

NOTES ON THE FAUNA OF THE CHIPOLA FORMATION — XIII
 THE FAMILY LIMIDAE (MOLLUSCA: BIVALVIA)

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In 1898 Dall described *Lima* (*Lima*) *tampaensis* from the "Chipolan Oligocene, near Bartow, and on the shores of Hillsborough Bay, near Tampa, Florida" (1898, p. 766, pl. 35, fig. 18). Subsequently in the same work he failed to include the species in his faunal lists from the Tampa region but did, apparently inadvertently, list it (1903, p. 1578) as an element in the fauna of "The Chipola Beds" with the prefix "C," which was said to include species from the "Chipola River at Ten-Mile Creek, and upper bed at McClellan's farm." Schuchert and Dall (1905, p. 354) give the type locality for the species as being "Hillsborough Bay, near Tampa, Florida."

This erroneous record is the only prior indication of the occurrence of any limid species in the Chipola fauna. In fact, Gardner's report of "imperfect and . . . immature" individuals from the Oak Grove Sand, which she somewhat uncertainly identified (1926, p. 53) as *Lima* (*Mantellum*) *carolinensis* Dall, constitutes the only prior record of any species of the family Limidae within the fauna of the entire Alum Bluff Group.

The more than one hundred specimens here studied prove referable to four species, assigned to three genera within the family. All come from localities stratigraphically higher in the type area of the Chipola Formation than were those available to Gardner. (Her localities "one mile below" and "one mile west of Bailey's Ferry," are equivalent to TU 457 and 546 respectively.)

Family LIMIDAE Rafinesque, 1815

Genus LIMA Bruguière, 1797

Lima BRUGUIÈRE, 1797, Encycl. Méth. (Tabl. Vers), Plates, v. 2, pl. 206 [six species figured, but not named].

Lima CUVIER, 1798 [1797], Tabl. Elem. Hist. Nat., p. 421 [monotype, *Lima alba* Cuvier, with *Ostrea lima* Linnaeus in synonymy; no reference to Encycl. Méth. pl. 206.]

Mantellum RÖDING, 1798, Mus. Boltenianum, p. 160 [includes 4 species; Gray, 1847, designated as type *Ostrea lima*, which appears in the synonymy of the fourth species *Mantellum lima*].

Lima LAMARCK, 1799, Mém. Soc. Hist. Nat. Paris, v. 1, p. 88 ["Ex. *Ostrea lima*. Lin."]; LAMARCK, 1801, Syst. Anim. s. Vert., p. 136 [*L. squamosa* proposed for pl. 206, fig. 4, of Encyc. Méth., with *Ostrea lima* Linnaeus in synonymy].

Limigenus RENIER, 1807, Tav. Class. Anim., tab. vii [invalid ICZN Opinion 427].

Limaria RAFINESQUE, 1815, Analyse Nat., p. 147 [nonLink, 1807].

Glaucion OKEN, 1815, Lehrb. Naturg., v. 3, Register, p. vii [invalid ICZN Opinion 417].

Radula "Klein" MÖRCH, 1853, Cat. Conch. Yoldi, pt. 2, p. 56 [non Gray, 1842; type by tautonymy: *vulgaris* Link, with "*Radula* Ch. 7 f. 651," in synonymy.]

Austrolima IREDALE, 1929, Rec. Australian Mus., v. 17, p. 165 [type orig. design.: *A. nimbifer* Iredale].

Type species, by subsequent tautonymy (Lamarck, 1801): *Ostrea lima* Linnaeus, 1758 [+ *Lima squamosa* Lamarck, 1801]. Recent.

Shell equivalved, higher than long, the anterior side straight, impressed, making the shell somewhat subangulate anteriorly, only slightly gaping; hinge margin relatively short with well-defined auricles that are approximately of equal length when viewed from the inner side, but when viewed externally has the anterior ear appearing to be much smaller than the posterior due to the impressed anterior lunular margin; hinge edentulous or with weak denticles near the outer ends of the margin; ligamental pit subumbonal, triangular, with the ventral margin slightly projecting into the body cavity of the shell; ventral margin broadly and regularly rounded, posterior margin short, straight, not as deeply impressed as the anterior. Ornamentation on main areas of valve of relatively strong radial ribs bearing raised scale-like imbrications on their crests; the anterior submargin usually with rather weak, irregularly radial to oblique ribs; the strong ribs of the main valve surface may continue, somewhat reduced in strength on to the posterior auricle.

