamented with sharply defined, *Scala*-like longitudinal ribs, about ten on the body whorl, and less prominent alternating spiral lines; columellar fold, denticulation, and number of whorls as in the above species.

The specimen figured is slightly below the normal size of the species, it was obtained near Vince Bluff, Saline River.

Localities:

Station 2404, Hammaker's well, 9 S., 12 W., section 8.

2403, three quarters of a mile north of Vince Bluff.—[Harris, 1894.]

The nuclear whorls of this species are similar to those found in *T. albirupina.* The denticulation of the labium varies in the same manner as in *T. albirupina, i. e.,* the columellar tooth is the most constant, although a tooth just above and another on the parietal area may be present or absent.

The longitudinal folds of this species are usually fewer than in *T. albirupina* but they are always broader than in that species.

Dimensions.—Height, 10 mm.; greatest diameter, 5 mm. +.

Holotype.—No. 135145, United States National Museum, Washington, D. C.

Occurrence.—Jackson of Arkansas, near Vince Bluff, Ark. (type). Moodys Branch marl, localities 921; 883; 1, 8. Danville Landing beds, localities 6, 886.

Tritiaria magnocostata (Johnson) Plate 45, figs. 16, 17

? *Phos* cf. *hilli* Harris, Vaughan, 1896, U. S. Nat. Mus., Bull., No. 142, p. 50.

Phos hilli magnocostatus Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 75, pl. I, fig. 10.

Shell elongate, spire acute, whorls eight, the three apical whorls smooth, on the adjoining whorl the oblique longitudinal ribs are small, gradually becoming larger. On the remaining four whorls the longitudinal ribs are very large, six to each whorl; the entire shell is covered with fine, somewhat alternating, revolving raised lines, a ridge runs obliquely from the end of the anterior canal to the middle of the peristome. Length 15 mm., greatest diam. 7 mm.

One specimen (figured) collected by the writer from the Jacksonian Eocene at Montgomery, Grant Parish, La., and numerous specimens from Jackson, Miss.

The types of this and the following variety seem very distinct from *P. hilli*, but among the large series before me are specimens that practically run the three together, *P. hilli* occupying an intermediate position. The type of *Phos hilli* is from the Jacksonian Eocene at Vince Bluff, Saline river, Cleveland, Co., Ark. The typical form is also common at Jackson, Miss.—[Johnson, 1899.]

This may be the species from Montgomery, Louisiana, which Vaughan collected and commented on as having fewer (six to eight) longitudinal folds than *Phos hilli.*

Holotype.—No. 9613, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, localities 10, 1054.

Tritiaria jacksonensis (Johnson) Plate 45, figs. 15

Phos hilli jacksonensis Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol LI, p. 76, pl. I, fig. 11.

The type of this variety may be described as follows: Shell with 8 whorls, apex smooth, the following whorl with only oblique ribs that soon assume the general sculpture of the shell, which consists of about 14 longitudinal ribs (on the body and first spiral whorl a number of these are united, forming, wide ribs or varices), these are crossed by prominent revolving ridges (5 on the spirals and about 18 on the body whorl) that form conspicuous nodules, there are also fine alternating revolving raised lines; above the basal fold of the columella a smaller one is present. Length 12 mm., greatest diam. 5 mm.

Numerous specimens from Jackson, Miss.—[Johnson, 1899.]

Holotype.—No. 9614, Academy of Natural Sciences, Philahelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Family PYRAMIMITRIDÆ

Genus PYRAMIMITRA Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 28.

Genotype by monotypy, *P. terebræformis* (Conrad) [=*P. costata* (Lea)]. Eocene. Southern United States. Plate 45, figs. 10, 11.

Pyramimitra terebræformis (Conrad) Plate 45, figs. 10, 11

Terebra costata Lea, 1833, Cont. Geol., p. 166, pl. 5, fig. 172 *non T. costata* Borson, 1823, Saggio orittogr., p. 309 *fide* De Gregorio, 1890.

Mitra terebræformis Conrad, 1848, Acad. Nat. Sci. Philadelphia, 2d ser., Jour., vol. 1, p. 132, pl. 14, fig. 30.

Terebra (*Pyramimitra*) *Leai* de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 19, pl. 1, fig. 55 new name for *T. costata* Lea.

For complete synonymy, copy of the original descriptions, discussion, and illustration of the species see Palmer, 1937, vol. VII, No. 32, p. 274,[75] pl. 37, figs. 12-15; pl. 85, figs. 5, 14.

I believe the description of the nuclear whorls as given in the Claiborne report should be modified to include the longitudinal ribbed stage of the two or three whorls there termed early postnuclear whorls. The postnuclear whorls begin with the axial and transverse sculpture.

This species, described from the Gosport sand, occurs in the lower Claiborne and in the Jackson Eocene. The Jackson shells have the wide longitudinal folds characteristic of the lower Claiborne specimens. Those present in the Gosport sand do not have such folds so well developed.

Dimensions.—Jackson. Height, 10 mm.; greatest diameter, 3 mm.

Occurrence.—Lower Claiborne. Gosport sand (type). Jackson, Moodys Branch marl, Jackson, Miss.

Family PYROPSIDÆ

Genus PYROPSIS Conrad, 1860

Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. IV, 1860, p. 288, pl. 46, fig. 39.

Genotype by monotypy, *P. perlata* Conrad. Cretaceous. Mississippi.

[75]The second line from bottom, p. 274 should be deleted. The same line is in the proper place top of p. 275.

The lone shell which has been found in the Jackson does not have preserved that part of the columella and labrum which exhibits the differentiating characters between *Tudicla* and *Pyropsis*. The distinctive shape places it as a *Tudicla*-like form. *Pyropsis* is represented by a species in the Midway and Sabine (Wilcox) Eocene, while true *Tudicla* has not been discovered in the southern Eocene as yet.

Cf. Pyropsis, sp. Plate 51, figs 12, 13

An internal mold of a medium-sized *Tudicla* or *Pyropsis* was found by Dr. J. M. Sullivan of Millsaps College, Jackson, Mississippi, who transferred the specimen to Mr. Norman E. Weisbord. Mr. Weisbord was at the time studying the Jackson fauna.

Because no external characters are preserved we hesitate to name the specimen specifically. The species to which it belongs is without doubt new, since there is no species known from the Claibornian or Jacksonian Eocene of a like character. In the Sabine (Wilcox) and Midway, *Pyropsis perula* (Aldrich)[76] occurs. It attains a large size in the Sabine.

Dimensions.—Height, 26+ mm. (beak broken); greatest diameter, 30 mm.

Specimen figured.—No. 4720, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Jackson, Miss.; locality 693.

Family BUCCINIDÆ

Genus BUCCITRITON Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 20.

Genotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 4 liv., 1901, p. 159), *Nassa cancellata* = *Buccinum sagenum* Conrad = *Buccitriton sagenus* (Conrad) (Fos. Shells Tert. Form., 1833, p. 34). Claibornian Eocene. Southern United States. Palmer, 1937, pl. 41, figs. 4, 7, 8, 9.

Buccitriton jacksonensis (Cooke) Plate 45, fig. 14

Alectrion jacksonensis Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 136, fig. 7.

[76]Aldrich, T. H.: Geol. Survey Alabama, Bull., No. 1, pt. I, 1886, p. 25, pl. 3, fig. 4; Harris, G. D., Bull. Amer. Paleont., vol. III, No. 11, p. 46, pl. 6, figs. 3, a. See for synonymy and for references to additional illustrations.

Shell small, robust, apical angle 50°. Nucleus small, smooth, globular, about 3 whorls. Postnuclear whorls 5, with a narrow band in front of the suture cut into beads by the ribs; area between the band and the periphery crossed by about 4 spiral striæ; base of body whorl with spiral threads; axial riblets high, narrow. Outer lip thick, with 6 strong threads within; columella straight, short, with 5 short folds. Canal outcurved. Altitude 7½ mm., latitude 4 mm.

Station 4250, Moodys Branch, Jackson, Miss. U.S.N.M. Nos. 353, 943. The type of *Alectrion jacksonensis* is unique.—[Cooke, 1926.]

This species is not an *Alectrion* Montfort (Conchyliol. Syst., t. 2, 1810, p. 566, genotype *Buccinum papillosum* Linnæus) since that genus has only a notch and not a short canal as in *B. jacksonensis*. *Alectrion* (Chemnitz, Conch. Cabinet, 4 Bd., 1780, p. 63, tab. 125, figs. 1204, 1205 *B. papillosum*) does not have the denticulate labrum or labium, and the longitudinal ribs predominate over the surface of the shell. The original figure of *B. jacksonensis* suggests that the species belongs to *Buccitriton* Conrad, the shells of which are so abundantly preserved in the lower Claiborne and Gosport sand. No mention is made in the description of *B. jacksonensis* of varices, the presence of which is characteristic of the genus. Certain young stages of the typical species do not show varices. The type illustration of *B. jacksonensis* gives the appearance of fully developed sculpture. The Jackson species has fewer nuclear whorls than the genotype.

Due to the national emergency an examination of the type was not possible, and we have not discovered representatives of the species in our collections.

Genus TEREBRIFUSUS Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 28.

Genotype by monotypy, *Buccinum amoenum* Conrad. Eocene. Southern United States. Palmer, 1937, pl. 53, figs. 6, 7, 9, 10, 13, 15, 16; pl. 88, figs. 10, 13, 14.

Terebrifusus amoenus (Conrad) Plate 45, figs. 1, 2

Buccinum amœnum Conrad, 1833, Sept., Fos. Shells Tert. Form., p. 45.

For complete synonymy, original description , additional notes, and figures see Palmer, 1937, p. 307, pl. 53, figs. 6, 7, 9, 10, 13, 15, 16; pl. 88, figs. 10, 13, 14.

This species described from the Gosport sand at Claiborne, has typically on the postnuclear whorls of young and immature specimens five spiral ribs with wide interspaces. The number increases on adult shells on the later whorls of the spire. The specimens from Orangeburg, South Carolina, are typical in this respect. On elongate shells from lower Claiborne localities there are six or seven spiral threads on the spire whorls. We have one specimen from the Cook Mountain formation at a locality in Louisiana (definite locality description lost) on which there are eight revolving threads on the early postnuclear whorls with nine or ten on the following whorls. One specimen found so far in the Jackson Eocene near Montgomery, Louisiana, is like the lower Claiborne shells in the increased number of spiral ribs.

There is a photographic resemblance between the Montgomery individual and *T. multiplicatus* H. C. Lea (see Palmer, pl. 53, figs. 3, 8; pl. 88, fig. 4), however, the Jackson shell lacks the several finer spiral threads which occur on *T. multiplicatus* between the primary spiral ribs. *T. multiplicatus* was described from the Gosport sand at Claiborne, Alabama.

The lone Jackson specimen is worn.

Dimensions.—Height, 10 mm. (incomplete); greatest diameter, 4 mm.

Occurrence.—Lower Claiborne. Gosport sand (type). Jackson, Moodys Branch marl, locality 10.

Genus **PSEUDOLIVA** Swainson, 1840

Swainson, Treatise on Malacology, 1840, p. 82, fig. 3a; pp. 133, 306.
Genotype by original designation (p. 82), *Buccinum plumbeum* Chemnitz (Neues syst. Conchyl. Cab., Bd. 11, 1795, p. 86, pl. 188, figs. 1806-07). Living. Africa ? Reeve, Conch. Icon., vol. III, Mon. *Monoceros*, 1846, pl. III, fig. 8.

Pseudoliva vetusta (Conrad) , Plate 46, figs. 1-6

Monoceros vetusta Conrad, 1833, Fos. Shells Tert. Form., Nov., p. 44; Conrad. 1834, App. in Morton, Synopsis Org. Remains, p. 4; Conrad, 1835, Fos. Shells Tert. Form., p. 37, pl. 15, fig. 3.

For complete synonymy, copy original description, and further discussion of *P. vetusta* see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 310, pl. 43, figs. 1, 4-8, 11-14.

Typical *P. vetusta* occurs occasionally in the Jackson. Our collection of hundreds of specimens of the variety, *P. perspectiva*, contains six individuals of *P. vetusta*, one from Jackson, Mississippi, the others from near Montgomery, Louisiana. Those figures do not include the shells from the Jackson in Arkansas.

On Crow Creek, St. Francis County, conditions seemed as conducive for the existence of *P. vetusta* as for that of the common form in the Jackson Eocene elsewhere. The state of preservation of the shells of *Pseudoliva* in the Crow Creek beds is not good so complete characters of all of the specimens are not available. Probably there are about as many specimens of *P. vetusta* with the closed, or nearly so, umbilicus as there are of the umbilicated *P. perspectiva*. For further discussion of the Arkansas forms see *P. vetusta* cf. *perspectiva*.

Dimensions.—Height, 33 mm.; greatest diameter, 25 mm.

Occurrence.—Sabine through Jackson. Gosport sand (type). Jackson: Moodys Branch marl, Jackson, Miss.; localities 15, 883; Jackson of Arkansas, localities 894; 1046.

Pseudoliva vetusta perspectiva Conrad in Gabb

Plate 46, figs. 7-15; Plate 47, figs. 1, 3-5; (see also Palmer, 1937, pl. 42)

Gastridium vetustum Conrad, 1854, Wailes, Agr. Geol. Mississippi, p. 289, pl. XVII, fig. 4; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 8, 19, pl. 4, fig. 4.

Pseudoliva perspectiva Conrad in Gabb, 1860, Acad. Nat. Sci. Philadelphia, Jour., n. s., vol. IV, p. 381, pl. 67, fig. 29.

Pseudoliva carinata Conrad in Gabb, 1860, *loc. cit.*, pl. 67, fig. 32.

Sulcobuccinum (*Buccinorbis*) *perspectiva* Conrad, 1865, Am. Jour. Conch., vol. 1, p. 21.

Sulcobuccinum (*Buccinorbis*) *carinata* Conrad, 1865, *loc. cit.*

Pseudoliva (*Buccinorbis*) *perspectiva* Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25.

Pseudoliva (*Buccinorbis*) *carinata* Conrad, 1886, *op. cit.*, p. 17.

Pseudoliva pyruloides var. *perspectiva* Conrad, Meyer, 1885, Am. Jour. Sci., vol. XXIX, p. 468.

Pseudoliva vetusta Conrad, de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 109, *partim*, pl. 8, pl. 35, 36, 39, 40.

Pseudoliva (*Buccinorbis*) *perspectiva* Conrad, Cossmann, 1901, Essais Paléoconch. comp., 4 liv., p. 193, pl. VIII, figs. 19-20.

Pseudoliva vetusta perspectiva Conrad in Gabb, Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 313, pl. 42, figs. 1-6; pl. 85, fig. 4 (pl. 42, figs. 1, 2 Jackson shells).

G. vetustum, Con., Pl. XVII, fig. 4,—Proc. Acad. Nat. Sci., vol. 6, p. 321.

The Jackson specimens of this species, being more perfect than those of Claiborne, Alabama, exhibit six or seven denticulations below the tooth on the labrum, which denticle is very short; the base of the shell is carinated, and an acute carinated line runs within the umbilicus near the outer margin.—[Conrad, 1855.]

Short, ovate, ventricose, spire very short, suture channelled; five revolving lines above the channel, below, seven or eight impressed revolving lines; columella callous; umbilicus large, polished within, and with a submarginal acute carina; umbilical margin carinated; labrum margin waved or dentate below the tooth at the termination of the canal.

"This is very distinct species."—*T. A. C.*—[Conrad, in Gabb, 1860.]

The nuclear whorls consist of 1½ smooth, bulbous whorls, the first is large for its position; early postnuclear whorls have longitudinal folds which are supplanted by revolving ribs. The spiral ribs may cover the whorls of the spire in the young and adult, become obscure over the upper portion of the body whorl in the adult and develop strongly below the fasciole. Or the spiral ribs may cover the entire shell in the adult. The strength of the revolving striæ over the upper part of the body whorl is a variable character. Typically, the umbilicus is large and constant in hundreds of specimens. But out of a large number of shells from numerous localities, several have been found which lack an umbilicus or have it very small. This represents a *P. vetusta* condition. I cannot take the size of the umbilicus in the *P. vetusta* stock too seriously in differentiating specific rank. It certainly is of little importance generically in classifying such species.

The discussion of this form as given here is a continuation of that begun in the Clairbornian work, Bull. Amer. Paleont., vol. VII, pp. 310-315, and most of the points enumerated there, will not be repeated.

The shape of *P. perspectiva* varies considerably, particularly in immature shells, in the globosity of the body whorl. Usually the shape becomes more globose with age.

The propriety of uniting the names, *P. perspectiva* and *P. carinata,* seems to rest on the fact—whether the figured specimen or type of *P. carinata* is natural size as stated by Conrad. The type collection of *P. carinata* Conrad at the Academy of Natural Sciences at Philadelphia consists of seven specimens. The one designated as type is broken, that condition was true also at the time Meyer examined the specimens.

The illustrations of *P. perspectiva* and *P. carinata* as given by Conrad in Gabb suggest two distinct species on the basis of shape. However, when the life history of *P. perspectiva* is known the differences between the two figures are similar to those between specimens of youth and old age. The type illustration of *P. perspectiva* (Wailes, pl. XVII, fig. 4) represents a globose form. A suite of figures is given herein, Plate 46, to show a variation in shape of the shell and size of the umbilicus. See also plate 42, figures 1, 2, Palmer, 1937.

The drawing by Meyer of one of the specimens of the Conrad type collection of *P. carinata* was given in Palmer, 1937, plate 85, figure 4. That shell was immature, 16 mm. in height. Specimens, over 20 mm. in height, from the Cook Mountain formation, Moseley's Ferry (loc. 723) and the Sabine River (loc. 725), Texas, are typical *P. carinata* in retaining the slender form. If the type of *P. carinata* is a young shell then it could be placed legitimately under *P. perspectiva.* If the type is an adult obviously then there was a group in the *P. vetusta* species-stock which maintained the elevated shape in adulthood.

Another interpretation would be that Conrad's type represents an individual of retarted growth.

The exact locality of *P. carinata* was not given. The only information regarding the locality that one has is that given by Conrad in 1866 in which he designated "Alabama." Immature specimens from the lower Claiborne, Lisbon formation at Lisbon, Alabama, are similar to the original figure. Because both the description and illustration of *P. carinata* emphasize the carinated umbilicus, it seems the species is strongly allied to *P. perspectiva.*

Regardless of the matter of uniting *P. carinata* and *P. perspectiva, P. perspectiva* is present abundantly in the lower Claiborne Eocene. Similar variations in the form take place in the lower Claiborne shells as in the Jackson specimens. The lower Claiborne individuals exhibit the pronounced carination of the umbilicus not seen in typical *P. vetusta.*

Strictly speaking, if one unites *P. perspectiva* and *P. carinata,* the name *carinata* would have priority because it comes first in the same publication.[77] However, since the rule governing the choice is not rigid, I prefer to retain *perspectiva* for the species because it has been used for a considerable time for the Jackson

[77]The Int. Rules Zool. Nomen., Art. 28, C. states, "the name is to be preferred which stands first," but does not make the decision obligatory.

shells, and there is no doubt from Conrad's statements as to its exact geologic position.

Dimensions.—Height, 31 mm.; greatest diameter, 25 mm. (lectotype).

Lectotype.—No. 13271, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Lower Claiborne. See Palmer, 1937, p. 314. Jackson Eocene: Moodys Branch marl, Jackson, Miss. (type); localities 785, 880, 879, 921, 881, 693; 900, 1098, 1099; 11, 15, 10, 883, 1054; 922; 1121; 7, 8, 912; 16; 1, 1119, 1118, 923; Yazoo clay, localities 2, 913; Danville Landing beds, localities 6, 886; 20; 1120.

Pseudoliva vetusta cf. perspectiva Conrad in Gabb Plate 47, figs. 2, 6

Monoceros vetustus Conrad, Owen, 1860. Rept. Geol. Recon. Arkansas, p. 417 [Cox], pl. IX, fig. 3; probably Call, 1891, Ann. Rept. Geol. Survey Arkansas for 1889, p. 8; Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 160 *Pseudoliva vetusta.*

In the Claiborne work, I included under *P. vetusta linosa* Conrad (p. 316) certain individuals of *Pseudoliva* from White Bluff, Arkansas, the shells of which were umbilicated but lacked the carination within that area.

However, the exact status of *P. linosa* is not clear. The type of *P. linosa* came from Texas and it therefore falls in one of the lower Claiborne varietal changes of *P. vetusta.* It exhibits in the young strong spiral lirations over the whole shell. That is also a character which may be found in typical *P. vetusta* and *P. perspectiva.*

The shells from White Bluff and Crow Creek, which are strongly umbilicated, are remarkably smooth for the species. I do not believe that they belong in *P. vetusta linosa* as I formerly classed them. They are not typical *P. perspectiva* or *P. carinata* in that the carination of the umbilicus, if any, is closer to the border and not set so deeply within the opening. Owen's early illustration of an Arkansas specimen depicts the same arrangement of the umbilicus very well. The young and immature specimens are commonly more slender with a pointed spire. Apparently the character of the Arkansas forms is due to an environmental influence rather than to a specific or varietal difference.

Dimensions.—Height, 32 mm.; greatest diameter, 25 mm.

Occurrence.—Jackson of Arkansas, localities 894, 896, 897, 1046, 1048, 1049.

Genus **CORNULINA** Conrad, 1853

Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. VI, 1853, p. 321.

Genotype by subsequent designation, Fischer (Man. Conchyliol., 1884, p. 621), *C. armigera* Conrad. Eocene. United States. Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, pl. 41, figs. 12, 14, 15 [*C. minax armigera* (Conrad)].

Although *C. minax* was distributed in the Eocene from England and France to Nigeria in the Eastern Hemisphere, with a variety in the United States, the genus was not represented by many species. One species so far has been described from Peru (Olsson, Bull. Amer. Paleont., vol. XIV, No. 52, 1922, p. 84). *C. minax* (Solander) is found from the lower Eocene through the upper Eocene in Europe and extends into the Oligocene in England. However, the American representative, *C. armigera*, which is found in the lower Eocene (Sabine) and Claibornian does not occur in the Jackson. Its place is apparently taken in the Jackson by the *C. dalli* species-stock which bearing the pertinent generic features on its shell is quite different specifically from the *C. minax* species-stock.

Cornulina dalli (Harris) Plate 47, figs. 7-15

.... Heilprin, 1880, U. S. Nat. Mus., Proc., vol. 3, fig. 7 in Smithsonian Misc. Coll., vol. 22, fig. 7 on plate facing p. 150, 1881.

Macron, sp, Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 106; in Call, 1891, Ann. Rept. Geol. Survey Arkansas for 1889, vol. II, p. 8, footnote.

Mazzalina dalli Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 166, pl. VII, fig. 7.

Monoceras jacksonium Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 473, pl. XVIII, fig. 16.

Cornulina armigera young var. Aldrich, 1897, Bull. Amer. Paleont., vol. II, No. 8, p. 6, pl. 4, fig. 4.

Cornulina armigera heilpriniana Harris, MS. in Aldrich, 1897, *op. cit.*, p. 6, pl. 4, fig. 4; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 340, pl. 41, fig. 13.

Mazzalina inaurata dalli (Harris), Palmer, 1937, *op. cit.*, p. 350, pl. 47, figs. 5, 6.

Shell short, fusiform; whorls about five, convex, with a well marked constriction just below the suture; aperture a little over one half the length of the shell, somewhat constricted above; canal short, nearly straight; columella smooth; interior of labrum smooth or containing acute, more or less interrupted striæ; shoulder or constriction, and lower part of body whorl marked by revolving lines; upper whorls of spire coarsely nodose; fine sinuous lines of growth appear over the whole surface, but are more noticeable at resting stages in the growth of the shell.

This may possibly prove to be but a small diseased form of *Màzzalina inaurata*.

Localities:

Station 2234, 2403, three quarters of a mile above Vince Bluff, Saline River.

? White Bluff, Arkansas River. *Macron* of Dall?—[Harris, 1894.]

The posterior end of the aperture has a deep notch which is supplemented by another rounded notch in the labrum, anterior to the posterior canal and at the shoulder of the body whorl. The more prominent basal revolving lines are bounded posteriorly by a conspicuous fasciola beginning at the parietal wall. The characters just mentioned place this species with *Cornulina* rather than with *Mazzalina* as originally believed.

The holotype of *C. dalli* (as *Mazzalina*) is a worn specimen, and hence the clear-cut features of the species are slightly obscured. The specimen came from Vince Bluff, Arkansas. A topotype, which has been compared with the holotype and found to belong to the same species, was figured by Palmer, 1937 (pl. 47, figs. 5, 6), and the same illustrations are included herein (Plate 47, figs. 7, 8). The finding of the prolific assemblage of *Cornulina dalli cetaria* and numerous specimens of *C. dalli* at Crow Creek, Arkansas, has solved the identity and relationship of the worn holotype of *Mazzalina dalli* Harris as well as that of a more obscure and rarer individual called *Cornulina heilpriniana* Harris from the Jackson Eocene of Texas. Comparing figures 7, 8, Plate 47, with figures 11-14 one notes that they all represent the same form. The less decorticated specimens show the fasciole band, posterior notch in the labrum, anterior tooth of the labrum, and the incipient nodes on the spiral whorls.

The identification of a shell, which was merely illustrated by Heilprin in 1880 without name or note, has remained in obscurity and doubt. The specimen was from the collections in the U. S. National Museum. Aldrich (1897) refigured the type and explained that Harris had identified similar specimens from Atascosa County, Texas. Aldrich states that Harris had used the varietal name, *heilpriniana* in his Texas manuscript report for the smooth form of *Cornulina armigera* to which he and Aldrich believed it was related. Comparison of the Aldrich illustration, Plate 47, figure 9, with the figures, particularly figure 14, on the same plate of *C. dalli* reveals the identity of the Texas shell with the Arkansas species.

Comparison also of the type figure of "*Monoceras*" *jacksonium* Harris (Plate 47, figure 15) and original description of the same with the figures on the same plate of *C. dalli* indicates that they all represent the same species.

The linking of the Atascosa County, Texas, specimen and the Jackson, Mississippi, shells (*M. jacksonium*) with those from Arkansas is an extremely important and interesting fact, increasing the knowledge of the distribution of *C. dalli* and confirming the Jackson Eocene age of the Atascosa fossils as well as marking the species as a Jackson guide.

Because the name *dalli* has priority, the name for the smooth stage of the stock stands for the species, with the more prolific and ornamented stage receiving a varietal designation. Whether, biologically, the smoother stage is an absolescence period or represents an early stage in the development of the stock, would be difficult to prove.

C. dalli, originally classed with *Mazzalina*, differs from *M. inaurata oweni* in having a shorter canal, more rounded whorls with a shoulder, and larger nodose axial folds. On *Mazzalina inaurata* and *M. oweni*, the axial folds are fine and are present just above the suture on the anterior area of the whorl. In *C. dalli* the axial folds are large and occur below the suture on the posterior region at the shoulder extending the length of the whorl on the first whorls. On worn specimens the folds are inconspicious. The chief generic differences which separate *C. dalli* and *M. oweni* are the fasciola and the posterior notch on the labrum. Such characters may be seen on well-preserved specimens such as figure 13, Plate 47. The shells are frequently badly eroded so that the two species may be confused. Both *C. dalli* and *M. oweni* have the basal area of the body whorl covered with spiral striæ.

Dimensions.—Height, 25 mm.; greatest diameter, 14 mm. (medium); incomplete specimen, greatest diameter, 23 mm. Holotype, *Mazzalina dalli* Harris, height, 13 mm. (from original drawing). Holotype (Heilprin), height, 17 mm. (Aldrich figure).

Holotype.—No. 35131, United States National Museum, Washington, D. C.

Occurrence.—Jackson of Arkansas, Vince Bluff, Saline River, Ark. (type). U. S. Nat. Mus., Bull., No. 53, Pt. 1, 1905, p. 393; ? White Bluff, Ark. (Harris); localities 897, 894, 1046; "Peeler's ranch; and S. E. of Campbellton, Atascosa county, Texas." (Harris in Aldrich); Moodys Branch marl, Jackson, Miss. (*M. jacksonium*, type, Harris).

Cornulina dalli cetaria, n. var Plate 48, figs. 9-14

Shell medium in size, stout, consisting of five or six whorls, variable in height of spire; nuclear whorls worn; from eight to ten strong nodose longitudinal folds are present below and not at the suture on the body whorl. There are from 10 to 14 similar folds on the penultimate whorl and from 10 to 12 on the second whorl from the body whorl. A shallow groove extends around each whorl above the nodes. The surface is covered with transverse ribs which may be irregular or alternate in size. The interspaces are linear over the middle and upper area, larger on the basal region. The revolving striæ over the body whorl are interrupted by a wide smooth fasciola which extends from the parietal wall around the whorl anteriorly and protrudes at the margin of the outer lip. The posterior siphonal notch is deep. A notch of varying strength is developed in the outer lip at the line of nodes. This notch may be conspicuous in depth or it may be only slight. The outer lip has prominent crenulations. The inner lip is smooth. The anterior canal is short and moderately wide. The shell is imperforate, although a columellar fissure may exist which varies in size on different individuals.

Typically, *C. cetaria* has strong nodose longitudinal folds on all the whorls. The species varies to a stage where the nodose axial ornamentation does not extend on to the penultimate whorl but is limited to the early whorls of the spire. The spiral sculpture also dies out and becomes limited to the basal area of the body whorl from the fasciola anteriorly. The spiral lines also occur in the groove below the suture on some individuals. The lack of axial sculpture is due to erosion in some cases but there does exist a smooth stage of the species in which the smoothness is the more constant character. Such form takes the specific name and is further discussed under *C. dalli* (Harris).

This variety is of great ecological as well as paleontological interest. Although it is very numerous in the Crow Creek beds, Arkansas, it has remained unmentioned in literature so far. We have over 530 specimens of it in our collection, over 470 made during one collecting trip. The gastropod is found intermingled with oyster shells in a thick bed of *Ostrea alabamiensis* Lea. Fish vertebræ, otoliths, and a fewer number of *Mazzalina inaurata, Pseudoliva vetusta*, and *Polinices eminula* are associated with the shells. A vertebra of *Basilosaurus cetoides* (Owen) was found in the vicinity.[78] The accumulation of the oysters was in beds at tide level such as the masses of the living mollusk exist along coasts today. *C. dalli* and *C. cetaria* were probably associated with *O. alabamiensis* as predaceans comparable in activity to such living gastropod carnivores as *Urosalpinx cinerea* (Say) and *Melongena corona* (Gmelin).

One large specimen, 37 mm. (spire broken) in height, was collected near Montgomery, Louisiana, which indicates that the species was established in that region.

The species-stock probably had its origin in the lower Claiborne Eocene of the southern embayment in such a form as *C louisianæ*. Suitable conditions particularly existed along the strand line in the Forrest City region of Arkansas in Jackson time which were conducive to *C. dalli cetaria* for extraordinary

[78]Palmer, K. V. W.: Bull. Amer. Assoc. Pet. Geol., vol. 23, No. 8, 1939, pp. 1228-1229.

growth in numbers.

Dimensions.—Height, 33 mm.; greatest diameter, 20 mm. (average).

Types.—Holotype, No. 4696; paratypes, Nos. 4693, 4694, 4695, Paleontological Research Institution.

Occurrence.—Jackson of Arkansas, localities 894 (type), 1046, 1047, 1048. Moodys Branch marl, localities 883; 16.

Cornulina louisianæ, n. sp. Plate 48, figs. 7, 8

Shell medium, stout, consisting of four or five whorls; nuclear whorls worn. On a young specimen 10+ mm. in height, there are 12 longitudinal prominent folds. On old specimens there are only eight similar folds. The whole surface of the shell is covered with coarse spiral ribs with wide interspaces. Although there are only four, with a finer posterior fifth, on the whorls of the spire in the young specimens, there are 10 on the whorls of the spire of the larger shell. The margin of the labrum is broken in the three specimens available of this species so that an important generic character is lost. A conspicuous band or fasciola occurs on the body whorl from the parietal wall to the anterior labrum. The fasciola is similar to that on *Cornulina dalli cetaria.* Such a distinguishing mark is not observed on any of the other southern Eocene gastropods, except the Pseudolivas. The Claibornian specimens apparently are related to the Jackson species and may be the ancestor from which the Jackson forms were derived. The general sculptural pattern is the same in both groups but the Jackson shells usually have more axial folds, a more pronounced posterior channel on the whorls, and the revolving ribs have finer interspaces.

Three shells representing *C. louisianæ* were differentiated by the author from other species during the Claibornian work but a new name or description was not given because of the uncertainty of the locality. The exact data of the locality have been lost although the location was known to be from the lower Claiborne of Louisiana. A description is now included because of the relationship revealed with its gregarious Jackson descendant.

Dimensions.—Height, 25 mm.; greatest diameter, 15.5 mm.

Types.—Holotype, No. 4697; paratypes, No. 4698, 4699, Paleontological Research Institution.

Occurrence.—Lower Claiborne Eocene, Cook Mountain formation, locality Louisiana, (No. 138, P. R. I.), exact data unknown.

Family NEPTUNEIDÆ

Genus SIPHONALIA A. Adams, 1863

A. Adams, Ann. Mag. nat. Hist., ser. III, vol. XI, 1863, p. 202.

Genotype by subsequent designation, Cossmann (Ann. Soc. roy. malacol. Belgique, tome XXIV, IV ser., t. IV, 1889, p. 149), *Buccinum cassidariæformis* [*e*] Reeve. Living. Japan. Tryon, Manual Conch., vol. III, 1881, pl. 55, figs. 364-369; Ruth, Univ. California Pub., Bull. Geol. Sci., vol. 26, No. 3, 1942, pl. 47, figs. 1a-b.

Siphonalia jacksonia Harris — Plate 48, figs. 1, 2

Siphonalia jacksonia Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 473, pl. 19, fig. 2.

Size and general form as indicated by the figure; whorls 7 or 8; marked by 10 rounded, longitudinal costæ, each in width a little over one-half that of the intermediate spaces, strong from lower suture to greatest diameter of shell, and from there decreasing rapidly in size and vanishing before reaching the suture above; strong spiral striæ about 8 on each whorl, with an equal number of finer alternate lines; columella sharply bent as in *Strepsidura*.

Locality, Jackson, Miss.—[Harris, 1896.]

This species superficially might be confused with *Cornulina dalli cetaria.* The characteristic fasciola on the body whorl of *C. cetaria* is the feature which helps distinguish easily the two species not only specifically but generically. The band is conspicuous in *C. cetaria,* revolving from the parietal area to the middle anterior margin of the labrum. The interspaces in the spiral ornamentation of *S. jacksonia* are wider than on *C. cetaria.* Such a character cannot be relied on when dealing with worn specimens or variations in ribbing. The posterior notch is larger on *C. cetaria* than on *S. jacksonia.*

"*Fusus*" *cooperi* Conrad (Palmer, 1937, p. 365, pl. 47, fig. 3; pl. 88, figs. 3, 9 as "*Papillina*") may be of the generic grouping as *S. jacksonia.* In *F. cooperi* of the Gosport sand, the longitudinal nodes curve upward more, making a greater shoulder to the body whorl than is true in *S. jacksonia.*

Dimensions.—Height, 33.3 mm.; greatest diameter, 18.9 mm. (holotype).

Holotype.—No. 6986, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 785 (one specimen).

Siphonalia sullivani, n. sp. Plate 48, figs. 3, 4

About 2½ nuclear whorls, rounded; earlier 1½ whorls smooth, remainder of nucleus with five obscure spiral ribs which gradually increase in size and merge with full strength into the postnuclear whorls; sutural area narrowly excavated in the young; spiral ribs of the early postnuclear whorls crossed first by obscure longitudinal folds which become more prominent anteriorly. On the later whorls of the spire and body whorl there are 11 nodose longitudinal folds, the nodosity developing about the midline and below, creating somewhat of a shoulder above. The revolving ribs are finer above the nodes. Irregularly there may be a microscopic thread between the primary ribs particularly on the body whorl or on old specimens. On the adult shells, the spiral ribs are fine but conspicuous. The interior of the labrum bears numerous denticulations. The canal is fairly wide. It, as well as the beak, is sharply recurved and medium in length. Columella smooth.

It may be that the apex of the nuclear whorls is like that of *S. sullivani ouachitæ,* n. var. and has two minute pointed early whorls. The tip is destroyed in all of the specimens examined of *S. sullivani.*

This species bears a strong resemblance to a form described by Conrad from the Gosport sand at Claiborne, Alabama. Conrad's *S. perlata* is known only by the original description and figure (Conrad, 1835, p. 54) and the figure of the type and notes by Palmer (1937, p. 317, pl. 86, fig. 4). The two forms certainly belong to the same species-group. *S. sullivani* is common in the Jackson near Montgomery, Louisiana. The Claiborne species is rare. *S. sullivani* differs from *S. perlata* in having a more elevated spire, shorter beak but more recurved. They both have the same number of nodose longitudinal folds.

Dimensions.—Height, 30 mm.; greatest diameter, 19 mm.

Types.—Holotype, No. 4702; paratype, No. 4701, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10 (type). Yazoo clay, locality 2. Danville Landing beds, localities 6; 12.

Siphonalia sullivani ouachitæ, n. var. Plate 48, figs. 5, 6

Nuclear whorls about 4½, early two minute and pointed, elevated; all the nuclear whorls are smooth except the last portion on which five fine spiral threads develop. These threads continue, increasing in strength, on to the postnuclear whorls where they cover the whole surface of the remaining whorls. The revolving ribs are crossed by longitudinal folds which extend the length of the whorls, slightly nodose above the midline. The longitudinal folds die out below the middle of the body whorl. There are 15 longitudinal costæ. The aperture, beak, columella, and canal are as in *S. sullivani.*

This variety so far is known only from the higher Jackson beds at Danville Landing and Carter Landing on the Ouachita River, Louisiana. It differs from the typical form, which also occurs at Danville Landing, in having more longitudinal folds and in the axial costæ extending a greater length over the whorls.

Dimensions.—Height, 20 mm.; greatest diameter, 12 mm.

Types.—Holotype, No. 4704; paratype, No. 4703, Paleontological Research Institution.

Occurrence.—Danville Landing beds, localities 6, 886 (type); 20; 14.

Genus VERCONELLA Iredale, 1914

Iredale, Malacol. Soc. London, Proc., vol. XI, 1914, p. 175 substitute for *Penion* Fischer, Man. Conchyliol., 1884, p. 625 *non Penium* Philippi, Verh. Zool.-botan. Gesell. Wien, vol. XV, 1865, p. 741.

Genotype by monotypy, *Fusus dilatatus* Quoy and Gaimard (Voyage of *Astrolabe*, Zoöl., vol. 11, 1832, p. 498, pl. 34, figs. 15-17). Living. Southern and western Pacific. Tryon, Manual Conch., vol. III, 1881, pl. 54, fig. 358.

"Verconella" penrosei, n. sp. Plate 49, fig. 11

Shell medium in size; nuclear whorls consist of about four smooth whorls, the last part of the nuclear whorls has longitudinal ribs and the initiation of spiral ribs, both of which become strongly developed on the postnuclear whorls. Eight or nine strong longitudinal folds continue the full length of the whorl. The surface of the shell is covered with fine spiral ribs with wide interspaces in which there is an interstitial thread. The labrum is crenate within and the labium may be smooth or show fine crenulations. The canal is short. Some specimens may be more slender than the holotype. The nuclear whorls are worn in all specimens so that the exact details are obliterated.

This species differs from *V. bella* (Conrad) and *V. delabechii* (Lea) (Palmer, 1937, pl. 45) of the Claibornian, the species which it resembles generically, in having larger interspaces between the revolving ribs. There is also a finer alternating spiral thread on *V. penrosei.* As stated in the Claibornian report, there may be some doubt that these species belong in *Verconella.*

Dimensions.—Height, 14 mm.; greatest diameter, 7.5 mm.

Holotype.—No. 4709, Paleontological Research Institution.

Occurrence.—Danville Landing beds, locality 6 (type); 20.

Genus **LEVIFUSUS** Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 17.

Genotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 4 liv., 1901, p. 14), *Fusus trabeatus* Conrad. Eocene. United States. Palmer, Bull. Amer. Paleont., vol. VII, No. 32, p. 326, pl. 51, figs. 3, 6, 12; pl. 85, fig. 2.

Levifusus mortoniopsis carexus (Harris) Plate 49, figs. 9, 10

Fusus mortoni carexus Harris, 1895, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVII, p. 72, pl. 7, fig. 5. *Non* Harris, 1896, *op. cit.*, vol. XLVIII, p. 472, pl. 18, fig. 12 = *Tritonoatractus pearlensis montgomeriensis* (Vaughan).

Levifusus mortoniopsis carexus (Harris), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 331, pl. 49, figs. 11, 13, 14.

The difference between this form and *Tritonoatractus pearlensis montgomeriensis* (Vaughan), with which it may be confused, is discussed under the latter species. I have found only one specimen of this species in the Jackson. The shell lacks the pronounced medial carination of the lower Claiborne form.

Dimensions.—Height, 19 mm.; greatest diameter, 12 mm.

Specimen figured.—No. 4708, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10.

Levifusus fulguriparens Maury Plate 49, figs. 7, 8

Levifusus fulguriparens Maury, 1909, Am. Jour. Sci., vol. XXVII, p. 335, fig.

Among a quantity of fossils lately collected by Professor G. D. Harris at Montgomery, Louisiana, from the Jackson horizon of the Eocene is a very interesting species which forms a perfect connecting link between *Levifusus* and *Fulgur*. A dozen specimens were found.

The relationship of the two genera was pointed out some years ago by Dr. Dall and Professor Harris. Dr. Dall in 1890 stated that *Fulgur*, which took its rise in the Eocene, was descended from such forms as *Levifusus Blakei* and *trabeatus*. Professor Harris later noted the tendency shown by many *Levifusi* to revert to an ancestral *Pleurotoma*-like form and traced the derivation of *Fulgur* from *Pleurotoma* through *Surcula*, *Levifusus* (*pagoda*-like forms), *Levifusus* (*suteri*-like forms), *Levifusus* (*trabeatus*-like forms), *Levifusus Branneri* to *Fulger echinatum*.

But *Levifusus Branneri* Harris in addition to shoulder spines is ornamented by a row of twelve nodules on the center of the body whorl. The Montgomery shell is without the slightest trace of this row, and as shown in the accompanying figure, presents such a striking resemblance to *Fulgur* that it might almost be taken as one of the many varietal forms of *Fulgur spiniger*. The spire, however, is almost exactly that of *Levifusus Branneri*. To emphasize the fact that it is the most direct ancestor of *Fulgur* known, the name *fulguriparens* has been given to the Montgomery shell. —[Maury, 1909.]

Nuclear whorls are destroyed on all specimens. Postnuclear whorls are sharply carinated with the margin of the carina nodose. Whorls are covered with fine spiral threads over the whole shell and are slightly coarser over the concave area of the body whorl. Twelve or thirteen well-developed nodes occur on the carina of the body whorl. Although the body whorl is sharply truncated below the carina, nodes do not develop along the margin.

This species differs from *L. branneri* in having only one row of nodes or spines on the body whorl. *L. branneri* also has the truncated margin of the body whorl puckered as though a third row of incipient nodes existed.

Dr. Maury mentioned only specimens of the species collected at Montgomery, Louisiana. However, other collections contain individuals from Wyant Bluff (Myatt), Carter Landing, Ouachita River, and Tullos, Louisiana. The species thus occurs in the lower to and including the higher beds.

Dimensions.—Height; 25 mm.; 14 mm., greatest diameter (holotype).

Holotype.—No. 4120, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Montgomery, La., (type); locality 10. Yazoo clay, locality 2; 12 (probably Tullos member). Danville Landing beds, locality 20.

Levifusus branneri Harris Plate 49, figs. 12-14

Levifusus branneri Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 163, pl. VI, fig. 8; Harris, 1895, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVII, p. 70; Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 473, pl. XIX, fig. 1; Veatch, 1906, U. S. Geol. Survey, Prof. Paper 46, pl. XX, figs. 5, 5a.

The general features of this species are well represented in the figure, except that it was drawn from a young specimen, hence the spire is slightly too long in proportion to the remainder of the shell. This is rendered more noticeable from the fact that the canal has been broken off.

Specific characters: Body whorl ornamented, (1) on the shoulder by a row of short, flattened, sharp-pointed tubercles (about 12 in number), (2) in the middle, by a row of flattened obtuse modulations (about 12 in number), (3) still lower by an obtuse spiral ridge over which the lines of growth are often prominent and distinctly arcuate.

The specimen figured is from Wadsworth's well, Drew county.

The body whorl of one specimen from White Bluff has a diameter of two inches.

Localities:

White Bluff, Arkansas River, Ark.

Station 2408, Wadsworth's well, Long Prairie, Drew county, Ark.—[Harris, 1894.]

This species was described from a young specimen found in southern Arkansas. Fragments of larger specimens were found by the writer at White Bluff on Arkansas River, and still others in the Jackson beds of Mississippi. This is by far the most perfect large specimen yet known. Its close relationship to *Fulgur* must be evident to all.

Locality, Jackson, Miss.—[Harris, 1896.]

There is considerable modification in the sculpture in the ontogeny of this species as may be surmised from a comparison of the illustrations of young specimens with that of a large adult.

Nuclear whorls consist of 4 or 4½ whorls, the early four smooth, followed by a short stage with longitudinal curved ribs which in turn passes into the fully sculptured postnuclear whorls. There is no demarcation between nuclear and postnuclear whorls. The axial ribs are crossed at first with about eight fine spiral ribs. After the early one or two postnuclear whorls, the whorls are sharply carinated submedially. The sutures are impressed and on the young shells there is an excavated area below the suture.

The nuclear whorls of this species are similar to *Tritonoa-*

tractus pearlensis and varieties. The curved longitudinal ribbed stage may continue slightly longer in *L. branneri.* The nuclear whorls may be a little carinated anteriorly in both species.

This is the largest siphonostomate gastropod in the Jackson Eocene of the Mississippi embayment area and in size is excelled only in the class by *Lithophysema grande* (Aldrich). A fragment of the anterior portion of the shell has a beak 20 mm. in width, with the canal 6 mm. across.

Dimensions.—Height of spire, 22 mm.; greatest diameter, 80.3 mm. (specimen figured, Harris, 1896).

Types.—The holotype properly would be with the Arkansas types of the Harris material in the U. S. National Museum. The specimen is not listed in Bull. 53, U. S. Nat. Mus., catalogue of type and figured specimens in U. S. Nat. Museum. Specimen figured, 1896, Harris, is No. 6943, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Jackson of Arkansas, Wadsworth's well, Drew County, Ark. (type); White Bluff, Ark.; Moodys Branch marl, Jackson, Miss.; localities 1; 10. Danville Landing beds, locality 6.

Levifusus moodianus Cooke Plate 49, figs. 1-3

Levifusus moodianus Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 137, fig. 12.

Shell stout, apical angle 75°. Nucleus smooth, whorls rounded (tip broken). Postnuclear whorls 5½ rounded, becoming faintly shouldered, covered with close spiral threads except a bare band on the anterior part of the body whorl. Canal long, straight (tip broken). Inner lip with two low broad folds. Outer lip thin, smooth within (broken). Altitude 31½ mm.; latitude 20 mm.

Station 6458, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,948. —[Cooke, 1926.]

This species may increase the components of its sculptural pattern with the development of nodes on the shoulder of the body whorl. This is shown by the specimen figured herein, Plate 49, figures 1, 2. That the shell is specifically identical with *L. moodianus* is proven by the presence of the peculiar wide smooth area on the anterior portion of the body whorl.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Family **FASCIOLARIIDÆ**

Genus **LATIRUS**[79] Montfort, 1810

Montfort, Conchyliol. Syst., t. 2, 1810, p. 531.

Genotype by original designation, *L. aurantiacus* Montfort (*Fusus filosus* Lamarck, Hist. nat. An. sans Vert., VII, p. 129 = *M. gibbulus* Gmelin, 13 ed., 1791, p. 3557). Living. New Holland. Tryon, Manual Conch., vol. III, 1881, pl. 67, fig. 117; pl. 68, fig. 126.

The Eocene species which I have grouped under *Latirus* differ from the genotype. The umbilicus is not so great in the Eocene species, and the plications on the columella and denticulations on the inner margin of the labrum are more conspicuous than on the typical species.

Latirus humilior (Meyer) Plate 50, figs. 14, 15

Turbinella humilior Meyer, 1885, Am. Jour. Sci., vol. XXIX, pp. 464, 468.

Latirus humilior Meyer, 1886, Geol. Survey Alabama, Bull., vol. 1, pt. II, p. 74 *partim*, pl. 2, figs. 20, 20a.

Lathyrus humilior (Meyer), Cossmann, 1901, Essais Paléoconch. comp., 4 liv., p. 42.

A species in Jackson, *Turbinella humilior*, n. sp., differs from *Turbinella protracta* C. in being shorter and stouter and having a somewhat reflected canal. The two species agree otherwise; for instance the following marks at the mouth are common to both. On the inner lip there are three little prominent folds; on the posterior part is a callous prominence; in a certain rather large distance from the outer lip there are seven elevated striæ within, at the beginning of the canal is a tooth-like prominence.

In the younger specimens from Jackson the canal is straiter than in the older ones.—[Meyer, 1885.]

As the illustrations of Meyer's type specimens depict, there is great variation in the amount of umbilical gaping and in the length of the canal. As none of the specimens which I have studied seems to coincide with the characters of Meyer's type of *L. humilior,* I am using varietal names to designate the forms which I have found most common.

Dimensions.—Height, 38.3 mm.; greatest diameter, 15.5 mm.; height, 17.3 mm.; greatest diameter, 7 mm. (types).

Types.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (Meyer).

