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A REVIEW OF THE VOLUTID GENERA *LYRIA* AND *FALSILYRIA* (MOLLUSCA:GASTROPODA) IN THE TERTIARY OF THE WESTERN ATLANTIC

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I. ABSTRACT

This report covers New World fossil species of two genera of the family Volutidae, *Lyria* and *Falsilyria,* and suggests the relationship between the genera. The previously recorded species of *Lyria* s.s. include one from the Paleocene of Alabama, two from the Oligocene of Mississippi, two from the lower Miocene of Florida, and one from the upper Miocene of the Dominican Republic.To these are added three new species: *Lyria (Lyria) inedita,* from the Clayton Formation of Alabama, *L. (L.) limata,* from the Chipola Formation of Florida, and *L. (L.) incomperta,* from the Gurabo Formation of the Dominican Republic. Two previously described species from the lower Miocene of North Carolina and Florida, respectively, are tentatively referred to the subgenus *Harpeola.* In the subgenus *Enaeta* there are three previously known species, one each from the lower Miocene of Florida, the upper Miocene of the Dominican Republic, and the (?)upper Miocene of Panamá; to these is added a fourth, *L. (Enaeta) olssoni,* n. sp., also from the (?)upper Miocene of Panamá.

Species of the genus *Falsilyria* have been confused with those of *Voluta* and *Lyria* and are intermediate between the two. The

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group is confined to the western Atlantic with the known fossil species including two from the Eocene of Florida, one from the Oligocene of Florida and Georgia, two from the lower Miocene of Florida and one from the (?)upper Miocene of Anguilla, B.W.I. One new species, *Falsilyria anoptos,* is described from the Chipola Formation of Florida.

II. INTRODUCTION

Numerous fossil species of the gastropod genus *Lyria* have been recorded from the New World. However, due to the scarcity of individuals of most species, little is known about the relationship of one to another. Fossil *Lyria* were common in the Old World during early Tertiary time and many representatives of the genus are living in the tropical Indo-Pacific region.

LYRIA SENSU STRICTO: *Lyria* is an ultraconservative group without much change in form and color pattern through geologic time. Aldrich (1894, p. 243) named *L. wilcoxiana* from the Paleocene Clayton Formation of Alabama and Gardner (1935, pp. 241, 242, 243) reported three undescribed species of *Lyria* from the Paleocene of Texas. A new species, *L. (L.) inedita,* also from the Paleocene Clayton Formation of Alabama is here added. In the New World between the Paleocene and Oligocene there is a gap in the record, with the exception of a single species reported by Woodring (1964, p. 288, pl. 39, figs. 25, 26) from the Eocene Gatuncillo Formation of the Canal Zone. As his specimen was not a true *Lyria* he erected a new genus, *Ctenilyria,* noting the strong denticulations on the outer lip. Only one other known species, *Voluta coroni* Morlet from the middle and upper Eocene of the Paris Basin, has this feature (Woodring, 1964, p. 288).

In the Oligocene of Mississippi there are two species: *L. nestor* Casey, from the lower Oligocene Red Bluff Formation; and *L. mississippiensis* (Conrad), from the middle and upper Oligocene. In the Miocene beds of Florida there are two species in the Aquitanian Tampa Limestone: *L. silicata* Dall and *L.* sp. cf. *L. mississippiensis* (figured by Dall as *"L. pulchella"*); and one in the Burdigalian Chipola Formation, *L. limata* n. sp. In the upper Miocene Gurabo Formation of the Dominican Republic there are another two species: *L. pulchella* (Sowerby) and *L. incomperta* n. sp. The latter undoubtedly gave rise to one of the two living representatives in the western Atlantic region: *L. vegai* Clench and Turner. The ancestry of the second Recent species, *L. beauii* (Fischer and Bernardi), is less certain. The color pattern is most like that of the lower Miocene *L. limata* but the shell morphology is somewhat different.

ENAETA: Enaeta, a New World subgenus of *Lyria,* apparently arose in the lower Miocene of Florida with *L. (E.) isabellae* (Maury). There is one species from the upper Miocene Gurabo Formation of the Dominican Republic, *L. (E.) perturbatrix* (Maury), and two from the (?)upper Miocene Gatun Formation, Panamá: *L. (E.) ecnomia* (Woodring) and *L. (E.) olssoni* n. sp. This subgenus fares much better in the Recent fauna as there are four described species from the western Atlantic and two from the eastern Pacific.

HARPEOLA: Harpeola, a subgenus of *Lyria,* heretofore has comprised only a few species from the Old World. These differ from *Lyria* sensu stricto in having a channeled suture, causing the whorls to be coronated by the extension of the ribs over the suture. The edge of the outer lip is thickened and usually ornamented with small, blunt denticles. *Lyria heilprini* from the Tampa Limestone of Florida and *L. carolinensis* from the "Silverdale beds" of North Carolina display these diagnostic features and are tentatively assigned to *Harpeola.*

FALSILYRIA: Pilsbry and Olsson (1954, p. 21, 22) erected a new genus *Falsilyria* (type species: *Lyria pycnopleura* Gardner, 1937) stating: "Species of this group have generally been referred to *Lyria,* but its relationship lies closer to the true volutes as shown by its columellar plaits intergrading with smaller lirations on the parietal wall, and by its strong recurved beak and short siphonal fasciole." Another point in common with living specimens of the genus *Voluta* is the color pattern. Under ultraviolet

light the Chipola specimens of *Falsilyria* reveal a typical *Voluta* pattern (see pl. 5, figs. 4c, 4d).

The genus *Voluta* s.s. is endemic to the western Atlantic (Clench and Turner, 1964, p. 139), and the first geologic record of its occurrence is the lower Miocene beds of the Cantaure Formation of Venezuela*. Seemingly, it has never radiated from the Caribbean and all known species, both fossil and Recent, are confined to this area. According to Clench and Turner (1964), the Recent forms occur from the Greater Antilles south to the coast of Brazil and along the mainland as far north as Nicaragua. *Falsilyria* (with a single exception, *F. vaughani* from Anguilla, B.W.I.) is known only from the Gulf of Mexico, with all but one of the known fossil species occurring in the Florida area and a single Recent form in the western Gulf.

Falsilyria and *Voluta* would seem to represent parallel evolution from a common ancestor. The color patterns of the two groups are strikingly similar and so unusual that they frequently look as though they were "drawn" on the shell by an artist with a pen. The most noticable difference between the two groups is the greater width of the shell of the true volutes and a lesser number of columellar plications. In the true volutes the number is about eight to ten, in the genus *Falsilyria* the number is usually nearer 14 in the later species, although it is also about ten in the earlier ones. The protoconch of *Falsilyria* is somewhat smaller than in *Voluta*.

Falsilyria morphologically is intermediate between *Lyria* and *Voluta,* having characteristics of both genera. Presumably diverging from true *Lyria* during the Eocene, *Falsilyria* first occurs in the upper Eocene Inglis Limestone of Florida with two species: *F. eocenica* (Palmer) and *F. citrusensis* (Palmer). In the upper Oligocene of the same area there is *F. mansfieldi* (Dall), of which *F. dalli* (Mansfield) is considered a synonym. *Falsilyria musicina* (Heilprin) occurs in the Aquitanian Tampa Limestone and *F. pycnopleura* and *F. anoptos,* n. sp., are in the Burdigalian Chipola Formation of Florida. There is a single Caribbean species, *F. vaughani* (Cooke) from the (?)upper Miocene of Anguilla, B.W.I. and the only known Recent example is *"Voluta" demarcoi* Olsson, described from the Gulf of Mexico, off the Texas-Mexico border.

*Jung (1965) considered the beds of the Paraguaná Peninsula to be middle Miocene in age; however, Hunter and Bartok (1974), who subsequently named the Cantaure Formation, ascertained the age to be Burdigalian.

III. ACKNOWLEDGMENTS

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IV. SYSTEMATIC DESCRIPTIONS

Family VOLUTIDAE Rafinesque, 1815
Subfamily LYRIINAE Pilsbry and Olsson, 1954
Genus LYRIA Gray, 1847

Lyria GRAY, 1847, Zool. Soc. London, Proc., (1847), p. 141.
Type species: *Voluta nucleus* Lamarck, 1811, by original designation; Recent, Indo-Pacific.

Otocheilus CONRAD, 1865, Amer. Jour. Conch., v. 1, p. 24.
Type species: *Otocheilus mississippiensis* (Conrad, 1848), here designated [= *Fulgoraria mississippiensis* Conrad, 1848]; Oligocene, Mississippi.

Sannilyria PILSBRY and OLSSON, 1954, Bulls. Amer. Paleontology, v. 35, no. 152, p. 23.
Type species: *Voluta pulchella* Sowerby, 1850, by original designation; Miocene, Dominican Republic.

Subgenus LYRIA s.s.

Diagnosis: Shell globose to fusiform; nucleus slender, consisting of one and one-half to three and one-half smooth whorls; early teleoconch whorls axially costate, subsequent whorls either smooth or ribbed. Suture distinct but not channeled, usually undulated by the axial ribbing. Aperture elliptical, labrum thickened by broad terminal varix, margin sharp, smooth within; columella heavily glazed, two or three prominent oblique plaits anteriorly, few or many weaker lirations on remainder of col-

umellar wall. Siphonal fasciole weakly developed; siphonal notch broad, shallow.

LYRIA (?LYRIA) WILCOXIANA
Aldrich
Plate 3, fig. 5

Lyria wilcoxiana ALDRICH, 1894, Paleontology of the Eocene of Alabama, Geol. Surv., p. 243, pl. 12, fig. 4.

Lyria wilcoxiana Aldrich. HARRIS, 1896, Bulls. Amer. Paleontology, v. 1, no. 4, p. 85, pl. 8, fig. 5.

Lyria Willcoxiana [sic] Aldrich. COSSMANN, 1899, Essais de Paléoconchologie comparée, v. 3, p. 114.

Lyria wilcoxiana Aldrich. BRANN and KENT, 1960, Bulls. Amer. Paleontology, v. 40, no. 184, p. 515.

Lyria wilcoxiana Aldrich. PALMER and BRANN, 1965, Bulls. Amer. Paleontology, v. 48, no. 218, p. 743.

Diagnosis: "Shell rounded fusiform, whorls four, spire blunt, first three whorls smooth, body whorl transversely ribbed, the ribs rather sharp with concave spaces; no spiral sculpture shown; suture distinct, not deeply impressed; body whorl long, terminating in a canal, which is missing in specimen figured; aperture long and narrow, inner lip showing a few plications, but the aperture is filled in so that the lips are almost completely hidden." (Aldrich, 1894)

Dimensions of holotype: height 22.3 mm, diameter 13.5 mm.

Holotype: USNM 111907.

Type locality: USGS 264, Prairie Creek, Wilcox County, Alabama.

Occurrence: Clayton Formation, lower Midway Group, Alabama; Paleocene.

Figured specimen: USNM 111907 (holotype).

Discussion: Apparently the type of *L. wilcoxiana* is unique; this species has not been reported by subsequent workers. The specimen is recrystallized, decorticated, and filled with matrix so that details of the aperture are not preserved; however, as nearly as can be determined it appears to be *Lyria* s.s.

A second species described by Aldrich at the same time (1894, p. 245, pl. 13, fig. 7) as *"Volutalithes" lyroidea* has been referred to the genus *Lyria* by Cossmann (1899, p. 144) and others but examination of the holotype (USNM 111844) does not substantiate this assignment. The type is again a unique specimen, lacking the early whorls. Likewise it is filled with a totally recalcitrant matrix and so the aperture is unknown (see pl. 4, fig. 3). On the basis of the few characters visible it most resembles some form of buccinid.

LYRIA (LYRIA) INEDITA, n. sp.
Plate 4, figs. 1, 2

Diagnosis: Shell fusiform; spire about four-tenths of total height; axially costate throughout. Adult specimens with probably six teleoconch whorls, all material incomplete or immature; nucleus unknown. Suture impressed but not channeled, somewhat undulating. Seven to ten heavy axial costae, sharply rounded, with wide interspaces. Aperture narrow, outer lip thin, smooth within; columella with three strong oblique plications at the anterior end, middle one the strongest, with five to seven nearly horizontal lirations toward the posterior. Weakly developed siphonal fasciole, with a broad, shallow siphonal notch. Shell surface smooth, no spiral ornament.

Dimensions of holotype: height 21.0 mm, diameter 10.6 mm.

Holotype: USNM 25760.

Type locality: McCormic's [McConnico's] plantation, Wilcox County, Alabama.

Paratype: USNM 25759; height 19.0 mm, diameter 10.1 mm; locality, Allenton, Wilcox County, Alabama.

