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NOTES ON THE FAUNA OF THE CHIPOLA FORMATION - XXXIV NEW SPECIES OF CANCELLARIOIDEA (MOLLUSCA: GASTROPODA)

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ABSTRACT

Five new species of *Trigonostoma* (Gastropoda: Cancellarioidea) are described from the Miocene Chipola Formation of Calhoun County, Florida. These new species are assigned to the genus *Trigonostoma sensu lato* pending additional study of cancellariid phylogeny. The new species are: *Trigonostoma xiphion, T. serilium, T. ritteri, T. nexum,* and *T. proteus*. Also, two new species of *Axelella* (Gastropoda: Cancellarioidea) are described from the same formation. These new species are *Axelella firma* and *A. axiologa*.

INTRODUCTION

Recent collecting in the Chipola Formation has brought previously unknown species of Cancellariidae to our attention. These discoveries prompted a re-examination of the Tulane collection and the Hoerle collection (now at the USNM), which uncovered additional specimens, enabling us to provide descriptions of these new taxa. No species of *Trigonostoma* or *Axelella* have previously been recorded from the Chipola Formation.

The neogastropod superfamily Cancellarioidea, recently catalogued by Petit and Harasewych (1990), is well represented in the Tertiary. Its members are considered to be valuable in stratigraphy due to the fact that they diversified rapidly, and few species-group taxa endured for long periods (Jung and Petit, 1990). Much work remains to be done on supraspecific taxa in the Cancellarioidea, but work on a phylogeny is in progress. Until such time as the relationships between various nominal genus-group taxa are better known, we are herein adopting the conservative tactic of using *Trigonostoma sensu lato* for the newly described species of *Trigonostoma*.

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These acknowledgments would not be complete without expressing our indebtedness to the late Shirley Hoerle, whose magnificent collection of Florida fossil mollusks was left to the National Museum of Natural History. Chipola cancellariids given by Mrs. Hoerle to one of us (REP) during her lifetime have been placed in the USNM with her other material.

SYSTEMATIC PALEONTOLOGY

Superfamily CANCELLARIOIDEA
Forbes and Hanley, 1851
Family CANCELLARIIDAE
Forbes and Hanley, 1851

Genus TRIGONOSTOMA Blainville, 1827

Trigonostoma BLAINVILLE, 1827, Manuel de Malacologie et de Conchyliologie, p. 652.

Type species: *Delphinula trigonostoma* Lamarck, 1822 [= *Buccinum scalare* Gmelin, 1791], by monotypy.

TRIGONOSTOMA XIPHION
Petit and Schmelz, n. sp.
Plate 1, figs. 1-3

Description: Protoconch of about two smooth whorls; teleoconch of about four whorls. First two postnuclear whorls ornamented only with strong spiral cords, six of which are visible on the spire whorls. Axial sculpture of seven to nine strong sharp ribs per whorl beginning at approximately the third teleoconch whorl. The axial ribs projecting above the well-defined shoulder as open spines. Early whorls with U-shaped channel between shoulder and suture, gradually becoming shallower and more shelved. Spiral cords, about 10 on body whorl, evenly spaced and forming small nodes where they cross the axial ribs. The posterior spiral cord strongest and forming the shoulder. Body whorl not constricted above siphonal fasciole. Attachment point for body whorl only slightly above the siphonal fasciole. Umbilicus not wide, but deep. Columella sloping abaxially, with three folds, the anterior one forming the inner edge of a short but distinct siphonal canal. Outer lip thin, prosocline, with about eight strong lirations within, extending well inside. Posterior canal present under the shoulder, delineated by the most adapical liration and a strong cord beneath the sutural shelf.

Holotype: USNM 452219; height 17.3 mm, diameter (excluding shoulder spine) 11.6 mm (Hoerle collection). (Plate 1, figs. 1-3)

Type locality: TU 951, Tenmile Creek, "Sexton's Bridge," about 1 1/4 miles west-northwest of mouth of creek at "Bailey's Ferry" (SE 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Paratype A: USNM 452220; height 17.0 mm, diameter (excluding shoulder spine) 12.5 mm; locality TU 820, Farley Creek, Calhoun County, Florida (Hoerle collection).