Latirus humilior urbanus, n. var. Plate 50, figs. 3-6

Nucleus composed of 3½ to 4 smooth whorls; the first

[79] *Latirus* is the original spelling of the name hence is used in preference to the amended form *Lathyrus.*

minute, others enlarged, the whole elevated; a portion of the last of the nuclear whorls, for a short distance, has longitudinal curved ribs. Postnuclear whorls begin with coarse spiral ribs, either irregularly equal in size or alternating, about six in number, crossed by large nodose longitudinal folds. There is a slight constriction or collar below the suture on the early whorls, such a collar becomes more obscure in later growth. The revolving ribs increase in number with nine or more primaries on the whorls of the spire. The major ribs are alternated with a finer series. There may be from six to eight longitudinal folds, more commonly seven or eight. The spiral ribs alternate in size over the body whorl.

This species differs from *L. jacksonensis* (Aldrich) in the number of spiral lines. There are about four spiral ribs on the first whorls of *L. jacksonensis* and that basic pattern of the revolving lines remains on the whorls of the spire increasing to more on the penultimate whorl. On *L. urbanus* there are about six primaries on the whorls of the spire, increasing to nine or more.

Apparently the *L. humilior* species-group was derived from the *L. moorei* stock of the lower Claiborne. The nuclear whorls and general appearance of the shell are alike in the two groups at different horizons. *L. moorei* varies considerably in the prominence of the constriction or collar below the suture and in the arrangement of the size of the revolving ribs.

Dimensions.—Height, 50 mm.; greatest diameter, 19 mm.

Types.—Holotype, No. 4715; paratype, No. 4716, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 785 (type), 881; 883, 10, 15; 1; 923; 1121. Jackson of Arkansas, locality 897.

Latirus humilior cognatus, n. var. Plate 50, figs. 7, 11-13

Nuclear whorls composed of 3½ or 4 smooth whorls; first minute, others enlarged, whole elevated; last portion of the last whorl for a short space has curved longitudinal ribs; the postnuclear whorls begin with four or five coarse spiral ribs, with sometimes a sixth fine one just above the suture. The lower two revolving costæ, excluding the sixth fine thread, are more prominent than the others and remain so over all the whorls. There is a collar below the suture, most conspicuous on the posterior whorls. There are five or six spiral ribs on the whorls of the spire, varying in strength; additional fine lines may develop on the penultimate whorl. The whorls are excavated below the sutural collar and contain fine revolving threads. The spiral ribs alternate in size over the surface of the body whorl. There are six to eight large longitudinal nodose folds. The beak and canal are medium in length. There are eight or less plications on the interior of the labrum with three or less plications on the labium, with the inner lip angulated or toothed where it meets the canal.

This variation resembles most *L. humilior jacksonensis* of the species-group. It differs from that form in having the longitudinal folds more enlarged and the outline of the whorls more excavated. In *L. cognatus* the longitudinal folds or nodes are enlarged on the body whorl.

So far this variety has been found only near Montgomery, Louisiana. The group may represent only a local modification.

Dimensions.—Height, 36 mm.; greatest diameter, 15 mm.

Types.—Holotype, No. 4718; paratypes, No. 4717, 4719, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 10, 15, 1054.

Latirus humilior jacksonensis (Aldrich) Plate 50, figs. 8-10

Fasciolaria Jacksonensis Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., vol. VIII, p. 150, pl. 2, fig. 12; Aldrich, 1886, Geol. Survey Alabama, Bull. 1, pt. 1, p. 22, pl. 2, fig. 12.

Latirus jacksonensis (Aldrich), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 343.

Shell long-oval, solid; whorls seven or eight, convex; surface with numerous revolving lines, and about eight ribs on each whorl; suture deep; apex sharp; longitudinal ribs on spire rounded and prominent, more faint on the body whorl, which is covered with raised lines, alternating with fainter ones; beak short, recurved; canal contracted; aperture oval; outer lip sharp, with revolving lines reaching the edge, plicate within, plications about eight, not reaching the edge; inner lip angulated and toothed where it meets the canal; also three plications higher up; a callosity at the upper end; callus reflected over the body whorl, leaving a slight opening or false umbilicus. Length, one inch; breadth, one-half inch.

Locality, Moody's Branch, Jackson, Miss.

This shell bears a wonderful resemblance to *Urosalpinx cinerus* Say, and may belong to the Murices; it differs, however, in the plications on the inner lip; it is close to *Fasciolaria Moorei*, Gabb from Texas.—[Aldrich, 1885.]

About 3½ nuclear whorls, the first minute, the whole elevated; early three whorls smooth, followed by a portion with well-developed curved longitudinal ribs; postnuclear whorls begin with large nodose longitudinal folds crossed by coarse spiral lines. There are four spiral ribs with wide interspaces on the early postnuclear whorls. The four primary ribs continue on the whorls of the spire, with the lower two commonly more prominent. Between the primaries there are one or more fine revolving lines. On large specimens in old age, there may be five or six primaries. The margin of the whorl just below the suture forms a collar with the spiral lines finer along the lower area. There are about eight longitudinal folds which may be less prominent on the body whorl. There is a slight excavation just above the suture. The spiral ribs alternate in size over the body whorl.

Meyer united *L. jacksonensis* (Aldrich) with the *L. humilior* previously named by Meyer. There is a great deal of variation in the *L. humilior* species-group so that I am retaining the two names to designate some of the changes in form and sculpture.

The illustrations included herein for *L. jacksonensis* have been compared with the holotype and they seem to portray a shell of the typical characters.

Dimensions.—Height, 25.7 mm.; greatest diameter, 11.2 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 8; 10, 883, 1054; 1.

Latirus suturalis Johnson Plate 49, fig. 6

Latirus suturalis Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 73, pl. 1, fig. 6.

Shell fusiform, whorls seven, the three apical whorls smooth, the lower one with a few smooth longitudinal ribs, followed by the general sculpturing of the shell which consists of eight longitudinal ribs, which are crossed by prominent revolving ridges, three on the spiral whorls and eight on the body whorl, small revolving raised lines alternate with the ridges, junction of the revolving ridges and longitudinal ribs subnodose, longitudinal ribs interrupted above the suture, forming a deep sutural area. interior of the outer lip with five teeth-like ridges, columella with three prominent plaits. Length 8 mm., greatest diam. 4 mm.

Three specimens from the material collected by Thomas A. Morgan at Jackson, Miss.—[Johnson, 1899.]

Holotype.—No. 9610, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss (type).

Subgenus **DOLICHOLATIRUS** Bellardi, 1884

Bellardi, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. IV, 1884, p. 38; Mem. Reale Accad. Sci. Torino, ser. II, Tom. XXXVII, 1886, p. 38. Date given by Bellardi and Sacco as 1883.

Subgenotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 4 liv., 1901, p. 23). *Turbinella Bronni* Michelotti (Foss. Mioc., 1847, pl. X, fig. 15). Miocene. Italy. Bellardi, *loc. cit.*, pl. 11, figs. 13, 14.

Latirus (Dolicholatirus) leaensis Harris Plate 50, figs. 1, 2

Latirus leaensis Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 472, pl. XVIII, fig. 13.

Dolicholathyrus leanus (Harris), Cossmann, 1901, Essais Paléoconch. comp., 4 liv., p. 24.

Specific characterization.—Size and general form as indicated by the figure; whorls 11; 1 and 2 smooth; 3 rather finely costate, remaining spiral whorls with eight rather low costæ, considerably wider than the interspaces, and arranged so that those on each succeeding larger whorl are a little behind those of the preceding or smaller whorl, and hence, although in line, the line falls back perhaps ¼ revolution from apex to base; spiral lines on each whorl 6, large, with an equal number of intermediate striæ. Body whorl ornamented by 8 costæ and alternate spiral lines to the end of the canal. Aperture contracted above and below; columella with 2 fairly well defined plaits.

Locality, Jackson, Miss. [Harris, 1896.]

Dimensions.—Height, 40.3 mm. canal (broken); greatest diameter, 11.6 mm. (holotype).

Holotype.—No. 6948, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 881; 883; 1; 922. Danville Landing beds, locality 6.

Genus **TRITONOATRACTUS**[80] Cossmann, 1901

Cossmann, Essais Paléoconch. comp., 4 liv., 1901, p. 54.

Genotype by original designation, *Fusus pearlensis* Aldrich. Jackson Eocene. Southern United States Plate 51, figs. 8, 9.

[80] Probably Cossmann meant the name to be *Tritonatractus* for when referring to the genus on the second page of his discussion (p. 55) he spells it so and also in the explanation of plate.

Tritonoatractus pearlensis (Aldrich) Plate 51, figs. 8, 9

Fusus Boettgeri Meyer, 1885, Am. Jour. Sci., vol. XXIX, 3d ser., pp. 464, 468.

Fusus pearlensis Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., vol. VIII, p. 152, pl. 3, figs. 17a, 17b; Aldrich, 1886, Geol. Survey Alabama, Bull., No. 1, pt. I, p. 21, pl. 1, figs. 17a, 17b; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 147.

Ptychatractus (*Tritonoatractus*) *pearlensis* (Aldrich), Cossmann, 1901, Essais Paléoconch. comp., 4 liv., p. 54, pl. IV, figs. 16, 17 *Tritonatractus*.

In Jackson and Vicksburg occurs a species, *Fusus Boettgeri** n. sp.,

*In honor of my friend, the able and careful naturalist, Oscar Boettger, in Frankfurt, A. M.

closely allied to *Fusus subtenuis* Heilpr. from Wood's Bluff. The only essential difference seems to be that the Jackson form has the inner lip covered by callus on which there are numerous little prominences, while this callus does not exist in *F. subtenuis*.—[Meyer, 1885, *F. Boettgeri*.]

Shell, small, fusiform, with eight whorls, surface covered with prominent revolving ridges and longitudinal folds; suture deeply impressed; whorls, convex; apex, pointed, smooth, first whorl below also smooth; center of each volution almost carinate; body, whorl with four prominent revolving ridges, nodular, situated on the central part of the whorl, less prominent ones above and below; lines of growth give the shell a pitted appearance; aperture, nearly half the length of the shell; canal, straight, contracted; columellar lip, with a reflected callus and plicate-dentate, its whole length; outer lip, incurved, plicate within. Length, 6/10; breadth, 3/10 inch.

*This may be the species mentioned by Meyer, *Am. Jour. Science*, June, 1885, under the name of *Fusus Boettgeri*, but without description or figure.

Locality.—Moody's Branch, Jackson, Miss.—[Aldrich, 1885.]

T. pearlensis, s. s.—Nuclear whorls consist of 3½ to 4½ whorls of which three to four are smooth, the smooth stage passes into a very convexly curved longitudinal ribbed stage for a short distance, followed by the postnuclear whorls. The axial ribs become less convex and are crossed by coarse spiral ribs, at first about six in number. There is no sharp demarcation between nuclear and postnuclear whorls. The nuclear whorls are elevated, the first one minute. The shell is irregularly varicose, more commonly just back of the exterior of the labrum.

T. pearlensis is an exceedingly variable species and the variations are continuous. The typical form was described of about the mean in rib development. The extreme in one direction, that of greatest ornamentation, is covered by the name *montgomeriensis* Vaughan. The other extreme, that of decrease of ornamentation, I have designated *danvillensis*. Such naming, where the changes in the species can be traced and connected, does not seem justifiable. Since two of the names were already available and the degree of difference between the two radicals is great, the use of several names to designate the variations appears practical.

Meyer's name for probably this species was given first In spite of Aldrich's remark (1885, p. 21) that the name was preoccupied I have not found it to be so. Meyer's description is meagre, a figure was not given, and the type is not available.

Dimensions.—Height, 17 mm.; greatest diameter, 8 mm.

Holotype.—Department of Geology, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Moodys Branch, Jackson, Miss. (type); localities 921, 881; 900, 1098; 10, 1054; 1119. Danville Landing beds, localities 6, 886.

Tritonoatractus pearlensis montgomeriensis (Vaughan) Plate 51, figs. 4-7

Fusus mortoni Lea var. near *carexus* Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 472, pl. XVIII, fig. 12.

Non Fusus mortoni carexus Harris, 1895, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVII, p. 72, pl. 7, fig. 5.

Fusus montgomeriensis Vaughan, 1896, U. S. Geol. Survey, Bull., No. 142, p. 35, pl. III, fig. 2.

For size and form see figure. Whorls, 10; 1-3 smooth; 4 costate, with obscure revolving lines; 4-7 costate, 13 costæ, four prominent revolving lines, one on the median portion of the whorls, two between this median line and the suture (above), and one below it. The median line and the one below it are about equal in prominence. On 7, finer intermediate lines between the coarser. On whorls 8, 9, and 10 the line on the median portion becomes more prominent, forming a carina. The other revolving lines coarse, alternate in size. Outer lip striate within; columella covered with a deposit of callus, which has striations corresponding to the more prominent revolving striæ of the part of the shell over which it is laid down. There are a few granulations (five can be seen in the type specimen) on the columella callus at the posterior end of the canal.

Locality.—Montgomery (Vaughan).

Geological horizon.—Jackson.

Type in the United States National Museum.—[Vaughan, 1896.]

The nuclear whorls are similar in this variety to that of the typical form. I believe the original description in regard to the revolving ribs of whorls 4-7 should be revised. There are two revolving lines below the median rib or carina and the suture and two revolving lines above the carina on the early whorls. Secondary revolving ribs develop above and below the carina. Above the median rib the secondaries may increase in size until they attain the size of the primaries. The callus extending along the parietal and columellar areas may stand out from the area behind and such formation may extend down the canal. Irregular obscure varices may occur, particularly back of the exterior border of the labrum.

This variety may be confused with *Levifusus mortoniopsis carexus* (Harris)[81] because of the conspicuous median carina and general similarity of sculpture. However, the two species belong to different genera and may be differentiated readily by the presence of dentations on the collarlike columellar callus of *T. pearlensis montgomeriensis*. The spire is higher with more whorls in *T. montgomeriensis* than in *L. carexus*. *T. montgomeriensis* imitates the ornamentation pattern of *L. carexus*. Prof. Harris reported *L. carexus* from the Jackson Eocene, however, the illustration he gave was one of *T. montgomeriensis*, and he speaks of the many different forms intimating that he had a large quantity of individuals. Abundance, a fact in itself, suggests, but does not prove, that the form he had in mind was *T. montgomeriensis*. I have found from near Montgomery, Louisiana, one specimen which belongs to *Levifusus mortoniopsis carexus*. The presence of such a shell verifies the statement that *L. carexus* is found in the Jackson Eocene but apparently the species is rare.

Dimensions.—Height, 27 mm.; greatest diameter, 14 mm. (medium).

Holotype.—No. 147035, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, Montgomery, La. (type); localities 10, 11, 15, 883; 785; 693; 8 Danville Landing beds, localities 6, 886. Jackson of Arkansas, locality 1046.

Tritonoatractus pearlensis danvillensis, n. var. Plate 51, figs. 1-3

Nuclear whorls consist of 4½ whorls, 4 or more of which are smooth; the smooth stage passes into a curved longitudinal ribbed period, which in turn is followed by the postnuclear sculpture. There is no demarcation between the nuclear and

[81] Harris, G. D.: Acad. Nat. Sci. Philadelphia. Proc., vol. XLVII, p. 72, pl. 7, fig. 5 *non* Harris, 1896, *op. cit.*, vol. XLVIII, p. 472, pl. 18, fig. 12. See Palmer, Bull. Amer. Paleont., vol. VII, No. 32, 1937, p. 331, pl. 49, figs. 11, 13, 14.

postnuclear condition of development. The axial ribs are crossed by six or seven spiral ribs which continue over the remainder of the shell. The whorls may be rounded or the median revolving rib may slightly carinate the whorl. The spiral ribs are generally uniform in size, they may be irregular, secondary revolving lines. An obscure but moderately large varix occurs back of the exterior margin of the labrum. The dentation of the labrum and of the columellar callus is typical but the callus of the columella is not so thickly developed nor does it project as collarlike as in the species, *sensu stricto*.

The longitudinal ribs die out over the later whorls and on immature shells appear only as nodes on the median spiral ribs. In large shells they probably would not be present on the body whorl and would be obscurely observed on later whorls of the spire.

This form may be differentiated from *T. pearlensis* and *T. montgomeriensis* in having longitudinal and revolving sculpture less conspicuously developed. *T. danvillensis* represents a retardation in ornamentation as opposed to *T. montgomeriensis* which exhibits a progression of sculptural inheritance.

So far, I have seen this variation only in the Danville deposits.

Dimensions.—Height, 23+ mm.; greatest diameter, 12+ mm.

Types.—Holotype, No. 4727; paratypes, Nos. 4726, 4728, Paleontological Research Institution.

Occurrence.—Danville Landing beds, locality 6.

Genus **MAZZALINA** Conrad, 1860
(**BULBIFUSUS** Conrad, 1865)

Conrad, Acad. Nat. Sci. Philadelphia, Jour., vol. IV, 2d ser., 1860, p. 295. Genotype by monotypy, *Mazzalina pyrula* Conrad (=*M. inaurata* Conrad, var.). Eocene. United States. Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, pp. 349, 350, pl. 47; pl. 85, fig. 13; pl. 86, fig. 8.

An inconstant character of *Mazzalina* is the variation in the dentation of the columellar area and the interior of the labrum. Within the species of the genus the plications are not even regular in appearance.

Mazzalina inaurata (Conrad) Plate 52, fig. 6

Fusus inauratus Conrad, 1833, Sept., Fos. Shells Tert. Form., p. 29; Conrad, 1835, Fos. Shells Tert. Form., p. 53, pl. 18, fig. 2.

For complete synonymy, copy of original description, additional notes, and figures see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 349, pl. 47, figs. 1, 7; pl. 86, fig. 8.

M. inaurata Conrad represents a species with great potentiality for variation. Several names have been given to identify certain more striking changes in the contour of the whorls. The species, described from the Gosport sand at Claiborne, Alabama, exhibits the typical form among the shells from the Jacksonian at White Bluff, Arkansas. Conrad constructed the name *pyrula* for a change in shape from that of the species, *sensu stricto*, found in the Gosport sand (Palmer, 1937, p. 350, pl. 85, fig. 13). The species continued to live throughout the Jackson with considerable abundance and variation. A common shape in the Jackson was named *oweni* by Dall. There is little consistency in the outline or form of *M. oweni* but in general it has a larger spire than *M. inaurata, s. s.* In the Jackson, principally in Arkansas, there is a variety, called *M. humerosa* by Harris, which developed a concavity below the suture on the body whorl. The margin of the hollow gives the whorl a sharp shoulder. Gradations occur from this shape to that of the typical shell.

The form, "*M.*" *dalli* Harris, I do not believe belongs to this species. It has been demonstrated under *Cornulina* that "*M.*" *dalli* represents a variation of another species of a different genus than *Mazzalina*. The differences between *Mazzalina inaurata* and *C. dalli* are given under *Cornulina dalli*.

Dimensions.—Height, 22 mm.; greatest diameter, 7 mm.

Occurrence.—Gosport sand, Claiborne, Ala. (type). Jackson of Arkansas, localities 896, 1049, (White Bluff, Ark.).

Mazzalina inaurata pyrula Conrad Plate 52, fig. 11

Mazzalina pyrula Conrad, 1860, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. IV, p. 295.

For synonymy, copy of original description, and figure see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 350, pl. 85, fig. 13.

The variations in shape of *M. inaurata* do not represent constant changes in the species but exhibit gradational features. Since names have been given to some of the variations, such appellations may be used to call attention to certain changes in shape. However, there are finer gradations which do not fit exactly under these names.

A particular form which Conrad found in the Gosport sand and called *M. pyrula* is duplicated by several specimens from the Jackson beds on Crow Creek, Arkansas.

Dimensions.—Height, 30+ (beak broken); greatest diameter, 33 mm.

Figured specimen.—No. 4731, Paleontological Research Institution.

Occurrence.—Gosport sand, Claiborne, Alabama (type). Jackson of Arkansas, locality 894.

Mazzalina inaurata oweni (Dall) Plate 52, figs. 7-10

Fusus, sp., Owen, 1860, Second Geol. Rept. Arkansas, pl. 9, fig. 1.
Fusus Fittonii Owen, *op. cit.*, p. 35 probably. *Non* Lea, 1833.
Fasciolaria oweni Dall in Call, 1891, Ann. Rept. Geol. Survey Arkansas for 1889, vol. II, p. 8 footnote; Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 165, pl. 7, fig. 1 as *Mazzalina inaurata oweni*.
Mazzalina oweni Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. I, p. 105; Dall, 1892, *op. cit.*, pt. II, p. 233.
Mazzalina inaurata var. Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 473, pl. XVIII, fig. 14.
Mazzalina inaurata oweni (Dall), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 351, pl. 47, figs. 2, 8, 11.

White Bluff, Jefferson Co., Arkansas, Middle Eocene.

Owen's types were deposited in the National Museum, and are before me as I write. The specimens, except when fully adult, show the plaits on the pillar only to an oblique view, so they do not appear on that figure. When young the species has three plaits on the pillar like *Fasciolaria*. At the first resting-stage, however, more are added, and thereafter are continuous, increasing to eight or nine in the fully mature shell; the surface is much like that of Conrad's type-species, but the shell is smaller and more slender; the young have the suture crenulated minutely by its being laid on a peripheral crenulated keel of the first two or three whorls; this keel becomes faint and smooth on the later whorls, obscurely indicating a shoulder to the whorls, which number in all about seven, with the outer lip internally callous and lirate. The nucleus is small and fusoid; the canal spirally striate externally. The adult measures 34x19 mm.; Owen's figure is somewhat too slender. It is doubtless the species referred to on page 35 as *Fusus Fittoni* (Lea), to which it bears a considerable but wholly superficial resemblance. Most of the specimens are obscurely constricted between the suture and the shoulder, which is not well shown by Owen's figure. The species has since been collected by the State Geological Survey under Dr. John C. Branner at the same locality and is accompanied by a species of *Macron* of rather similar external form. *Lagena rhomboidea* Gabb (Geol. St. Dom., p. 218, 1873) is, from the types, a young *Mazzalina* much resembling *M. Oweni*, but more slender and with a proportionally longer canal.—[Dall, 1890.]

There is the most common form of *M. inaurata* in the Jackson and does not seem to have occurred earlier in the Eocene.

Since *M. inaurata* varies with gradational connections it would be too burdensome to have names to cover all the stages. Such a specimen as figured by Harris from Jackson, Mississippi, I have included under *M. oweni* although it is not shaped according to type but does fall within the variation of *M. oweni.*

Dimensions.—Height, 39 mm.; greatest diameter, 20 mm.

Syntypes.—No. 135103, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, Jackson, Miss. (Harris, Acad. Nat. Sci. Philadelphia, No. 6940; localities 1; 10, 1054, 883; Yazoo clay, locality 2; Danville Landing beds, localities 6, 886; 20; 14, 1120; 1 mile north of Rosefield, Catahoula Parish (1899), La.; Jackson of Arkansas, White Bluff, Ark. (type); localities 896, 1049; 894; 1046.

Mazzalina inaurata humerosa Harris Plate 52, figs. 1-5

Mazzalina inaurata humerosa Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, pl. VII, fig. 4 [text under *M. inaurata*, p. 165]; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 352, pl. 47, fig. 10.

This variety is like the typical form in the pointedness of the apical whorls, in the shape and shortness of the spire, in having conspicuous nodes on the apical whorls, and in the slenderness and curvature of the beak.

The form differs from *M. inaurata, s. s.,* in having the upper part of the body whorl with a conspicuous concavity, the lower margin of which gives a decided shoulder to the body whorl. The development of plications on the labrum and labium varies. Some specimens have the plications well developed, on others the lips are smooth, and on other shells, the labial areas are nearly smooth.

The holotype came from a well at Rison, Arkansas. Our later collections yielded numerous individuals from the beds at White Bluff and on Crow Creek, Arkansas.

Dimensions.—Height, 26 mm.; greatest diameter, 15 mm.

Holotype.—No. 135130, United States National Museum, Washington, D. C.

Occurrence.—Jackson of Arkansas, well at Rison, Arkansas (type, Bull. U. S. Nat. Mus., No. 53, 1905, p. 393); localities

896, 1049; 1046.

Genus **FUSINUS** Rafinesque, 1815
(*Fusus* Lamarck, 1799; *Non Fusus* Helbing, 1779)

Rafinesque, Analyse de la Nature, 1815, p. 145. (See Iredale, Malacol. Soc. London, Proc., vol. IX, 1911, p. 262.) Substitute name for *Fusus* Lamarck.

Genotype by monotypy of *Fusus* Lamarck (Soc. Hist. nat. Paris, Mem., 1799, p. 73), *Murex colus* Linnaeus (1758, p. 753). Living. Indo-Pacific. Tryon, Manual Conch., vol. III, 1881, pl. 32, figs. 89-92, 95.

Fusinus insectoides (Harris) Plate 49, figs. 4, 5

Fusus insectoides Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 472, pl. XVIII, fig. 11.

Specific characterization.—Size and general outline as figured; whorls 12 or 13; apex acute; upper whorls broadly costate and with strong and weak alternating spiral lines; 5 spiral lines on the shoulder, decreasing in strength toward the suture; sides of the whorls with two or three strong, raised spiral lines, with two weaker ones above and two or three weaker ones below; longitudinal lines faint, showing only between the coarse spirals; columella twisted below; labium sharp and extending some distance away from the columella; sutures most remarkably constricted.

Locality, Jackson, Miss.—[Harris, 1896.]

One and one-half smooth nuclear whorls, the first minute, not flatly coiled; smooth stage followed by longitudinal folds crossed by fine spirals which pass into the strong sculpture of the post-nuclear whorls. Beak with canal slightly longer than the body whorl and spire combined. Canal practically covered by the margin of the right wall.

This species bears a remarkable similarity in the character of the whorls and length of the canal to the common Barton Eocene *F. porrectus* (Solander).[82] It is unique in the southern Eocene for no other "fusoid" known so far from the Eocene of the Mississippi embayment area conforms to this type. The conspicuous rounded loosely coiled whorls with the sunken sutures and long beak parallel *F. porrectus* and its variations. *F. insectoides* has eight primary spirals, *F. porrectus* has seven.

The species is rare.

Dimensions.—Height, 51 mm.; greatest diameter, 10 mm.

Holotype.—No. 6845, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785; 883.

[82] Solander, D. C.: in Brander Fossilia Hantoniensia, 1766, p. 21, pl. II, figs. 35, 36; Wrigley, A., Malacol. Soc. London, Proc., vol. XVII, 1927, p. 220.

Genus **CLAVILITHES** Swainson, 1840[83]

(*Clavella* Swainson, 1835 *non* Oken. *Rhopalithes* Grabau, 1904.)[84]

Swainson, Treatise on Malacology, 1840, p. 304. *Clavalithes, op. cit.*, pp. 77, 78.

Genotype by subsequent designation, Herrmannsen (Ind. Gen. Mal., vol. 1, 1846, p. 246), *Fusus noæ* (Chemnitz) (Conch. Cabinet, vol. XI, 1795, p. 296, pl. 212, figs. 2096, 2097; Lamarck, Ann. Mus. Hist. nat., t. II, p. 317). Eocene. Paris Basin and England. Cossmann and Pissarro, Icon. comp. Coq. foss. Eocène Env. Paris, t. II, 1910-1913, pl. XL, fig. 198-7.

Clavilithes humerosus Conrad — Plate 53, figs. 5-12

Clavelithes humerosus Conrad, 1854, Wailes, Rept. Agr. and Geol. Mississippi, p. 289, pl. XV, fig. 2; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 5, 19, pl. 2, fig. 2; Grabau, 1904, Smithsonian Misc. Coll., vol. XLIV, No. 1417, p. 129, pl. VIII, figs. 17, 18 *partim*.

Clavelithes varicosa Conrad, 1854, *loc. cit.*, pl. XVI, fig. 7.

Clavelithes Mississippiensis Conrad, 1854, *loc. cit.*, pl. XVII, fig. 8.

Clavilithes humerosa Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 259.

Clavilithes varicosa Conrad, 1855, *loc. cit.*

Clavilithes Mississippiensis Conrad, 1855, *loc. cit.*

Clavella humerosa Conrad, 1865, Am. Jour. Conch., vol. 1, p. 17; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Cossmann, 1901, Essais Paléoconch. comp., 4 liv., p. 20, fig. 9.

Clavella varicosa Conrad, 1865, *op. cit.*, p. 18; Cossmann, 1901, *loc. cit.*

Clavella Mississippiensis Conrad, 1865, *op. cit.*, p. 18; Conrad, 1866, *op. cit.*, p. 26.

1. *C. humerosa.* Pl. XV., fig. 2.—Fusiform, volutions eight?, rounded; body whorl and penultimate entire, the others with broad rounded ribs; whorls carinated below the suture and with revolving lines, most prominent towards the apex; body whorl and penultimate, channeled above and contracted near the summit; body whorl angulated inferiorly; beak long and straight.

2. *C. varicosa.* Pl. XVI., fig. 7.—Fusiform, spire and beak elongated; whorls nine, with distant, rounded, thick ribs and with revolving acute lines, which are obsolete or less prominent on the ventricose portion of the body whorl; papillated apex formed of three volutions; columella nearly straight, and with microscopic longitudinal lines.

C. Mississippiensis. Pl. XVII, fig. 8 is probably the same species.—[Conrad, 1854.]

Nuclear whorls large, except the first which is minute and may be pointed, whorls rounded, smooth, number of whorls varies from three to four; nuclear and postnuclear whorls obliquely joined. There is no line of demarcation between the nuclear and postnuclear whorls. The sculpture of the conch begins with fine spiral lines, which become coarser and increase in number. There are eight or nine spiral ribs on the early whorls of the spire. Finer interstitial spiral lines may develop on the middle whorls and several lines may be added just be-

[83] Palmer, K. V. W.: Bull. Amer. Paleont., vol. XXIV, No. 80, 1938, p. 4.
[84] Grabau, A. W.: Smithsonian Misc. Coll., vol. 44. No. 1417, 1904, p. 135.

low the suture. As age increases the spiral lines tend to become obscure on the later whorls so that on mature and old specimens the body whorl and penultimate whorl are smooth or the spiral lines may be finely traceable except over the base of the body whorl where they are conspicuously present. Narrow longitudinal folds begin on the postnuclear whorls, rapidly developing in size, until they are present as broad heavy folds over the whorls of young shells. There are five to seven longitudinal folds. In adult specimens the longitudinal ribs are obliterated, leaving no trace of them on the body whorl. On the early whorls of the conch, the area just below the suture becomes constricted, gradually rising above the suture, until on the body whorl there is a noticeable channel in the sutural line. Beak and canal long; canal narrow; posterior notch present.

One specimen, Plate 53, figures 5, 6, from among a group of typical shells at the same locality, displays a series of very fine lines in the concave area below the suture. The striations were so fine that they did not photograph conspicuously.

Conrad gave three different names to the Jackson species of *Clavilithes* and in some of his later writings apparently became confused and forgetful concerning his own names.

The species is abundant and variable but certainly may be classed under one specific name. Conrad figured three specimens of Jackson *Clavilithes* in Wailes, Report of the Agriculture and Geology of Mississippi, naming each *humerosus*, "*varicosa*" and *mississippiensis*. Later (1855) he described "*humerosa*" and "*varicosa*" but decided that "*mississippiensis*" was the same as "*varicosa*." He retained the names in 1865 (pp. 17, 18) under *Clavella* but in 1866 (pp. 25, 26) he dropped *C. varicosa*, listed *C. humerosa* and *C. mississippiensis*, although in 1855 he thought *C. mississippiensis* was the same as *C. varicosa*. In 1866, he lists *C. mississippiensis* from Vicksburg as well as from Jackson.

From an examination of the Conradian types and a study of a large collection from different localities, I see no reason for separating the forms specifically. Through the courtesy of Dr. Horace Richards, Academy of Natural Sciences, Philadelphia, dimensions and illustrations of the type of *Clavilithes varicosus* are included herein.

Dimensions.—Height, 76.6 mm.; greatest diameter, 27 mm. (type, *C. humerosus*). Height, 55 mm.; greatest diameter, 16.5 mm. (type, *C. mississippiensis*). Height, 46.5 mm.; greatest diameter, 20 mm. (type, *C. varicosus*).

Types.—*C. humerosus,* No. 13201; *C. mississippiensis,* No. 13202; *C. varicosus,* No. 13200, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, localities 785, 880, 879, 881, 787, 1051, Jackson, Miss. (type); 900; 1111; 10, 883, 1054, 15; 8, 7, 912; 16; 1119, 1. Jackson of Arkansas, locality 897.

Genus PAPILLINA[85] Conrad, 1855

(*Turrispira* Conrad, 1866; *Clavifusus* Conrad, 1866)

Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, Jan. 1855, p. 262. Genotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 4 liv., 1901, p. 70), "*Fusus dumosus*" Conrad = *Papillina dumosa* (Conrad) (= *P. mississippiensis* Conrad, 1855; 1865). Jackson Eocene. United States. Plate 52, figures 12-15.

Dall (1890, p. 125), by confusing the references in the synonymy which he gave for *Papillina dumosa,* considered the naming of the genus as that given by Conrad in 1865. Dall's synonymy should read "*Papillina mississippiensis*" in place of "*Strepsidura dumosa*", and *Strepsidura dumosa* belongs with the reference to Wailes. The Wailes's reference should precede the Academy of Natural Science reference. The omitting and misplacing of names caused Dall to make the statement, "The first species of *Papillina* . . . *Fusus altilis.*" He was then thinking of the reference of 1865 which is not the original. Dall's remarks are therefore not based on the original definition and so need not be contemplated. Cossmann considered Dall's remarks as correct but chose *P. dumosa* as genotype (neotype).

Finlay and Marwick (Geol. Survey New Zealand, Pal. Bull., No. 15, 1937, p. 70) disregarded Cossmann's designation of *Fusus dumosus* because he used the word neotype. However, Cossmann (Essais Paléoconch. comp., 2 liv., 1896, p. 2) defined his term neotype, and hence one knows in this case that he is

[85]*Non Papillina* Moquin-Tandon, 1855, [1st part April] (Palmer, Bull. Amer. Paleont., vol. XXIV, No. 80, 1938, p. 3); *non Papillina* Schmidt, 1862.

referring to the genotype. Finlay and Marwick stated that the type of *Papillina* was fixed by absolute tautonymy as *Papillina papillatus* Conrad. But that seems to be unnecessary and stretches the definition. Under the generic description *P. mississippiensis* (=*P. dumosa*) is described first, followed by the remark, "To this genus *Papillina* belongs the Eocene species, *Fusus papillatus*." The choice of either species does not modify the generic characters.

Papillina dumosa (Conrad) Plate 52, figs. 12-15

Strepsidura dumosa Conrad, 1854, Wailes, Rept. Agr. and Geol. Mississippi, p. 289, pl. XVII, figs. 10a, 10b.

Papillina Mississippiensis Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, p. 8, pl. 4, 10a, 10b; Conrad 1865, Am. Jour. Conch., vol. 1, p. 17.

Clavifusus dumosus Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 26.

Fusus (*Papillina*) *dumosus* (Conrad), Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 125.

Fusus Jacksonensis de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 80.

Fusiform, with a series of distant, very prominent spines and longitudinal undulations; revolving lines prominent, alternated, wrinkled and undulated: three volutions from the apex entire, and forming the papillary top; fold on the columella obtuse; beak slightly tortuous.

In the Geology of Mississippi where the shell is figured, I have incorrectly referred it to the genus *Clavelithes*. To this genus *Papillina* belongs the Eocene species, *Fusus papillatus* Con., of Claiborne. I have never met with a species of this genus in the Miocene or more recent formation. It is probably most nearly related to *Turbinella*.—[Conrad, 1855.]

Nuclear whorls large, consist of about four smooth whorls, flatly coiled; the postnuclear whorls begin abruptly, covered with about eight coarse close-set spiral ribs which gradually increase in number; over the first postnuclear whorl, there is a slight undulating longitudinal puckering of the surface which on the following whorls develops into wide longitudinal folds. Those folds rapidly become spinose and on the later whorls are of considerable projection. The spiral ribs on the body whorl are coarse with wide interspaces and finer intervening threads. Sharp posterior sinus; labrum and labium smooth; canal and beak long, straight; beak twisted slightly anteriorly. Specimens attain a large size.

P. dumosa bears a closer resemblance to *P. trapaquara* of the lower Claiborne than to *P. papillata,* the species in the Gosport sand. For figures of the species mentioned see Palmer, 1937, pl. 52.

P. trapaquara is a stouter form with the beak less attenuated and the body whorl less concave.

Conrad, when writing the description of this species after he had previously figured it, became confused with his own names. He originally (1854) named the species *dumosus*, illustrating it under the generic name *Strepsidura*. When he described the species later (1855) and coined for it the new generic name, *Papillina*, he apparently forgot the original specific name and confused it with "*Clavelithes mississippiensis*" which he had figured in the same publication. His remark, as to referring it to "*Clavelithes*," is a lapse.

De Gregorio gave the unnecessary name of *Fusus Jacksonensis* because he placed the species in *Fusus* and believed *Fusus mississippiensis* would be preoccupied by *F. mississippiensis* Conrad (Acad. Nat. Sci. Philadelphia, vol. I, n. ser., 1848, p. 117) from the Vicksburg. Since the original name was not *mississippiensis* and is not combined with *Fusus* there is no preoccupation in this case.

Dimensions.—Height, 85± mm. (apex broken) ; greatest diameter, 45 mm. (not including length of spines).

Holotype.—No. 13203, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type) ; localities 881, 785, 1051 ; 10, 1054; 7, 916, 1119; 16; 1. Jackson of Arkansas, locality 897.

Family XANCIDÆ

Genus VASUM Roeding in Bolten, 1798

Roeding in Bolten, Museum Boltenianum, 1798, p. 56.

Genotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 4 liv., 1901, p. 65), *Turbinella cornigera* Lamarck (Hist. nat. An. sans Vert., t. 7, p. 105) = *Voluta turbinellus* Linnæus (12 ed., 1767, p. 1195). Living. Philippines, Molluccas, East Indies. Tryon, Manual Conch., vol. IV, 1882, pl. 21, figs. 16, 20-22.

Vasum humerosum Vaughan — Plate 51, figs. 10, 11

Vasum humerosum Vaughan, 1896, U. S. Geol. Survey, Bull., No. 142, p. 34, pl. II, figs. 7, 8.

Size and form indicated by figures. The specimen upon which this species is founded is not very good. Whorls shouldered, about six, each having eight sharp, short, thick, pointed humeral spines; surface marked by distinct coarse elevated revolving lines; there are several between the shoulder and suture, one on the shoulder and five below it. About two-thirds the distance from the shoulder to the anterior extremity there is a spiral row of spines; one spine for each humeral spine. Anterior to these spines there is a prominent subspinous revolving elevation. Shell umbilicated. On the columella there are three revolving folds, the uppermost the most prominent.

Locality.—Montgomery (Vaughan).

Geological horizon.—Jackson.

Type in the United States National Museum.—[Vaughan, 1896.]

This is the first appearance of *Vasum* in the southern and eastern American Tertiaries. Several species occur in the Recent fauna of the West Indies and in the Miocene and Pliocene of Florida and the West Indies.

Dimensions.—Height, 50 mm.; greatest diameter, 28 mm.

Holotype.—No. 147037, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, localities 10, 1054.

Family **VOLUTIDÆ**

Genus **ATHLETA** Conrad, 1853

Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. VI, 1853, p. 449.

Genotype by subsequent designation, Dall (Wagner Free Inst. Sci., Trans., vol. 3, pt. I, 1890, p. 75), *Voluta rarispina* Lamarck (Am. Mus. nat. Hist. nat., t. XVII, 1811, p. 79), Miocene. Europe. Palmer, 1937, pl. 57, figs. 3-9, as *A. ficulina rarispina* (Lamarck).

Athleta petrosa (Conrad) Plate 53, figs. 1-4

(See also Palmer, 1937, pl. 58, figs. 1, 9, 10, 14.)

Voluta petrosa Conrad, 1833, Aug., Fos. Shells Tert. Form., p. 29; Conrad, 1835, Fos. Shells Tert. Form., p. 41, pl. 16, fig. 2.

Volutalithes symmetrica Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XV, fig. 6; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 260; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 6, 19, pl. 2, fig. 6; Conrad 1865, Am. Jour. Conch., vol. 1, p. 24; Conrad, 1866, Smithsonian Misc. Coll., vol. 7, No. 200, p. 25.

Volutalithes dumosa Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XVI, fig. 1; Reprint *op. cit.*, pl. 3, fig. 1; Conrad, 1865; *op. cit.*, p. 23.

Volutilithes petrosus (Conrad), Smith, B., 1906. Acad. Nat. Sci. Philadelphia, Proc., vol. LVIII, p. 67, text fig. 7, pl. II, figs. 4, 7.

Athleta petrosa (Conrad), Smith, B., 1907, Acad. Nat. Sci. Philadelphia, Proc., vol. LIX, p. 234.

For complete synonymy, copy of the original description, illustration of types, and additional notes on the species-group, see Palmer, 1937, pp. 372-375, pl. 58, figs. 1-14; pl. 88, figs. 1, 7, 11. Besides the original reference to the species, only those pertaining to the Jackson Eocene are included here.

The details of morphology of the species-group of *Athleta petrosa* have been carefully worked out by Dr. Burnett Smith and published in the two papers listed in the synonymy, hence there is no need of further repetition.

There seems to be two strains of variation toward which the species trends. Connecting forms of innumerable variations occur between the extremes so that they cannot be separated from the parent stock specifically or subspecifically. Conrad noticed the extremes. He named and figured shells representing such forms under the names, *V. symmetrica* and *V. dumosa.* The variations may be found at the same localities, repeated at different localities, and are connected by intermediate forms. Therefore one could illustrate many specimens showing a diversity of sculpture, which to a reader not familiar with a large suite of the species-group, not only in the Jackson Eocene but in the Sabine (Wilcox) and Claibornian, would give the impression that there were many distinct species. In such a case, it seems better to illustrate only what appears to represent the two phases of Jackson development. The several illustrations of the Jackson shells given in the 1937 report should be referred to in addition to those given herein.

When the growth of the species-group or stock of *A. petrosa* in the Jackson is compared with that which went on in the Sabine and Claibornian. it appears to be a matter of acceleration of growth. The one phase of Jackson growth exhibits fewer but larger spines on the body whorl. This phase Conrad called *"dumosa."* The revolving striæ tend to die out in this variation and the upper part of the body whorl becomes smooth. There is no constancy in the amount of smoothness of the body whorl. The other extreme which the Jackson shells may approach or vary toward, has an increase in the number of spines on the body whorl but not in size of the spines and strengthening of the spiral striæ over the complete surface of the body whorl.

A senile character, such as the formation of excess callus which spreads from the parietal region over the spines of the penultimate whorl and first part of body whorl, frequently occurs. This abnormal feature does not cover so large an area as in the Sabine (Wilcox) shells of "*tuomeyi*." The conditions at Carter Landing, upper Jackson, probably were unfavorable for this species, for all of several specimens from that locality displays the feature more excessively than elsewhere in the Jackson.

Dimensions.—Height, 45 mm. (medium); 27 mm., greatest diameter.

Type.—*Volutalithes symmetricus* Conrad, No. 13207, Acad. Nat. Sci., Philadelphia, Pa.

Occurrence.—Sabine. Lower Claiborne. Gosport sand. Jackson: Moodys Branch marl, localities 785, 881, 880, 693, 1051; 11, 15, 10, 1054; 8, 7, 912; 1, 1118, 1119; 922; 1121; Yazoo clay, locality 12; Danville Landing beds, localities 6, 886; 14; 1120; Jackson of Arkansas, localities 1046, 896, 897.

Athleta haleana jacksonia, n. var. Plate 53, figs. 13-15

For complete synonymy, copy original description, figure of the holotype, and additional notes on the parent species, *Mitra haleana* Whitfield, see Palmer, 1937, p. 379, pl. 61, figs. 5-8.

This Jackson variety of the characteristic lower Claiborne species of *Athleta* is known by three specimens from near Montgomery, Louisiana. Among its associates is *Phalium brevicostatum creolum*, a variety of a typical lower Claiborne species.

The smooth apical and the spinose whorls of the spire are as in the species, *s. s.* The surface of the body whorl is covered with coarse spiral ribs. The ribs have wider interspaces than on *A. haleana*. On *A. jacksonia*, the interspaces become considerably wider on the basal area of the body whorl with the finer interstitial thread obscure. The longitudinal nodes on the shoulder of the whorls are fewer in number on *A. jacksonia* than on *A. haleana, s. s.* The longitudinal wrinkles in *A. haleana* which extend over the body whorl to the nodes on the shoulder are undeveloped as folds. In the Jackson variety, the longitudinal striations have developed into conspicuous folds. The nodes and folds are fewer than the nodose series in *A. haleana*.

Dimensions.—Height, 22± (spire broken); greatest diameter, 11 mm.

Types.—Holotype, No. 4751; paratypes, Nos. 4749, 4750, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality No. 10, Montgomery, La.

Genus **CARICELLA** Conrad, 1835

Conrad, Fossil Shells Tertiary Formations North America, 1835, p. 44.

Genotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 1899, 3 liv., p. 129), *Turbinella piruloides* Conrad (*C. pyruloides* (Conrad), Fos. Shells Tert. Form., 1832, p. 24). Claibornian Eocene. Southern and southeastern United States. Conrad, 1832, *op. cit.*, pl. 10, fig. 1; Palmer, 1937, pl. 63, figs. 1-3, 6, 9-12; pl. 89, fig. 3.

Caricella polita Conrad — Plate 54, figs. 1, 2, 4, 6, 9, 11, 14

Caricella polita Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XVI, fig. 4; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 261; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 7, 19, pl. 3, fig. 4; Conrad, 1865, Am. Jour. Conch., vol. 1, p. 24; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Cossmann, 1899, Essais Paléoconch. comp., 3 liv., p. 130.

Caricella pyruloides polita Conrad, Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 88; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 391, pl. 63, figs. 4, 7.

Fusiform; smooth and polished, with revolving lines inferiorly, and on two volutions of the spire; the whorl above is papillary and smooth; columella with closely arranged microscopic longitudinal lines; plaits four, slender, prominent, remote; beak slightly curved.

Allied to C.   but proportionally shorter and very distinct.—[Conrad, 1855.]

Nuclear whorls bulbous, smooth, consisting of about two whorls, greatly enlarged, merging gradually with the postnuclear whorls; first postnuclear whorl constricted in longitude, covered with fine, spiral threads. The whole surface of young shells is covered with fine revolving threads with wide interspaces. Finer microscopic interstitial lines may be present. The spiral ribs become obsolete with age over the middle and upper portions of the body whorl but remain conspicuous on the basal area of the body whorl.

The young of different species of Caricellas associated in the same beds are difficult to separate.

The general shape and obsolescence of the spiral lines over the upper and middle of the body whorl are similar in *C. pyruloides* and *C. polita*. *C. polita* may apparently be differentiated by the wider primary ribs. Where the surface of the shell has become smooth without a trace of the ribs, separation of the two forms is not easy.

Through the courtesy of Dr. Horace G. Richards of the Academy of Natural Sciences of Philadelphia, the types of *C. polita* and *C. subangulata* were made accessible for photographing. The illustrations are included herein.

Dimensions.—Height, 35.8 mm.; greatest diameter, 17 mm. (lectotype).

Lectotype.—No. 13209, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 693, 880, 785; 10, 15, 883, 1054; 7, 8, 1119.

Caricella subangulata Conrad Plate 54, figs. 10, 12, 13, 15

Caricella subangulata Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XV, fig. 8; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 261; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 7, 19, pl. 2, fig. 8; Conrad, 1865, Am. Jour. Conch., vol. 1, p. 24; Conrad; 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Cossmann, 1899, Essais Paléoconch. comp., 3 liv., p. 130.

Scaphella (Caricella) subangulata Conrad, Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 87, pl. 6, fig. 11.

Turbinate; labrum expanded; shoulder subangulated; body whorl flattened above; spire short, conical, consisting of 4½ volutions, with microscopic revolving lines near the apex; columella with four remote plaits the two inferior ones most oblique.—[Conrad, 1855.]

Nuclear whorls large, mammiform, smooth, consisting of about two whorls joined to the postnuclear whorls by an oblique fold or obscurely differentiated from the later whorls; first postnuclear whorl covered with microscopic spiral lines which continue over the early whorls of the spire. On immature specimens the spiral lines cover most of the whorls; they are stronger on the area just below the suture and over the basal portion of the body whorl. The revolving threads become obsolete on the large adult shells, showing on the early whorls of the spire and obscurely over the basal portion of the body whorl.

The immature specimens of this species may be differentiated from similar shells of *C. polita,* with which it is associated, by having one more whorl, thus elevating the spire.

This species attains a large size. It may be equaled in dimensions by the variety, *C. howei.* Fragments of large shells of *C. howei* have been found near Montgomery, Louisiana.

Dimensions.—Height, 62.3 mm.; greatest diameter, 45.5 mm. (lectotype).

Lectotype.—No. 13208, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 786, 880, 921, 881, 1051; 1100, 1098; 10, 883, 1054. Jackson of Arkansas, localities 1046, 897.

Caricella howei, n. sp. Plate 54, figs. 7, 8

Shell large; spire elevated; body whorl produced posteriorly with a concavity between the suture and the shoulder; nuclear whorls enlarged, typical, early postnuclear whorls restricted vertically; early whorls of adults and young shells covered with spiral striations. On medium-sized specimens and adults the spiral lines become obscure and the whole surface of the shell is smooth. Faint lines may be seen below the suture on the first whorl of immature shells. Columella with four plications.

This species bears the closest resemblance to *C. subangulata cherokensis* Harris of the lower Claiborne. It differs from that species by the presence of the conspicuous concave area above the shoulder of the body whorl. It differs from *C. subangulata* and *C. polita*, with which it is associated, in the more elevated spire and shoulder furrow. The surface of the shell is smoother than that of *C. polita*. *C. howei* attains a large size as indicated by fragments.

Dimensions.—Height, 43 mm.; greatest diameter, 25 mm. (medium).