Occurrence: Clayton Formation, lower Midway Group, Alabama; Paleocene.

Figured specimens: Fig. 1, USNM 25760 (holotype). Fig. 2, USNM 25759 (paratype).

Discussion: In the collections of the U.S. National Museum there are several specimens that were catalogued as *"Volutalithes lyroidea* Aldrich." Comparison with the holotype of that species (here figured, pl. 4, fig. 3) reveals that there are marked differences between these specimens and *"V." lyroidea.* The latter is a larger species, with sinuous axial ribs and a strongly recurved siphonal canal. The preservation of the unique holotype is such that an absolute generic identification is impossible but it is certainly not a *Lyria.* The new species, however, is unquestionably referrable to *Lyria* s.s. and as such is the oldest definite member of the subgenus in the New World. As noted above, there are several other species of *"Lyria"* from the Paleocene beds, but only this one has the unmistakable columellar plications, three stronger anterior and several weaker

posterior, with the strong axial ribs that identify the group.

Because of the misidentification as *"V. lyroidea"* this new species has languished in the U.S. National Museum collections for years, thus the name *inedita* (Latin – "not made known, unpublished") seems appropriate.

LYRIA (LYRIA) NESTOR Casey
Plate 1, fig. 1

Lyria costata Sowerby. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 85, pl. 6, fig. 2. *(Not* of Sowerby.)

Lyria nestor CASEY, 1903, Acad. Nat. Sci. Phila., Proc., v. 55, pt. 1, p. 282.

Lyria costata (Sowerby). SCHUCHERT *et al.,* 1905, U.S. Natl. Mus., Bull. 53, p. 378 ("Red Bluff, Mississippi"). *(Not* of Sowerby.)

Diagnosis: "It is much more elongate in outline than the Vicksburg species *[L. mississippiensis],* and is more distinctly sculptured. The longitudinal ribbing is more obtusely rounded and less distinct." (Casey, 1903)

Shell fusiform in outline, spire nearly one-half the total height. Nucleus of three to three and one-half slender smooth whorls, about seven axially costate teleoconch whorls in adult specimens. Costae sinuous, broadly-rounded, with wide interspaces, averaging eleven ribs on final whorl. Suture impressed, undulated by the termination of the axial ribs. Outer lip with heavy varix, margin sharp, non-lirate, thickened within; columella heavily callused, three oblique plaits anteriorly, medial one strongest, posterior weakest, about five widely spaced lirations on remainder of columella area. Teleoconch whorls with closely spaced fine revolving threads, stronger and more widely spaced on basal portion of final whorl. Weakly developed siphonal fasciole; broad, shallow siphonal notch.

Dimensions of lectotype: height 43 mm, diameter 18 mm.

Lectotype: USNM 480042 (selected by MacNeil MS).

Type locality: Red Bluff, Mississippi.

Occurrence: Red Bluff Clay, Mississippi; lower Oligocene.

Figured specimen: USNM 253217; height 33.1 mm, diameter 13.5 mm; locality TU 226.

Discussion: Lyria nestor was not recognized as a distinct species by Dall (1890, p. 85, pl. 6, fig. 2), who confused it with *L. mississippiensis* and *L. costata* (Solander *in* Brander, 1776) of the Barton beds, upper Eocene of southern England. Although the latter bears a superficial resemblance to *L. nestor,* the two species can be readily separated by the higher, more rounded whorls, narrower, less oblique aperture, and less constricted outer lip of the British species. *Lyria mississippiensis* has a proportionately shorter spire, more numerous and sharply-rounded axial costae, and a different arrangement of the plications and lirations on the columella area, thus differentiating the species from *L. nestor.*

The species of *Lyria* that occurs in the Oligocene of Germany, *L. decora* Beyrich, 1853, bears a marked resemblance to *L. nestor;* however, the illustrations given by von Koenen (1890, pl. 37, figs. 9, 10) indicate that the adult shell is more elongate.

Under ultraviolet light *L. nestor* shows the basic spiral lines of color that are typical of the genus *Lyria.*

LYRIA (LYRIA) MISSISSIPPIENSIS (Conrad)
Plate 1, fig. 2

Fulgoraria mississippiensis CONRAD, 1848, Acad. Nat. Sci. Phila., Jour., (2nd Ser.) v. 1, p. 119, pl. 13, fig. 1.

Otocheilus mississippiensis CONRAD, 1865, Amer. Jour. Conch., v. 1, p. 24.

Lyria mississippiensis Conrad?. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 108, pl. 3, fig. 3.

Lyria sp. cf. *L. mississippiensis* (Conrad). MANSFIELD, 1940, Jour. Paleontology, v. 14, no. 3, p. 208, pl. 27, fig. 41.

Diagnosis: "Elliptical, volutions nine, fluted, the ridges distant, acute, and generally one or two of them large, thick and very remote from each other, on the body whorl; spire conical, acute; aperture auriform; columella with nearly equal plaits, not oblique; labrum thick, with a sharp margin." (Conrad, 1848)

Shell fusiform; spire about one-third total height; axially costate throughout. Adult specimens consisting of six teleoconch whorls plus a small smooth nucleus of three and one-half whorls. Suture impressed but not channeled, undulated by the axial ribs. Fourteen to seventeen sinuous, sharply-rounded axial costae, separated by slightly wider interspaces on final whorl. Aperture lenticular; outer lip thickened by terminal varix, smooth within, margin sharp and reflected; parietal wall heavily callused and lirate, anteriorly three strong plications, abapical two oblique, third a little weaker and horizontal, seven to nine horizontal lirations on remainder of columella. Weakly developed siphonal fasciole; shallow, broad siphonal notch. Close-set, fine, wavy, spiral threads through-

out the extent of the shell, becoming wider-spaced and coarser anteriorly.

Dimensions of lectotype: "height one and one-half inches." (Conrad, 1848)

Lectotype: ANSP 13453 (selected by MacNeil MS).

Occurrence: Byram Marl, Mississippi; Suwannee Limestone, Suwannee County, Florida; middle Oligocene. Chickasawhay Limestone, Alabama; upper Oligocene.

Figured specimen: USNM 253218; height 25.0 mm, diameter 12.0 mm; locality TU 335.

Discussion: As discussed above, *L. mississippiensis* was thought by Dall (1890, p. 85) to be synonymous with *L. costata* (Solander *in* Brander). *Lyria mississippiensis* is distinct, but there was no justification for Conrad (1865) to erect a new genus, *Otocheilus,* to accommodate this species. Conrad listed two species, *O. nereidis* and *O. mississippiensis,* but did not designate which of the two was the genotype. Since the first listed, *O. nereidis,* is "an unfigured and unidentifiable" specimen (Dall, 1890, p. 85) it is assumed he had *L. mississippiensis* in mind. The new genus is unnecessary for, if *L. mississippiensis* is considered the genotype, that species, without question, is a *Lyria.* The slender, smooth nucleus, axially ribbed early whorls, plicated and lirated columella, weakly developed siphonal fasciole, and broad siphonal notch are all features indicative of the genus.

Apparently conditions of preservation were not conducive to retaining any trace of a color pattern: none could be brought out under ultraviolet light.

LYRIA (LYRIA) SILICATA Dall
Plate 4, fig. 7

Lyria silicata DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 59, pl. 10, fig. 3.

Lyria heilprini DALL, 1915, U.S. Natl. Mus., Bull. 90, in part, pl. 10, fig. 13 *only*.

Lyria heilprini Dall. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 107 (in part).

Diagnosis: "Shell small, light, slender, with 5 or more gently convex whorls, the apex decollate in the type-specimen; suture distinct, not channeled; third whorl (counting backward from the aperture) with about 16 narrow, rather sharp, riblets, with much wider interspaces extending from suture to suture; these riblets on the later whorls become less regularly spaced and obsolete, on the last whorl absent, except for these riblets the surface appears to be smooth; last whorl much the largest, terminating at the outer lip in a thickened, rounded, and expanded varix; aperture narrowly lunate with no sinus or channel at the posterior commissure; inside of the outer lip smooth, without lirae; body with a thin layer of callus; pillar short, thick, with two strong anterior plaits behind which are indications of six or more minor unequal lirae; canal short, wide, deep, the pillar extending a little in advance of the outer lip, twisted, and with a faint siphonal fasciole." (Dall, 1915).

Dimensions of holotype: "Length of (decollate) shell 27.2, of last whorl 22.5, of aperture 16, maximum diameter 14 mm." (Dall, 1915).

Holotype: USNM 165065.

Type locality: Ballast Point, Tampa Bay, Hillsborough County, Florida.

Occurrence: Tampa Limestone, Florida; early lower Miocene.

Figured specimen: USNM 165063; height 34.8 mm, diameter 15.7 mm; locality same as holotype.

Discussion: In the lower Miocene beds of the Tampa Limestone there are three species of *Lyria.* The first named of these was *"Voluta" zebra* Heilprin, 1887, which was renamed *Lyria heilprini* by Dall (1915, p. 58). This species is here referred to *Harpeola* (see below). Unfortunately, the specimen Dall figured as *"L. heilprini"* (1915, pl. 10, fig. 13) is not Heilprin's species but is a tall slender species of *Lyria* s.s. (To further complicate the issue, true *L. heilprini,* i.e., *V. zebra* Heilprin, Dall figured as *"L. pulchella* (Sowerby), on the same plate—pl. 10, fig. 11). At the same time Dall named a second species from the Tampa as *L. silicata.* The type specimen is poorly preserved but there is enough so that when it is compared with the beautiful example figured as *"L. heilprini"* one can see the two represent the same species. The better specimen is here refigured. A third species of *Lyria,* also in the Tampa, is that one figured by Dall in 1890 as *"L. pulchella"* (Sowerby) and here treated as *L.* sp. cf. *mississippiensis.*

The numerous (20-25 on final whorl), low narrow sharp axial ribs with wider interspaces distinguish *L. silicata* from other fossil *Lyria* of the region. The columella is irregularly lirate; the anterior two, occasionally three plications, are the strongest.

LYRIA sp. cf. L. MISSISSIPPIENSIS
Plate 1, fig. 3

Lyria pulchella (Sowerby). DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 84, pl. 4, fig. 3. (*Not* of Sowerby.)

Lyria pulchella (Sowerby). SCHUCHERT *et al.,* 1905, U.S. Natl. Mus., Bull. 53, p. 378 ("Ballast Point, Tampa, Florida"). (*Not* of Sowerby.)

Diagnosis: Shell fusiform; spire about one-third total height. Unique specimen with five teleoconch whorls and a protoconch of (?) one and one-half bulbous whorls. Suture only slightly impressed, undulating. Fourteen gently rounded axial ribs on each whorl. Aperture incomplete, elongated. Columellar wall bearing but three oblique anterior plications, with very faint lirations posterior to them. Shell surface almost smooth, with a few fine spiral lines on the anterior portion.

Occurrence: Tampa Limestone, Florida; early lower Miocene.

Figured specimen: USNM 112109; height 28.2 mm, diameter 13.1 mm; locality, Ballast Point, Tampa Bay, Hillsborough County, Florida.

Discussion: The shell that Dall (1890, pl. 4, fig. 3) figured as "*Lyria pulchella* (Sowerby)" is not that species. The protoconch is most like *L. pulchella,* and one can see why Dall might have made this identification. However, the shell is much less globose and in overall outline is most like the Oligocene *L. mississippiensis.* The latter has a small protoconch of three and one-half whorls; the Tampa shell has a relatively large protoconch with, as best as can be determined from the silicified specimen, one and one-half whorls.

This is clearly a new species, markedly distinct from the other Tampa form, *L. silicata* Dall, but with no better material than the single specimen presently available it seems best not to describe it at this time.

LYRIA (LYRIA) LIMATA, n. sp.
Plate 1, figs. 4, 5

Diagnosis: Shell slender; fusiform; axially costate. Adult specimens consisting of seven to eight teleoconch whorls plus two and one-half smooth, tapering, nuclear whorls. Teleoconch ornament initiated by weak, slightly sinuous, axial costae. After one-quarter turn axial costae becoming more pronounced, persisting throughout the whorls, twelve to fifteen (usually thirteen) on the final whorl. Suture distinct, but not channeled, undulated by the axial ribbing. Aperture lenticular; outer lip with broad terminal varix, margin sharp and barbed, interior smooth, thickened abapically; parietal wall heavily callused, columella with three strong plaits, the anterior two oblique, the posterior or slightly weaker and more horizontal, seven or eight long lirations, extending into the aperture, on adapical two-thirds of columella area. Spiral sculpture restricted to four to six wavy threads on base. Siphonal fasciole not strongly developed; siphonal notch shallow, broad.

