

NOTES ON *CHICOREUS* (MOLLUSCA:GASTROPODA) FROM THE CENOZOIC OF THE WESTERN ATLANTIC REGION, WITH THE DESCRIPTION OF NEW SPECIESEMILY H. VOKES
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I. ABSTRACT

Three new species of fossil *Chicoreus* and two new Recent species are described from the western Atlantic region. The fossil species are: *C. elusivus*, from the late lower Miocene Chipola Formation of northwestern Florida; *C. xestos*, from the middle Pliocene Pinecrest beds of southwestern Florida; and *C. prolixus* from the Pleistocene Moín Formation of Costa Rica. The Recent species are *C. mergus* and *C. bullisi*. In addition, a form that occurs in the Recent fauna of the Gulf of Mexico, here identified as *C. dilectus* variety, becomes the first record of the genus in the early Pliocene Agueguexquite Formation of Veracruz, Mexico. The earliest

occurrence of *C. brevifrons* is noted in the middle Miocene (?) Encanto Formation of Mexico. *Chicoreus argo* is shown to be a synonym of *C. spectrum*, a Caribbean Recent species.

II. INTRODUCTION

In an earlier monograph of the gastropod genus *Chicoreus* s.s. in the western Atlantic region (Vokes, 1965) it was noted that there are but few species of *Chicoreus* in this area, in contrast to the many species found in the Indo-Pacific. At that time there was a total of 12 known species, both fossil and Recent, in the entire western Atlantic Cenozoic. Since then extensive collecting has

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continued in the fossil beds of the area, and much additional collecting of the Recent fauna has been done, primarily by the U.S. Bureau of Commercial Fisheries, under Harvey R. Bullis, Jr., until recently Base Director of the Pascagoula Laboratory. Several new species are among this material and in this paper three fossil and two Recent species of *Chicoreus* are described. However, two of the formerly accepted names, *C. spectrum* (Reeve) and *C. argo* (Clench and Perez Farfante), are herein placed in synonymy, so that the net gain is four. Another fossil species was subsequently removed to *Chicoreus (Phyllonotus)* (Vokes, 1967, p.143). Thus we may now say there are nine fossil and six Recent species, of which two are also represented in the fossil record, or a total of 15 species of *Chicoreus* s.s. in the Cenozoic of the western Atlantic.

In addition to new forms discovered, other new data on occurrences and extensions of both stratigraphical and geographical range are documented. A few errors from the 1965 paper are rectified.

III. ACKNOWLEDGMENTS

The writer wishes to express her gratitude to those persons who contributed material that made this new study possible. They are: J. Wyatt Durham and Joseph H. Peck, Jr., University of California, Berkeley; Harvey R. Bullis, Jr., National Fisheries Service; William G. Lyons, Florida Department of Natural Resources; Mr. and Mrs. Robert C. Hoerle, West Palm Beach, Florida; Mrs. Bonnie McCash, Casey, Illinois; and John Phillips, Santa Barbara, California. She would also like to thank the members of the Editorial Committee for their time and assistance in improving the manuscript.

IV. SYSTEMATIC DESCRIPTIONS

CHICOREUS (CHICOREUS) ELUSIVUS

E. H. Vokes, n. sp.

Plate 1, figs. 1-4

Chicoreus (Chicoreus) cornurectus (Guppy). E. H. VOKES, 1965, Tulane Stud. Geol., v. 3, no. 4, p. 186 (in part, Chipola references only).

Diagnosis: Protoconch small, of $3\frac{1}{2}$ smooth, conical whorls ending at a small varix, with spiral and axial ornamentation immediately well-developed. Probably eight post-nuclear whorls in a full-grown adult, seven maximum in type material. Spiral ornamentation beginnings on first post-nuclear whorl with three smooth cords, continuing to third whorl where smaller spiral threads are intercalated, one between each two major cords; on fourth whorl another set of tertiary threadlets appearing until by fifth and succeeding whorls the entire surface of the shell is covered with spiral lines of varying sizes, superimposed on spiral ridges developed from the original three spiral cords. On the body whorl five or six of these ridges, plus an additional two on the extended siphonal canal. Axial ornamentation on first post-nuclear whorl of about 12 axial lines, forming sharp nodes where they cross the spiral cords; continuing to about the third whorl where every third axial line is strengthened to form a small varix, leaving the others as intervarical nodes, two between each varical pair. By the fourth and succeeding whorls three well-developed varices present on each whorl; where the spiral ridges cross the varices long, open, foliated spines produced, with smaller spinelets where the smaller threadlets cross. On the median whorls two or three spines per varix, and on the body-whorl five or six, corresponding to the major spiral ridges, plus another two on the siphonal canal. Two varical spines at the shoulder with the posterior one the larger, then two median smaller spines, one often almost lost, and finally the two anterior-most spines nearly as large as the second shoulder spine. Two long spines on the siphonal canal, in addition to the long, recurved distal end of each succeeding canal, which gives rise to a strongly diverging spur. Aperture oval; outer lip crenulated into the open spines of the terminal varix, with several paired lirations on the inner side. Inner lip smooth, with a narrow, free-standing rim that crosses over the entrance of the siphonal canal, almost closing it. Canal covered by a thin plate extending from the columellar wall but open by a narrow slit along the varical side.

Dimensions of holotype: height 44.6 mm, diameter (excluding spines) 21.0 mm.

Holotype: USNM 647110.

Type locality: TU 547, west bank of Chipola River, about 2000 feet above Four Mile Creek (SW $\frac{1}{4}$ Sec. 29, T1N, R9W), Calhoun County, Florida.

Paratype A: USNM 647111; height 29 mm, diameter (excluding spines) 14.5 mm; locality TU 825.

Paratype B: USNM 647112; height 34.5 mm, diameter 19.0 mm; locality TU 655.

Paratype C: USNM 647113 (a fragment to show potential size); height 26.9 mm, width 43.5 mm; locality TU 950.

Occurrence: Chipola Formation, Florida; late lower Miocene.

Figured specimens: Fig. 1, USNM 647110 (holotype). Fig. 2, USNM 647111 (paratype A).

Fig. 3, USNM 647112 (paratype B). Fig. 4, USNM 647113 (paratype C). Other occurrences: TU locality nos. 70, 196, 458, 459, 546, 555, 709, 817, 820, 830, 951, 998.