Types.—Holotype, No. 4757; paratype, No. 4758, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, No. 1119, Bunker Hill, Ouachita River, La. (type); 883, 10. Danville Landing beds, locality 886.

Caricella turneri, n. sp. Plate 54, figs. 3, 5

Shell medium in size; spire short; nuclear whorls large, smooth, bulbous; postnuclear whorls completely covered with coarse revolving ribs crossed by longitudinal folds which give the surface a reticulate appearance. The whole surface of the shell is covered with sculpture but the longitudinal element is less emphasized on the body whorl. There are about seven equal spiral ribs on the penultimate whorl; on the body whorl, the revolving ribs alternate in size with wider interspaces than on the whorls of the spire. The margin of the whorl below the suture is collared. Below the collar the area is concave.

This *Caricella* belongs in the ornamented group of *C. reticulata*. It differs from *C. reticulata* of the Red Bluff Oligocene, in having the nuclear whorls more bulbous, less whorls of the spire, spiral ribs of the spire closer together and more equal in size, and the longitudinal folds better developed.

Dimensions.—Height, 18+ mm. (beak broken); greatest diameter, 12 mm.

Types.—Holotype, No. 4760; paratype, No. 4761, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, Creole Bluff, Montgomery, La., locality 883 (type); loc. 1.

Family HARPIDÆ

Genus HARPA Pallas, 1774

Pallas, Spicilegia Zoologica, fasc. 10, 1774, pp. 33, index, pl. III, fig. 1. Genotype by monotypy, *Harpa nobilis* (Linnæus) (=*Buccinum harpa*, 1758, p. 738; Hanley, 1855, p. 251). Recent. Indian Ocean. Martini, Neues Syst. Conch.-Cab., Bd. III, 1777, p. 415, pl. 119, fig. 1091; Tryon, Manual Conch., vol. V, 1883, pl. 41, fig. 68 (*H. nobilis* Lamarck =Linnæus.)

The genus *Harpa* is usually credited to Bolten[86], however, that of Pallas of earlier date is valid, and the type is less complicated in designation than that of Bolten.

Subgenus EOCITHARA Fischer, 1883

Fischer, Man Conchyliol., 1883, p. 601.

Subgenotype by monotypy, *H. mutica* Lamarck (Ann. Mus. nat. Hist. nat., t. 2, 1803, p. 167). Eocene. Paris Basin. Cossmann and Pissarro, Icon. comp. Coq. Fos. Éocéne Env. Paris, t. 2, 1910-1913, pl. XLVI, fig. 209-1; Vokes, Jour. Paleont., vol. 11, No. 1, pl. 2, figs. 1, 3.

Harpa (Eocithara) jacksonensis Harris — Plate 56, figs. 19, 20

Harpa jacksonensis Harris, 1896, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, p. 472, pl. 18, fig. 10; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 398 genus *Eocithara*.

Specific characterization.—Size and general form as indicated by the figure; volutions 8; 1 and 2 very minute, smooth; 3 much larger; smooth; 4 somewhat larger than 3, showing vertical costæ in its first half, then assuming the characteristic markings of the remaining whorls; costæ on the body-whorl nine in number, somewhat deflected below the suture,

[86] Melvill, J. C.: Jour. Conch., vol. XV, 1916, p. 25; Vokes, H. E., Jour. Paleont., vol. 11, No. 1, 1937, p. 10.

as in *Drillia;* between the costæ the shell is finely cancellated with a network of raised lines; anterior canal slightly larger than usual for the genus.

Locality, Jackson, Miss.—[Harris, 1896.]

Dimensions.—Height, 31.5 mm.; greatest diameter, 18.7 mm. (holotype).

Holotype.—No. 6722, Academy of Natural Sciences, Philadelphia, Pa.

Occurence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 881; 883.

Family **MITRIDÆ**

Genus **UROMITRA** Bellardi, 1887

Bellardi, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. V (cont'd), 1887, p. 23; Mem. Reale Accad. Sci. Torino, ser. II, t. XXXVIII, 1888, p. 277.

Genotype by subsequent designation, *M. cupressina* Brocchi (Conch. foss. sub., 1814), Cossmann (Essais Paléoconch. comp., 3 liv., 1899, p. 168). Miocene and Pliocene. Italy. Bellardi, *op. cit.*, 1888, Mitridæ (*fine*), pl. V, figs. 25a, 25b.

Bellardi did not designate a type for his genus, and Cossmann chose a species for the genotype which has a more elevated spire and elongate body whorl than the Jackson species, *M. grantensis.* However, *M. grantensis* is similar in appearance to *Uromitra scalæformis* Bellardi and *U. notabilis* Bellardi (*loc. cit.*) which Bellardi included in his genus.

Uromitra grantensis (Johnson) Plate 56, figs. 11, 12

Mitra grantensis Johnson, 1899, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, p. 71, pl. 1, fig. 2.

Shell fusiform, specimen showing eight whorls (apex wanting), the first whorl below the apex smooth, the two following whorls show only the numerous longitudinal ribs, while the remaining whorls have equally prominent revolving ridges, which are somewhat larger on the anterior portion of the body whorl, while the third and fourth ridges below the suture are slightly smaller, the interstices formed by the two series of ridges consists of deep square pits, interior of the outer lip with numerous small ridges, columella with four folds, the anterior one very small. Length 14 mm., greatest diam. 5 mm.

One specimen collected by the writer from the Jacksonian Eocene at Montgomery, Grant Parish, La.—[Johnson, 1899.]

Holotype.—No. 6831, Academy of Natural Sciences, Philadelphia, Pa.

Occurence.—Moodys Branch marl, locality 1054.

Genus **FUSIMITRA** Conrad, 1855

Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, 1855, p. 261; Palmer, 1937, p. 404.

Genotype by subsequent designation, Grant and Gale (San Diego Soc. Nat. Hist., Mem., vol. 1, 1931, p. 636), *Mitra* "*Mellingtoni*" (*Millingtoni* Conrad[87]). Jackson Eocene. Southern United States. Plate 55, figs. 1-5, 9, 11.

I am including *F. millingtoni* in this report under the prior name of *F. conquisita*, the Vicksburg representative of the species-group. If such a procedure is justified after more study of the Vicksburg is accomplished, the genotype of *Fusimitra* becomes *F. conquisita*.

Fusimitra conquisita (Conrad) Plate 55, figs. 1-9, 11
(*F. millingtoni*, figs. 1-6, 9, 11)

Mitra conquisita Conrad, 1848, Acad. Nat. Sci. Philadelphia, Jour., n. s., vol. 1, p. 119, pl. 12, fig. 1.

Fusimitra conquisita Conrad, 1865, Am. Jour. Conch., vol. 1, p. 25; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, pp. 25, 29.

Mitra Millingtoni Wailes, 1854, p. 275 and Conrad, 1854, Wailes Rept. Agr. Geol. Mississippi, p. 289, pl. XVI, fig. 5; Conrad, 1865, Am. Jour. Conch., vol. 1, p. 25, synonymous with *M. conquisita* Conrad; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3,, pt I, p. 94; Veatch, 1906, U. S. Geol. Survey, Prof. Paper, 46, pl. XX, fig. 4.

Mitra (*Fusimitra*) *Mellingtoni* Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. 7, p. 261; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 7, 19, pl. 3, fig. 5.

Mitra subconquisita de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 76, pl. 5, figs. 50, 51.

Mitra missipiensis [*sic*] (Conrad), de Gregorio, 1890, *loc. cit.*, pl. 5, figs. 52-55.

Fusiform, slender, smooth and polished; whorls eleven, slightly convex; penultimate whorl entire, except at the summit, where there are two impressed lines forming a raised line between them; the other whorls of the spire with revolving lines, and towards the apex the intervening spaces transversely wrinkled; apex acute; body whorl above the aperture, except the lines near the suture, without striæ; inferiorly striated; aperture narrow; labrum 3-plaited. Length 1 4-10. Very rare.—[Conrad, 1848, *M. conquisita*.]

Profoundly elongated, fusiform; volutions ten, convex, six of which towards the apex have revolving impressed lines with the interstices transversely striated; in the contiguous whorl they are distant and obsolete, except near the summit, where there are two distinct impressed lines; on the penultimate whorl one distinct impressed line, and the summit of the body whorl obtusely carinated; spire longer than the aperture, which is narrow; plaits four, the two superior ones very prominent, robust.

Allied to *M. conquisita*, but much larger, proportionally longer, and with the striæ less deeply impressed. It may prove, however, to be the same when many specimens from the two localities can be compared. If it should be identical with the former it is the only specimen common to the Vicksburg and Jackson deposits out of the 40 species of the latter and 100 of the former deposit.—[Conrad, 1855, *M.* "*mellingtoni.*"]

Nuclear whorls four, smooth, elongated, first whorl minute;

[87]See Wailes, Rept. Agr. Geol. Mississippi, 1854. p. 275. Spelling of specific name should be *millingtoni*.

postnuclear whorls begin abruptly with four or five coarse revolving ribs. The ribs are flat-topped with interspaces of equal width. Crossing the interspaces are microscopic curved longitudinal striæ. The spiral ribs remain, on the upper whorls of the spire, four or five in number with equal interspaces. The spiral ribs increase slightly anteriorly in width until on the penultimate whorl the interspaces are reduced and on some immature specimens the spiral ribs may remain over all of the body whorl. In such cases, they are wide on the upper part of the body whorl, narrower over the basal portion with alternating fine threads. Usually the revolving ribs are obsolete or absent on the upper part of the body whorl and penultimate whorl, and they may be absent on the whorl above. There is a great deal of variation in the presence or absence of the spiral sculpture on the whorls except on the earliest whorl of the postnuclear whorls. Usually if the spiral ribs are obsolete on the whorl, two or more spiral ribs remain just below the suture and over the basal portion of the body whorl. On extremely large specimens the whole of the body whorl may be smooth, although there is no constancy in any amount of ribbing or smoothness except over the early whorls of the spire. There are four plaits on the columella but there may be three and frequently when four the anteriormost is obscure.

The obsolescence of sculpture with age is the conspicuous feature of the shell of this species. The amount of smoothness is not entirely dependent on the size of the individual, for many of similar size vary greatly in the amount of ribbing present.

The detailed description given here is taken from the Jackson shells, *F. millingtoni*. The type of *F. millingtoni* is a gerontic individual with smooth whorls. A series of illustrations is given of Jackson specimens to illustrate the change in sculpture. A drawing (Plate 55, fig. 8) of the type of *F. conquisita* (Vicksburg Oligocene) is included. It represents a shell with the upper portions of the body whorl and penultimate whorl smooth. This condition is duplicated commonly amongst shells of *F. millingtoni*. For this reason I am including *F. millingtoni* under *F. conquisita* as Conrad did in 1865 and 1866 although authors have since separated them. An additional figure of *F.*

conquisita is given on Plate 55, figure 7.

Perhaps *F. mississippiensis* (Conrad) (1848, *loc. cit.*, pl. 12, fig. 2) also should be included in the synonymy. I am not sure until more of the Oligocene is studied. A figure of the type of *F. mississippiensis* (Oligocene) is included for convenience (Plate 55, fig. 10).

In the Red Bluff Oligocene, *F. conquisita* seems to present a local variation in that the shells are not so slender and the body whorl is plumper with the body whorl slightly more shouldered below the suture.

Prof. Harris[88] found *F. millingtoni* in the impure limestone just above the Gosport sand at Claiborne Bluff, Alabama.

Dimensions.—Height, 126± mm.; greatest diameter, 30± mm. (lectotype, *F. millingtoni*).

Lectotype.—*F. millingtoni*, No. 13203, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—*F. conquisita* (type) Vicksburg Oligocene. *F. millingtoni* (type) Jackson, Miss. Jackson Eocene: Moodys Branch marl, localities 785, 693, 880, 1051; 10, 15, 883, 1054; 4, 7, 8; 1118, 1119, 1; Danville Landing beds, locality 6; Jackson of Arkansas, locality 896.

Genus **CONOMITRA** Conrad, 1865

Conrad, Am. Jour. Conch., vol. 1, 1865, p. 25.

Genotype by subsequent designation, Dall (Mus. Comp. Zoöl. Harvard Bull., vol. XVIII, 1899, p. 163), *Mitra fusoides* Lea (Cont. Geology, 1833, p. 169). Claibornian Eocene. United States. Palmer, 1937, pl. 66, figs. 24-26 (including holotype).

Conomitra jacksonensis Cooke — Plate 56, figs. 17, 18

Conomitra jacksonensis Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 134, fig. 6; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 409.

Shell fusiform, stout, apical angle about 45°. Nucleus small, globular, smooth. Postnuclear whorls 5¼, cancellated, turrited; entire whorl except a narrow band in front of the suture covered with fine, impressed, spiral lines; axial sculpture of close, rounded riblets with interspaces as wide as the ribs, tending to form beads on the sutural band, becoming obsolete near the aperture. Inner lip with 4 strong, straight, parallel folds; outer lip with 14 threads within. Altitude 8½ mm.; latitude 4 mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,942.

This species greatly resembles *Conomitra fusoides* (Lea), but its pro-

[88]Harris, G. D.: Science, n. s., vol. 92, No. 2386, 1940, p. 258.

toconch is smaller and its sculpture more uniform and more persistent than in the species from Claiborne.—[Cooke, 1926.]

This form in the Jackson is definitely of the same species-group as *C. fusoides*. The sculpture of *C. jacksonensis* can hardly be said to be "more uniform or persistent" than that of *C. fusoides* from Claiborne. After many specimens are examined, one sees that the Jackson shells exhibit the same variation in sculpture as do those from the Gosport sand. Both may have the longitudinal folds prominent with spiral lines limited to the basal portion of the body whorl, or others may have the longitudinal folds more or less completely crossed by spiral ribs. There are gradations between the two extremes as well as a variation from conspicuous longitudinal ribs to smoothness of the shell. De Gregorio gave the name *lepa* to the smooth Gosport sand variety. In the Jackson the smooth variety was called *C. hammakeri* by Harris.

The distinction which seems to be most constant between the Claiborne and Jackson forms of the *C. fusoides* stock, is that the Jackson shells are slenderer with a higher spire.

Dimensions.—Height, 9 mm.; greatest diameter, 4 mm.

Holotype.—No. 353,942, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, Moodys Branch, first bluff below the first bridge east of the Institution for the Blind, Jackson, Miss. (type); localities 785, 883; 1054. Danville Landing beds, locality 886. Jackson of Arkansas, locality 897.

Conomitra hammakeri (Harris) Plate 56, figs. 13-16

Mitra hammakeri Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, vol. II, p. 163, pl. VI, fig. 4.

Conomitra hammakeri (Harris), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 411.

Specific characters.—General form as figured; whorls 6; apical $1\frac{1}{2}$, smooth; below, faintly sculptured by, (a) longitudinal folds or costæ, and by (b) a slightly impressed subsutural line; body whorl spirally striate at base; columellar plaits, 4, the second, counting from above, slightly stronger than the others; labrum with about 12 crenules within.

This shell is proportionally much longer than *M. fusoides* Lea; the sculpturing too is less marked.

Locality:

Station 2404, 12S., 9W., section 8, Lee Hammaker's well, Bradley County, Ark.—[Harris, 1894.]

Apparently *C. hammakeri* Harris is to *C. jacksonensis* in the Jackson as *C. lepa* de Gregorio is to *C. fusoides* in the Claiborne. There seems to be more gradation between *C. fusoides* and *C. lepa* than between *C. jacksonensis* and *C. hammakeri* of the Jackson. The three forms, *C. lepa* and the two in the Jackson, possibly should have their names linked with *C. fusoides* as varieties. Such grouping would not indicate the relationship of *C. jacksonensis* and *C. hammakeri.* Since priority in biologic nomenclature would place the older name in specific rank and obscure the biologic relationship, I am retaining the two names as of separate species although they probably represent gradations of the same species. Several specimens have been figured to show variation.

Dimensions.—Height, 11 mm.; greatest diameter, 5 mm.

Holotype.—No. 135,132, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, locality 10. Yazoo clay, locality 2. Danville Landing beds, localities 6, 886.

Genus LAPPARIA Conrad, 1855

Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, 1855, p. 260; Stenzel and Turner, Univ. Texas Pub. 3945, 1940, pp. 803-822.

Genotype by monotypy, *Mitra* (*Lapparia*) *dumosa* Conrad (*loc. cit.*). Jackson Eocene. Southern United States. Plate 56, figs. 1-4, 9, 10, 21.

Lapparia dumosa (Conrad) Plate 56, figs. 1-4, 9, 10, 21

Mitra dumosa Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. 15, fig. 4; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, p. 19, pl. 2, fig. 4.

Mitra (*Lapparia*) *dumosa* Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 260; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 6, 19, pl. 2, fig. 4.

Lapparia dumosa Conrad, 1865, Am. Jour. Conch., vol. 1, p. 24; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 79, pl. 6, fig. 6 *L. pactilis partim;* Cossmann, 1899, Essais Paléoconch. comp., 3 liv., p. 111, pl. VIII, fig. 8, text fig; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 386, pl. 62, figs. 1, 3; Stenzel and Turner, 1940, Univ. Texas Pub. 3945, p. 819, pl. 45, fig. 2; Stenzel and Turner, [1942], Type Invert. Fos. N. America, Eocene, Gastropoda 6, Card No. 34, figs. 2, 4.

Short-fusiform, volutions seven, direct, obliquely flattened above, with a series of transversely compressed, distant spines on the two largest whorls; on the contiguous whorl they become nodules; two whorls below the apex papillary, smooth; the next two longitudinally ribbed, and the others longitudinally striated or with prominent lines of growth; whole surface with revolving wrinkled lines; plaits four; beak profoundly ringed.—[Conrad, 1855.]

Nuclear whorls consist of 2½ smooth whorls, all large except the tip; postnuclear whorls begin with longitudinal folds extending the length of the whorl, after several longitudinal folds are initiated, the following folds are crossed by coarse spiral lines which continue over the remainder of the shell. There is considerable variation in the amount of strength displayed by the spiral lines, many specimens having such striæ obscure or absent on the upper part of the body whorl.

The longitudinal folds on the later whorls of the spire are nodose and limited on the spire whorls to just below the midline, but on the body whorl they are present on the upper part of the whorl. There are six to eight on the body whorl. The length of the spire varies, as well as the width of the body whorl and the size of the protoconch.

Size of the protoconch is known to vary within species. Embryonic shells of different sizes are found in the same egg capsule of living gastropods. A variation in size of the embryonic shell is probably due in part to a difference in food supply.

The shell Conrad figured, which becomes the type of the species, has a short spire and is sharply spinose. The individuals of this abundantly developed stock vary too much in form and sculpture at any one locality to allow much naming of the species to be taken seriously. Some of the variation in height of spire are illustrated herein. If species are made on variations in the characters such as occur in such species-groups as *Lapparia dumosa,* and its progenitors, and as *Athleta petrosa,* then the term species becomes only a tag for individual shells and not worth more in our concept of species. The specimens of *L. dumosa* figured on Plate 56 are from the same locality. It has been my practice to figure profusely rather than name variations so that collectors may gain an idea of the range of species and perhaps be able to identify with the parent species some of the changes which may be found.

Material would probably be adequate within such stocks as *Lapparia dumosa, Athleta petrosa,* and *Turritella nasuta* for statistical studies which would determine the limits of the species.

Dimensions.—Height, 30.8 mm.; greatest diameter, 18.7 mm. (lectotype).

Lectotype.—No. 13205, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 693, 880, 921, 1051; 900, 1111; 10, 15, 883, 1054; 7, 1; 1119; 16; 922; 1121.

Lapparia dumosa exiqua Palmer Plate 56, figs. 5-8

(See also Palmer, 1937, pl. 62, figs. 2, 5.)

Lapparia dumosa exiqua Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 386, pl. 62, figs. 2, 5; Stenzel and Turner, 1940, Univ. Texas Pub. 3945, p. 821, pl. 45, figs. 4, 6, 8, 9; Stenzel and Turner, [1942], Type Invert. Fossils N. America, Eocene, Gastropoda 7, Card No. 35, figs. 1, 2, 5.

Additional figures of this form are included herein to show a variation in the height of the spire, width of the body whorl, and an obsolescence of the spiral lines on the body whorl. Stenzel and Turner have given illustrations which show the obliteration of the spiral lines.

Syntypes.—No. 3202 and 3203, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 8, one-half mile below Gibson Landing, Ouachita River, La. (type) (Veatch, Geol. Agr. Louisiana, pt. VI, Special Rept. 4, 1902, p. 165); localities 912, 7, 8, 9; 1118, 1, 1119; 16, 785; 786, 787; 15, 10, 883, 1054.

Family MARGINELLIDÆ

Genus PERSICULA Schumacher, 1817

Schumacher, Essais d'un Nouveau Système des Habitations des Vers Testacés, 1817, p. 235.

Genotype by monotypy, *Voluta persicula* Linnæus (1758, p. 730)=*P. variabilis* Schumacher.[59] Living. West Africa. Tryon, Manual Conch., vol. V, 1883, p. 36, pl. 10, fig. 10.

Subgenus BULLATA Jousseaume, 1875

(*Volutella* Swainson, 1820, 1835, 1840 *non* Perry, 1810, 1811)

Jousseaume, Revue Magasin Zool., ser. 3, t. 3, 28th year, 1875, pp. 167, 250.

[59]Tomlin, J. R. Le B.: *A systematic list of the Marginellidæ*, Malacol. Soc. London, Proc., vol. XII, 1917, pp. 289, 303.

Subgenotype by absolute tautonymy, *Bullata bullata* (Born) = *Voluta bullata* Born (Index Rer. Nat. Mus. Cæs. Vindob., pt. 1, p. 205).[90] Living. Brazil. Tryon, Manual Conch., vol. V, 1883, p. 35. pl. 10, figs. 3, 4.

Persicula (Bullata) semen (Lea) Plate 62, figs. 9-12, 19

Marginella semen Lea, 1833, Cont. Geology, p. 178, pl. 6, fig. 190.
Marginella incurva jacksonensis Meyer, 1885, Am. Jour. Sci., 3d ser., vol. XXIX, p. 465; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 420.
Persicula (Bullata) semen (Lea), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 422, pl. 67, figs. 13, 14, 16-19; pl. 90, fig. 15.

See Palmer, 1937, for complete synonymy, copy of original description, discussion of species, and illustration of Claibornian specimens and type.

P. semen may be differentiated from other Claibornian species of the Marginellidæ by the presence of six to seven plications on the labium. The labrum may be thickened and be finely crenulate within on its entire margin or the labrum may be thickened without crenulations within or it may be thin with no crenulations. Such variation of the labrum probably depends on the stage of growth of the shell but not upon the size of the individual. There is considerable variation in the spread of the posterior callus over the spire. Some, mostly young, have no conspicuous posterior callus, others have a slight wash, and others spread a thickened knob over or in the region of the spire.

The type of Meyer's *Marginella incurva jacksonensis* was borrowed from the Geology Department, the Johns Hopkins University, and figures of the shell are included herein. Meyer's specimen has the larger number of plications more characteristic of *P. semen* than of *M. incurva* (*columba*) Lea (see Palmer, 1937, pp. 419, 423, pl. 67).

Meyer's notes as regards *M. jacksonensis* consist of the following:

"A Marginella in Jackson agrees essentially with specimens from Claiborne, which I determined as *Marg. incurva* Lea, but seems to be generally larger and much inclined to deposit callus on the posterior part of the mouth. It may be called *var. jacksonensis.*"

The so-called type of *M. jacksonensis* Meyer has marked on its label, "Typical for *Marginella incurva* ? Lea var. *Jackson-*

[90]Tomlin, J. R. Le B.: *Op. cit.*, p. 255.

ensis Meyer, Jackson, Miss."

The specimen has six plications on the inner lip, and about 17 denticulations on the outer lip. A thin callus is spread over the spire so that the sutures are not clearly indicated.

The species is abundant in the Moodys Branch marl at Jackson, Mississippi.

Dimensions.—Height, 7 mm.; greatest diameter, 4 mm. (lectotype, *M. incurva jacksonensis* Meyer).

Types.—Lectotype, No. 5900A, Academy of Natural Sciences, Philadelphia, Pa. *P. semen* (Lea); lectotype, *M. incurva jacksonensis* Meyer, Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Gosport sand, Claiborne, Ala. (type). Jackson, Moodys Branch marl, locality 921; 1121.

Family OLIVIDÆ

Genus AGARONIA Gray, 1839

Gray, Zool. Capt. Beechey's Voyage (*Blossom*), Moll. Animals, 1839, p. 132.

Genotype by monotypy, *Agaronia hiatula* (Lamarck) (Hist. nat. An. sans Vert., t. VII 1822, p. 435) *Oliva hiatula* Gmelin, Syst. Nat., XIII, 1791, p. 3442. West Africa. Tryon, Manual Conch., vol. V, 1883, p. 88, pl. 34, figs. 60-63.

Agaronia media (Meyer) Plate 63, figs. 7, 9-13

Oliva media Meyer, 1885, Am. Jour. Sci., 3d ser., vol. XXIX, pp. 465, 468.
? *Olivella jacksonensis* Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 134, fig. 5.

I relate three species to each other, one from Claiborne, determined as *Oliva gracilis* Lea, the above mentioned one from Jackson, which is generally stouter, and *Oliva mississippiensis* C., from Vicksburg, which is larger and again stouter and where the main inflation is generally somewhat higher. The Jackson species may be called *Oliva media*.—[Meyer, 1885.]

Shell small, spire high, apical angle about 40°. Nucleus spherical, ¾ mm. in diameter. Whorls 4½ or 5, slightly convex, suture deep; no deposit of enamel behind the suture. Altitude 11 mm.; latitude 4 mm.; altitude of outer lip 5½ mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,941.

This species is very common in the Moodys marl member at Jackson. Most of the shells are a little smaller than the type. *O. jacksonensis* is similar in general aspect to specimens from the Gosport sand at Claiborne, Ala., labelled *Oliva gracilis* Lea, [*O. bombylis* Conrad] which are somewhat higher-spired and have larger nuclei. The suture is like that of *O. mississippiensis* Conrad from the Byram marl at Vicksburg, but *O. mississippiensis* is much higher-spired and its nucleus is much larger.—[Cooke, 1926.]

Through the courtesy of Miss Winnie McGlamery of the Alabama Museum of Natural History, the type material of *Oliva media* Meyer, consisting of eight specimens, was loaned for study and figuring. The specimens are labeled "types." There are in the Aldrich collection of types in the Geology Department at the Johns Hopkins University, two specimens which are designated "typical for *Oliva media* Meyer." Those specimens were selected by Meyer or Aldrich from the original lot as the typical suite and hence they went with the type collection when the Aldrich Collection was sold and transferred to the Johns Hopkins University. The rest of the specimens, still labeled types, remained in Alabama. Therefore, since Meyer did not figure his species and no particular specimen amongst the original suite was definitely designated as a type, I am selecting the specimen figured herein, Plate 63, figure 7, as the lectotype. This specimen and the others (paratypes), figures 11 and 12, Plate 63, are in the Alabama Museum of Natural History, University, Alabama.

Meyer's description of *Oliva media* hardly seems adequate to maintain priority in naming. But the illustration which Cooke gave for *O. jacksonensis* does not depict the proper outline for what he stated and what we find to be the common "*Olivella*" at Jackson, Mississippi. Meyer's type material is herein figured for the first time. Meyer's statement that the *O. media* is generally stouter than *O. gracilis* Lea (=*A. alabamensis* (Conrad)) mostly[91] and that "*O. mississippiensis*" is stouter than "*O. media*" is true. *A. media* (=*A. jacksonensis* probably) is like *A. alabamensis* and *A. mississippiensis* in the character of the deeply cut suture the protoconch, and the character of the anterior callus. Just below the posterior margin of the aperture in *A. alabamensis* there is a spiral band, probably colored in life, which can be seen microscopically but does not show in photographing. Such a band on *A. media* is more obscure but a trace may be seen. Frequently the band in *A. media* is conspicuous microscopically.

A. mississippiensis differs from *A. alabamensis* and *A. media*

[91]Palmer, K. V. P.: Bull. Amer. Paleont., vol. VII, No. 32, 1937, pp. 431-434, pl. 89, fig. 5.

in having a series of smaller plications which extends over the columellar callus posteriorly from the anterior thick callus. The plications on the anterior callus are heavier than those above the callus.

O. alabamensis and *O. mississippiensis* show, particularly on large specimens, a sutural callus (described and figured by Palmer, 1937). The callus may become eroded so completely that no trace is discerned on the surface of the whorl. Unless many specimens have been examined, if the callus is obliterated, one can be deceived readily in believing that none existed. Such a sutural callus does not seem to be developed in *A. media* as in the Claiborne and Vicksburg species.

There is some misgiving in using Cooke's name for the species in that the illustration as given by Cooke indicates less convexity of the body whorl and more of an emargination in the basal area of the body whorl. Yet we have numerous specimens from loc. 4250 (U. S. Nat. Mus., type locality) and 6458 (U. S. Nat. Mus.) as well as abundant material from our own collecting at the type locality and the specimens are similar to the type material of *A. media*. Cooke stated that his species was very common in the Moodys marl at Jackson. It is reasonable to suppose that the most prolific form of *Agaronia* is the same as what Cooke had in spite of the illustration which he gave. It may be that the type figure has been retouched, giving a misleading appearance. The type is not available during "the emergency" hence I cannot verify the correctness of the figure. Probably what I am calling *A. media* (Meyer) is *A. jacksonensis* (Cooke). From the standpoint of the inadequacy of Meyer's description and lack of illustration, Cooke's name should be used. However, until one can examine the type of *A. jacksonensis* and determine the equivalency of *A. media* and *A. jacksonensis*, the better way seems to be to use the first name which we are sure was given for specimens which we find to be so common at Moodys Branch.

Cooke also states that "*O. mississippiensis*" is a much higher spired species than "*O. jacksonensis*." This could hardly be, judging from the type figure of "*O. jacksonensis*" which depicts a reasonably high-spired shell. *A. mississippiensis* as the original figure and abundant material from Vicksburg show, is shorter spired than *A. bombylis* (*gracilis*), *A. media*, or *A. jacksonensis*.

Dimensions.—Lectotype and paratypes, respectively, Alabama Museum of Natural History. Height, 12 mm.; 9.5 mm.; 8 mm.; 8.5 mm.; 7.5 mm.; 8.5 mm.; 8 mm.; 6 mm. Greatest diameter, 4.75 mm.; 4 mm; 5 mm.; 4 mm.; 3+ mm.; 4 mm.; 3.75 mm.; 3 mm.

Types.—Lectotype, Plate 63, figure 7; paratypes, Plate 63, figures 11, 12. Alabama Museum of Natural History, University, Ala.

Occurrence.—Moodys Branch marl, localities 921, 879; 900; 912; 1; 11.21. Jackson of Arkansas, locality 897.

Agaronia mississippiensis (Conrad) Plate 63, figs. 17-19

Oliva mississippiensis Conrad, 1847, Acad. Nat. Sci. Philadelphia, Proc., vol. III, p. 289; Conrad, 1848, Acad. Nat. Sci. Philadelphia, Jour., vol. I, 2d ser., p. 119, pl. 13, figs. 6, 38.

Lamprodoma Mississippiensis Conrad, 1865, Am. Jour. Conch., vol. I, p. 22.

Subelliptical; volutions six and a half; on the middle of the body whorl is a sligntly impressed revolving line. Length 1 1-10. Usual size ¾. Abundant.—[Conrad, 1847 and 1848.]

Several specimens from near Montgomery, Louisiana, including the largest shell of *Agaronia* in the collection, are similar to *A. mississippiensis* from the Vicksburg Oligocene. The largest specimen would measure about 26+ mm. in height.

Occurrence.—Vicksburg, Miss. Oligocene (type). Moodys Branch marl, localities 883, 11.

Agaronia, sp. Plate 63, figs. 5, 6

A perfect large slender specimen was found with typical *A. media* (Meyer) at Garland Creek, Mississippi. It has a higher spire and more slender body whorl than *A. media* and *A. mississippiensis*. It is like *A. bombylis* in the less convexity of the surface, but it has a higher spire than that species. Its spire is like that of *A. jacksonensis* (Cooke), it is more similar to the illustration of *A. jacksonensis* than is any other shell we have found in the Jackson sediments, and it may be that it is a representative of *A. jacksonensis*. If so, *A. jacksonensis* is not a common species. Because of the doubt of the true character of *A. jacksonensis* and lack of more specimens like the one under this heading we doubt the feasibility of naming this form as new.

Dimensions.—Height, 24 mm.; greatest diameter, 9 mm.

Figured specimen.—No. 20008, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 900.

Family CANCELLARIIDÆ

Genus TRIGONOSTOMA Blainville, 1825

Blainville, Manuel malacol. Conchyliol., vol. 1, 1825, p. 652.

Genotype by monotypy, *Delphinula trigonostoma* Lamarck (Hist. Nat. An. sans Vert., 2d ed., Deshayes and Milne Edwards, t. 9, p. 88). Living. "?Ceylon; ? Moluccas" Tryon, Manual Conch., vol. VII, 1885, pl. 5, fig. 79.

Trigonostoma selectum, n. sp. Plate 63, figs. 20-22

Shell medium in size; nuclear whorls rounded, smooth, first minute, others enlarged, consist of three whorls; nuclear and postnuclear whorls are without a special demarcation; postnuclear whorls begin with two or three sharp longitudinal ribs which are not crossed by spiral ribs; postnuclear whorls shouldered. The longitudinal ribs extend from the shoulder to the anterior margin of the whorl and are nodose at the shoulder. After the area of the two or three longitudinal ribs, the lower part of the whorls has revolving spiral ribs which occur over the lower part of the whorls of the spire and on all of the body whorl in young shells but become obsolete or only obscurely preserved on older and mature specimens. Two plications on the columella; umbilicus large; labrum is crenulated or smooth.

From the Jackson we have four specimens of this species which is the Jackson representative of the *T. panones-gemmatum* species-group of the Claibornian Eocene. The specimens are from near Montgomery, Louisiana, and fortunately include a young shell as well as an adult. Of the four, one has the labrum smooth and one has that area distinctly crenulated. The Jackson form differs from the Claibornian species of the species-stock in being shorter and having fewer longitudinal ribs. That the stock is virile is evidenced by the number of related species which occur in the lower Claiborne. For a discussion of *T. gemmatum* and allied species see Palmer, 1937, pp. 438-444, plate 69.

Dimensions.—Height, 12 mm ; greatest diameter. 8 mm.

Types.—Holotype, No. 20003 ; paratype, No. 20007, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10.

Genus **BONELLITIA** Jousseaume, 1887

Jousseaume, Le Naturaliste, 9 yr., 2d ser., No. 19, 1887, Dec. 15, p. 223, text fig. 6.

Genotype by original designation, *B. bonelli* "Brocchi" [Bellardi] (Mem. Reale Acc. Sci. Torino, ser. 2, t. III, 1841, p. 248.) Miocene-Pliocene. Southern Europe. Sacco, I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. XVI, 1894, pl. III, fig. 1.

Section **ADMETULA** Cossmann, 1889

Cossmann, Ann. Soc. malac. Belgique. t. XXIV, IV ser., t. 4, 1889, p. 224.

Type by original designation, *Cancellaria evulsa* (Solander) (in Brander, Foss. Hanto [ienis]ia. 1766, p. 13, pl. 1, fig. 14). Barton Eocene. England. Wrigley, Malac. Soc. London, Proc., vol. XXI, pt. VI. 1935, p. 364, pl. 33, figs. 12. 13 ; pl. 35, figs. 44. 49, 59.

Bonellitia jacksonica (Cooke) Plate 63, figs. 2, 3, 8, 16

Cancellaria jacksonica Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 134, fig. 4.

Shell large, stout, falsely umbilicated, apical angle about 60°. Nucleus naticoid, of 2 smooth whorls. Postnuclear whorls 5 in type, decorated with many spiral threads; ribs retractive, making an angle of about 25° with the axis, about twice as thick as the threads; 13 moderately large varices on type. Pillar lip with 3 folds; outer lip with 9 denticulations. Altitude 15 mm.; latitude 8½ mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,940.

Cancellaria jacksonica is very abundant in the Moodys marl member of the Jackson formation at Jackson. It is stouter, more profusely ribbed, and has larger varices and more denticulations than *C. mississippiensis* Conrad, from Vicksburg.—[Cooke, 1926.]

A drawing of the type of *C. mississippiensis* from the Vicksburg, made by Otto Meyer for T. H. Aldrich, is included in this report (Plate 63, fig. 1). Meyer's drawing is better than the original illustration.

Dimensions.—Height, 12 mm. ; greatest diameter, 8 mm. (medium).

Holotype.—No. 353,940, United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type, see above) ; localities 921 ; 10 ; 1118. Jackson of Arkansas, locality 897.

Genus **COPTOSTOMA** Cossmann, 1899

Cossmann, Essais Paléoconch. comp., 3 liv., 1899, p. 34, as a section.
Genotype by original designation, *Cancellaria quadrata* Sowerby (Min. Conch., vol. 4, 1822, p. 83, pl. 360). Barton Eocene. England. Wrigley, Malacol. Soc. London, Proc., vol. XXI, pt. VI, 1935, p. 357. pl. 32, fig. 1; pl. 35, fig. 46.

Coptostoma ulmulum secutorum, n. var. Plate 63, figs. 23-25

Shell medium, about five whorls including the nucleus; nucleus worn; postnuclear whorls with coarse revolving ribs, interspaces equal to or wider than width of the rib; six or seven spiral ribs on the penultimate whorl; 13 or 14 spiral ribs on the body whorl; sutures depressed; three plications on the labium, posterior two are the stronger; labrum denticulate the full length; strength of columellar callus varies, leaving a slight or conspicuous false umbilicus; no longitudinal folds except where the growth lines become prominent. One specimen, Plate 63, figure 22, has the lines of growth developed conspicuously and the surface is worn. The result of which gives the ornamentation a definite cancellation.

This variety differs from *C. ulmulum*, in the lower Claiborne, in having fewer revolving ribs over the body whorl. The longitudinal folds as represented on the type figure seem to be stronger than on *C. secutorum*. *C. secutorum* is decidedly closer to typical *C. ulmulum* than is *C. rameum* Palmer (Bull. Am. Paleont., vol. XXVIII, No. 112, 1944, p. 19) the species which bears a superficial and suggestive relation with *C. ulmulum.*

Dimensions.—Height, 22 mm.; greatest diameter, 14 mm.

Types.—Holotype, No. 20004; paratypes, Nos. 20005, 20006, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10.

Genus **UNITAS**, new name
(=*Uxia* Jousseaume, 1887)

Jousseaume, Le Naturaliste, 9 yr., 2d ser., No. 19, 1887, Dec. 15, p. 222, text fig. 5, for *Uxia*.
Genotype by original designation, *Uxia* (=*Cancellaria*) *costulata* (Lamarck) (Ann. Mus. nat. Hist., nat., t. 2, 1803, p. 63; t. 6, 1805, pl. II, fig. II, a, b). Eocene. France and England. Cossmann and Pissarro, Icon. comp. Coq. foss. Eocène Env. Paris, t. 2, 1910-1913, pl. XLVII, figs. 212-1.

The name *Uxia* Jousseaume, 1887, is preoccupied by *Uxia*

Walker, 1866 (List of Specimens of Lepidopterous Insects in the Collection of the British Museum, pt. XXXV, Supp., pt. 5, p. 1897). The name *Unitas* is therefore proposed as a substitute for *Uxia* Jousseaume, 1887, of which *U. costulata* (Lamarck) is the genotype. See above.

Unitas pearlensis (Meyer and Aldrich) Plate 63, fig. 4

Cancellaria pearlensis Meyer and Aldrich, in Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 7, pl. 1, fig. 4.

Uxia pearlensis (Meyer and Aldrich), Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 42.

Ziemlich schlank. Zwei glatte embryonische Windungen bilden einen stumpfen Nucleus. Erwachsene Umgänge mit starkem. schrägen Rippen, zwölf auf der letzten Windung. Dieselben werden von erhabenen Spiralen gekreuzt; die Kreuzungspunkte sind verdickt. Mündung ziemlich eng. Aussenlippe scharf, innen stark gezähnt. Innenlippe bei erwachsenen Exemplaren ausgebreitet. Unterer Teil der Columella mit drei Falten, nach oben in Stärke zunehmend. Auf dem oberen Teil der Innenlippe ist eine faltenähnliche Erhebung. Aeltere Windungen und Mundsaum mit sehr starken Wülsten.—[Meyer and Aldrich, 1886.]

Two and one-half or three nuclear whorls, first minute, last enlarged. There is no sharp line between the nuclear and postnuclear whorls. The sculpture begins with large longitudinal folds with faint spiral ribs. The spiral ribs increase in size but the longitudinal folds predominate. They are nodose where they are crossed by the spiral ribs. Four spiral ribs are present on the early two postnuclear whorls, with five on the third and penultimate whorls. Spire elevated; varices very large; intermediate spirals on the lower part of the body whorl.

The description is taken from the holotype. We do not have other specimens for comparison.

Dimensions.—Height, 12 mm.; greatest diameter, 5.5 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Family **TURRIDÆ**[92]

In his introductory remarks on this family, Tryon (1884, p. 151) says:

In no other group of mollusks is it so difficult to make a satisfactory

[92]The notes and illustrations on the Turridæ are the work of Prof. G. D. Harris.

classification as in the Pleurotomidae [Turridae]. The forms are exceedingly numerous, and known in many species to be very variable in their characters, whilst the material for the recognition of most of those described is generally scanty. Of the figured species, a very large proportion were described from single or few specimens, and most cabinets, however large, do not possess shells which can be certainly identified with these; then there is an unusually large proportion (amounting to hundreds) of unfigured species, the recognition of which is simply impossible.

A third of a century later, Dall (1918, p. 313) wrote regarding the fossil representatives:

From the recent species we must reason by analogy to determine the proper place of fossils, as no other course is open. It would require several years' work and access to European collections to place the known species and determine the synonymy of the entire family, a task beyond my powers under present conditions.

Now, a quarter of a century since Dall's remarks were made, it is safe to say that "to place the known species and determine the synonymy of the entire family" will not be a matter of "several years' work" for one worker, but for many workers, and the collecting of new material will continually call for important taxonomic modifications.[93]

Genus **TURRIS** (Rumph.) Bolten-Röding, 1798

(Museum Boltenianum, p. 123)

Genotype.—*Turris babylonica* Rumph., 1705 = *Murex babylonius* Linné, 1758; *Turris babylonia* Bolten-Röding, 1798.

Illustration.—Kiener, Iconographie des Coquilles Vivantes, vol. 1, *Pleurotoma*, pl. 1; Reeve, Conch. Icon., 1843, *Pleurotoma*, pl. 1, fig. 5; Woodward, Manual of the Mollusca, 1871, pl. 7, fig. 3.

One year after the publication of the "Museum Boltenianum," Lamarck (1799, p. 73) proposed the name *Pleurotoma*, taking the species *babylonia* as genotype. The appropriateness of this name and Lamarck's prestige caused it to be almost exclusively used throughout the nineteenth century.

Turris babylonia, being a rather large and somewhat showy species, was early noted in European conchological literature. Lister (1685, pl. 917, fig. 11) refers to it as *Buccinum maculatum;* the "Plinius Indictus," Rumph. (1741, p. 97) styles it *Turris babylonica*. In Linné's "Systems" of 1758, 1767, 1791,

[93]A few works giving references to many others on the Turridæ may be mentioned: *American*—Tryon, 1883, 1884; Casey, 1904; Dall, 1918; Woodring, 1928; Grant and Gale, 1931; Harris, 1937; *Foreign.*—Reeve, 1843-1846; Kiener, 1839, 1840; Bellardi, 1877; Fischer, 1883; Weinkauff, 1887; Von Koenen, 1890; Hoernes, 1891; Cossmann, 1896; Hedley, 1922; Thiele, 1929.

it is known as "*Murex babylonius.*" In the "Museum Boltenianum," Röding restores (1798, p. 123) the name *Turris babylonica* of Rumph.

Typical *Turris,* as found in the East Indies, seems not to occur in the Western Hemisphere (Woodring, 1928, p. 145), nor perhaps elsewhere in a fossil state (Casey, 1904, p. 130). Its place seems to be taken in the West Indies by "*Pleurotoma*" *albida* Perry and its near relatives.

The comparatively large size of the East Indian *Turris,* the long fusoid form, the deep and narrow retral sinus, the strong spiral liration, and the absence of longitudinal noding, make this genus seem like a special, or end, product of a turrid line. Size and coloration bespeak warm shallow seas with plenty of sunshine and suitable food.

The various Jacksonian turrid species which follow are classified under the so-called generic names heretofore used. These will doubtless soon be materially changed, but the illustrations may be referred to, by plate and figure, for all time to come.

Genus **PLEUROLIRIA** de Gregorio, 1890

(Monographie de la Faune Eocénique de l'Alabama, p. 58)

For discussion of this generic name, see Palæontographica Americana, vol. 2, 1937, p. 29.

Pleuroliria jacksonella Casey — Plate 57, fig. 1

Pleuroliria jacksonella Casey, 1904, St. Louis Acad. Sci., Trans., vol. 14, p. 131.

Pleuroliria jacksonella Harris, 1937, Palæont. Amer., vol. 2, p. 31, pl. 2, fig. 7.

The one, immature, imperfect specimen on which this species was founded—herewith illustrated—is too poor for accurate specific characterization. Jackson material, especially from Montgomery, La., the type locality, must be more thoroughly searched for more satisfactory material. The outstanding character of this form seems to be the great size of the subsutural band.

Holotype.—U. S. Nat. Mus., No. 191,344.

Genus **GEMMULA** Weinkauff, 1875

(Jahrb. des Deutsche Malacolog. Gesell., vol. 2, p. 285)

Genotype.—*Pleurotoma gemmata* Hinds, Zoöl. Soc. Lond., Proc., pt. 11, 1843, p. 37. See Cossmann, Essais de Paléoconchologie compareé, 2 liv., 1896, p. 62.

Illustration.—Reeve, Conch. Icon., *Pleurotoma*, pl. 10, fig. 83; Harris, Palaeont. Amer., vol. 2, 1937, pl. 2, fig. 33.

Weinkauff (1875, p. 287) thus characterizes his "subgenus" *Gemmula*:

Schale spindelförmig, Kanal ziemlich lang und schlank, zuweilen gebogen. Einschnitt des Mundrandes grade, mehr order weniger eng und lang, Umgänge mit gekerbten Hauptkiel, der am Mundrand Träger des Einschnitte ist. Embryonalende aus 3 oder 4 Umgängen bestehend, wovon der erste und oberste aufgeræ tet, der dritte und vierte längs gerippt ist.

Weinkauff mentions and figures six living species belonging to *Gemmula; Pleurotoma monilifera* Pease, *Pl. carinata* Reeve, *Pl. gemmata* Hinds, *Pl. amabilis* Jickeli, *Pl. speciosa* Reeve and *Pl. græffei* Weinkauff; all Indo-Pacific or west American, rare.

Hedley says regarding the genotype (1922, p. 217):

It may be here observed that *gemmata* should be ascribed to Reeve, not as usual to Hinds, for Reeve published it in April, 1843, and Hinds in October, 1843.

However, since Reeve refers to it as Hinds's species it would seem that Hinds was the author (in MS.) of the species. Hedley continues:

The bead-row of the fasciole readily distinguishes this genus from the related forms. Between the smooth protoconch and the adult whorls two or three whorls intervene with discrepant sculpture of fine arcuate longitudinal riblets.

With *Gemmula* so defined, in a broad sense many American Tertiary turrids may be classed under this generic name. But when we consider the long fusiform outline, the strong centrally located carination whereupon the deep fasciole is located and marked with its characteristic row of beading, there seems reason to believe typical *Gemmula* to be a specialized, end-development of some more generalized Tertiary ancestor.

Gemmula (?) plentopsis, n. sp. Plate 58, fig. 7

Characterization.—Size and general appearance as indicated by the illustration; outline closely resembling a slender *Plentaria,* but having centrally located, fine, short costæ on the larger whorls, with no columellar fold; apex somewhat eroded but produced in a pointed spire; distinguished at once from *Infracoronia* forms by the central location of the crenulate carina.

Holotype and specimen figured.—Danville Landing on the Ouachita River, Louisiana.

Paleontological Research Institution, No. 4435.

Owing to its imperfect state of preservation the referring of this species to *Gemmula* is questionable.

Subgenus **CORONIA** de Gregorio, 1890
(Monographie de la Faune Éocénique de l'Alabama, p. 23)

Subgenotype.—*Pleurotoma acutirostra* Conrad, *fide* Cossmann, Essais de Paléoconchologie compareé, 2 liv., 1896, p. 78.
Illustration.—*Pleurotoma* (*Coronia*) *acutirostra* (Con.) de Gregorio, 1890, pl. 1, figs. 70-72: Harris, Palæont. Amer., vol. 2, 1937, pl. 2, fig. 22.

Hemipleurotoma Cossmann (1889, p. 260) with *Pl. archimedis* as type can scarcely be considered as synonymous with *Coronia* de Gregorio even though Cossmann (1896, p. 78) did try to shift the genotype of *Hemipleurotoma* from *archimedis* to a very *acutirostra*-like species, *denticula* Basterot, as a "neotype." De Gregorio's text indicates that *Coronia* was instituted for the reception of the denticulid turrids typically represented by *acutirostra;* but, contrary to Cossmann's statements we do not find that De Gregorio definitely states that this is the type species of *Coronia.* Naming this species first, he follows it with a confusing melange of supposed representatives, belonging to various turrid subdivisions. We are assuming *acutirostra* to be the type however.

Coronia is in general less regularly spindle-shaped than *Gemmula, s. s.*, its spire being generally much longer than its aperture, and the riblike crenulæ may seem coarser and longer than in typical *Gemmula.*

Beginning with the Midway Eocene (Harris, Bull. Amer. Paleont., vol. 1, 1895, p. 193, pl. 17, fig. 16) this type of turrid is abundantly represented in our Gulf Coast Eocene. Figures on plates 29 and 30 of Edward's Eocene Mollusca of England (1860) show that this turrid type is well developed in middle and upper Eocene in England, but the climax was reached in the lower Oligocene of north Germany as depicted by Von Koenen (1890, pls. 25-28).