Dimensions of holotype: height 38.8 mm, diameter 16.5 mm.

Holotype: USNM 253219.

Type locality: TU 546, Ten Mile Creek, about 1-1/2 miles west of Chipola River (NW 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Paratype: USNM 253220; height 35.8 mm, diameter 17.6 mm; locality TU 951.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 4, USNM 253219 (holotype). Fig. 5, USNM 253220 (paratype). Other occurrences: TU locality nos. 830, 998.

Discussion: This new species is known to occur only in the lower beds of the Chipola Formation along Ten Mile Creek, near the contact with the underlying Chattahoochee Limestone. It shows a greater affinity to the Oligocene *L. nestor* than to any other fossil species occurring in the southeastern United States; nevertheless, there are distinct differences to be noted. The axial ribbing of *L. limata* is sharper, the whorls are more straight-sided in outline, and the spiral sculpture is confined to the basal area. The outstanding feature that differentiates the Chipola species is the barbs on the sharp margin of the outer lip (pl. 1, fig. 4a). Spiral lines of color extend onto the barbs and on partially corroded shells the spiral lines appear as raised threads.

Lyria limata derives its specific name from the Latin word *limatus,* meaning "elegant," an apt description of this new species. The same adjective can be used to describe the color pattern revealed by ultraviolet light. The Recent Caribbean species, *Lyria beauii* (Fischer and Bernardi, 1857) has a color pattern similar to that seen in *L. limata,* with numerous, strong, spiral color bands and three wider, more diffuse, blotchy bands at the shoulder, the top of the aperture and the base of the body whorl. However, the morphology of the Recent species differs in having the axial ribs more pronounced and angulate at the shoulder.

LYRIA (LYRIA) PULCHELLA (Sowerby)

Plate 2, figs. 3, 4

Voluta pulchella SOWERBY, 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 46, pl. 9, fig. 4.
Voluta soror SOWERBY, 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 46.
Lyria pulchella (Sowerby). GABB, 1873, Amer. Phil. Soc., Trans., (N.S.) v. 15, p. 219.
Voluta pulchella Sowerby. GUPPY, 1876, Geol. Soc. London, Quart. Jour., v. 32, p. 528.
Lyria pulchella Sowerby. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 84; in part, *not* pl. 4, fig. 3, = *L.* sp. cf. *L. mississippiensis.*
Lyria pulchella Sowerby. DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 58; in part, *not* pl. 10, fig. 11, = *L. (H.) heilprini* Dall.
Lyria pulchella Sowerby. MAURY, 1917, Bulls. Amer. Paleontology, v. 5, no. 29, p. 73, pl. 11, figs. 10, 10a.
Lyria pulchella (Sowerby). PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 338.
Lyria soror (Sowerby). PILSBRY, 1922, Acad. Nat. Sci. Phila., Proc., v. 73, p. 338, pl. 24, figs. 11, 12.
Lyria pulchella Sowerby. RAMÍREZ, 1949, Publ. Univ. Santo Domingo, (ser. 4a) v. 1, no. 70, p. 24, pl. 3, fig. 8.
Lyria (Sannilyria) pulchella Sowerby. PILSBRY and OLSSON, 1954, Bulls. Amer. Paleontology, v. 35, no. 152, p. 23, pl. 3, fig. 2.
Lyria (Lyria) pulchella (Sowerby). PFLUG, 1961, Acta Humboldtiana, Ser. Geol. Paleont., no. 1, p. 53, pl. 14, figs. 10-15 (figs. 11, 15, lectotype).
Lyria pulchella soror (Sowerby). PFLUG, 1961, Acta Humboldtiana, Ser. Geol. Paleont., no. 1, p. 54, pl. 15, figs. 1, 7 (lectotype).

Diagnosis: "Testa oblongo-ovata, laevis, longitudinaliter costata, anfractibus senis subrotundatis, spira acuminata: costellis plerumque antice subobseletis; labio externo intus laevi, columella plicata, plicis anticis majoribus." (Sowerby, 1850)

Shell globose with short spire; axially costate. Adult specimens consisting of five convex whorls plus one and one-half well-rounded nuclear whorls. Final teleoconch whorl with fourteen to sixteen sharply rounded, slightly sinuous axial costae, costae tending to fade anteriorly. Suture deeply impressed but not channeled. Outer lip ascending, with a broad terminal varix; margin sharp, smooth within. Parietal callus heavy, abapical half free-standing; two, occasionally three, coarse, oblique columellar plaits anteriorly, eight to twelve long lirations ornamenting remainder of columella. Siphonal fasciole weakly developed, with a few fine, wavy, spiral threads; siphonal notch broad and shallow.

Dimension of lectotype: height 37.0 mm, diameter 18.0 mm. (Pflug, 1961, p. 54).

Lectotype: BMNH Nr. G 83 956.

Type locality: Dominican Republic, Rio Amina, west of Potrero (= TU 1219), here designated.

Occurrence: Gurabo Formation, Dominican Republic; upper Miocene.

Figured specimens: Fig. 3, USNM 253223; height 27.4 mm, diameter 17.1 mm; locality TU 1210. Fig. 4, USNM 253224: height 23.5 mm, diameter 14.3 mm; locality Bluff 1, Rio Mao. Other occurrences: TU locality nos. 1211, 1212, 1213, 1214,.1215, 1219, 1227, 1246, 1248.

Discussion: Lyria pulchella is abundant in the Gurabo Formation of the Dominican Republic but it is not known to occur elsewhere. Dall (1890, 1915) employed this name for two different species found in the Tampa Limestone. The first of these is here treated as *L.* sp. cf. *L. mississippiensis,* the second is *L. (H.) heilprini* Dall.

Pilsbry and Olsson (1954, p. 23) erected a new subgenus, *Sannilyria,* for *L. pulchella,* which they stated differed from *Lyria* s.s. in having the parietal wall strongly lirate throughout. However, this trait varies within the genus *Lyria* and does not justify this separation. *Lyria pulchella* exhibits the characteristic features of *Lyria* s.s.: small, smooth nucleus, costate early whorls, plicate and lirate columella, but the outline, with a globose final whorl and short broad spire, distinguishes this species.

Sowerby had no type locality for *Lyria pulchella* other than "Santo Domingo." Inasmuch as the writers and spouses have collected nearly 300 specimens of this species from TU 1219 on the Rio Amina and as this was certainly one of Heneken's localities, it is here designated as the type locality.

The arrangement of broken spiral lines of color pattern appearing on costae only, shown with the aid of ultraviolet light, is illustrated on pl. 2, fig. 4.

LYRIA (LYRIA) INCOMPERTA, n. sp.

Plate 2, figs. 1, 2

Diagnosis: Adult specimens with one and one-half nuclear whorls plus six axially costate whorls. About fourteen low, rounded axial costae, bent forward at the suture and reaching nearly to the base on the final whorl. Suture distinct, slightly undulated by costae. Aperture elliptical; outer lip not ascending, terminal varix broad, smooth within, margin sharp; parietal wall callused, three

strong oblique plaits anteriorly with the posterior one slightly weaker, ten to fifteen long thread-like lirations on remaining portion of columella. A few wavy spiral threads marking the weak siphonal fasciole; siphonal notch broad and shallow.

Dimensions of holotype: height 24.7 mm, diameter 12.7 mm.

Holotype: USNM 253221.

Type locality: TU 1215, bluffs on both sides of Rio Gurabo, from bridge to approximately one km above bridge, Dominican Republic.

Paratype: USNM 253222; height 24.0 mm, diameter 11.7 mm; locality TU 1215.

Occurrence: Gurabo Formation, Dominican Republic; upper Miocene.

Figured specimens: Fig. 1, USNM 253221 (holotype). Fig. 2, USNM 253222 (paratype).

Discussion: Lyria incomperta, as far as is known, is endemic to one locality (TU 1215) in the Gurabo Formation of the Dominican Republic. The fauna at TU 1215 is different from the normal Gurabo Formation and several unusual muricids have been collected from that locality.

Undoubtedly this new species is closely related to *Lyria pulchella;* however, *L. pulchella* is found throughout the Gurabo Formation, except at TU 1215 where it is extremely rare (only four specimens in contrast to 28 examples of *L. incomperta*). In comparison with the frequently occurring *Lyria pulchella, L. incomperta* is a more slender shell with a proportionately higher spire; slightly narrower nucleus; fewer, longer and less sharp axial ribs; thinner parietal glaze; and non-ascending outer lip.

The color pattern, revealed by ultraviolet light, shows not only the usual basic spiral lines typical of the genus, but three bands of square spots on the final whorl (see pl. 2, fig. 2). This color pattern is identical to that exhibited by *Lyria vegai,* only recently named by Clench and Turner (1967, p. 84) from a single specimen taken off the southwestern coast of the Dominican Republic. The Recent species has a higher spire than *L. incomperta* and the axial ribs are almost non-existant.

Considering the limited geographic range of this species in the Gurabo Formation, it is understandable why it has remained "unknown" until now *(incomperta,* Latin adjective for "unknown").

Subgenus HARPEOLA Dall, 1907

Harpella Gray *in* H. and A. Adams, 1858, The genera of Recent Mollusca, v. 2, p. 618 [*non Harpella* Schrank, 1802, Lepidoptera].

Type species: *Voluta costata* Swainson, 1824 [*non Voluta costata* Gmelin, 1791, = *Voluta anna* Lesson, 1835].

Harpeola Dall, 1907, Smithsonian Misc. Coll., v. 48, no. 3, p. 350.

Type species: *Voluta anna* Lesson, 1835, by original designation; Recent, Indo-Pacific.

Diagnosis: "Shell like *Lyria* s.s. but with a channeled suture and shallow posterior sulcus." (Dall, 1907)

Shells are moderate in size; light or solid in weight; protoconch smooth, turbinate or bulbous. Axial ribbing, either narrow or broad, throughout teleoconch. Suture channeled, whorls coronated by extension of axial ribbing. Labrum slightly thickened, with or without feeble denticles on inner margin. Columellar plications, siphonal fasciole and siphonal notch as in *Lyria* s.s.

LYRIA (?HARPEOLA) CAROLINENSIS Kellum

Plate 2, fig. 5

Lyria carolinensis KELLUM, 1926, U.S. Geol. Surv., Prof. Paper 143, p. 40, pl. 11, figs. 4, 5.

Lyria heilprini Dall. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 107 (in part, *not* of Dall).

Diagnosis: "Shell fusiform, with an elevated spire of about five volutions; nucleus small, smooth; whorls axially sculptured with closely spaced, low costae numbering about 28 on the body whorl; base of body whorl spirally sculptured with a few impressed striae; outer lip thickened on the border, slightly ascending; inner lip irregularly plicated over its entire extent, the two or three basal plicae much the strongest; aperture somewhat more than two-thirds the height of the shell, moderately wide, elliptical, and broadly canaliculate anteriorly." (Kellum, 1926)

Dimensions of holotype: height 31.0 mm, diameter 15.0 mm.

Holotype: USNM 353253.

Type locality: USGS 10655, half a mile southeast of Silverdale, Onslow County, North Carolina, on farm of John Gillette, on left side of Webb Creek (= TU 704).

Occurrence: "Silverdale beds," North Carolina; lower Miocene.

Figured specimen: USNM 253225; height 29.6 mm, diameter 15.0 mm; locality TU 866. Other occurrences: TU 562.

Discussion: The axial costae on the final whorl of *L. carolinensis* have a tendency to become obsolete: thus, with the exception

of the subsutural coronation, the final whorl on some specimens may be entirely smooth. Mansfield (1937, p. 107) considered the Silverdale species to be synonymous with *L. heilprini* Dall and *L. silicata;* however, the latter, which includes the specimen figured by Dall as *L. heilprini,* is a *Lyria* s.s. True *L. heilprini (nom. nov.* for *V. zebra* Heilprin) shares with *L. carolinensis* a slightly channeled suture and paired denticles on the thickened labrum. Both are here tentatively assigned to the subgenus *Harpeola.*

Ultraviolet light reveals an unusual color pattern – "dashed" broken spiral lines. This is unlike that of *L. anna* (type of *Harpeola*), which has a typical *Lyria* pattern of lines and broad bands.

LYRIA (?HARPEOLA) HEILPRINI Dall
Plate 2, fig. 6

Voluta (Lyria) zebra HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 110, pl. 15, fig. 46 [*non Voluta zebra* Leach, 1814, Zool. Misc., v. 1, pl. 12, fig. 1].

Lyria zebra Heilprin. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 84.