Paratype B: USNM 452221; height unknown, shell broken; diameter (excluding shoulder spine) 9.8 mm; locality TU 830, Tenmile Creek, Calhoun County, Florida (Hoerle collection).

Paratype C: Petit collection 1727; height 18.4 mm, diameter (excluding shoulder spine) 11.8 mm; locality TU 825, Farley Creek, Calhoun County, Florida.

Paratype D: Schmelz collection 884; height 15.5 mm, diameter (excluding shoulder spine) 11.4 mm; locality TU 951, Tenmile Creek, Calhoun County, Florida.

Additional material: One fragment (USNM 452222) consisting only of the body whorl, TU 819 (Hoerle collection).

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: Trigonostoma xiphion differs from the other Chipola species of *Trigonostoma* in having spines on the shoulder. These spines are similar to those on the Pinecrest Formation species *T. druidi* Olsson and Petit, 1964. These two species have much in common, but *T. druidi* has broad spiral cords and is much less attenuate. The change in the overall shell shape of *T. xiphion* when the axial sculpture begins to develop is striking.

Trigonostoma umbilicaris (Brocchi, 1814) from the Italian Pliocene resembles *T. xiphion* in sculpture and overall appearance, but lacks the anterior columellar fold bordering the siphonal canal and has axial sculpture that commences with the beginning of the teleoconch whorls.

Etymology: Dimunitive of Greek *xiphos,* sword.

TRIGONOSTOMA SERILIUM
Petit and Schmelz, n. sp.
Plate 1, figs. 4-6

Description: Protoconch of about two smooth whorls; teleoconch of five or six whorls. Axial ribs and spiral cords developing with the onset of the teleoconch. Spiral sculpture of low, shallowly angular, raised cords, about six on the penultimate whorl with weaker spiral cords in the interspaces; these weaker cords becoming more numerous with increase in shell size. Axial ribs on early whorls rather weak but gradually become larger and prominent. On adult specimens the axial ribs developing into varices; large, rounded, and reflected backwards. These varices rising over the shoulder and descending to the suture, forming a canaliculate sutural shelf. Prosocline outer lip thickened by the terminal varix with numerous strong lirations within. Lirations not extending to the edge of the lip, but extending deeply into the aperture. A pronounced posterior canal present under the shoulder and delineated by the most adapical liration and two strong lirations beneath the sutural ramp. Columella sloping slightly with three folds, the adapical one being strongest. Numerous weak lirations on the columella above the posterior fold. Pustules sometimes present on the inductura. Anterior canal shallow but well defined. Umbilicus deep; moderately wide.

Holotype: USNM 452223; height 28.6 mm, diameter 20.5 mm (Hoerle collection). (Plate 1, figs. 4-6)

Type locality: TU 546, north bank of Tenmile Creek, about 1.75 miles west-northwest of mouth of creek at "Bailey's Ferry" (NE 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Paratype A: USNM 452224; height 23.9 mm, diameter 17.9 mm; locality TU 951, Tenmile Creek, Calhoun County, Florida (Hoerle collection).

Paratype B: USNM 452227; height 21.4 mm, diameter 15.7 mm; locality TU 830, Tenmile Creek, Calhoun County, Florida (Hoerle collection).

Paratype C: USNM 452230; height 22.0 mm, diameter 16.0 mm; locality TU 547, Chipola River, Calhoun County, Florida (Hoerle collection).

Additional paratypes: Additional paratypes from TU 951 consist of 24 subadult or broken specimens: 19 from the Hoerle collection (USNM 452225), three from the Tulane collection (USNM 452226), and two in the Schmelz collection. Additional paratypes from TU 830 consist of 23 subadult or broken specimens: 14 from the Hoerle collection (USNM 452228) and 9 from the Tulane collection (USNM 452229). In addition, there are two immature and incomplete specimens from TU 1098 (Schmelz collection), and one (USNM 452231) from TU 546 (Hoerle collection).

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: In overall shape *Trigonostoma serilium* resembles *T. gurabis* (Maury, 1917) from the late Miocene Gurabo Formation of the Dominican Republic, but that species does not possess numerous uniform varices, having only one or two axial ribs produced into varices on each whorl, and the sculptural pattern is different. This new species differs from *T. ritteri*, described below, in the shape and frequency of the axial ribs and in the presence of two or more lirations within the aperture directly below the sutural ramp.