So far as early adumbrations of *Coronia* are concerned, they seem not to be present in the Upper Cretaceous Coon Creek fauna (Compare Wade, 1926, pls. 36, 45) nor in the Fox Hill beds (Meek, 1876, pl. 31). Gardner's Midway fauna of Texas (1933, pl. 20) shows no close relatives nor does that of Wangaloan (Danian?) of New Zealand (Finlay and Marwick, 1937, pls. 11 and 12). But "*Pl. mediavia*" Harris (1896, pl. 17, fig. 16) seems to be a fairly good representative.

Coronia nodulina (Casey) Plate 57, fig. 2

We have already given (1937, p. 36) a reprint of Casey's description of the poorly preserved holotype, from Moodys Branch, and have also given an illustration of the same from a negative furnished by the U. S. Nat. Museum. We herewith introduce a copy of the same somewhat enlarged.

Holotype.—U. S. Nat. Mus., No. 494,355.

Coronia nodulina (Casey), vars. Plate 57, figs. 3-10

With no better material from Moodys Branch than the rather poorly preserved holotype, exact relationships with more or less related forms from other localities and horizons in the Jackson stage seem none too sure. Our collections from Bunker Hill Landing on the Ouachita River contain rather short, coarsely ribbed or crenate forms that have received the varietal name of *bunkerensis* Harris (1937, p. 36, pl. 3, figs. 1, 2) and are herewith refigured as Plate 57, figs. 4, 4a. They are recorded in the Paleontological Research Museum catalog under the number 2376. A small, imperfect specimen of what seems to be the same form is represented by figure 3 and recorded in the Museum catalog as No. 4436. It is from Danville Landing on the Ouachita River. Figure 5 (No. 4437), fig. 6 (No. 4438), and fig. 7 (No. 4439) show varietal forms in various stages of development—all from Danville Landing, Louisiana.

Comparatively longer forms, here represented by figure 8, (No. 4440), fig. 9 (No. 4441), and fig. 10 (No. 4442) tend to show a more oblique costation and an absence of a strong subsutural band. The name *ouachitensis* we have applied (Palæont. Amer., vol. 2, 1937, p. 40, pl. 4, figs. 6-9) to such forms should probably be used as denoting a variety and not a distinct species. These, too, are from Danville, Louisiana.

Coronia childreni (Lea) Plate 57, figs. 11-14

For synonymy and general discussion of this species see Palæontographica Americana, vol. 2, 1937, p. 33, pl. 2, figs. 15-18. Figures 11-14 of the present work show specimens seemingly of this species. As a rule the typical *childreni* from the "sand" at Claiborne are smaller, with more nodular apex and with peripheral carinal nodulæ more submerged by revolving striæ. Apices, however, are not so blunt as in *conjuncta* Casey.

Figures 11 and 12 of specimens from White Bluff, Arkansas, appear to be *childreni* representatives. They are cataloged as No. 4443, Paleontological Research Institution.

Figures 13 and 14 show varietal representatives from Crow Creek, Arkansas; Catalog No. 4444.

Holotype.—Phila. Acad. Nat. Sci., No. 5717.

The *childreni* from Bayou Toro (Pl. 57, fig. 16) has carinal crenulæ too pronounced for a typical representative of this species, suggesting, in fact, relationship with *conjuncta* though without the latter's blunt apex. Catalog No. 4446.

Coronia conjuncta (Casey) Plate 57, fig. 15

With Casey's holotype and description in hand one feels uncertain as to the relationship of this *childreni*-like form to other varietal representatives of this species.

For an illustration of the holotype, see Palæontographica Americana, vol. 2, 1937, pl. 2, fig. 23. U. S. Nat. Mus., No. 494,349. The young specimen represented in the present work on Plate 57, fig. 15 is probably of this species. Paleontological Research Institution, No. 4445.

Coronia montgomeryensis Harris Plate 57, fig. 17

In Palæontographica Americana, vol. 2, 1937, p. 34, pl. 2, fig. 25, we described this form as a variety of *childreni* and with this species it seems closely allied. However, its fine carinal crenulæ and spiral lines, as well as its high spire, small body whorl and central angulation of the whorl all tend to set this form off as a distinct species. A decidedly comely form. Holotype from Danville Landing, La. Paleontological Research Institution, No. 2371.

Coronia amica Casey Plate 58, fig. 1

This species has been discussed in Palæontographica Americana (vol. 2, 1937, p. 35, pl. 2, figs. 26-28).

The specimen we figure here is from a deep well at Sour Lake, Texas, (1500 ft.) with exact horizon unknown, but probably not far from the Red Bluff level. The high embryonic whorls recall Casey's *nucleata*, but the proportions of spire to length of aperture place this form with *amica*.

Holotype.—U. S. Nat. Mus., No. 494,346.

Specimen figured.—Sour Lake, oil well at a depth of 1500 feet. Paleontological Research Institution, No. 4447.

Coronia genitiva Casey, var. Plate 58, fig. 2

This species has been discussed in Palæontographica Americana (vol. 2, 1937, p. 37, pl. 3, figs. 11-13). The Jacksonian specimens bear a close resemblance to the St. Maurice forms, though there seem to be no closely related forms in the Claiborne sand.

Young Jackson specimens show short, distinct costation appearing rather high on each whorl, giving this part of the same a shouldered appearance.

Holotype.—U. S. Nat. Mus., No. 494,349.

Specimen figured.—Danville Landing, La.

Paleontological Research Institution, No. 4448.

Coronia weisbordi Harris Plate 58, fig. 9

For discussion of this species see Palæontographica Americana, vol. 2, 1937, p. 37, pl. 3, fig. 7. This is evidently of the *childreni* stock but has not the blunt apex nor the relatively large whorl of that species, while the ribbing on the whorls is less confined to the central portion of the peripheral zone. When compared with Casey's *conjuncta* the same remarks would seem to apply though the holotype of that species is so obscure no final conclusions can now be drawn.

Holotype.—Montgomery, La.

Specimen figured.—Paleontological Research Institution, No. 2380.

Coronia? ludonorma, n. sp. Plate 58, fig. 8

Specific characterization.—Size and form as indicated by the illustration, distinguished from *weisbordi*, vars., by its bipartite subsutural band, its fine, curved riblets, its constriction below the subsutural band and its aperture nearly as long as the spire.

Holotype.—Myatt Landing, Ouachita River, La.

Specimen figured (holotype).—Paleontological Research Institution, No. 4449.

Genus **TRYPANOTOMA** Cossmann, 1893
(Annales de Géologie et de Paléontologie, pt. 12, p. 46, pl. 2, fig. 18)

Genotype.—*Pleurotoma terebriformis* Meyer, Alabama Geol. Survey, Bull., No. 1, 1886, p. 75, pl. 2, fig. 8; so designated by Cossmann originally, *op. cit.*, p. 46.

Illustration.—See figures of Meyer and Cossmann referred to above; Harris, Palæont. Amer., vol. 2, 1937, pl. 4, figs. 15, 16.

Trypanotoma terebriformis, var. **curta** Harris Plate 58, fig. 3

Trypanotoma terebriformis, var. *curta* Harris, 1937, Palæont. Amer., vol. 2, p. 43, pl. 4, figs. 17, 18.

This varietal form has been discussed in Palæontographica Americana as cited above. Our only Jacksonian specimen seems to show no appreciable variations from the St. Maurice representative, though sharply differing from the Claiborne sand type.

Holotype.—Hickory, Miss., St. Maurice Eocene. No. 2404, Paleontological Research Institution.

Specimen figured.—Danville Landing, La. Jackson Eocene. Paleontological Research Institution, No. 4433.

Genus **SINISTRELLA** Meyer, 1887
(Sonder-Abdruck aus Bericht über die Senckenbergische Naturforschende Gesellschaft, p. 18)

Genotype.—*Triforis Americanus* Aldrich, Cincinnati Soc. Nat. Hist., Jour., July, 1885, p. 151, pl. 3, fig. 16; by monotypy.

Illustration.—Aldrich, *loc. cit.*; Cossmann, Essais de Paléoconchologie, 2 liv., 1896, pl. 7, figs. 22, 23.

Sinistrella americana (Aldrich) Plate 58, figs. 4, 5

Triforis americanus Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., July, 1885, p. 151, pl. 3, fig. 16.

Pleurotoma americana Aldrich, 1886, Alabama Geol. Survey, Bull., No. 1, p. 29, pl. 1, fig. 16.

Sinistrella americana Meyer, 1887, Sonder-Abdruck, Ber. Senckenberg. Naturf. Gesell., p. 18.

Sinistrella americana Cossmann, 1893, Notes Complémentaires sur la Faune Eocenique de l'Alabama, p. 47.

Trypanotoma (Sinistrella) americana Cossmann, 1896, Essais de Paléoconchologie, 2 liv., p. 110, pl. 7, figs. 22, 23.

Aldrich's description.—Shell sinistral, small conical; whorls, nine, striate, covered with revolving beadlike lines; suture, distinct, shell compressed just above the suture, with two lines thereon, a broad, prominent beaded line encircling the whorls just above the center, itself divided in some specimens by an impressed line; apex, smooth, mammillated; shell, slightly shouldered at the suture, it being bordered by an impressed line; body whorl convex, lines of growth giving it a cancellated appearance; canal twisted, one-third length of aperture, not quite closed; mouth, oblong-ovate, about one-fourth the length of the shell; outer lip, sharp, plicate within.

Locality.—Jackson, Miss.

Cossmann (*sup. cit.*, p. 110) places *Sinistrella* as a section under *Trypanotoma*, as it seems to be but a sinistral type of the latter, obviously feeling that the six-year priority of *Sinistrella* is outweighed by the inapplicability of this name to forms for the most part dextral (as he supposes).

Occurrence.—Though this species was described from the Jackson, Miss., beds, it seems most abundant at Danville Landing, La., on the Ouachita. It also occurs at Bunker Hill on the Ouachita River.

Holotype.—Jackson, Miss., the Johns Hopkins University.

Specimens figured.—Danville Landing, La.

Paleontological Research Institution, No. 4434.

Subgenus **INFRACORONIA**, new subgenus

Type.—*Gemmula ludoviciana* (Vaughan), Harris, Palæont. Amer., vol. 2, 1937, pl. 3, fig. 26, herewith so designated.

In *Coronia* with more or less centrally placed dentate carina and marked subsutural band, there are marked variations as to comparative length of beak and spire as shown on plate 3 in the publication cited above. Some, also, are rather long fusiform, as *alternata* Conrad (figs. 19, 20, 21 of the same plate). But in the new subgenus here proposed, the dentate carina drops to the base of each whorl, just above the suture, and the subsutural band disappears. This is typically a St. Maurice (lower Claiborne) form, though a slender variety, *normani*, occurs at Montgomery, La., in the Jackson Eocene.

Infracoronia ludoviciana, var. normani (Harris) Plate 58, fig. 6

Gemmula ludoviciana, var. *normani* Harris, 1937, Palæont. Amer., vol. 2, p. 39, pl. 4, fig. 3.

By consulting Plate 58, fig. 6, it will be seen that considerable modifications have taken place in this species from St. Maurice to Jackson times. The carinal crenulæ have no tendency to lengthen as is shown, for example, by figure 2, plate 4, Palæontographica Americana, volume 2.

Holotype.—Length, 28 mm., from Montgomery, La. Paleontological Research Institution, No. 2396.

Genus **EUCHEILODON** Gabb, 1860

(Academy of Natural Sciences of Philadelphia, Journal, 2d ser., vol. 4, p. 379, pl. 67, fig. 18)

Genotype.—*Eucheilodon reticulatus* Gabb, by monotypy (*vid. sup.*)

Illustration.—Gabb (*vid. sup.*); Harris, Palæont. Amer., vol. 2, pl. 5, figs. 3, 3a. (As shown on Plate, not as given by error "3a" in Explanation of Plate 5.)

This genus has been discussed at length on page 47, volume 2 of Paleontographica Americana (1937). The Jacksonian form, *crenocarinatus*, is discussed below.

Eucheilodon crenocarinatus Heilprin Plate 58, figs. 10-13

Eucheilodon crenocarinata Heilprin, 1880, U. S. Nat. Mus., Proc., vol. 3, p. 150, pl. 4, fig. 4.

Eucheilodon creno-carinata Harris, 1896, Acad. Nat. Sci. Philadelphia. Proc., p. 471, pl. 18, fig. 9.

Eucheilodon creno-carinatus Aldrich, 1897, Bull. Amer. Paleont., vol. 2, p. 171, pl. 5, fig. 1.

Euchilodon crenocarinatus Cossmann, 1899. Essais de Paléoconchologie, 3 liv., p. 189.

Eucheilodon creno-carinatus Harris, 1937, Palæont. Amer., vol. 2, p. 47, pl. 5, fig. 3b.

Heilprin's description.—Whorls subscalariform, flattened above, the angulation formed by a doubly crenulated carina; volutions ornamented by numerous revolving, profoundly elevated striæ, which are decussated by the much finer sinuated lines of growth; the upper or flattened portion with a prominent beaded line bordering the suture, and two (a finer and a coarser line) intermediate ones between the same and the carina; outer lip grooved within, and probably sharply crenulated by the terminations of the revolving striæ; columella with about eleven beads, which decrease in size from abo e downwards. Aperture nearly equal in length to the spire? Length of fragment 1 inch (No. 8921) Jackson, Miss.

Whether we regard this as a distinct species or simply a subspecies of *reticulatus*, the Jackson forms are generally much larger and with much less prominent embryonic whorls than the St. Maurice prototypes. Central carination and crenulation vary extremely in the later forms. These features are very subdued in the earlier representatives. Contrast figures 3 and 3a on plate 5 (Palæont. Amer., vol. 2) from Texas middle Eocene beds with figure 3b (erroneously given as fig. 3a on Explanation of plate 5) from the upper Eocene (Danville Landing) of Louisiana.

The figures of *creno-carinatus*, referred to in the synonymy above, vary greatly in carinal crenulation, but occasionally there is a reversion in general form to *reticulatus*, as in figure 10, Plate 58 herewith shown, but here the posterior swelling on the interior of the labrum becomes tripartite, the revolving lirations are more numerous than in *reticulatus* and there are faint traces of crenulated carinæ.

Correction. Palæontographica Americana, vol. 2, 1937, p. 48, lines 1 and 2, change "*crenulo-carinatus*" to *crenocarinatus*; and on p. 124, change fig. "3," to 3, 3a, and fig. "3a" to 3b.

It seems noteworthy that we have no Claibornian representatives of this well-marked stock.

Holotype.—U. S. Nat. Mus., No. 8921.

Specimens figured.—Fig. 10, from Montgomery, La.; fig. 11, Danville Landing, La.; fig. 12, Montgomery, La.; fig. 13, apical portion magnified about 7 times, showing details of early whorls.

Paleontological Research Institution: fig. 10, No. 4450; figs. 11, 13, No 4451; fig. 12, No. 4452.

Genus BATHYTOMA Harris and Burrows, 1891

(Eocene and Oligocene Beds of the Paris Basin, p. 113 [new name for Bellardi's *Dolichotoma*, pre-occupied])

Genotype.—*Murex cataphractus* Brocchi, Conchologia Fossile Subappennina, vol. 2, 1843, p. 221, pl. 8, fig. 16.

Illustration.—Brocchi (*op. cit.*); Bellardi, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 2, 1877, pl. 7, figs. 20, 20a-d; Cossmann, Essais de Paléoconchologie, 2 liv., 1896, pl. 8, figs. 12, 14.

For discussion of this genus, see Palæontographica Americana, vol. 2, 1937, p. 44.

"Genus" GLYPTOTOMA Casey, 1904

(St. Louis Academy of Science, Transactions, vol. 14, p. 140)

Genotype.—Since Gabb's *crassiplicata* is the first mentioned and the only one of the three species noted by Casey in a really good state of preservation, it must be taken as the typical *Glyptotoma*.

Illustration.—Gabb, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, pl. 67, fig. 19; Harris, Palæont. Amer., vol. 2, 1937, pl. 4, fig. 27.

Glyptotoma appears like a small, coarsely ornamented *Bathytoma* and hence deserving no more than subgeneric rank. It seems poorly represented in the Jackson beds, but a somewhat imperfect specimen has already been illustrated from Montgomery (Palæont. Amer., vol. 2, p. 45) and is herewith shown in a different view, Plate 58, fig. 18.

Bathytoma (Glyptotoma) crassiplicata, var. montgomeryensis Harris

Plate 58, fig. 18

See Palæontographica Americana (*loc. cit.*) for description of this variety. Its spire is somewhat more pointed than in the type form, its body whorl broader, and the ornamentation of a finer pattern.

Holotype of montgomeryensis.—Jackson, Miss., Paleontological Research Institution, No. 2409.

THE EOPLEUROTOMIDS

We have already discussed at some length (Palæont. Amer., vol. 2, 1937, p. 48) the general type of turrids called "*Strombina*" by De Gregorio and *Eopleurotoma* by Cossmann. If we take more or less typical forms like *sayi* and *nupera* we can conceive of their development from some costate fusoid ancestry by the development of a humeral sinus cutting off the subsutural portion of the costæ from the anterior, peripheral portion. This process of developing surculid forms was well under way in Upper Cretaceous times as demonstrated by Wade's Coon Creek work of 1926. *Eopleurotoma* may perhaps be regarded as intermediate in development between the surculids and the gemmulids already discussed.

"Section" **EOPLEUROTOMA** Cossmann, 1889
(Annales de la Société Royale de Malacologie de Belgique, vol. 24, p. 265)

Type.—*Pleurotoma multicostata* Deshayes, designated as type by Cossmann (*op. cit.*, p. 265); as "plesiotype" Cossmann mentions *Pleurotoma curvicosta* Lamarck and gives the same as figs. 1 and 2, plate 6 in Essais de Paléoconchologie comparée, 2 liv., 1896, p. 81. He instituted this as a "section" name.

Illustration of *multicostata*.—Deshayes, Description des Coq. Foss. des Environs de Paris, 1837, Atlas pl. 64, figs. 8-13; Cossmann, Essais etc., pt. 2, pl. 6, figs. 1, 2, "plesiotype."

Eopleurotoma ouachitensis Harris Plate 58, figs. 14, 15

For the original characterization of this species see Palæontographica Americana, vol. 2, 1937, p. 49, pl. 5, figs. 11, 11a.

Type.—From Danville Landing, Paleontological Research Institution, No. 2422.

The resemblance of this species to *cainei* of the Sabine Eocene of Alabama has been pointed out in the publication above referred to. It is quite possible that this may be a form of *julia* Cooke, yet if the drawing of that species as cited below is reliable, the aperture in *julia* is proportionally longer, the ribs more rectilinear and the sinus much nearer the suture line. We are reproducing Cooke's original drawing (enlarged), for comparison with *ouachitensis*. This may perhaps be regarded as a rather primitive *Eopleurotoma*, one in which the sinus is shallow, not yet close to the suture nor yet effacing all traces of the ribs along the sinus zone.

Eopleurotoma julia Cooke Plate 58, fig. 16

Eopleurotoma julia Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, p. 134, fig. 3.

Cooke's description.—Shell small, fusiform; apical angle about 30°. Nucleus large, smooth, tip broken, 2½ whorls remaining. Post nuclear whorls 4¼ in type, shouldered, cancellated; entire whorl covered by regularly spaced and nearly equal spiral threads, 7 threads on the third whorl; many low, rounded protractive ribs becoming obsolete on the body whorl. Canal straight; aperture wide, three-sevenths as long as the shell; columella smooth, outer lip thin, smooth within. Sinus adjacent to the suture, shallow. Altitude 7 mm.; latitude 2¼ mm.

Station 4250, Moodys Branch, Jackson, Miss., U. S. N. M., No. 353,939.

This pretty little species, of which only one specimen is in the National Museum collection, is given the obsolete name "Pleurotoma" because of the chaotic condition of the nomenclature of the Turritidae.

Since at this writing the type specimen is not available for study we are here showing a somewhat enlarged copy of the original drawing, kindly loaned by Dr. Paul Bartsch of the Department of Mollusca, United States National Museum. Our Jackson, Miss., material has not furnished us with additional specimens of this species, but Danville Landing has contributed several specimens of our *ouachitensis* which may turn out to be a variety of this species.

Eopleurotoma carya Harris, var. Plate 59, figs. 1, 2

This form has already been referred to in Palæontographica Americana, vol. 2, p. 56, pl. 6, fig. 18. The apex is pointed, consisting of three smooth embryonic whorls followed by two with the usual pleurotomoid costation, larger spiral and body whorls with coarse spiral lines increasing in strength from the lower ends of the ribs to the suture below; smaller spiral whorls ornamented by rather prominent, curved, thin ribs with one line above the suture and a crenulated subsutural band below, spiral lines over costæ and above to the suture mainly microscopic.

This variety seems to be more nearly related to St. Maurice types than to those from the Claiborne sand.

Occurrence.—Montgomery, La.

Specimens figured.—Fig. 1, Montgomery, La.; fig. 2, Jackson Eocene, exact locality not given.

Paleontological Research Institution: fig. 1, No. 2440; fig. 2, No. 4987.

Eopleurotoma carya Harris, var. **carola** ? Plate 59, figs. 3, 4

With the imperfect material at hand, it is not possible to state whether this is a new form or whether it should be referred to some former described species—perhaps as a more or less well-defined variety. It proves, however, that Eopleurotomas were not extinct in Jackson times, though by no means so abundant as in Claiborne beds below.

Occurrence of specimens figured.—Montgomery, La.; fig. 3, Jackson Eocene, exact locale unknown; fig. 4, Montgomery, La.

Paleontological Research Institution: fig. 4, No. 4988a.

Eopleurotoma ? albirupsis, n. sp. Plate 59, fig. 5

In our White Bluff, Ark., material there are imperfect turrid specimens showing not the usual type of costation on the larger whorls (*i. e.*, severed into a lower oblique portion and a smaller portion forming crenulations on the subsutural band) but having a more perfect surculoid swing, and crossed by uniform spirals. Certain general resemblances may be seen between this species and *Surculoma floweri* Harris from the Eocene at Smithville, Tex. (Palæont. Amer., vol. 2, p. 80, pl. 11, fig. 29). But faint indications of subsutural crenulæ suggest its affinity with *Eopleurotoma.*

Holotype and specimen figured.—White Bluff, Arkansas River, Ark.

Paleontological Research Institution, No. 4989.

Genus **TURRICULA** Schumacher, 1817
(Essai d'un Nouveau Système, Vers Testacés, p. 218)

Genotype.—*Turricula flammea* Schumacher; Chemnitz, Conch. Cab., vol. 4, p. 172, pl. 143, figs. 1336-1338

Illustration.—Chemnitz (*op. cit.*); *Pleurotoma javana* Reeve, Conch. Icon., 1843, *Pleurotoma*, pl. 4, fig. 26; *Turricula flammea* Grant and Gale, San Diego Soc. Nat. Hist., Mem., vol. 1, 1931, pl. 25, fig. 9a-b.

Recent Turriculas are frequently referred to *Surcula* (H. and A. Adams), with *T. javana* Linné as genotype; while strongly lirate, early Tertiary forms have been designated Pleurofusias by De Gregorio and Casey.

Subgenus **PLEUROFUSIA** de Gregorio, 1890
(Monographie de la Faune Eocénique de l'Alabama, pp. 33, 34)

Subgenotype. *Pleurofusia longirostropsis* de Gregorio, *op. cit.*, pl. 2, figs. 26, 27.

Illustration.—De Gregorio (*vid. sup.*).

For a copy of De Gregorio's Latin description of *Pleurofusia*, see Palæontographica Americana, vol. 2, 1937, p. 72. In his original observations, he writes:

These Pleurotomas have such a fusoid appearance that it frequently happens they have been referred to this genus, when the surface is a little worn and one does not observe the lines of growth showing the notch on the lip . . . These Pleurotomas are provided with remarkable costation, often heavy and coarse and with spirals that often become real cords.

De Gregorio refers to *Pleurofusia* as a new subgenus with *longirostropsis* as the type, listing nine of Bellardi's Surculas as belonging to this new subgenus. *Pleurotoma servata* Conrad of the Vicksburg Oligocene is likewise included.

Judging from the character of the species referred to, it would seem that the most characteristic feature of these fusoid forms is the sunken band below the suture, marking the position of the retral sinus. Typically the ribs do not cross this band.

Turricula (Pleurofusia) danvicola Harris Plate 59, fig. 6

Turricula (*Pleurofusia*) *danvicola* Harris, 1937, Palæont. Amer., vol. 2, p. 81, pl. 11, fig. 33.

For discussion of this species, see the above reference. This is one of the more common, fair-sized turrids from the upper Jackson at Danville Landing on the Ouachita River, La., but so far as we have observed, it is not known elsewhere. The broad, spirally striate sinus band of the penultimate and body whorls is very distinctive. On the large whorls, there is likewise a rather characteristic twinning of the two large spirals over the medial portion of the ribs, recalling similar characters in *Pleurotoma servata* Conrad of the Vicksburg Oligocene.

The holotype is No. 2542 of the Paleontological Research Institution. Specimen figured, No. 4990.

Turricula (Pleurofusia) danvicola Harris, var.? Plate 59, fig. 7

The form illustrated is perhaps that of a *danvicola* relative with short whorls and very prominent subcentral spirals increasing in strength as they pass over the short, obtuse ribs. More material must be obtained before its true relationship can be determined. It is one of the various and varying forms of turrids found at Danville Landing on the Ouachita River, La.

Paleontological Research Institution, No. 4991.

Turricula (Pleurofusia) danvicola, var. parahilgardina, n. var.
Plate 59, fig. 8

Characterization.—Size and form as indicated by the illustration; differing from the typical form by its broader fusoid form, its less pronounced sunken sinus band, and lack of costal deletion on the body whorl; closely approaching Casey's *Pleurofusia hilgardi* from Jackson, Miss.

Holotype and specimen figured.—Montgomery on the Red River, La.

Paleontological Research Institution, No. 4992.

Turricula (Pleurofusia) hilgardi Casey Plate 59, figs. 9, 10

Pleurotoma hilgardi Casey, 1903, Acad. Nat. Sci. Philadelphia, Proc., p. 270; 1904, St. Louis Acad. Sci., Trans., vol. 14, p. 152 as *Pleurofusia hilgardi.*

This species is described and figured in Palæontographica Americana (vol. 2, 1937, p. 74, pl. 11, fig. 7) as from Moodys Branch, Jackson, Miss. The holotype seems closely related to the variety *danvicola* described above, but is not so large, less rugged, and seemingly without the sunken sinus band and strong subsutural collar. The intimate relationship of this species to *collaris* on the one hand and *fluctuosa* on the other is evident from the illustrations here presented.

We have no specimens from Moodys Branch; figure 10, is from Garland Creek, near Shubuta, Miss.

Holotype.—U. S. Nat. Mus., fig. 9, No. 481,669; fig. 10, No. 4993.

Turricula fluctuosa Harris (Weisbord, MS.) Plate 59, figs. 11, 12

Turricula fluctuosa Harris, 1937, Palæont. Amer., vol. 2, p. 81, pl. 12, fig. 1.

This species has already been discussed (see above reference) in Palæontographica Americana. Another view of the holotype is herewith presented, fig. 12. It will be seen at once how intimately this is related to *hilgardi,* though its length, small number of broad ribs and constriction at suture lines produce an appearance quite at variance with that species.

The holotype is from Bunker Hill, on the Ouachita River, La.

Paleontological Research Institution, fig. 11, No. 4994; fig. 12, No. 2543.

Turricula (Pleurofusia) collaris Casey Plate 59, figs. 13-15

Pleurotoma collaris Casey, 1903, Acad. Nat. Sci. Philadelphia, Proc., p. 270.

Pleurofusia collaris Casey, 1904, St. Louis Acad. Sci., Trans., vol. 14, p. 127, 152.

Pleurofusia collaris Harris, 1937, Palæont. Amer., vol. 2, p. 74, pl. 11, fig. 8.

Casey's description is copied in Palaeontographica Americana, vol. 2, p. 74 and the holotype is figured on plate 11, fig. 8.

With other Jacksonian material in the Paleontological Research Institution is a specimen — apparently from Jackson, Miss.—which is with very little doubt referable to this species. It is herewith illustrated as figure 14. The spirals on the sinus band are exceedingly fine, the subsutural collar very strong, and, in place of three anterior lines as described by Casey, four are visible on the larger whorls.

Holotype.—Moodys Branch, Jackson, Miss.; U. S. Nat. Mus., fig. 13, No. 481,668. Fig. 14, probably Jackson, Miss.

Paleontological Research Institution, figs. 14, 15, No. 4995.

Turricula plutonica (Casey), var. weisbordi Harris Plate 59, figs. 16-18

We have already called attention to this variety of what seems to be Casey's *plutonica* from the Vicksburg Oligocene. (See Palæont. Amer., vol. 2, p. 80, pl. 11, fig. 30). Considerably more material is now available from the type locality of this varietal form (Danville Landing, Ouachita River, La., and Myatt Landing) but there seems to be no need of modifying our former characterization. The apex is pointed as is here illustrated; the spiral lines are obsolete except on the anterior of the body whorl; lines of growth are practically microscopic.

The holotype of *plutonica* is small and poorly preserved as will be seen from our illustrations.

For additional illustrations, see figures 16-18 of the present plate; all from Danville Landing, La.

Paleontological Research Institution: fig. 16, No. 4996; fig. 17, No. 4997; fig. 18, No. 4998.

Turricula (Pleurofusia) subservata, n. sp. Plate 59, figs. 19, 20

Specific characterization.—Size and general appearance as illustrated; apex and earlier whorls closely resembling the same of *plutonica;* later whorls of *serrata*-like aspect, *i. e.*, with two subequal, strong central spirals; body whorl with four strong, raised spirals; secondary or intermediate spirals seemingly not developed, entire surface covered with microscopic, even and evenly spaced spiral threads. These are many times finer than any of the finer spirals on *serrata* or *vicksburgensis*. Best observed after applying a thin coating of ammonium chloride.

Occurrence.—Holotype specimen the only one known; from Montgomery on the Red River, La.

Paleontological Research Institution, No. 4999.

Genus SULLIVANIA, new genus

Genotype.—*Pleurotoma perexilis* Aldrich, Alabama Geol. Survey, Bull., No. 1, 1886, p. 30, pl. 3, fig. 2.

Illustration.—Aldrich, *op. cit.*, pl. 3, fig. 2; Harris, *Hemisurcula? perexilis* (Aldrich), Palæont. Amer., vol. 2, 1937, p. 88, pl. 12, fig. 27.

Generic characterization.—Shell of medium size, long-biconical in outline, showing no costation at any stage of growth; lines of growth swing upward and diagonally to the right until they reach the lower and weaker of the two subsutural bands, then swing rather abruptly to the left up to the suture; fairly well-marked revolving lines generally on all whorls and always present on the anterior portion of the body whorl.

The type species is evidently closely related to *exiloides* of the Woods Bluff horizon and quite probably is of the same general stock as "*Hemisurcula*" *hicoricola* and *fischerensis* Harris (1937, p. 88, pl. 12, figs. 25, 26). These seem to come up through *Pleurotoma tombigbeensis* Aldrich (1899, pl. 2, figs. 12, 12a). The Barton, and even lower beds in England, yield a similar form, *Murex priscus* Solander (Fossilia Hantoniensia, 1766, p. 16, figs. 25, 44), better described and illustrated by Edwards in his Monograph of the Eocene Mollusca (1852, p. 320, pl. 33, figs. 1, 1a-c).

The *Conorbis*-like genus, *Cryptoconus* von Könen, as represented by its type species, *filosus* Lamarck (Cossmann and Pissarro, Iconographie Complete, etc., 1904-1906, pl. 49, fig. 216-1), seems to have little in common with *Sullivania*, but certain forms that have been referred to *Cryptoconus* may approach very closely what appear to be Sullivanian relatives—as suggested above. Incidentally, it may be pointed out here that if we adhere to the genotype characteristics of *Hemisurcula*, forms like *H. hicoricola* and *fischerensis* (Palæont. Amer., vol. 2, 1937, pl. 12, figs. 23, 26) must eventually be placed elsewhere.

The genus is dedicated to Professor J. M. Sullivan of Millsaps College, Jackson, Miss., who has gathered many remarkable fossils from central Mississippi.

Sullivania perexilis (Aldrich) Plate 60, figs. 1-3

Pleurotoma perexilis Aldrich, 1886, Alabama Geol. Survey, Bull., No. 1, p. 30, pl. 3, fig. 2.

Aldrich's description.—Shell slender, acuminate; whorls eight, convex, surface covered by revolving lines, which in some places have finer ones between, especially on the lower half of the shell. Lines of growth faint, very distinct under a glass; suture bordered below by an impressed line; slit wide and shallow; aperture half the length of the shell.

Locality.—Moodys Branch, Jackson, Miss.

The species is exactly the shape and appearance of *Pleurotoma venusta* Heilprin, but. on submitting the above specimen to Professor Heilprin, he stated it to be distinct, as *P. venusta* has its revolving lines arranged in pairs. The type specimen belonged to the National Museum, but on sending our shell there it could not be found, so a comparison could not be made.

Holotype.—*Vid. sup.*, the Johns Hopkins University.

Specimens figured.—Jackson, Miss.

Paleontological Research Institution: fig. 1, No. 4977; figs. 2, 3, No. 4978.

Genus **PSEUDOTOMA** Bellardi, 1875
(Societa Malacologica Italiana, Bollettino, vol. 1, p. 20)

Genotype.—*Murex intortus* Brocchi, Conchologia Fossile Subappennina, vol. 2, 1843, p. 220, pl. 8, fig. 17.

Illustration.—Brocchi (*op. cit.*); Bellardi, R. Accad. Sci. Torino, Mem., 2d ser., vol. 29, pl. 7, fig. 10; Cossmann, Essais de Paléoconchologie, 2 liv., 1896, pl. 8, fig. 11

Finlay changed this name to *Pseudotoma*, pointing out that "*Pseudotomus* Cope, 1872 (Mammalia) has a year's priority and invalidates Bellardi's name." (See Trans. and Proc. New Zealand Inst., vol. 55, 1924, p. 515.) But this is not in conformity with Article 36, Rules of Zoological Nomenclature.

Brocchi's type specimen seems to be unusually long spired as compared with specimens referred to the same species by Bellardi and Cossmann.

Pseudotoma heilprini (Aldrich) Plate 60, figs. 6, 7

For discussion of this species, see Palæontographica Americana, vol. 2, 1937, p. 103, pl. 14, figs. 32a, b.

The apical embryonic whorl of this species is exceedingly small, but other whorls expand rapidly, and on the fourth, faint spirals are seen eventually crossed by crescentic fine ribbing. After an abrupt change to more adult costation, on the fifth whorl the costation is as described by Aldrich.

Holotype.—Aldrich Collection, the Johns Hopkins University; from Moodys Branch, Jackson, Miss.

Specimen figured.—Figs. 6, 7, Moodys Branch, Jackson, Miss. Paleontological Research Institution, No. 4981.

Pseudotoma heilprini, vars. Plate 60, figs. 4, 5, 7a, 8

In restudying the various Louisiana forms referred to *Pseudotoma*, one notes that there are two fairly distinct and wide spread varieties that seem worthy of special consideration. The first, the more typical *heilprini* described above and discussed in Palæont. Amer., vol. 2, p. 103 (pl. 14, fig. 32), with sharper apex and coarser ornamentation, and the second, with opposite characteristics. They may occur together, but the second form is more characteristic of the Red River, Montgomery locality. We now think it probable that the form heretofore described as var. *gibsoni* is a pathologic individual perhaps of this second and less typical variety of *heilprini*. The shell shows that while young it had sustained considerable injury which could well have produced later deformities. No similar specimen is known to exist.

Holotype.—Pl. 60, fig. 8; Gibson Landing, Ouachita River, La. Paleontological Research Institution, No. 2590.

Specimens here figured.— Fig. 4, Montgomery, La., (No. 4979); fig. 5, Danville Landing, Ouachita River (No. 4980); fig. 7a, Danville Landing, (No. 4981a).

Pseudotoma axeli, n. sp. Plate 60, fig. 8a

Characterization.—General form and size as indicated by the illustration; outline more nearly that of *gibsoni* than *heilprini*, but having the depressed sinus zone of neither; as in the young of *heilprini*, there are two strong, subcentral spirals on each whorl passing over about ten low costæ, costæ becoming crescent-shaped and narrower in approaching the upper suture line; subsutural collar weak; columella short, heavy; umbilicus subobsolete.

Occurrence.—Moodys Branch, Jackson, Miss.

Holotype.—Paleontological Research Institution, No. 4983.

Genus **COCHLESPIRA** Conrad, 1865
(American Journal of Conchology, vol. 1, pp. 19, 210)

Genotype.—*Cochlespira cristata* Conrad, by subsequent designation by Casey, St. Louis Acad. Sci., Trans., vol. 14, 1904, p. 144.
Illustration.—Conrad, Acad. Nat. Sci. Philadelphia, Jour., ser., 2, vol. 1, 1848, pl. 11, fig. 20; Harris, Palæont. Amer., vol. 2, 1937, pl. 10, fig. 1.

For discussion of this genus, see page 66 of the above-cited volume of Palæontographica Americana.

Cochlespira bella, var. polita Harris Plate 60, fig. 9

Found with *Ancistrosyrinx columbaria* on the Ouachita River and described in Palæontographica Americana (vol. 2, p. 68, pl. 10, fig. 12).

The embryonic whorls of some forms of *Cochlespira* are shown on plate 10 of volume 2 of Palæontographica Americana, as, for example, figures 8-10, indicating a rapid increase in size of the earlier three smooth whorls, and an early type of ribbing on the fourth and fifth whorls. This gives way anteriorly to the obliquely set denticles of the sharp keel. We have not observed the early costate stage just mentioned in our specimens of more typical *Ancistrosyrinx*. Here the smooth whorls soon show a beginning of carination that in the fourth and fifth whorls develops the characteristic serration.

This is one of our most beautiful and characteristic groups of the whole turrid family. Little wonder authors have made use of such specific designations as *bella, elegans* and *cedo-nulli*.

Paleontological Research Institution, No. 2513.

Genus **ANCISTROSYRINX** Dall, 1881
(American Naturalist, vol. 15, p. 718; also Museum of Comparative Zoölogy, Bulletin, vol. 9, 1881, p. 54)

Genotype.—*Ancistrosyrinx elegans* Dall (original designation), *loc. cit.*
Illustration.—Dall, *Pleurotoma* (*Ancistrosyrinx*) *elegans*, Mus. Comp.

Zoöl., Bull., vol. 18, pl. 38, fig. 3; Harris, Palæont. Amer., vol. 2, 1937, pl. 10, fig. 23.

For discussion of this pleurotomid type, see Woodring, Publication 385 of the Carnegie Institute of Washington (1928); Harris, p. 66 of the volume above referred to.

Ancistrosyrinx columbaria (Aldrich) Plate 60, figs. 10-12

For description and discussion of this species, see volume 2, page 69, plate 10, figures 20-21 of Palæontographica Americana. Additional material fails to furnish better specimens than those there depicted.

Holotype.—"Dry Branch, Jackson, Miss." Aldrich Collection, the Johns Hopkins University.

Specimens figured.—Ouachita River at Bunker Hill Landing. Paleontological Research Institution: figs. 10, 11, No. 2516 A; fig. 12, No. 2516B.

It is also represented in our collections from Town Creek, Jackson, Miss. Sta. 785.

Genus **SCOBINELLA** Conrad, 1847

(Academy of Natural Science of Philadelphia, Proceedings, p. 289; its Journal, 2d ser., vol. 1, 1848, p. 120, pl. 12, figs. 8, 9)

Genotype by monotypy.—*Scobinella cælata* Conrad, *loc. cit.*

Illustration.—Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, 1848, pl. 12, figs. 8 and 9.

Conrad's description of this genus as given on pages 289-290 of the Academy Proceedings is as follows:

Shell subfusiform, with a deep angular sinus in the labrum as in *Pleurotoma;* spire, long, turreted; pillar lip wanting; columella with plaits decreasing in size downwards, as in *Mitra;* canal short.

For further discussion of the genus, see Woodring (1928, p. 199), and Harris (1937, p. 89).

Scobinella newtonensis Aldrich Plate 60, fig. 13

Scobinella newtonensis Aldrich, 1911, Bull. Amer. Paleont., vol. 5, p. 5, pl. 2, fig. 2.

Scobinella newtonensis Harris, 1937, Palæont. Amer., vol. 2, p. 90, pl. 13, figs. 10-12.

A general discussion of both genus and species has been given in the Palæontographica series as cited above.

Figure 13, Plate 60 shows a somewhat different view of the specimen from Montgomery which we have referred to Aldrich's St. Maurice Eocene species *newtonensis*. No additional material has come to hand since our publication of 1937.

Paleontological Research Institution, No. 2564.

Scobinella transitionalis Harris Plate 60, fig. 14

Scobinella transitionalis Harris, 1937, Palæont. Amer., vol. 2, p. 91, pl. 13, figs. 13, **14**.

For description and discussion, see the above-mentioned publication.

Holotype.—Fig. 14, from Montgomery, La.

Paleontological Research Institution, No. 2565.

Scobinella louisianæ Harris Plate 60, figs. 15-18

Scobinella louisinæ Harris, 1937, Palæont. Amer., vol. 2, p. 93, pl. 13, fig. 21.

For description and figure of the holotype of this species see the above reference.

Perhaps one of the most remarkable characters of this species is the great difference in proportion of length of aperture to length of shell. In the specimens herewith illustrated this proportion varies from .42 to .34. Again, the width to length of shell may vary from .21 to .27. Columellar plications, decreasing in strength anteriorly, may become very well developed as shown by fig. 15.

Specimens figured.—Fig. 15, Montgomery, La.; fig. 16, Garland Creek, Miss.

Paleontological Research Institution: fig. 15, No. 4984; fig. 16, No. 4985.

The high-spired form illustrated by figs. 17, 18 is from Montgomery and is registered as No. 4986.

Scobinella? jacksonensis Meyer Plate 60, fig. 19

This small and somewhat imperfect specimen from the collection of the Philadelphia Academy of Natural Sciences has been discussed in Palæontographica Americana, vol. 2, 1937, p. 95, as *Mitromorpha ? jacksonensis* but its proper generic location must await additional and more perfect material. Meyer (Geol. Surv. Ala., Bull., No. 1, p. 75, pl. 2, fig. 10) originally referred his holotype specimen, seemingly of this species, to *Pleurotoma*. His specimen is now in the Johns Hopkins University collection.

Scobinella famelica Casey Plate 61, figs. 1, 2

Scobinella famelica Casey, 1903, Acad. Nat. Sci. Phila., Proc., p. 274.

Scobinella famelica Harris, 1937, Palæont. Amer., vol. 2, p. 93, pl. 13, figs. 22, 23.

The close resemblance of this Montgomery Jackson specimen to the typical Vicksburgian form has been commented on in Palæontographica Americana, p. 93.

Holotype.—U. S. Nat. Mus., specimen, No. 481,662.

Specimen figured.—Mongtomery, La.

Paleontological Research Institution, No. 2571.

Genus **CORDIERIA** Rouault, 1848
(Société Géologique de France, Bull., (2) vol. 5, p. 207)

Genotype.—*Cordieria iberica* Rouault, chosen by Cossmann (Essais de Paléoconchologie comparée, 2 liv., 1896, p. 98, not *Borsonia calvimontensis* (Deshayes) Cossmann, *idem.*, pl. 6, figs. 21-22) as "plesiotype."

Illustration.—Rouault, Soc. Géol. France., Mém., 2d ser., vol. 3, 1849, pl. 17, fig. 7.

Cordieria ludoviciana (Vaughan) Plate 61, fig. 3

Borsonia ludoviciana Vaughan, 1896, U. S. Geol. Survey, Bull., 142, p. 34, pl. 2, fig. 6, 6a.

Cordieria ludoviciana Harris, 1937, Palæont. Amer., vol. 2, p. 84, pl. 12, fig. 9.

For description and discussion of this species, see the above reference to Palæontographica Americana. A somewhat different view of the specimen figured there is herewith given showing clearly the character of the retral sinus. It is from Jackson, Miss. Paleontological Research Institution, No. 2547.

Genus **MICRODRILLIA** Casey, 1903
(Academy of Natural Science of Philadelphia, Proceedings, p. 276)

Genotype.—*Pleurotoma cossmanni* Meyer, Sonder-Abdruck, Ber. Senckenberg. Naturf. Gesell., 1887, p. 9, pl. 1, fig. 5. See Woodring (1928, p. 196).

Illustration.—Meyer, *loc. cit.*, pl. 1, fig. 5; Harris, Palæont. Amer., vol. 2, 1937, pl. 15, figs. 42, 43.

Cossmann (1906, p. 224) terminates his discussion of *Microdrillia* thus:

> Although there are some very slight differences, I can admit *Microdrillia* as a Section of *Asthenotoma*, but without any connection with *Drillia*.

Hedley (1922, p. 218) treats *Microdrillia* as strictly synonymous with *Asthenotoma*. Woodring (1928, p. 196) considers it a valid genus.

If we assume "*Oligotoma tuberculata* (Pusch)" as illustrated by Bellardi (1877, p. 239, pl. 7, fig. 26) to be the genotype of *Asthenotoma*, then there would seem to be little in common between this genus and *Microdrillia.* If *basteroti* Desm., especially when including such forms as "var. A" (Bellardi, 1877, p. 236, pl. 7, fig. 22), be regarded as genotypic, then there would be much more in common between the two genera. Until the question, what is *basteroti?*, is settled, the status of *Asthenotoma* is in doubt. Compare Cossmann (1896, p. 104, pl. 6, figs. 23, 24) with Kautsky (1925, pl. 11, fig. 35).

The immature and fragmentary specimens described as *Fusus nanus* Lea and *Pleurotoma insignifica* Heilprin—and constituting a new genus, *Cochlespirella,* according to Casey—very probably should be included under *Microdrillia.*

Microdrillia meyeri Cossmann Plate 61, fig. 4

This species is discussed on pages 111 and 116 of Palæontographica Americana, vol. 2, 1937. The type specimen (*cossmanni* Meyer=*meyeri* Cossmann) according to Meyer came from Jackson, Miss. His figure (herewith copied as figure 4) shows an extremely wide form. This agrees fairly well with the specimen in the Casey Collection (U. S. Nat. Mus), labelled *cossmanni* and shown as figure 43, plate 15 in the publication cited. Our collections from Jackson have yielded no specimens of this comparative breadth. Two figures, "*Scobinella læviplicata* (Gabb)", are given by Cossmann (1893, pl. 2, fig. 19; 1896, pl. 6, fig 35) of specimens said to have come from Jackson, Miss. The one is a drawing herewith shown as figure 5, Plate 61, and the other, a photograph shown as figure 6. The reference of these forms to *Scobinella* seems difficult to understand. Figure 6 represents a specimen differing but little from the specimen in the Philadelphia Academy labelled *Pleurotoma cossmanni* Meyer, likewise from Jackson, Miss. (See Palæont. Amer., vol. 2, pl. 15, fig. 46.)

Microdrillia parthenoides, n. sp. Plate 61, fig. 7

Characterization.—Form and general appearance as indicated by the figure (of the only specimen at hand); general outline like that of *ouachitæ;* three very heavy carinæ on each whorl, the middle one the strongest; lines of growth far apart and very pronounced, seeming—on the sinus band—like a row of columns supporting the subsutural carina; oral parts close to those of *ouachitæ*.

Occurrence.—Sabine River, Texas side, about one mile below Robinson's Ferry, with other Jackson Eocene Mollusca.

Holotype.—Paleontological Research Institution, No. 4976.

Microdrillia ouachitæ Harris Plate 61, fig. 8

Microdrillia ouachitæ Harris, 1937, Palæont. Amer., vol. 2, p. 114, pl. 15, figs. 31, 32.

This species was described and discussed in 1937 as referred to above. The most obvious character of this species is the length of the spire in comparison with the length of the aperture. Figure 8 of this paper is of the same specimen cited as figure 31 above. The specimen came from the Jackson Eocene of Ouachita River and is No. 2613 in the catalog of the Paleontological Research Institution.

Asthenotoma danvitexa, n. sp. Plate 61, figs. 9, a, b

The general features of this species are shown by the illustrations. The representative of the broad, smooth spiral band on the upper portion of each whorl in *texana* is delimited above and below in this form by heavy spirals. On the earlier whorls these spirals closely approach each other, showing a narrow channel between. Costæ or nodules seem to be outgrowths of the lower spiral, while the upper remains intact and serves as a strong subsutural band. Though the uppermost whorls of figure 9 show considerable erosion their features contrast strongly with the earlier whorls shown by 10, the apex of the specimen of *texana* shown as figure 9, plate 15, Palæont. Amer., vol. 2, 1937.

Holotype and specimen figured.—Danville Landing on the Ouachita River, La. Paleontological Research Institution, No. 4965.

Asthenotoma, sp. Plate 61, fig. 11

This specimen seems to represent a species related to *danvicola* but with more evenly distributed spirals and subdued nodules. More material must be collected before its relationship to other forms can be ascertained.

Specimen figured.—Danville Landing, La.

Asthenotoma, sp. Plate 61, fig. 12

This specimen shows a clear-cut spiral in the middle of the smooth band of species of this type and the body whorl is unusually large. From Danville Landing, La. Paleontological Research Institution, No. 4967.

Genus **GLYPHOSTOMA** Gabb, 1872
(Academy of Natural Sciences of Philadelphia, Proceedings, p. 270, pl. 9 ?, fig. 4)

Genotype.—Gabb (*vid. sup.*).
Illustration.—Gabb (*vid. sup.*).