Lyria heilprini DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 58, in part only, *not* pl. 10, fig. 13 (=*L. silicata* Dall) (*nom. nov.* for *V. zebra* Heilprin).

Lyria pulchella Sowerby. DALL, 1915, U.S. Natl. Mus., Bull. 90, pl. 10, fig. 11 *only. (Not* of Sowerby.)

Lyria heilprini Dall. MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 107 (in part).

Lyria heilprini tampaensis MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 108.

Diagnosis: "Shell cylindriform, with an elevated, slightly scalariform spire of about six volutions; whorls costated, the costae (about twenty on the body-whorl) closely-placed, sharply defined, oblique, forming a pseudocoronation on top of the whorls; outer lip greatly thickened on the border, slightly ascending; inner lip irregularly plicated over its entire extent, the three or four basal plicae much the strongest; aperture somewhat more than half the length of shell, narrow, elliptical, contracted basally into a short open canal; surface of shell, barring the costae, smooth over almost of its entire extent, with a few impressed revolving lines on the base of the body-whorl." (Heilprin, 1887)

Dimensions of holotype: height 1-1/4 inches, diameter .6 inch. (Heilprin, 1887)

Holotype: Wagner Free Institute of Science, Philadelphia.

Type locality: Ballast Point, Tampa Bay, Hillsborough County, Florida.

Occurrence: Tampa Limestone, Florida; early lower Miocene.

Figured specimen: USNM 165064 (holotype—*L. heilprini tampaensis* Mansfield); height 28.3 mm; diameter 16.1 mm; locality same as holotype.

Discussion: In his study of the "Tampa Silex beds" Dall (1915, p. 58) renamed the preoccupied *"V." zebra* of Heilprin as *L. heilprini* but figured a specimen markedly different from that shown by Heilprin. The shell figured by Dall at the same time as *"Lyria pulchella"* (1915, pl. 10, fig. 11) is, in fact, the Heilprin species. This confusion resulted in Mansfield (1937, p. 108) naming the *"L. pulchella"* of Dall, 1915, as a new subspecies, *L. heilprini tampaensis.* The specimen figured by Dall as *"L. heilprini"* (*ibid.,* pl. 10, fig. 13) proves to be another species he named at the same time, *L. silicata* (see above). Both specimens are refigured here. Our plate 2, fig. 6, is the shell figured as *"L. pulchella",* which is the type of *L. tampaensis,* and is in truth *L. heilprini,* a new name for *Voluta zebra* Heilprin.

Heilprin, in his original description of this species called attention to the channeled suture, the "pseudocoronation on top of the whorls," and the greatly thickened outer lip. He did not note the small paired denticles on the edge of the outer lip although Mansfield mentioned them in his description of *"L. tampaensis".* All of these characteristics suggest that this species, as well as the closely related *L. carolinensis,* should be referred to *Harpeola.* This subgenus does not exist today in the New World, these two species being the only record of its presence. In the Old World the subgenus occurs in the Eocene of the Paris Basin and the type is found in the Recent of the Indo-Pacific area.

Subgenus ENAETA H. and A. Adams, 1853

Enaeta H. and A. ADAMS, 1853, The genera of Recent Mollusca, v. 1, p. 167.

Type species: *Voluta harpa* Barnes, 1824, by subsequent designation of Cossmann, 1899; Recent, eastern Pacific. [*Voluta harpa* Barnes, 1824, *non* Mawe, 1823, = *Voluta barnesii* Gray, 1825 (as *barnsii*)].

Diagnosis: Shell fusiform or ovate-fusiform; nucleus narrow; early teleoconch whorls costate, subsequent whorls may or may not be costate. Columella with two to four oblique plications anteriorly, few or many lirations on remainder of

columella. Suture adpressed. Siphonal fasciole moderately developed; siphonal notch narrow, deep. A tooth-like projection about midpoint on inside of outer lip, inner edge of outer lip either crenulated or smooth.

Discussion: The type species of *Enaeta* has usually been cited as "*Voluta barnesii* Gray;" however, that species was not among the original list of species given by Adams and Adams (1853, p. 167). The oldest valid designation of *Voluta harpa* Barnes as type is that of Cossmann (1899, p. 105).

LYRIA (ENAETA) ISABELLAE (Maury)

Plate 3, figs. 1, 2

Caricella isabellae MAURY, 1910, Bulls. Amer. Paleontology, v. 4, no. 21, p. 17, pl. 4, fig. 7.

Strigatella americana DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 61, pl. 9, fig. 2.

Strigatella isabellae (Maury). GARDNER, 1937, U.S. Geol. Surv., Prof. Paper 142-F, p. 419.

Enaeta americana (Dall). PILSBRY and OLSSON, 1954, Bulls. Amer. Paleontology, v. 35, no. 152, p. 24, pl. 3, fig. 3 (holotype).

[Enaeta] isabellae Maury. WOODRING, 1964, U.S. Geol. Surv., Prof. Paper 306-C, p. 289 (with "*Strigatella*" *americana* Dall in synonymy).

Mitreola americana (Dall). CERNOHORSKY, 1970, Aukland Inst. Mus., Bull., no. 8, p. 88, pl. 12, fig. 5 (after Pilsbry and Olsson, 1954, pl. 3, fig. 3).

Lyria (Enaeta) isabellae (Maury). CATE, 1972, Tulane Stud. Geol. Paleont., v. 10, no. 1, p. 47-50, pl. 1, fig. 1-3.

Diagnosis: "Shell of moderate size, thick and strong, whorls 6, exclusive of the eroded nucleus; suture distinct. Sculpture consisting only of numerous longitudinal striations. Columella with 4 plaits; canal short; reflexed." (Maury, 1910)

Dimensions of holotype: height 27.4 mm, diameter 14.0 mm.

Holotype: PRI 3446.

Type locality: USGS 2212 (= TU 546), here designated.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 1, USNM 114343 (holotype — *S. americana* Dall); height 28.2 mm, diameter 14.0 mm; locality USGS 2212 (= TU 546). Fig. 2, USNM 646935; height 24.2 mm, diameter 13.0 mm; locality TU 951. Other occurrences: TU locality nos. 457, 458, 547, 830, 951, 998.

Discussion: As was discussed in the Introduction of this paper, fossil representatives of the subgenus *Enaeta* are limited in numbers; only four species are known, the Chipola form being the oldest. This species cannot be considered rare, particularly in the lower beds along Ten Mile Creek, as there are over 90 specimens in our collections, only three of which came from river localities — one each from TU 457, 458, and 547. *Lyria isabellae* has axial ornament on only the first three post-nuclear whorls, but the growth lines are so strong the shell has the appearance of being delicately axially ribbed. The early teleoconch whorls are finely spirally striated, these spiral lines fading on the final whorl in front of the suture. All the specimens examined showed only the four coarse plications on the columella, no auxiliary lirations as noted on other species of *Enaeta.* The outer lip is thickened by a terminal varix and bears a blunt tooth about midway. The outline of this species is similar to that of the Recent eastern Pacific *Enaeta barnesii,* and with the aid of ultraviolet light the color pattern of the fossil species may be seen to resemble that of the Recent species. For further discussion of *Lyria (Enaeta) isabellae,* the reader is referred to Cate (1972, p. 47-50).

Maury's locality for "*Caricella*" *isabellae* was only "Chipola Marls, Bailey's Ferry, Fla." As noted in previous publications in this series the Chipola Formation does not occur at Bailey's Ferry. The type locality of Dall's "*Strigatella*" *americana* is USGS 2212, one mile west of Bailey's Ferry on Ten Mile Creek [Cate's reference to TU 457 is an error] and, as the majority of specimens occur in that area, USGS 2212 (= TU 546) is here designated as the type locality for *Lyria (Enaeta) isabellae.*

LYRIA (ENAETA) ECNOMIA (Woodring)

Enaeta ecnomia WOODRING, 1964, U.S. Geol. Surv., Prof. Paper 306-C, p. 289, pl. 46, figs. 2, 3.

Diagnosis: "Of medium size, columbelloid, inflated, spire rapidly tapering. Body whorl bearing a faint sutural collar. Protoconch worn and partly missing. First three post-protoconch whorls bearing low, wide axial ribs. Ribs more subdued and retractive on remaining spire whorls: 18 ribs on body whorl. Spiral sculpture limited to weak threads, aside from a stronger thread bordering siphonal

fasciole. Outer lip thickened, ascending, interior bearing a heavy denticle about two-thirds of distance from anterior end to posterior end of lip. Siphonal fasciole moderately inflated. Columella bearing four folds, not including two minor folds on parietal wall." (Woodring, 1964)

Dimensions of holotype: height 20.2 mm, diameter 11.5 mm.

Holotype: USNM 643693.

Type locality: USGS 16909, Transisthmian Highway, latitude 9° 21' N, plus 1,525 meters, longitude 70° 50' W, plus 300 meters, Panamá.

Occurrence: Lower part of Gatun Formation, Panamá; (?)upper Miocene.

Discussion: Woodring (1964, p. 289) noted that *Enaeta ecnomia* is closely related to the Recent eastern Pacific *Enaeta barnesii,* type of the genus. Minor features, such as a smaller size, faint sutural collar, stronger spiral threads, weaker and less numerous axial ribs, and stronger columellar plications, distinguish the Gatun species from the Recent species. The holotype of *E. ecnomia* is the sole representative of the species.

LYRIA (ENAETA) OLSSONI, n. sp.

Plate 3, fig. 4

Diagnosis: Shell solid, fusiform; nucleus unknown, six teleoconch whorls remaining. Early whorls faintly axially ribbed, only growth lines evident on final whorl; suture closely adpressed. Spire short, a little less than one-third the height of entire shell. Outer lip broken; columella slightly sinuous with weak callosity, lirate throughout, three strong oblique plaits anteriorly, changing to lirae, more horizontal in direction, posteriorly. Siphonal fasciole moderately developed; siphonal notch narrow and deep.

Dimensions of holotype: height 32.0 mm, diameter 16.3 mm.

Holotype: USNM 253227.

Type locality: TU 757, Panamá Highway 3, at junction of road to "Refinera Panamá, S.A.," just east of Cativa, Colón, Panamá.

Occurrence: Gatun Formation, Panamá; (?)upper Miocene.

Figured specimen: USNM 253227 (holotype).

Discussion: There are two species of *Enaeta* in the Gatun Formation of Panamá. Although each is represented by a single specimen they are so completely distinct there is no possibility that they are the same species. *Lyria (Enaeta) ecnomia* Woodring is much like the Recent Pacific *L. barnesii,* whereas *L. olssoni* is more nearly akin to the Chipola *L. isabellae.* The spire of *L. isabellae* is more elongate and the columella of *L. (E.) olssoni* is lirate throughout its length with three strong oblique plaits anteriorly, but the Chipola species has no lirations on the posterior portion of the columella with four strong plicae anteriorly.

Although the nucleus is lost and the lip is badly damaged on this unique specimen, there can be no question as to its taxonomic placement. The adpressed suture, moderately developed siphonal fasciole and narrow, deep siphonal notch are indicative of the subgenus *Enaeta.* The color pattern (pl. 3,

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PLATE 1

Figures Page

1. *Lyria nestor* Casey (x 2) 109
   USNM 253217; height 33.1 mm, diameter 13.5 mm.
   Locality: TU 226, Wayne Co., Mississippi. Red Bluff Clay, lower Oligocene.
2. *Lyria mississippiensis* (Conrad) (x 2) 109
   USNM 253218; height 25.0 mm, diameter 12.0 mm.
   Locality: TU 335, Vicksburg, Mississippi. Byram Marl, middle Oligocene.
3. *Lyria* sp. cf. *L. mississippiensis* (x 1-1/2) 110
   USNM 112109; height 28.2 mm, diameter 13.1 mm.
   Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone, early lower Miocene.
4, 5. *Lyria limata* , n. sp. (x 1-1/2) 111
   4. USNM 253219 (holotype): height 38.8 mm, diameter 16.5 mm.
      Locality: TU 546, Ten Mile Creek. Chipola Fm., late lower Miocene.
   5. USNM 253220 (paratype); height 35.8 mm, diameter 17.6 mm.
      Locality: TU 951, Ten Mile Creek. Chipola Fm., late lower Miocene.