The above generalized description covers a type of bivalved mollusc that has a world-wide distribution in the warmer tropical and subtropical waters. Authors have disagreed as to whether the various geographic entities involved are to be considered as separate species or as "formae" of one cosmopolitan type, which should be denominated as *Lima lima* (Linnaeus). Further, there has been almost universal disagreement as to which of the geographic entities should be considered as representing the Linnaean species, *sensu stricto*. Linnaeus gave the habitat of his species (1758, p. 699, sp. 175, as "*Ostrea lima*") as "in *O. meridionali*," which, as noted by Dodge (1952, p. 186) "is almost completely uninformative." The writer (1963, p. 76) has reviewed the conclusions of previous workers as to this factor. There seems to have been a general concept that the various forms involved were so similar as to preclude morphologic distinction of the Linnaean species. The one possibly significantly variable character mentioned in the original description is the number of radiating ribs—22. Available material, other than that of the western Atlantic form, is not sufficient to permit more than the suggestion that further investigation of this character might yield

information leading to definitive conclusions. Table 1 summarizes our results.

The most thorough, modern study of the Recent species is represented by Lamy's "Revision des Limidae vivants du Muséum National d'Histoire Naturelle de Paris" (1930). In this work he recognized *Lima lima* s.s., with 20 to 25 strong ribs; a "Forme *Sowerbyi* Deshayes" with 18 or 19 ribs; a "Forme *zealandica* Sowerby," a "Forme *tetrica* Gould," a "Var. *paucicostata* Sowerby" with 9 to 12 ribs; but noting that Lischke had reported a specimen from Japan with 16 ribs and that A. H. Cooke had indicated the rib count as varying between 9 and 15; and a "Var. *multicostata* Sowerby" with 36 ribs. No rib counts were given for *zealandica* Sowerby or *tetrica* Gould; both are said by other writers to have 18 costae.

Examination of these rib count figures, plus those gleaned from the works of many other writers, reveals that when only this one factor is taken into account there are a number of well-marked limid "species-groups:" (1) a *paucicostata*-group with 9-15, possibly 16, costae; (2) a *persquamifer-sowerbyi-tetrica-zealandica*-group with 18-21 costae; (3) a *lima-bullifera-tropicalis*-group with 20-25 costae; and (4) a *multicostata-nimbifer*-group with 30-36 costae.

TABLE 1

Geographic area:	Number of ribs on main body of valve												Number of specimens			
	18	19	20	21	22	23	24	25	26	27	28	29		30	31	32
Western Atlantic	—	—	—	—	—	—	1	11	22	17	8	7	5	3	1	75
Somali Coast	—	—	2	5	2	—	—	—	—	—	—	—	—	—	—	9
Philippines	—	3	2	—	—	—	—	—	—	—	—	—	—	—	—	5
Australia	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Mediterranean Sea (Bay of Naples)	—	—	2	—	1	1	—	—	—	—	—	—	—	—	—	4

Notes—The specimens from the Somali Coast have the high, rounded tubercles of *L. bullifera* Deshayes; those from the Philippines have been identified as *L. sowerbyi* Deshayes, originally described as from the Red Sea. The Australian specimens represent the *L. persquamifer* of Iredale.

In the Tulane collections there are numerous specimens of *Lima* from western Atlantic localities ranging from Florida to Brazil. As shown in Table 1, this species does not fall into any of these "groups," essentially occupying the interval between "*limabullifera-tropicalis*" and the "*multicostata-nimbifer*" numerations. The only described species with which the writer is acquainted that have rib-counts in this interval are the Japanese forms: *L. zushiensis* Yokoyama with about 26 ribs and *L. fujitai* Oyama with 28. Both of these differ markedly from the West Atlantic form in other characteristics: *L. zushiensis* being larger, somewhat proportionately narrower, and having a distinctive reddish-brown coloration marked by darker concentric banding—our specimens are uniformly white in color; *L. fujitai* though of similar coloration, is smaller and broader, almost semicircular in outline.