Etymology: Latin *serilium*, rope or cord.

TRIGONOSTOMA NEXUM
Petit and Schmelz, n. sp.
Pl. 1, figs. 7-9

Description: Protoconch eroded; teleoconch of about five whorls. Sculpture on first teleoconch whorl consisting only of spiral cords with axial ribs appearing only on about the second teleoconch whorl. About six strong spiral cords on the penultimate whorl between the shoulder and the suture, and about 12 on the body whorl anterior to the shoulder. Usually one, and sometimes two, secondary cords in the interspaces. On the shoulder the spiral cords lacking intermediates and crowded together. The spiral cords persisting onto the excavated sutural ramp and in the umbilicus. Axial sculpture consisting of rounded axial ribs and numerous fine growth lines; the closely spaced spiral cords crossing the axial growth lines giving the shell surface a pitted appearance. Axial ribs crowded together near the outer lip forming a terminal varix. Prosocline outer lip thin with about a dozen lirations within, not reaching the outer edge of the lip and not extending deeply into the aperture. A well-defined posterior canal situated beneath the shoulder. Anterior canal short but well-defined. Columella sloping abaxially with threefolds, the most adapical one being strongest. The anterior columellar fold bifurcate. Columella with numerous pustules and irregular lirations on the columellar callus and the inductura. Umbilicus deep.

Holotype: USNM 452232; height 24.1 mm, diameter 19.0 mm (Hoerle collection). (Plate 1, figs. 7-9)

Type locality: TU 547, west bank of Chipola River, about 1/4 mile above Four Mile Creek (SW 1/4 Sec. 29, T1N, R9W), Calhoun County, Florida.

Paratype A: USNM 452233; height 23.1 mm, diameter 17.9 mm; locality TU 546, Tenmile Creek, Calhoun County, Florida (Hoerle collection).

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: The protoconch is eroded on all specimens. The bifurcate anterior columellar fold of *Trigonostoma nexum* is a feature not known in any other species of *Trigonostoma*. The closely packed spiral sculpture, which combines with visible growth lines to give it a distinctive pitted appearance, also serves to separate *Trigonostoma nexum* from all other Chipola species.

Etymology: Latin *nexus*, coiled or complicated.

TRIGONOSTOMA RITTERI
Petit and Schmelz, n. sp.
Plate 2, figs. 1-3

Description: Protoconch of about two and one-half smooth whorls; teleoconch of about four whorls. Weak spiral cords and axial ribs, beginning with the onset of the teleoconch, about equal in size and spacing on the first teleoconch whorl but axial ribs gradually becoming more widely spaced with about 15 on the penultimate whorl and only about nine on the body whorl. These axial ribs strongest at the shoulder where they form nodes. The spiral cords form-

ing angular nodes where they cross the axial ribs, cords on the shoulder and at widest point of the shell being strongest. Intermediate spiral cords varying in number and strength. A rather strong cord present on the body whorl at the attachment point for future whorls. Sutural ramp narrowly U-shaped. Outer lip prosocline, thin, with about 10 short lirations within. Lirations not extending to the outer lip nor deeply into the aperture. A noticeable posterior canal developed under the shoulder, sometimes delineated by a plication under the sutural ramp. Columella almost vertical with three weak folds, the adapical one being strongest. Umbilicus rather narrow but deep.

Holotype: USNM 452234; height 20.5 mm, diameter 14.6 mm (Hoerle collection). (Plate 2, figs. 1-3)

Type locality: TU 830, Tenmile Creek at power line crossing about 1 mile west-northwest of mouth of creek at "Bailey's Ferry" (SE 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Paratype A: USNM 452235; height 19.9 mm, diameter 15.6 mm, from type locality (Hoerle collection).

Paratype B: USNM 452236; height 18.8 mm, diameter 14.6 mm, from type locality (Hoerle collection).

Additional paratypes: Five specimens (USNM 452237) from the type locality, five specimens from TU 951 (USNM 452238), and one from TU 546 (USNM 452239) (Hoerle collection). Also, there are two specimens in the Schmelz collection from TU 951.

