

THE GENUS *CONUS* (MOLLUSCA: GASTROPODA) FROM THE ALUM BLUFF GROUP OF NORTHWESTERN FLORIDA

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I. ABSTRACT

This study of the gastropod genus *Conus* comprises 24 species from the Alum Bluff Group of northwestern Florida, including 16 species from the Chipola Formation, late lower Miocene; four species from Oak Grove Sand, (?) late lower Miocene; and four species from the Shoal River Formation, middle Miocene. Eleven species are new: *C. aneuretos*, *C. ambonos*, *C. cracens*, *C. tapetus*, *C. erugatus*, *C. aquoreus*, *C. praecipuus*, *C. vegrandis*, *C. tricoloratus*, *C. runculus* from the Chipola Formation and *C. drezi* from the Shoal River Formation. In

addition, three homonyms are renamed: *C. gardnerae* for *C. corrugatus* Gardner non Sowerby; *C. vitius* for *C. fusiformis* Gardner non G. Fischer, nec Lamarck, nec Pease; *C. infulatus* for *C. turbinopsis* Gardner non Deshayes. All 24 species are treated systematically.

II. INTRODUCTION

The gastropod genus *Conus* Linné is primarily a Tertiary development, although a few ancestral forms likely occurred in late Cretaceous time. The group expanded rapidly in numbers and forms, becoming abundant during the Miocene epoch and reaching its greatest diversity in Recent time, particularly in the Indo-Pacific region. *Conus* is mainly a tropical genus with a varying

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habitat, living on reefs, rocks, mud, or sand, from the inter-tidal zone to 100 fathoms. The exotic coloring of the Recent specimens of *Conus* led to numerous taxonomic designations by earlier European workers, many of them vying with each other to be the first to publish a particular species. Oftentimes the proper locality data were not designated and the haste of the authors resulted in a confusion of synonyms. Tomlin (1937) compiled an invaluable catalog listing over 2,700 species of *Conus* (both fossil and Recent) in which he attempted to determine the validity of the specific taxa, the original locality from which each species was collected, and the repository of the holotype, if known. This study revealed many instances of three or more different names assigned to the same species plus the fact that some type localities still remain in doubt.

A natural subdivision of the genus *Conus* with its multiplicity of species would be useful in classification, however, most of the proposals so far suggested have not met with general acceptance by most workers. Clench (1942, p. 36) stated, "The entire family of Conidae must be studied as a whole before any stability can be reached and the complex relationship worked out."

Color has long been a determining factor in the identification of *Conus*. Dall (1890, p. 27) noted that it was "almost impossible, without the color markings, to identify [fossil] cones; and therefore, identifications must always be taken as approximate." The color pattern and the degree of intensity of color do not necessarily signify a different species of *Conus*. These color factors may be merely an indication of an ecologic or genetic variance within the species. Von Linden (1896) and Burnett Smith (1929, 1945, 1946) pioneered a new approach to the recognition of species by using the characteristics of the early whorls as determining factors. Unfortunately their method was not adopted because workers found few unabraded specimens. With advanced techniques in obtaining Recent shells and an increase in the number of available fossil localities, better specimens are being collected. Van Mol, Tursch and Kempf (1967) in the "Resultats Scientif-

iques des Campagnes de la *Calypso*" advocate the same logical procedure for determination of species.

The present paper is concerned only with the members of the genus from the Miocene Alum Bluff Group of northwestern Florida. The species from the Chipola Formation far out-number those from either the Oak Grove Sand or the Shoal River Formation. Sixteen species occur in the Chipola fauna and only one of these, *C. cracens* n. sp., has a recognizable affiliation with a species of earlier age. Another new species, *C. praecipuus*, is considered ancestral to *C. consobrinus* common in the Miocene of Santo Domingo, Panamá, Mexico and Jamaica.* Of the 24 species of *Conus* studied in this paper, only one occurs in more than one formation, *C. gardnerae* nom. nov., from both the Chipola Formation and the Oak Grove Sand.

During the course of this study, the writer examined nearly 25,000 specimens. The majority of the Chipola *Conus* are well preserved with perfect apical and spire whorls, thus facilitating their specific identification by the system used herein. Taxonomic determinations were based solely on morphological characteristics, such as the nuclei, early post-nuclear whorls, sutures, and anal fascioles. Regardless of the number of whorls comprising an adult specimen, the early whorls remain constant throughout life. As an example, if the first three or four post-nuclear whorls are beaded on a juvenile specimen it will retain the beading regardless of the size or number of whorls it acquires with maturity. Misleading factors in species identification are: the angle and height of the spire; the angle of the shoulder; the basal sculpture; and pustules on final whorl. These features oftentimes change with the growth of the shell.

The color pattern of several species, as revealed by ultraviolet light, has been figured. (For details of the process see Vokes and Vokes, 1968, p. 76.) These figures are not intended to be used as a means of identification but as an additional point of

*World-wide planktonic foraminiferal correlation indicates that some formations previously known as middle or upper Miocene are, in the planktonic chronology, middle Pliocene in age.

interest, noting that different species do have different color patterns. The Chipola *Conus*, with the exception of one species, *C. aneuretos*, all have a basic color pattern of interrupted spiral lines, overlain by either flammules, blotches or bands. Judging by the patterns shown with the aid of ultraviolet light it is evident that many of the cones from the Chipola fauna were exceedingly well-marked and colorful.

The 10,000+ *Conus* specimens in the writer's own collection were used as a basis for a study of the geographic distribution of the genus within the Chipola Formation. Approximately 70% of the specimens were collected from Ten Mile Creek, the remaining 30% nearly equally divided between the Chipola River and Farley Creek. Apparently the fine sandy clay of Ten Mile Creek and adjacent areas of the Chipola River were better suited for their habitat. On the other hand, some species are confined to the coral reefs and calcareous beds of Farley Creek and downstream portions of the Chipola River. Reef and rock dwellers as well as sand and mud dwellers occurred during Chipola time.

As there is no continuous section exposing the three Alum Bluff formations (Chipola, Oak Grove Sand and Shoal River) the exact stratigraphic relationship between the Chipola Formation and the Oak Grove Sand has not been clearly established. Later workers are generally agreed that the Oak Grove Sand is probably a facies of the Chipola Formation. This hypothesis is substantiated by the number of species common to both beds. However, the silty bottom of the Oak Grove sea provided a more favorable environment for pelecypods than for gastropods. Apparently there was a cooling of the waters during the Shoal River time, as the fauna loses some of the tropical aspects and is more comparable to that of temperate waters.

Only five of the 24 species of *Conus* reported in this paper occur in the Oak Grove, one of these, *C. gardnerae*, is also in the Chipola beds. Three of the above-mentioned five were named from single specimens. Four species have been collected from the Shoal River Formation and two of

these are represented by single examples: only *C. waltonensis* is found in abundance. Apparently this one species evolved and thrived on a silty bottom.

The meager (compared to the Chipola fauna) representation of the genus *Conus* in the Shoal River fauna may reflect cooling of the waters during the later stage (Gardner, 1926, p. 2). The distribution of the genus *Conus* in Recent fauna demonstrates that, although a few species can tolerate temperate waters and some prefer subtropical waters, the majority are found in a tropical environment. Many more individuals are living in the tropical waters of the vast Indo-Pacific than in either the western Atlantic or eastern Pacific Provinces.

III. ACKNOWLEDGMENTS

The writer wishes to express appreciation to all those that made this study possible: Harold E. and Emily H. Vokes (Department of Geology, Tulane University) for their superb photographs and loan of Tulane University materials; Paul E. Drez, Chapel Hill, North Carolina, for the use of his personal collection and his contribution of a unique specimen; Druid Wilson and Thomas R. Waller (U. S. Geological Survey and Smithsonian Institution, respectively) for making the U. S. National Museum specimens available; and Katherine Van Winkle Palmer, Paleontological Research Institution, for providing type specimens for study.

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IV. SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA

Class GASTROPODA

Subclass PROSOBRANCHIA

Order NEOGASTROPODA

Suborder TOXOGLOSSA

Superfamily CONACEA

Family CONIDAE Rafinesque, 1815

Subfamily CONINAE Rafinesque, 1815

Genus CONUS Linné, 1758

Conus LINNÉ, 1758, *Systema Naturae*, 10th ed., p. 712. Type species: *Conus marmoreus* Linné by subsequent designation, Children, 1823.

TABLE 1. CHIPOLA FORMATION

SPECIES	NUCLEAR WHORLS	TELEO. WHORLS	SUTURES	ANAL FASCIOLE	SPIRE OUTLINE	BODY OUTLINE	BASAL SCULPTURE	REMARKS
<i>C. chipolanus</i> Dall	3¼ slender	9	adpressed	flat-concave	high, concave	slender, attenuated	wide bands and narrow grooves	first ¼ teleo. whorl with axial riblets
<i>C. demiurgus</i> Dall	2¼ bulbous	8	impressed	flat	flat-low	slender, flat-sided	unequal spiral threads, crowded, sinuous	large, slender; juv. nucleus with erect calcarella
<i>C. isomitratu</i> Dall	2 slender	8	impressed	convex	low, convex-str.	stubby	coarse, evenly spaced rounded cords	small, heavy
<i>C. sulculus</i> Dall	2½ slender	10	adpressed	concave	low, concave; apex elevated	gradually tapering	alternating in size sinuous threads	large; spire whorls threaded; granules basally on juv.
<i>C. gardnerae</i> <i>nom. nov.</i>	3½ slender, taper.	7	adpressed	flat-concave	high, concave	flat-sided tapered	bands and grooves	occasional pustules on spiral bands
<i>C. trajectionis</i> Maury	3½ slender, taper.	10	distinct adpressed	flat	low, straight-sided	pyriform	spiral threads rough- ened by growth lines	early whorls noded; spire whorls threaded
<i>C. aneuretos</i> n. sp.	3 slender	8	closely adpressed	concave	med. high, concave	broad, tapering	flat spiral bands, striated grooves	no spiral threading; occasional pustules on final whorl
<i>C. ambonos</i> n. sp.	3 tapering	8	adpressed	concave	low, concave	elongate, constricted	flattened spiral cords	elevated rimmed shoulder, 3 post- nuclear whorls axially costate
<i>C. cracens</i> n. sp.	3 slender	10	lightly adpressed	concave	low, concave	attenuated, constricted	incised lines separat- ing wide, flat bands	large, light weight; nodes, spiral threading, acute shoulder
<i>C. tapetus</i> n. sp.	1¾ broadly rounded	9	adpressed	flat	low, elevated apex	straight-sided	8-12 unequal, inequa- spaced cords, heavier on adapical edge	first 3-4 whorls beaded; spiral threading
<i>C. erugatus</i> n. sp.	1½ broadly rounded	8½	impressed	flat	low, elevated apex	flat-sided	coarse spiral threads	early whorls noded; one thread on spire whorls

<i>C. aquoreus</i> n. sp.	1¾ slender	9	lightly adpressed	flat-concave	flat, erect nucleus	elongate, slender, flat-sided	meager, irregularly spaced flattened cords on anterior fifth	weak spiral lineation on whorl summits
<i>C. praecipuus</i> n. sp.	unknown	9	closely adpressed	narrow, concave	high, flat-sided	tapering	cords over entire final whorl	spire whorls threaded, heavily tubercled
<i>C. vegrandis</i> n. sp.	2 rounded	7	lightly adpressed	flat-convex	mod. high	conic	heavy rounded cords, unevenly spaced	small; early whorls axially costate; shoulder cord; microscopic threading
<i>C. tricoratus</i> n. sp.	3 slender	7	adpressed	flat	high, concave	slender, attenuate	10 rounded spiral cords	first 4 whorls axially costate
<i>C. rapunculus</i> n. sp.	3½ tapering	8	adpressed	flat	conic	elongate, constricted	broad bands, narrow grooves	first 3 post-nuc. whorls axially costate; columella twisted; canal recurved

TABLE 2. OAK GROVE SAND

SPECIES	NUCLEAR WHORLS	TELEO. WHORLS	SUTURES	ANAL FASCIOLE	SPIRE OUTLINE	BODY OUTLINE	BASAL SCULPTURE	REMARKS
<i>C. draperi</i> Maury	unknown	8	lightly adpressed	flat	low, straight-sided	broad, gradu- ally tapering	faint lines	large, heavy
<i>C. nemorideditus</i> Maury	unknown	8	adpressed	convex	mod. high, slightly convex	rounded shoulder, taper to base	raised threads	large, light weight
<i>C. dodona</i> Gardner	3 tapering	7	adpressed	concave	mod. low, concave	elongate, basally constricted	unequal and uneven spaced sinuous threads	heavy shell; rimmed shoulder
<i>C. vitius</i> <i>nom. nov.</i>	3½ tapering	6	distinct, slightly impressed	concave	high, straight-sided	slender, tapering	bands and grooves	small, slender, fusiform; bands and grooves cover final whorl

TABLE 3. SHOAL RIVER FORMATION

SPECIES	NUCLEAR WHORLS	TELEO. WHORLS	SUTURES	ANAL FASCIOLE	SPIRE OUTLINE	BODY OUTLINE	BASAL SCULPTURE	REMARKS
<i>C. drezi</i> n. sp.	unknown	9	distinct, lightly adpressed	concave	mod. high, flat-sided	grad. taper, base constricted	flat spiral bands, striated grooves	early post-nuc. whorls axially costate; smooth flat rim on shoulders
<i>C. waltonensis</i> Aldrich	3½	8	impressed	concave	mod. high, straight-sided	stubby	bands and grooves	numerous or few pustules on final whorl
<i>C. infulatus</i> nom. nov.	2	8	distinct	flat-concave	mod. high, concave	inflated in front of shoulder, base constricted	bands and grooves	heavy shell; bands and grooves cover final whorl
<i>C. submoniliferus</i> Gardner	unknown	10	deeply impressed	concave	low, straight- concave	grad. taper.	beaded spiral threads	spiral lineation on summits of spire whorls

CONUS CHIPOLANUS Dall

Pl. 1, figs. 1, 2

Conus chipolanus DALL, 1896, U. S. Natl. Mus., Proc., v. 18, p. 42; 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, pl. 60, fig. 23.