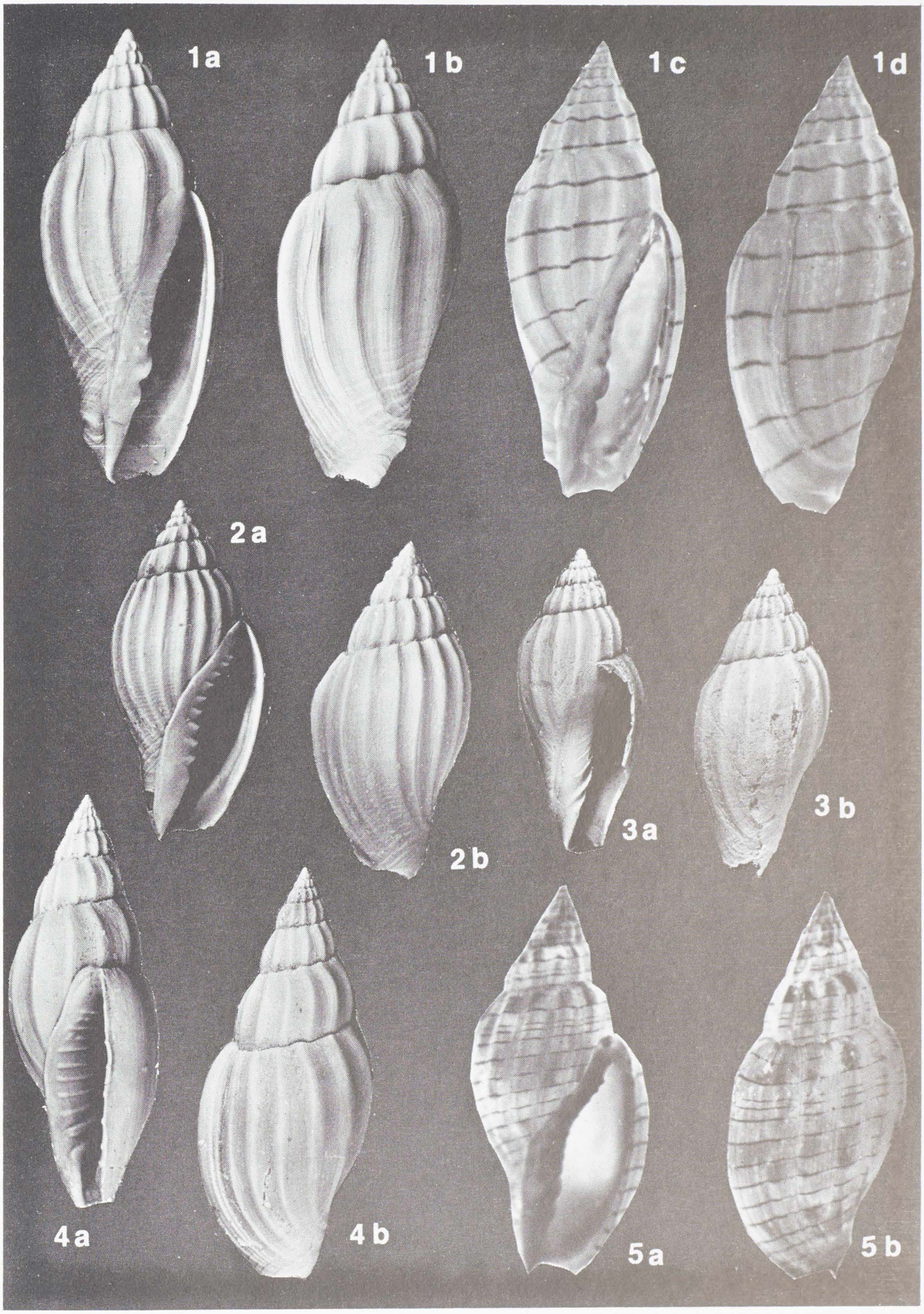

PLATE 1

fig. 4c) further substantiates its assignment.

This new species is named in honor of the late Dr. Axel A. Olsson of Coral Gables, Florida, as it was in his Panamá collection that this unusual specimen was found.

LYRIA (ENAETA) PERTURBATRIX (Maury)

Plate 3, fig. 3

Mitra (Strigatella?) perturbatrix MAURY, 1917, Bulls. Amer. Paleontology, v. 5, no. 29, p. 76, pl. 14, figs. 1, 2.

[Enaeta] perturbatrix Maury. WOODRING, 1964, U.S. Geol. Surv., Prof. Paper 306-C, p. 289.

Diagnosis: "Shell slender, somewhat Columbelliform, spire a trifle shorter than the aperture; suture distinct; whorls eight, the first two smooth, nuclear; post-nuclear whorls slightly convex, ornamented with weak, equidistant longitudinal plications, about twenty on each of the last two whorls; the plications are strongest over the convex portion of the volutions and fade out near the sutures; aperture narrowly elliptical, inner lip with a callus; columella with three sharp anterior and two weaker posterior plications; outer lip thickened with a stout, marginated external band, marked by an internal posterior Strombinoid notch and showing traces of obsolescent crenulations within, not lirate." (Maury, 1917)

Dimensions of lectotype: height 19.5 mm, diameter 8.5 mm.

Lectotype: PRI 28710 (here designated).

Type locality: Zone D, Rio Gurabo at Los Quemados, Dominican Republic (= TU 1215).

Occurrence: Gurabo Formation, Dominican Republic; upper Miocene.

Figured specimen: USNM 253226; height 20.5 mm, diameter 9.0 mm; locality TU 1215.

Discussion: Only three examples of this species are known, two "co-types" and one from the Tulane University collection, here figured. In the type lot of Maury's species there are two specimens now catalogued at the Paleontological Research Institution as nos. 28709 (pl. 14, fig. 1) and 28710 (pl. 14, fig. 2). Neither specimen has the measurements cited by Maury (both are 19.5 mm in height); thus, that figured in the apertural view (PRI 28710) is here selected as the lectotype. The outer lip of *L. perturbatrix* is thickened, the inner edge having feeble short denticles on the anterior two-thirds with one strong blunt tooth adapical to the denticles, and a rounded callosity in front of the posterior commissure (see pl. 3, fig. 3c). The blunt tooth about midway on the labrum is a characteristic of the subgenus *Enaeta,* but the faint crenulations and rounded callosity do not appear on any of the known fossil species. *L. (Enaeta) cylleniformis* (Sowerby), a Recent Caribbean species, shows the same features but is a heavier, stouter shell, with more prominent axial ornament. Two other Recent western Atlantic species show strong similarities to *L. perturbatrix*: *L. (Enaeta)*

PLATE 2

Figures

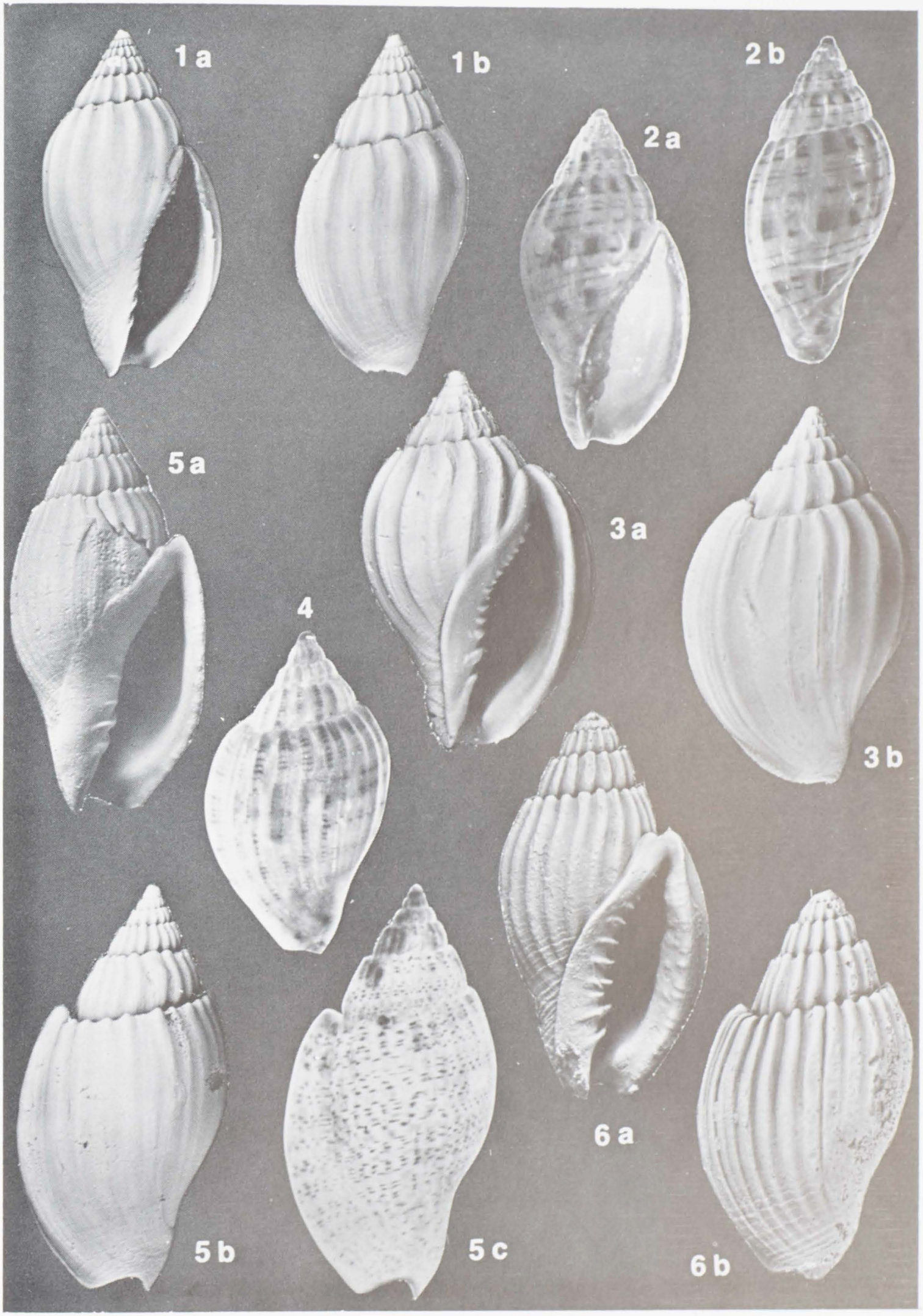

PLATE 2

reevei (Dall, 1907) [a new name for *Voluta guttata* Reeve, 1849, *non* Dillwyn, 1817], which has a shorter spire; and *L. (Enaeta) guildingi* (Sowerby, 1844), which has a higher spire. Neither has the posterior callosity as well developed as in *L. (Enaeta) perturbatrix,* which is almost certainly ancestral to both.

The color pattern of *Enaeta* is usually strong and distinctive; however, treatment with sodium hypochlorite failed to induce a color pattern on this specimen.

Subfamily VOLUTINAE Rafinesque, 1815
Genus FALSILYRIA Pilsbry and Olsson, 1954

Falsilyria PILSBRY and OLSSON, 1954, Bulls. Amer. Paleontology, v. 35, no. 152, p. 21.

Type species: *Lyria pycnopleura* Gardner, 1937, by original designation.

Diagnosis: "Similar to *Voluta* Linné but with a narrower shell and higher spire; nucleus relatively small, consisting of but one [to two plus] rather loosely coiled whorl; sculpture formed by strong, smooth, nearly straight axial ribs, generally somewhat noded or coronated at the suture and with faint spirals showing around the base and on the canal; aperture semi-elliptical, the outer lip thickened by the last rib, smooth within; plaits on the columella and parietal wall are similar to those of *Voluta;* of these the four or five lower ones form large, strong, sharp folds which spiral deeply into the interior while above them the plaits on the parietal wall are small and weak; end of pillar appressed and turned sharply backwards to form a recurved beak forming a deep, siphonal notch; siphonal fasciole short but strong." (Pilsbry and Olsson, 1954)

FALSILYRIA EOCENIA (Palmer)

Lyria pycnopleura eocenia PALMER, 1953, Florida Geol. Surv., Bull. 35, p. 38, pl. 5, figs. 1, 14.

Diagnosis: "Shell medium in size, solid, spire elevated; postnuclear whorls five; nuclear whorls smooth, of about 2 or 2-1/2 whorls; whorls with eight or nine large coarse longitudinal lirae, those over the body whorl somewhat irregular in size and position; the lirae crossed by fine spiral striations, most conspicuous on the body whorl; below the suture there is a concave appressed area which causes the lirae to be nodose between it and the suture and the lirae slightly nodose just below it; anterior notch recurved, short in length but deep with coarse spiral lines above it; columellar callus thick; plications medium in size." (Palmer, 1953)

Dimensions of holotype: height 21+ mm, diameter 11.0 mm.

Holotype: Florida Geol. Surv. I-7630.

Type locality: Road metal pit 2.9 miles south of the north limits of town of Gulf Hammock (SW 1/4, Sec. 34, T14S, R16E), Levy County, Florida.