Discussion: During the more than 15 years that the writer and associates have been collecting fossils from the Chipola Formation of northwestern Florida, numerous fragments of a new, markedly distinct, species of *Chicoreus* have appeared. Prior to the recent finding of the holotype by Mrs. Bonnie McCash the collections consisted of 31 juvenile or broken adults specimens and 117 identifiable fragments. The next best shells previously taken were the one figured as paratype A, from TU 825, and the somewhat atypical paratype B, from TU 655. In addition, there was one complete adult from TU 546, which has, however, a very elongate siphonal canal much like that of *C. spectrum* (Reeve). The name of this species, an arbitrary combination of letters with the connotation of being elusive, was originally bestowed upon the form during the long search for a well-preserved type specimen.

When the writer treated *Chicoreus* s.s. in 1965, she had in her possession only the paratype B and three tiny juvenile specimens from localities TU 70 and 196. Unfortunately the TU 655 specimen is not a normal example of the form or the writer would never have confused it with *C. cornurectus* (Guppy) as she did (1965,p.187).

This new species more nearly resembles the Recent *Chicoreus brevifrons* (Lamarck) than any other species, including *C. cornurectus*. From *C. brevifrons* it differs primarily in the varical spine arrangement: in *C. brevifrons* there are a pair of shoulder spines, which are much like those of *C. elusivus*. However, they are separated by a spinelet not seen in the latter; in *C. brevifrons* these are followed by three approximately equal-sized anterior spines, all smaller than the shoulder spine. *C. cornurectus* has a single shoulder spine and four smaller anterior spines.

Although there is the one elongate specimen from TU 546, mentioned above, in general the species is not as elongate as *C. spectrum*. It also differs from this Recent

species in the varical fronds: *C. spectrum* has a single large spine at the shoulder, with three smaller spines anteriorly; *C. elusivus* has one long spine at the shoulder also, but the second spine, immediately anterior to that one is almost as large as the first, then there are two smaller spines, and the two anteriormost spines are almost as large as the shoulder spine.

C. elusivus is smaller than either of these Recent species but it is larger than any other Chipola *Chicoreus*. The fragment here figured as paratype C suggests a total height of at least twice that of the holotype, or some 90 mm. The largest specimens of *C. lepidotus* (Vokes, 1963) or *C. dujardinoides* (Vokes, 1963), the other Chipola species of *Chicoreus*, are both under 60 mm. *C. cornurectus* alone is of a comparable size, with the lectotype being 89.2 mm. The shell is relatively thin, much like some of the Indo-Pacific species. Presumably it is this thinness that causes the shells of larger specimens to be broken too easily to be preserved, leaving only juveniles and fragments as representatives in the fossil record.

From the occurrence list it can be seen that the species was widespread in the Chipola Formation; however, only at TU 546 and 830 does it approach anything but extreme rarity. At TU 546 there have been ten more-or-less entire specimens and 43 fragments. For all other localities, except for the holotype, there are one or two fragments or juvenile specimens. This species is so distinctive that even the smallest piece of a varix, bearing long spines, is readily recognizable.

In addition to the Florida occurrences of this new species, in the collections of the Museum of Paleontology, University of California, Berkeley, there is a single specimen from "San Gregorio Rancho, Chiapas." This locality is stated to be lower Miocene in age and there is no question but that it is directly correlative with the Chipola Formation. Along with the specimen of *C. elusivus* there is a specimen of *Poirieria (Panamurex) laccapoia* (Gardner, 1947), another Chipola species. The precise location of this remarkable occurrence is not certain

but it probably is in the lower Grijalva River area.

CHICOREUS (CHICOREUS) BREVIFRONS
(Lamarck)

Plate 1, figs. 5, 6

Figured specimens: Fig. 5, UCMP A-8124; height 40.0 mm, diameter (incomplete) 21.5 mm; locality TU 635, (?) Encanto Formation, Oaxaca, Mexico; middle Miocene. Fig. 6, USNM 734373; height 54.0 mm, diameter (excluding spines) 25.2 mm; Puerto Rico, Recent.

Discussion: In the literature over the last 100 years both "*Murex*" *cornurectus* Guppy, 1876, and "*Murex*" *brevifrons* Lamarck, 1822, have been reported from many Caribbean fossil localities. Since 1965 some new material has been recovered and certain additions and deletions should be made to the synonymy of both of these species.

In the collections of the Museum of Paleontology, University of California, Berkeley, there is a specimen of true *C. brevifrons*, from the Isthmus of Tehuantepec, Mexico, upon which the identification made by Woodring (in Durham *et al.*, 1955, p. 984) was made. That reference, unfortunately, was overlooked in 1965, for this proves to be the

oldest known occurrence of the species. The locality (=TU 635) has been determined by Akers (1972, p. 11), on the basis of planktonic foraminifera, to be middle Miocene in age and is tentatively referred to the Encanto Formation. The Mexican specimen of *C. brevifrons* is here figured for the first time (pl. 1, fig. 5), together with a Recent example of *C. brevifrons* of about the same size (pl. 1, fig. 6) for comparison.

One reference for "*Murex (Chicoreus) calcitrapa* Lamarck" should be deleted from the synonymy of *C. brevifrons*. This is the shell listed by Gabb (1881, p. 350) from the "Pliocene Clay Beds" near Moín, Costa Rica. Collections made at that locality have shown this species to be, not *C. brevifrons*, but a new species here described as *C. prolixus*.

CHICOREUS (CHICOREUS) CORNURECTUS
(Guppy)

As shown above, specimens from the Chipola Formation of northwestern Florida, formerly identified as *C. cornurectus* (Vokes, 1965, p. 187), are referable to the new species herein named *C. elusivus*. It may well be that *C. elusivus* is the direct ancestor of *C. brevifrons*, which subsequently replaced *C. cornurectus* in the more southern reaches of

PLATE 1

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2. USNM 647111 (paratype A); height 28.5 mm, diameter (excluding spines) 15.6 mm. Locality: TU 825. Chipola Formation, late lower Miocene.	
3. USNM 647112 (paratype B); height 34.5 mm, diameter (excluding spines) 19.0 mm. Locality: TU 655. Chipola Formation, late lower Miocene.	
4. USNM 647113 (paratype C); height 26.0 mm, diameter 43.5 mm. Locality: TU 950. Chipola Formation, late lower Miocene.	
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6. USNM 734373; height 54.0 mm, diameter (excluding spines) 25.2 mm. Locality: Puerto Rico. Recent.	