Lima caribaea d'Orbigny (1842, pl. 28, figs. 17-19; 1845, p. 354) was described as having 32 to 33 costae and hence was included by Lamy in the synonymy of his "Var. *multicostata* Sowerby." The original illustration of *caribaea*, a drawing, appears to have 27 or 28 costae on the main body of the valve and it seems possible that the 32 to 33 mentioned in the original description include the radials on the anterior auricle. If this indeed be the case then the present species is to be referred to *L. caribaea*. Not having access to the types or to topotype specimens, it will for the present be referred to as *Lima (Lima) cf. caribaea* d'Orbigny.

LIMA (LIMA) cf. CARIBAEA d'Orbigny

Plate 1, figure 1

cf. *Lima caribaea* d'ORBIGNY, 1842, in de la Sagra, Hist. fisica, polit. y nat. de Isla de Cuba, Pt. 2, Hist. Nat., Tom. 5, Molluscos, Atlas, pl. 28, figs. 17-19; 1845, (text), p. 354. [French ed., 1853, Mollusques, p. 337.]

This name is here tentatively applied to the western Atlantic species noted in the

above discussion. These are marked by the possession of 24 to 31 strong radial costae on the main surface of the valve. These costae are separated by interspaces that are only approximately two-thirds as wide and are ornamented by raised squamae that do not cross the interspace areas. The hinge-line is short, with a ligamental pit that is triangular and longer than high. There are two minute denticle-like teeth at the dorsal angles in most specimens, with the inner, more ventral one, usually the strongest. In the largest specimens the outer, more dorsal denticles tend to become weakened, almost lost. It is a relatively small form, the largest specimen in our collection is a left valve having a height of 42.5 mm, length 36.2 mm and a semi-diameter of 8.2 mm. In contrast a large specimen from the Philippines, identified as *L. sowerbyi* Deshayes, has a height of 98 mm, length 77.1 mm, and a semi-diameter of 18.8 mm.

In addition to the specimens from the western Atlantic there are also three from the Chipola Formation that agree in all details with those from the Recent fauna. Two are small and immature, but the third is almost as large as the largest Recent specimen, the measurements of which are given above. This third specimen, from TU locality 547, has 24 radial costae; the two smaller ones, both from TU 555, have 25 and 26 costae, respectively.

Lima (Lima) tampaensis Dall (1898, p. 766, pl. 35, fig. 18) which, as noted above, was apparently inadvertently reported as from the Chipola Formation, is the only described American fossil species that might be confused with the present form. The original illustration shows only the interior of the valve and hence is not too useful. Dall, however, in his description notes that there are 27 radial costae, which are narrow and smooth, and "separated by wider channelled interspaces."

Figured specimen: USNM 647013; height 41.4 mm, length (incomplete) 34 mm, semi-diameter (left valve) 8.5 mm; locality TU 547.

Genus CTENOIDES Mörch, 1853

Ctenoides MÖRCH, 1853, Cat. Conch. Yoldi, pt. 2, p. 56.

Divaricolina ROVERETO, 1898, Atti Soc. Linguistica, v. 9, pp. 153, 167 [type, orig. desig.: *Lima eximia* Giebel, 1864, Fauna von Lattorf., p. 78, pl. 4, fig. 17; Oligocene, Germany].

Type species, by subsequent designation (Stoliczka, 1871): *Ostrea scabra* Born, 1778. Recent, South Florida, Yucatan Peninsula, West Indies to northeastern Brazil.

Shell ovate, high in proportion to length, somewhat compressed, with well-developed, narrow and elongate byssal gape bordered by lip-like reflections of the valve margins; auricles well-differentiated, the anterior one slightly larger than the posterior; resilifer trigonal, usually wider than high; cardinal area narrow, marked by relatively strong lateral teeth at either end below the auricles. Sculpture of numerous rounded, radial riblets that increase by divarication more or less along the mid-length of the valve; surface of ribs bearing fine, relatively distant squamose scales.

CTENOIDES (CTENOIDES) FLORIDANA
(Olsson and Harbison)

Plate 1, figures 3, 4

Lima tenera G. B. SOWERBY II, 1843, Thesaurus Conch., v. 1, pt. 3, p. 84, pl. 21, figs. 10, 11.

NOT *Lima tenera* TURTON, 1826, Zool. Jour., v. 2, p. 362, pl. 13, fig. 2 [= *L. hians* (Gmelin)].