Conus chipolanus Dall. GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 360, pl. 43, fig. 6.

Conus aff. *C. chipolanus* Dall. WOODRING, 1970, U. S. Geol. Surv. Prof. Paper 306-D, p. 354.

Diagnosis: "Shell double-conic, with a rather elevated spire of 9 normal and about 3 lucid nuclear whorls; profile of the spire somewhat concave, turreted shoulder of the whorls sharply keeled, concave between the keel and the suture, without spiral grooving but showing faint microscopic spiral scratches, the prominent sculpture of this area being the delicately arched lines of the anal fasciole, which are sometimes very conspicuous; the keel is wholly without nodules; sides in front of the keel straight, slightly concave toward the canal, smooth, except for incremental lines, polished anteriorly, with about 9 sharp, channeled spiral grooves, besides some striations on the canal; the grooves are separated by wider interspaces and crossed by numerous elevated lines of growth, which only appear in the channels; each channel in the fully adult shell has a spiral row of faint, round tubercles close to its anterior margin; in the young the grooves sometimes cover the whole shell before the keel, and the nodules are often absent; in the adult the grooves cover somewhat less than half the whorl, while on the smooth part traces of 5 narrow, revolving color bands are sometimes visible, with wider interspaces; anal notch moderately deep; outer lip thin, only moderately arched; aperture narrow, with nearly parallel sides; the pillar straight, thin, slightly twisted." (Dall, 1896)

Dimensions of holotype: height 32.0 mm, diameter 15.0 mm.

Holotype: USNM 113985.

Type locality: USGS 2213, 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 220093; height 29.1 mm (decollate), diameter 12.8 mm; locality TU 546. Fig. 2, USNM 220094; height 33.3 mm, diameter 14.1 mm; locality TU 458. Other occurrences: TU locality nos. 70, 196, 456, 457, 458, 459, 547, 553, 554, 655, 708, 709, 710, 711, 786, 787, 817a, 820b, 821, 823, 825, 826, 827, 828, 830, 950, 951, 998, 999, 1020, 1021, 1047, 1048, 1050, 1051, 1052, 1097, 1098.

Discussion: Of the nearly 1400 specimens of *C. chipolanus* in the writer's collection 1250 were taken from Ten Mile Creek localities. To study the variability of the species the over 500 specimens taken from a

single locality—TU 546—were used as a representative unit. Dall stated in his diagnosis of the species: "...in the young the grooves sometimes cover the whole shell before the keel, and the nodules are often absent; in the adult the grooves cover somewhat less than half the whorl." In the material studied, fewer than 20% (91 specimens) had sculpture (bands and grooves) covering the entire final whorl, and of these 50% were adult, as evidenced by the 9 teleoconch whorls. These adult shells are more slender and the spires less attenuated than those adult specimens with fewer bands and grooves on the final whorl. No pustules were noted on any of these 91 specimens. However, pustules were observed on 30% of the entire lot from TU 546.

The early whorls of *C. chipolanus* can be divided into three stages: nuclear stage of three and one-quarter whorls, curved-rib stage of one-quarter turn, and keeled stage. Even though the outline of the shell and ornamentation of the final whorl show a great amount of variability the details of the early whorls are constant.

Dall (1896) suggested that *C. chipolanus* is related to *C. marylandicus* Green "of the newer Miocene" and to *C. floridanus* Gabb of the Recent Caribbean, but the Chipola species bears only a slight resemblance to either species. *C. marylandicus* is a stout cone with channeled whorls and has a much lower and broader spire with straight to convex outline. The final turn is not constricted basally. The early whorls of *C. floridanus* are axially costate in front of the carinated shoulders and the ornament of the last whorl consists of a few unevenly spaced impressed lines, with no incremental striation. The early whorls of *C. jaspideus* Gmelin, another Recent Caribbean species, are more in agreement with those of *C. chipolanus*, although they lack the curved-rib stage. This Recent species is smaller and has a broader biconic outline, nevertheless, in the opinion of the writer, it could more logically be given consideration as a descendent of the lower Miocene species than could either of the others.

CONUS DEMIURGUS Dall

Pl. 1, figs. 3-5

Conus demiurgus DALL, 1896, U. S. Natl. Mus., Proc., v. 18, p. 43; 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, pl. 60, fig. 22.

Conus demiurgus Dall. GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 358, pl. 43, fig. 1.

Diagnosis: "Shell large, elongate, with a large, somewhat bulbous nucleus, and about 10 subsequent whorls; spire low, in the young nearly flat, with a distinct but not channeled suture; shoulder of the whorl angular, the space between the sutures flattish or feebly excavated, sculptured with obvious lines of growth, crossed by few faint, obsolete spiral traces; sides of the whorl smooth, except for obsolete spiral lines, rather wide and irregularly spaced; in the anterior third they are stronger, but even there not very marked; some specimens seem to indicate a faded color pattern of continuous, narrow spiral lines, rather evenly and uniformly spaced; aperture narrow, of equal width or nearly so; the anal notch moderately deep, the pillar straight, with a narrow callous part not showing any ridge or plait." (Dall, 1896)

Dimensions of holotype: height 65.0 mm, diameter 35.0 mm.

Holotype: USNM 113920.

Type locality: USGS 2213, one mile below Bailey's Ferry, Chipola River, Calhoun County, Florida (=TU 457).

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 3, USNM 220095; height 52.5 mm, diameter 27.9 mm; locality TU 825. Fig. 4, USNM 22096; height 7.0 mm, diameter 3.2 mm; locality TU 825. Fig. 5, USNM 220097; height 41.4 mm, diameter 22.5 mm; locality TU 548. Other occurrences: TU locality nos. 457, 458, 459, 546, 547, 554, 555, 817a, 818, 819, 820b, 821, 822, 824, 826, 827, 830, 950, 951, 998, 999, 1050, 1052.

Discussion: The most outstanding characteristic of *C. demiurgus* is its bulbous nucleus tipped with an erect, pointed calcarella, more reminiscent of the family Volutidae than Conidae. This feature is observed on only the very young (see pl. 1, fig. 4) and is abraded long before reaching adulthood with only a round knob-like nucleus of about two whorls remaining.

C. demiurgus is well represented throughout the Chipola Formation, but it is not considered to be abundant at any one locality. About 25% of the 450 specimens examined were taken from Ten Mile Creek localities, the remainder evenly divided

between the Chipola River and Farley Creek. Regardless of locality this species shows only a minor degree of variability. Many of those taken from certain river localities (TU 459 in particular) retain traces of their original color pattern. This species fluoresces well and shows a brilliant pattern with the aid of ultraviolet light (pl. 1, fig. 5).

CONUS ISOMITRATUS Dall

Pl. 1, figs. 6, 7

Conus isomitratus DALL, 1896, U. S. Natl. Mus., Proc., v. 18, p. 43; 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, pl. 60, fig. 26.

Conus isomitratus Dall. GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 358, pl. 43, fig. 2.

Diagnosis: "Shell small, solid, short, stout, with a rather low spire of 8 or 9 whorls beside the nucleus; a single elevated thread runs at the shoulder, on which the suture is laid; between the sutures, which are deep and distinct, the whorl is convex, turgid, with only incremental lines; in front of the shoulder the sides are slightly swollen, the posterior half obsoletely spirally striate or smooth, anteriorly with distinct spiral threads and equal interspaces crossed by conspicuous lines of growth; the siphonal fasciole distinct, swollen, showing as a rounded ridge; outer lip straight, thin, sharp; anal notch shallow, aperture narrow, siphonal notch deep; pillar with the edge thickened and twisted, forming in well-developed specimens with the siphonal fasciole two obscure plaits; body with little or no callus." (Dall, 1896)

Dimensions of holotype: height 28.0 mm, diameter 17.5 mm.

Holotype: USNM 113980.

Type locality: USGS 2212, one mile west of Bailey's Ferry, Ten Mile Creek, Calhoun County, Florida (=TU 546).

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 6, USNM 220098; height 31.1 mm, diameter 18.6 mm; locality TU 546. Fig. 7, USNM 220099; height 30.2 mm, diameter 20.4 mm; locality TU 546. Other occurrences: TU locality nos. 70, 196, 457, 458, 459, 547, 548, 549, 554, 555, 655, 710, 786, 787, 806, 810, 817a, 818, 819, 820b, 821, 822, 823, 824, 825, 826, 827, 828, 830, 831, 949, 950, 951, 998, 999, 1020, 1021, 1047, 1048, 1049, 1050, 1051, 1052, 1097, 1098.

Discussion: *Conus isomitratus* has the dual distinction of being not only the most abundant but also the most variable of any *Conus* species in the Chipola Formation. The writer has in her collection over 10,000 specimens of Chipola *Conus* and nearly 50% of these can be categorized as some form of

C. isomitratus. The criteria for distinguishing this species are the slender two-whorled nucleus, unornamented early teleoconch whorls, impressed sutures, and convex anal fasciole. The spire whorls of the holotype are extremely turgid and the shoulder appears rounded or "dropped" because of the cord that outlines it. The shell is stocky with little basal constriction. The spiral cords on the anterior half of the final volution are evenly spaced. Only 21.5% of the specimens of this species in the writer's collection can be classified as "typical" *C. isomitratus*. The remaining individuals display a wide degree of variation in height of spire, convexity and sometimes lineation of spire whorls, outline and ornamentation of final whorl. It is probable that these variants are the result of hybridization between *C. isomitratus* and *C. sulculus* as they show features of both species. This subject is discussed further under *C. sulculus*.

Dall (1896) stated: "The young of this species have 9 or 10 deep grooves, with narrower interspaces, covering a little more than the anterior half of the shell. These grooves during growth become gradually modified to the adult sculpture." A paratype, USNM 113984, is an example of Dall's "young of the species." Examination of this paratype revealed that the identification was in error. In many instances the ornamentation of the final whorl of a cone will alter as the shell becomes adult, intercalary threads may be added or the existing cords become stronger and more crowded. However, bands and grooves do not change to cords nor do cords change to bands and grooves. The sutures of Dall's paratype are closely adpressed and the spire whorls are carinate and concave. His specimen bears no relationship to *C. isomitratus* but is actually an adult specimen of a somewhat common cone, *C. aneuretos* n. sp. described and figured in the present paper.

CONUS SULCULUS Dall

Pl. 1, figs. 8-10

Conus isomitratus var. *sulculus* DALL, 1896, U. S. Natl. Mus., Proc., v. 18, p. 43; 1903, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, pl. 60, fig. 27.

Conus sulculus Dall. GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 359, pl. 43, fig. 3.
Not *Conus sulculus* Dall. PERRILLIAT MONTTOYA, 1963, Paleontologia Mexicana, no. 14, p. 28, pl. 6, figs. 11, 12.

Conus cf. *C. sulculus* Dall. WOODRING, 1970, U. S. Geol. Surv. Prof. Paper 306-D, p. 349.

Diagnosis: "Shell resembling the type [of *C. isomitratus*] except that the sutural border or shoulder of the shell is flattened or excavated with a few or numerous spiral grooves upon its surface. It is also larger." (Dall, 1896)

Adult shell large, flat spired, consisting of ten teleoconch whorls plus two and one-half nuclear whorls. Sutures adpressed. Spire whorls flat to concave, sculptured with three to five spiral threads. Spiral lineation appearing on fourth or fifth whorl beginning with one thread in front of suture, rapidly increasing in number. Growth lines moderately arcuate. Outer lip nearly straight; anal notch moderately deep; anal fasciole concave. Shoulder subacute; final whorl with a slight bulge at posterior third, tapering rapidly to base. Anterior third of shell with numerous, close-set sinuous threads, alternating in size. Heavier threads may be pustulated in juvenile specimens.

Dimensions of holotype: height 39.0 mm, diameter 22.0 mm.

Holotype: USNM 113924.

Type locality: USGS 2212, one mile west of Bailey's Ferry, Ten Mile Creek, Calhoun County, Florida (=TU 546).

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 8, USNM 220100; height 47.5 mm, diameter 28.0 mm; locality TU 458. Fig. 9, USNM 220101; height 26.6 mm, diameter 14.0 mm; locality TU 951. Fig. 10, USNM 220102; height 42.9 mm, diameter 24.0 mm; locality TU 998. Other occurrences; TU locality nos. 70, 196, 456, 457, 459, 546, 547, 548, 549, 550, 553, 554, 555, 655, 708, 709, 711, 786, 787, 810, 817a, 818, 820b, 821, 824, 825, 827, 828, 830, 831, 949, 950, 999, 1021, 1047, 1050, 1051, 1052, 1097, 1098.

Discussion: *C. sulculus* was considered by Dall to be a subspecies of *C. isomitratus*. He stated: "The transition from a concave to a turgid sutural border, from smooth to spirally grooved, is quite gradual, though the extremes have a very different aspect, and would, by some writers, be put in different sections of the genus." Gardner (1937) chose to give it full specific rating, commenting, "*Conus sulculus* Dall is most certainly near of kin to *C. isomitratus* Dall, but it is so readily separable by reason of its larger size, more attenuated anterior portion, and sulcated shoulder and is connected with *C.*

isomitratus by so few intermediate forms that it seems worth while to give it specific rank." Examination by the writer of nearly 5,000 specimens showed that *C. sulculus* is distinct from *C. isomitratus*. The identifying features, such as the nucleus, early whorls, sutures and anal fasciole are considerably different in the two species. However, the apparent cross-breeding of *C. isomitratus* and *C. sulculus* resulted in numerous and varied intermediate forms. These possess morphological characteristics of both species to a greater or lesser degree and the only criterion that can be used for separation is the suture, adpressed in *C. sulculus*, impressed in *C. isomitratus*. Any attempt to further divide the in-between forms would result in cluttering the literature with a multitude of names.