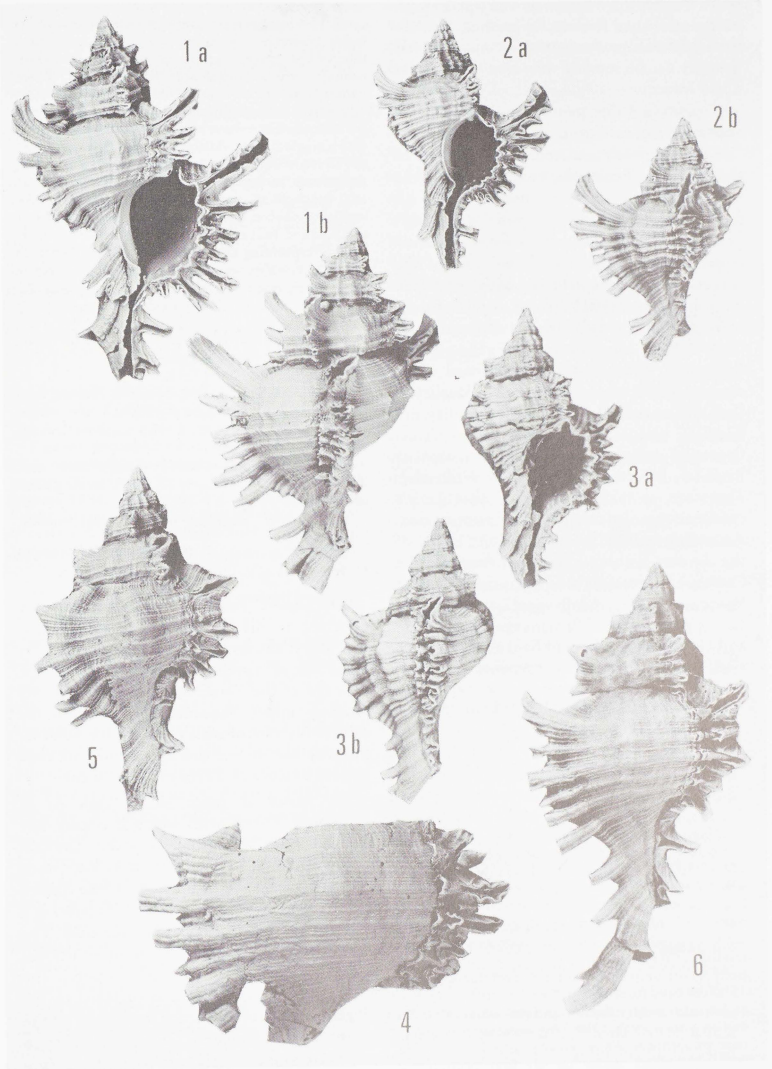


PLATE 1

the Caribbean. Students of planktonic foraminifera are finding, in general, that the beds where *C. cornurectus* occurs, formerly thought to be middle Miocene in age, are upper Miocene.

Jung (1965, p. 521) reported the appearance of two young specimens from the "middle Miocene" Cantaure Formation, of the Paraguan Peninsula, Venezuela, which he felt might be *C. brevifrons*. However, his decision was based upon Woodring's synonymizing of *C. brevifrons* and *C. cornurectus*, for he stated that one of the specimens "agrees perfectly with the figure given by Maury (1917, pl. 16, fig. 10) for *M. cornurectus* Guppy." In the University of California Museum of Paleontology Collection, there is a large specimen of *C. cornurectus* from exactly the same locality as Jung's material (Univ. of Calif. locality no. S-8360, about 300 meters south of Casa Cantaure, which is about 10 km west of Pueblo Nuevo, Paraguan Peninsula). Therefore, it may be assumed that Jung's specimens are also referable to *C. cornurectus*. According to the Second Edition (1970) of the *Lexico Estratigrafico de Venezuela* the Cantaure Formation is now considered upper Miocene in age, and is correlated with the Gatun Formation of Panama and the Cercado and Gurabo formations of Santo Domingo. In all of these beds we find *C. cornurectus*.

CHICOREUS (CHICOREUS) XESTOS

E. H. Vokes, n. sp.

Plate 2, figs. 1, 2

Diagnosis: Protoconch of 1½ whorls, tip noticeably flattened; post-nuclear whorls seven in adult. Spiral ornamentation beginning gradually with three or four small cords, increasing by intercalation to become by the fourth whorl, numerous fine spiral threads, all approximately the same size, with the three or four original cords tending to remain slightly more prominent. On the body whorl, between two of the larger threads about 15 of the finer threads; spiral ornamentation tending to become more subdued on later whorls than on earlier whorls so that the final appearance is one of near smoothness. Axial ornamentation of about 12 small, indistinct nodes on the first post-nuclear whorl, about ten on the second whorl, nine on the third and fourth whorls; by the fifth whorl every

third strengthened to form a small varix, with the other two remaining as intervarical nodes; one of the latter becoming increasingly indistinct with each intervarical space, and by about the sixth whorl usually only a single large node present. Three varices on each whorl; ornamented with six equal-sized open foliaceous spines on the body portion, tending to have a thin plate connecting them into a single flange; additional two or three spines on the siphonal canal. Suture deeply impressed causing the whorls to appear very inflated. Aperture oval, anal notch small, open, outer lip crenulated by the varical spines but not opening into them; a series of small paired lirations on the inner side of the outer lip, corresponding to the interspiral areas. Inner lip smooth, with a narrow free-standing callus. Siphonal canal short, open by a narrow slit, recurved at the distal end forming a series of divaricating spurs.

Dimensions of holotype: height 42.3 mm, diameter (excluding spines) 21.7 mm.

Holotype: USNM 647114.

Type locality: TU 1000, Sarasota, Florida, road metal pits at end of 17th Street, about 8 miles east of U.S. Highway 301 (T36S, R19E), Sarasota County, Florida.

Paratype: USNM 647115; height 30.5 mm, diameter (excluding spines) 16.5 mm; locality same as holotype.

Occurrence: Pinecrest beds, Florida; middle Pliocene.

Figured specimens: Fig. 1, USNM 647114 (holotype). Fig. 2, USNM 647115 (paratype).

Discussion: This new species is apparently confined to the Pinecrest beds at Sarasota, Florida; it has not been taken even at nearby localities of approximately equivalent age. The age of the Pinecrest has been previously cited as upper Miocene, but work on the calcareous nannofossils (Akers, this volume, p. 119) has shown the age of the Pinecrest beds to be Zone N. 20, or middle Pliocene.