Occurrence: Inglis Limestone, Florida; early upper Eocene.

Discussion: Palmer (1953, p. 38) reported two species here referred to *Falsilyria* from the Inglis Formation, upper Eocene, in central Florida. She considered one of these,

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PLATE 3

Figures

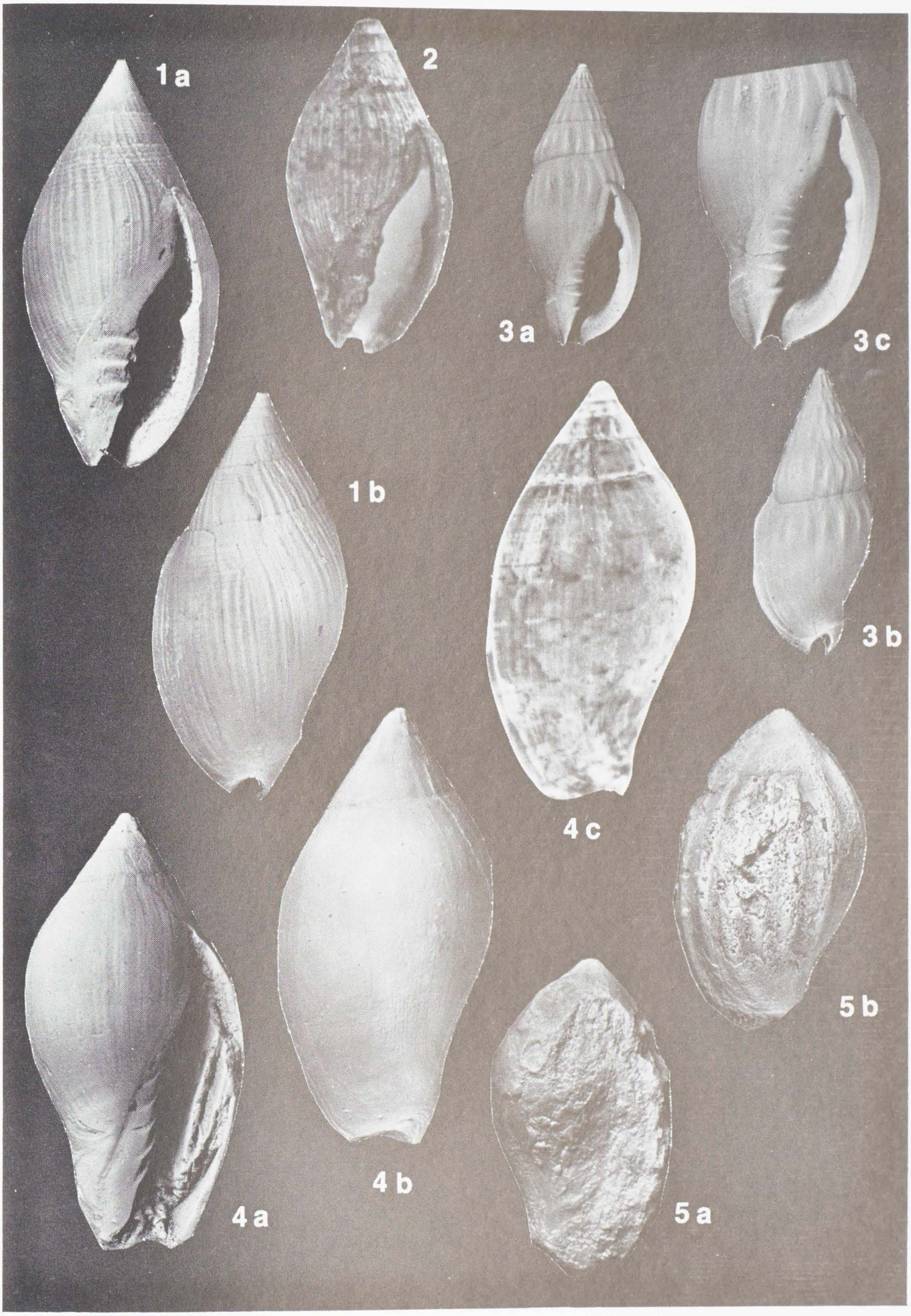

PLATE 3

Lyria pycnopleura eocenia (ibid. pl. 5, figs, 1, 14), to be a subspecies of Gardner's Chipola form *L. pycnopleura* because of the similarity in shape, longitudinal costae and groove in front of the suture. In the opinion of the writers, the figures depict a shell more nearly corresponding to *L. musicina* Heilprin from the Tampa Limestone. Both *L. pycnopleura* and *L. musicina* have a groove in front of the suture that causes the posterior extremity of the costae to appear nodose, but only *L. musicina* has numerous revolving threads over the entire shell. Both *F. eocenia* and *F. musicina* retain the narrow nucleus of *Lyria.* This latter feature demonstrates that this *Falsilyria* is an early stage of evolvement from the genus *Lyria. Falsilyria pycnopleura* has a broader nucleus, and the anterior portion of the columella is beginning to broaden, indicating its closer affinity to *Voluta.*

FALSILYRIA CITRUSENSIS (Palmer)

Lyria citrusensis PALMER, 1953, Florida Geol. Surv., Bull. 35, p. 38, pl. 8, fig. 7.

Diagnosis: "Shell medium in size, robust; spire short; whorls about four; nuclear whorls worn; whorls with strong longitudinal ribs, about nine or ten ribs on the body whorl, the last enlarged fold forming a strong varix on the margin of the labrum; concave groove below the suture developing a shoulder to the ribs; about 10 plications on columella, the anterior ones are larger and more regular." (Palmer, 1953)

Dimensions of holotype: height 22.0 mm, diameter 13+ mm.

Holotype: Fla. Geol. Surv. I-7629 (plastotype).

Type locality: Pit of Dunnellon Phosphate Mining Co. (SW 1/4 of SE 1/4, Sec. 10, T18S, R19E), Citrus County, Florida.

Occurrence: Inglis Limestone, Florida; early upper Eocene.

Discussion: Palmer's second species from the Inglis Limestone, *F. citrusensis,* is "represented by the holotype only which is a plastotype;" consequently, some of the various morphological characteristics are indistinct. Palmer stated this species also has the "concave groove below the suture developing a shoulder to the ribs" but differentiates *L. citrusensis* from *L. eocenia* by its "short spire, the plumper shape and lack of spiral threads." Perhaps the two Eocene species should be synonymized, but due to the lack of specimens, the writers hesitate to do so at this time.

PLATE 4

Figures Page

1, 2. *Lyria (Lyria) inedita,* n. sp. (X 2) 108
1. USNM 25760 (holotype); height 21.0 mm, diameter 10.6 mm.
Locality: Wilcox Co., Alabama. Clayton Fm., Paleocene.
2. USNM 25759 (paratype); height 19.0 mm, diameter 10.1 mm.
Locality: Allenton, Wilcox Co., Alabama. Clayton Fm., Paleocene.

3. *"Volutalithes" lyroidea* Aldrich (X 1-1/2) 108
USNM 111844 (holotype); height 30.2 mm, diameter 14.8 mm.
Locality: Prairie Creek, Wilcox Co., Alabama. Clayton Fm., Paleocene.

4, 5. *Falsilyria mansfieldi* (Dall) (x 1-1/2) 124
4. USNM 166724 (holotype-*mansfieldi* Dall); height 47.0 mm, diameter 21.3 mm.
Locality: Flint River, Decatur Co., Georgia. Flint River Fm. upper Oligocene.
5. USNM 495942 (holotype-*dalli* Mansfield); height 37.8 mm, diameter 18.7 mm.
Locality: Blackwater Creek, Hillsborough Co., Florida. Suwannee Limestone, upper Oligocene.

6. *Falsilyria musicina* (Heilprin) (x 1-1/2) 124
USNM 112106; height 42.3 mm, diameter 21.8 mm.
Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone, early lower Miocene.

7. *Lyria (Lyria) silicata* Dall (X 1-1/2) 110
USNM 165063; height 34.8 mm, diameter 15.7 mm.
Locality: Ballast Point, Tampa Bay, Florida. Tampa Limestone, early lower Miocene.

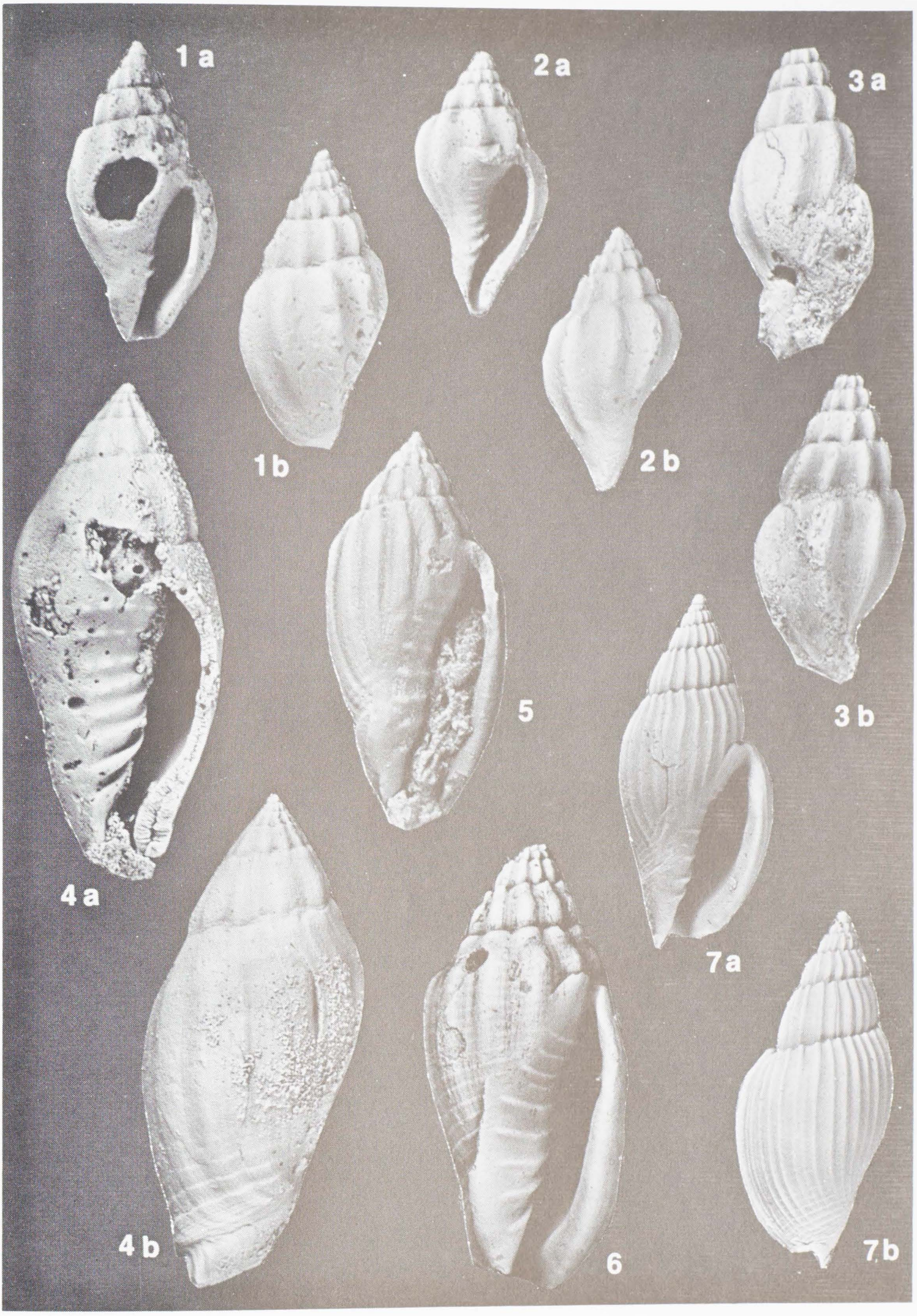

PLATE 4

FALSILYRIA MANSFIELDI (Dall)
Plate 4, figs. 4, 5

Lyria mansfieldi DALL, 1916, U.S. Natl. Mus., Proc., v. 51, no. 2162, p. 504, pl. 86, fig. 3.
Lyria musicina dalli MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 106, pl. 3, fig. 2.

Diagnosis: "Shell fusiform, solid, with about seven whorls, excluding the (lost) nucleus; suture distinct but not impressed; whorls rapidly enlarging, moderately convex, with an acute apex; axial sculpture of about (on the penultimate whorl) nine low and ill-defined ribs, none distinct on the earlier whorls and on the last whorl becoming obsolete anteriorly; the lines of growth are also rather marked; spiral sculpture near the canal of four or five flattish threads with wider interspaces; the canal is bent to the right and has a distinct siphonal fasciole; outer lip defective; inner lip with eight or more columellar plaits more prominent anteriorly, with a rather heavy callus on the body near the junction of the outer lip." (Dall, 1916)

Dimensions of holotype: height 47.0 mm, diameter 21.3 mm.