Lima (Ctenoides) floridana OLSSON and HARBISON, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 59, pl. 8, fig. 4 [Caloosahatchee Fmtn., Florida].

Prior to the issuance of Opinion 184 of the International Commission on Zoological Nomenclature, in 1944, which ruled that the new specific names appearing in the "Neues Systematisches Conchylien-Cabinet" of Martini and Chemnitz were not nomenclatorially available, most authors referred the present species (sometimes cited as a variety of *Lima scabra* Born) to "*Lima tenera* Chemnitz" (1784, pp. 267, 354, pl. 68, fig. 653). Subsequent to that date it has been usually cited as of the "Thesaurus Conchyliorum . . ." of G. B. Sowerby II, following Dall (1898, p. 768), who early had rejected the Chemnitz work. Unfortunately, however, the combination *Lima tenera* had been used previously in binomial nomencla-

ture by Turton for the European form now generally referred to *L. hians* (Gmelin) (1791, p. 3332) and the Sowerby name must be rejected as a primary homonym.

The next available name appears to be "*Lima (Ctenoides)*" *floridana* Olsson and Harbison, which was originally proposed for the Pliocene form referred to *tenera* by Dall (1898, p. 768), being described as: "Similar to *Lima tenera* in sculpture but differs by its narrower form, hence somewhat more convex or vaulted along its slightly inclined longitudinal axis; with a narrower, heavier and higher hinge area bearing a deeper ligamental pit. Hinge as in *tenera* . . ." Measurement of 25 right and 25 left valves of Pliocene specimens from the Caloosahatchee River area (TU R-109) compared with those of a similar number of specimens from the coast of Panamá (TU R-109) reveals that the Pliocene and Recent forms are almost wholly identical in relative valve proportions, differing only in that the fossil specimens tend to be smaller than those from the Recent seas. This may, however, be an accident of preservation and collection, although it may also be significant since all of the lower Miocene specimens from the Chipola Formation tend to be, in turn, notably smaller than are those from the Pliocene strata, suggesting that we may have here another example of progressive phyletic size-increase. Table 2 indicates the relative size and proportions of the specimens measured.

It may be noted that the range of variation in the length to height ratios is slightly greater in the Recent than in the fossil specimens. Indeed, it is actually greater than indicated in the table for one obviously gerontic specimen from off the coast of Panamá (TU R-109), with a ratio of .556, being 30.6 mm long and 55.0 mm high, was not included in the above calculations. It may also be observed that the dimensions given for the type specimen of *Ct. floridana*—height 27 mm, length 20.8 mm, diameter 10.7 mm—yield a ratio of .770 and indicate a valve a little broader than the average of either the Recent or the fossil specimens.

TABLE 2

	Recent (TU R-109)	Pliocene (TU 529)	Miocene (TU 555)
number measured	50	50	9
average length	30.7 mm.	18.7 mm.	7.3 mm
average height	40.6 mm.	24.7 mm.	9.6 mm
length:height ratio.756:1758:1754:1
length:height range596 - .845:1.683 - .839:1634 - .873:1

Study of the ligamental area of these same specimens reveals that there is also a high degree of variability in the relative height of the area as well as in the size and depth of the resilial pit. In general, however, it may be observed that the more narrow specimens appear to have a relatively higher area than do those in which the longer shell allows a greater hinge-length; the highest (7.6 mm) and most strongly developed area is on the gerontic specimen cited above.

The collections from the Chipola Formation contain nine entire and twelve broken valves that are here assigned to *Ct. floridana*. All are from locality TU 555, near the uppermost strata of the formation as exposed in the banks of the Chipola River.

Figured specimens: Fig. 3, Hypotype, USNM 647014; height 21.3 mm, length 13.5 mm, semi-diameter (right valve) 3.9 mm; locality TU 555. Fig. 4, Hypotype, USNM 647015; height 12.2 mm, length 9.2 mm, semi-diameter (right valve) 2.4 mm; locality TU 555.

from the forms here referred to *Ctenoides floridana* by the possession of stronger, more squamose, radial ribbing, an apparently broader valve area as compared with the height, and a tendency to show relatively strong concentric growth interruptions on the earliest portion of the shell. The first character is the feature that distinguishes the typical form of *Ct. scabra* from *Ct. floridana*, the two species being otherwise similar in shape and hinge structure. The available material is too scanty to permit any significant conclusions to be drawn from measurements of valve shape, and the growth "interruptions" may be only a function of type of preservation. Accordingly these specimens are here tentatively referred to *Ctenoides scabra* pending discovery of additional and more complete material for study.