C. xestos is most nearly akin to *C. floridanus* Vokes, with which it occurs, but has several distinguishing characters. The anal notch is perhaps the single most important difference; that of *C. floridanus*, like that of the younger *C. dilectus* and *C. florifer*, is a narrow, constricted, almost closed tube. The anal notch of *C. xestos* is the more normal *Chicoreus* type, broadly open. The equal-sized varical spines, as opposed to the single larger shoulder spine in all three of the above mentioned species, and the tendency to an interconnecting plate between the spines are other characters that permit the recognition of this new species. But in the

final analysis the most immediately obvious distinction is the smooth appearance of the shell: *C. floridanus*, *C. dilectus*, and *C. florifer* all are marked by strong spiral cords. It is this feature that gives the species its name *xestos*, a Greek adjective meaning polished or scraped, i.e., smooth.

The aperture of the holotype is not completely formed; hence another example with a complete outer lip is figured as paratype. This smaller specimen also shows the tendency toward the varical flange, which usually is found only in the younger individuals.

CHICOREUS (CHICOREUS) DILECTUS

(A. Adams) variety

Plate 2, figs. 3, 4

Figured specimens: Fig. 3, USNM 734874, height 39.0 mm, diameter (excluding spines) 15.5 mm; locality "Hourglass" Station E, 27 degrees 37' N, 84 degrees 13' W, 40 fathoms. Fig. 4, USNM 647116; height (incomplete) 31.5 mm, diameter 24 mm; locality TU 638, Agueguexquite Formation, Veracruz, Mexico; Pliocene.

Discussion: In the Tulane collections from the Isthmus of Tehuantepec area of Mexico over the years there have accumulated a number of fragments (more than 35) of a species of *Chicoreus* taken from two outcrop localities (TU 638, 1046) in the Agueguexquite Formation, of lower Pliocene age (see Akers, 1972, p. 28). These fragments indicate a form that is very closely related to the Recent *C. dilectus* (A. Adams, 1855) but differing in having only five varical spines instead of six. In view of the poor quality of the fossil material there was little that could be done except to record its presence as the only *Chicoreus* known from this formation.

Recently a number of specimens of an unusual form of *Chicoreus*, taken in the Gulf of Mexico by the Florida Department of Natural Resources "Hourglass" Cruises, were sent to the writer for identification. Although they resemble *C. dilectus*, no specimens of *C. dilectus* were taken at the stations where this new form appeared. The specimens are from two "Hourglass" stations, E and M, 75 miles off the west coast of Florida, between Tampa

and Fort Myers, at about 40 fathoms. They were sent by Mr. William G. Lyons, who wrote that the form "was quite common at the 40 fathom stations, with as many as six coming up in a single dredge haul."

It is apparent when one compares the Agueguexquite fragments with the "Hourglass" specimens that they are the same morphologic form. Perhaps they represent an ecologic variant for the sole (though consistent) difference from *C. dilectus* is one less varical spine.

Whether this is, in fact, a valid ecologic subspecies remains a question. The depth would not seem to be a factor, for *C. dilectus* has been taken in great numbers not very far away in only slightly shallower water. The answer may lie in bottom type. Mr. Lyons (*in litt.*) writes concerning the "Hourglass" Cruises: "Stations E and M were our two deepest stations (both 73 m); in general, stations at equivalent depths along the two transects were similar, more so than were stations separated by depth along the same transect. A well-defined break occurs between 37 m and 55 m stations along each transect. At 37 m and more inshore, bottoms were of scattered but numerous limestone outcrops, with associated loggerhead sponges, etc. and many "reef" type mollusks. Deeper, there was hardly any rock outcrop, the bottom being smoother; sediments were much finer and more "organic." *Chicoreus dilectus* was most common at 18 and 37 m stations but the "dilectus variety" occurred only at 73 m stations." Joyce and Williams (1969, p. 18) describe the stations in greater detail, noting that "operations indicated a generally smooth bottom with a few loggerhead sponges . . . The bottom is characterized by bryozoans, calcareous algae, foraminifera tests, small sponges, and alcyonarians. The substrate is composed of crushed shell, dead bryozoans, and calcareous algae particles."

It is probable that the Agueguexquite Formation was deposited in an environment not unlike this. In outcrop it is a fine gray silt, with lenses of bryozoan remains and worn, rounded fragments of a colonial coral, which is identified by Dr. John Wells, Cornell University, as *Madracis* aff. *M. mirabilis* (Duchassaing and Michelotti). In these lenses there are many mollusk shells, often tumbled

and worn, and an abundance of foraminiferal tests, both benthonic and planktonic, the most predominant species being *Amphistegina lessonii*, *Cibicides floridanus*, *Reussella atlantica*, and *Neoeponides antillarum*. Among the mollusks the most conspicuous members are large turrids of the genera *Scobinella* and *Polystira*, *P. cf. P. tellea* (Dall, 1889) being perhaps the most abundant single species of gastropod in the fauna. These and other relatively deep water forms suggest that turbidity currents may have played a part in mixing a more shallow water fauna with an indigenous deeper one.

CHICOREUS (CHICOREUS) PROLIXUS

E. H. Vokes, n. sp.

Plate 2, fig. 5

Murex (Chicoreus) calcitrata Lamarck. GABB, 1881, Acad. Nat. Sci. Phila., Jour., (Ser. 2) v. 8, no. 4, p. 350 (not of Lamarck).