Subgenus **EOCLATHURELLA** Casey, 1904
(St. Louis Academy of Science, Transactions, vol. 14, p. 166)

Subgenotype.—Casey does not specify which of these two species is the subgenotype, but as only one, *E. obesula*, is in a fair state of preservation, it should be regarded as the subgenotype.
Illustration.—Harris, Palæont. Amer., vol. 2, 1937, pl. 14, fig. 11.

In comparing world-wide representatives of these American forms, special attention should be given to the relationship of *Clathurella* (Carpenter) to *Glyphostoma* and *Lienardia* (Jousseaume), and *Etrema* (Hedley) to *Eoclathurella*.

Clathurella (Eoclathurella) obesula Casey Plate 61, figs. 13, 14

Eoclathurella obesula Casey, 1904, St. Louis Acad. Sci., Trans., vol. 14, p. 167.
Eoclathurella obesula Harris, 1937, Palæont. Amer., vol. 2, p. 97, pl. 14, fig. 11.

Casey's description and a figure of the type specimen of this species will be found in Palæontographica Americana as cited above.

Figured specimens.—Fig. 13, holotype, Montgomery, La.; fig. 14, Jackson, Miss.

Paleontological Research Institution, fig. 14, No. 4968.

"Eoclathurella jacksonica" Casey Plate 61, fig. 15

Eoclathurella jacksonica Casey, 1904, St. Louis Acad. Sci., Trans., p. 167.
Eoclathurella jacksonica Harris, 1937, Palæont. Amer., vol. 2, p. 98, pl. 14, fig. 13.

From the condition of the type, we do not feel sure of the generic relationship of this specimen with *obesula*. More and better material must be at hand before this "species" can be well characterized.

Figured specimen.—U. S. Nat. Mus. "From the Jackson Eocene of the Red River, Kimbrel Bed." Negative furnished by the Museum.

Genus **CYMATOSYRINX** Dall, 1889
(Museum of Comparative Zoölogy, Bulletin, vol. 18, p. 95)

Genotype.—*Pleurotoma lanata* Lea, Amer. Phil. Soc., Trans., vol. 9, 1843, p. 270, pl. 37, fig. 93.

Cymatosyrinx dorseyi (Cooke) Plate 61, fig. 16

Drillia dorseyi Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, p. 133, fig. 2.

Cooke's description.—Shell small, robust, apical angle 35° to 40°; nucleus blunt, polished, containing about 3½ convex whorls, about ¾ mm. long. Postnuclear whorls 4¾ in type, about 2½ times as wide as long; polished smooth or very faintly threaded back of the suture but distinctly threaded on the anterior half of the body whorl; decorated with 11 or 12 rounded axial ribs on each whorl. Suture distinct, somewhat flexuous. Canal straight; aperture about two-thirds as long as the body whorl. Outer lip broken. Alt. 5½ mm.; lat. 2 mm.

Station 4-50, Moodys Branch, Jackson, Miss., U. S. N. M., No. 353,938. *Drillia dorseyi* is smaller, less slender and has a somewhat shorter nucleus than *D. tantula* (Conrad) from the Bryam marl at Vicksburg. A somewhat larger shell of 5 whorls, measuring 6½ mm. in altitude and 2¼ mm. in latitude, has only 7 ribs on each whorl. It may be a distinct variety.

Cooke's figure is copied herewith (Pl. 61, fig. 16).

Cymatosyrinx palmeræ, n. sp. Plate 61, fig. 17

Characterization.—General appearance of holotype as figured. There are ten ribs per whorl; about twice the size of *dorseyi;* no spiral lines, not even on the anterior portion of the body whorl; no subsutural collar; retral sinus broad and very shallow; lines of growth only seen where smooth surface has been decorticated.

Holotype (specimen figured).—Danville Landing on the Ouachita River, La.

Paleontological Research Institution, No. 4969.

Genus **CONORBIS** Swainson, 1840
(Cabinet Cyclopædia of Natural History, p. 312)

Genotype.—*Conus dormitor* Solander, Fossilia Hantoniensia, 1766, p. 16, pl. I, fig. 24.

A. von Könen in 1867 proposed (vol. 16, p. 167) the name *Cryptoconus* for turrids very similar in appearance to species of *Conorbis.* He gave longitudinal sections of species belonging to both genera as well as to *Pleurotoma.*

Fischer (1887, p. 589) remarked:

Les Conorbis, exactment semblables au sous-genre *Cryptoconus* du genre *Genotia*, en diffèrent par la résorption partielle de leurs cloisons internes. Cette résorption n'est jamais poussée aussi loin que chez les cônes.

De Gregorio and Cossmann have made similar remarks

That the Jackson species herewith discussed belongs to the genus *Conorbis* is proven by the longitudinal sections shown in Plate 61, figures 21-25.

In Europe this genus is best represented from the Bartonian Eocene of England to the Lattorfian Oligocene of north Germany; though in England and in the Paris Basin it may range down to the middle Eocene.

Conorbis alatoideus Aldrich Plate 61, figs. 18-25

Conus (*Conorbis*) *alatoideus* Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., p. 149, pl. 2, fig. 11; 1886, Alabama Geol. Survey, Bull., No. 1, p. 32, pl. 2, fig. 11.

Aldrich's description.—Shell fusiform; whorls ten, slightly convex; suture shouldered, distinct; shell indented below the suture with close set longitudinal lines showing on this part; below, a number of raised lines; apex sharp, body whorl with a large number of close set raised lines on the lower part, a few finer ones alternating; aperture narrow; raised lines stop at the columellar lip, which is slightly sinuous, reflected at the base, thickened above, outer lip large, almost semicircular, with a notch on the upper part. Length, one inch.

Locality.—Moodys Branch, Jackson, Miss.

This shell at sight would be taken for a *Pleurotoma*. It so nearly resembles *Conus alatus* Edwards from the English Eocene that it may be found on direct comparison to be the same species.

We give (Pl. 61, fig. 18) a copy of Aldrich's type specimen.

Under the caption *Conorbis alatoideus*, Cossmann (1893, p. 42) has made the following remarks:

Les observations que fait M. de Gregorio sur la simillitude des espèces fossiles de *Conorbis* et *Cryptoconus* sont assez justes; cependant, à défaut de la section transversale qu'on ne peut pas toujours, faire sur des échantillons rares ou uniques, j'ai indiqué (Catal. Eoc. IV, p. 239) un caractère qui permit de les distinguer à peu près sûrement, c'est le parallèlisme des leux bords de l'ouverture dans les *Conorbis*, tandis que tous les *Cryptoconus* ont la columelle tordue, et par conséquent l'ouverture un peu large au milieu; en outre ils ont une échancrure plus triangulaire près de la suture, tandis que celle des *Conorbis*, est plus arrondie. L'espèce figurée par Aldrich, mais non décrite (Prelim. Rep. p. 23, pl. II, fig. 11) vient de Jackson et j'en possède un magnifique exemplaire, que m'a envoyé M. Meyer: je l'ai comparé a *C. alatus* Edw. de Barton, qui est presque identique, mais est un peu plus ventrue, dont la spire a un contour plus curviligne, et dont les filets spiraux sont un peu moins serrés; en outre l'espèce américaine porte, sur le milieu de chaque tour, un sillon ponctué que fait défaut a l'espèce anglaise.

Not only is this species close to *alatus* Edwards, but (in some forms) it is not far from the genotype *dormitor*. Both shell form and markings vary considerably in one and the same locality. See figures shown on Plate 61.

Occurrence.—Figs. 20-24, Town Creek, Jackson, Miss.; fig. 19, Gibson Landing, La.; fig. 25, Bunker Hill, La.

Paleontological Research Institution: fig. 19, No. 4971; figs. 20, 21, No. 4975; fig. 23, No. 4973; fig. 24, No. 4972; fig. 25, No. 4974.

Family CONIDÆ

Genus CONUS Linnæus, 1758

Linnæus, Syst. Nat., 1758, p. 712.

Genotype by subsequent designation, Children (Quart. Jour. Sci., XVI, 1823, p. 69; Kennard, Salisbury, and Woodward, Smithsonian Misc. Coll., vol. 82, No. 17, 1931, p. 35), *Conus marmoreus* Linnæus (*loc. cit.*). Living. Indo-Pacific. Tryon, Manual Conch., vol. VI, 1884, pl. 1, figs. 1-5.

Subgenus LITHOCONUS Mörch, 1852

Mörch, Cat. Conch. Yoldi, fasc. I, 1852, p. 66.

Subgenotype by subsequent designation, Cossmann (Ann. Soc. roy. malac. Belgique, t. XXIV, IV ser., t. IV, 1889, p. 232), *Conus millepunctatus* Lamarck (Hist. nat. An. sans Vert., VII, 1822, p. 461). Living. Indo-Pacific. Tryon, Manual Conch., vol. VI, 1884, pl. 2, fig. 19.

Conus (Lithoconus) sauridens (Conrad) Plate 62, figs. 15-18, 20

(See also Palmer, 1937, pl. 71, figs. 8, 12, 14, *C. tortilis*.)

Conus sauridens Conrad, 1833, Aug., Fos. Tert. Form., p. 33, Conrad, 1835, Fos. Tert. Form., p. 38, pl. 15, fig. 7.

Conus tortilis Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XV, fig. 5; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 260; 1939, Reprint. Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 6, 19, pl. 2, fig. 5; Conrad, 1865, Am. Jour. Conch., vol. I, p. 29; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 25; Dall, 1895, U. S. Nat. Mus., Proc., vol. 18, p. 41.

Conus jacksonensis Meyer, 1885, Am. Jour. Sci., vol. XXIX, 3d ser., p. 466; Tomlin, 1937, Malacol. Soc. London, Proc., vol. XXII, pt. IV and pt. V, p. 263.

For complete synonymy and discussion of *C. sauridens*, see Palmer, Bull. Amer. Paleont., vol. VII, No. 32, pp. 458-463, pl. 71, figs. 1-14; pl. 90, fig. 3. On p. 461 of that report, lines 25 and 26, pl. 72 should be pl. 71.

The following description is of *C. tortilis* Conrad, Jackson representative:

Nuclear whorls composed of 3½ or 4 smooth whorls, elevated, pointed, followed by four of five small finely nodose postnuclear whorls. The postnuclear whorls are elevated above the broad or less sloping base which constitutes the remaining whorls of the spire and carinated margin of the body whorl. The early five to six (depending on the age of the specimen) apical whorls have a well-developed median keel which is crenulated. There are fine spiral lines above and below the keel and microscopic growth lines may be seen. Four or five strong spiral lines occupy the area on the whorls between the suture and the carination. The carination of the whorls projects narrowly above the suture. The body whorl may be smooth below the carination to just below the midline or it may show spiral lines with wide interspaces in varying degrees of strength. The subsutural flexure is very conspicuous at the keel of the body whorl where it swings below the keel in a broad curve to the base. Basal callus well developed and twisted in semblance of a plication.

The curvature of the spire is not constant. Some specimens are almost flat topped with the small apical whorls projecting above. Other specimens from the same locality will have the slope of the spire more convex and others, particularly gerontic individuals, have the whorls of the spire in a bulging shape.

Conrad distinguished his Jackson specimens of *Conus* (which he called *tortilis*) from *C. sauridens* by the greater convexity of the spire and the large twisted callus of *C. tortilis.* However, the amount of the convexity of the spire is far from constant in *C. tortilis,* as may be seen by a comparison of the several figures given herein and in Palmer, 1937, pl. 71, figs. 12, 14. A similar condition is found in the species-stock in the lower Claiborne, localities of which yield abundant material. Also on the lower Claiborne specimens the basal callus may thicken and become twisted in a similar manner as that on the Jackson shells. The subsutural flexure and the apical whorls of the lower Claiborne and Jackson specimens are similar. Collections from the Gosport sand do not yield the large suites of individuals of the species as the older and younger beds do.

The species is common in the Vicksburg Oligocene but it remains small in size, an average of about 30+ mm. in height. Gerontic individuals in the Jackson reach a height of 95-100 mm. Such specimens in the lower Claiborne may become 75 mm. in height.

Meyer named a new cone from the Jackson, *C. jacksonensis*, without adequately describing or figuring it.

Dr. Charles Berry, formerly of the Geology Department, the Johns Hopkins University, kindly loaned the type of *C. jacksonensis*, and it is figured herein. The specimen, as it exists today, consists of the apical whorls. They appear to be the characteristic type of the *C. sauridens* stock and probably are therefore the apical whorls of *C. tortilis*.

Dimensions.—Height, 100± mm.; greatest diameter, 53 mm. (lectotype).

Types.—Lectotype, *C. tortilis* Conrad, No. 13196, Academy of Natural Sciences, Philadelphia, Pa.; holotype, *C. jacksonensis* Meyer, Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Lower Claiborne. Gosport sand (type). Jackson, Moodys Branch marl, localities 693, 785, 787, 880, 881, 1051; 1054, 10, 883, 15; 7, 8, 9; 16; 1119, 1; Danville Landing beds, locality 6; Jackson of Arkansas, locality 897.

Family TEREBRIDÆ

Genus TEREBRA Lamarck, 1799

Bruguière, Hist. Nat. Vers Moll., Ency. Méth., VI, vol. 1, 1789, p. XV no species mentioned; Lamarck, Soc. Hist. nat. Paris, Mem., 1799, p. 71.

Genotype by monotypy, *Buccinum subulatum* Linnæus (12 ed., 1767, p. 1205), Lamarck, 1799. Living. Indo-Pacific. Tryon, Manual Conch., vol. VII, 1885, p. 10, pl. 1, fig. 3; pl. 3, fig. 35.

"Terebra" abditiva, n. sp. Plate 62, fig. 5

Shell medium; nucleus unknown; adult consists of more than 10 whorls; sides of whorls straight, only slightly emarginated at the suture; canal short, slightly twisted; no columellar fold; surface covered with numerous longitudinal ribs which are about equally developed over the whole length of the shell. The only indication of a subsutural band is the swelling below the suture and a suggestion of a constricted line on the older whorls.

The form is known only by two specimens hence the amount of variation is in doubt. There is a great deal of variation in the presence or absence of the subsutural band in the Terebridæ, for that reason it is debatable how much value should be placed on the obscurity of such a band on these specimens.

The species has been separated from the common Jackson form, *T. jacksonensis*, because of the persistence of the longitudinal folds on these specimens. In *T. jacksonensis*, the longitudinal ribs die out more commonly with increased age. The specimens of *T. abditiva* are not large for the Terebridæ but they are large for Jacksonian species of the family.

Dimensions.—Height, 23.5 mm.; greatest diameter, 4.5 mm. (holotype).

Holotype.—No. 4799, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, locality 10.

Subgenus **MIRULA** Palmer, 1942
(*Terebrella* Palmer, 1937 *non* Packard, 1867)

Palmer, Jour. Paleont., vol. 16, No. 5, 1942, p. 674 substitute for *Terebrella* Palmer, 1937, p. 466.

Subgenotype by original designation, *Terebra mirula* de Gregorio (Ann. Géol. Paléont., 7 liv., 1890, p. 17, pl. 1, figs. 45, 46). Claibornian Eocene. Southern United States. Palmer, 1937, pl. 72, figs. 19-21.

Terebra (Mirula) jacksonensis Cooke Plate 62, figs. 1-4; 6-8

Terebra jacksonensis Cooke, 1926, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 133, fig. 1.

Terebra divisura Meyer, 1885, Am. Jour. Sci., vol. XXIX, 3d ser., pp. 465, 468. *Non* Conrad, 1848.

Shell slender, apical angle about 20°, suture distinct; nucleus containing 3 or 4 smooth, polished, convex whorls; postnuclear whorls 9½ in type, ornamented by even, rounded, slightly sinuous axial ribs which are cut by an impressed spiral line one-third the width of the whorl in front of the suture and which become obsolete at the anterior end of the body whorl. Rounded fasciole bordered posteriorly by a strong cord which terminates abruptly at the inner lip. Altitude 13½ mm.; lat. of body whorl 3½ mm.

Station 4250, Moodys Branch, Jackson, Miss. U. S. N. M. No. 353,937.

This species, which is very abundant in the Moodys marl member at Jackson, somewhat resembles de Gregorio's figure of *T. andrega*, which has a deeper spiral furrow on the whorls.—[Cooke, 1926.]

Terebra jacksonensis differs from De Gregorio's figure of *T. andrega* in having a shorter columellar area and canal. This difference also holds for the common species of this stock, *T. texagyra* Harris, which is abundantly developed in the lower Claiborne. Whether *T. texagyra* is the same as *T. mirula*, the name De Gregorio gave to Gosport sand specimens, is not definitely decided. I united *T. mirula* and *T. texagyra* in the Clairbornian report (Palmer, 1937, p. 467, pl. 72, figs. 8, 10, 11, 16-20) using De Gregorio's figures mainly because specimens of *T.*

mirula from the Gosport sand were not available.

Meyer, in 1885, probably had specimens of *T. jacksonensis* when he spoke of the *T. divisura* Conrad as being common in the Jackson. *T. jacksonensis* differs from *T. divisura* of the Vicksburg in having the impressed spiral line less sharply cut and in having the canal shorter. The number of longitudinal folds varies on young and older specimens in each of the species hence the number of folds is not a good criterion for specific distinction. Specimens of different stages of individual development of the same species from the same locality in the lower Claiborne show a different number of longitudinal folds.

At White Bluff, Arkansas, there is a local variation of *T. jacksonensis*. The feature which is most noticeable in the specimens is the tendency for obsolescence of the longitudinal ribs on the body whorl as well as the lack of a subsutural groove on the whorls. The shells have somewhat the appearance of *Hastula houstonia* (Harris) from the lower Claiborne but differ from that species in the character of the columellar area and canal. The White Bluff specimens have the canal and columellar region of *T. jacksonensis*, as well as similar sculptural features. The shells grade into typical *T. jacksonensis* and the character of evanescence of subsutural line and the longitudinal ribs is not constant.

Some specimens show the subsutural band, others do not. The variation in this case is not worthy of a distinct name. The shells at White Bluff commonly have the surface considerably eroded. Allowance has been made for such a factor but there is yet natural obsolescence of the surface sculpture not accounted for by weathering of the specimens.

Holotype.—No. 353,937. United States National Museum, Washington, D. C.

Occurrence.—Moodys Branch marl, localities 921, 669, 879; Jackson of Arkansas, localities 1049, 896.

Genus PUSIONELLA Gray, 1847

Gray, Zoöl. Soc. London, Proc., pt. XV, 1847, p. 137.

Genotype by original designation, *Terebra* (Nifat) Adanson (Hist. Nat. du Sénégal, 1757, Hist. Coq., p. 52, pl. 4, fig. 3). Living. West Africa.

Tryon, Struct. Syst. Conchology, II, pl. LVII, fig. 12.

Wrigley, after examining shells of Recent *Pusionella* from west Africa, is of the opinion that *Pusionella* belongs in the Terebridæ (Malacol. Soc. London, Proc., vol. XXIII, pt. V, 1939, p. 283).

"Pusionella" marnochi (Heilprin) Plate 62, figs. 13-14

Fusus marnochi Heilprin, 1880, U. S. Nat. Mus., Proc., vol. 3, p. 151, plate fig. 6; Aldrich, 1897, Bull. Amer. Paleont., vol. II, No 8, p. 5, pl. 3, figs. 4, 4a.

Fusus (*Strepsidura?*) *Marnochi* Heilprin, 1890, Acad. Nat. Sci. Philadelphia, Proc., vol. XLII, p. 395.

Pusionella marmodei [*sic*] (Heilprin), Cossmann, 1899, Essais Paléoconch. comp., 3 liv., p. 187 error in spelling of specific name.

Volutions seven or eight, the earlier three or four convex, the remainder flattened; body-whorl subangulate; suture impressed; aperture less than one-half the length of shell, the canal sharply twisted; columella with a pseudo-fold following the curve of the canal. The whorls in the single specimen before me are destitute of ornamentation, but some traces of the former existence of revolving lines are apparent.

Length, 4/5 inch. (No. 8917.)

Atascosa County, Texas.

Named after Mr. G. W. Marnoch, through whom this and other species of older Tertiary Texas fossils have been obtained.—[Heilprin, 1885.]

Additional data have not been collected regarding this species since Aldrich refigured the type and noted that Dall had suggested that the form was a *Pusionella*. Its general appearance somewhat suggests the Columbellidæ.

Holotype.—No. 8917, United States National Museum, Washington, D. C.

Occurrence.—Jackson Eocene, Atascosa County, Texas (Heilprin).

Family SCAPHANDRIDÆ

Genus SCAPHANDER Montfort, 1810

Montfort, Conchyliol. Syst., t. 2, 1810, p. 335.

Genotype by original designation, *S. lignarius*=*Bulla lignaria* Linnæus (1758, p. 727). Living. Pliocene and Pleistocene. Europe. Pilsbry, Manual Conch., vol. XV, 1893, p. 245, pl. 31, figs. 17, 21-23; Harmer, Palæont. Soc., 1923, vol. LXXV, p. 806, pl. LXIII, figs. 14, 15.

Scaphander jacksonensis, n. sp. Plate 64, figs. 6, 7

Scaphander primus Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 15; Aldrich, 1895, Bull. Amer. Paleont., vol. I, No. 2, p. 6, pl. 2, figs. 1, 1a.

Non Scaphander primus Aldrich, 1885, Cincinnati Soc. Nat. Hist., Jour., vol. VIII, No. 2, p. 148, pl. 2, figs. 7, a, b; Aldrich, 1886, Geol. Survey Alabama, Bull., vol. 1, pt. I, p. 35, pl. 2, figs. 7, a, b; Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 17; Dall, 1915, U. S. Nat. Mus., Bull. 90, p. 34. Dall's references equal *partim S. primus*

Aldrich, 1885, and *partim S. ballistus* Mansfield, 1937, Florida Geol. Survey, Bull., No. 15, p. 75, pl. 1, figs. 5, 6.

Shell large, more contracted posteriorly, spire sunken; aperture narrowed posteriorly with the labrum curved upward and protruding above; aperture greatly widened anteriorly; callus thin but well spread, sometimes paperlike and peels off; no umbilicus; callus marginal on the columellar area; surface covered with conspicuous spiral striæ, with no alternating striæ in size.

This common Jackson *Scaphander* was well figured by Aldrich and has been identified as the same as that from Red Bluff, Mississippi, Oligocene. If the original figures of *S. primus* Aldrich are correct, the Jackson form is distinct from the Oligocene species, *S. primus*. *S. jacksonensis* is distinctly more contracted posteriorly like typical *Scaphander*. The spiral lines are finer on *S. primus*.

Dimensions.—Height, 37 mm.; greatest diameter, 20+ mm.

Types.—Holotype, No. 20015; paratypes, Nos. 20016, 20017, Paleontological Research Institution.

Occurrence.—Moodys Branch marl, localities 785, 699, 881, 879; 900. Yazoo clay, locality 915.

Genus CYLICHNINA Monterosato, 1884

Monterosato, Nomen. Gen e Spec. Conch. Mediterranee, 1884, p. 143.

Genotype by subsequent designation, Bucquoy, Dautzenberg, and Dollfus (Moll. marins Roussillon, vol. 1, 1886, p. 524), *Bulla umbilicata* Montagu (Test. Brit., I, 1803, p. 222) [*non Bulla umbilicata* Roeding in Bolten, 1798]=*Cylichna strigella* Loven[94] (Index Moll., 1846, p. 10). Living. Western Europe. Forbes and Hanley, Hist. British Moll., vol. III, 1851, p. 519, pl. CXIV, c, fig. 9.

Cylichnina jacksonensis (Meyer) Plate 64, figs. 3, 4

Cylichna Jacksonensis Meyer, 1886, Geol. Survey Alabama, Bull., vol. 1, pt. II, p. 77, pl. 2, fig. 25; Cossmann, 1893, Ann. Geol. Paléont., 12 liv., p. 50 *C. jacksonensis*.

Bullinella jacksonensis (Meyer), Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, p. 158.

Length two and a half times the breadth; umbilicate at the top and with an umbilicate fissure at the columella; the faint impressed, revolving lines are more distinct near the base and the top.

Locality.—Jackson, Miss.

Considerably more slender than the preceding species [*C. oviformis*]. *Cylichna St. Hilairii*, Lea, sp., from Claiborne, is flat, almost cylindrical, while *Cylichna Jacksonensis* is rounded. The same differences exist in regard to *Cylichna Kellogii*, Gabb, from Texas.—[Meyer, 1886.]

[94]Iredale, T.: Malacol. Soc. London, Proc., vol. XI, 1915, p. 340.

The umbilical fissure is small, the columellar callus is well developed, and in many examples thickened with an incipient fold. The microscopic spiral lines are only conspicuous on the anterior end and may become obscure posteriorly. Many specimens are smooth over the medial area. A few will show heavy but microscopic longitudinal growth stages.

Dimensions.—Height, 7+ mm.; greatest diameter, 3 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 921, 699; 912; 922; 710, 7883. Arkansas (Harris).

Cylichnina jacksonensis exta (Harris) Plate 64, figs. 1, 2

Bullinella jacksonensis exta Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, p. 158, pl. VI, fig. 3.

By comparing *C. galba* Con. with *C. jacksonensis* Meyer, it will be found that the former is much more cylindrical than the latter. The White Bluff form represents a yet greater removal from the *galba* type. Moreover, the upper extremity of the outer lip is generally slightly produced, giving the shell a *Volvaria*-like aspect. This feature is not well shown in the specimen figured.

Locality:

White Bluff, Arkansas River.—[Harris, 1894.]

The form at White Bluff differs from the typical species by having a shallower sunken spire, and the posterior portion of the labium is nearer to the apical point.

Dimensions.—Height, 7 mm.; greatest diameter, 3 mm.

Holotype.—No. 135,143, United States National Museum, Washington, D. C.

Occurrence.—Jackson of Arkansas, localities 702, 896, 1049.

Genus MNESTIA H. and A. Adams, 1854

Henry and Arthur Adams, Genera Recent Mollusca, vol. II, 1854, p. 10. Genotype by subsequent designation, Cossmann (Essais Paléoconch. comp., 1 liv., 1895, p. 99), *Bulla marmorata* A. Adams (in Sowerby, Thes. Conchyl., II, 1850, p. 594, pl. CXXV, fig. 145). Living. Philippines. Pilsbry, Manual Conch., vol. XV, 1893, p. 323, pl. 27, fig. 86.

Mnestia meyeri (Cossmann) Plate 64, fig. 5

Cylichna Dekayi Lea (var?) Meyer, 1885, Am. Jour. Sci., vol. XXIX, No. 174, p. 468; Meyer, 1887, Acad. Nat. Sci. Philadelphia, Proc., vol. XXXIX, p. 54, pl. III, fig. 10.

Volvulella Meyeri Cossmann, 1893, Ann Géol. Paléont., 12 liv., p. 49, pl. I, figs. 38-39.

Mnestia meyeri (Cossmann), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 483.

M. Meyer m'ayant envoyé trois individus de l'Eocène supérieur de Jackson, j'ai constaté, en les comparant à ceux de Claiborne, qu'ils sont beaucoup plus ventrus et plus courts: leur diamètre est au moins égal à la moitié de leur longeur; en outre leur ouverture se prolonge moins en arrière du sommet, ils ont la fente ombilicale à peu près close, leur pli columellaire est beaucoup plus gros. Pour toutes ces raisons, je suis d'avis que c'est une forme bien distincte qu'on ne peut admettre comme une simple variété de l'espèce de Lea, et par conséquent je propose de lui donner le nom *V. Meyeri, nobis.*

Loc. Jackson, post type (pl. 1, fig. 38-39) ma coll.—[Cossmann, 1893.]

Some specimens are less ventricose medially than others. The species is common and easily recognized in the Moodys Branch marl.

Dimensions.—Height, 4 mm.; greatest diameter, 2 mm.

Holotype.—Probably in the Laboratoire de Géologie de la Faculté des Sciences Université de Paris (Sorbonne). The location of the *C. Dekayi* var.? Meyer, 1886, is unknown.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 921, 699.

Genus **VOLVULELLA** Newton, 1891
(*Volvula* Adams, 1850 *non* Gistl, 1848)

Newton, Syst. List Oligocene Eocene Moll. British Mus., 1891, p. 268 substitute name for *Volvula* Adams (in Sowerby, Thes. Conch., vol. II, 1850, p. 558).

Genotype by subsequent designation, Bucquoy, Dautzenberg, and Dollfus (Moll. Marins Roussillon, vol. 7, pt. 13, 1886, p. 533), *Bulla rostrata* A. Adams (*op. cit.*, p. 596, pl. CXXV, f. 154). Living. Australia. Pilsbry, Manual Conch., vol. XV, 1893, p. 241, pl. 26, fig. 60.

Volvulella cf. minutissima (Gabb) Plate 64, fig. 24

Volvula minutissima Gabb, 1860, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. IV, p. 386, pl. 67, fig. 52; Conrad, 1865, Am. Jour. Conch., vol. I, p. 35; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 9.

Volvutella minutissima (Gabb), Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 493, pl. 74, figs. 9-12.

Gabb's figure of the lower Claiborne species is poor, and the type has been lost so that it is difficult to discern fine distinctions between forms with somewhat the shape of this species.

There is one minute specimen from Danville Landing which has a similar shape as *V. minutissima* of the lower Claiborne. It does not seem proper to differentiate the Jackson form on such meagre data both in regard to itself and *V. minutissima*. The specimen figured herein has a broken labrum.

Dimensions.—Height 1.5 mm.; greatest diameter, 1 mm.

Figured specimen. No. 20026, Paleontological Research Institution.

Occurrence.—Danville Landing beds, locality 886.

Family **ACTEONIDÆ**

Genus **ACTEON** Montfort, 1810

(*Tornatella* Lamarck, 1822)

Montfort, Conchyliol. Syst., t. 2, 1810, p. 315.

Genotype by original designation, *A. tornatilis*=*Voluta tornatilis* Linnæus (Syst. Nat., ed. XII, 1767, p. 1187). Recent. Western Europe including Mediterranean and Adriatic. Miocene-Pleistocene. Western Europe. Pilsbry, Manual Conch., vol. XV, 1893, p. 152, pl. 19, figs. 7-11, 15. Harmer, Palæont. Soc., vol. LXXV, 1923, p. 782, pl. LXII, figs. 13, 14.

Acteon idoneus Conrad Plate 63, figs. 14, 15

Acteon idoneus Conrad, 1833, Nov., Fossil Shells Tert. Form., vol. 1, No. 3, p. 45.

Acteon pomilius Conrad. Harris, 1894, Ann. Rept. Geol. Survey Arkansas for 1892, p. 158 probably.

For complete synonymy, copy of original description, illustration of the type, and discussion of the species see Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 500, pl. 74, figs. 19-22; pl. 90, figs. 1, 5, 13.

Narrow-elliptical, with narrow transversely striated sulci, which are distant on the superior portion of the body whorl; fold on the columella elevated and very obtuse; labrum thickened.—[Conrad, 1833.]

Typically this species may be easily distinguished from the other species of *Acteon* in the southern Eocene by the lack of spiral punctate striations on the upper part of the body whorl and over the greater portion of the whorls of the spire. The larger number of specimens have a single spiral punctate line below the suture, often one above the suture on the whorls of the spire. There is some variation in that feature and two or more spiral lines may occur above the smooth band on the body whorl. Occasionally a specimen will be found in which there are spiral threads covering the usual smooth area on the body whorl. In such cases the whorls of the spire show the usual smoothness.

The variation as explained is not confined to any one horizon but has been noted on specimens from different localities of the lower Claiborne, Gosport sand, and of the Jackson.

Some show a variation in the height of the spire. The spire is shortened giving a plumper appearance to the shell. This change is particularly noticeable among the shells in the collection from White Bluff, Arkansas, and such a variation might well deserve a varietal name.

Of the Eocene Acteons, *A. idoneus* represents the longest lived stock. It is found in the Sabine (Wilcox) (Harris, Bull. Amer Paleont., vol. II, No. 11, 1899, p. 5, pl. 1, fig. 4), is well distributed in the lower Claiborne, attained its largest size in the Gosport sand, and throve in the Jackson.

The lectotype, from the Gosport sand, measures 11 mm. in height. We have from the Gosport sand, fragments of which the body whorl alone measures 10 mm. in height. The tallest Jackson specimen in our collection is 7+ mm.

Dimensions.—Jackson. Height, 7+ mm.; greatest diameter, 4 mm.

Specimen figured.—No. 20013, Paleontological Research Institution.

Occurrence.—Sabine. Lower Claiborne. Gosport sand (type). Jackson, Moodys Branch marl, localities 699, 921. Jackson of Arkansas, localities 896 (var.); 897.

Acteon annectens Meyer Plate 63, figs. 26, 27

Actæon annectens Meyer, 1885, Am. Jour. Sci., 3d ser., vol. XXIX, No. 174, pp. 466, 468; Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 77, pl. II, fig. 30.

Non Actæon annectens Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 48, pl. 1, fig. 37—*A. pompilius* Conrad.

Acteon annectens Meyer, Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 498, pl. 74, fig. 30.

Conic-ovate; whorls six; one and one-half smooth, embryonic whorls form a blunt apex; adult whorls nearly flat, covered with elevated, flat, smooth spiral lines, separated by interstices of about equal breadth. These interstices are set with rather distant, elevated, transverse riblets, which, under the glass, give to the shell an almost cancellated appearance. Inner lip with a very strong and broad fold; in the oldest specimens, with a smaller one above it.

Localities.—Jackson, Miss., Red Bluff, Miss.

The figured specimen from Jackson is much larger than the others; and from Red Bluff I have only the smaller form, represented by more than a dozen specimens. Resembles *Actæon punctatus*, Lea, from Claiborne, but is much smaller, has a stronger fold, besides an additional one. The interstices between the revolving lines are larger, and the small ribs in them more distant and distinct.—[Meyer, 1886.]

Nuclear whorls fairly large for the shell, first whorl and less than one-half of another smooth; the smooth nuclear whorls are separated from the postnuclear whorls by a definite band or line. The sculpture of the conch begins abruptly on the postnuclear whorls with fine spiral ribs, the interspaces cut by longitudinal threads. Such ornamentation continues over the whole surface of the shell. There are five or six very fine spiral ribs on the first postnuclear whorls. These ribs increase in strength but decrease in number on the remaining whorls of the spire, until there are about an average of four on the penultimate whorl.

The differences between *A. annectens* Meyer and *A. pomilius* and varieties of the Claibornian has been discussed in my Claiborne monograph.

Dimensions.—Height, 5+ mm.; greatest diameter, 4 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 669, 921; 10.

Genus LITHOPHYSEMA Stewart, 1927

Stewart, Acad. Nat. Sci. Philadelphia, Proc. for 1926, vol. LXXVIII, 1927, p. 438.

Genotype by original designation, *Haminea grandis* Aldrich. Eocene. Southern United States. Plate 64, fig. 23.

Lithophysema grande (Aldrich) Plate 64, fig. 23

(See also Palmer, 1937, pl. 76, figs. 6-9.)

Haminea grandis Aldrich, 1886, Geol. Survey Alabama, Bull., No. 1, pt. 1, p. 35, pl. 3, fig. 1; Veatch, 1906, U. S. Geol. Survey, Prof. Paper 46, pl. XX, fig. 2.

Bulla (Haminea) grandis (Aldrich), de Gregorio, 1890, Ann. Géol Paléont., 8 liv., p. 169, pl. 17, fig. 10.

Scaphander grandis (Aldrich), Dall, 1890, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 17, pl. 10, fig. 9, section *Bucconia;* Cossmann, 1895, Essais Paléont. comp., 1 liv., p. 88.

Lithophysema grandis (Aldrich), Stewart, 1927, Acad Nat. Sci. Philadelphia, Proc., vol. LXXVIII, p. 438; Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 484, pl. 76, figs. 6-9.

Shell large, very thin, broadly ovate, summit rounded, with a deep pit marking the position of the spire. Surface covered with narrow, transverse striæ, with rounded spaces between; spaces below the center again subdivided by more shallow lines, closer set as the base is approached, but nearly obsolete at apex; lower extremity obliquely but broadly rounded; aperture rather large, nearly equal in width as far as shown. Inner lip represented by an exceedingly thin lamina, reflected, showing in the type a narrow, oblique umbilicus.

Locality.—Bunker Hill, La.; Jackson Group.

This species is the largest yet described from the Southern Tertiary. The specimen is partly a cast; substance of shell is thinner than ordinary writing-paper. The lines of growth and transverse striæ are well shown on cast.—[Aldrich, 1886.]

A callus covers the umbilical area with a slight groove at the back. Worn specimens or casts show a small umbilical opening but such a character is present only because the callus has been obliterated.

This species, a giant of Jackson mollusks, was discussed in my Claiborne report, and the presence of the form in what has been determined as lower Claiborne in Texas was pointed out. No new data have been brought to the attention of the writer either in regard to the age of the beds in Angelina County, Texas, or the discovery of addititonal specimens from lower Claiborne sediments. I have reëxamined the collection of *L. grande* and still cannot find any differences worthy of specific or varietal distinction between the three casts from the lower Claiborne and the specimens of *L. grande* from Jackson localities.

Until the age of the beds near Marion, Angelina County, Texas, is unquestionably established the range of this species is still in doubt. Caution should be used when determining the Jackson age of sediments on this species without corroborating evidence.

The holotype is small. Large specimens 110 mm. in height, 80 mm. in greatest diameter, are common. The species attains larger dimensions than those given. The specimens usually occur in the form of casts.

Dimensions.—Holotype, height, 45+ mm., greatest diameter, 34+ mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Lower Claiborne, localities 745 and 761; Jackson, Moodys Branch marl, localities, Bunker Hill, Ouachita River, La. (type); 1, 8, 7; 5; 881; 10, 883, 1054; 744.

Genus ABDEROSPIRA Dall, 1896

Dall, U. S. Nat. Mus., Proc. for 1895, vol. 18, 1896, p. 32.

Genotype by original designation *Bullina* (*Abderospira*) *chipolana* Dall (*loc. cit.*). Chipola Miocene. Florida. Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, pl. 59, fig. 23; Gardner, 1937, U. S. Geol. Survey, Prof. Paper, 142 F, pl. XXXVII, fig. 37.

The presence of several species of *Abderospira* in the southern Eocene modifies the range of the genus as given by Gardner, 1937, p. 273.

Abderospira oviformis (Meyer) Plate 64, figs. 21, 22

Cylichna oviformis Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 77, pl. 2, fig. 32; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 50, as *Alys*.

Length nearly double the breadth; umbilicate at the top and with an umbilicate fissure at the columella; smooth, except some faint impressed, revolving lines.

Localities.—Jackson, Miss., Red Bluff, Miss.

The type-specimen is from Jackson. The form in Red Bluff seems to be a little more flattened.—[Meyer, 1886.]

The strength of the microscopic spiral lines varies. The lines occur over the whole surface of the shell with wider interspaces over the middle of the body whorl. They become obscure on the middle area.

The species is fairly abundant in the Moodys Branch marl at Jackson, Mississippi.

Dimensions.—Height, 4 mm.; greatest diameter, 2.5 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 699; 10.

Abderospira leblanci, n. sp. Plate 64, figs. 8, 9

Shell small, plump, sides nearly parallel; perforate; slightly umbilicate; surface covered with microscopic spiral lines, coarser anteriorly and posteriorly, the interspaces cut by fine longitudinal threads.

This species differs from *A. oviformis* (Meyer), with which it bears a similarity of shape, in the character of the spiral threads. *A. oviformis* lacks the longitudinal threads dissecting the spiral interspaces. The umbilical area is not so large as in *A. oviformis*, but the columellar callus is more elongate and wider in *A. leblanci*.

In character of sculpture this species is like *A. aldrichi* (Langdon) of the Claibornian and *A. sabina* Palmer[95] of the

[95]Palmer, K. V. W.: Bull. Amer. Paleont., vol. VII, No. 32, p. 485-487, pl. 75, figs. 10, 11; pl. 75, fig. 12; *op. cit.*, vol. XXVIII, No. 112, p. 20, pl. 1, figs. 1-2.

Sabine.

Dimensions.—Height, 4.5 mm.; greatest diameter, 2.5 mm.

Holotype.—No. 20021, paratype, No. 20022, Paleontological Research Institution.

Occurrence.—Danville Landing beds, locality 6.

Family ACTEOCINIDÆ
Genus CYLICHNELLA Gabb, 1873

Gabb, Acad. Nat. Sci. Philadelphia, Proc. for 1872. vol. XXIV, 1873, p. 273.

Genotype by monotypy, *Bulla bidentata* d'Orbigny (Moll. Cuba., I, 1841, p. 125, pl. 4, figs. 13, 16; in Sagra, Hist. fis. pol. nat. Cuba, 2d pt., T. V. (Spanish ed), p. 63, pl. IV, figs. 13, 16). Living. Florida, Gulf Coast and West Indies. Pilsbry, Manual Conch., vol. XV, 1893, p. 325, pl. 22, fig. 42; pl. 27, fig. 9.

Cylichnella bitruncata (Meyer) Plate 64, figs. 19, 20

Bulla bitruncata Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 76, pl. 2, fig. 24.

Short and stout; spire hidden; columella anteriorly with a strong, oblique fold; surface covered with indistinct, elevated, rounded, revolving lines.

Locality.—Jackson, Miss.—[Meyer, 1886.]

This species is easily determined by its heavy columellar callus with a stout fold, thickened labrum, and posterior area of the aperture.

This species has a stouter columellar fold than the type of the genus and in that respect is more like *C. ovumlacerti* (Guppy) (Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., vol. LXXIII, 1922, p. 311, text figure 7) from the Miocene of Santo Domingo.

Dimensions.—Height, 5 mm.; greatest diameter, 3.5 mm.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 699.

Genus TORNATELLÆA Conrad, 1860

Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. IV, 1860, p. 294.

Genotype by monotypy, *T. bella* Conrad (*loc. cit.*, pl. 47, fig. 23). Sabine (Wilcox) Eocene. United States. Plate 64, fig. 10.

Tornatellæa lata (Conrad) Plate 64, figs. 11-16

Actæon latus Conrad, 1834, ? p. in Morton, Synopsis Organic Remains

Cretaceous Group, p. 4; d'Orbigny, 1850, Prodrome Paléont., vol. II, p. 343.

Actæon (*Nucleopsis*) *latus* Conrad, 1865, Am. Jour. Conch., vol. 1, p. 34.

Tornatellæa lata Conrad, 1865, Am. Jour. Conch., vol. 1, pp. 145, 192, 212, pl. 20, fig. 13; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 9.

Tornatellæa bella (Conrad), de Gregorio, 1890, Ann. Géol. Paléont., 8 liv., p. 166 *partim*, pl. 16, fig. 20 copy original figure. Palmer, 1937, Bull. Amer. Paleont., vol. VII, No. 32, p. 501, *partim*, pl. 90, fig. 21, figured holotype of *T. lata*.

Subglobose, with numerous revolving lines; spire short, acute; aperture patulous; columella with two distant plaits.

Actæon latus, Conrad, Eocene Catalogue, p. 34.

Locality.—Alabama.—[Conrad, 1865, p. 145.]

Suboval, spire acute; whorls 5, convex; body whorl ventricose; ribs close and numerous; columella with 2 distant plaits.

Locality.—Alabama?—[Conrad, 1865, p. 212.]

In 1937 there did not seem to be much information on *T. lata* (Conrad), and I tentatively gave notes and figured the type under the heading, *T. bella* Conrad. It now seems that *T. lata* is not the same as *T. bella*. Although there are no new data as regards the type to contribute since that time, specimens have been found in the Gosport sand at Little Stave Creek, Clarke County, at Baker's Bluff (Gopher Hill), Washington County, and Bladon Springs road, ¾ mile east of Fail P. O., Choctaw County, Alabama, of the species of *Tornatellæa* which occurs abundantly at Garland Creek, Mississippi, Jackson Eocene.

Miss Winnie McGlamery wrote me in 1939 that they had found "*T. lacta*" at the first two localities mentioned above. Miss McGlamery kindly loaned the collections mentioned as well as shells from near Fail, Alabama. Probably *T.*, sp. in Dr. Gardner's list (Jour. Paleont., vol. 13, No. 3, 1939, p. 343) refers to the same form. Our collections now include specimens from Little Stave Creek and Gopher Hill.

The first reference to *T. lata* was by Conrad in Morton, 1834, p. 4, but with the locality not given. In 1865, p. 192, Conrad in "Corrections and Additions" to his "Catalogue of Eocene and Oligocene Fossils," definitely separated *T. bella* and *T. lata*. In the description of the species, 1865, p. 212, he questioned Alabama as the type locality. There is, therefore, no definite proof as to the exact horizon at which to assign the type of *T. lata*.

The shell marked as type in the Academy of Natural Sciences, Philadelphia, is a poor specimen (as can be seen from the illustration, Palmer, 1937, pl. 90, fig. 21; Conrad's figure is reconstructed) to represent such a well-developed species with perfectly preserved shells as occur in the Gosport sand at certain localities and in the Jackson at Garland Creek. The type was a subglobose individual More specimens from Garland Creek correspond to the typical shape than do those from the Gosport sand localities. The shells from the Gosport material differ in general from those at Garland Creek, but there is much variation in the shape amongst the Garland Creek specimens with some approaching the shape of the Gosport sand variety. It seems unwise to separate specifically at this time the forms discovered at Little Stave Creek, Gopher Hill, and near Fail, Alabama, from the Jackson representatives at Garland Creek although each horizon apparently has its own variation.

The extended description included is, therefore, taken from specimens from Gosport sand and Jackson Eocene localities. I am restricting *T. bella* to the Sabine (Wilcox) Eocene.

Shell large; spire consists of six or seven whorls; nuclear whorls composed of about 1½ smooth whorls; postnuclear whorls ornamented with flat spiral ribs with linear punctate interspaces; postnuclear sculpture is not sharply demarcated from the nuclear whorls; four to seven spiral ribs on the whorls of the spire varying with size and age of specimens. Earliest whorls and largest specimens seem to have the largest number of revolving ribs. Medium-sized shells have an average of four or five spiral ribs. Interspaces between the revolving ribs become larger with age. The shape varies. Some individuals are shorter spired and the body whorl is more gibbose than others. Illustrations from one locality, Garland Creek, have been included, to show such variation. Labrum thickened and coarsely crenulated; commonly, previous stages of growth may be noted by the presence of earlier series of crenulations on the interior of the labrum.

T. bella (Plate 64, fig. 10) differs from *T. lata* in having a narrower and more attenuated shape with a broader body whorl.

T. lata is a larger species than *T. bella*.

Dimensions.—Height, 21.4 mm.; greatest diameter, 11.7 mm. Holotype, height, 16 mm.; greatest diameter, 11 mm.

Holotype.—Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Alabama ? (type). Gosport sand. Jackson, Moodys Branch marl, localities 700, 900, 1100, 1098, 1099.

Family **UMBRACULIDÆ**

Genus **UMBRACULUM** Schumacher, 1817

Umbraculum Schumacher, 1817, Essais Nouveau Syst. Hab. Vers. Test., p. 177; Dall, 1889, Mus. Comp. Zoöl. Harvard, Bull., vol. XVIII, p. 29; Harris, 1897, Cat. Tert. Moll. British Mus., Pt. I, Australasian Tert. Moll., p. 22.

Umbrella Lamarck, 1819, Hist. nat. An. sans Vert., VI, p. 339.

Operculatum H. and A. Adams, 1854, Genera Recent Moll., vol. II, p. 41.

Umbrella [*sic*] Cossmann, 1895, Essais Paléoconch. comp., 1 liv., p. 131 "*non Umbrella* Lamarck *sed* Chemnitz."[96]

Genotype by monotypy, *Umbella chinensis* Martini (Neues Syst. Conch. Cab., I, 1769, p. 103, t. VI, fig. 44; Chemnitz, X, 1788, p. 341, t. 169, figs. 1645, 1646) = *Patella sinica* Gmelin and *P. umbellata* Gmelin, Syst. Nat., 13 ed., pp. 3705, 3720 *non Patella chinensis* Linnæus, 1758, p. 781= *Calyptræa lævigata* Lamarck). Living. East Africa to Hawaiian Islands. Tryon and Pilsbry, Manual Conch., vol. XVI, 1895-6, p. 180, pl. 70, figs. 58-60; pl. 71, figs. 63-65; pl. 72, figs. 70, 71.

Umbraculum planulatum (Conrad) Plate 64, figs. 17, 18

Umbrella planulata Conrad, 1854, Wailes, Rept. Agr. and Geol. Mississippi, p. 289, pl. XIV, figs. 1a, 1b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 259; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 5, 19, pl. 1, figs. 1a, 1b; Vaughan, 1896, U. S. Geol. Survey, Bull., No. 142, p. 50; Veatch, 1906, U. S. Geol. Survey, Prof. Paper 46, pl. XX, figs. 1, 1a.

Operculatum plannlatum (Conrad), Conrad, 1865, Am. Jour. Conch., vol. 1, p. 35 typographical error in specific name.

Operculatum planulatum (Conrad), Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, pp. 24, 37.

? *Umbrella planulata* Aldrich, 1887, Cincinnati Soc. Nat. Hist., Jour., vol. X, No. 2, p. 82.

Umbraculum planulatum (Conrad), Tryon and Pilsbry, 1895-6, Manual Conch., vol. XVI, p. 177.

Suboval, flattened, surface undulated, rising a little towards the apex, which is prominent and acute, and situated much nearer to one side and nearer to one end; lines of growth conspicuous; inner side with a very large suboval cicatrix, with radiating interrupted lines.

[96]Cossmann intended to revive the term of Chemnitz, 1788. However, neither Chemnitz nor Martini used the name "*Umbrella*." Their spelling was *Umbella* so that if the name of Chemnitz is ruled as valid it could not be as Cossmann has transcribed it nor would it be confused with Lamarck's *Umbrella* except as authors have misspelled the Chemnitz name.

This fine species is the only one yet known in North America. Two specimens occur, one of which is marked with some hair-like brown radiating lines, both internally and externally.—[Conrad, 1855.]