The basic color pattern of interrupted close-set spiral lines, shown by aid of ultraviolet light, is evident on both *C. sulculus* and *C. isomitratus* (see pl. 1, fig. 10 and pl. 1, fig. 7). *C. sulculus* s. s. has three distinct bands of large blotches and *C. isomitratus* s. s. has an evenly distributed pattern of small markings. The hybrid forms, if more nearly like *C. isomitratus*, may have one medial band, while others that are more similar to *C. sulculus* may have two bands. The color pattern alone can not be used as a means of identification. Many of the larger and better preserved *C. sulculus* show no pattern whatsoever, others show spiral lines only. This does not necessarily signify that in life the color was lost as the shell matured, as for example is true with *C. fergusonii* Sowerby, a Recent species of the Eastern Pacific. A more plausible explanation may be that the larger sized *C. sulculus* possess a thicker than normal final coating of enamel that partially retards the penetration of ultraviolet light. Fossil *Cypraea*, *Oliva* and *Marginella* have distinctive patterns but they cannot be revealed with ultraviolet light until the outer layer of enamel is removed.

Perrilliat Montoya (1963) reported *C. sulculus* from the Agueguexquite Formation of Mexico. Her figured specimen portrays a cone with beaded early spire whorls, a feature not found in *C. sulculus*.

CONUS ANEURETOS

S. E. Hoerle, n. sp.

Pl. 2, figs. 1, 2

Diagnosis: Shell broad for the height; medium high spire; last whorl rapidly tapering with slight basal constriction. Slender protoconch of three whorls, eight teleoconch whorls in adult specimens. Spire outline slightly concave; shoulders sharply keeled; sutures closely adpressed. Summits of early spire whorls flat, later ones concave; close-set moderately arcuate growth lines. Anterior half of last whorl ornamented with eight broad, flat, spiral bands, decreasing in width anteriorly, bands separated by incrementally striated grooves. Outer lip moderately arched, anterior portion crenated in harmony with basal sculpture. Siphonal fasciole slightly bulging.

Dimensions of holotype: height 17.5 mm, diameter 10.1 mm.

Holotype: USNM 220103.

Type locality: TU 825, Farley Creek at abandoned mill about ¼ mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 1, USNM 220103 (holotype). Fig. 2, USNM 220104; height 17.6 mm, diameter 10.7 mm; locality TU 546. Other occurrences: TU locality nos. 458, 548, 554, 818, 819, 820b, 821, 822, 823, 824, 826, 827, 828, 830, 951, 998, 999.

Discussion: This new species is distinguished by its small size, slender, three-whorled nucleus, closely adpressed sutures, unornamented, concave spire whorls and keeled shoulder. The basal sculpture shows no change at any period of growth, although a few pustules may be scattered along the broad bands that encircle the final whorl. However, this is the exception not the rule.

C. aneuretos is remarkably constant in outline from the juvenile to the adult stage. Many species show a change in the height of the spire, usually lowering with growth, and

PLATE I

Figures	Page
1,2. <i>Conus chipolanus</i> Dall (X2)	6
1. USNM 220093; height 29.1 mm (decollate), diameter 12.8 mm. Locality: TU 546, Ten Mile Creek.	
2. USNM 220094; height 33.3 mm, diameter 14.1 mm. Locality: TU 458, Chipola River.	
3-5. <i>Conus demiurgus</i> Dall	7
3. (X1½) USNM 220095; height 52.5 mm, diameter 27.9 mm. Locality: TU 825, Farley Creek.	
4. (X10) USNM 220096; height 7.0 mm, diameter 3.2 mm. Locality: TU 825, Farley Creek.	
5. (X1½) USNM 220097; height 41.4 mm, diameter 22.5 mm. Locality: TU 548, Chipola River.	
6,7. <i>Conus isomitratu</i> s Dall (X2)	8
6. USNM 220098; height 31.1 mm, diameter 18.6 mm. Locality: TU 546, Ten Mile Creek.	
7. USNM 220099; height 30.2 mm, diameter 20.4 mm. Locality: TU 546, Ten Mile Creek.	
8-10. <i>Conus sulculus</i> Dall	8
8. (X1½) USNM 220100; height 47.5 mm, diameter 28.0 mm. Locality: TU 458, Chipola River.	
9. Young specimen showing basal pustules. (X2) USNM 220101; height 26.6 mm, diameter 14.0 mm. Locality: TU 951, Ten Mile Creek.	
10. (X1½) USNM 220102; height 42.9 mm, diameter 24.0 mm. Locality: TU 998, Ten Mile Creek.	

All specimens from the Chipola Formation, lower Miocene. Color patterns as revealed by ultraviolet light.

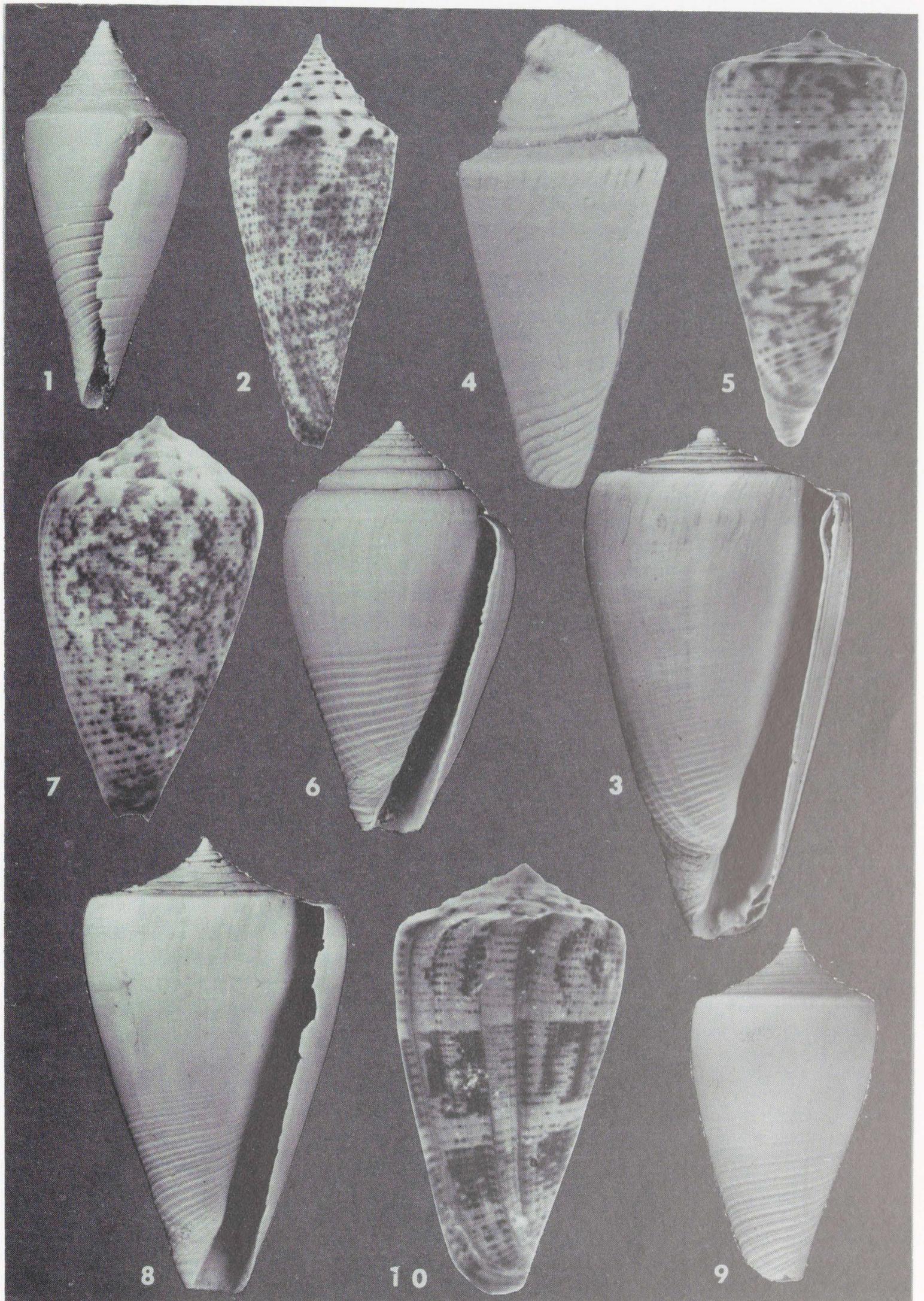


PLATE 1

oftentimes a sharp shoulder on a juvenile becomes a rounded shoulder on an adult. These expected outline changes, and lack of them in some species, have added to the confusion of identification in numerous occasions. Possibly this explains Dall's selection of *C. aneuretos* as a paratype and juvenile example of *C. isomitratatus*. The Greek word *aneuretos*, meaning "undiscovered," is selected for this species as the taxa so aptly describes the fate of this *Conus* since 1896. (See final paragraph of discussion under *C. isomitratatus*.)

Of the nearly 500 specimens in the writer's collection 70% were collected from Farley Creek, 28% from localities on Ten Mile Creek, and the remaining 2% from the Chipola River.

The color pattern of *C. aneuretos* (pl. 2, fig. 2) is unique to the Chipola cones. The other species of this formation have a basic similarity, close-set, interrupted spiral lines overlain with a definite design. This new species shows only solid spiral stripes, with no overlay of design.

CONUS GARDNERAE

S. E. Hoerle, *nom. nov.*

Pl. 2, fig. 3

Conus corrugatus GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 360, pl. 43, fig. 9.
Non Conus corrugatus Sowerby, 1870, Proc. Zool. Soc., London, p. 257, pl. 22, fig. 7.

Diagnosis: "Shell rather small, biconic, the sharply angulated periphery of the body forming the base of each cone. Spire rather high, approximately one-third the altitude of the entire shell. Whorls ten or more, including the 3 or 4 turns of the protoconch. Nuclear turns small, polished, laterally compressed, and very gradually increasing in size; line of differentiation between conch and protoconch marked by the abrupt initiation of the angulated shoulder and the incremental sculpture. Whorls of conch increasing in size with a moderate degree of rapidity, the sides of the spire serrated by the projecting peripheries of the successive volution. Shoulder behind the periphery conspicuously flattened as a rule, a broad spiral fillet being thus formed, which is persistent in some individuals almost to the nucleus. Sculpture of the spire restricted to arcuate incremental striations that mark the former presence of the posterior siphonal notch and restricted, in those individuals that are conspicuously flattened upon the front part of the shoulder, to the area between the fillet and posterior suture. Sutures distinct, even a little impress-

ed. Body whorl sculptured with 12 or more low, broad spiral bands and in front of these upon the anterior canal 4 to 6 crowded lirae; interspirals linear in most individuals and finely striated by the incrementals. Aperture more than half the altitude of the entire shell, rather narrow, with subparallel margins. Outer lip thin, sharp, deeply indented upon the shoulder for the protrusion of the posterior siphon. Inner lip oblique, parietal wall smooth. Anterior canal slightly flaring, obliquely truncate." (Gardner, 1937)

Dimensions of holotype: height 15.5 mm, diameter 7.9 mm.

Holotype: USNM 349864.

Type locality: USGS 2646, Oak Grove, west bank of Yellow River, Okaloosa County, Florida (=TU 91).

Occurrence: Chipola Formation and Oak Grove Sand, Florida; late lower Miocene.

Figured specimen: USNM 220105; height 13.8 mm, diameter 6.8 mm; locality TU 546. Other occurrences: TU locality nos. 457, 458, 459, 547, 554, 555, 655, 817a, 820b, 821, 825, 830, 831, 951, 998, 999.

Discussion: The specific name *C. corrugatus* of Gardner is preoccupied by that of the Recent species, *C. corrugatus* Sowerby, 1870 (Proc. Zool. Soc., p. 257, pl. 22, fig. 7. Habitat unknown. Type in British Museum.). The new name *C. gardnerae* is here proposed for this species.

Gardner (1937) noted that the species "has a meager distribution in the Chipola, but in the Oak Grove sand it is abundant and widely distributed." Of the 110 specimens in the writer's collection, 85% were taken from Ten Mile Creek; however, the species is also represented at Chipola River and Farley Creek localities.

C. gardnerae can be readily distinguished from *C. chipolanus* by its stouter outline, smaller size, and lack of the curved-rib stage that is noted on *C. chipolanus*. Pustules have been observed on a few specimens. They are positioned medially along the broad spiral bands whereas those on *C. chipolanus* are smaller and placed on the adapical edge of the bands.

Although the size and outline of *C. gardnerae* are nearly in agreement with those of the Recent Caribbean *C. jaspideus* Gmelin the nuclei and details of the spire whorls are totally different. The nucleus of the Recent species has fewer whorls and the summits of the spire whorls do not have the flattened area seen on *C. gardnerae*.

CONUS AMBONOS

S. E. Hoerle, n. sp.

Pl. 2, fig. 4

Diagnosis: Shell thin; moderately low spire; attenuated basally. Adult specimens consisting of eight teleoconch whorls plus three slender nuclear whorls; sides of first three post-nuclear whorls axially costate. Summits of spire whorls concave, marked by strong, moderately arcuate growth lines; shoulders elevated, forming a ridge; sutures adpressed. Anal fasciole concave; outer lip slightly arched. Aperture uniformly narrow. Anterior third of last whorl ornamented with twelve to fifteen unequal-sized and unevenly-spaced flattened cords.

Dimensions of holotype: height 34.6 mm, diameter 18.2 mm.

Holotype: USNM 220106.

Type locality: TU 546, Ten Mile Creek, about 1½ miles west of Chipola River (NW ¼ Sec. 12, T1N, R10W), Calhoun County, Florida (?=USGS 2212, "one mile west of Bailey's Ferry").

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimen: USNM 220106 (holotype).

Other occurrences: TU locality nos. 547, 554, 830, 950, 951, 998.

Discussion: *C. ambonos* is an uncommon species in the Chipola Formation and has a limited geographic range. With the exception of three juveniles taken from river localities, all of the specimens were collected along Ten Mile Creek. The shell is delicate and extremely fragile, consequently, the final whorl is always damaged.