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: This species is easily distinguished from its Chipola congeners by the angular nodes on the shoulder and the angular aspect of the body whorl. It differs from *Trigonostoma serilium* in having fewer and less rounded axial ribs, which are not produced as varices.

Etymology: Named for Mr. Steve Ritter, Naples, Florida, a long-time collector of Florida fossils, who generously made specimens from his collection of Chipola material available for study.

TRIGONOSTOMA PROTEUS
Petit and Schmelz, n. sp.
Plate 2, figs. 4-6

Description: Protoconch of about one and one-quarter smooth whorls; teleoconch of about five whorls. Spiral and axial sculpture beginning with onset of teleoconch. Spiral cords evenly spaced on early whorls with intermediate secondary cords. On the body whorl only a few spiral cords identifiable as primary; crowded secondary and tertiary spiral cords in the interspaces. Axial sculpture of raised, slightly rounded ribs, about seven or eight on the body whorl; more on earlier whorls, their spacing increasing with growth. Closely spaced growth lines crossed by the spiral cords, giving the surface of the body whorl a somewhat scabrous appearance. Spire whorls tabulate with sides almost vertical and sutural shelf very flat. Body whorl rounded and sutural shelf slightly concave. Shoulder set off by nodes formed by the axial ribs. Outer lip extremely prosocline on adults, almost orthocline on juveniles. Outer lip thin with about ten short lirations within, not extending to the lip edge. Shallow posterior canal beneath shoulder. Anterior canal narrow and deep. Columella with three weak folds, the most adapical one strongest. Umbilicus rather narrow but deep.

Holotype: USNM 452240; height 15.5 mm, diameter 11.9 mm (Hoerle collection). (Plate 2, figs. 4-6)

Type locality: TU 546, north bank of Ten Mile Creek about 1.75 miles west-northwest of mouth of creek at "Bailey's Ferry" (NE 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Paratype A: USNM 452241; height 16.1 mm, diameter 12.9 mm; locality TU 830, Tenmile Creek, Calhoun County, Florida (Hoerle collection).

Additional paratypes: Three specimens (USNM 452242), two broken and one juvenile

PLATE 1

Figures Page

1-3. *Trigonostoma xiphion* Petit and Schmelz, n. sp. 62
(X 3) USNM 452219 (holotype); height 17.3 mm, diameter (excluding shoulder spine) 11.6 mm.
Locality: TU 951; Chipola Formation, Florida.

4-6. *Trigonostoma serilium* Petit and Schmelz, n. sp. 62
(X 2) USNM 452223 (holotype); height 28.6 mm, diameter 20.5 mm.
Locality: TU 546; Chipola Formation, Florida.

7-9. *Trigonostoma nexum* Petit and Schmelz, n. sp. 63
(X 2) USNM 452232 (holotype); height 24.1 mm, diameter 19.0 mm.
Locality: TU 547; Chipola Formation, Florida.