This species is, so far as our collections are concerned, limited to the Jackson Eocene. Aldrich (1887, p. 82) identified a small specimen from near Palestine, Texas, in a typical Clai-bornian fauna, as the young of *U. planulata.* Harris described an *Umbraculum* from the Sabine (Wilcox) at Woods Bluff, Alabama (Bull. Amer. Paleont., vol. III, No. 11, 1899, p. 10).

Dimensions.—Greatest width, 62+ mm. (lectotype).

Lectotype.—No. 13191, Academy of Natural Sciences, Philadelphia, Pa.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); localities 785, 880, 881; 10, 11, 883.

Order **PTEROPODA**

Suborder **THECOSTOMATA**

Genus **CLIO** Linnæus, 1767

Clio Browne, 1756, Civil and Natural History Jamaica, p. 386.
Clio Linnæus, 1767, Systema Naturæ, 12 ed., t. 1, pars II, p. 1094; Gray, 1847, Zoöl. Soc. London, Proc., pt. XV, p. 203; Pelseneer, 1888, Voy. *Challenger,* Zoöl., vol. XXIII, p. 42.
Non Clio Pallas, 1774, Spicilegia Zoologica, fasc. X, p. 28, pl. 1, figs. 18, 19; Lamarck, 1819, Hist. nat. An. sans Vert., t. VI, p. 286; Lamarck, *op. cit.*, 2d ed., Deshayes and Milne Edwards, 1836, t. VII, p. 423; Souleyet, 1852, Voy. autour du Monde, *La Bonite,* Zool., t. 2, p. 275.
Cleodora Péron and Lesueur, 1810, Ann. Mus. nat. Hist. nat., t. XV, p. 66, monotype; Lamarck, 1819, *op. cit.*, p. 290; Deshayes and Milne Edwards, 1836, *op. cit.*, p. 429.
Clione Pallas, Gray, 1847, *op. cit.*, p. 204.

Genotype by subsequent designation, Gray, 1847 (*op. cit.*, p. 203), *Clio pyramidata* Linnæus (*loc. cit.*). Living. Atlantic Ocean; Mediterranean; Indian Ocean; Pacific Ocean. D'Orbigny, Voy. Amer. Merid., t. V, p. 113, pl. VII, figs. 25-29 (as *Cleodora*).

Subgenus **CRESEIS** Rang, 1828

Rang. Ann. Sci. nat., n. s., t. 13, 1828, p. 305.

Subgenotype by subsequent designation, Pelseneer (Voy. *Challenger,* Zoöl., vol. XXIII, 1888, p. 45), *Creseis acicula* Rang (*op. cit.*, p. 318, pl. 17, fig. 6). Living. Central America, Mediterranean, and Indian Ocean. Pacific Ocean. Souleyet, Voy. *Bonite,* Zoöl., t. II, pl. VIII, figs. 10-17 (as *Cleodora*); Collins, 1934, Johns Hopkins Univ. Studies Geol., No. 11, p. 207, pl. IX, figs. 6-7; pl. XIII, figs. 7-8.

Clio (Creseis) corpulenta (Meyer) Plate 62, figs. 25, 26

Styliola corpulenta Meyer, 1886, Bericht Senkenberg. naturf. Gesell., p. 9, pl. 2, fig. 16; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 51.
Meioceras cocoense (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans.,

vol. 3, pt. 11, p. 302.

Cleodora (*Creseis*) *corpulenta* (Meyer), Collins, 1934, Johns Hopkins Univ. Studies Geol., No. 11, p. 206, pl. IX, fig. 4; pl. XIII, fig. 3.

Verlängert kegelförmig; gerade oder schwach gebogen. Querschnitt Kreisförmig. Spitzes Ende mit Auftreibung.

Diese Art is. seltener als *Styliola simplex* Mr. von derselben Lokalität. —[Meyer, 1886.]

For additional notes and measurements see Collins's paper on the pteropods.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Clio (Creseis) simplex (Meyer) Plate 62, figs. 23, 24

Styliola simplex Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 78, pl. 3, fig. 10; Cossmann, 1893, Ann. Géol. Paléont., 12 liv., p. 51.

Creseis simplex (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 430.

Cleodora (*Creseis*) *simplex* (Meyer), Collins, 1934, Johns Hopkins Univ. Studies Geol., No. 11, p. 207, pl. IX, fig. 5; pl. XIII, fig. 6.

Shell subulate, nearly straight, smooth; section circular.

Locality.—Jackson, Miss.

The closed end of this species is not inflated.—[Meyer, 1886.]

Supplementary notes on the species have been given by Collins.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type); locality 921.

Clio (Creseis) hastata (Meyer)

Styliola hastata Meyer, 1886, Geol. Survey Alabama, Bull., No. 1, pt. II, p. 78; de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 15, pl. 17, figs. 56, 57.

Creseis hastata (Meyer), Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, pp. 430, 432.

Cleodora (*Creseis*) *hastata* (Meyer), Collins, 1934, Johns Hopkins Univ. Studies Geol., No. 11, p. 204, pl. IX, fig. 1; pl. XIII, figs. 1-2.

Clio (*Creseis*) *hastata* (Meyer), Shimer and Shrock, 1944, Index Fossils North America, p. 517.

Shell subulate, nearly straight; section circular; closed end inflated.

Localities.—Vicksburg, Miss. (Higher and Lower Vicksburgian). Red Bluff, Miss.

Seems to be of smaller size than the preceding species. The type-specimen is from the Lower Vicksburgian.—[Meyer, 1886.]

Dr. Collins has added additional notes on this species and figured the type. The reader is referred to those. The species was described from the Oligocene at Vicksburg and Red Bluff, Mississippi. Collins has identified the species in the Moodys Branch marl from Garland Creek and near Jackson, Mississippi.

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Oligocene (type). Jackson, Moodys Branch marl, Garland Creek, and near Jackson, Miss. (Collins).

Genus **BOVICORNU** Meyer

Meyer, Geol. Survey Alabama, Bull., No. 1, pt. II, 1886, p. 79.

Genotype by monotypy, *B. eocenense* Meyer (*loc. cit.*, pl. 3, fig. 2). Red Bluff Oligocene. Red Bluff, Mississippi. Collins, Johns Hopkins Studies Geology, No. 11, 1934, pl. IX, fig. 3; pl. XIII, fig. 5.

This genus, as Collins has pointed out (p. 166), may prove to be synonymous with *Euchilotheca* Fischer of the Paris Basin Eocene.

Bovicornu gracile Meyer Plate 62, figs. 21, 22

Bovicornu gracile Meyer, 1886, Bericht Senckenberg. naturf. Gesell., p. 9, pl. 2, fig. 17; Collins, 1934, Johns Hopkins Univ. Studies Geol., No. 11, p. 213, pl. IX, fig. 8; pl. XIII, fig. 4.

Meioceras eocenense (Meyer), Dall, 1892, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 302 *partim*.

Schlanker und stärker spiralig gewunden als *Bovicornu eocenense* Md.*) von Red Bluff; auch fehlt die Auftreibung an der Spitze.

*Bull. 1. Geol. Survey Ala. 1886, p. 79, Taf. 3 Fig. 12.

Diese Art dürfte typischer für das genus *Bovicornu* sein, als die zuerst von mir beschriebene.—[Meyer, 1886.]

The additional notes and illustration by Collins of this form indicate that the genus is a pteropod and not the second stage of *Meioceras* as stated by Dall. Dall's reasoning is based on the similarity of the twisted shapes of the two genera. However, Collins has demonstrated that the shell of *Bovicornu* has the swollen or bulblike inflation of the apical area which is not present on the cæcid stage. Several other differences between the characters of Meyer's type and *Meioceras* are brought out by Collins (p. 212).

Dimensions.—Height, 2.6 mm.; greatest diameter, 0.5 mm. (holotype).

Holotype.—Geology Department, the Johns Hopkins University, Baltimore, Md.

Occurrence.—Moodys Branch marl, Jackson, Miss. (type).

Class CEPHALOPODA

Order NAUTILOIDEA

Genus ATURIA Bronn, 1838

Bronn, Letnæa Geognostica, vol. 2. 1838, pp. 1122-1123, pl. 42, fig. 17 a-e.

Genotype by subsequent designation, Herrmannsen, 1846 (Indicis Gen. Mal., vol. I, p. 90). *Nautilus aturi* Basterot (Soc. Hist. nat. Paris, Mem., vol. 2, pt. 1, 1825, pp. 12, 17-18). Burdigalian (lower Miocene). France. Schenck, Univ. California Pub., Bull. Dept. Geol. Sci., vol. 19, No. 19, pl. 72, figs. 3, 4.

Aturia alabamensis (Morton) Plate 65, fig. 8

Nautilus Alabamensis Morton, 1834, Synopsis Org. Remains Cretaceous Group, p. 33, pl. 18, fig. 3; Morton, 1842, Acad. Nat. Sci. Philadelphia, Jour., 1st ser., vol. VIII, p. 217; Aldrich, 1886, Geol. Survey Alabama, Bull., No. 1, pt. 1, p. 43.

Aturia, sp., Edwards, 1849, Palæont. Soc., pp. 52, 55.

Megasiphonia Alabamensis (Morton), d'Orbigny, 1850, vol. 1, p. 338.

Aturia alabamensis (Morton), Conrad, 1865, Am. Jour. Conch., vol. 1, p. 15; Conrad, 1866, Smithsonian Misc. Coll., vol. VII, No. 200, p. 26; Cooke, 1915, U. S. Geol. Survey, Prof. Paper, 95, pp. 111, 116-117; Hopkins, 1917, U. S. Geol. Survey, Bull. 661-H, p. 296 (as *Belosepia ungula*), pl. 27, fig. 1; Cooke, 1926, Geol. Survey Alabama, Spec. Rept., No. 14, pl. 96, fig. 6; Kellum, 1926, U. S. Geol. Survey, Prof. Paper, No. 143, pp. 7, 8, 11, 32; Schenek, 1931, Univ. California Pub., Bull. Geol. Sci., vol. 19, No. 19, pls. 77, 78; Aldrich, 1931, Geol. Survey Alabama, Mus. Paper 12, p. 7, pl. 4, fig. 1; Gardner, in Trowbridge, 1932, U. S. Geol. Survey, Bull., 837, pl. 43, figs. 4-5; Miller and Furnish, 1938, Jour. Paleont., vol. 12, No. 2, p. 153, pl. 25, figs. 1, 2, 5, 6; Stenzel, [1942], Type Invertebrate Fossils North America, Cephalopoda 21a, 21b, figs. 1-2b.

Aturia ziczac (Sowerby), Geinitz, 1887, Neues. Jarb., Bd. 2, pp. 53-56, pl. III *partim*.

Aturia ziczac (Sowerby), de Gregorio, 1890, Ann. Géol. Paléont., 7 liv., p. 14 *partim*.

Aturia ? Alabamensis (Morton), de Gregorio, 1890, *op. cit.*, p. 15, pl. 1, fig. 39.

Nautilus alabamiensis Morton, Cossmann, 1893, Ann. Géol. Paleont., 12 liv., p. 51.

Aturia (near *alabamensis*) (Morton), Dall, 1903, Wagner Free Inst. Sci., Trans., vol. 3, pt. VI, p. 1557.

Aturia (*Brazaturia*) *alabamensis* (Morton), Stenzel, 1935, Jour. Paleont., vol. 9, No. 7, p. 556, pl. 63, figs. 2 a-b; text fig. 5.

Shell suboval, compressed; septæ profoundly sinuous; siphuncle very large. Length 10 inches; height 9 inches; greatest diameter 4½ inches.

From the newer cretaceous rocks, near Claiborne, Alabama.—[Morton, 1834.]

This species has been described and figured in detail by Stenzel, and Miller and Furnish have enumerated the characters of Mexican specimens. It is not necessary to repeat such data here.

Through the courtesy of Miss McGlamery of the Alabama Museum of Natural History, the specimen figured by Schenck, 1931, Aldrich, 1931, and Stenzel, 1942, was loaned to the author. An illustration of that shell is included herein.

Prof. G. D. Harris collected several large crushed fragments of a discoidal "*Aturia*" from the clays 5 feet above the water's edge and below typical Red Bluff Oligocene at Red Bluff, "about ¼ mile above R. R. bridge, south of Shubuta, Mississippi," presumably from the uppermost Jackson.

Holotype.—No. 16120, Academy of Natural Sciences, Philadelphia, Pa. (*Fide* A. K. Miller, *in litt.*)

Occurrence.—Jackson Eocene: "Near Claiborne, Ala." (Morton), the probable holotype was labeled "near Mobile, Ala., Dr. Wm. Spillman," (*fide* A. K. Miller, *in litt.*) ; localities 794 ; 1091 ; Danville Landing beds, locality 886.

PLATES

PLATE 26

22. **Dentalium mississippiense jacksonense, n. var.** 212
Paratype. Length, 39.3 mm.; greatest diameter, 4.4 mm.; loc. 879. Jackson, Miss; No. 4478, Pal. Res. Inst.

23. **Dentalium danvillense, n. sp.** 210
Paratype. Length. 17.3 mm.; greatest diameter, 3 mm.; loc. 20, Carters Landing, La.; No. 4476, Pal. Res. Inst.

24. **Dentalium danvillense, n. sp.** 210
Paratype. Length, 6 mm.; greatest diameter, 4 mm.; loc. 6, Danville Landing, La.; No. 4475, Pal. Res. Inst.

25. **Dentalium danvillense, n. sp.** 210
Paratype. Length, 3.5 mm.; greatest diameter, 3.4 mm.; loc. 6, Danville Landing, La.; No. 4474, Pal. Res. Inst.

26. **Dentalium danvillense, n. sp.** 210
Paratype. Length, 25.7 mm.; greatest diameter, 3.2 mm.; loc. 6, Danville Landing, La.; No. 4473, Pal. Res. Inst.

27. **Dentalium danvillense, n. sp.** 210
Holotype. Length, 37.6 mm.; greatest diameter, 4 mm.; loc. 6, Danville Landing, La.; No. 4472, Pal. Res. Inst.

28. **Dentalium minutistriatum Gabb** 210
Length, 10 mm.; greatest diameter, 3.2 mm.; loc. ? 10, Montgomery, La.; No. 4471, Pal. Res. Inst.

29. **Dentalium vincense, n. sp.** 209
Paratype. Length, 7.5 mm.; greatest diameter, 1 mm.; loc. 896, White Bluff, Ark.; No. 4470, Pal. Res. Inst.

30. **Dentalium vincense, n. sp.** 209
Holotype. Length, 10.3 mm.; greatest diameter, 1.5 mm.; loc. 897. Vince Ferry, Ark.; No. 4468, Pal. Res. Inst.

31. **Dentalium vincense, n. sp.** 209
Paratype. Length, 9.6 mm.; greatest diameter, 1.4 mm.; loc. 897, Vince Ferry, Ark.; No. 4469, Pal. Res. Inst.

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Explanation of Plate 26

Figure — Page

1. **Cadulus jacksonensis** Meyer 216
   Length, 9.3 mm.; greatest diameter, 1.3 mm. Enlarged to show slits and coloration rings. Loc. 921, Jackson, Miss.; No. 4485, Pal. Res. Inst.

2, 3. **Cadulus jacksonensis** Meyer 216
   Same specimen as figure 1. Showing complete specimen. Figure 3 side view.

4. **Cadulus jacksonensis** Meyer 216
   Copy Meyer, Geol. Survey Alabama, Bull. 1, pt. II, pl. III, figs. 8a, 8b.

5. **Cadulus jacksonensis** Meyer 216
   Copy, Meyer, *ibid.*, pl. III, fig. 8. Length, 8.5 mm.

6. **Dentalium subcompressum** Meyer 214
   Copy, Meyer, *ibid.*, pl. III, figs. 3, 3a. Length, 6.5 mm.

7. **"Dentalium bitubatum"** Meyer 215
   Copy, Meyer, *ibid.*, pl. III, fig. 1. Length, 3.5± mm.

8-10. **Cadulus margarita**, n. sp. 217
   Holotype. Length, 10 mm.; greatest diameter, 1.5 mm. Enlarged to show slits. Loc. 699, Jackson, Miss.; No. 4483, Pal. Res. Inst.

11. **Cadulus margarita**, n. sp. 217
   Paratype. Length, 9.5 mm.; greatest diameter, 1.8 mm.; loc. 699, Jackson, Miss.; No. 4484, Pal. Res. Inst.

12. **Dentalium danai** Meyer 213
   Copy, Meyer, *ibid.*, pl. III, fig. 2. Length, 5 mm.

13. **Dentalium danai** Meyer 213
   Copy, Meyer, *ibid.*, pl. III, fig. 2a. Length, 5 mm.

14. **Cadulus juvenis** Meyer 216
   Copy, Meyer, *ibid.*, pl. III, fig. 4. Length, 2+ mm.

15. **Dentalium** cf. **subcompressum** Meyer 214
   Length, 8.3 mm.; greatest diameter, 1.5 mm.; loc. 699, Jackson, Miss.; No. 4481, Pal. Res. Inst.

16. **Melanella jacksonensis** (de Gregorio) 224
   Height, 5.4 mm.; greatest diameter, 1.3 mm.; Jackson, Miss; No. 4487, Pal. Res. Inst.

17. **Niso umbilicata** (Lea) 225
   Height, 13.4 mm.; greatest diameter, 5 mm.; loc. 6, Danville Landing, La.; No. 4486, Pal. Res. Inst.

18. **Dentalium** cf. **danai** Meyer 218
   Length, 16.5 mm.; greatest diameter, 2.6 mm.; loc. 699, Jackson, Miss.; No. 4482, Pal. Res. Inst.

19. **Dentalium**, sp. 213
   Length, 26.4 mm.; greatest diameter, 3.4 mm.; St. Stephens Bluff, Ala.; No. 4480, Pal. Res. Inst.

20. **Dentalium mississippiense jacksonense**, n. var. 212
   Paratype. Length, 36 mm.; greatest diameter, 5.5 mm.; loc. 881, Jackson, Miss.; No. 4479, Pal. Res. Inst.

21. **Dentalium mississippiense jacksonense**, n. var. 212
   Holotype. Length, 62.6 mm.; greatest diameter, 6.5 mm.; loc. 693, Jackson, Miss.; No. 4477, Pal. Res. Inst.

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PLATE 27

EXPLANATION OF PLATE 27

Figure		Page
1.	**Solariorbis quadrangularis** (Meyer) Height, 1.5 mm.; greatest diameter, 3 mm.; Jackson, Miss.; No. 4495, Pal. Res. Inst.	232
2.	**Solariorbis quadrangularis** (Meyer) Same specimen as fig. 1; ventral view.	232
3.	**Circulus ottonius**, n. n. Height, 2.5 mm.; greatest diameter, 5 mm.; Jackson, Miss.; No. 4494, Pal. Res. Inst.	231
4.	**Circulus ottonius**, n. n. Same specimen as fig. 3; ventral view.	231
5.	**Solariorbis subangulatus** (Meyer) Height, 1.5 mm.; greatest diameter, 2.5 mm.; Jackson, Miss.; No. 4496, Pal. Res. Inst.	233
6.	**Solariorbis subangulatus** (Meyer) Same specimen as fig. 6; ventral view.	233
7.	**Solariorbis subangulatus** (Meyer) Height, 1.5 mm.; greatest diameter, 3 mm.; Jackson, Miss.; No. 4497, Pal. Res. Inst.	233
8-10.	**Solariella cancellata jacksonia**, n. var. Holotype. Height, 3+ mm.; greatest diameter, 3.5 mm.; Jackson, Miss.; No. 4492, Pal. Res. Inst.	229
11.	**Diodora tenebrosa antica**, n. var. Paratype. Height, 3± mm.; length, 6± mm.; width, 5± mm.; lower Claiborne Eocene, Cook Mountain formation, Wautubbee, Miss.; No. 4488, Pal. Res. Inst.	218
12.	**Diodora tenebrosa antica**, n. var. Paratype. Height, 2.5 mm.; length, 4.5 mm.; width, 3.5 mm.; lower Claiborne Eocene, Cook Mountain formation, Wautubbee, Miss.; No. 4489, Pal. Res. Inst.	218
13.	**Diodora tenebrosa antica**, n. var. Paratype. Height, 6.5 mm.; length, 14 mm.; width, 10 mm. (specimen crushed); lower Claiborne Eocene, Cook Mountain, Hammett's Branch, La.; No. 4490, Pal. Res. Inst.	218
14.	**Puncturella jacksonensis** Meyer Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 15.	221
15,16.	**Diodora tenebrosa veatchi**, n. var. Holotype. Height, 3.5 mm.; length, 7.5 mm.; width, 5.5 mm.; loc. 9, Gibson Landing, La.; No. 4491, Pal. Res. Inst.	219
17,18.	**Tornus infraplicatus** (Johnson) Height, 1 mm.; greatest diameter, 2.5 mm.; Jackson, Miss. No. 4493, Pal. Res. Inst.	231
19.	**Pyramidella crassispirata** (Meyer) Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 13.	227

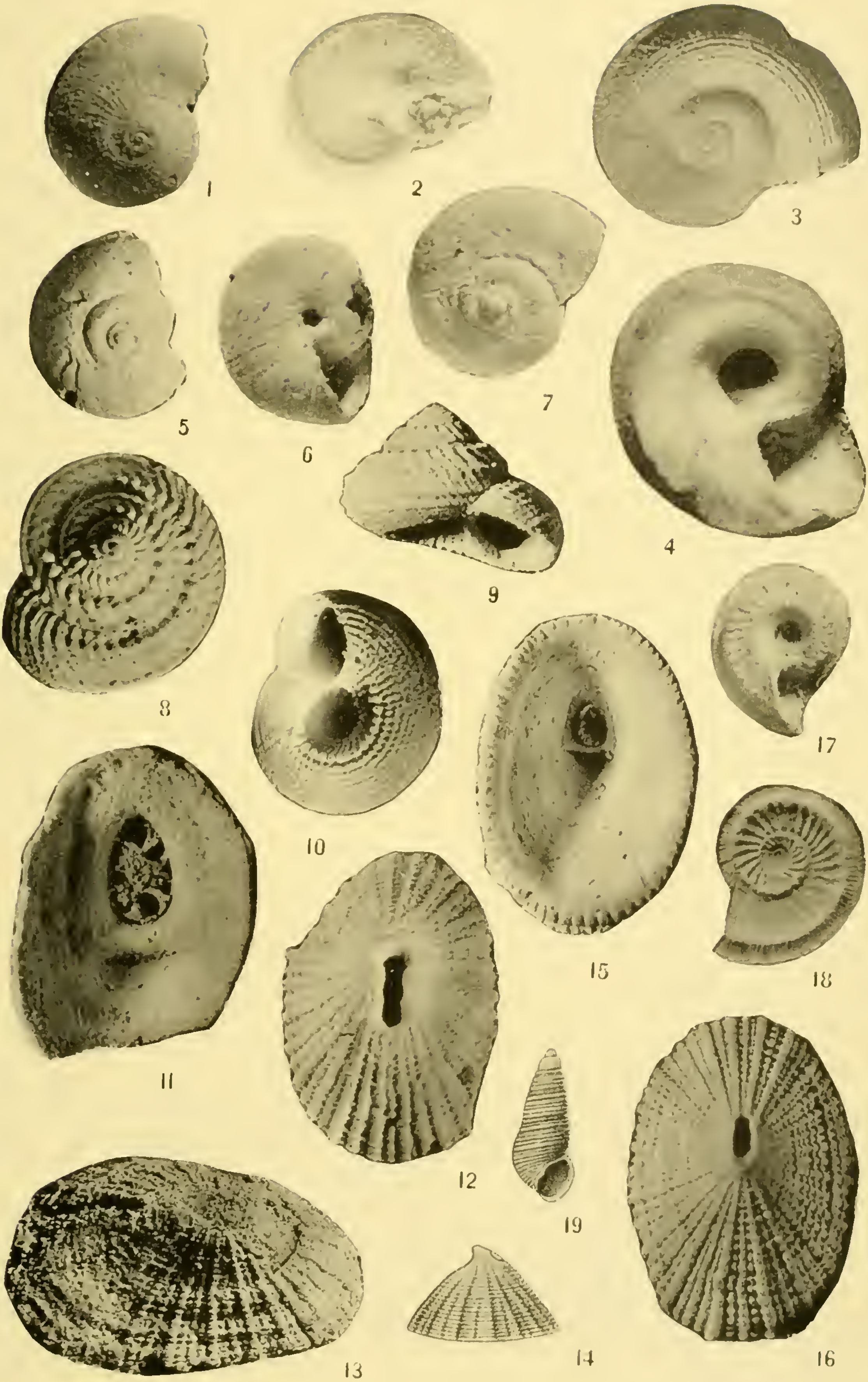
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PLATE 28

17. **Cirsotrema nassulum creolum**, n. var. 242
Holotype. Height, 23.6 mm.; greatest diameter, 10 mm.; loc. 10, Montgomery, La.; No. 4504, Pal. Res. Inst.

18. **Pliciscala pearlensis** (Meyer) 243
Height, 3 mm.; greatest diameter, 1 mm.; Jackson, Miss.; No. 4505, Pal. Res. Inst.

19. **Cirsotrema ranellinum** (Dall) 237
Height, 21.6 mm.; greatest diameter, 13.3 mm.; loc. 794, Shubuta, Miss.; No. 4501, Pal. Res. Inst.

20. **Acrilla unilineata** (Heilprin) 244
Aldrich's original figure of holotype, published in Bull. Amer. Paleont., vol. II, No. 8, pl. 3, fig. 5a.

EXPLANATION OF PLATE 28

Figure — Page

1. **Teinostoma moodiënse**, n. sp. 221
   Holotype. Height, 2 mm.; greatest diameter, 3.7 mm.; Jackson, Miss.; No. 4498, Pal. Res. Inst. The genus and species of *Teinostoma* are out of place in text. They should be under Cyclostrematidæ, p. 230.
2. **Teinostoma verrilli** Meyer 222
   Height, 1 mm.; greatest diameter, 2 mm.; loc. 921, Jackson, Miss.; No. 4499, Pal. Res. Inst.
3. **Teinostoma moodiënse**, n. sp. 221
   Same specimen as figure 1.
4. **Teinostoma verrilli** Meyer 222
   Same specimen as figure 2.
5. **Acrilla unilineata** (Heilprin) 244
   Height, 3.5 mm.; greatest diameter, 1.5 mm.; loc. ?; No. 4506, Pal. Res. Inst.
6. **Turbonilla major** Meyer 229
   Height, 3.5 mm.; greatest diameter, 1.5 mm.; loc. 921, Jackson, Miss.; No. 4755, Pal. Res. Inst.
7. **Pyramidella meyeri** (Cossmann) 225
   Height, 4 mm.; greatest diameter, 1 mm.; loc. 921, Jackson, Miss.; No. 4500, Pal. Res. Inst.
8. **Cirsotrema danvillense**, n. sp. 240
   Holotype. Height, 17.4 mm.; greatest diameter, 8 mm.; loc. 6, Danville Landing, La.; No. 4502, Pal. Res. Inst.
9. **Mathilda regularis** (Meyer) 234
   Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 12.
10. **Tenuiscala aspersa** (Meyer) 236
    Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 11.
11. **Turbonilla major** Meyer 229
    Copy, Meyer, Acad. Nat. Sci. Philadelphia, Proc., vol. XXXIX, pl. III, fig. 3.
12. **Acrilla unilineata** (Heilprin) 244
    Aldrich's original figure of holotype, published in Bull. Amer. Paleont., vol. II, No. 8, pl. 3, fig. 5.
13. **Pliciscala cribrum** (Cooke) 244
    Copy, Cooke, Washington Acad. Sci., Jour., vol. 16, No. 5, p. 135, fig. 11.
14. **Cf. Cirsotrema nassulum** (Conrad) 242
    Copy, Conrad, Wailes, Rept. Agr. Geol. Mississippi, pl. XVI, fig. 6.
15. **Pliciscala pearlensis** (Meyer) 243
    Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 9.
16. **Cirsotrema danvillense**, n. sp. 240
    Paratype. Height, 20.8 mm.; greatest diameter, 10.7 mm.; loc. 6, Danville Landing, La.; No. 4503, Pal. Res. Inst.

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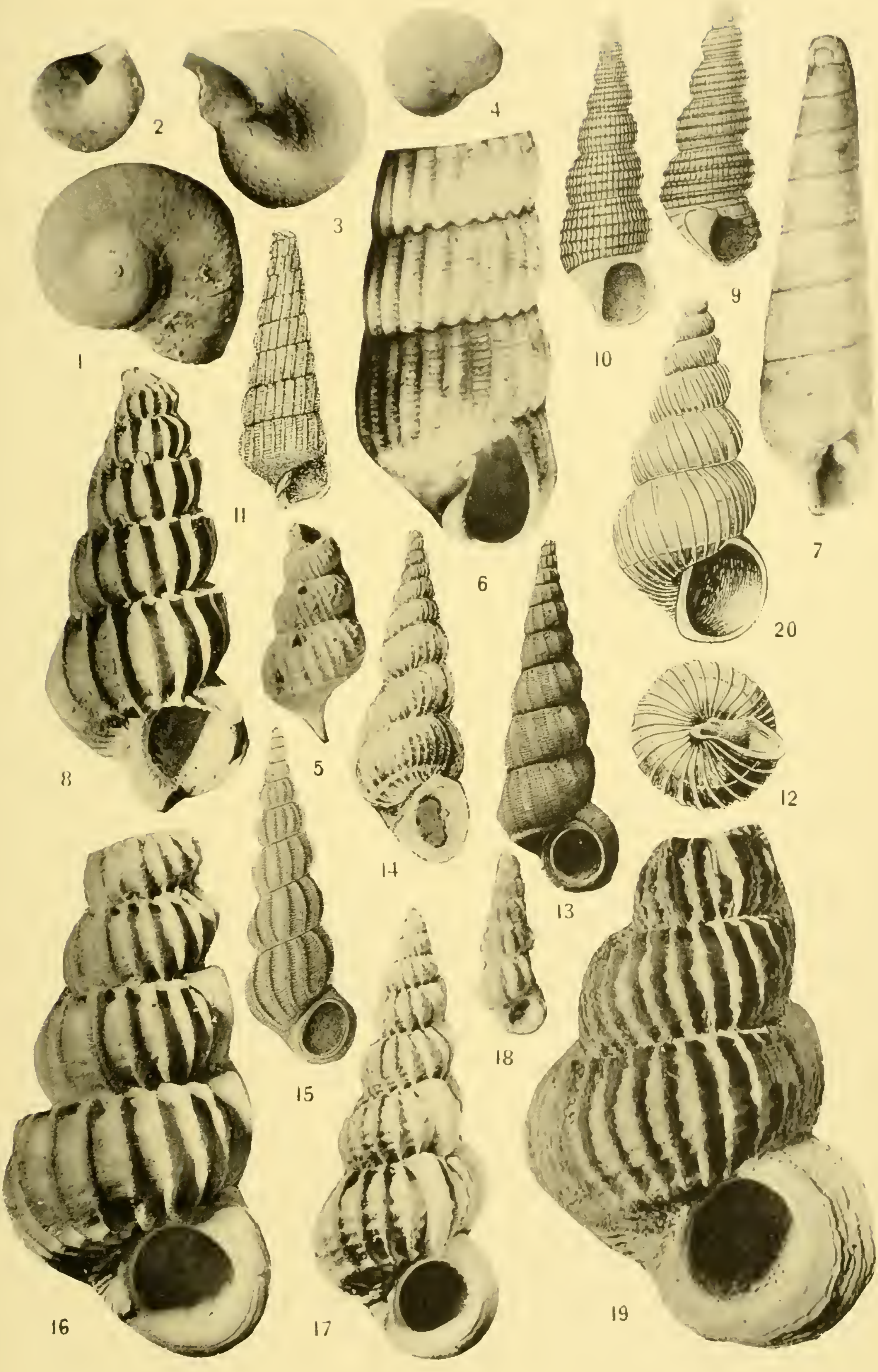
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PLATE 29

18. **Euspira jacksonensis**, n. sp. 251
Paratype. Height, 17.6 mm.; greatest diameter, 17 mm.; loc. 900, Garland Creek, Miss.; No. 4518, Pal. Res. Inst.

19. **Euspira jacksonensis**, n. sp. 251
Paratype. Height, 8 mm.; greatest diameter, 6.8 mm.; young; loc. 900, Garland Creek, Miss.; No. 4520, Pal. Res. Inst.

EXPLANATION OF PLATE 29

Figure | Page

1. **Operculum of species of Naticinæ** 247
   Probably of *N. permunda* Conrad. Interior view. Greatest length, 11 mm.; loc. 10, Montgomery, La. No. 4507, Pal. Res. Inst. (In text, pl. 3 should read pl. 29.)
2. **Operculum of species of Naticinæ** 247
   Same specimen as figure 1. Exterior view.

3, 4. **Natica permunda** Conrad 246
   Holotype. Height, 18.7 mm.; greatest diameter, 18.2 mm. Photo from Acad. Nat. Sci. Philadelphia.

5, 6. **Natica permunda** Conrad 246
   Height, 16.3 mm.; greatest diameter, 17.3 mm.; loc. 880, Jackson, Miss.; No. 4508, Pal. Res. Inst.

7. **Polinices weisbordi** Palmer 248
   Height, 18.8 mm.; greatest diameter, 13.3 mm.; loc. 883, Montgomery, La.; No. 4509, Pal. Res. Inst.
8. **Polinices weisbordi** Palmer 248
   Height, 17.2 mm.; greatest diameter, 16 mm.; loc. 883, Montgomery, La. Short spire form. No. 4510, Pal. Res. Inst.
9. **Polinices weisbordi** Palmer 248
   Height, 17.3 mm.; greatest diameter, 12.3 mm.; loc. 10, Montgomery, La.; No. 4512, Pal. Res. Inst.
10. **Polinices weisbordi** Palmer 248
    Height, 13.2 mm.; greatest diameter, 10.5 mm.; loc. 883, Montgomery, La. Short spire form. No. 4511, Pal. Res. Inst.
11. **Polinices weisbordi** Palmer 248
    Holotype. Figured Bull. Amer. Paleont., vol. VII, No. 32, pl. 12, fig. 10, No. 2785, Pal. Res. Inst.
12. **Polinices eminulus** (Conrad) 250
    Height, 17 mm.; greatest diameter, 12 mm.; loc. 1046, Crow Creek, Ark.; No. 4513, Pal. Res. Inst.
13. **Polinices eminulus** (Conrad) 250
    Height, 11.5 mm.; greatest diameter, 9.3 mm.; loc. 1049, White Bluff, Ark.; No. 4514, Pal. Res. Inst.
14. **Polinices eminulus** (Conrad) 250
    Height, 15 mm.; greatest diameter, 11.8 mm.; loc. 896, White Bluff, Ark.; No. 4515, Pal. Res. Inst.
15. **Polinices eminulus** (Conrad) 250
    Height, 17 mm.; greatest diameter, 12.5 mm.; loc. 140, Gosport sand, Claiborne, Ala. Typical form. No. 4516, Pal. Res. Inst.
16. **Euspira jacksonensis**, n. sp. 251
    Paratype. Height, 15 mm.; greatest diameter, 14 mm.; loc. 900, Garland Creek, Miss.; No. 4519, Pal. Res. Inst.
17. **Euspira jacksonensis**, n. sp. 251
    Holotype. Height, 22.3 mm.; greatest diameter, 21 mm.; loc. 785, Jackson, Miss.; No. 4517, Pal. Res. Inst.

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PLATE 30

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EXPLANATION OF PLATE 30

Figure — Page

1. **Litiopa spirata** (Meyer) ... 300
Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 7.

2. **Xenophora humilis** (Conrad) ... 259
Copy, Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. I, pl. 11, fig. 46.

3, 4. **Sinum**, sp. ... 254
Height, 2 mm.; greatest diameter, 4.5 mm.; loc. 10, Montgomery, La.; No. 4522, Pal. Res. Inst.

5. **Crommium jacksonense** (Harris) ... 256
Copy, Harris, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, pl. XIX, fig. 3.

6. **Sinum danvillense**, n. sp. ... 253
Holotype. Height, 13 mm.; greatest diameter, 13 mm.; loc. 6, Danville Landing, La.; No. 4521 Pal. Res. Inst.

7. **Sinum danvillense**, n. sp. ... 253
Paratype. Height, 11 mm.; greatest diameter, 10.5 mm.; loc. 6, Danville Landing, La.; No. 4521A, Pal. Res. Inst.

8. **Rissoina mississippiensis** Meyer ... 266
Copy, Meyer, Geol. Survey Alabama, Bull., No. 1, pt. II, pl. 2, fig. 17.

9. **Ottoina kinkelini** (Meyer) ... 267
Copy, Meyer, Bericht Senckenberg. naturf. Gesell., 1886, pl. 1, fig. 14.

10. **Crommium willemeti** (Deshayes) ... 256
Height, 26.3 mm.; greatest diameter, 21.4 mm. Lutetian, two km. north of Damery, France; No. 4523, Pal. Res. Inst.

11, 12. **Globularia morgani** (Johnson) ... 255
Height, 25.5 mm.; greatest diameter, 23 mm.; loc. 785, Jackson, Miss.; No. 4525, Pal. Res. Inst.

13. **Globularia sigaretina** (Lamarck) ... 255
Height, 37 mm.; greatest diameter, 34.2 mm.; Lutetian, Chaumont, France; No. 4526, Pal. Res. Inst.

14. **Crommium willemeti** (Deshayes) ... 256
Height, 26 mm.; greatest diameter, 21.3 mm. Lutetian, two km. north of Damery, France; No. 4524, Pal. Res. Inst.

15. **Xenophora trochiformis** (Born) ... 258
Height, 14 mm.: greatest diameter, 21 mm.; loc. 785, Jackson, Miss.; No. 4527, Pal. Res. Inst.

16. **Xenophora trochiformis** (Born) ... 258
Height, 17 mm.; greatest diameter, 23 mm.; loc. 785, Jackson, Miss.; No. 4528, Pal. Res. Inst.

17. **Xenophora trochiformis** (Born) ... 258
Same specimen as figure 15.

18. **Xenophora trochiformis** (Born) ... 258
Same specimen as figure 16.

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PLATE 31

EXPLANATION OF PLATE 31

Figure		Page
1.	**Calyptræa alta** (Conrad) Height, 15 mm.; greatest diameter, 18 mm.; loc. 883, Montgomery, La.; No. 4529, Pal. Res. Inst.	263
2.	**Calyptræa aperta** (Solander) Height, 3+ mm.: greatest diameter, 8 mm.; loc. 6, Danville Landing, La.; No. 4531, Pal. Res. Inst.	260
3.	**Calyptræa alta** (Conrad) Height, 9.3 mm.; greatest diameter, 18.5 mm.; loc. 785. Jackson, Miss.; No. 4530, Pal. Res. Inst.	263
4.	**Calyptræa aperta** (Solander) Height, 15 mm.; greatest diameter, 17.3 mm.; loc. 883, Montgomery, La.; No. 4532, Pal. Res. Inst.	260
5.	**Calyptræa aperta** (Solander) Height, 3 mm.; greatest diameter, 5 mm.; loc. 921, Jackson, Miss.; No. 4533, Pal. Res. Inst.	260
6.	**Calyptræa aperta** (Solander) Height, 4 mm.; greatest diameter, 7.5 mm.; Loc. 10, Montgomery, La.; No. 4534, Pal. Res. Inst.	260
7.	**Calyptræa aperta** (Solander) Height, 9 mm.; greatest diameter, 18.2 mm.; loc. 10, Montgomery, La.; No. 4535, Pal. Res. Inst.	260
8.	**Calyptræa aperta** (Solander) Height, 2.5 mm.; greatest diameter, 5.5 mm.; loc. 921, Jackson, Miss.; No. 4536, Pal. Res. Inst.	260
9.	**Calyptræa aperta** (Solander) Height, 5.5 mm.; greatest diameter, 11 mm.; loc. 11, Montgomery, La.. No. 4537, Pal. Res. Inst.	260
10.	**Calyptræa aperta** (Solander) Height, 6 mm.; greatest diameter, 11 mm.; loc. 900, Garland Creek. Miss.; No. 4538, Pal. Res. Inst.	260
11.	**Calyptræa aperta** (Solander) Same specimen as figure 7.	260
12.	**Calyptræa aperta** (Solander) Height, 14 mm.; greatest diameter, 19 mm. (fragment); loc. 10, Montgomery, La.; No. 4539, Pal. Res. Inst.	260

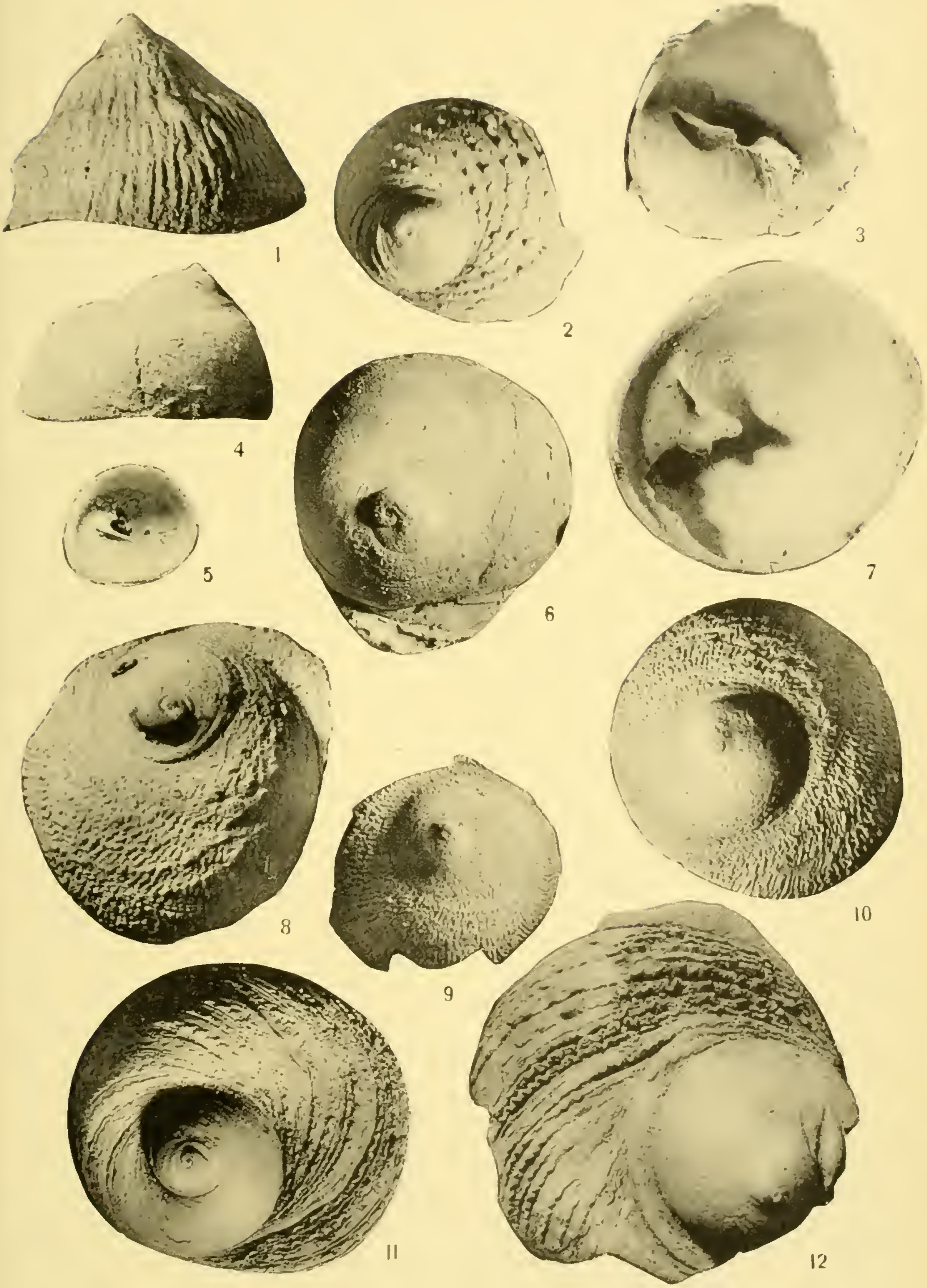
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PLATE 32

Explanation of Plate 32

Figure		Page
1.	**Hipponix pygmæus** Lea Height, 2 mm.; greatest diameter, 3 mm.; loc. 921, Jack-Miss.; No. 4540, Pal. Res. Inst.	265
2, 3.	**Hipponix pygmæus** Lea Height, 1.5 mm.; greatest diameter, 3 mm.; loc. 921, Jackson, Miss.; No. 4541, Pal. Res. Inst.	265
4-6.	**Architectonica trilirata** (Conrad), var. Height, 8 mm.; greatest diameter, 15.6 mm.; loc. 693, Jackson, Miss.; No. 4547, Pal. Res. Inst.	269
7.	**Architectonica trilirata** (Conrad) Copy, Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, pl. 11, fig. 4.	269
8.	**Capulus americanus** Conrad Height, 11 mm.; greatest diameter of aperture, 13.5 mm.; loc. 1, Bunker Hill Landing, La.; No. 4542, Pal. Res. Inst.	263
9, 10.	**Architectonica alveata** (Conrad) Height, 9 mm.; greatest diameter, 16.4 mm.; loc. 883, Montgomery, La.; No. 4551, Pal. Res. Inst.	276
11.	**Architectonica alveata** (Conrad) Height, 5.4 mm.; greatest diameter, 13 mm.; loc. 10, Montgomery, La.; No. 4550, Pal. Res. Inst.	276
12.	**Capulus americanus** Conrad Height, 2.3 mm.; greatest diameter of aperture, 4 mm.; loc. 921, Jackson, Miss.; No. 4543, Pal. Res. Inst.	263
13.	**Capulus americanus** Conrad Height, 7.4 mm.; greatest diameter of aperture, 18 mm.; loc. 1118, Bunker Hill, La.; No. 4545, Pal. Res. Inst.	263
14.	**Capulus americanus** Conrad Young. Greatest width, 2— mm.; loc. 921, Jackson, Miss.; No. 4544, Pal. Res. Inst.	263
15.	**Capulus americanus** Conrad Height, 15 mm.; greatest diameter of aperture, 21.5 mm.; loc. 8, Gibson Landing, La.; No. 4546, Pal. Res. Inst.	263
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17-19.	**Architectonica bellistriata** Conrad Height, 11.7 mm.; greatest diameter, 19.4 mm.; Jackson, Miss.; No. 4549, Pal. Res. Inst.	268

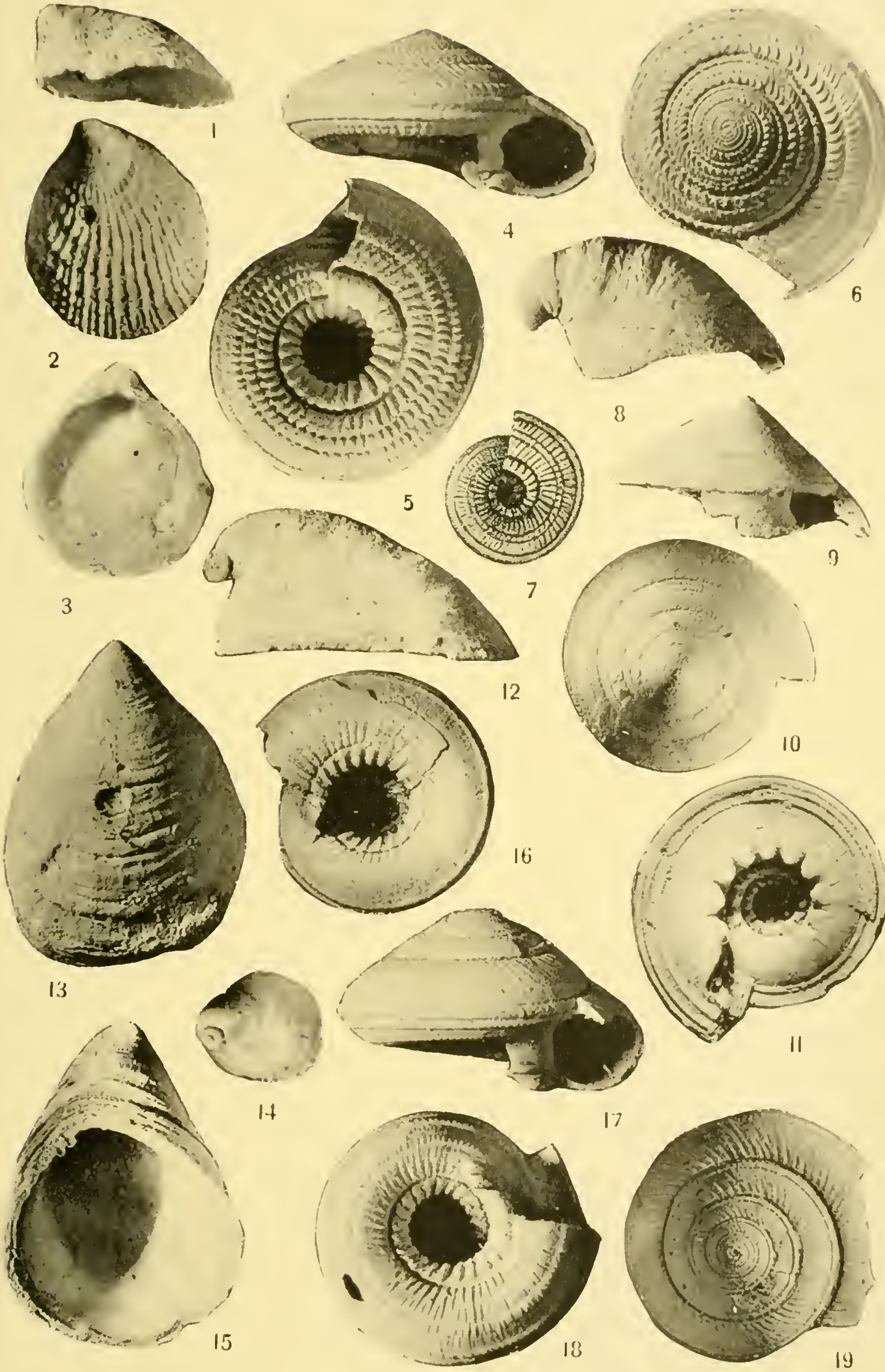
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PLATE 33

EXPLANATION OF PLATE 33

Figure — Page

1. **Architectonica meekana subsplendida**, n. var. — 271
Holotype. Height, 8 mm.; greatest diameter, 16.6 mm.; loc. 10, Montgomery, La.; No. 4555, Pal. Res. Inst.