The elevated, rimmed shoulder and concave summits of the spire whorls are similar to those of a more massive shell, *C. dodona* Gardner, from the Oak Grove Sand (see pl. 4, fig. 8). However, the early post-nuclear whorls of *C. dodona* show no axial costae, a characteristic feature of *C. ambonos*. Also, the Oak Grove species has a more excavated anal fasciole and is not as attenuated and constricted basally.

This species derives its name from the Greed word *ambonos* meaning "rim" or "ridge".

CONUS TRAJECTIONIS Maury

Pl. 2, figs. 5, 6

Conus trajectionis MAURY, 1910, *Bulls. Amer. Paleontology*, v. 4, no. 21, p. 5, pl. 1, fig. 6.

Conus trajectionis MAURY, GARDNER, 1937, *U. S. Geol. Surv. Prof. Paper* 142-F, p. 359.

Conus trajectionis MAURY, JUNG, 1965, *Bulls. Amer. Paleontology*, v. 49, no. 233, p. 576, pl. 78, figs. 3, 4.

Diagnosis: "Shell of medium size, elongately pyriform, with an elevated and very acute spire not convex in profile; whorls 11, of which the first 2 nuclear are smooth, the 5 following show a coronation under the lens, while the remainder have only a spiral ornamentation. Spiral sculpture of 3 or 4 strong threads on each volution of the spire. The spirals are absent on the last whorl below the shoulder but are strongly developed near the base of the shell. Lines of growth inconspicuous." (Maury, 1910)

Shell slender, pyriform, attenuated anteriorly. Three and one-half tapering nuclear whorls plus ten teleoconch whorls in adult specimens, first four and one-half coarsely noded, nodes decreasing in size and number with each succeeding turn. Sutures distinct, lightly adpressed. Summits of whorls flat, with spiral lineation; growth lines inconspicuous, slightly opisthocyrt. Anal fasciole flat; anal notch shallow; lip nearly straight. Posterior two-thirds of last whorl with obsolete spiral threads, becoming more pronounced and roughened by growth lines on anterior third.

Dimensions of holotype: height 52.0 mm, diameter 27.7 mm.

Holotype: PRI 3429.

Type locality: "Bailey's Ferry, Florida." TU locality 459, east bank of Chipola River, above Farley Creek (SW ¼ Sec. 20, T1N, R9W), Calhoun County, Florida (here designated).

Occurrence: Chipola Formation, Florida; late lower Miocene. Unnamed formation, Paraguaná Peninsula, Venezuela; late lower Miocene.

Figured specimens: Fig. 5, USNM 220107; height 41.0 mm, diameter 22.0 mm; locality TU 951. Fig. 6, USNM 220108; height 10.6mm, diameter 5.3 mm; locality TU 951. Other occurrences: TU locality nos. 70, 459, 546, 548, 830.

Discussion: Maury had only one specimen from which she described and figured her species *C. trajectionis*. Gardner (1937) stated: "Nothing specifically identical with Miss Maury's *trajectionis* is included in our collections" and suggested that it had much in common with *C. sulculus*. The writer disagrees with this contention. A detailed description, based on the study of 25 specimens, is given above to more clearly define the points of dissimilarity between *C. trajectionis* and *C. sulculus*.

The mere fact of the post-embryonic whorls being noded is sufficient criterion to differentiate this species from *C. sulculus*. In the juvenile stage *C. trajectionis* could possibly be confused with *C. cracens* n. sp., reported in the present paper, but upon examination of the summits of the spire whorls (*C. cracens*, summits concave with strong arcuate growth lines; *C. trajectionis*,

summits flat with inconspicuous growth lines), the two species may be readily distinguished.

Jung (1965) reported the finding of two specimens of *C. trajectionis* from the Paraguaná Peninsula, Venezuela. These are deposited at the Natural History Museum, Basel, Switzerland. The writer has not seen these specimens but Jung's description and figures coincide with the species. It is not unknown for the same species to occur in both the Chipola Formation and the Paraguaná Peninsula of Venezuela. Other examples are *Potamides suprasulcatus* (Gabb), *Aturia curvilineata* Miller and Thompson and *Murexiella (Subpterynotus) textilis* (Gabb). In a recent paper on the microfauna of the Cantaure Formation, Diaz de Gamero (1974) indicates the age to be Burdigalian (Zones N7 and N8 of Bolli), in which case the two formations are exact equivalents in age.

Maury designated "Bailey's Ferry, Florida" as the type locality for *C. trajectionis* but there is no Chipola Formation at that site. Undoubtedly her specimen was obtained further downstream where there are numerous exposures of the marl. Only two of the 25 specimens studied for this paper were from Chipola River localities (TU

459, Drez coll., and TU 548, Tulane University coll.). TU 459 is here designated as the type locality for *Conus trajectionis*. The remaining 23 specimens came from localities along Ten Mile Creek, twelve of these were from TU 951.

No color pattern appears under ultraviolet light on any of the specimens. Either they were a solid color, devoid of pattern, or conditions were such that they were unable to retain a pattern.

CONUS CRACENS

S. E. Hoerle, n. sp.

Pl. 3, figs. 1-3

Diagnosis: Shell large, thin, tapering, low spire and angulated shoulder. Adult specimens consisting of ten teleoconch whorls, plus three slender, nuclear whorls. Tubercles and spiral threading beginning simultaneously on first post-nuclear whorl, tubercles continuing for about seven whorls, spiral lineation constant and moderately strong. Close-set arcuate growth lines cutting, at times roughening, the spiral lineation. Sutures distinct, lightly adpressed. Anal fasciole concave; anal notch deep; outer lip arched forward. Widely spaced incised lines encircling medial portion of last whorl, ornament gradually changing to crowded, wavy, unevenly-spaced, flattened cords around base. Aperture narrow with a slight flare anteriorly; no siphonal notch.

Dimensions of holotype: height 37.8 mm, diameter 20.0 mm.

PLATE 2

Figures	Page
1,2. <i>Conus aneuretos</i> S. E. Hoerle, n. sp.	10
1. (X4) USNM 220103 (holotype); height 17.5 mm, diameter 10.1 mm. Locality: TU 825, Farley Creek.	
2. (X3) USNM 220104; height 17.6 mm, diameter 10.7 mm. Locality: TU 546, Ten Mile Creek.	
3. <i>Conus gardnerae</i> S. E. Hoerle, <i>nom. nov.</i> (X4)	12
USNM 220105; height 13.8 mm, diameter 6.8 mm. Locality: TU 546, Ten Mile Creek.	
4. <i>Conus ambonos</i> S. E. Hoerle, n. sp. (X2)	13
USNM 220106 (holotype); height 34.6 mm, diameter 18.2 mm. Locality: TU 546, Ten Mile Creek.	
5,6. <i>Conus trajectionis</i> Maury	13
5. (X2) USNM 220107; height 41.0 mm, diameter 22.0 mm. Locality: TU 951, Ten Mile Creek.	
6. (X10) USNM 220108; height 10.6 mm, diameter 5.3 mm. Locality: TU 951, Ten Mile Creek.	

All specimens from the Chipola Formation, lower Miocene. Color patterns as revealed by ultraviolet light.

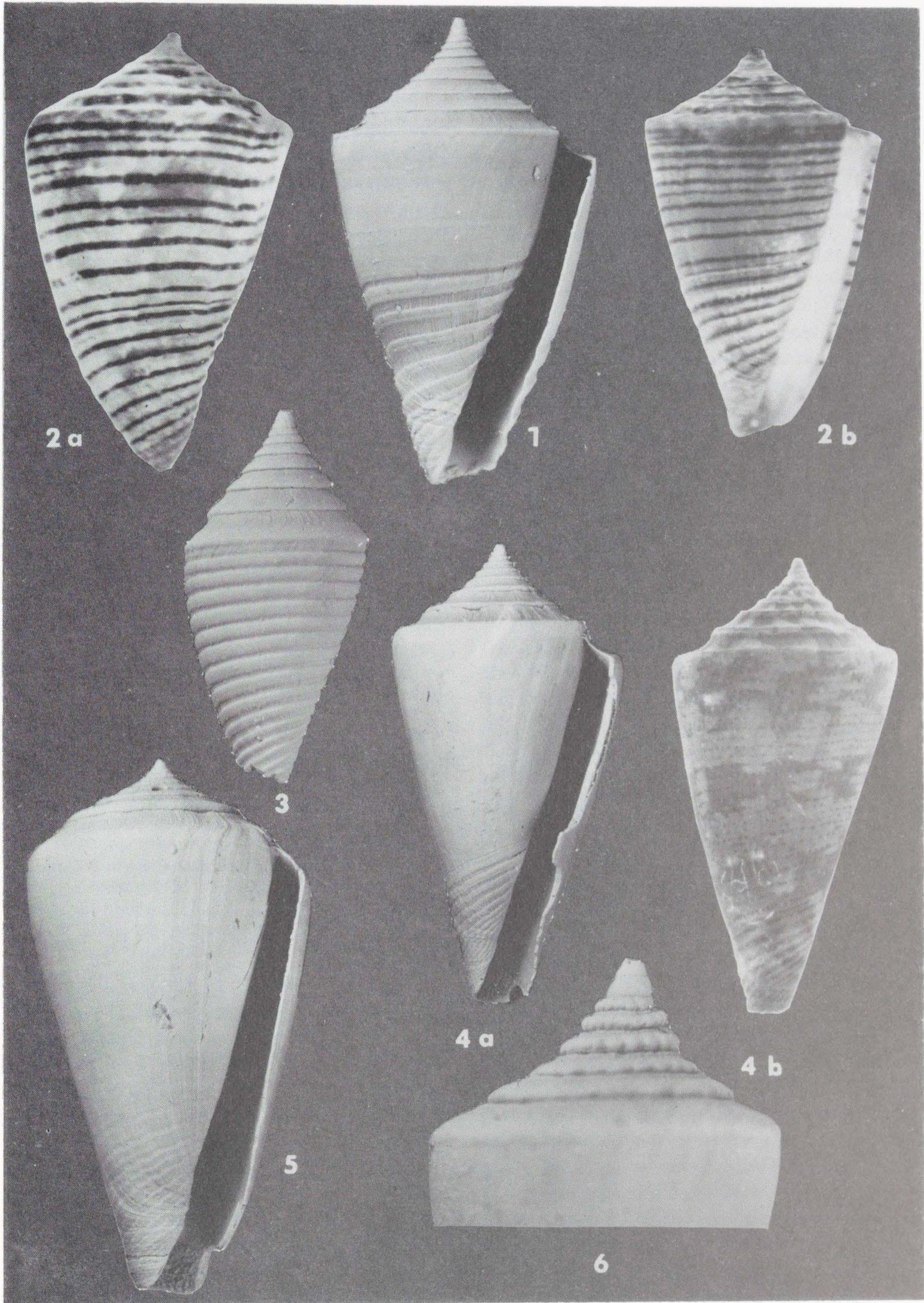


PLATE 2

Holotype: USNM 220109.

Type locality: TU 655, Ten Mile Creek, about 0.1 mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 29, T1N, R9W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 1, USNM 220109 (holotype). Fig. 3, USNM 220111; height 19.4 mm, diameter 10.5 mm; locality TU 546. Fig. 2, USNM 220110; height 52.1 mm, diameter 28.3 mm; locality TU 830. Other occurrences: TU locality nos. 70, 196, 456, 457, 459, 554, 787, 817a, 820b, 825, 826, 951, 999, 1050, 1098.

Discussion: *C. cracens*, although not common at any one locality, is well represented throughout the Chipola Formation and attains a greater size (60 to 70 mm) than other members of the group. One specimen in the Tulane University collection (TU 458) measures 87.8 mm in height and 52.5 mm in diameter. In this gerontic stage the rim disappears and the shoulder becomes rounded, the base is less constricted and the entire appearance is one of massiveness.

C. cracens appears to be a descendant of the widespread (Alabama, Mississippi, Texas) middle Eocene to Oligocene species, *C. sauridens* Conrad. The development of the early post-nuclear whorls is identical in the two species, as is also true of the anal fasciole, the forward arch of the outer lip and the rimmed shoulder. Although the two species have a number of characteristics in common, there are consistent differences, justifying the new specific name for the Chipola form. The nodes on the spire whorls persist for a greater number of turns on *C. cracens*, also it is larger, more slender, with stronger and more opisthocyrt growth lines and more pronounced basal ornament.

C. stenostoma Sowerby reported from the (?) middle Miocene of Santo Domingo and Costa Rica and the (?) upper Miocene of Bowden, Jamaica and Springvale, Trinidad, possibly is derived from the Chipola species *C. cracens*. The affinity is shown by the three-whorled nucleus, the tuberculation of the first three to five post-nuclear whorls, the spiral lineation, the concave fasciole, the rimmed shoulders and arched outer lip. However, the sutures of *C. stenostoma* are more closely adpressed and the shell is consistently more attenuated anteriorly with

less crowded basal ornament. Under ultraviolet light this species displays a different collar pattern (broken spiral lines plus two solid spiral bands) in contrast to only broken spiral lines observed on *C. cracens*.

Cracens, Latin for "slender," "graceful," was selected as an appropriate description of this species.

CONUS TAPETUS

S. E. Hoerle, n. sp.

Pl. 3, figs. 4, 5

Diagnosis: Shell nearly straight-sided, low spired, early whorls elevated. Adult specimens with nine teleoconch whorls plus one and three-quarters smooth, broadly rounded nuclear whorls. First three or four post-protoconch whorls with beaded shoulders, remainder smooth. Sutures lightly adpressed, bounded in front by a cord. Summits of spire whorls flat, ornamented with spiral threads; growth lines faint, close-set, arcuate. Anal fasciole flat; shoulder subacute; outer lip nearly straight in front of deep anal notch. Columella straight with a slight thickening at base; scarcely discernible siphonal fasciole. Spiral sculpture on last whorl confined to anterior third of the shell, consisting of eight to twelve unequal and inequidistant flattened cords, heavier on their adapical edge.