Diagnosis: Protoconch with large, bulbous whorls, probably two in number, seven post-nuclear whorls in adult. Protoconch ending in a conspicuous band-like varix, with strong ornamentation immediately following. Spiral ornamentation of sharp cords, three in number on first post-nuclear whorl, continuing thus until the fourth whorl where

several smaller threads appear; the three strong cords, continuing on succeeding whorls with several smaller threads between each pair; about six major cords on the body-whorl, alternating with a series of smaller threads, which in turn alternate with tertiary threadlets; an additional three major cords and associated smaller spirals on the siphonal canal. Axial ornamentation beginning on first post-nuclear whorl with about 12 indistinct ridges, strengthened by the beginning of the third whorl to form a small varix at every third ridge, three to a complete turn, with the other ridges remaining as two small intervarical nodes between each pair. The varices on each whorl appearing just behind the equivalent varix of the preceding whorl so that a slightly curving line is formed up the spire. Long, open, foliated spines produced where certain of the major cords cross the varices, that at the shoulder the largest, and two smaller anterior ones, corresponding to the third and fifth cords, abapically from the shoulder; the intervening major cords forming only small open spinelets on the face of the varix. An additional three spines on the extended siphonal canal corresponding to the three major cords there. Suture appressed, situated very low on the whorl so that the spire is noticeably elongated, more so on early whorls than later ones. Aperture ovate to circular, almost entire, but with a small, constricted anal notch adjacent to the suture and a narrow opening into the siphonal canal. Outer lip serrated, corresponding to external spiral ornamentation but not open into the spines; smooth on the inner side. Inner lip also smooth, with narrow free-standing rim. Anterior canal moderately long, slightly recurved at

PLATE 2

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1. USNM 647114 (holotype); height 42.3 mm, diameter (excluding spines) 21.7 mm. Locality: TU 1000. Pinecrest Beds, middle Pliocene.	
2. USNM 647115 (paratype); height 30.5 mm, diameter (excluding spines) 16.5 mm. Locality: TU 1000. Pinecrest Beds, middle Pliocene.	
3-4. <i>Chicoreus (Chicoreus) dilectus</i> (A. Adams) variety (X 1½)	87
3. USNM 734374; height 39.0 mm, diameter (excluding spines) 15.5 mm. Locality: "Hourglass" Station E, 40 fathoms, off west coast of Florida. Recent.	
4. USNM 647116; height (incomplete) 31.5 mm, diameter 24.0 mm. Locality: TU 638. Agueguexquite Formation, Pliocene.	
5. <i>Chicoreus (Chicoreus) proluxus</i> E.H. Vokes, n. sp. (X 1½)	88
USNM 647117 (holotype); height 49.0 mm, diameter (excluding spines) 23.5 mm. Locality: TU 954. Moín Formation, early Pleistocene.	

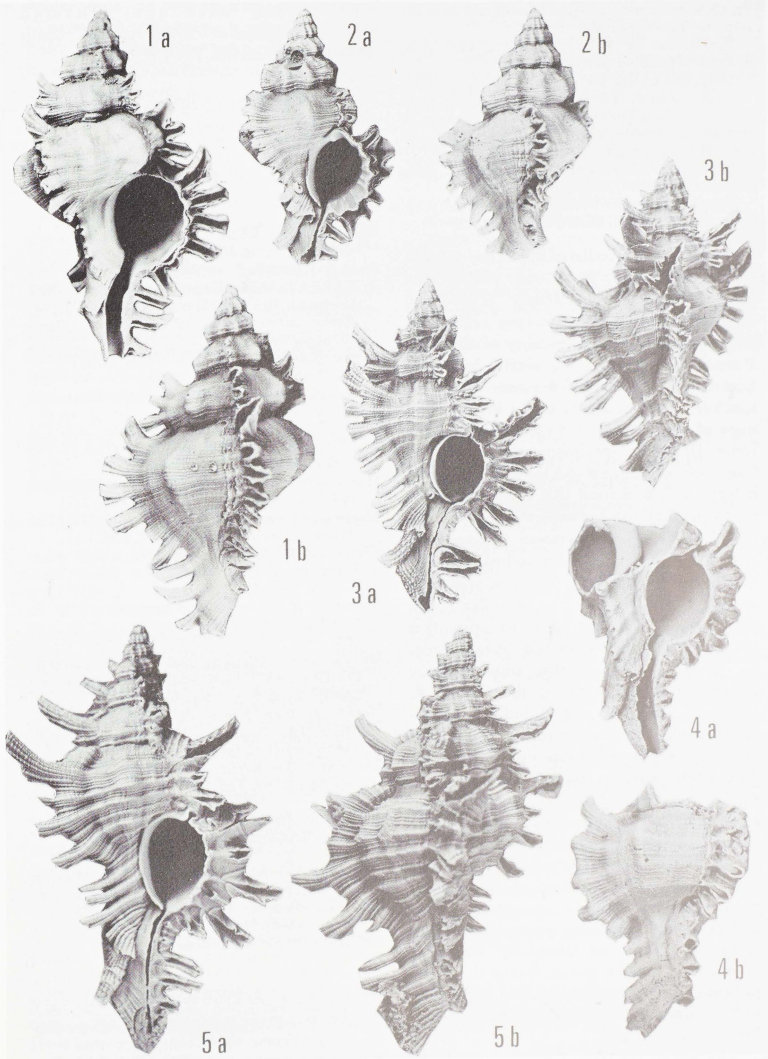


PLATE 2

the distal end, forming a series of spurs that mark the position of former canals.

Dimensions of holotype: height 49.0 mm, diameter (excluding spines) 23.5 mm.

Holotype: USNM 647117.

Type locality: TU 954, hill cut immediately behind Standard Fruit Co. box factory, just west of cemetery at Pueblo Nuevo, about 2 kms west of Puerto Limón, Costa Rica.

Occurrence: Moín Formation, Costa Rica; early Pleistocene.

Figured specimen: USNM 647117 (holotype). Other occurrence: TU locality no. 953.

Discussion: In his list of fossils occurring in the "Pliocene Clay Beds" near Moín, Costa Rica, Gabb cited "*Murex (Chicoreus) calcitrata* Larmarck." However, collections made both at the type locality of the Moín Formation (TU 953) and nearby in Puerto Limón (TU 954) revealed numerous specimens of a new species of *Chicoreus* but none of "*M. calcitrata*" (= *C. brevifrons*). As some 10 entire specimens, plus numerous fragments, of the new species were recovered it seems safe to assume that this was, in fact, the form that Gabb had before him.

The resemblances between *C. brevifrons* and *C. prolixus*, n. sp., seem to be little more than generic in nature. The new species is actually much more akin to *C. bullisi*, n. sp., also described herein, than to any other species of *Chicoreus* in the Caribbean region. *C. prolixus* shows the same peculiar constricted anal notch of the Recent *C. florifer*, *C. dilectus*, and *C. bullisi*, and this alone would be adequate to separate it from *C. brevifrons*. However, the varical spines are completely different from either *C. florifer* or *C. dilectus*, both of them having six varical spines, the shoulder spine being larger and the five anterior spines of approximately the same size. *C. bullisi* has a single large shoulder spine and three smaller anterior spines, but *C. prolixus* has only a single large shoulder spine and two smaller anterior spines. The spire of *C. prolixus* has an unusually elongated appearance for the genus, hence the name *prolixus*, a Latin word meaning "stretched out" (commerated in our English word "prolix").