2-4. **Architectonica ornata jacksonia**, n. var. — 270
Holotype. Height, 13 mm.; greatest diameter, 19 mm.; loc. 10, Montgomery, La.; No. 4552, Pal. Res. Inst.

5. **Architectonica meekana subsplendida**, n. var. — 271
Paratype. Height, 2 mm.; greatest diameter, 6.5 mm.; loc. 6, Danville Landing, La.; No. 4556, Pal. Res. Inst.

6, 7. **Architectonica meekana subsplendida**, n. var. — 271
Same specimen as figure 1.

8. **Architectonica meekana subsplendida**, n. var. — 271
Paratype. Height, 3.5 mm.; greatest diameter, 10.5 mm.; loc. 6, Danville Landing, La.; No. 4557, Pal. Res. Inst.

9. **Architectonica acuta** Conrad — 275
Lectotype. Height, 8.5 mm.; greatest diameter, 22.6 mm.; Photo. Acad. Nat. Sci. Philadelphia. See Plate 65, fig. 1.

10. **Architectonica acuta** Conrad — 275
Height, 5.5 mm.; greatest diameter, 14.2 mm.; loc. 785, Jackson, Miss. No. 4558, Pal. Res. Inst.

11. **Architectonica acuta** Conrad — 275
Height, 3.6 mm.; greatest diameter, 9 mm.; loc. 6, Danville Landing, La.; No. 4559, Pal. Res. Inst.

12. **Architectonica ornata** (Lea) — 271
Height, 2 mm.; greatest diameter, 4.3 mm.; Gosport sand, loc. 140, Claiborne, Ala.; typical form. No. 4554, Pal. Res. Inst.

13. **Architectonica ornata jacksonia**, n. var. — 270
Paratype. Height, 2.3 mm.; greatest diameter, 5.5 mm.; loc. 10, Montgomery, La.; young; No. 4553, Pal. Res. Inst.

14. **Architectonica acuta** Conrad — 275
Height, 13 mm.; greatest diameter, 23.5 mm.; loc. 10, Montgomery, La.; No. 4560, Pal. Res. Inst.

15. **Architectonica acuta** Conrad — 275
Height, 15.3 mm.; greatest diameter, 30.7 mm.; loc. 10, Montgomery, La.; No. 4561, Pal. Res. Inst.

16. **Architectonica acuta** Conrad — 275
Same specimen as figure 9. Lectotype. See Plate 65, fig. 2.

17. **Architectonica acuta** Conrad — 275
Height, 9.5 mm.; greatest diameter, 21.5 mm.; loc. 10, Montgomery, La.; No. 4562, Pal. Res. Inst.

18. **Architectonica acuta** Conrad — 275
Same specimen as figure 14.

19. **Architectonica acuta** Conrad — 275
Same specimen as figure 17.


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PLATE 34

EXPLANATION OF PLATE 34

Figure Page

1. **Turritella arenicola danvillensis** Stenzel and Turner 284
   Height, 15 mm.; greatest diameter, 5 mm.; loc. 6, Danville Landing, La.; No. 4573, Pal. Res. Inst.
2. **Turritella arenicola branneri** Harris 283
   Height, 13 mm.; greatest diameter, 4 mm.; loc. 1120, Bayou Toro, La.; No. 4568, Pal. Res. Inst.
3. **Turritella arenicola branneri** Harris 283
   Height, 4 mm.; greatest diameter, 1.8 mm.; loc. 896, White Bluff, Ark.; No. 4567, Pal. Res. Inst.
4. **Turritella arenicola danvillensis** Stenzel and Turner 284
   Height, 8 mm.; greatest diameter, 2.7 mm.; loc. 6, Danville Landing, La.; No. 4572, Pal. Res. Inst.
5. **Turritella arenicola danvillensis** Stenzel and Turner 284
   Height, 30.4 mm.; greatest diameter, 10.2 mm.; loc. 6, Danville Landing, La.; No. 4571, Pal. Res. Inst.
6. **Turritella arenicola branneri** Harris 283
   Height, 7.5 mm.; greatest diameter, 2.7 mm.; loc. 896, White Bluff, Ark.; No. 4569, Pal. Res. Inst.
7. **Turritella arenicola branneri** Harris 283
   Height, 35.8 mm.; greatest diameter, 9.6 mm.; White Bluff, Ark.; No. 4570, Pal. Res. Inst.
8. **Turritella arenicola** (Conrad) 281
   Height, 39.5 mm.; greatest diameter, 11 mm.; loc. 10, Montgomery, La.; No. 4563, Pal. Res. Inst.
9. **Turritella arenicola** (Conrad) 281
   Height, 27 mm.; greatest diameter, 10.4 mm.; loc. 900, Garland Creek, Miss.; posterior septum visible. No. 4564, Pal. Res. Inst.
10. **Turritella arenicola** (Conrad) 281
    Height, 34.1 mm.; greatest diameter, 10.6 mm.; loc. 900, Garland Creek, Miss.; No. 4565, Pal. Res. Inst.
11. **Turritella arenicola** (Conrad) 281
    Height, 36.4 mm.; greatest diameter, 12.3 mm.; loc. 900, Garland Creek, Miss.; No. 4566, Pal. Res. Inst.

PLATE 35

EXPLANATION OF PLATE 35

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1.	**Turritella arenicola danvillensis** Stenzel and Turner Height, 28.2 mm.; greatest diameter, 8.5 mm.; loc. 6, Danville Landing, La.; No. 4576, Pal. Res. Inst.	284
2.	**Turritella creola**, n. sp. Paratype. Height, 12.6 mm.; greatest diameter, 4.2 mm.; loc. 1054, Montgomery, La.; No. 4577, Pal. Res. Inst.	286
3.	**Turritella bunkerhillensis**, n. sp. Holotype. Height. 26.5 mm.; greatest diameter, 9.3 mm.; loc. 1, Bunker Hill Landing, La.; No. 4581, Pal. Res. Inst.	287
4.	**Turritella creola**, n. sp. Paratype. Height, 10.3 mm.; greatest diameter, 3.7 mm.; loc. 11, Montgomery, La.; No. 4578, Pal. Res. Inst.	286
5.	**Turritella creola**, n. sp. Holotype. Height, 32.5 mm.; greatest diameter, 10 mm.; loc. 883, Montgomery, La.; No. 4579, Pal. Res. Inst.	286
6.	**Cæcum alterum** Meyer Copy, Meyer, Bericht Senckenberg, naturf. Gesell., 1886, pl. 1, fig. 8.	279
7.	**Hemisinus jacksonius**, n. sp. Paratype. Height, 29 mm.; greatest diameter, 21 mm.; loc. 894, Crow Creek, Ark.; No. 4575, Pal. Res. Inst.	277
8, 9.	**Hemisinus jacksonius**, n. sp. Holotype. Height, 46.4 mm.; greatest diameter, 18.5 mm.; loc. 1046, Crow Creek, Ark.; No. 4574, Pal. Res. Inst.	277
10.	**Turritella bunkerhillensis**, n. sp. Paratype. Height, 18 mm.; greatest diameter, 8.5 mm.; loc. 1, Bunker Hill Landing, La.; No. 4582, Pal. Res. Inst.	287
11.	**Turritella creola**, n. sp. Paratype. Height, 24.2 mm.; greatest diameter, 10 mm.; loc. 883, Montgomery, La.; No. 4580, Pal. Res. Inst.	286


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PLATE 36

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1.	**Turritella clevelandia** Harris Height, 25.5 mm.; greatest diameter, 6.4 mm.; loc. 896, White Bluff, Ark.; No. 4583, Pal. Res. Inst.	290
2.	**Turritella clevelandia** Harris Height, 28.2 mm.; greatest diameter, 8.4 mm.; loc. 6, Danville Landing, La.; No. 4584, Pal. Res. Inst.	290
3.	**Turritella clevelandia** Harris Same specimen as figure 1.	290
4.	**Turritella clevelandia** Harris Height, 17 mm.; greatest diameter, 5 mm.; loc. 886, Danville Landing, La.; No. 4586, Pal. Res. Inst.	290
5.	**Turritella clevelandia** Harris Height, 6.2 mm.; greatest diameter, 3.5 mm.; loc. 1049, White Bluff, Ark.; No. 4585, Pal. Res. Inst.	290
6.	**Turritella clevelandia** Harris Height, 19.3 mm.; greatest diameter, 5.7 mm.; loc. 886, Danville Landing, La.; No. 4587, Pal. Res. Inst.	290
7, 8.	**Turritella alveata** Conrad Height, 39 mm.; greatest diameter, 12 mm.; loc. 785, Jackson, Miss.; No. 4588, Pal. Res. Inst.	288
9.	**Turritella alveata** Conrad Height, 25.5 mm.; greatest diameter, 6.2 mm.; loc. 900, Garland Creek, Miss.; apical tip slightly deformed. No. 4589, Pal. Res. Inst.	288
10.	**Turritella alveata** Conrad Height, 7.5 mm.; greatest diameter, 2.5 mm.; loc. 921, Jackson, Miss.; No. 4590, Pal. Res. Inst.	288
11.	**Turritella alveata** Conrad Height, 11.6 mm.; greatest diameter, 3 mm.; loc. 883, Montgomery, La.; No. 4591, Pal. Res. Inst.	288
12.	**Turritella alveata** Conrad Height, 44.5 mm.; greatest diameter, 11.3 mm.; loc. 880, Jackson, Miss.; No. 4592, Pal. Res. Inst.	288

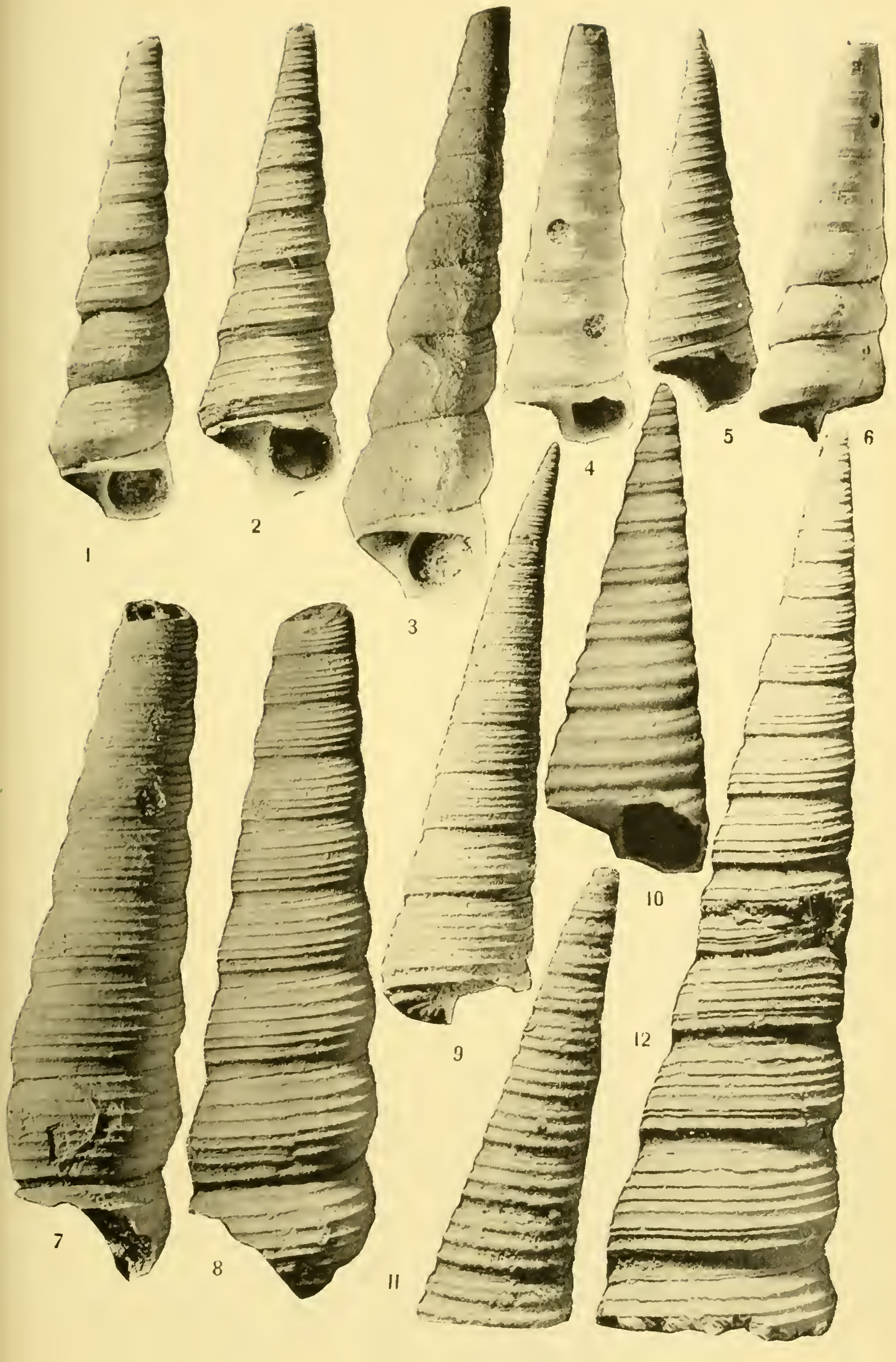
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PLATE 37

Explanation of Plate 37

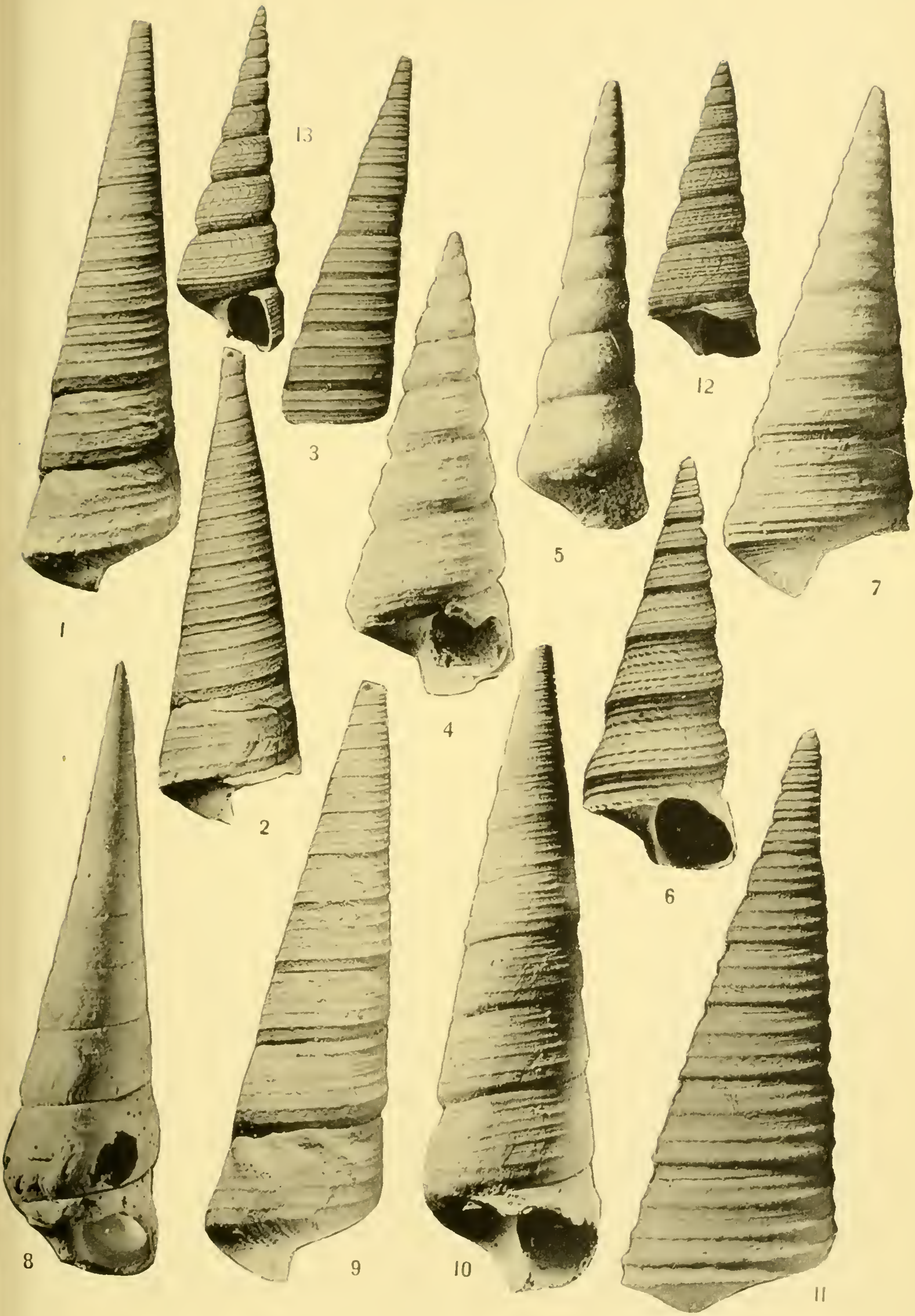
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PLATE 38

EXPLANATION OF PLATE 38

Figure Page

1. **Mesalia vetusta** (Conrad) 297
Height, 23 mm.; greatest diameter, 8 mm.; Claibornian, loc. 1062, Little Stave Creek, Ala.; No. 4607, Pal. Res. Inst.
2. **Mesalia vetusta** (Conrad) 297
Height, 27.5 mm.; greatest diameter, 9.5 mm.; loc. 1054, Montgomery, La.; No. 4608, Pal. Res. Inst.
3. **Mesalia vetusta** (Conrad) 297
Height, 21 mm.; greatest diameter, 10 mm.; loc. 1050, Sims Siding, Miss.; No. 4609, Pal. Res. Inst.
4. **Mesalia vetusta** (Conrad) 297
Height, 25.5 mm.; greatest diameter, 8 mm.; Gosport sand, loc. 140, Claiborne, Ala.; typical form; No. 4610, Pal. Res. Inst.
5. **Mesalia vetusta** (Conrad) 297
Height, 22 mm.; diameter, 9 mm.; White Bluff, Ark. Specimen in U. S. Nat. Mus., No. 138,845. Photo and measurements made by G. D. Harris.
6. **Turritella rivurbana** Cooke 295
Height, 9.5 mm.; greatest diameter, 4 mm.; Jackson, Miss.; No. 4604, Pal. Res. Inst.
7. **Turritella rivurbana** Cooke 295
Height, 11.5 mm.; greatest diameter, 12 mm.; Jackson, Miss.; No. 4605, Pal. Res. Inst.
8. **Turritella rivurbana** Cooke 295
Copy of original retouched photo. Courtesy of C. W. Cooke.
9. **Turritella rivurbana** Cooke 295
Height, 7+ mm.; greatest diameter, 2.5+ mm. (broken); Jackson, Miss.; No. 4606, Pal. Res. Inst.
10. **Serpulorbis chavani**, n. sp. 299
Paratype. Length, 27 mm.; greatest diameter, 15.5 mm.; loc. 11, Montgomery, La.; No. 4611, Pal. Res. Inst.
11. **Serpulorbis chavani**, n. sp. 299
Holotype. Length, of mass, 51 mm.; greatest diameter of single tube, 11 mm.; loc. 11, Montgomery, La.; No. 4612, Pal. Res. Inst.
12. **Serpulorbis chavani**, n. sp. 299
Paratype. Length, 37 mm.; greatest diameter, 11 mm.; loc. 10, Montgomery, La.; No. 4613, Pal. Res. Inst.


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PLATE 39

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	Lectotype; × 2. Photo courtesy of Wm. M. Ingram.	
3, 4.	**Cypræa ludoviciana** Johnson	317
	Lectotype; × 2. Photo courtesy of Wm. M. Ingram.	
5.	**Cerithiella jacksonensis** (Meyer)	305
	Height, 12.5 mm.; greatest diameter, 7.3 mm.; loc. 8, Gibson Landing, La.; No. 4616, Pal. Res. Inst.	
6.	**Cerithiella jacksonensis** (Meyer)	305
	Copy, Meyer, Bull. Geol. Survey Alabama, No. 1, pt. II, pl. 2, fig. 13.	
7.	**Bittium kœneni** Meyer	301
	Height, 4 mm.; greatest diameter, 1 mm.; loc. 921, Jackson, Miss.; No. 4614, Pal. Res. Inst.	
8.	**Bittium kœneni** Meyer	301
	Height, 2.5 mm.; greatest diameter, 1 mm.; loc. 921, Jackson, Miss.; No. 4615, Pal. Res. Inst.	
9.	**Bittium kœneni** Meyer	301
	Copy, Meyer, Bull. Geol. Survey Alabama, No. 1, pt. II, pl. 2, fig. 12.	
10.	**Cerithiella ouachitensis**, n. sp.	306
	Holotype. Height, 5.3 mm.; greatest diameter, 1.5 mm.; loc. 8, Gibson Landing, La.; No. 4617, Pal. Res. Inst.	
11.	**Harrisianella plicifera** (Heilprin)	302
	Syntype. Aldrich drawing, published in Bull. Amer. Paleont., vol. II, No. 8, pl. 3, fig. 2.	
12.	**Harrisianella plicifera** (Heilprin)	302
	Same specimen as figure 11. Aldrich drawing, published in Bull. Amer. Paleont., vol. II, No. 8, pl. 3, fig. 2 a.	
13.	**Cypræa healeyi** Aldrich	315
	Height, 17 mm.; greatest diameter, 12 mm.; loc. 883, Montgomery, La.; No. 4618, Pal. Res. Inst.	
14.	**Cypræa healeyi** Aldrich	315
	Holotype; × 3. Photo courtesy of Wm. M. Ingram.	
15.	**Cypræa healeyi** Aldrich	315
	Same specimen as figure 13.	
16.	**Cypræa healeyi** Aldrich	315
	Same specimen as figure 14, holotype. Photo courtesy of Wm. M. Ingram.	
17.	**Cypræa healeyi** Aldrich	315
	Height, 21.5 mm.; greatest diameter, 14 mm.; loc. 10, Montgomery, La.; No. 4619, Pal. Res. Inst.	
18.	**Cypræa jacksonensis** Johnson	317
	Holotype, natural size. Photo courtesy of Wm. M. Ingram.	

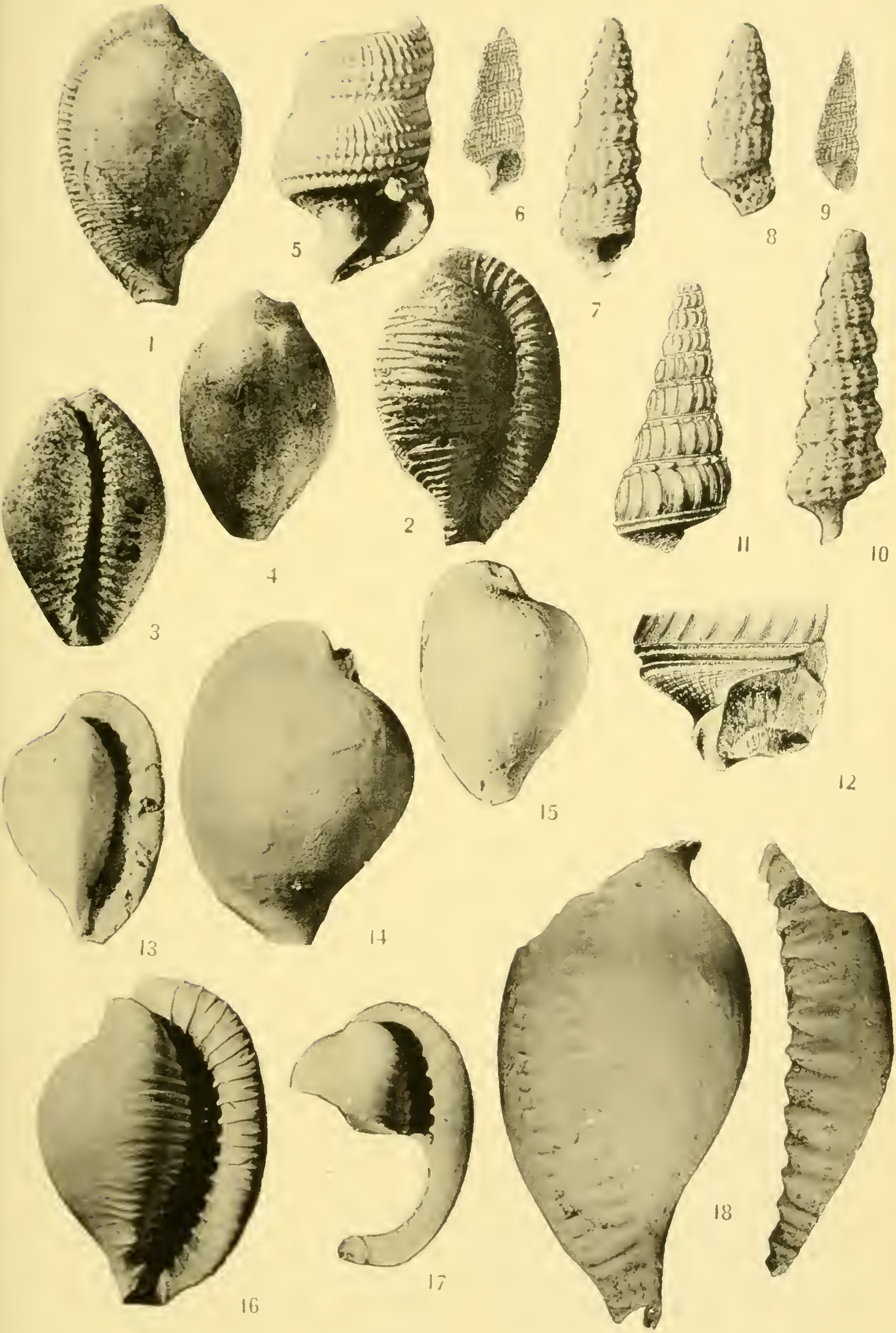
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PLATE 40

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Figure — Page

1. **Strombus albirupianus** Dall 307
Copy, Dall, Trans. Wagner Free Inst. Sci., vol. III, pt. 1, pl. 12, fig. 2.

2. **Strombus albirupianus** Dall 307
Copy, Dall, *ibid.*, pl. 12, fig. 10.

3. **Ectinochilus laqueatum** (Conrad) 308
Height, 31.5 mm.; greatest diameter, 7.5 mm.; Gosport sand, loc. 140, Claiborne, Ala.; No. 4623, Pal. Res. Inst.

4. **Ectinochilus laqueatum** (Conrad) 308
Same specimen as figures 3 and 8.

5. **Ectinochilus stenzeli, n. sp.** 308
Holotype. Height, 16 mm.; greatest diameter, 7.5 mm.; loc. 10, Montgomery, La.; No. 4624, Pal. Res. Inst.

6. **Ectinochilus stenzeli, n. sp.** 308
Paratype. Height, 12 mm.; greatest diameter, 5.5 mm.; loc. 10, Montgomery, La.; No. 4625, Pal. Res. Inst.

7. **Ectinochilus stenzeli, n. sp.** 308
Same specimen as figure 5.

8. **Ectinochilus laqueatum** (Conrad) 308
Same specimen as figures 3 and 4.

9, 10. **Cyprædia fenestralis** Conrad 320
Lectotype; natural size. Photo courtesy of Wm. M. Ingram.

11. **Cypræorbis ventripotens** (Cossmann) 318
Lectotype, *Cypræa pinguis* Conrad. Height, 26 mm.; greatest diameter, 17.6 mm.; Jackson, Miss. Photo courtesy of Acad. Nat. Sci. Philadelphia.

12. **Cypræorbis ventripotens** (Cossmann) 318
Height, 25 mm.; greatest diameter, 17.5 mm.; loc. 785, Jackson, Miss.; No. 4620, Pal. Res. Inst.

13, 14. **Cypræorbis sphæroides** Conrad 317
Lectotype; natural size. Vicksburg Oligocene, Vicksburg, Miss. Photo courtesy of Wm. M. Ingram.

15. **Cypræorbis ventripotens** (Cossmann) 318
Same specimen as figure 12.

16. **Cypræorbis ventripotens** (Cossmann) 318
Same specimen as figure 11.

17. **Cyprædia fenestralis** Conrad 320
Height, 32.5 mm.; greatest diameter, 28.4 mm.; loc. 883, Montgomery, La.; No. 4621, Pal. Res. Inst.

18. **Cyprædia fenestralis** Conrad 320
Length of fragment, 36.5 mm.; width, 12 mm.; loc. 883, Montgomery, La.; No. 4622, Pal. Res. Inst.

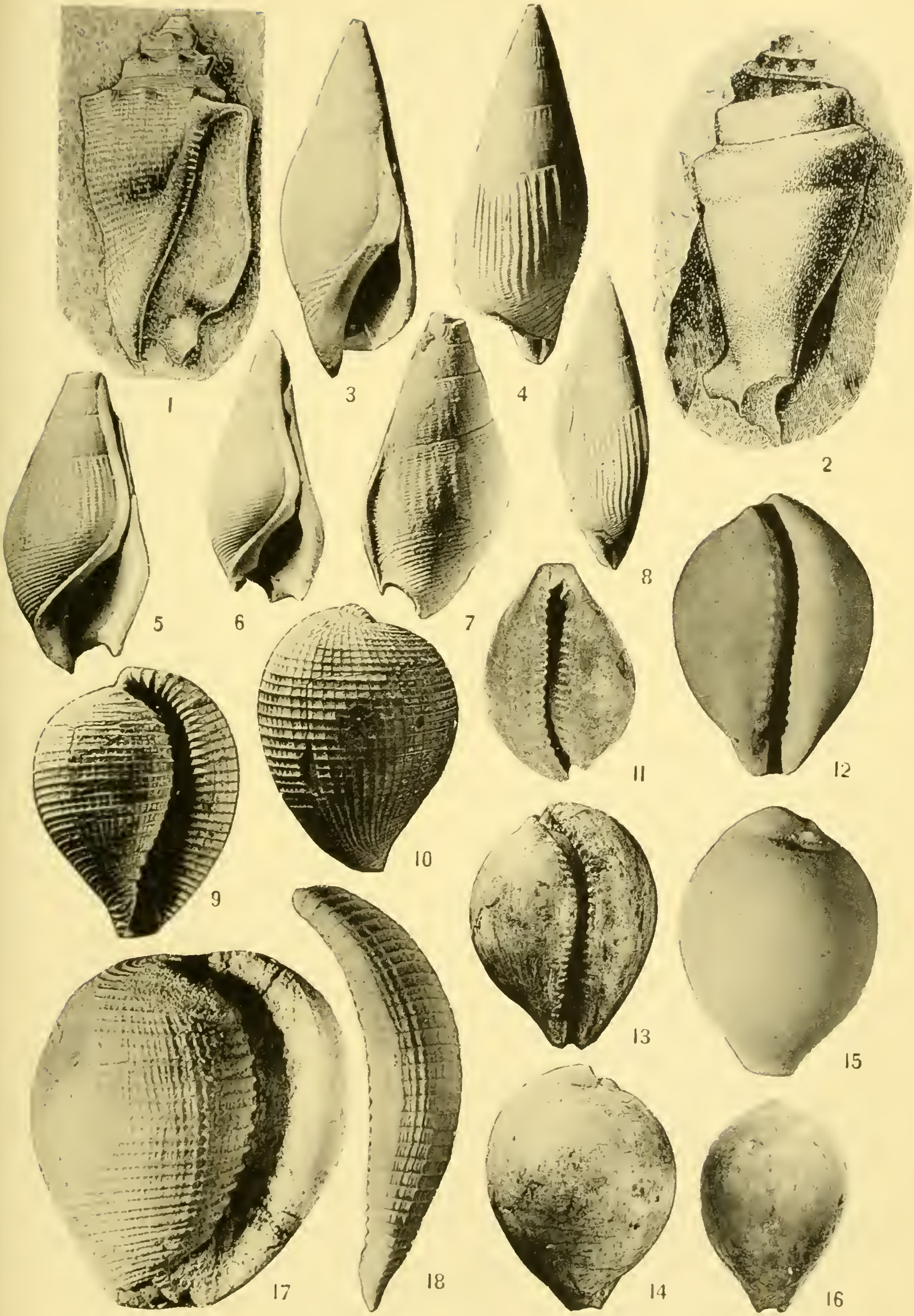
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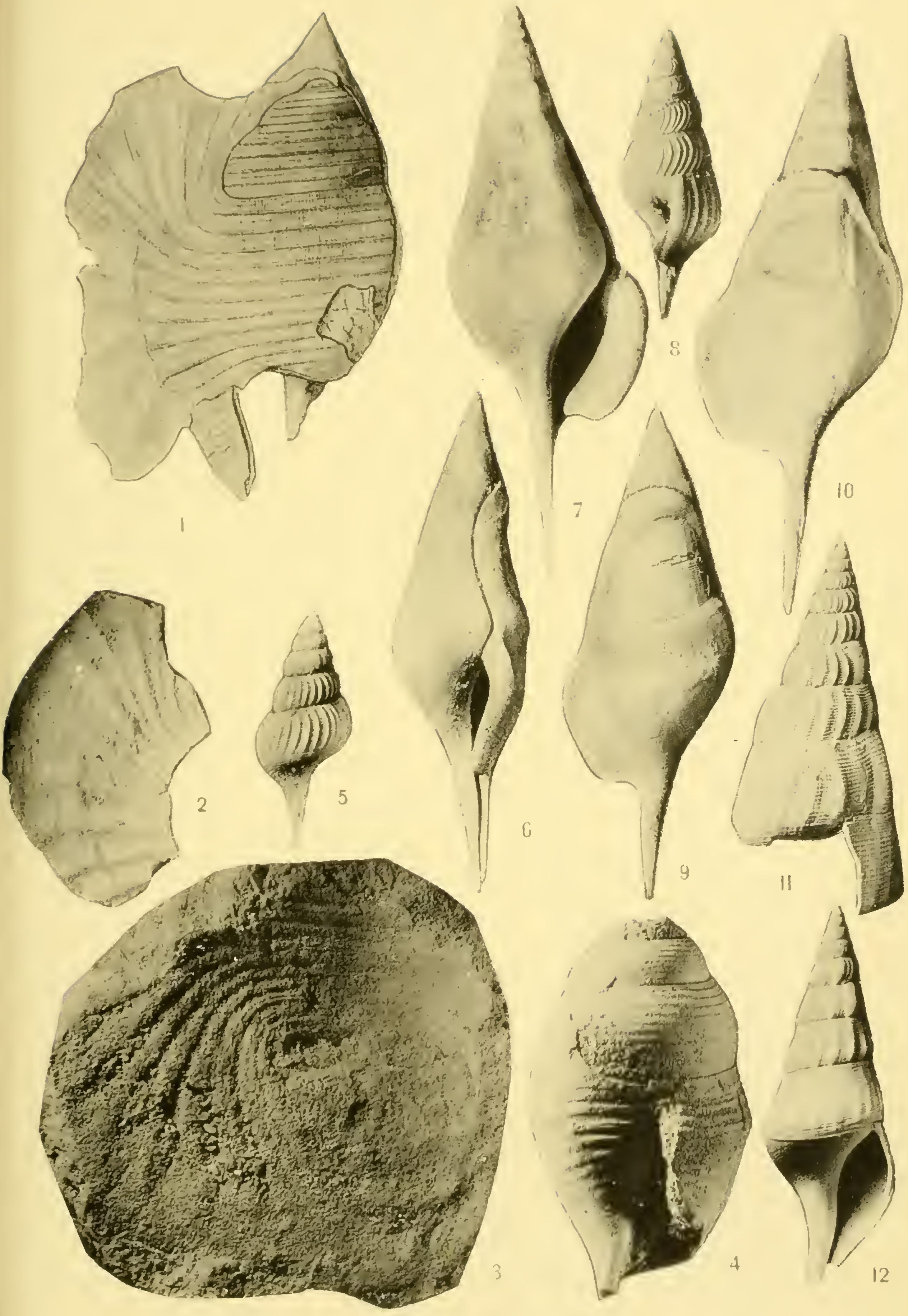
PLATE 41

EXPLANATION OF PLATE 41

Figure | Page

1. **Platyoptera extenta** (Conrad) 314
   Lectotype. Acad. Nat. Sci. Philadelphia. Meyer drawing. Height, 43+ mm.; greatest diameter, 31 mm.
2. **Platyoptera extenta** (Conrad) 314
   Fragment of wing. Length of fragment, 28 mm.; loc. 1, Bunker Hill Landing, La.; No. 4633, Pal. Res. Inst.
3. **Platyoptera extenta** (Conrad) 314
   Impression; height, 42 mm.; width, 47 mm.; loc. 1056, Gopher Hill, Ala.; No. 4635, Pal. Res. Inst.
4. **Platyoptera extenta** (Conrad) 314
   Height, 27.5 mm.; greatest diameter, 17 mm.; loc. 1, Bunker Hill Landing, La.; No. 4634, Pal. Res. Inst.
5. **Calyptraphorus velatus stamineus** (Conrad) 311
   Height, 17.3 mm.; greatest diameter, 6.3 mm.; loc. 921, Jackson, Miss.; No. 4628, Pal. Res. Inst.
6. **Calyptraphorus velatus stamineus** (Conrad) 311
   Height, 54 mm.; greatest diameter, 18.4 mm.; loc. 693, Jackson, Miss.; No. 4630, Pal. Res. Inst.
7. **Calyptraphorus velatus stamineus** (Conrad) 311
   Height, 50.5 mm.; greatest diameter, 16.4 mm.; loc. 785, Jackson, Miss.; No. 4626, Pal. Res. Inst.
8. **Calyptraphorus velatus stamineus** (Conrad) 311
   Height, 8.5 mm.; greatest diameter, 3.7 mm.; loc. 921, Jackson, Miss.; No. 4627, Pal. Res. Inst.
9. **Calyptraphorus velatus stamineus** (Conrad) 311
   Height, 58 mm.; greatest diameter, 18.7 mm.; loc. 785, Jackson, Miss.; No. 4631, Pal. Res. Inst.
10. **Calyptraphorus velatus stamineus** (Conrad) 311
    Same specimen as figure 7.
11. **Calyptraphorus velatus stamineus** (Conrad) 311
    Height, 21.4 mm.; greatest diameter, 10 mm.; loc. 921, Jackson, Miss.; No. 4629, Pal. Res. Inst.
12. **Calyptraphorus velatus stamineus** (Conrad) 311
    Height, 34.6 mm.; greatest diameter, 11.6 mm.; loc. 785, Jackson, Miss.; No. 4632, Pal. Res. Inst.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7, 8. **Cornulina dalli** (Harris) 360
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9. **Cornulina dalli** (Harris) 360
Figure of "*Cornulina armigera* Con. var." by Aldrich, Bull. Amer. Paleont., vol. II, No. 8, pl. 4, fig. 4.

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Copy, Harris, "*Monoceras*" *jacksonium* Harris, Acad. Nat. Sci. Philadelphia, Proc., vol. XLVIII, pl. 18, fig. 16.


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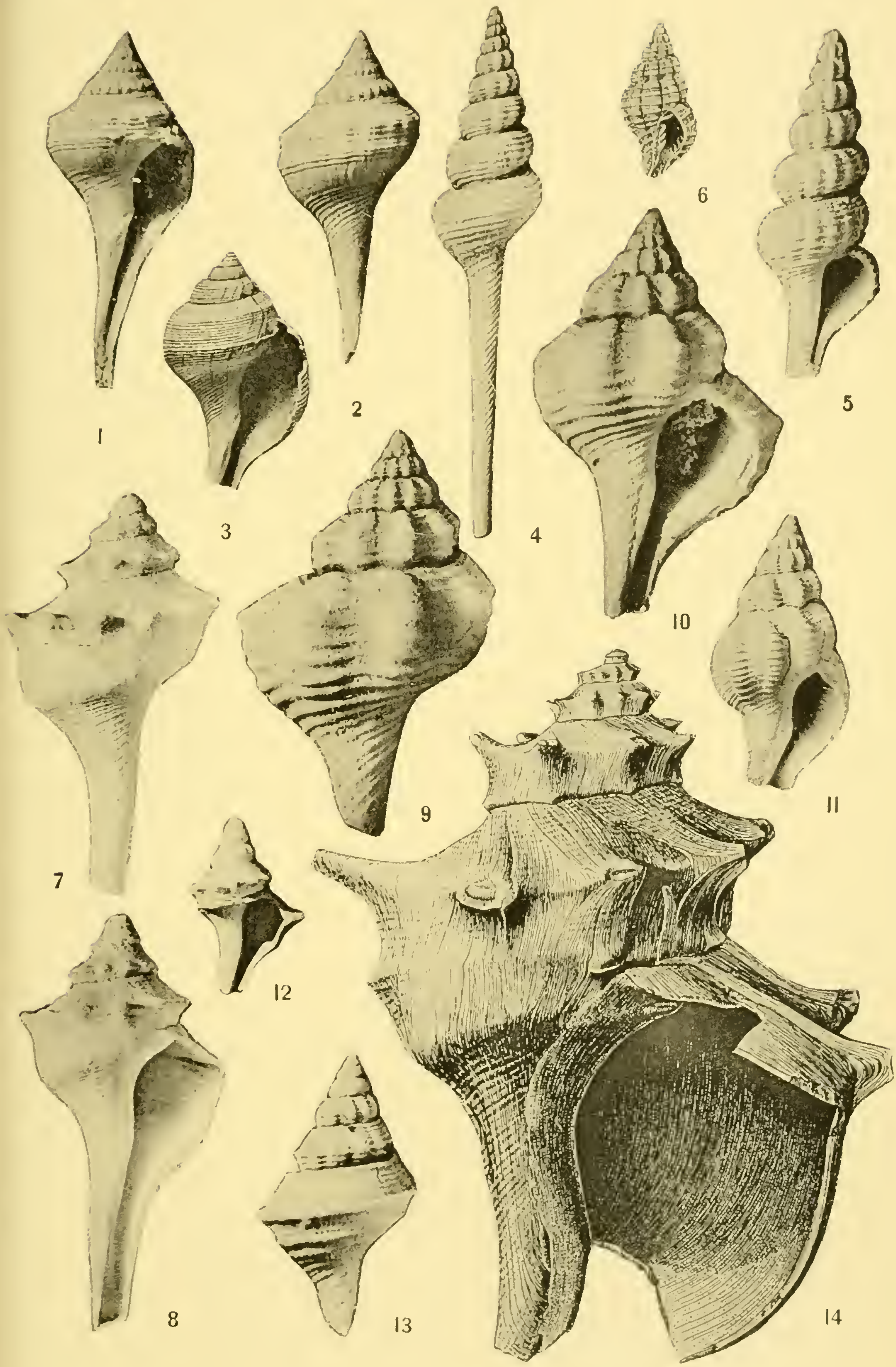
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14. **Latirus humilior** Meyer 373
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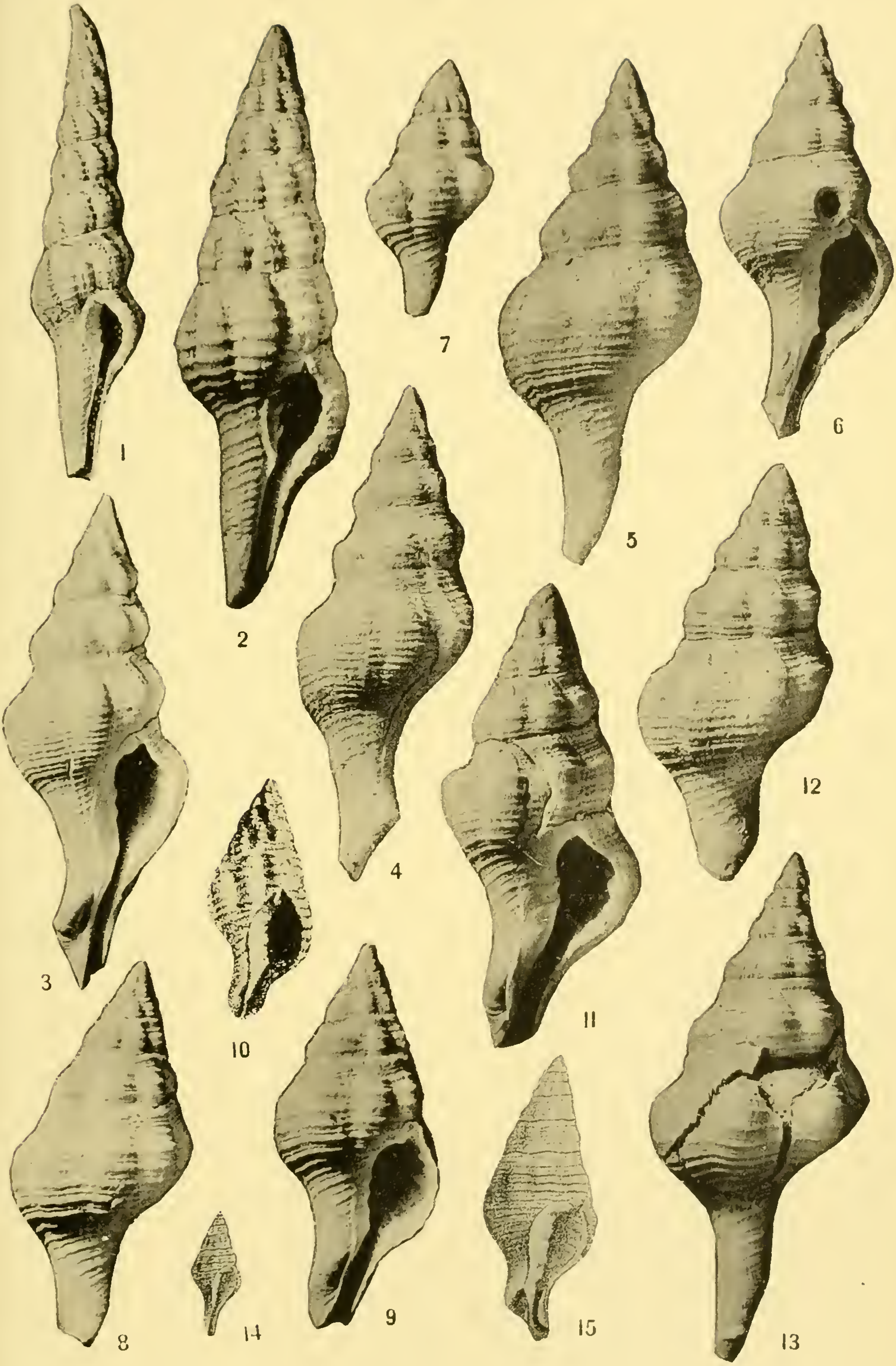
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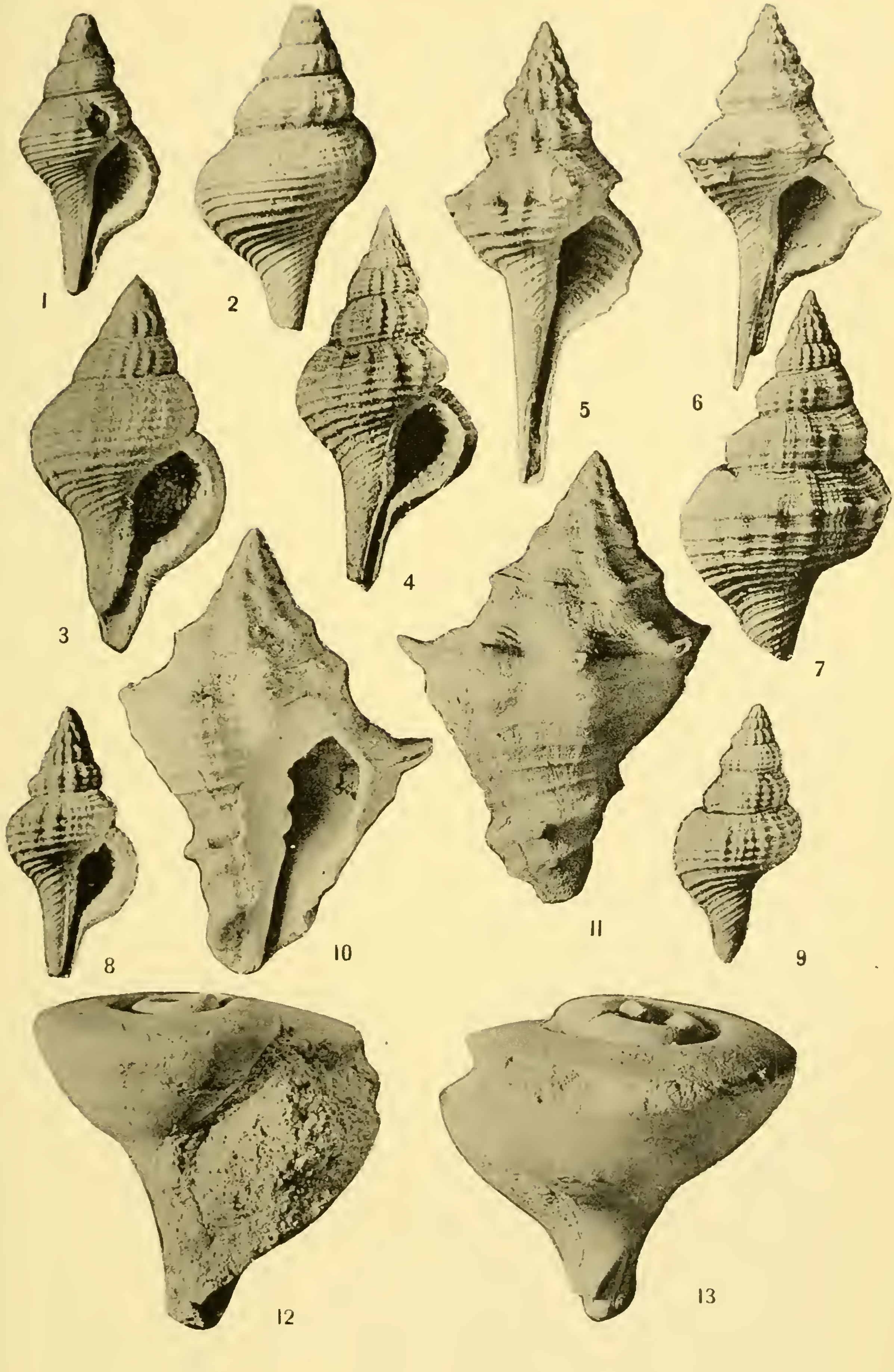
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2.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 21.5 mm.; greatest diameter, 7.5 mm.; loc. 8, Gibson Landing, La.; No. 4767, Pal. Res. Inst.	399
3.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 45.5 mm.; greatest diameter, 15 mm.; loc. 693, Jackson, Miss.; No. 4763, Pal. Res. Inst.	399
4.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 43 mm.; greatest diameter, 12 mm.; loc. 880, Jackson, Miss.; No. 4766, Pal. Res. Inst.	399
5.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 87 mm.; greatest diameter, 23 mm.; loc. 883, Jackson, Miss.; No. 4764, Pal. Res. Inst.	399
6.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 18 mm.; greatest diameter, 5.5 mm.; Jackson, Miss.; No. 4768, Pal. Res. Inst.	399
7.	**Fusimitra conquisita** (Conrad) Height, 47 mm.; greatest diameter, 16 mm.; Vicksburg, Miss., Vicksburg Oligocene; No. 4769, Pal. Res. Inst.	399
8.	**Fusimitra conquisita** (Conrad) Lectotype, *F. conquisita* (Conrad). Height, 31.5 mm. Meyer drawing. Acad. Nat. Sci. Philadelphia, Pa.	399
9.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 33 mm.; greatest diameter, 8.7 mm.; loc. 785, Jackson, Miss.; No. 4770, Pal. Res. Inst.	399
10.	**Fusimitra mississippiensis** (Conrad) Lectotype. Vicksburg Oligocene. Height, 42 mm., Meyer drawing. Acad. Nat. Sci. Philadelphia, Pa.	401
11.	**Fusimitra conquisita** (Conrad) *F. millingtoni.* Height, 100 m..; greatest diameter, 30 mm.; loc. 883, Montgomery, La.; No. 4765, Pal. Res. Inst.	399


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PLATE 56

17. **Conomitra jacksonensis** Cooke 401
Height, 9.5 mm.; greatest diameter, 4 mm.; type loc., Jackson, Miss.; No. 4788, Pal. Res. Inst.