Figured specimen: USNM 647016; height 13.2 mm, length (incomplete) 11.7 mm, semi-diameter (right valve) 2.8 mm; locality TU 555. [Length:height ratio .886+:1]

CTENOIDES (CTENOIDES) cf. SCABRA
(Born)

Plate 1, figure 2

cf. *Ostrea scabra* BORN, 1780, Test. Mus. Caes. Vind., p. 110.

cf. *Ostrea glacialis* GMELIN, 1791, Syst. Nat., ed. 13, p. 3332 [pars, not var. β = *Ctenoides floridana*].

Three broken valves in the Chipola collections from locality TU 555 are distinguished

Genus LIMARIA Link, 1807

Limaria LINK, 1807, Besch. Natur.-Samml. Univ. Rostock, p. 157.

Mantellum MÖRCH, 1853, Cat. Conch. Yoldi, pt. 2, p. 57 [non *Mantellum* Röding, 1798, = *Lima* Bruguière, 1797].

Promantellum IREDALE, 1939, Gt. Barrier Reef Exped., 1928-29, Sci. Rpts., v. 5, no. 6, Moll., Pt. 1, p. 385 [type, orig. desig.: *P. parafragile* Iredale].

Submantellum OLSSON and HARBISON, 1953, Acad. Nat. Sci. Phila., Mon. 8, p. 60 [type orig. desig.: *Lima orbigny* Lamy].

Limatulella Sacco, STENZEL, KRAUSE and TWINING, 1957, Univ. Texas Publ. 5704, p. 86.
Winckworthia GLIBERT and VAN DE POEL, 1965, Mém. Inst. Roy. Sci. Nat. Belg., (Ser. 2) fasc. 78, p. 49 [type, orig. desig.: *Ostrea tuberculata* Olivij].

Type species, by subsequent designation (Winckworth, 1930): *Limaria inflata* Link, 1807 = *Ostrea tuberculata* Oliv. Miocene to Recent, Mediterranean Sea and western Europe.

Somewhat obliquely elliptical, moderately to rather strongly inflated shell that has a wide posterior gape immediately below the cardinal margin and a narrower anterior one that is well separated from that margin. The sculpture consists of irregularly spaced narrow radial riblets separated by wide interspaces; the number of riblets and their relative spacing tends to vary so greatly within a species that it is not a reliable character for identification, and the relative width of the interspaces may vary widely in different area of the same valve. The cardinal region is marked by relatively small auricles, subequal in size, the anterior being slightly longer than the posterior; the broad ligamental pit is essentially central but

extends slightly more anteriorly than posteriorly. The hinge is edentulous.

There has been much uncertainty as to the use of *Limaria* Link, 1807. This stemmed to a considerable extent from Iredale's (1939, pp. 382, 286) disagreement with Winckworth's (1930, p. 116) designation of *inflata* Link as type species.

In proposing the genus Link included four species, of which the first was *vulgaris* Link, with "O. Lima. L. G. [melin] p. 3332" in the synonymy, and the fourth was *inflata* with sole reference to "Ch. Conch. 7. t. 68. f. 641. a." Iredale apparently misinterpreted the version of the International Rules of Zoological Nomenclature then in force when he stated (p. 386) that "the type of *Limaria* must be *vulgaris* by tautonymy . . ." It is true that the selection of *vulgaris* was strongly recommended by the Rules (Art. 30, Par. III, Recommendations i

PLATE 1

1. *Lima* (*Lima*) cf. *caribaea* d'Orbigny.
 Figured Specimen—USNM 647013, (X 1); height 41.4 mm, length 34 mm.
 Locality: TU 547.
2. *Ctenoides* (*Ctenoides*) cf. *scabra* (Born).
 Figured Specimen—USNM 647016, (X 4); height 13.2 mm, length 11.7 mm.
 Locality: TU 555.
- 3, 4. *Ctenoides* (*Ctenoides*) *floridana* (Olsson and Harbison).
 3. Hypotype. USNM 647014, (X 3); height 21.3 mm, length 13.5 mm.
 Locality: TU 555.
 4. Hypotype. USNM 647015, (X 4); height 12.2 mm, length 9.2 mm.
 Locality: TU 555.
- 5, 6, 7. *Limaria* (*Limaria*) *chipolana* H. E. Vokes, n. sp.
 5. Paratype. USNM 647018, (X 6); height 6.2 mm, length 4.9 mm.
 Locality: TU 459.
 6. Holotype. USNM 647017, (X 6); height 9.0 mm, length 7.6 mm.
 Locality: TU 459.
 7. Paratype. USNM 647019, (X 6); height 5.6 mm, length 4.9 mm.
 Locality: TU 459.