The age of the Moín beds from both the megafauna and planktonic microfauna is early Pleistocene (Akers, 1972, p. 44); they are

correlated with the unnamed post-Caloosahatchee formation of south Florida (see Emerson, 1964, p. 8).

CHICOREUS (CHICOREUS) SPECTRUM (Reeve)

Plate 3, fig. 1

Murex spectrum REEVE, 1846, Conch. Icon., v. 3, *Murex*, pl. 36, fig. 187.

Murex (Chicoreus) imbricatus HIGGINS and MARRAT, 1877, Literary and Philosophic Soc. Liverpool, Proc., v. 31, p. 413, pl. 1, fig. 2. *Non Murex imbricatus* Brocchi, 1814; *nec* Risso, 1826; *nec* Nardo, 1847.

Murex (Chicoreus) argo CLENCH and PÉREZ FARFANTE, 1947, *Johnsonia*, v. 1, no. 17, p. 31, pl. 17. New name for *Murex imbricatus* Higgins and Marrat.

Murex argo Clench and Pérez Farfante. CLENCH, 1953, *Johnsonia*, v. 2, no. 32, p. 360, pl. 178 (holotype).

Murex argo Clench and Pérez Farfante, VERRILL, 1959, *Nautilus*, v. 63, p. 127, pl. 10, fig. 2.

Murex argo Clench and Pérez Farfante. RIOS, 1964, *Hawaiian Shell News*, v. 13, no. 2, p. 4.

Chicoreus (Chicoreus) argo (Clench and Pérez Farfante). E. H. VOKES, 1965, *Tulane Stud. Geol.*, v. 3, no. 4, p. 194.

Chicoreus (Chicoreus) spectrum (Reeve). E. H. VOKES, 1965, *Tulane Stud. Geol.*, v. 3, no. 4, p. 195.

Murex argo Clench and Pérez Farfante. PLOCKELMAN, 1966, *Seafari* (Palm Beach Shell Club), v. 8, no. 9, p. 3, four text figures.

Murex spectrum Reeve. PLOCKELMAN, 1966, *Seafari* (Palm Beach Shell Club), v. 8, no. 11, p. 3, text figure of holotype.

Murex spectrum Reeve. MATTHEWS, 1967, *Est. Biol. Mar. Univ. Fed. Ceará, Arq.*, v. 7, no. 1, p. 102.

Murex (Chicoreus) spectrum Reeve. RIOS, 1970, *Coastal Brazilian Seashells*, p. 78, pl. 22.

Figured Specimen: Holotype—British Museum (Nat. Hist.) no. 1950-10-23-1; height (incomplete) 113 mm; diameter (excluding spines) 49 mm; locality unknown. Photograph reprinted courtesy of the Trustees of the British Museum.

Discussion: In 1965 there were only a few known specimens referable to either *C. argo* or *C. spectrum*; therefore, there was some reluctance on the part of the writer to place them in synonymy. Since that time numerous specimens have been collected and it now is

event that the two names *C. spectrum* and *C. argo* refer to the same form. Although the holotype of the former was figured previously in a shell club publication, *Seafari*, it seems appropriate to refigure it here in the interest of greater circulation.

In 1965 the only localities reported (Vokes, 1965, p. 194-195) for both "species" were the Lesser Antilles islands of Granada and Dominica. There had been another record of "*Murex argo*" from off the northeastern coast of Brazil (Rios, 1964, p. 4) but, as the *Hawaiian Shell News* is not usually the place to find occurrence records of western Atlantic species, it was overlooked. Since that time numerous specimens have been taken off the Brazilian coast. Matthews (1967, p. 103) reported examples from off the states of Maranhão and Rio Grande Do Norte. Rios (1970, p. 78) added the states of Piauí and Bahia, and northern Brazil seems to be the general area for most of the specimens that have appeared on the shell market.

CHICOREUS (CHICOREUS) MERGUS
E. H. Vokes, n. sp.

Plate 3, fig. 2

Diagnosis: Protoconch of 1½ large, smooth whorls, ending at a marked varix; seven post-nuclear whorls in the adult. Ornamentation on early whorls consisting of three spiral cords and about a dozen small axial nodes, reduced to three varices and three intervarical nodes on second and all subsequent whorls. Three major spiral cords continue through penultimate whorl and an additional three major cords appear on the body with two or three major cords developed on the extended siphonal canal, for a total of usually nine major spirals on the final whorl. Between these major spirals about six or eight smaller threadlets, alternating in size. One long spine produced where the shoulder spiral crosses each varix and at the junction of three of the remaining five major spirals additional smaller spines are also formed. Tertiary spinelets may appear at either of the other cords but in general the pattern, from posterior to anterior, is large shoulder spine, bare spiral, small spine, very small spinelet, and then two more small spines, corresponding to the six major spirals, with an additional two or three small spines on the anterior canal. Axial ornamentation of three heavy varices and three strong intervarical nodes on each whorl, with numerous fine axial growth lines giving a typical shagreened texture to the entire shell surface. Aperture small, ovate-circular, surrounded by a small, smooth raised rim, nearly entire but with

an almost closed anal notch. Outer lip smooth, not folded into the spines of the terminal varix. Color of shell light to dark brown, with darker brown varices and spiral ornamentation. Operculum ovate, corneous, with a somewhat laminar surface, and with a latero-basal nucleus typical of the *Chicoreus florifer* group. Radula also typical of the *Chicoreus* group, small, with three larger cusps and two smaller intermediate cusps on the rachidian tooth, and two simple hook-like lateral teeth.

Dimensions of holotype: height 48.8 mm, diameter (excluding spines) 25.0 mm.

Holotype: USNM 734375.

Type locality: Bridgetown, Barbados, 40 fathoms.

Occurrence: Recent only, from Florida Keys to northern South America. R/V *Oregon* Stations 6435 (dead shell only), 5731, 5732, 5737; also Queenstown, British Guiana, 50 fathoms; Loo Key, Florida (Edith Mugridge, Sanibel, Florida, Coll.), TU locality no. R-287.

Figured specimen: USNM 734375 (holotype).