Dimensions of holotype: height 31.6 mm, diameter 17.4 mm.

Holotype: USNM 220112.

Type locality: TU 547, west bank of Chipola River, about 2000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 4, USNM 220112 (holotype). Fig. 5, USNM 220113; height 8.6 mm, diameter 4.6 mm; locality TU 825. Other occurrences: TU locality nos. 457, 458, 459, 548, 554, 555, 818, 819, 820b, 821, 822, 823, 824, 826, 827, 828, 999, 1020, 1048, 1050.

Discussion: After *C. isomitratu*s this new species is the most common of the cones collected by the writer along the Chipola River. The greatest numbers were taken from two coral reef localities, TU 547 (190 specimens) and TU 555 (62 specimens). *C. tapetus* is extremely rare at "one mile below Bailey's Ferry" (TU 457) and does not occur at "one mile west of Bailey's Ferry" (TU 546). As these were the only two localities available to early workers, it is understandable why this distinctive species is totally absent from the older collections.

C. tapetus bears a greater similarity to *C. erugatus* n. sp. than to any other species

from the Chipola Formation. Both have beaded early whorls and a nearly straight-sided outline of the final volution. *C. tapetus* can easily be separated from its congener by the adpressed suture, spiral lineation, and larger size. Adults of *C. tapetus* average 30 to 35 mm whereas those of *C. erugatus* seldom reach 25 mm. This species demonstrates the unreliability of employing basal ornamentation as a diagnostic feature for means of identification. The cords, confined to the anterior third (sometimes to the anterior fifth only) of the shell, may be flattened, rounded, coarse or fine, all within the species.

Those specimens from the river localities TU 547 (type locality) and TU 555 fluoresce exceedingly well (pl. 3, fig. 4b), showing a pattern remarkably like a piece of finely woven tapestry. The Latin word *tapetus*, meaning "tapestry" is descriptive of the species.

CONUS ERUGATUS

S. E. Hoerle, n. sp.

Pl. 3, figs. 6, 7

Diagnosis: Adult shell of eight and one-half teleoconch whorls plus one and one-half well-rounded nuclear whorls. First three or four post-nuclear whorls beaded on shoulders, remainder smooth. Spire low except for the much elevated early whorls. Sutures impressed but not channeled. Spire whorls without spiral lineation, or with a single, faint thread midway between suture and shoulder. Slightly arcuate growth lines, not distinct. Shoulder subacute; last whorl nearly flat-sided; anal fasciole flat; anal notch shallow; outer lip nearly straight. Eight to ten coarse spiral cords encircling anterior fifth of shell, cords becoming crowded abapically. Columella straight; anterior canal obliquely truncate.

Dimensions of holotype: height 21.4 mm, diameter 12.0 mm.

Holotype: USNM 220114.

Type locality: TU 825, Farley Creek at abandoned mill about ¼ mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 6, USNM 220114 (holotype). Fig. 7, USNM 220115; height 23.0 mm, diameter 13.2 mm; locality TU 999. Other occurrences: TU locality nos. 457, 458, 459, 547, 554, 818, 819, 820b, 821, 823, 824, 826, 827, 828, 949, 950, 1020, 1049.

Discussion: *C. erugatus* has a similar outline to *C. tapetus* and both have beaded early whorls. The significant characteristics that differentiate the two species are the impressed sutures and shallow anal notch of *C. erugatus* as opposed to the adpressed sutures and deep anal notch of *C. tapetus*.

The majority of the 274 specimens of *C. erugatus* in the writer's collection were taken from the banks of Farley Creek, the remainder were collected from river localities. This is in exact reversal to the distribution of *C. tapetus*. Neither species has been found to occur on Ten Mile Creek.

Both *C. erugatus* and *C. tapetus* have a basic color pattern of broken spiral lines, but the predominant pattern is consistently different in the two species (see pl. 3, figs. 7b, and 4b).

CONUS AQUOREUS

S. E. Hoerle, n. sp.

Pl. 4, fig. 1

Diagnosis: Shell elongate, straight-sided, low to flat spire. Slender erect nucleus of one and three-quarters turns, nine teleoconch whorls; sutures lightly adpressed; summits of whorls flat to slightly concave, ornamented by weak spiral lineation and crowded, strong, shallowly arcuate growth lines; shoulder acute. Anal fasciole flat to slightly concave; outer lip straight. Irregularly spaced spiral threads confined to abapical fifth of final whorl.

Dimensions of holotype: height 33.5 mm, diameter 19.1 mm.

Holotype: USNM 220116.

Type locality: TU 554, east bank of Chippla River at power line crossing (SW ¼ Sec. 17, T1N, R9W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured Specimen: USNM 220116 (holotype). Other occurrences: TU locality nos. 457, 458, 459, 547, 830, 950, 1050.

Discussion: The distribution of the 250 examined specimens of *C. aquoreus* is confined solely to Chipola River localities, with the exception of two individuals from TU 830. It is a common species at both the type locality, TU 554, and TU 457 ("one mile below Bailey's Ferry"). The reasons for this restricted range are not known; however, it should be noted that other species of the Chipola Formation share the same confines of distribution. One typical example is the muricid *Chicoreus lepidotus* (Vokes).

C. aquoreus can be recognized by its elongate, straight-sided outline, nearly flat spire and erect nucleus of one and three-quarters whorls. The spire whorls are usually ornamented with faint spiral threading although a few individuals show no lineation.

Treatment with sodium hypochlorite solution has failed to produce any fluorescent qualities in specimens of this species. Perhaps the shells were a solid color devoid of pattern in life, as is the Recent Panamic species, *C. patricius* Hinds. The smooth surface of this species is suggestive of the Latin word *aquoreus*.

CONUS VEGRANDIS

S. E. Hoerle, n. sp.

Pl. 4, figs. 2, 3

Diagnosis: Shell small; slender; spire moderately high, flat-sided to slightly concave in outline. Adult specimens consisting of seven teleoconch whorls plus two rounded nuclear whorls. Sutures distinct, lightly adpressed. First three post-nuclear whorls elevated, exposing axially costate ornamentation in front of carinate shoulders. Early spire whorls flat on summits, later whorls barely convex. Growth lines faint, close-set, shallowly opisthocyrt. Microscopic spiral threading present. Shoulder of final whorl outlined by small cord. There is a scarcely

perceptible widening of the last whorl at the adapical third. Anal notch shallow; lip nearly straight; aperture narrow posteriorly, widening anteriorly and crenated in harmony with basal sculpture. Abapical third of last whorl ornamented with ten, heavy, rounded cords, separated by narrower, unequal interspaces.

Dimensions of holotype: height 15.1 mm, diameter 8.5 mm.

Holotype: USNM 220117.

Type locality: TU 546, Ten Mile Creek, about 1½ miles west of Chipola River (NW ¼ Sec. 12, T1N, R10W), Calhoun County, Florida (?=USGS 2212, "one mile west of Bailey's Ferry").

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 2, USNM 220117 (holotype). Fig. 3, USNM 220118; height 9.1 mm, diameter 4.8 mm; locality TU 546. Other occurrences: TU locality nos. 196, 457, 458, 459, 554, 655, 710, 830, 950, 951, 998, 1050, 1098.

Discussion: *C. vegrandis* bears a resemblance to *C. tricoratus* n. sp. in the similar outline, adpressed sutures and axially costate early whorls. Both species have seven teleoconch whorls in the adult stage, however, *C. vegrandis* is consistently slightly larger. The dissimilarities are the two nuclear whorls and convex anal fasciole of *C. vegrandis* as opposed to three nuclear whorls and flat anal fasciole of *C. tricoratus*. The latter

PLATE 3

Figures	Page
1-3. <i>Conus cracens</i> S. E. Hoerle, n. sp.	14
1. (X2) USNM 220109 (holotype); height 37.8 mm, diameter 20.0 mm. Locality: TU 655, Ten Mile Creek.	
2. (X1¼) USNM 220110; height 52.1 mm, diameter 28.3 mm. Locality: TU 830, Ten Mile Creek.	
3. (X8) USNM 220111; height 19.4 mm, diameter 10.5 mm. Locality: TU 546, Ten Mile Creek.	
4,5. <i>Conus tapetus</i> S. E. Hoerle, n. sp.	16
4. (X2) USNM 220112 (holotype); height 31.6 mm, diameter 17.4 mm. Locality: TU 547, Chipola River.	
5. (X10) USNM 220113; height 8.6 mm, diameter 4.6 mm. Locality: TU 825, Farley Creek.	
6,7. <i>Conus erugatus</i> S. E. Hoerle, n. sp. (X2)	17
6. USNM 220114 (holotype); height 21.4 mm, diameter 12.0 mm. Locality: TU 825, Farley Creek.	
7. USNM 220115; height 23.0 mm, diameter 13.2 mm. Locality: TU 999, Farley Creek.	

All specimens from Chipola Formation, lower Miocene. Color patterns as revealed by ultraviolet light.



PLATE 3

species has a narrow smooth band in front of the suture. This band is absent on *C. vegrandis*.

Of the over 350 specimens of this small (*vegrandis*, Latin for "little") species collected by the writer 75% were taken from Ten Mile Creek, 25% from Chipola River localities and none were found along Farley Creek.

CONUS PRAECIPUUS

S. E. Hoerle, n. sp.

Pl. 4, fig. 4

Diagnosis: Shell slender, spire high, shoulder rounded; nucleus unknown, nine teleoconch whorls remaining. Spire whorls flat to concave, ornamented with three or four spiral threads; shoulders heavily tuberculate, tubercles absent on final turn; sutures closely adpressed, undulating with the tubercles; anal fasciole narrow and concave; anal notch deep; outer lip arched forward. Sculpture of last whorl consisting of narrow spiral cords, nearly obsolete adapically, stronger abapically.

Dimensions of holotype: height 38.0 mm, diameter 18.7 mm.

Holotype: USNM 220119.

Type locality: TU 546, Ten Mile Creek, about 1½ miles west of Chipola River (NW ¼ Sec. 12, T1N, R10W), Calhoun County, Florida (?=USGS 2212, "one mile west of Bailey's Ferry").

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimen: USNM 220119 (holotype). Other occurrences: TU locality nos. 459, 951.

Discussion: *C. praecipuus*, an exceedingly rare species, is known from only three specimens, the holotype, a badly eroded paratype measuring 49.0 mm (incomplete) in the writer's collection, and one juvenile paratype, 28.8 mm in height, in the collection of Paul Drez, Chapel Hill, North Carolina. The latter specimen is in somewhat better condition than the other two, but the spiral sculpture on the final whorl is barely discernible. Whether this ornamentation increases with the maturity of the shell or is but a variable feature cannot be stated with any degree of certainty at this time. Additional specimens are needed to clarify this detail. Morphological characteristics such as the heavy tubercles, narrow, concave fasciole, deeply arcuate growth lines and prosocyrte labrum, are common to the three specimens examined.

C. praecipuus possibly is ancestral to *C. consobrinus* Sowerby, commonly found in (?) Miocene localities of Santo Domingo, Panamá, Mexico, and Jamaica, as there is a marked resemblance in the two species. *C. consobrinus* is not known from southeastern United States. The high spire with heavy tubercles on the whorls, low rounded shoulder, attenuated and strongly sculptured final whorl all tend to make *C. consobrinus* a distinctive species. *C. praecipuus* is not as elongate, nor is the final volution as strongly ornamented; however, the similarity between the two species is apparent.

No species similar to *C. consobrinus* has been reported from beds earlier than (?) upper Miocene. Because of the age differentiation and minor diagnostic features, the writer deems it more judicious at this time to give full taxonomic recognition to the Chipola form.

CONUS TRICORATUS

S. E. Hoerle, n. sp.

Pl. 4, fig. 5

Diagnosis: Shell small, anteriorly attenuated, consisting of three slender nuclear whorls and seven teleoconch whorls. Spire high, outline concave; first four post-nuclear whorls elevated, axially costate in front of carinate shoulders; narrow smooth band in front of adpressed sutures; summits of whorls flat, microscopically striate; growth lines feeble and shallow; labrum moderately prosocyrte. Obsolete, widely-spaced spiral cords on adapical two-thirds of final whorl, ten rounded cords, crowded anteriorly, on abapical one-third.

Dimensions of holotype: height 13.3 mm, diameter 6.7 mm.

Holotype: USNM 220120.

Type locality: TU 951, Ten Mile Creek, about 1½ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimen: USNM 220120 (holotype). Other occurrences: TU locality nos. 457, 458, 546, 655, 817a, 830, 998, 1097.

Discussion: *C. tricoratus* is the smallest of the Chipola cones, seldom reaching 15.0 mm in height. It could be easily confused with the young of *C. sulculus*, as the outline is similar. However, the resemblance is only coincidental as this new species has a three whorled nucleus and axial ribbing on the early teleoconch whorls. A seven whorled

young *C. sulculus* will be about twice the height of an adult (seven whorls) *C. tricoloratus*.

About 100 individuals of this species have been collected and, with the exception of three specimens, all were taken from Ten Mile Creek localities.

CONUS RAPUNCULUS

S. E. Hoerle, n. sp.

Pl. 4, figs. 6, 7

Diagnosis: Shell of medium size, broadly fusiform; eight teleoconch whorls plus three and one-half nuclear whorls in adult specimens. First three post-orthoconch whorls axially costate in front of carinate shoulders. Sutures distinct and adpressed; growth lines deeply arcuate. Spiral sculpture restricted to anterior half of last whorl, consisting of broad bands and narrow, incrementally ornamented grooves; bands becoming narrower and crowded on siphonal fasciole. Base constricted; columella with a sharp twist to the left and bent slightly backwards. Anal fasciole flat; anal notch deep; outer lip moderately prosocyrte.

Dimensions of holotype: height 22.5 mm (incomplete), diameter 13.0 mm.

Holotype: USNM 220121.