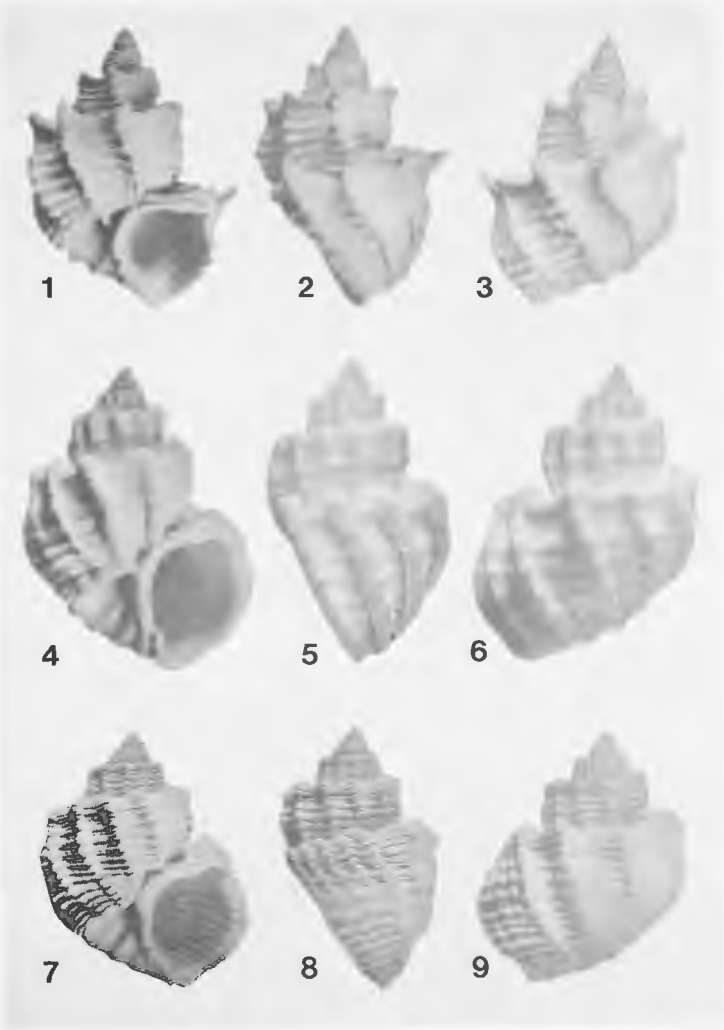

PLATE 1

(Hoerle collection), and one large incomplete specimen (USNM 452243) measuring 16.5 mm in height and 14 mm in diameter (Tulane collection); all from locality TU 830.

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: Trigonostoma proteus can be distinguished from *T. ritteri*, to which it is most similar in size and shape, by its more numerous spiral cords and its tabulate spire with perpendicular sides and flat sutural ramp. Also, *T. proteus* has a proportionally shorter shell, a wider umbilicus, and its columella has a much more pronounced abaxial slope.

The only juvenile specimen in the collections has a vertical columella and an almost orthocline outer lip, whereas adults have a broadly sloping columella and a strongly prosocline outer lip. The existence of two distinct groups of species differentiated by these sets of characters was noted by Jung and Petit (1990, p. 113). This is, however, the first observation of both sets of characters being present in the ontogeny of a single species.

Etymology: The Greek god Proteus, who was able to change shape.

Genus AXELELLA Petit, 1988

Olssonella PETIT, 1970, Tulane Stud. Geol. Paleont., v. 8, p. 83. Not *Olssonella* Glibert and Van de Poel, 1967.

Axelella PETIT, 1988, Nautilus, v. 102, p. 130.

Type species: *Cancellaria smithii* Dall, 1888, by original designation for *Olssonella* Petit, 1970.

AXELELLA FIRMA
Petit and Schmelz, n. sp.
Plate 2, figs. 7-9

Description: Protoconch of about two smooth whorls; teleoconch of five or six whorls. Sculpture of axial ribs and spiral cords beginning with onset of teleoconch. Spiral cords rounded, about six visible on penultimate whorl, usually with weaker cords in the interspaces. Axial ribs, about seven or eight on penultimate whorl and six or seven on body whorl, strong and rounded. Body whorl rounded, a pronounced shoulder behind sloping to an impressed suture. Aperture roughly trigonal. Outer lip thin with about 11 short lirations, not extending to the edge. A shallow posterior canal located under the sutural ramp just abaxial to the suture, delineated by the most adapical of the inner lip lirations and a single weak cord on the parietal wall. Columella straight, vertical, with three folds, the two most abapical ones very close, sometimes appearing as one wide bifurcate fold. Columella callus thin, extending slightly outward at the inductura. Small pustules often present on parietal wall. Anterior canal short and narrow. No umbilicus.

Holotype: USNM 452244; height 22.4 mm, diameter 13.4 mm (Hoerle collection). (Plate 2, figs. 7-9)

Type locality: TU 546, north bank of Tenmile Creek, about 1.75 miles west-northwest of mouth of creek at "Bailey's Ferry" (NE 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Paratype A: USNM 452245; height 15.0 mm; diameter 8.7 mm; from the type locality (Hoerle collection).

Paratype B: USNM 452248; height 16.5 mm; diameter 10.2 mm; locality TU 830, Tenmile Creek, Calhoun County, Florida (Tulane collection).