All specimens are from the Chipola Formation, lower Miocene, of Florida. Magnifications approximate only.

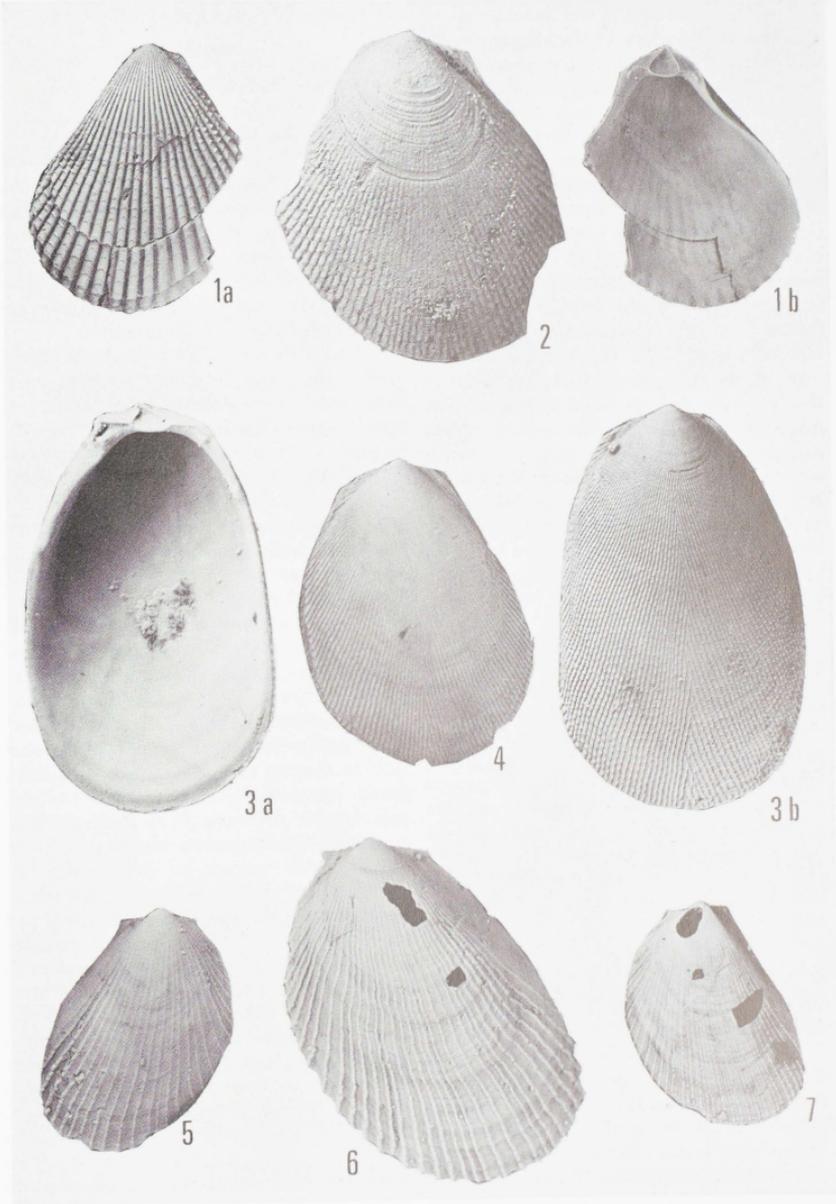


PLATE 1

and *m*, as published in the Proceedings of the Biological Society of Washington, v. 39, pp. 75-104, 1926), but the synonym *lima*, being only *virtually* tautonomous with *Limaria* did not fix the type solely on the basis of the original publication (Article 30, I, d). Type designation by virtual tautonomy was a matter for subsequent designation and the designating author was clearly given the right to select a species from the original list other than that indicated by the virtual tautonomy in cases where "such preference is strongly contraindicated by other factors." In the present case the "other factors" included the fact that the designation of *vulgaris* would make *Limaria* an absolute synonym of *Lima* Bruguière. The designation of *inflata* would make the name available for the group long known by authors under the name of *Mantellum* Bolten [= Röding], 1798, after Mörch and H. & A. Adams, who had overlooked the designation of *Ostrea lima* as type by Gray, 1847, making *Mantellum* also an absolute synonym of *Lima*.