Type locality: TU 951, Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 6, USNM 220121 (holotype). Fig. 7, USNM 220122; height 19.5 mm, diameter 9.8 mm; locality TU 830. Other occurrences: TU locality nos. 196, 457, 459, 546, 655, 710, 998, 1051.

Discussion: *C. rapunculus* is distinguished by its pronounced tapered outline and the sharp twist on the anterior portion of the columella. Juvenile specimens of this species do not show this latter feature to a great extent. Some large specimens of *C. chipolanus* have the canal slightly recurved but not to the degree that is seen on *C. rapunculus*. While there are minor similarities between these two species, the consistent characteristic that differentiates them is the early post-nuclear whorls. Those of *C. rapunculus* are axially costate and those of *C. chipolanus* are smooth, the only ornament being the curved-rib stage of the first one-quarter turn.

C. rapunculus is another species that occurs almost solely along Ten Mile Creek. Of the total lot of 83 specimens only three

were from Chipola River localities and none from Farley Creek. The outer lip is exceedingly fragile and consequently was broken on every individual.

The Latin word *rapunculus*, meaning "turnip," describes the outline of this new species.

CONUS DRAPERI* Maury

Conus draperi MAURY, 1910, *Bulls. Amer. Paleontology*, v. 4, no. 21, p. 5, pl. 1, fig. 4.

Conus draperi Maury. GARDNER, 1937, *U. S. Geol. Surv. Prof. Paper 142-F*, p. 363.

[?] *Conus molis* Brown and Pilsbry. GARDNER, 1937, *U. S. Geol. Surv. Prof. Paper 142-F*, p. 363.

Diagnosis: "Shell large, surpassing in size all the other species of the genus yet found in the Chipola beds. General form conic, with 8 whorls exclusive of the eroded nucleus; spire moderately elevated, not convex in profile; last whorl distinctly shouldered; surface of shell eroded in small circular spots, which may be an indication that the original color pattern consisted of small dark spots on a light ground. Transverse sculpture lacking except for faint lines near the base of the shell; lines of growth inconspicuous." (Maury, 1910)

Dimensions of holotype: height 60.0 mm, diameter 38.0 mm.

Holotype: PRI 3427.

Type locality: "Chipola marls, Bailey's Ferry, Calhoun County, Florida." [Oak Grove Sand, exact locality unknown].

Occurrence: Oak Grove Sand, Florida; (?) late lower Miocene.

Discussion: Examination of the benthonic foraminifera found in the matrix of the holotype of *C. draperi* reveals that the specimen is from the Oak Grove Sand fauna, not the "Chipola marls" as was stated by Maury (W. H. Akers, *in litt.*).

Gardner was of the opinion that the "description and figure indicate a shell rather similar to *C. demiurgus* Dall [from the Chipola Formation], but broader relatively and less angular". The writer does not concur with that view. Although the sole representative of Maury's species is in

*The specific taxon "*draperi*" appears to be a *lapsus* on the part of Maury, as she clearly stated (1910, p. 5), "Named in honor of Mrs. Henry Draper of New York City." The specific name should have the feminine ending, making it "*draperae*."

wretched condition and some of the diagnostic features are abraded it can be stated unequivocally that *C. draperi* bears no resemblance to *C. demiurgus*. A better tentative placement might be in the ancestral line leading to the Recent western Atlantic species *C. spurius* Gmelin.

A worn fragment of a large cone occurring in the Oak Grove Sand was reported by Gardner (1937, p. 363) as *C. molis* Brown and Pilsbry. The specimen is so worn as to be specifically unidentifiable but similarity of size and locality tend to indicate that it is another example of *C. draperi*.

As Gardner (1937, p. 363) noted, the perforations on the type specimen are due to the activities of a boring sponge, rather than indicative of the original color pattern as was suggested by Maury in her diagnosis of the species.

CONUS NEMORIDEDITUS Maury

Conus nemorideditus MAURY, 1910, *Bulls. Amer. Paleontology*, v. 4, no. 21, p. 5, pl. 1, fig. 5.

Conus nemorideditus Maury. GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 363.

Diagnosis: "Shell large, smooth, thin in proportion to its size; whorls eight exclusive of the eroded nucleus; spire moderately elevated, not concave in profile, last whorl of the shell full and rounded near the shoulder and tapering rapidly to a rather slender base. Spiral sculpture consisting only of rather faint raised lines on the lower one-third of the shell; lines of growth inconspicuous." (Maury, 1910)

Dimensions of holotype: height 70.0 mm, diameter 42.0mm.

Holotype: PRI 3428.

Type locality: "Oak Grove, Florida." (?=TU 91).

Occurrence: Oak Grove Sand, Florida; (?) late lower Miocene.

Discussion: The type of *C. nemorideditus* remains unique. Gardner (1937, p. 363) stated: "This species does not appear in later collections" and no similar specimens have been recovered by subsequent collectors. This is not surprising when we consider the fact that *Conus* is not a common genus in the Oak Grove Sand fauna. The holotype of *C. nemorideditus* is poorly preserved and

PLATE 4

Figures	Page
1. <i>Conus aquoreus</i> S. E. Hoerle, n. sp. (X2)	17
USNM 220116 (holotype); height 33.5 mm, diameter 19.1 mm.	
Locality: TU 554, Chipola River.	
2,3. <i>Conus vegrandis</i> S. E. Hoerle, n. sp.	18
2. (X4) USNM 220117 (holotype); height 15.1 mm, diameter 8.5 mm.	
Locality: TU 546, Ten Mile Creek.	
3. (X10) USNM 220118; height 9.1 mm, diameter 4.8 mm.	
Locality: TU 546, Ten Mile Creek.	
4. <i>Conus praecipuus</i> S. E. Hoerle, n. sp. (X2)	20
USNM 220119 (holotype); height 38.0 mm, diameter 19.7 mm.	
Locality: TU 546, Ten Mile Creek.	
5. <i>Conus tricoratus</i> S. E. Hoerle, n. sp. (X4)	20
USNM 220120 (holotype); height 13.3 mm, diameter 6.7 mm.	
Locality: TU 951, Ten Mile Creek.	
6,7. <i>Conus rapunculus</i> S. E. Hoerle, n. sp. (X3)	21
6. USNM 220121 (holotype); height 22.5 mm (incomplete), diameter 13.0 mm.	
Locality: TU 951, Ten Mile Creek.	
7. USNM 220122; height 19.5 mm, diameter 9.8 mm.	
Locality: TU 830, Ten Mile Creek.	
8. <i>Conus dodona</i> Gardner (X1½)	24
USNM 349858 (holotype); height 33.8 mm, diameter 19.0 mm.	
Locality: USGS 2646. Oak Grove Sand, (?) late lower Miocene.	

All specimens except as noted from Chipola Formation, lower Miocene. Color patterns as revealed by ultraviolet light.



PLATE 4

nothing would be accomplished by re-figuring the specimen. Maury's figures of both *C. nemorideditus* and *C. draperi* were drawings, not photographs, therefore a certain amount of "artistic license" was involved.

CONUS DODONA Gardner
Pl. 4, fig. 8

Conus dodona GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 359, pl. 43, fig. 4.

Diagnosis: "Shell rather large and heavy. Spire not more than one-fifth of the entire altitude in the adult forms. Whorls approximately 9, including the 2 or 3 nuclear coils, which are small, of nearly the same size, and laterally compressed and form a sharp and prominent little knob in the center of the low spire. Earlier whorls of conch flattened upon the shoulder; later whorls concave, the sutures very closely appressed and the peripheral margin slightly elevated. Incremental sculpture well developed in the concave area between the periphery and the suture. Spiral sculpture restricted to a dozen or more unequal and inequipped, irregular oblique spirals upon the anterior third of the body. Aperture of average width. Outer lip thin, sharp, deeply emarginate at the shoulder. Inner lip smooth, reinforced at the anterior canal. Anterior canal wide, flaring slightly, obliquely truncated." (Gardner, 1937)

Dimensions of holotype: height 33.8 mm, diameter 19.0 mm.

Holotype: USNM 349858.

Type locality: USGS 2646, Oak Grove, Yellow River, Okaloosa County, Florida.

Occurrence: Oak Grove Sand, Florida; (?) late lower Miocene.

Figured specimen: USNM 349858 (holotype).

Discussion: There is a marked similarity in appearance between *C. dodona* and *C. ambonos* n. sp. from the Chipola Formation, as both species have a concave anal fasciole and rimmed shoulder. However, the Oak Grove species is a much heavier shell with a less constricted base and more excavated anal fasciole. The significant characteristic that differentiates *C. dodona* from *C. ambonos* is the absence of any ornamentation on the early post-nuclear whorls in contrast with the axial costae seen on the Chipola species. Another dissimilarity noted is the color patterns of the two shells as shown under ultraviolet light (see pl. 2, fig. 4b, and pl. 4, fig. 8b).

Gardner (1937, p. 360) reported this cone as "abundant at certain localities" [all

of various USGS locality numbers cited by Gardner designated the same locality, "Oak Grove, Yellow River, Okaloosa County, Florida"] but the holotype and 18 paratypes were the only representatives of the species that could be located in the U. S. National Museum. None have been obtained by subsequent collecting. The largest paratype (from USGS 7054) measured 43.8 mm in height, thereby indicating that *C. dodona* does not attain the size of either *C. draperi* or *C. nemorideditus*, two other species from the Oak Grove Sand.

CONUS DREZI
S. E. Hoerle, n. sp.
Pl. 5, fig. 1

Diagnosis: Spire moderately high, flat-sided in outline; shoulder acute; base constricted. Nucleus unknown, nine teleoconch whorls remaining. Sides of first three post-nuclear whorls with coarse axial costae, costae less strong on later whorls, entirely absent by seventh whorl. Summits of early whorls flat, later ones slightly concave. Whorls ornamented with strong, moderately opisthocyrt growth lines and spiral striae, striae confined to adapical half of whorl summits, thus forming a broad, smooth, flat rim on each shoulder. Sutures distinct, lightly adpressed; outer lip with a moderate forward arch; anal fasciole concave. Basal sculpture consisting of twelve flat spiral bands separated by narrower, deep, incrementally ornamented interspaces, the six adapical bands medially grooved, the remainder crowded. Columella straight.

Dimensions of holotype: height 30.0 mm (incomplete), diameter 16.3 mm.

Holotype: USNM 220123.

Type locality: TU 69A, first ravine upstream from Shell Bluff, Shoal River (NW ¼ Sec. 4, T3N, R21W), about 3½ miles north of Mossyhead, Walton County, Florida.

Occurrence: Shoal River Formation, Florida; middle Miocene.

Figured specimen: USNM 220123 (holotype).

Discussion: *C. drezi*, based on a single specimen, is unlike any other *Conus* species in the Alum Bluff Group. The flat band bordering the shoulders of the spire whorls is the most outstanding diagnostic feature. This characteristic has not been seen by the writer on any other specimens, fossil or Recent. An unnamed species in the middle Pliocene Pinecrest beds of south Florida (see Akers, 1974, p. 119) and the Recent Caribbean *C. stimpsoni* Dall have similar early whorls and concave anal fascioles but both lack the shoulder band.

The color pattern, seen with the aid of ultraviolet light, (pl. 5, fig. 1c) differs from that of any of the species figured in the present paper. It is more suggestive of the pattern sometimes noted on the above mentioned Recent species.

C. drezi is named in honor of its collector, Paul Drez of Chapel Hill, North Carolina, who has a talent for locating unusual specimens.

CONUS VITIUS

S. E. Hoerle, *nom. nov.*

Pl. 5, fig. 2

Conus fusiformis GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 361, pl. 43, fig. 10. *Non Conus fusiformis* G. Fischer, 1807, Mus. Demidoff, v. 3, p. 144; *nec Conus fusiformis* Lamarck, 1810, Ann. Mus. Hist. Nat. (Paris), v. 15, p. 423, (= *C. attractus* Tomlin, 1937); *nec Conus fusiformis* Pease, 1861, Proc. Zool. Soc. London (1860), p. 398.

Diagnosis: "Shell small for the genus, slender, fusiform in outline. Spire elevated, scalariform, between one-third and one-half the height of the entire shell. Whorls 9 to 9½, including the 3 or 3½ small, smooth, laterally compressed protoconchial turns. First whorl of conch axially costate, the peripheral keel developing only toward the close of the turn. Later whorls of spire strongly angulated at the periphery, which falls a little less than two-thirds the distance from the posterior to the anterior suture. Incremental sculpture vigorous near the posterior suture, especially in the early whorls, becoming more feeble toward the periphery and absent altogether in front of it. Sutures distinct, even a little impressed. Shoulder of body whorl sharply angulated, outlined by the posterior of 20 prominent, subequal rounded spirals separated by interspaces of slightly greater width upon the earlier portion of the whorl but becoming more and more narrow toward the anterior canal, where they are reduced to linear dimensions. Incrementals well developed in the interspiral sulci. Aperture very narrow but little more than half the total height. Outer lip broken; the posterior siphonal notch as revealed by the growth lines only moderately deep. Inner lip smooth, straight. Anterior canal narrow, obliquely truncate. The type, which is unique, had suffered injury, but the animal has been able to make effective repairs upon its shell." (Gardner, 1937)

Dimensions of holotype: height 13.8 mm, diameter 5.4 mm.

Holotype: USNM 349870.

Type locality: USGS 5633, Yellow River below Oak Grove Bridge, Okaloosa County, Florida (=TU 91).

Occurrence: Oak Grove Sand, Florida; (?) late lower Miocene.

Figured specimen: USNM 220124; height 11.9 mm, diameter 4.4 mm; locality TU 91.

Discussion: Gardner's specific name *C. fusiformis* is preoccupied three times: G. Fischer, 1807; Lamarck, 1810; and Pease, 1861: therefore a new name, *C. vitius*, is here proposed.

The holotype of *C. vitius* remains unique except for one specimen of this small species found in the Tulane University collections. It too has suffered injury and has been repaired. Because of the badly broken lip (*vitius*, Latin for "fault") a dorsal view is shown (pl. 5, fig. 2). Gardner so adequately described her species that no further comment is required.