Paratype C: Schmelz collection number 885; height 18.8 mm; diameter 10.3 mm; locality TU 951, Tenmile Creek, Calhoun County, Florida.

Additional material: Additional material from the type locality consists of 19 specimens, six complete and 13 broken or juvenile, from the Hoerle collection (USNM 452246), and 15 subadult specimens from the Tulane collection (USNM 452247). Additional material from TU 830 consists of 17 specimens (USNM 452249), some broken and/or juvenile (Tulane collection), and six juvenile and/or broken specimens (USNM 452250) (Hoerle collection).

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: This Chipola species appears to be closer to *Axelella bifoliata* (Aldrich, 1903) from the Oak Grove Sand of Florida than to any other known species. That species, however, has a protoconch of three or three and one-half volutions, sharper spiral cords, is constricted above the siphonal canal, and has a single narrow anterior columellar fold. In general appearance *A. firma* is also close to the Recent Panamic-Pacific *A. funiculata* (Hinds, 1843) but the Recent species has fewer axial ribs, a strong siphonal fasciole, and is umbilicate. In overall form some specimens of *A. firma* approach the more attenuate Recent Panamic-Pacific *A. campbelli* (Shasky, 1961) but that species also possesses fewer axial ribs and is umbilicate. *Axelella williamsi* (Petit, 1976) from the Pliocene Yorktown Formation of Virginia has only two columellar folds and differs in details of sculpture.

Etymology: Latin *firma*, stout.

AXELELLA AXIOLOGA
Petit and Schmelz, n. sp.
Plate 2, figs. 10-12

Description: Protoconch of two smooth whorls; teleoconch of five whorls. Sculpture of strong axial ribs crossed by spiral cords beginning with onset of teleoconch. The prominent axial ribs high and rounded, extending over the shoulder to an impressed suture. Evenly spaced spiral cords, about nine on the body whorl anterior to the shoulder, divided by secondary cords in the interspaces, in turn subdivided by tertiary cords. The closeness of the spiral cords combined with visible growth lines in the interspaces giving the shell surface a textured appearance. Aperture ovate, with about 10 liration within outer lip, not extending deeply into the aperture. Columella straight, slightly recurved at anterior end, with two strong folds. A very weak third fold forming the edge of the shallow but well-defined anterior canal. Inner lip reflected over the parietal wall as a thin callus. Body whorl slightly constricted behind siphonal fasciole. Umbilicus narrow but deep.

Holotype: USNM 452342; height 15.4 mm, diameter 8.1 mm (Tulane collection). (Plate 2, figs. 10-12)

Type locality: TU 830, north bank of Tenmile Creek at power line crossing about 1 mile west-northwest of mouth of creek at "Bailey's Ferry" (SE 1/4 Sec. 12, T1N, R10W), Calhoun County, Florida.

Occurrence: Chipola Formation, Calhoun County, Florida.

Discussion: Although this species is known only from the holotype, it is so distinct that description is deemed to be proper. Its elaborate sculpture of spiral cords, strong siphonal fasciole, and small deep umbilicus immediately distinguish it from *A. firma,* n. sp.

Etymology: Greek *axiologos,* worthy of mention.

LOCALITY DATA

Drs. H. E. and E. H. Vokes assigned Tulane University fossil locality numbers (prefixed TU) to all of the Chipola Formation localities collected by them. The Tulane University localities relevant to this paper are listed below. All are in Calhoun County, Florida. Other collectors, such as Shirley Hoerle, have utilized these "Tulane numbers," whether or not their collections were made in the company of the Vokes. The Hoerle Collection is on deposit in the USNM.

TU 546. Tenmile Creek, about 1.75 miles west-northwest of mouth of creek at "Bailey's Ferry" (NE 1/4 Sec. 12, T1N, R10W).

TU 547. West bank of Chipola River, about 1/4 mile above Four Mile Creek (SW 1/4 Sec. 29, T1N, R9W).

TU 819. South bank of Farley Creek, about 0.2 mile west of bridge on Florida Highway 275 (SW 1/4 Sec. 21, T1N, R9W).

TU 820. North bank of Farley Creek, immediately upstream from bridge on Florida Highway 275 (SW 1/4 Sec. 21, T1N, R9W).