Holotype: USNM 166724.

Type locality: USGS Station 7096, at Red Bluff, on west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia.

Occurrence: Flint River Formation, Georgia; Suwannee Limestone, Florida; upper Oligocene.

Figured specimens: Fig. 4, USNM 166724 (holotype). Fig. 5, USNM 495942 (holotype-*Lyria musicina dalli* Mansfield); height 37.8 mm, diameter 18.7 mm; locality, Blackwater Creek, at S.A.L. Railway crossing, Hillsborough County, Florida.

Discussion: The aperture of the holotype of *"Lyria" mansfieldi* is broken, but the columellar plications are still present and it is obvious from them that the species should be referred to the genus *Falsilyria.* They are identical to those of the younger *F. pycnopleura* (compare with pl. 5, fig. 2). The axial ribs show the subsutural groove only faintly delineated. This may be an evolutionary trend as later forms show a stronger groove, culminating in the (?)upper Miocene *F. vaughani* (Cooke).

Mansfield (1937, p. 106) named *"Lyria dalli"* as a subspecies of *"Lyria" musicina* (Heilprin). He did not compare his specimen with Dall's *"L." mansfieldi,* although the two forms are of the same age. He should have, for it seems obvious when one does that the two are synonymous. The holotype of *F. mansfieldi* is larger and the axial ribs of the body whorl are not as strongly developed as those of the body whorl of *"L." dalli;* however, examination of a specimen of *F. pycnopleura* (pl. 5, fig. 1) indicates that this is the normal state for a fully mature individual.

FALSILYRIA MUSICINA (Heilprin)
Plate 4, fig. 6

Voluta musicina HEILPRIN, 1887, Wagner Free Inst. Sci., Trans., v. 1, p. 109, pl. 15, fig. 45.
Lyria musicina Heilprin. DALL, 1890, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 85 (in part).
Lyria musicina Heilprin. DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 59; in part, *not* pl. 9, figs. 1, 4

PLATE 5

Figures — Page

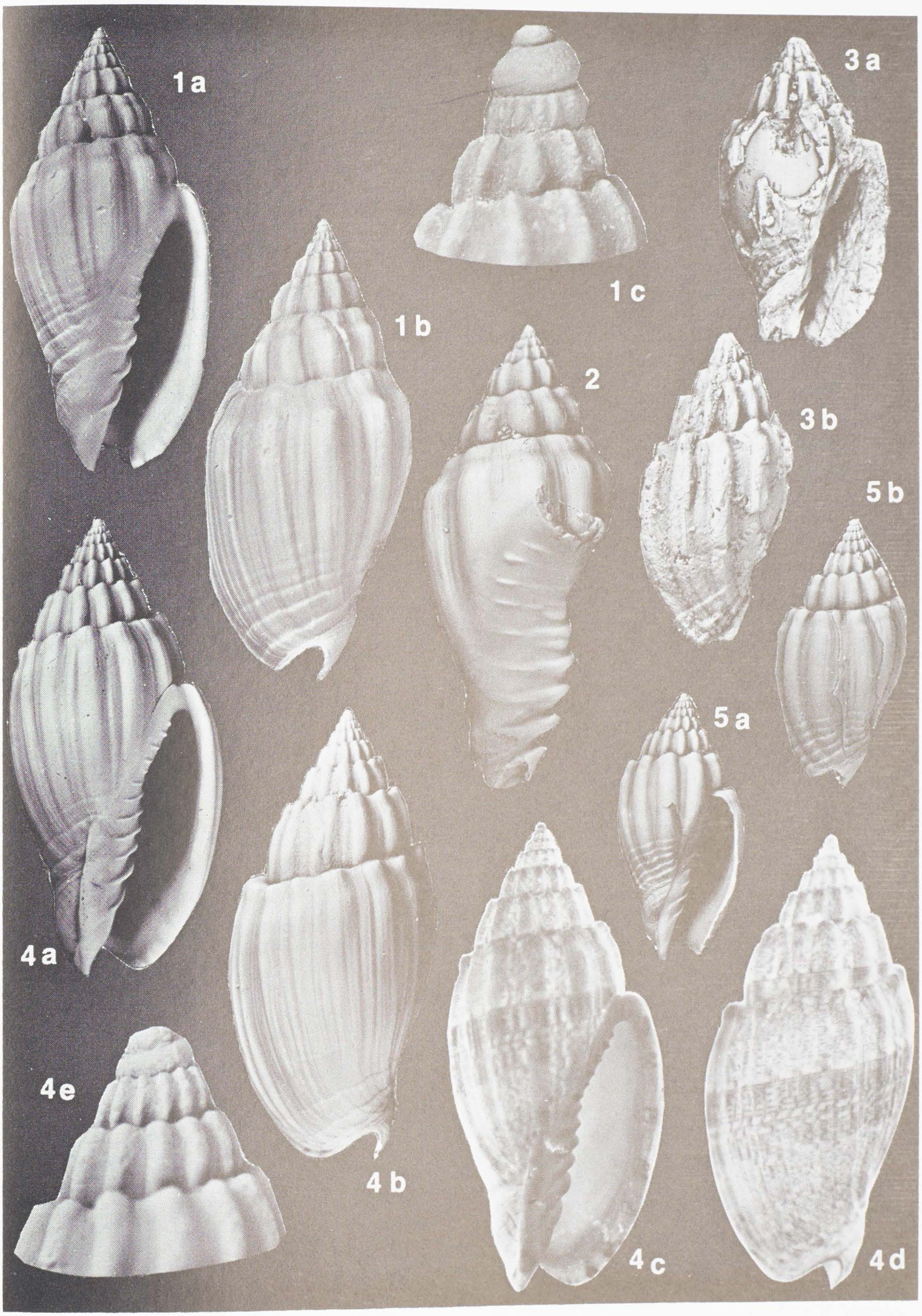

PLATE 5

= *Falsilyria pycnopleura* (Gardner).

Lyria musicina (Heilprin). COOKE and MOSSOM, 1929, Florida Geol. Surv., Ann. Rept. 20, p. 85 (list); *not* pl. 8, fig. 6 (after Dall, 1915, pl. 9, figs. 1, 4) = *Falsilyria pycnopleura* (Gardner).

Lyria musicina (Heilprin). MANSFIELD, 1937, Florida Geol. Surv., Bull. 15, p. 105, pl. 3, figs. 1, 4.

Diagnosis: "Shell cylindriform; spire elevated, of about seven volutions; whorls convex, strongly costated, impressed below the suture, so as to divide the costae into a double series; costae very prominent, obtuse, about ten on the body-whorl, crossed at right angles by rather distantly-placed elevated revolving lines; outer lip with a reflected border; inner lip distinct in its lower half, plicated over its entire extent, the plicae increasing in size from above downward, nearly transverse in direction; aperture considerably over half the length of shell, narrow." (Heilprin, 1887)

Dimensions of holotype: "Length, nearly two inches; greatest width, at about the middle of the shell, slightly exceeding one inch." (Heilprin, 1887)

Holotype: Wagner Free Institute of Science, Philadelphia.

Type locality: Ballast Point, Tampa Bay, Hillsborough County, Florida.

Occurrence: Tampa Limestone, Florida; early lower Miocene.

Figured specimen: USNM 112106, height 42.3 mm, diameter 21.8 mm; locality, Ballast Point, Tampa Bay, Hillsborough County, Florida.

Discussion: Falsilyria musicina retains some *Lyria* characteristics, such as the narrow nucleus, and the slender-appearing columella, with only a slight suggestion of broadening on the anterior half. The *Voluta* characteristics are shown by the five heavy columellar plications, beveled edge of the outer lip, well-developed siphonal fasciole, and deep narrow siphonal notch.

FALSILYRIA PYCNOPLEURA (Gardner)

Plate 5, figs. 1, 2

Lyria musicina Heilprin. DALL, 1915, U.S. Natl. Mus., Bull. 90, p. 59, pl. 9, figs. 1, 4. (*Not* of Heilprin.)

Lyria musicina (Heilprin). COOKE and MOSSOM, 1929, Florida Geol. Surv., Ann. Rept. 20, pl. 8, fig. 6 (after Dall, 1915).

Lyria pycnopleura GARDNER, 1937, U.S. Geol. Surv., Prof. Paper 142-F, p. 404, pl. 48, figs. 1, 2.

Falsilyria pycnopleura (Gardner). PILSBRY and OLSSON, 1954, Bulls. Amer. Paleontology, v. 35, no. 152, p. 21, pl. 3, fig. 1.

Falsilyria pycnopleura (Gardner). OLSSON, 1965, Bulls. Amer. Paleontology, v. 49, no. 224, p. 665, pl. 83, fig. 8.

Diagnosis: "Shell heavy, solid, rather large, attaining an altitude in one individual of 63.0 millimeters. Spire moderately elevated in the type, one-third of the altitude of the entire shell, turriculated, the whorls of the spire narrowly tabulated behind, the sides trapezoidal, their outline obscured, however, by the heavy axial ribbing. Body ovate, not sharply constricted at the base. Whorls of conch usually 6, in the larger individuals, 7. Protoconch of moderate dimensions and performing between 2 and 2-1/2 volutions; initial turn of protoconch strongly and smoothly rounded, immersed at the tip, the succeeding turn becoming increasingly flattened laterally toward the close of the protoconch. Opening of conch marked only by the introduction of the axial ribbing and not by any perceptible change in the contour of the shell. Costals upon the early volutions narrow, sharply and prominently elevated; cordate ridges uniform in elevation throughout their extent, terminating abruptly at the posterior suture, thus forming an obscurely defined sutural corona; axials normally 10 to each whorl not including the terminal varix, the axials upon the later volutions broader and more broadly rounded than upon the earlier and much lower and inclined to be less regularly spaced upon the last turn of the body. Spiral sculpture restricted to 2 or 3 ridges at the base of the body, and obscure threading upon the fasciole and a very obscure groove a little before the posterior suture, which partly dissects the axials. Sutures deeply impressed, crenulated by the costae of the preceeding volution. Aperture narrow, obtusely angulated at the posterior commissure. Outer lip approximately straight medially, curving anteriorly into the terminal notch, posteriorly produced for a short distance, dragging the suture about one-fourth of the way across the penult. Marginal varix narrow but rather heavy; inner surface of labrum thickened but smooth. Inner margin of the aperture feebly constricted by the curvature of the body. Parietal wall heavily glazed, the callus extending in a wide arcuate area between the extremities of the aperture, heaviest anteriorly; transversely lirate with 3 or 4 fine but rather sharp, commonly broken lirae approximately parallel to the labial plications in front of them but not persistent far within the aperture. Columella folds usually 6, the posterior approximately horizontal, the anterior, especially the foremost, slightly oblique; fold broadest and most prominent just at the entrance to the aperture, evanescing externally. Siphonal fasciole strongly arched, incrementally striated, cut off from the base of the body by a shallow sulcus. Anterior canal incipient, the extremity profoundly emarginate, the walls parallel and obliquely directed." (Gardner, 1937)

Dimensions of holotype: height 39.0 mm, diameter 18.5 mm.

Holotype: USNM 328729.

Type locality: USGS 3419, one mile below Bailey's Ferry, Chipola River, Calhoun County, Florida (= TU 457).

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 1, USNM 258143; height 43.3 mm, diameter 19.8 mm; locality TU 457. Fig. 2, USNM 253229; height 45.0 mm, diameter 19.6 mm; locality TU 546. Other occurrences; TU locality nos. 458, 459, 547, 554, 555, 820, 821, 825, 830, 950, 951, 998, 999, 1048, 1196.

Discussion: Falsilyria pycnopleura is a descendant of the Tampa species, *F. musicina.* Although they were confused by Dall (1915, p. 59) the two species are distinct. Both have the subsutural groove crossing the axial ribs, but the spiral sculpture of *F. pycnopleura* is confined to the basal area of the shell and the spire is consistently higher than that of the Tampa species of *Falsilyria.* The Chipola species shows a stronger affinity toward the genus *Voluta* as demonstrated by its broader nucleus, greater widening of the anterior half of the columella, and coarser columellar lirations and plications (see pl. 5, fig. 2).

Falsylyria pycnopleura is a common species occurring throughout the Chipola Formation, particularly along the Chipola River and Farley Creek.

FALSILYRIA ANOPTOS, n. sp.