Discussion: This new species and *C. bullisi*, n. sp. have a strong degree of similarity and, although they are separated geographically for the most part, there is some overlapping of ranges in the southern Caribbean. *C. mergus* is the more widespread species, ranging from the Florida Keys to the Gulf of Darien, occurring in depths of less than 50 fathoms. It is usually confused with the more common *C. florifer* (Reeve), which is larger, with more elaborate spines, and with five smaller spinelets on each varix, in contrast to the three of *C. mergus*. From *C. bullisi* it differs in being smaller, darker, and less frondose. The varical pattern, however, in the two species is identical, with a single large shoulder spine and three smaller spines, which are divided into two parts by an almost obsolete spinelet. The two forms may represent only ecologic variants, with *C. mergus* being the shallow water form and *C. bullisi* the deeper water form. But inasmuch as the two ranges are essentially distinct it seems more likely that they represent two divarications from a single parent.

CHICOREUS (CHICOREUS) BULLISI
E. H. Vokes, n. sp.

Plate 3, fig. 3

Diagnosis: Shell large in size, whorls convex, sutures appressed. Protoconch of 1½ smooth

bulbous whorls; termination of nuclear whorls marked by a small varix and the abrupt initiation of ornamentation. Spiral sculpture consisting of primary threads, three on earlier whorls, increasing to six on body-whorl; secondary threads variable, usually two between each pair of primaries; several tertiary threadlets between each pair of secondary threads. Axial sculpture consisting of 12 equal nodes on the first two whorls; certain of these on subsequent whorls being strengthened to form three varices, usually with a single intervarical node between each pair, although a trace of a second intervarical node may sometimes appear; varices offset slightly on succeeding whorls, forming a spiral line up the spire. Spines on each of the varices formed where the major spirals cross; on the body-whorl the shoulder spine by far the largest; proceeding anteriorly the second and fourth spines much reduced, almost lost; third, fifth and sixth somewhat larger. Three larger spines on the extended siphonal canal and one or two additional spinelets in the area between the spines of the body-whorl and those of the canal. Aperture oval, with a small, constricted, almost tubular anal notch, curving into the suture. Outer lip erect and crenulated at the edge by six raised areas where the primary spiral threads terminate; smooth on inner side. Parietal lip smooth, slightly reflected over the body at the posterior end, free-standing at the anterior end. Siphonal canal moderately long, broad and gently recurving over the entire length; former canals divergent. Color from totally white to light brown. Operculum ovate, corneous, with a somewhat laminar surface and latero-basal nucleus typical of the *C. florifer* group. Radula also typical of the *Chicoreus* group, small, with three larger cusps and two smaller intermediate cusps on the rachidian tooth, and two simple hook-like lateral teeth.

Dimensions of holotype: height 65.0 mm; diameter (excluding spines) 31.5 mm.

Holotype: USNM 734215.

Type locality: R/V Oregon Station 6456, 13 degrees 54' N, 81 degrees 58' W, about 90 miles off the east coast of Nicaragua, 75 fathoms.

Occurrence: Recent only, off the Caribbean coast of Nicaragua. R/V Oregon Stations 3578, 6437, 6456, 6457, 6461.

Figured specimen: USNM 734215 (holotype)

Discussion: This new species is not unlike *C. florifer* (Reeve), which occurs in essentially the same geographic area. It may be distinguished from that form by the different arrangement of varical spines: those of *C. florifer* have five equal-sized smaller spines anterior to that at the shoulder, which is largest; *C. bullisi* having also the large shoulder spine but only three smaller anterior spines. The spines of *C. bullisi* are less flaring and open, and together with the lesser number give an "uncrowded" appearance to the varices. However, the peculiar constricted anal notch of *C. florifer* may be seen in *C. bullisi*, which together with *C. mergus* brings to four the number of Recent species marked by this development.

There seems to be a direct ancestral relationship between *C. prolixus*, n. sp., from the Pleistocene of Costa Rica and *C. bullisi*, the fossil species differing primarily in the possession of a greatly elongated spire and one less small spine on each varix. Both forms have the *C. florifer* type of anal notch and in general are very similar in overall appearance.

PLATE 3

Figures		Page
1.	<i>Chicoreus (Chicoreus) spectrum</i> (Reeve) (X 1)	90
	BMNH no. 1950-10-23-1 (holotype); height (incomplete) 113 mm, diameter (excluding spines) 49 mm.	
	Locality: Unknown. Recent.	
2.	<i>Chicoreus mergus</i> E.H. Vokes, n. sp. (X 1½)	91
	USNM 734375 (holotype); height 48.8 mm, diameter (excluding spines) 25.0 mm.	
	Locality: Bridgetown, Barbados, 40 fathoms. Recent.	
3.	<i>Chicoreus (Chicoreus) bullisi</i> E.H. Vokes, n. sp. (X 1¼)	91
	USNM 734215 (holotype); height 65.0 mm, diameter (excluding spines) 31.5 mm.	
	Locality: R/V Oregon Station 6456, 90 fathoms, off the east coast of Nicaragua. Recent.	