18. **Conomitra jacksonensis** Cooke 401
Photo of original retouched photograph. Courtesy of C. W. Cooke.

19, 20. **Harpa jacksonensis** Harris 397
Height, 29.5 mm.; greatest diameter, 18 mm.; loc. 881, Jackson, Miss.; No. 4771, Pal. Res. Inst.

21. **Lapparia dumosa** Conrad 403
Height, 40.5 mm.; greatest diameter, 22 mm. (including spines); loc. 785, Jackson, Miss.; No. 4778, Pal. Res. Inst.

EXPLANATION OF PLATE 56

Figure		Page
1.	**Lapparia dumosa** (Conrad) Height, 11.4 mm.; greatest diameter, 17.5 mm. (including spines); loc. 785, Jackson, Miss.; No. 4772, Pal. Res. Inst.	403
2.	**Lapparia dumosa** (Conrad) Height, 30 mm.; greatest diameter, 16 mm. (including spines); loc. 883, Montgomery, La.; No. 4773, Pal. Res. Inst.	403
3.	**Lapparia dumosa** (Conrad) Height, 34 mm.; greatest diameter, 19 mm. (including spines); loc. 785, Jackson, Miss.; No. 4774, Pal. Res. Inst.	403
4.	**Lapparia dumosa** (Conrad) Height, 28 mm.; greatest diameter, 16.4 mm. (including spines); loc. 785, Jackson, Miss.; No. 4775, Pal. Res. Inst.	403
5.	**Lapparia dumosa exigua** Palmer Height, 29 mm.; greatest diameter, 12.5 mm.; loc. 1, Bunker Hill Landing, La.; No. 4779, Pal. Res. Inst.	405
6.	**Lapparia dumosa exigua** Palmer Height, 27.5 mm.; greatest diameter, 13 mm.; loc. 1, Bunker Hill Landing, La.; No. 4780, Pal. Res. Inst.	405
7.	**Lapparia dumosa exigua** Palmer Height, 32.5 mm.; greatest diameter, 12.3 mm.; loc. 1, Bunker Hill Landing, La.; No. 4781, Pal. Res. Inst.	405
8.	**Lapparia dumosa exigua** Palmer Height, 25.5 mm.; greatest diameter, 10 mm.; loc. 10, Montgomery, La.; No. 4782, Pal. Res. Inst.	405
9.	**Lapparia dumosa** (Conrad) Height, 26 mm.; greatest diameter, 13 mm. (including spines); loc. 785, Jackson, Miss.; No. 4776, Pal. Res. Inst.	403
10.	**Lapparia dumosa** (Conrad) Height, 32.5 mm.; greatest diameter, 14.5 mm. (including spines); loc. 1 Bunker Hill Landing, La.; No. 4777, Pal. Res. Inst.	403
11.	**Uromitra grantensis** (Johnson) Copy, Johnson, Acad. Nat. Sci. Philadelphia, Proc., vol. LI, pl. 1, fig. 2.	398
12.	**Uromitra grantensis** (Johnson) Height, 8 mm.; greatest diameter, 3 mm.; loc. 1054, Montgomery, La.; No. 4783, Pal. Res. Inst.	398
13.	**Conomitra hammakeri** (Harris) Height, 7 mm.; greatest diameter, 3.5 mm.; loc. 10, Montgomery, La.; No. 4784, Pal. Res. Inst.	402
14.	**Conomitra hammakeri** (Harris) Height, 8 mm.; greatest diameter, 3.4 mm.; loc. 10, Montgomery, La.; No. 4785, Pal. Res. Inst.	402
15.	**Conomitra hammakeri** (Harris) Height, 5 mm.; greatest diameter, 4.5 mm.; loc. 10, Montgomery, La.; No. 4786, Pal. Res. Inst.	402
16.	**Conomitra hammakeri** (Harris) Height, 9 mm.; greatest diameter, 4.5 mm.; loc. 10, Montgomery, La.; No. 4787, Pal. Res. Inst.	402

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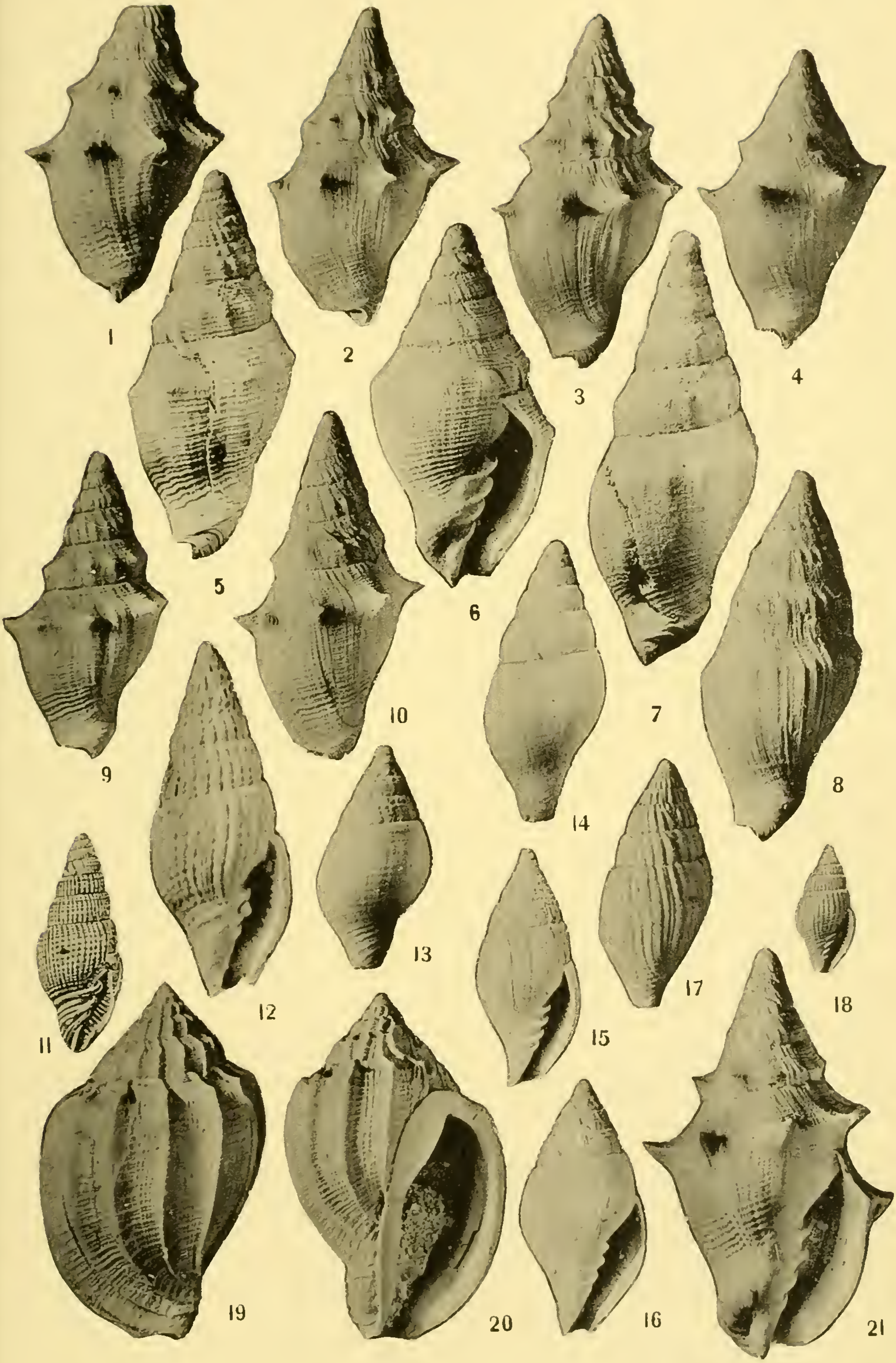
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PLATE 57

EXPLANATION OF PLATE 57

Figure Page

1. **Pleuroliria jacksonella** Casey 416
   Holotype; length, 4.5 mm.; Montgomery, La.; U. S. Nat. Mus., No. 494,344.

2-10. **Coronia nodulina** (Casey), and varieties 419
   2. Holotype, length, 9.5 mm.; from U. S. Nat. Mus. negative; Moodys Branch, Jackson, Miss.; U. S. Nat. Mus., No. 494,355.
   3. Var. *bunkerensis* Har., length, 7.5 mm.; Danville, La.; Pal. Res. Inst., No. 4436.
   4,a. Reverse of figs. 1 and 2, Palæont. Amer., vol. 2, pl. 3; Bunker Hill, Ouachita River, La.
   5. Var. of *nodulina*, Danville, La.; length, 7.5 mm.; Pal. Res. Inst., No. 4437.
   6. The same; length, 8 mm.; Danville, La.; Pal. Res. Inst., No. 4438.
   7. The same; length, 12 mm.; Danville, La.; Pal. Res. Inst., No. 4439.
   8. The same; length, 14.5 mm.; Danville, La.; Pal. Res. Inst., No. 4440.
   9. Var. *ouachitensis* Har., length, 13 mm.; Danville, La.; Pal. Res. Inst., No. 4441.
   10. The same; length, 14 mm.; Danville, La.; Pal. Res. Inst., No. 4442.

11-16. **Coronia childreni** (Lea), and vars. 419-20
   11. Variety, length, 11 mm.; somewhat eroded but showing general characters of the spire; White Bluff, Arkansas.
   12. Variety, length 13 mm.; showing clearly the characters of ultimate and penultimate whorls, approaching *nodulina;* White Bluff, Arkansas; Pal. Res. Inst., No. 4443.
   13. Variety, length, 10 mm.; Crow Creek, Arkansas.
   14. Variety, length, 9 mm.; compare this and figs. 11 and 13 with *conjuncta* Casey, Crow Creek, Arkansas; Pal. Res. Inst., No. 4444.
   15. Variety *conjuncta ?* Casey; length, 7.5 mm.; magnified to show apical and sculptural details; Danville, La.; Pal. Res. Inst., No. 4445.
   16. Variety, length, 6 mm.; Bayou Toro, western La.; Pal. Res. Inst., No. 4446.

17. **Coronia montgomeryensis** Harris 420
   Length, 18 mm.; same specimen illustrated in Palæont. Amer., vol. 2, pl. 2, fig. 25.; Danville, La.; Pal. Res. Inst., No. 2371.

18. Apex of "**Pleurotoma (Gemmula) gemmata,**" 416
   Magnified, after Weinkauff, showing two small smooth apical whorls and two wi h longitudinal ribbing. See Weinkauff (1875, pl. 9).

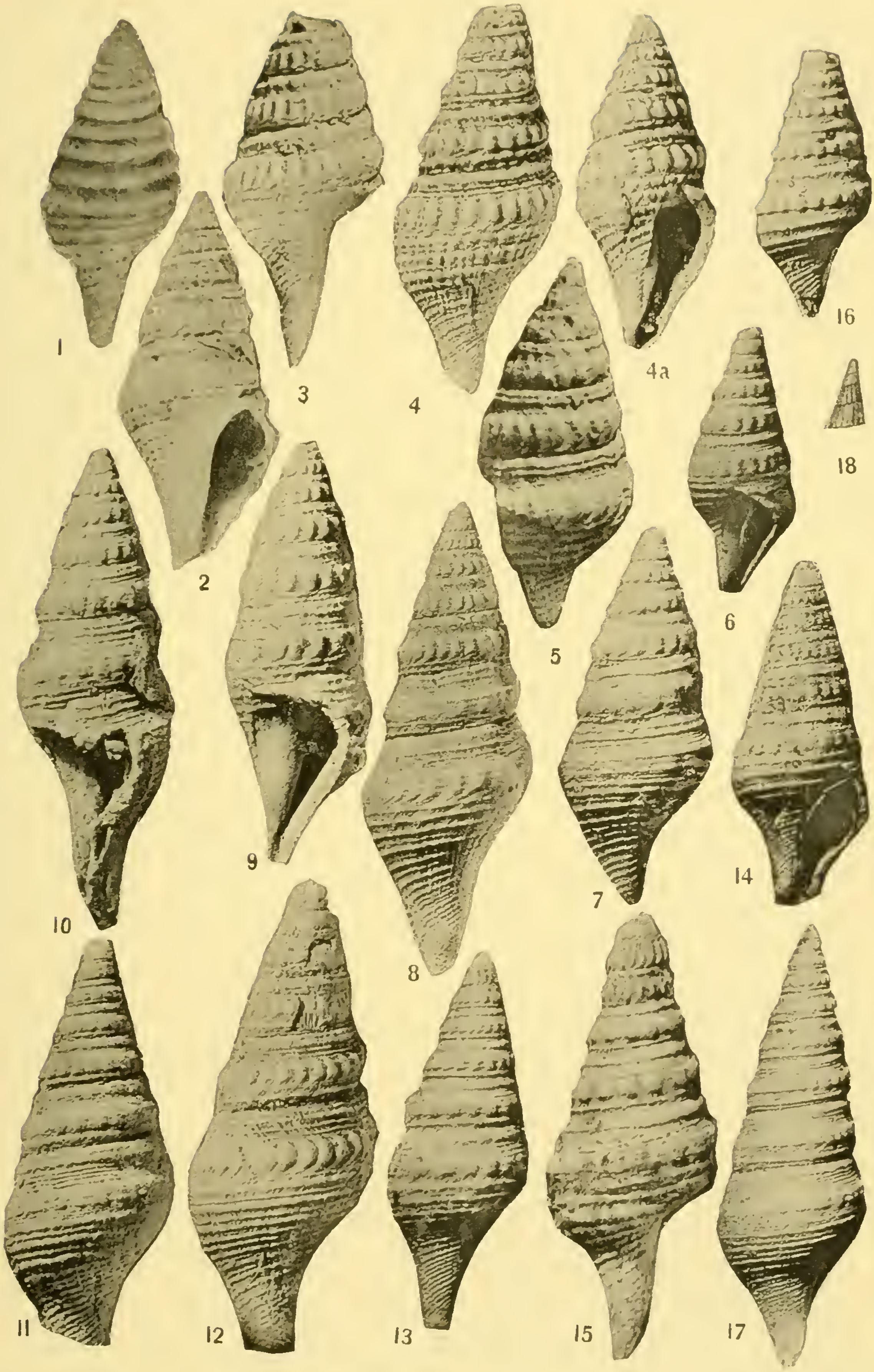
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PLATE 58

EXPLANATION OF PLATE 58

Figure | Page

1. **Coronia amica** (Casey) 420
Length, 7.5 mm.; showing well the number and size of embryonic whorls; oil well, Sour Lake, Texas; Pal. Res. Inst., No. 4447.

2. **Coronia genitiva** (Casey), var. 421
Length, 13 mm.; Danville, La.; Pal. Res. Inst., No. 4448.

3. **Trypanotoma terebriformis, var. curta** Harris 422
Length, 8 mm.; eroded specimen, seemingly much nearer the St. Maurice form than the Claiborne representative; Danville, La.; Holotype, Pal. Res. Inst., No. 2404; specimen figured, Pal. Res. Inst., No. 4433.

4, 5. **Sinistrella americana** (Aldrich) 422
Length, 11 mm.; Danville, La.; Pal. Res. Inst., No. 4434.

6. **Infracoronia ludoviciana, var. normani** (Harris) 423
Length, 28 mm.; same specimen used for fig. 3, pl. 4, vol. 2, Palæont. Amer.; Danville, La.; Pal. Res. Inst., No. 2396.

7. **Gemmula plentopsis, n. sp.** 417
Length, 19 mm.; Danville, La.; Pal. Res. Inst., No. 4435.

8. **Coronia ? ludonorma, n. sp.** 421
Length, 12 mm.; Myatt Bluff, Ouachita River, La.; Pal. Res. Inst., No. 4449.

9. **Gemmula ? weisbordi** Harris 421
Length, 17.5 mm.; shown also as fig. 7, pl. 3, vol. 2, Palæont. Amer.; Montgomery, La.; Pal. Res. Inst., No. 2380.

10-13. **Eucheilodon crenocarinatus** Heilprin 424
10. Length, 15 mm.; showing oral dentition and faint carination of whorls; Montgomery, La.; Pal. Res. Inst., No. 4450.
11. Length, 18 mm.; nodose carination appearing; Danville, La.; Pal. Res. Inst., No. 4451.
12. Length, 23 mm.; subdued oral dentition, but with carinal nodulation; Montgomery, La.; Pal. Res. Inst., No. 4452.
13. The same, ×7, showing apical details.

14-15. **Eopleurotoma ouachitensis** Harris 426
14. Length, 8 mm.; broad form; Danville, La.; Pal. Res. Inst., No. 4453.
15. Length, 9 mm.; slender form; Danville, La.; Pal. Res. Res. Inst., No. 4454.

16. **Eopleurotoma julia** (Cooke) 427
Length, 7 mm.; copied from Cooke's original drawing of the type specimen; U. S. Nat. Mus., No. 353,939; Jackson, Miss.

17. **Eopleurotoma canei** (Harris) 426
Length, 10 mm.; a Sabine Eocene form here introduced for comparison with *julia* of Jackson horizon. See also Claiborne relative; Palæont. Amer., vol. 2, pl. 5, fig. 8.

18. **Bathytoma crassiplicata, var. montgomeryensis** Harris 425
Length, 6.5 mm.; same specimen as figured in vol. 2, pl. 4, fig. 26, of Palæont. Amer.; Pal. Res. Inst., No. 2409.


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PLATE 59

EXPLANATION OF PLATE 59

Figure Page

1-4. **Eopleurotoma carya** Harris, vars. 427-428
1. Length, 13 mm.; Montgomery, La.; Pal. Res. Inst., No. 2440.
2. Length, 12.5 mm.; Jackson Eocene; exact locality not given; Pal. Res. Inst., No. 4987.
3. Var. *carola?;* length, 12.5 mm.; a slender nodose form approaching this variety as figured in Palæont. Amer., vol. 2, pl. 6, fig. 17, and not far from the Mosley's Ferry type of *E. nodocarinata* Gabb: Jackson Eocene; Pal. Res. Inst., No. 4988.
4. Length, 11 mm.; showing details of nodulation; Montgomery, La.; Pal. Res. Inst., No. 4988a.

5. **Eopleurotoma ? albirupsis**, n. sp. 428
Length, 6 mm.; holotype; White Bluff, Ark.; Pal. Res. Inst., No. 4989.

6, 8. **Pleurofusia danvicola** Harris, vars. 429-430
6. Length, 19 mm.; the more typical form; Danville, La.; Pal. Res. Inst., No. 4990.
7. Length, 6 mm.; small specimen showing details of markings; Danville, La.; Pal. Res. Inst., No. 4991.
8. Length, 19 mm.; var. *parahilgardina*, n. var. holotype; Montgomery, La.; Pal. Res. Inst., No. 4992.

9. **Pleurofusia hilgardi** Casey 430
Length, 16 mm.; holotype; U. S. Nat. Mus., No. 481,669.

10. Specimen here referred to **P. hilgardi**; length, 18 mm.
Note the broad ribs and strong subsutural band like *collaris* but without the depressed shoulder zone of the species as shown clearly in fig. 14; Garland Creek, Miss.; Pal. Res. Inst., No. 4993.

11, 12. **Pleurofusia fluctuosa** (Harris) (Weisbord, MS.) 430
11. Length, 15 mm.; Garland Creek, Miss.; Pal. Res. Inst., No. 4994.
12. Length, 20 mm.; holotype; same specimen as represented by fig. 1, pl. 12, vol. 2, Palæont. Amer., Bunker Hill, Ouachita River; Pal. Res. Inst., No. 2543.

13-15. **Pleurofusia collaris** (Casey) 431
13. Length, 17 mm.; holotype; U. S. Nat. Mus., No. 481,-668; Jackson, Miss.
14. Length, 14 mm.; Jackson Eocene; Pal. Res. Inst., No. 4995.
15. Apex of same ×5.

16-18. **Turricula plutonica** (Casey), var. **weisbordi** Harris 431
16. Length, 27 mm.; Danville, La.; Pal. Res. Inst., No. 4996.
17. Apex of the same, ×4; Danville, La.; Pal. Res. Inst., No. 4997.
18. The same; Danville, La.; Pal. Res. Inst., No. 4998.

19, 20. **Pleurofusia subservata**, n. sp. 431
Length, 27 mm.; microscopic spirals not visable in these figures; Montgomery, La.; Pal. Res. Inst., No. 4999.

21. Apex of **P. servata** Conrad of the Vicksburg Oligocene, for comparison with Jackson forms.

22. Apex of **P. vicksburgensis** Casey from the Vicksburg Oligocene, introduced for comparison with figs. 17, 20, and 21.

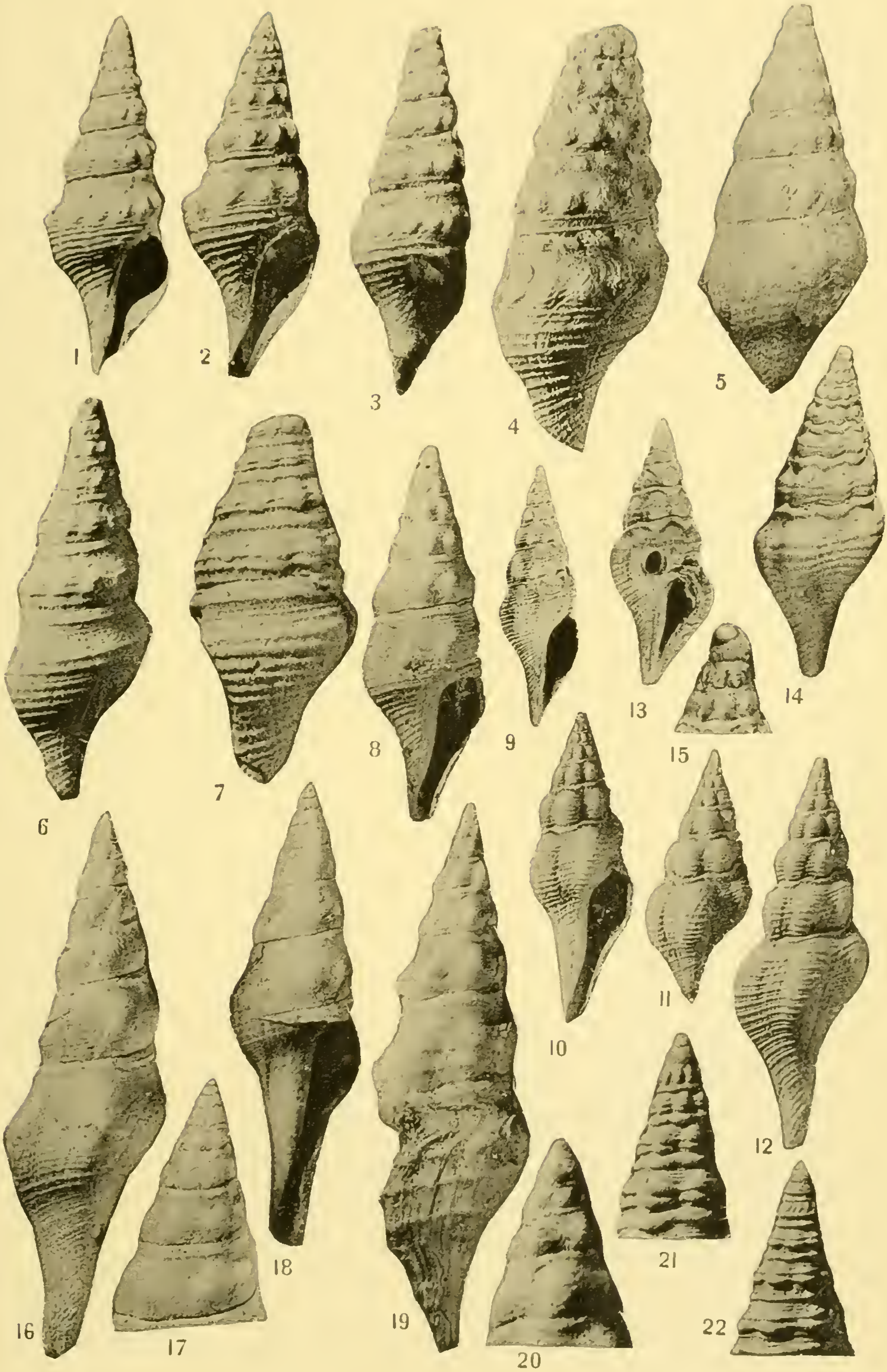

PLATE 60

16. Length, 21 mm.; Garland Creek, Miss.; Pal. Res. Inst., No. 4985.
17. Length, 14 mm.; high-spired form; Montgomery, La.; Pal. Res. Inst., No. 4986.
18. Fig. 17, ×6 showing details of apex.

19. **Scobinella ? jacksonensis Meyer** 437
In Phila. Acad. Coll., No. 9596; length, 9.3 mm.

EXPLANATION OF PLATE 60

(*Continued on previous page*)

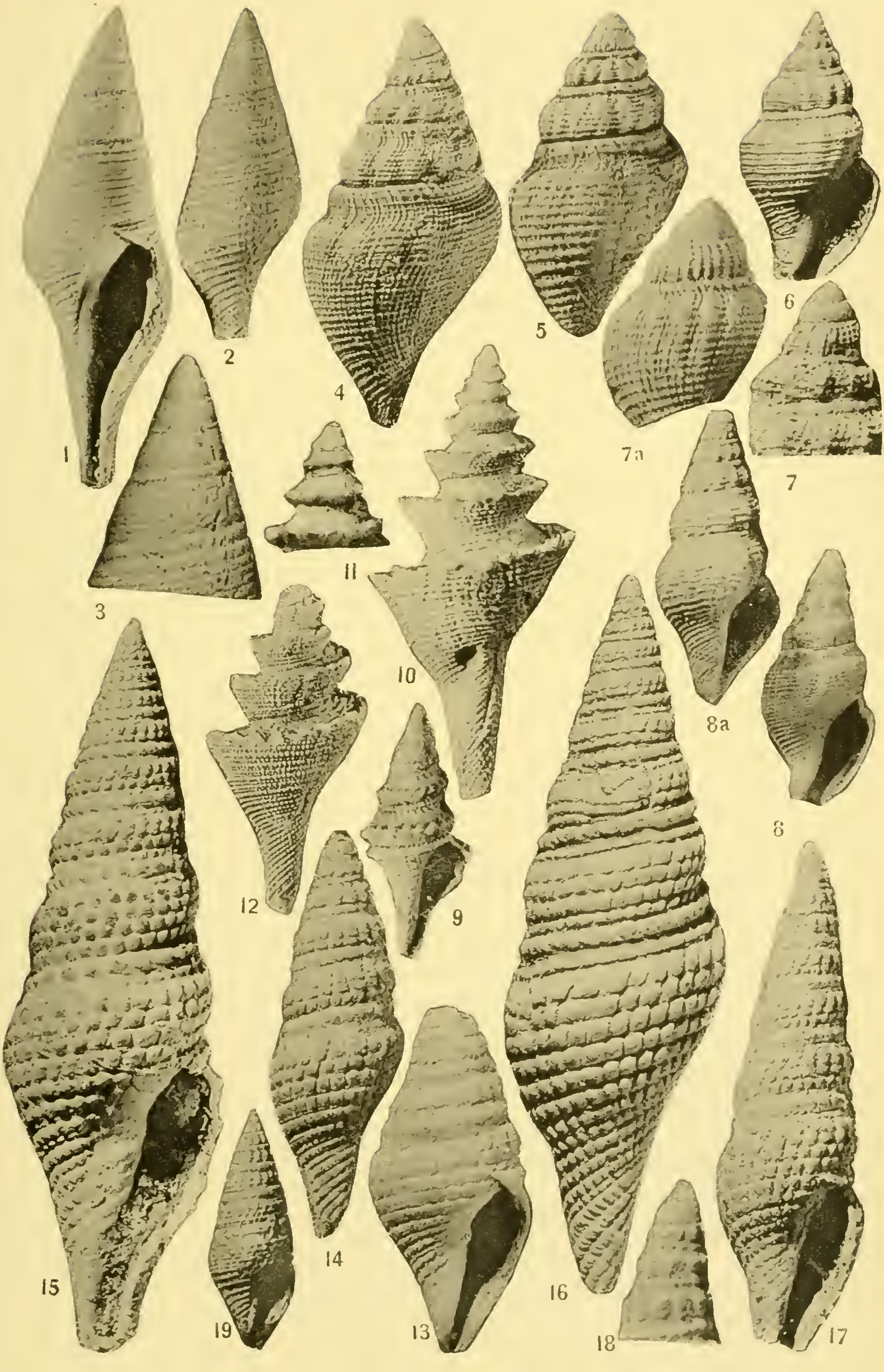
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PLATE 61

17. **Cymatosyrinx palmeræ**, n. sp. 442
Length, 9.5 mm.; Danville, La., on the Ouachita River; Pal. Res. Inst., No. 4969.

18-25. **Conorbis alatoideus** Aldrich 443
18. Length, 25 mm.; after Aldrich; Moodys Branch, Miss.
19. Length, 8 mm.; young showing apical markings; Gibson Landing, Ouachita River, La.; Pal. Res. Inst., No. 4971.
20-21. Length, 21 mm.; showing internal and external details; Town Creek, Jackson, Miss.; Pal. Res. Inst., No. 4975.
22. Magnified exterior of figs. 21-22 showing the course of growth lines.
23. Length, 37 mm.; showing character of aperture and outer lip; Town Creek, Jackson, Miss.; Pal. Res. Inst., No. 4973.
24. Length, 39 mm.; showing interior absorption of whorls within, a typical large *alatoideus*, Town Creek, Jackson, Miss.; Pal. Res. Inst., No. 1972.
25. Spire enlarged to show details of markings in a Bunker Hill variety of this species; Pal. Res. Inst., No. 4974.

EXPLANATION OF PLATE 61

Figure		Page
1, 2.	**Scobinella famelica** Casey Length, 26 mm.; specimen as figured in vol. 2, Palæont. Amer., pl. 13, fig. 23; Montgomery, La.; Pal. Res. Inst., No. 2571.	437
3.	**Cordieria ludoviciana** (Vaughan) Length, 20 mm.; same specimen as figured in vol. 2, Palæont. Amer., pl. 12, fig. 9; Jackson, Miss.; Pal. Res. Inst., No. 2547.	438
4.	**Microdrillia meyeri** Cossmann Length, 3.2 mm.; copied from Meyer; Jackson, Miss.	439
5, 6.	**"Scobinella læviplicata** Gabb" Cossmann 5. Length, 5.5 mm.; after Cossmann; Jackson, Miss. 6. Length, 5.5 mm.; after Cossmann; Jackson, Miss.	439
7.	**Microdrillia parthenoides,** n. sp. Length, 4 mm.; Sabine River, Texas side below Robinson's Ferry; Pal. Res. Inst., No. 4976.	439
8.	**Microdrillia ouachitæ** Harris Length, 6 mm.; also figured in vol. 2, Palæont. Amer., pl. 15, fig. 31; Danville, La. Pal. Res. Inst., No. 2613.	440
9.	**Asthenotoma danvitexa,** n. sp. 9. Length, 17.5 mm.; Danville, La.; Pal. Res. Inst., No. 4965. 9a. Apex of 9, ×6, showing strong subsutural and nodulations below on each whorl. 9b. Penultimate whorl of fig. 9; showing smooth zone above and three lirations below, also growth lines and position of sinus.	440
10.	**Asthenotoma texana** (Gabb) Apex of the specimen illustrated in Palæont. Amer., vol. 2,, 1937, pl. 15, fig. 9; magnified about 5 diameters.	440
11.	**Asthenotoma,** sp. Length, 15.5 mm.; showing unusually evenly distributed spiral lines on upper portion of whorls; nodulations subdued on upper whorls. Danville, La.; Pal. Res. Inst., No. 4966.	440
12.	**Asthenotoma,** sp. Length, 11 mm.; Danville, La.; perhaps a marked variety of *danvitexa;* showing an unusually large ultimate whorl; smooth band traversed by well-marked spiral line; Pal. Res. Inst., No. 4967.	441
13, 14.	**Clathurella (Eoclathurella) obesula** Casey 13. Length, 5 mm.; photo of Casey's type; Montgomery, La. U. S. Nat. Mus., No. 494,370. 14. Length, 4 mm.; Jackson, Miss.; Pal. Res. Inst., No. 4968.	441
15.	**"Eoclathurella jacksonica"** Casey Length, 4.5 mm.; Casey's holotype; "Red River Kimbrel" bed, Jackson Eocene; U. S. Nat. Mus. not numbered.	441
16.	**Cymatosyrinx dorseyi** (Cooke) Length, 6.5 mm.; copy of Cooke's illustration; Moodys Branch, Jackson, Miss.; U. S. Nat. Mus., No. 353,938.	442

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PLATE 62

19. **Persicula semen** (Lea) 406
Height, 5 mm.; greatest diameter, 3.5 mm.; Jackson, Miss. No. 4789, Pal. Res. Inst.

20. **Conus sauridens** Conrad 444
Height, 26 mm.; greatest diameter, 13.3 mm.; loc. 880, Jackson, Miss.; No. 4793, Pal. Res. Inst.

21. **Bovicornu gracile** Meyer 464
Holotype. Apex. Copy, Collins, Johns Hopkins Univ. Studies Geol., No. 11, 1934, pl. XIII, fig. 4.

22. **Bovicornu gracile** Meyer 464
Holotype. Length, 2.6 mm.; greatest diameter, 0.5 mm. Copy, Collins, *op. cit.*, pl. IX, fig. 8.

23. **Clio simplex** (Meyer) 463
Holotype. Length, 4.5 mm.; greatest diameter, 0.6 mm. Copy, Collins, *op. cit.*, pl. IX, fig. 5.

24. **Clio simplex** (Meyer) 463
Holotype. Apex. Copy, Collins, *op. cit.*, pl. XIII, fig. 6.

25. **Clio corpulenta** (Meyer) 462
Holotype. Length, 3.25 mm.; greatest diameter, 1.0 mm. Copy, Collins, *op. cit.*, pl. IX, fig. 4.

26. **Clio corpulenta** (Meyer) 462
Holotype. Apex. Copy, Collins, *op. cit.*, pl. XIII, fig. 3.

EXPLANATION OF PLATE 62

Figure		Page
1, 4.	**Terebra jacksonensis** Cooke Height, 13 mm.; greatest diameter, 3 mm.; loc. 921, Jackson, Miss.; No. 4794, Pal. Res. Inst.	447
2.	**Terebra jacksonensis** Cooke, var. Height, 8 mm.; greatest diameter, 2 mm.; loc. 1049, White Bluff, Ark.; No. 4795, Pal. Res. Inst.	448
3.	**Terebra jacksonensis** Cooke Height, 9.5 mm.; greatest diameter, 3 mm.; loc. 921, Jackson, Miss.; No. 4798, Pal. Res. Inst.	447
5.	**"Terebra" abditiva, n. sp.** Holotype. Height, 23.5 mm.; greatest diameter, 4.5 mm.; loc. 10, Montgomery, La.; No. 4799, Pal. Res. Inst.	446
6.	**Terebra jacksonensis** Cooke, var. Height, 11.4 mm.; greatest diameter, 3 mm.; loc. 1049, White Bluff, Ark.; No. 4796, Pal. Res. Inst.	448
7.	**Terebra jacksonensis** Cooke, var. Height, 12 mm.; greatest diameter, 2.5 mm.; loc. 1049, White Bluff, Ark.; No. 4797, Pal. Res. Inst.	448
8.	**Terebra jacksonensis** Cooke Photo of original retouched photograph. Courtesy of C. W. Cooke.	447
9, 10.	**Persicula semen** (Lea) Type of *Marginella incurva jacksonensis* Meyer. Height, 7 mm.; greatest diameter, 4 mm.; Jackson, Miss., Geology Department, Johns Hopkins University.	406
11.	**Persicula semen** (Lea) Height, 4.5 mm.; greatest diameter, 2.5 mm. Figured, 1937, pl. 67, fig. 14; No. 3276, Pal. Res. Inst.	406
12.	**Persicula semen** (Lea) Height, 6 mm.; greatest diameter, 4 mm.; Figured, 1937, pl. 67, fig. 13; No. 3275, Pal. Res. Inst.	406
13.	**"Pusionella" marnochi** (Heilprin) Holotype. Height, 25 mm. Original drawing, Aldrich, Bull. Amer. Paleont., vol. II, No. 8, pl. 3, fig. 4.	449
14.	**"Pusionella" marnochi** (Heilprin) Holotype. Original drawing, Aldrich, Bull. Amer. Paleont., vol. II, No. 8, pl. 3, fig. 4a.	449
15.	**Conus sauridens** Conrad Height, 37.3 mm.; greatest diameter, 19.5 mm.; loc. 883, Montgomery, La.; No. 4792, Pal. Res. Inst.	444
16.	**Conus sauridens** Conrad Height, 41.5 mm.; greatest diameter, 21.5 mm.; loc. 787, Jackson, Miss.; No. 4790, Pal. Res. Inst.	444
17.	**Conus sauridens** Conrad Holotype of *Conus jacksonensis* Meyer. Height, 3.5 mm.; greatest diameter, 3.5 mm.; Jackson, Miss.; Geology Department, Johns Hopkins University.	446
18.	**Conus sauridens** Conrad Height, 49 mm.; greatest diameter, 29 mm.; loc. 881, Jackson, Miss.; No. 4791, Pal. Res. Inst.	444

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PLATE 63

19. **Agaronia mississippiensis** (Conrad) ... 410
Height, 24 mm.; greatest diameter, 10 mm.; loc. 883, Montgomery, La.; No. 20012, Pal. Res. Inst.

20. **Trigonostoma selectum**, n. sp. ... 411
Paratype. Height, 10 mm.; greatest diameter, 5.5 mm.; loc. 10, Montgomery, La.; No. 20007, Pal. Res. Inst.

21, 22. **Trigonostoma selectum**, n. sp. ... 411
Holotype. Height, 12 mm.; greatest diameter, 7.5 mm.; loc. 10, Montgomery, La.; No. 20003, Pal. Res. Inst.

23. **Coptostoma ulmulum secutorum**, n. var. ... 413
Paratype. Height, 15 mm.; greatest diameter, 10 mm.; loc. 10, Montgomery, La.; No. 20006, Pal. Res. Inst.

24. **Coptostoma ulmulum secutorum**, n. var. ... 413
Paratype. Height, 12.3 mm.; greatest diameter, 8 mm.; loc. 10, Montgomery, La.; No. 20005, Pal. Res. Inst.

25. **Coptostoma ulmulum secutorum**, n. var. ... 413
Holotype. Height, 20 mm.; greatest diameter, 12 mm.; loc. 10, Montgomery, La.; No. 20004, Pal. Res. Inst.

26, 27. **Acteon annectens** Meyer ... 454
Height, 6 mm.; greatest diameter, 3.5 mm.; loc. 699, Jackson, Miss.; No. 20014, Pal. Res. Inst.

EXPLANATION OF PLATE 63

Figure		Page
1.	**Bonellitia mississippiensis** (Conrad) Lectotype. Height, 11 mm.; Vicksburg Oligocene. Meyer. drawing; Acad. Nat. Sci. Philadelphia.	412
2.	**Bonellitia jacksonica** (Cooke) Height, 3 mm.; greatest diameter, 2 mm.; young. Jackson, Miss.; No. 20000, Pal. Res. Inst.	412
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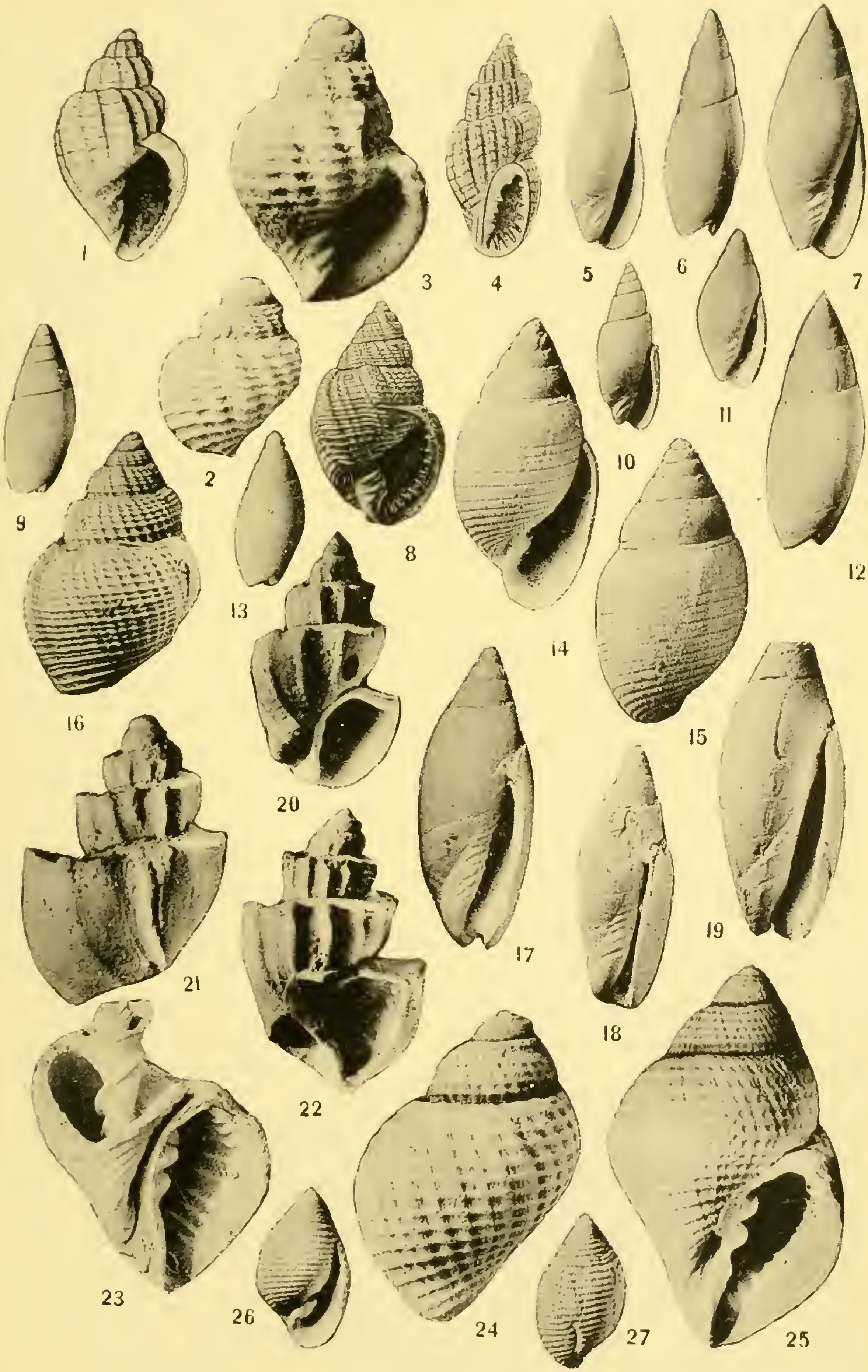
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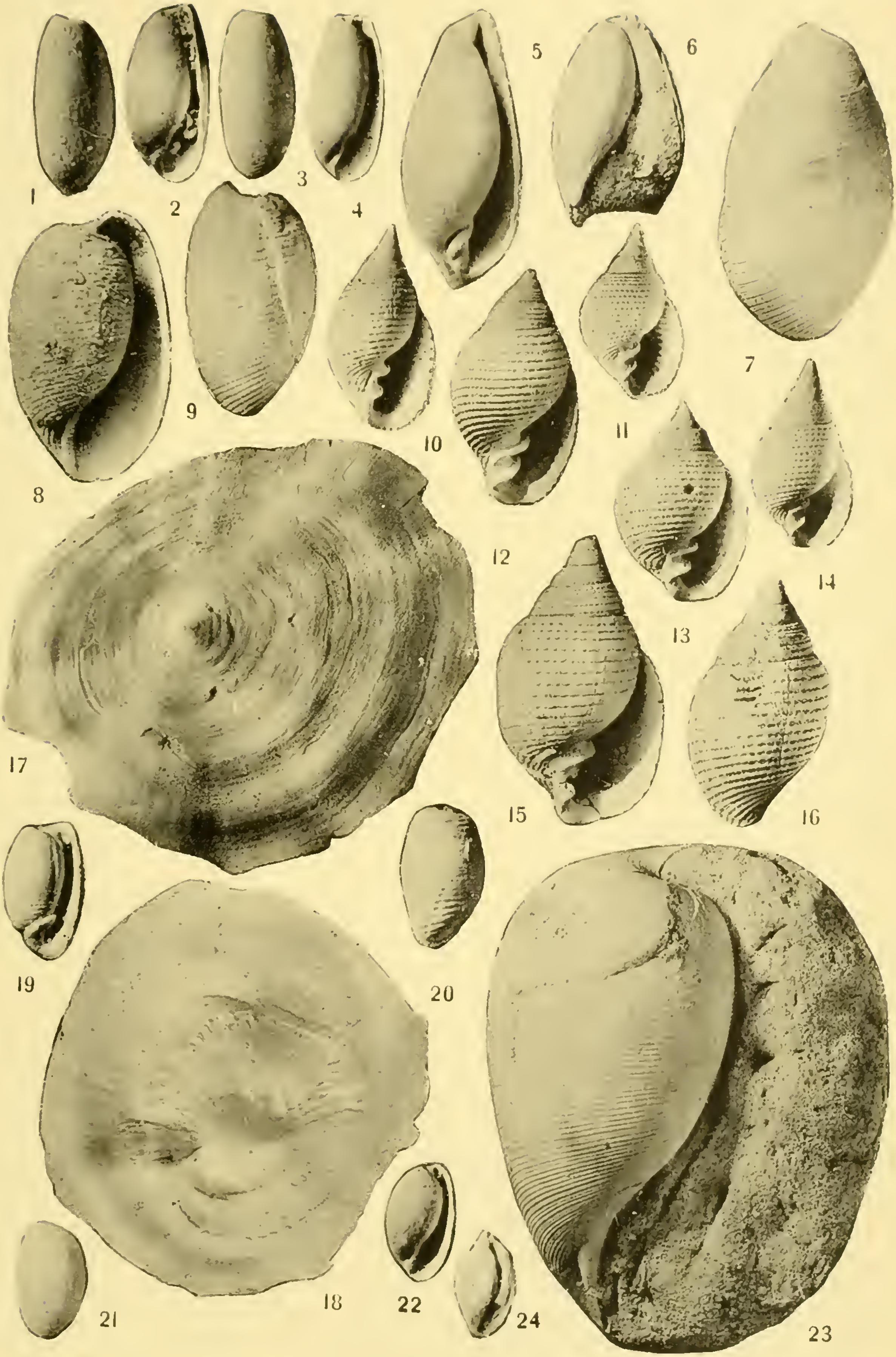
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