CONUS SUBMONILIFERUS Gardner

Pl. 5, fig. 3

Conus submoniliferus GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 363, pl. 43, fig. 10.

Diagnosis: "Shell rather large, moderately heavy. Spire low, a little less than one-sixth of the total altitude. Whorls apparently 10 exclusive of the protoconch, which is broken away, the first 5 whorls converging at an angle of approximately 70°, the last 5 at an angle of about 125°; whorls shouldered, those of the earlier turns oblique, and those of the later not far from horizontal. Suture line deeply impressed, following the periphery of the preceding turn except on the later volutions, where it drops forward a little to reveal the slightly elevated peripheral margin. Spire sculptured with somewhat irregular spiral lirations, 3 on the shoulder of each whorl. Incremental sculpture strong enough to crenulate the spiral minutely. Body whorl feebly inflated in front of the shoulder, so that the maximum diameter does not coincide, as in the majority of the cones, with the outer margin of the shoulder; sculptured on its medial portion, with 7 faint moniliform spirals that grow fainter and, with the exception of the anterior 2 or 3, evanesce before reaching the labrum. Simple, irregular, spiral lirae developed between the 3 or 4 anterior beaded spirals and in front of them, becoming more regular and more crowded toward the anterior extremity. Labrum broken away, probably thin and deeply emarginate at the shoulder. Labium simple, smooth, reinforced at the anterior canal. Canal short, somewhat flaring, truncate." (Gardner, 1937)

Dimensions of holotype: height 40.0± mm, diameter 25.5 mm.

Holotype: USNM 351132.

Type locality: USGS 3732, Dave Adams Mill Creek, Sec. 2, T3N, R21W, Walton County, Florida.

Occurrence: Shoal River Formation, Florida; middle Miocene.

Figured specimen: USNM 351132 (holotype).

Discussion: Gardner (1937, p. 363) stated, "*C. submoniliferus* suggests a *C. sulculus* [from the Chipola Formation] that has been influenced by the prolific and co-existent *C. waltonensis* Aldrich to the extent of developing a faint copy of the *C. waltonensis* sculpture." The writer agrees that *C. submoniliferus* bears a slight resemblance to *C. sulculus* but disagrees with Gardner's contention that *C. submoniliferus* might be the result of hybridization between *C. sulculus* and *C. waltonensis*. As the type of this species is unique perhaps if more specimens were available they would demonstrate the unreliability of placing credence in the presence or absence of basal pustules for definitive separation of species. Although the protoconch is missing the early post-nuclear whorls have a "mammilate" appearance, whereas those of *C. sulculus* indicate a more slender nucleus. The suture of *C. submoniliferus* is deeply impressed in contrast to that of *C. sulculus*, which has an adpressed suture. Another notable difference

is the color pattern shown under ultraviolet light (compare pl. 1, fig. 10, and pl. 5, fig. 3c).

CONUS WALTONENSIS Aldrich
Pl. 5, figs. 4-8

Conus waltonensis ALDRICH, 1903, Nautilus, v. 16, no. 11, p. 131, 2 text figs.

Conus waltonensis Aldrich. GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 362, pl. 43, figs. 13, 14.

Conus waltonensis anodosus GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 362, pl. 43, fig. 15.

Diagnosis: "Shell medium in size, substance rather thin; spire elevated, with 9 whorls including the apex, which is rather sharp; profile of spire slightly broken by a shoulder just above the suture on each whorl, the sutures impressed, each whorl of the spire concave, and marked by numerous curved lines; periphery sharp; body whorl below the keel in some specimens over one-half smooth, then below this bearing two or three spirals of evenly spaced nodules without any grooves between, gradually changing to rows of nodules on bands between grooves, which are 8 or 10 in number, the nodules fading away as the canal is reached, but in the type specimen the nodules are present over the whole of the smooth part, without, however, any grooves between. Anal notch rather deep and marking the spire with its

PLATE 5

Figures	Page
1. <i>Conus drezi</i> S. E. Hoerle, n. sp. (X2)	24
USNM 220123 (holotype); height 30.0 mm (incomplete), diameter 16.3 mm.	
Locality: TU 69A. Shoal River Fm., middle Miocene.	
2. <i>Conus vitius</i> S. E. Hoerle, <i>nom. nov.</i> (X4)	25
USNM 220124; height 11.9 mm, diameter 4.4 mm.	
Locality: TU 91. Oak Grove Sand, (?) late lower Miocene.	
3. <i>Conus submoniliferus</i> Gardner (X1½)	25
USNM 351132 (holotype); height 40.0± mm, diameter 25.5 mm.	
Locality: USGS 3732. Shoal River Fm., middle Miocene.	
4-8. <i>Conus waltonensis</i> Aldrich	26
4. (X8) USNM 220155; height 14.2 mm, diameter 8.0 mm.	
5. (X2) USNM 220126; height 21.4 mm, diameter 12.3 mm.	
6. (X2) USNM 220127; height 19.0 mm, diameter 10.8 mm.	
7. (X2) USNM 220128; height 14.3 mm, diameter 8.2 mm.	
Nos. 5, 6 and 7 show variations in development of pustules.	
8. (X2) USNM 220129; height 20.5 mm, diameter 12.2 mm.	
Locality: All specimens, TU 69A. Shoal River Fm., middle Miocene.	
9. <i>Conus infulatus</i> S. E. Hoerle, <i>nom. nov.</i> (X2)	28
USNM 371397 (holotype- <i>C. turbinopsis</i> Gardner); height 20.0 mm, diameter 12.0 mm.	
Locality: USGS 3856. Shoal River Fm., middle Miocene.	

Color patterns as revealed by ultraviolet light.



PLATE 5

former positions; outer lip thin, pillar straight with a very slight twist; aperture straight above, widening near the base." (Aldrich, 1903)

Dimensions of holotype: height 20.0 mm, diameter 12.0 mm.

Holotype: Unknown. Two topotypes: USNM 371398.

Type locality: "Shoal Creek", Walton County, Florida. TU locality 69, Shell Bluff, Shoal River, 5 to 6 miles on dirt road north of Mossyhead, U. S. Highway 90 (NW ¼ Sec. 4, T3N, R21W), Walton County, Florida (here designated).

Occurrence: Shoal River Formation, Florida; middle Miocene.

Figured specimens: Fig. 7, USNM 220128; height 14.3 mm, diameter 8.2 mm. Fig. 6, USNM 220127; height 19.0 mm, diameter 10.8 mm. Fig. 5, USNM 220126; height 21.4 mm, diameter 12.3 mm. Fig. 4, USNM 220125; height 14.2 mm, diameter 8.0 mm. Fig. 8, USNM 220129; height 20.5 mm, diameter 12.2 mm; locality for all specimens TU 69A. Other occurrences: TU locality nos. 69, 91.

Discussion: *C. waltonensis*, a most prolific species, is confined to the Shoal River Formation. The only variability expressed by this species is in the extent of development of pustules on the final whorl (see pl. 5, figs. 5-7). The diagnostic features, such as a three and one-half whorled nucleus, impressed sutures, concave anal fasciole, shallow anal notch and nearly straight outer lip, remain constant throughout the species.

Gardner (1937, p. 362) created a subspecies of *C. waltonensis*, *C. w. anodosus*, stating: "The subspecies differs most radically from *C. waltonensis* s. s. in the nondevelopment of spiral rows of pustules upon the body whorl." The development or nondevelopment of pustules on the final whorl is not a major morphological characteristic. Taxonomic distinction should not be based on such a variable feature; therefore, *C. w. anodosus* is placed in synonymy with *C. waltonensis*.

The axial zig-zag color pattern shown under ultraviolet light is unusual (pl. 5, fig. 8), closely resembling that seen on some specimens of the Recent Panamic species, *C. princeps* Linné. However, there is not the remotest relationship between the two species, again demonstrating the fallacy of basing specific determination on color pattern only.

CONUS INFULATUS

S. E. Hoerle, *nom. nov.*

Pl. 5, fig. 9

Conus turbinopsis GARDNER, 1937, U. S. Geol. Surv. Prof. Paper 142-F, p. 361, pl. 43, fig. 12.
Non Conus turbinopsis Deshayes, 1865, Descr. Anim. sans Vert. Bassin Paris, v. 3, p. 425, pl. 100, figs. 10, 11.

Not *Conus turbinopsis* Gardner. PERRILLIAT MONTROYA, 1960, Paleontologia Mexicana, no. 8, p. 27, pl. 4, figs. 3, 4 [= *C. multiliratus* Böse].

Diagnosis: "Shell of medium size, moderately heavy, rather stout, suggesting in outline a rather slender, elongated top. Spire between one-fourth and one-third the height of the entire shell, the sides uniformly converging at an angle of about 90° until the nucleus is reached, when the slope becomes abruptly much more steep. Suture line running directly in front of the periphery of the preceding whorl, thus making a barely perceptible break in the uniformity of the slope. Whorls 10 or more, including the 1 or 2 small, smooth, laterally compressed protoconchal volutions and an axially costate turn. Periphery developed on the succeeding whorl acute, that of the whorls of the spire barely visible behind the suture line. External sculpture of spire restricted to vigorous incrementals, which mark the successive margins of the posterior siphonal notch. Suture lines distinct but inconspicuous. Body whorl sculptured in front of the periphery with 20 to 25 spiral fillets separated by squarely channeled sulci of rarely more than half the width of the fillets; spirals uniform for the most part in size and spacing but slightly narrower near the periphery and, at the anterior canal, appearing as crowded linear lirations; interspiral sulci finely striated by the incrementals. Shell rather conspicuously constricted and attenuated near the base of the body. Aperture rather narrow, the margins subparallel. Outer lip probably thin but broken in all specimens collected. Posterior siphonal notch moderately deep. Anterior canal narrow, feebly marginate." (Gardner, 1937)

Dimensions of holotype: height 20.0 mm, diameter 12.0 mm.

Holotype: USNM 371397.

Type locality: USGS 3856, five to six miles west-northwest of Mossyhead, Walton County, Florida (=TU 69).

Occurrence: Shoal River Formation, Florida; middle Miocene.

Figured specimen: USNM 371397 (holotype).

Discussion: *C. turbinopsis* Gardner, 1937, is preoccupied by *C. turbinopsis* Deshayes, 1865, therefore a new name, *C. infulatus*, is proposed for the Shoal River species.

Perrilliat Montoya (1960, p. 27, pl. 4, figs. 3, 4) has figured a specimen of *Conus*

from the Pliocene Agueguexquite Formation of Vera Cruz, Mexico, which she referred to the Shoal River species *C. turbinopsis* Gardner. Her illustration depicts a cone with beaded early whorls and the presence of this feature is confirmed in her description. As there are no beads on the early whorls of Gardner's species, Perrilliat Montoya's shell is undoubtedly *C. multiliratus* Böse, a species that occurs abundantly throughout the Isthmian area. The two species have a similar outline and the ornamentation of the last whorl of both consists of broad bands separated by incrementally striated grooves. The first post-nuclear whorl of *C. infulatus* *nom. nov.* bears a few axial costae but the remainder of the spire whorls are plain. The two species may easily be separated by this criterion alone.

V. LOCALITY DATA

The following are Tulane University fossil localities. Except as noted all are in the Chipola Formation, Calhoun County, Florida.

69. Shoal River Fm., (type locality), Shell Bluff, Shoal River (NW ¼ Sec. 4, T3N, R21W), about 3½ miles north of Mossyhead, Walton Co., Florida.
- 69A. Shoal River Fm., first ravine upstream from Shell Bluff, Shoal River (NW ¼ Sec. 4, T3N, R21W), about 3½ miles north of Mossyhead, Walton Co., Florida.
70. Ten Mile Creek, at bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W).
91. Oak Grove Sand, (type locality), west bank of Yellow River, about 100 yards below bridge at Oak Grove, (NE ¼ Sec. 20, T5N, R23W), Okaloosa Co., Florida.
196. Ten Mile Creek, about ¼ mile upstream from bridge of Florida Highway 73 (NE ¼ Sec. 11, T1N, R10W).
456. Ten Mile Creek, about ¼ mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W).
457. West bank of Chipola River, about ½ mile below Ten Mile Creek (SW ¼ Sec. 17, T1N, R9W).
458. East bank of Chipola River, above Farley Creek (SW ¼ Sec. 20, T1N, R9W).
459. East bank of Chipola River, steep bank about 1500 feet above the mouth of Taylor Lake Branch (NW ¼ Sec. 29, T1N, R9W).
546. Ten Mile Creek, about 1½ miles west of Chipola River (NW ¼ Sec. 12, T1N, R10W).
547. West bank of Chipola River, about 2000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W).
548. West bank of Chipola River (NW ¼ Sec. 29, T1N, R9W).
549. East bank of Chipola River, about ¼ mile below Four Mile Creek (NE ¼ Sec. 32, T1N, R9W).
550. East bank of Chipola River, 1¼ mile below mouth of Ten Mile Creek (NE ¼ Sec. 20, T1N, R9W).
553. East bank of Chipola River at mouth of Farley Creek (SW ¼ Sec. 20, T1N, R9W).
554. East bank of Chipola River at power line crossing (SW ¼ Sec. 17, T1N, R9W).
555. East bank of Chipola River, about 1000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W).
655. Ten Mile Creek, about 0.1 mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W).
708. At small waterfall on tributary to Ten Mile Creek, south bank, about ¼ mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W).
709. South bank of Ten Mile Creek, about ¼ mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W).
711. West bank of Chipola River, about ¼ mile up from mouth of Farley Creek (SW ¼ Sec. 20, T1N, R9W).
786. Ten Mile Creek, about 50 yards upstream from TU 196 or about ¼ mile upstream from bridge of Florida Highway 73 (NE ¼ Sec. 11, T1N, R10W).
787. Ten Mile Creek, south bank about 1½ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W).
806. West bank of Chipola River, about one mile below power line crossing (NW ¼ Sec. 20, T1N, R10W).
810. East bank of Chipola River, opposite mouth of Taylor Branch (SW ¼ Sec. 17, T1N, R9W).
817. South side of Ten Mile Creek, large gully on the property of Mr. A. Sexton (1967) (SE ¼ Sec. 12, T1N, R10W).
818. Farley Creek, 0.1 mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W).
- 820b. Farley Creek (lower beds), at bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W).
821. Farley Creek, 0.1 mile east of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W).
822. Farley Creek, south bank, ¼ mile east of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W).
823. Farley Creek, south bank about 2000 ft. east of bridge of Florida Highway 275 (SE ¼ Sec. 21, T1N, R9W).