Iredale is correct, however, in noting that *inflata* Link, being based upon the Chemnitz figure 649a, was not the same form as the *Ostrea inflata* of Gmelin (1791, p. 3321) the references for which include the Chemnitz figure 649b [= *bullata* Born], but not 649 a. Winkworth clearly missed this distinction when he synonymized the *inflata* of Link with that of Gmelin. It is possible that he was influenced by the fact that Lamarck (1819, p. 156) had used the name *inflata* for, among other references, Chemnitz's fig. 649a. According to the extensive synonymy of Bucquoy, Dautzenberg and Dollfus (1887, p. 53), the next available name for *inflata* Link (non Gmelin) is *Ostrea tuberculata* Olivi (1792, p. 120).

Stenzel, Krause and Twining (1957, pp. 86-88) appear to have been misled by Iredale and concluded that the next available name for the group previously known as *Mantellum* was *Limatulella* Sacco, 1898, type by original designation: *Lima loscombi* Sowerby, 1823. Typical forms of *Limatulella* differ from those of *Limaria*, however, in the almost complete absence of the anterior and posterior marginal gapes.

LIMARIA (LIMARIA) CHIPOLANA

H. E. Vokes, n. sp.

Plate 1, figures 5-7

This is the most abundant and widely distributed limid species in the Chipola collections, being represented by 116 specimens, many of which, however, are broken and incomplete. The majority of the specimens come from one locality, TU 459, which has yielded 86 valves; twelve are from TU 548, six from TU 825, and the rest are from seven different collection sites.

Limaria chipolana is a typical representative of the genus differing from most other described western Atlantic fossil and Recent species primarily in its smaller size, the largest of the valves in the collection being but 13.2 mm high, 10.6 mm long and 2.6 mm in diameter. This size difference is particularly marked with respect to the "middle" Miocene, Calvert Formation, species *L. papyria* (Conrad) (1841, p. 30; 1845, p. 76, pl. 43, fig. 7), the "upper" Miocene *L. carolinensis* (Dall) (1898, p. 767, pl. 35, fig. 21) of the Duplin Marl and related units, and the Pliocene *L. caloosana* (Dall) (1898, p. 767, pl. 28, fig. 3) of the Caloosahatchee Formation. It is also proportionately higher and narrower in general outline than is any of these three species, being most closely approximated in this aspect by *L. pellucida* (C. B. Adams) (1846, p. 102), which appears to be even more narrow with respect to height than *L. caloosana*. It may be distinguished from *L. pellucida* by the much more broadly and regularly rounded posterior and posteroventral margin, a feature that serves also to distinguish it from the other species mentioned above. Surface ornament is of the type characteristic of the genus, but the radial ribbing is absent over the greater part of the anterior slope of the valve resulting in a long, unusually broad smooth margin area. Posteriorly the ribbing dies out below the auricle and both auricles are smooth. This latter feature is shared with *L. pellucida* and some specimens *L. carolinensis*, but the majority of the valves of the latter species available for study showed at least traces of ribbing on the posterior auricle.

TABLE 3

	<i>carolinensis</i>	<i>caloosana</i>	<i>pellucida</i>	<i>chipolana</i>
number measured	14	50	7	26
average length	24.9 mm	22.7 mm	10.4 mm	5.1 mm
average height	27.2 mm	25.0 mm	13.5 mm	6.3 mm
average diameter	9.1 mm	7.3 mm	2.6 mm	1.5 mm
ratio length/height	.914:1	.908:1	.770:1	.801:1
range length/height	.850-1.00	.819-.977	.721-.813	.702-.857
ratio length/diameter	.365:1	.322:1	.250:1	.288
range length/diameter	.304-.428	.252-.428	.226-.278	.245-.348

In overall appearance *L. chipolana* is most similar to *L. smithvillensis* (Stenzel and Twining) (1957, p. 88, pl. 8, fig. 13, as "*Lima (Limatulella)*"), both species being marked by a very regularly rounded posterior and postero-ventral margin. But the Texas Eocene species is proportionately much longer with a length/height ratio of .941, and this has led to the development of a more broadly rounded antero-ventral margin than is present in our lower Miocene form. In addition the posterior auricle of *L. smithvillensis* is described as being ornamented by "many crowded, fine, low ribs."