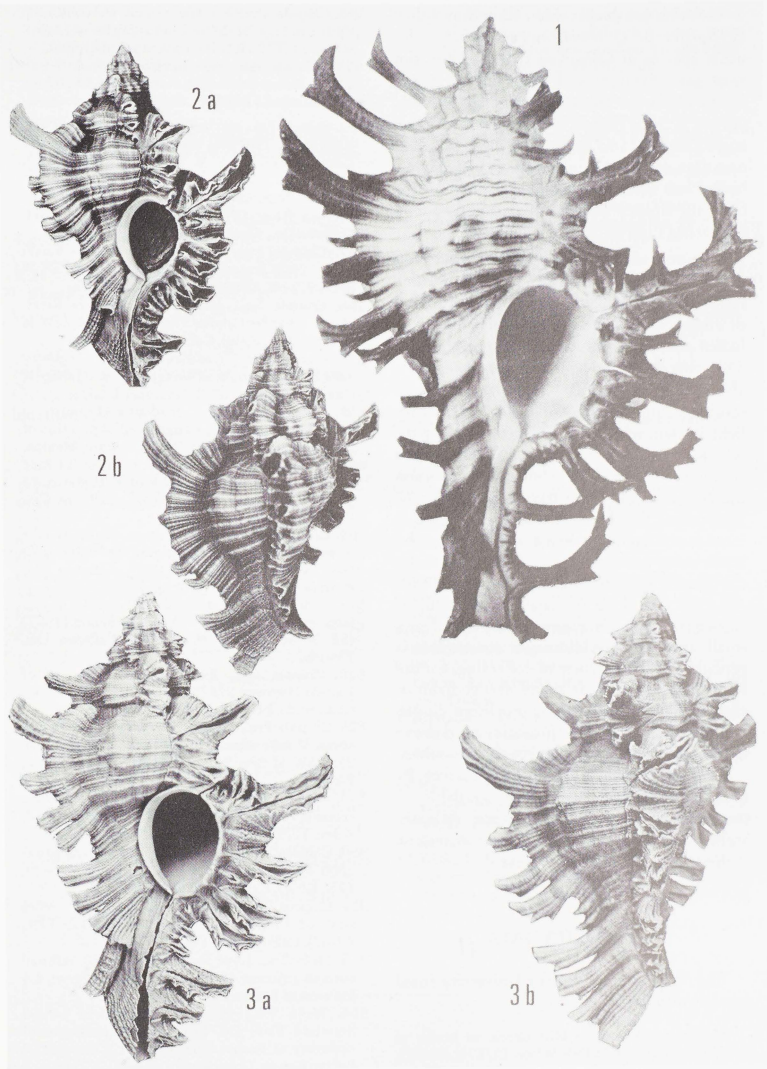


PLATE 3

C. bullisi is a deeper water form than either *C. florifer* or *C. brevifrons* (Lamarck), the other species of *Chicoreus* that occur in the same area. Springer and Bullis (1956, p. 28) report *C. florifer* from 5 to 58 fathoms; Bullis (1964, p. 105) reports *C. brevifrons* from 15 to 40 fathoms; and Bayer (1971, p. 157) adds new data of 6 to 45 fathoms for the latter. *C. bullisi* has been taken only from 75 to 100 fathoms, deeper than is usual for the genus *Chicoreus*.

As noted above, this species has a marked resemblance to *C. mergus*, n. sp. The latter is the smaller of the two, with a maximum size of about 50 mm. The largest specimen of *C. bullisi* seen is a paratype from *Oregon* Station 6457 that measures 85 mm in height. There is also a marked color difference, with *C. mergus* ranging from usually dark brown to rarely light brown, whereas *C. bullisi* is usually pure white, but occasionally a light brown specimen is seen. The relationship between the two forms is much like that between *C. florifer* and *C. dilectus*. *C. bullisi* has a much more restricted range than does *C. mergus*, the latter being found along the outer edge of the Caribbean to the north coast of South America and along the coast to the Gulf of Darien. *C. bullisi* is apparently confined to a small area off the Nicaragua coast. This is probably not an artifact of collecting, for the R/V *Oregon* has made many dredge hauls in all of the Caribbean and northern South American region and the localities cited above are the only ones where this species was taken.

This new species is named for Harvey R. Bullis, Jr., who has made available a tremendous amount of western Atlantic molluscan material not only to the writer but to the scientific world as a whole.

V. LOCALITY DATA

The following are Tulane University fossil locality numbers:

70. Chipola Fm., Ten Mile Creek, at bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

196. Chipola Fm., Ten Mile Creek, about ¼ mile upstream from bridge of Florida Highway 73 (NE ¼ Sec. 11, T1N, R10W), Calhoun Co., Florida.

458. Chipola Fm., east bank of Chipola River, above Farley Creek (SW ¼ Sec. 20, T1N, R9W), Calhoun Co., Florida.

459. Chipola Fm., east bank of Chipola River, steep bank about 1500 feet above the mouth of Taylor Lake Branch (NW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.

546. Ten Mile Creek, about 1¼ miles west of Chipola River (NW ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

547. Chipola Fm., west bank of Chipola River, about 2000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.

555. Chipola Fm., east bank of Chipola River, about 1000 feet above Four Mile Creek (SW ¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.

635. Encanto Fm. (?), roadcut on Mexico Highway 185, 1.4 miles south of bridge over Rio Jaltepec, Oaxaca, Mexico.

638. Agueguexquite Fm., roadcut and quarry on Mexico Highway 180, 1.4 miles east of junction of side road into Coatzacoalcos, Veracruz, Mexico.

655. Chipola Fm., Ten Mile Creek, about 0.1 mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

709. Chipola Fm., Ten Mile Creek, about ¼ mile downstream from bridge of Florida Highway 73 (NW ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

817. Chipola Fm., south side of Ten Mile Creek, large gully on property of Mr. A. Sexon (1967) (SE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

820. Chipola Fm., Farley Creek, at bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

825. Chipola Fm., Farley Creek, at abandoned mill about ¼ mile west of bridge of Florida Highway 275 (SW ¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.

830. Chipola Fm., Ten Mile Creek, at power line crossing about one mile west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

950. Chipola Fm., Chipola River, west bank about 2000 feet above Farley Creek (SW ¼ Sec. 20, T1N, R9W), Calhoun Co., Florida.

951. Chipola Fm., Ten Mile Creek, about 1¼ miles west of Chipola River (SE ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.

953. Moín Fm., (type locality) Moín Hill, railroad cut and adjacent ditches on road to Sandoval, 4.5 km west of Puerto Limon, Costa Rica.

954. Moín Fm., Hill cut immediately behind Standard Fruit Co. box factory, just west of cemetery at Pueblo Nuevo, about 2 km west of Puerto Limon, Costa Rica.

998. Chipola Fm., Ten Mile Creek, about 1¼ miles west of Chipola River (SW ¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.
1000. Pinecrest Beds, Sarasota, road metal pits at end of 17th Street, about 8 miles east of U.S. Highway 301 (R36S, R19E), Sarasota Co., Florida.
1046. Agueguexquite Fm., road cut on Mexico Highway 180, 7.5 miles east of junction with side road into Coatzacoalcos, Veracruz, Mexico.

The following is a Tulane University Recent locality number.

- R-287. Corn Island, about 50 miles east of Bluefields, Nicaragua.

The following are National Marine Fisheries Service (formerly U.S. Bureau of Commercial Fisheries) R/V *Oregon* dredging localities.

	Latitude North	Longitude West	Depth in fathoms
3578.	12°28'	82°25'	100
5731.	8°45'	77°26'	43
5732.	8°46'	77°27'	44
5737.	9°37'	79°03'	36
6435.	12°37.5'	82°20'	83
6437.	12°34'	82°23'	80/85
6456.	13°47.5'	81°57'	90
6457.	13°54.5'	81°58'	75
6461.	14°10'	81°57.5'	80

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