TU 825. Farley's Creek at abandoned mill about 1/4 mile west of bridge on Florida Highway 275 (SW 1/4 Sec., T1N, R9W).

TU 830. North bank of Tenmile Creek at power line crossing about one mile west-northwest of mouth of creek at "Bailey's Ferry" (SE 1/4 Sec. 12, T1N, R10W).

TU 951. Tenmile Creek, "Sexton's Bridge," about 1 1/4 miles west-northwest of mouth of creek at "Bailey's Ferry" (SE 1/4 Sec. 12, T1N, R10W).

TU 1098. South bank of Tenmile Creek, just east of power line crossing (SE 1/4 Sec. 12, T1N, R10W).

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PLATE 2

Figures Page

1-3. *Trigonostoma ritteri* Petit and Schmelz, n. sp. 63
(X 2) USNM 452234 (holotype); height 20.5 mm, diameter 14.6 mm.
Locality: TU 830; Chipola Formation, Florida.

4-6. *Trigonostoma proteus* Petit and Schmelz, n. sp. 64
(X 2 1/2) USNM 452240 (holotype); height 15.5 mm, diameter 11.9 mm.
Locality: TU 546; Chipola Formation, Florida.

7-9. *Axelella firma* Petit and Schmelz, n. sp. 66
(X 2) USNM 452244 (holotype); height 22.4 mm, diameter 13.4 mm.
Locality: TU 546; Chipola Formation, Florida.

10-12. *Axelella axiologa* Petit and Schmelz, n. sp. 67
(X 2 1/2) USNM 452342 (holotype); height 15.4 mm, diameter 8.1 mm.
Locality: TU 830; Chipola Formation, Florida.

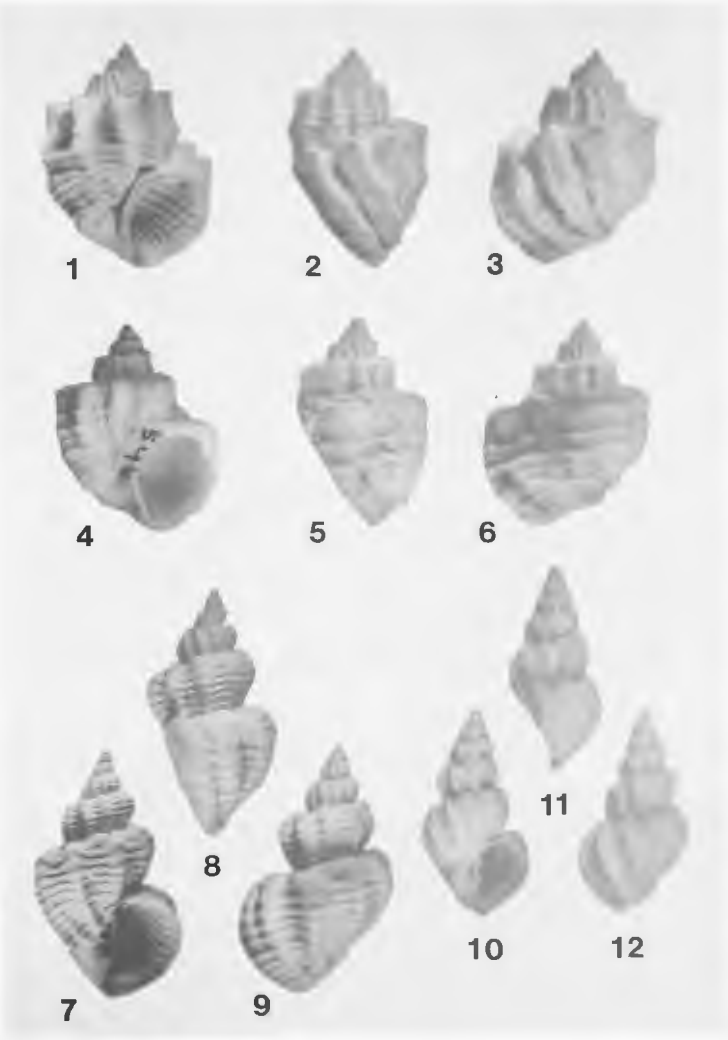

PLATE 2