Table 3 compares *L. chipolana* with specimens from the type locality of the Jackson Bluff Formation* (Tu 60) and from the Caloosahatchee Formation (TU 529).

The Jackson Bluff species was identified by Mansfield (1932, p. 67, pl. 13, fig. 4) as "*Lima (Mantellum) carolinensis* Dall;" the Caloosahatchee specimens are here identified

as *L. caloosana* (Dall). In addition measurements are given of the few available specimens of *L. pellucida* (C. B. Adams) from Pleistocene and Recent localities in Florida and the Caribbean Sea.

The writer is inclined to the opinion that the relative shell diameter (and inflation ratio) is not a significant specific character in this genus. Specimens of almost identical length and height may differ considerably in diameter, to the point that it seems quite possible that this may be an expression of sexual dimorphism. Two valves of *L. caloosana*, for example, each 25.3 mm in height, and differing in length only by 0.1 mm, have diameters of 7.2 and 8.4 mm, giving length/diameter ratios of .313 and .363 respectively. It is here assumed that the more inflated individuals reflect the larger gonads of the females.

Figured specimens: Fig. 6, Holotype, USNM 647017; height 9.0 mm, length 7.6 mm, semi-diameter (right valve) 1.9 mm; locality TU 459. Fig. 5, Paratype, USNM 647018, height 6.2 mm, length 4.9 mm, semi-diameter (left valve) 1.5 mm; locality TU 459. Fig. 7, Paratype, USNM 647019, height 5.6 mm, length 4.9 mm, semi-diameter (right valve) 1.4 mm; locality TU 459. Other occurrences: Tulane University localities 555, 818, 820, 821, 825, 826, 827, 1020.

*Akers (1972, Tulane Stud. Geol. Paleont., v. 9, pp. 18-24, 30-34, figs. 1, 2, 4) has recently demonstrated that the Jackson Bluff and Yorktown formations contain planktonic foraminiferal faunas equivalent to those of the upper part of the Neogene zone 18 and to zone 19 of Blow. These are considered as being of lower and lower middle Pliocene age.

LOCALITY DESCRIPTIONS

Note: All of the following Tulane University fossil localities are in the Chipola Formation of lower Miocene age, from Calhoun County Florida.

459. Steep bank on east side of Chipola River about 1500 feet above mouth of Taylor Lake Branch (NW¼ Sec. 29, T1N, R9W).
 547. West bank of Chipola River about 2000 feet above mouth of Four Mile Creek (SW¼ Sec. 29, T1N, R9W).
 548. West bank of Chipola River at sharp bend about 1800 feet below mouth of Farley Creek (NW¼ Sec. 29, T1N, R9W).
 555. East bank of Chipola River about 1000 feet above mouth of Four Mile Creek (SW¼ Sec. 29, T1N, R9W).
 818. Farley Creek, south bank 0.1 mile west of bridge on Florida Highway 275 (SW¼ Sec. 21, T1N, R9W).
 820. Farley Creek at bridge on Florida Highway 275 (SW¼ Sec. 21, T1N, R9W).
 821. Farley Creek, 0.1 mile east of bridge on Florida Highway 275 (SW¼ Sec. 21, T1N, R9W).
 825. Farley Creek, at abandoned mill about one-quarter mile west of bridge on Florida Highway 275 (SW¼ Sec. 21, T1N, R9W).
 826. Farley Creek, about 0.1 mile west of TU 825 (on line between Secs. 20 and 21, T1N, R9W).
 827. Farley Creek, about one-half mile west of bridge on Florida Highway 275 (SE¼ Sec. 20, T1N, R9W).
 1020. East side Chipola River inside mouth of small, unmapped tributary about one-half mile below power line crossing (NE¼ Sec. 20, T1N, R9W).

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