824. Farley Creek, about ½ mile east of bridge of Florida Highway 275 (SE ¼ Sec. 21, T1N, R9W).
825. Farley Creek at abandoned mill about ¼ mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W).
826. Farley Creek, about 0.1 mile west of abandoned mill which is ¼ mile west of bridge of Florida Highway 275 (on section line between Sec. 20 and 21, T1N, R9W).
827. Farley Creek, about ½ mile west of bridge of Florida Highway 275 (SE ¼ Sec. 20, T1N, R9W).
828. Farley Creek, just upstream from mouth of unnamed tributary about ¾ mile downstream from bridge of Florida Highway 275 (SE ¼ Sec. 20, T1N, R9W).
830. Ten Mile Creek, at power line crossing about one mile west of Chipola River (SE ¼ Sec. 12, T1N, R10W).
831. Ten Mile Creek [lowest Chipola beds exposed], slightly less than one mile west of Chipola River (SW ¼ Sec. 7, T1N, R9W).
949. Chipola River, west bank, about 0.1 mile below power line (SW ¼ Sec. 17, T1N, R9W).
950. Chipola River, west bank about 2000 ft. above Farley Creek (SW ¼ Sec. 20, T1N, R9W).
951. Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W).
998. Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W).
999. Farley Creek, about 1000 yards downstream from bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W).
1020. Small tributary (not shown on USGS topographic map) on east bank of Chipola River about ½ mile below power line crossing (NE ¼ Sec. 20, T1N, R9W).
1021. Ten Mile Creek, north bank, about 2200 ft. east of bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W).
1047. Chipola River, west bank 0.1 mile below mouth of Farley Creek (SW ¼ Sec. 20, T1N, R9W).
1048. Farley Creek, south bank, about 0.8 mile east of bridge of Florida Highway 275 (NE ¼ Sec. 21, T1N, R9W).
1049. Farley Creek, south bank, about 1.0 mile east of bridge of Florida Highway 275 (NE ¼ Sec. 21, T1N, R9W).
1050. West bank of Chipola River at power line crossing (SW ¼ Sec. 17, T1N, R9W).
1051. Ten Mile Creek, south bank just downstream from large gully on property of Mr. A. Sexton (1967) (SE ¼ Sec. 12, T1N, R10W).
1052. Ten Mile Creek, just up from large dry former creek bed cut off, north bank (SE ¼ Sec. 12, T1N, R10W).
1097. Ten Mile Creek, south bank at a new (1972) cut off meander, 500 yards west of Florida Highway 73 (SE ¼ Sec. 12, T1N, R10W).
1098. Ten Mile Creek, south bank just east of power line crossing (SE ¼ Sec. 12, T1N, R10W).

The following are U. S. Geological Survey Tertiary Fossil localities.

- USGS 2646. Oak Grove Sand, Oak Grove, Yellow River, Okaloosa County, Florida.
- USGS 3732. Shoal River Fm., Dave Adams Mill Creek (Sec. 2, T3N, R21W), Walton County, Florida.
- USGS 3856. Shoal River Fm., 6 miles west-northwest of Mossyhead, Walton County, Florida.
- USGS 5633. Oak Grove Sand, Oak Grove, Yellow River, Okaloosa County, Florida.

VI. LITERATURE CITED

- AKERS, W. H., 1974, Age of Pinecrest Beds, South Florida: *Tulane Stud. Geol. Paleont.*, v. 11, no. 2, p. 119-120, 1 text fig.
- CLENCH, W. J., 1942, The Genus *Conus* in the Western Atlantic: *Johnsonia*, v. 1, no. 6, p. 1-40, pls. 1-15.
- DALL, W. H., 1890, Contributions to the Tertiary fauna of Florida: *Wagner Free Inst. Sci., Trans.*, v. 3, pt. 1, p. 1-200, pls. 1-12.
- DALL, W. H., 1896, Diagnosis of new Tertiary Fossils from the Southern United States: *U. S. Nat. Mus., Proc.*, v. 18, no. 1035, p. 21-46.
- DALL, W. H., 1903, Contributions to the Tertiary fauna of Florida: *Wagner Free Inst. Sci., Trans.*, v. 3, pt. 6, p. i-xiv, 1219-1654, pls. 48-60, 2 tables.
- DIAZ de GAMERO, M.L., 1974, Microfauna y edad de la Formación Cantaure, Peninsula de Paraguaná, Venezuela: *Assoc. Venezolana de Geol., Min., y Petrol., Bol. Inform.*, v. 17, no. 4,5,6, p. 41-47.
- GARDNER, JULIA, 1937, The Molluscan fauna of the Alum Bluff Group of Florida, Part 6: *U. S. Geol. Surv. Prof. Paper 142-F*, p. 251-421, pls. 37-48.
- JUNG, PETER, 1965, Miocene Mollusca from the Paraguana Península, Venezuela: *Bulls. Amer. Paleontology*, v. 49, no. 223, p. 385-652, pls. 50-79, 2 tables, 2 text figs.
- MAURY, C. J., 1910, New Oligocene shells from Florida: *Bulls. Amer. Paleontology*, v. 4, no. 21, p. 119-164, pls. 18-26.
- PERRILLIAT MONTOYA, M. C., 1960, Moluscos del Mioceno de la Cuenca Salina del Istmo de Tehuantepec, Mexico: *Paleontologia Mexicana*, no. 8, 38 p., 4 pls., 2 text figs., 1 table.
- PERRILLIAT MONTOYA, M. C., 1963, Moluscos de la Formación Agueguexquite (Miocene medio) del Istmo de Tehuantepec, Mexico: *Paleontologia Mexicana*, no. 14, 45 p., 6 pls.

- SMITH, BURNETT, 1929, Young stages of *Conus adversarius* Conrad: Acad. Nat. Sci. Phila., Proc., v. 81, p. 659-663, 2 text figs.
- TOMLIN, J. R. le B., 1937, Catalogue of Recent and Fossil Cones: Malac. Soc. London, Proc., v. 22, p. 205-236 (March), p. 237-322 (July).
- VAN MOL, J. J., B. TURSCH, and M. KEMPF, 1967, Résultats Scientifiques des Campagnes de la "Calypso", fasc. 8: Masson et Cie, Editeurs, Paris, p. 233-254, pls. 1-10, 17 text figs.
- VOKES, H. E. and E. H. VOKES, 1968, Variation in the Genus *Orthaulax* (Mollusca: Gastropoda): Tulane Stud. Geol., v. 6, no. 2, p. 71-79, pls. 1-3.
- VON LINDEN, GRÄFIN MARIA, 1896, Die Entwicklung der Skulptur und der Zeichnung bei den Gehäuseschnecken des Meeres: Zeitschr. f. Wissenschaftliche Zoologie, v. 61, p. 261-317, pls. 11.

ADDENDUM

A NEW SPECIES OF *CONUS* FROM THE CHIPOLA FORMATION

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While the preceding paper was in press another species of Chipola *Conus* was brought to light by the writer's husband. Although the specimen is unique and bears a slight damage anteriorly, its morphological characteristics are so distinct from any other Chipola *Conus* the writer feels it essential to note its occurrence. The shell was collected along Ten Mile Creek, TU 951, in the basal beds of the Chipola Formation. A number of unusual and unexpected genera and species have appeared at this locality, one example being "*Ranella*" *poppelacki* Hörnes (see E. H. Vokes, 1974, p. 96).

CONUS SEXTONI S. E. Hoerle, n. sp.

Text fig. 1

Diagnosis: Shell low spired; slender; periphery about one-fourth distance in front of shoulder; tapering anteriorly with a suggestion of a slight twist to the left. Adult specimen consisting of two and one-half rounded nuclear whorls and seven teleoconch whorls. Sutures distinct, slightly impressed. Summits of early post-nuclear whorls flat, those of later whorls convex with an adaxial slope, forming a slight concavity in front of suture. Whorls ornamented by prominent, but not crowded, moderately arched growth lines. Anal notch shallow; outer lip nearly straight. Sculpture of last whorl consisting of broad, flat bands separated by narrow, incrementally striated grooves; growth lines prominent, giving the shell an axially roughened appearance.

Dimensions of holotype: height 19.0 mm (incomplete), diameter 9.2 mm.

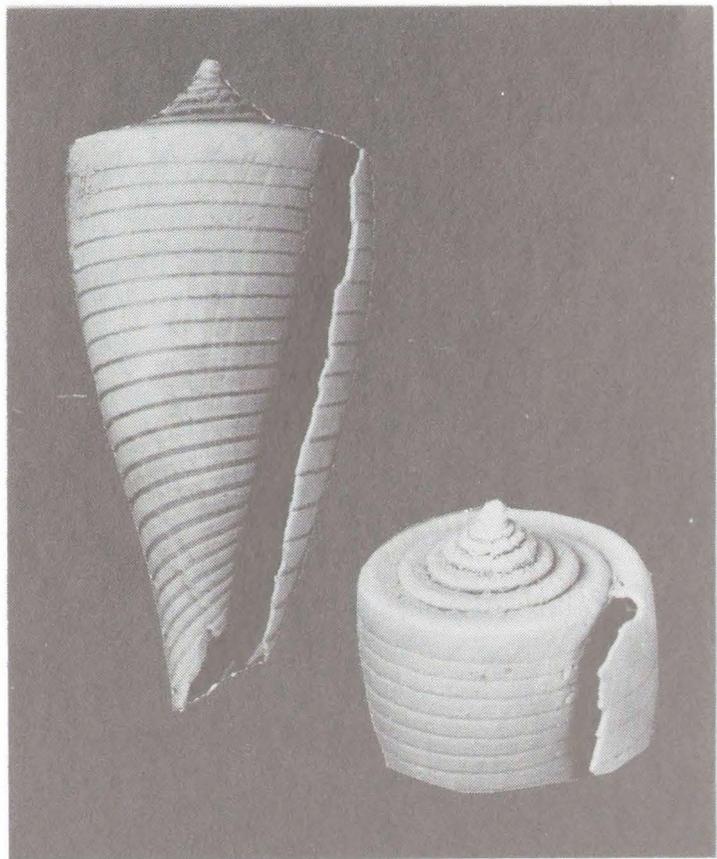
Holotype: USNM 647645.

Type locality: TU 951, Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun County, Florida.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimen: USNM 647645. (holotype).

Discussion: *C. sextoni* is represented only by the type specimen and does not appear to



Text figure 1. *Conus sextoni* S. E. Hoerle, n. sp. Holotype, USNM 647645.

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be allied to any other *Conus* species from the Chipola Formation. It cannot definitely be stated at this time if the bands and narrow grooves, completely covering the final whorl, are a constant feature of this species as, generally, the extent of ornamentation of the last whorl is a variable factor, e.g., *C. chipolanus* Dall. The two and one-half whorl nucleus, the lack of ornamentation of the early whorls and the uniquely formed summits of the spire whorls easily differentiate this species from other *Conus* of the Alum Bluff Group. The only other fossil cone to which this new species bears a resemblance, and only superficially, is *C. cruzianus* Dall, 1890, from the Pliocene limestone of the "Island of Santa Cruz, West Indies" [St. Croix, U.S. Virgin Islands]. The one feature *C. sextoni* and *C. cruzianus* have in common is a slight channel in front of the suture. The ornamentation on the last whorl of *C. cruzianus* consists of rounded, finely

striated cords, the posterior ones medially sulcated, as contrasted to the bands and grooves of *C. sextoni*.

A Recent Caribbean species, *C. granulatus* Linné, 1758, has the final whorl sculpture similar to *C. sextoni* but the spire characteristics are entirely different. Treatment failed to reveal any color pattern and so it must be assumed that in life the shell was unpatterned, unlike *C. granulatus*, which has strong shoulder markings.

This shell is named in honor of Mr. Cecil Sexton, Altha, Florida, who has generously permitted workers to collect at TU 951, which is located on his property.

LITERATURE CITED

- VOKES, E. H., 1974, Notes on the fauna of the Chipola Formation — XV. On the occurrence of "*Ranella*" *poppelacki* Hörnes, a gastropod of uncertain affinities: Tulane Stud. Geol. Paleont., v. 11, no 2, p. 96-98, text fig. 1, 2.

REVIEWS

GEOGRAPHICAL VARIATIONS IN COASTAL DEVELOPMENT, by J. L. Davies. Published by Hafner Publishing Company, New York, 1973, viii + 204 pp., 130 figs.

This is an investigation of how the morphological development of coastal areas varies from one part of the world to another which attempts to isolate the factors causing such variations. An attempt is made to recognize broad patterns in coastal processes on a global scale. The claim is made that climate is a major factor which modifies the effects of geological structure and the influence of lithology. Three broad latitudinal zones are recognized from which conceptual models of shoreline evolution can be generated, low-latitude, mid-latitude, and high-latitude. The differing characteristics of each are enumerated.

DEPOSITIONAL SEDIMENTARY ENVIRONMENTS, by Hans-Erich Reineck and Indra Bir Singh. Published by Springer-Verlag, New York, Heidelberg, and Berlin, 1973, xvi + 439 pp., 579 figs., \$41.60

This volume is intended as a compilation of the information needed to reconstruct ancient depositional environments. Though it is not a textbook on sedimentology and does not include methods of study, it is a comprehensive review of those sedimentary features considered by the authors to be significant and useful in environmental interpretation. The book is profusely illustrated. It is well and clearly written and deserves a place on the shelf of every active geologist.

--H.C.S.