Plate 5, figs. 4, 5

Diagnosis: Shell large, heavy; seven teleoconch whorls in adult; plus a nucleus of one and one-half smooth, bulbous whorls. Eleven or twelve rounded axial ribs, becoming flattened and evanescent in the adult. Suture slightly channeled by coronated terminations of axial ribs. Aperture elongate, outer lip only slightly thickened by the terminal rib and bearing very faint paired denticulations, which in life corresponded to dashes of color. Columella lightly glazed, bearing ten to twelve plications, three anteriormost the strongest and most oblique, becoming weaker and more horizontal toward posterior end. Spiral ornament of three to six flattened ridges at the base of the body whorl and an obscure groove in advance of the suture. Weak siphonal fasciole; anterior canal gently recurved.

Dimensions of holotype: height 44.7 mm, diameter 20.7 mm.

Holotype: USNM 253228.

Type locality: TU 555, east bank of Chipola River, about 1000 feet above Four Mile Creek (SW 1/4 Sec. 29, T1N, R9W), Calhoun Co., Florida.

Paratype: USNM 258144; height 25.8 mm, diameter 12.3 mm; locality TU 555.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 4, USNM 253228 (holotype). Fig. 5, USNM 258144 (paratype). Other occurrence: TU locality no. 547.

Discussion: In the coral-reef facies of the Chipola Formation (TU localities 547, 555) there is a second species of *Falsilyria* that occurs together with *F. pycnopleura.* Although similar in appearance the new species may be distinguished by having the subsutural groove less pronounced, the suture more impressed and the axial ribs slightly coronated in the manner of *Harpeola.* But even more importantly the two protoconchs are different: that of *F. pycnopleura* is of two and one-half large whorls (1.5 mm approximate diameter); that of the new species is only one and one-half whorls and smaller (1 mm approximate diameter). The color patterns of the two species are identical and that of *F. anoptos* is here figured (pl. 5, figs. 4c, 4d). This pattern is similar to that of the Recent *"Voluta" demarcoi* Olsson, from off El Mezquital, Tamps., Mexico (Olsson's citation of "Texas" is an error). Although named as *Voluta* by Olsson (1965, p. 663), from the nature of the columellar plications (about 14 in number) and the subsutural constriction (well shown in Olsson's pl. 82, fig. 1c) it seems obvious that the species is better referred to *Falsilyria,* and as such is the first known Recent example of the genus.

Gardner (1937, p. 404) compared *F. pycnopleura* with the Caribbean *"Lyria" vaughani* Cooke but the latter is more closely akin to this new species. From *F. vaughani, F. anoptos* differs in having more axial ribs per whorl and in having the spiral sculpture at the base of the body whorl more strongly developed. On the basis of a single specimen of *F. vaughani* it is not certain, but the size of the Chipola species also seems to be greater. The holotype of *F. vaughani* is 22 mm in height but our largest example of *F. anoptos* measures 47 mm (TU 547) and is comparable in size to *F. pycnopleura.*

Falsilyria vaughani and *F. anoptos* show many similarities to the subgenus *Lyria (Harpeola)*. Both have slightly coronated axial ribs, which cause the suture to be channeled, and *F. anoptos* shows very faint labral denticulations akin to those of *Harpeola*. However, the color dashes that correspond to these color lines (see pl. 5, fig. 4c) are paired, as in the genus *Voluta* s.s., rather than single as in *Harpeola anna*. In fact, the entire color pattern is most like that of *Voluta* s.s. reinforcing our opinion that *Falsilyria* is a northern offshoot of the *Voluta* lineage.

In contrast to the commonly occurring *F. pycnopleura*, this new species is relatively rare (less than a dozen specimens) and is confined to only two localities in the coral-reef facies of the Chipola Formation. As the early collections from the Chipola had no material from these localities it is understandable that the species as remained unkown until this time, hence the name *anoptos* (Greek – "unseen").

FALSILYRIA VAUGHANI (Cooke)

Plate 5, fig. 3

Lyria vaughani COOKE, 1919, Carnegie Inst. Washington, Publ. 291, p. 111, pl. 1, fig. 4.

Lyria vaughani Cooke, GARDNER, 1937, U.S. Geol. Surv., Prof. Paper 142-F, p. 404.

Diagnosis: "Shell volutiform, spire high; nucleus small, succeeded by 5 whorls with high narrow axial costae, about 9 on the body whorl, near the anterior extremity of which are several oblique threads; aperture wide, about two-thirds the length of the shell; pillar lip with 3 basal folds and apparently several indistinct folds and an elliptical node at the posterior end; anterior canal short, with an oblique fasciole." (Vaughan, 1919)

Dimensions of holotype: height 20.6 mm, diameter 12.0 mm.

Holotype: USNM 166955.

Type locality: Crocus Bay, Anguilla, British West Indies.

Occurrence: Anguilla Limestone, Anguilla, B.W.I.; (?)upper Miocene.

Figured specimen: USNM 166955 (holotype).

Discussion: Cooke (1919, p. 108) considered the beds on Anguilla, from whence came this species, as Oligocene in age, stating: "The fossil horizon of Anguilla is evidently intermediate in age between the Oligocene deposits at Bainbridge and the Bowden marl, and its stratigraphic position is probably not far from that of the Tampa limestone of Florida." However, the presence of *Spondylus bostrychites* Guppy and *Orthaulax aguadillensis* Maury* (identified as *O. pugnax*) in these beds indicates that a younger age is more likely. According to Eames *et al.* (1962, fig. 5) the Anguilla Limestone is correlated with the Los Puertos Limestone of Puerto Rico, a formation that is now dated as upper Miocene by Seiglie and Moussa (1975, p. 2315).

Gardner (1937, p. 404) compared her species *"L." pycnopleura* with *"L." vaughani* and noted that the Anguillan species was smaller, with differences in the sculptural details. The holotype of *"L." vaughani* is poorly preserved, the aperture is almost obliterated by matrix and details are obscured. Three strong columellar plications may be observed at the anterior end but no more. The suture is impressed and the subsutural groove is strong. The ribs are coronated almost to the point of resembling a *Harpeola*, but comparison with the specimen of *F. anoptos*, n. sp., here figured (pl. 5, fig. 4) shows this is not confined to that group. Although the aperture appears to have a posterior sulcus this is due to the breaking of the aperture at an axial rib.

V. LOCALITY DATA

The following are Tulane University fossil locality numbers:

226. Red Bluff Clay, Chickasawhay River at Hiwannee, 3-1/2 miles south of Shubuta (Sec. 28, T10N, R7W, St. Stephens Base and Meridian), Wayne Co., Mississippi.

335. Byram Marl, roadcut on U.S. Highway 61 (Business) about one mile north of Vicksburg Natl. Military Cemetery, Vicksburg, Warren Co., Mississippi.

457. Chipola Fm., west bank of Chipola River, about 1/2 mile below Ten Mile Creek (SW 1/4 Sec. 17, T1N, R9W), Calhoun Co., Florida.

458. Chipola Fm., east bank of Chipola River

**Orthaulax aguadillensis* Maury is found in beds that are now determined to be upper Miocene and Pliocene in age, making the species much younger than previously thought. This will be discussed further in a forthcoming paper by E. H. Vokes.

above Farley Creek (SW 1/4 Sec. 20, T1N, R9W), Calhoun Co., Florida.

459. Chipola Fm., east bank of Chipola River, steep bank about 1500 feet above the mouth of Taylor Lake Branch (NW 1/4 Sec. 29, T1N, R9W), Calhoun Co., Florida.

546. Chipola Fm., Ten Mile Creek, about 1-1/2 miles west of Chipola River (NW 1/4 Sec. 12, T1N, R10W), Calhoun Co., Florida.

547. Chipola Fm., west bank of Chipola River, about 2000 feet above Four Mile Creek (SW 1/4 Sec. 29, T1N, R9W), Calhoun Co., Florida.

554. Chipola Fm., east bank of Chipola River at power line crossing (SW 1/4 Sec. 17, T1N, R9W), Calhoun Co., Florida.

555. Chipola Fm., east bank of Chipola River, about 1000 feet above Four Mile Creek (SW 1/4 Sec. 29, T1N, R9W), Calhoun Co., Florida.

562. "Silverdale beds", Onslow County marl pit, on south side of Webb Creek, near Silverdale, Onslow Co., North Carolina.

704. "Silverdale beds", Gillette's Marl Pits (old pit) 1/3 mile from junction of roads to Stella and Swansboro at Silverdale, North Carolina.

757. Gatun Fm., roadcut on south side of Boyd-Roosevelt Highway at junction of road to "Refineria Panamá, S.A.", just east of Cativa, Prov. of Colón, Panamá.

820. Chipola Fm., Farley Creek (lower beds), at bridge of Florida Highway 275 (SW 1/4 Sec. 21, T1N, R9W), Calhoun Co., Florida.

821. Chipola Fm., Farley Creek, 0.1 mile east of bridge of Florida Highway 275 (SW 1/4 Sec. 21, T1N, R9W), Calhoun Co., Florida.

825. Chipola Fm., Farley Creek, at abandoned mill about 1/4 mile west of bridge of Florida Highway 275 (SW 1/4 Sec. 21, T1N, R9W), Calhoun Co., Florida.

830. Chipola Fm., Ten Mile Creek, at power line crossing about one mile west of Chipola River (SE 1/4 Sec.. 12, T1N, R10W), Calhoun Co., Florida.

866. "Silverdale beds", marl pit on north side of Webb Creek and east side of unnumbered county highway, Silverdale, Onslow Co., North Carolina.

950. Chipola Fm., Chipola River, west bank, about 200 feet above Farley Creek (SW 1/4 Sec. 20, T1N, R9W), Calhoun Co., Florida.

951. Chipola Fm., Ten Mile Creek, about 1-1/4 miles west of Chipola River (SE 1/4 Sec. 12, T1N, R10W), Calhoun Co., Florida.

998. Chipola Fm., Ten Mile Creek, about 1-1/4 miles west of Chipola River (SE 1/4 Sec. 12, T1N, R10W), Calhoun Co., Florida.

999. Chipola Fm., Farley Creek, about 1000 yards downstream from bridge of Florida Highway 275 (SW 1/4 Sec. 21, T1N, R9W), Calhoun Co., Florida.

1048. Chipola Fm., Farley Creek, south bank, about 0.8 miles east of bridge of Florida Highway 275 (NE 1/4 Sec. 21, T1N, R9W), Calhoun Co., Florida.

1196. Chipola Fm., Farley Creek, north (=NW) bank about 1/2 between 1048 and 1049, or about 0.8 mi. east of bridge on Florida Highway 275 (NE 1/4 Sec. 29, T1N, R9W), Calhoun Co., Florida.

1210. Gurabo Fm., Rio Gurabo, east bank, first bluff below bridge on the road from Los Quemados to Sabaneta, Dominican Republic (= USGS 8544; Maury's Zone B).

1211. Gurabo Rm., Rio Gurabo, west bank, second bluff below the bridge on the road from Los Quemados to Sabaneta, Dominican Republic (= USGS 8546).

1212. Gurabo Fm., Rio Gurabo, east bank, third bluff below the bridge on the road from Los Quemados to Sabaneta, Dominican Republic (= USGS 8548).

1213. Gurabo Fm., Rio Gurabo, east bank, fourth bluff below the bridge on the road from Los Quemados to Sabaneta, Dominican Republic (= USGS 8549).

1214. Gurabo Fm., Rio Gurabo, fifth (= USGS 8550), sixth (= USGS 8551), seventh (= USGS 8552), and eighth (= USGS 8553) bluffs on both sides of river below the bridge on the road from Los Quemados to Sabaneta, Dominican Republic.

1215. Gurabo Fm., bluffs on both sides of Rio Gurabo, from the bridge upstream to approximately one km above the bridge, on the road from Los Quemados to Sabaneta, Dominican Republic (= USGS 8539+8543; Maury's Zone D).

1219. Gurabo Fm., Rio Amina, bluffs on east side of river, just above the ford, which is 2 kms west of Potrero, and about 3 kms downstream from "La Represa", Dominican Republic (= USGS 8516).

1227. Gurabo Fm., deep arroyo, which crosses the road to Jánico from Santiago de los Caballeros, 11 kms south of the bridge over Rio Yaque del Norte, at Santiago, Dominican Republic.

1246. Gurabo Fm., Rio Gurabo, from 1 km to 2 kms (airline) upstream from bridge on Los Quemados-Sabaneta road, Dominican Republic (= USGS 8538).

1248. Gurabo Fm., Rio Amina, first bluff downstream from ford at Potrero, on west side of river, Dominican Republic.

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