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THE VELIGER

The Pliocene Cancellariidae (Mollusca: Gastropoda) of the Cubagua Formation (Cerro Negro Member) from Cubagua Island, with a new species from the Miocene Cantaure Formation, Venezuela

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Abstract. This is the first description of gastropod family Cancellariidae from the Lower Pliocene Cerro Negro Member of the Cubagua Formation from the Island of Cubagua, Venezuela. These deposits hold a rich and varied fauna of cancellariids, comprising at least nine species, plus a group which may contain more than one species, including two new taxa; *Cancellaria (Cancellaria) capeloi* nov. sp. and *Cancellaria (Massyla) cubaguaensis* nov. sp. Two new species are also described for the Lower Miocene Cantaure Formation of mainland Venezuela; *Cancellaria (Bivetiella) lugogonzalezorum* nov. sp., and *Cancellaria (Bivetopsia) herberti* nov. sp., increasing the number of cancellariids known from the Cantaure beds to 14. *Cancellaria (Pyruclia) diadela* Woodring, 1970 is here considered a junior synonym of *Cancellaria (Pyruclia) scheibei* Anderson, 1929. *Ventrilia kissimmeensis* Petuch, 1994 is here considered a synonym of *Trigonostoma (Ventrilia) rucksorum* (Petuch, 1994), as first revisers the latter name is chosen, the holotype of which is more characteristic of the species. The composition of the Neogene southern Caribbean cancellarid fauna is strongly paciphile, with most of the subgenera now restricted to the eastern Pacific. The Caribbean cancellariid fauna suffered a severe impoverishment following the uplift of the Panama Isthmus and closure of the Central American seaway, with only *Cancellaria (s. s.)* and *Cancellaria (Ventrilia)* of the larger-shelled taxa present in the Recent faunas.

INTRODUCTION

Numerous Neogene (including Quaternary, according to the latest revision of the chronostratigraphic scale, see Gradstein et al., 2004) fossiliferous deposits, rich in molluscan fossils, outcrop along or adjacent to the northern Caribbean coast of Venezuela. The fossil assemblage of the better known deposits, such as the Lower Miocene Cantaure and the Lower Pliocene Punta Gavilán Formations, Falcón State, have been described (Rutsch, 1934; Jung, 1965), whilst others remain almost unknown.

The presence of fossils of molluscs on the Island of Cubagua, Nueva Esparta State, situated between the Island of Margarita to the North and the Araya Peninsula to the South, is known since at least the 1930s (Schilder, 1939). Ingram (1947) described two new species of *Cypraea, C. grahami* and *C. rugosa*, from the Neogene deposits of the island, Gibson-Smith (1973) described *Voluta cubaguaensis*, and Vokes (1990) a new *Haustellum* species, *H. mimiwilsoni*. This work is part of an ongoing project to monograph the Pliocene gastropod fauna of Cubagua Island (Landau, Capelo and Silva, in press).

Geological Setting

The geological units outcropping on Cubagua Island are the Cubagua Formation and Tortuga Formation (Padrón et al., 1993). The sediments of the Upper Miocene to Upper Pliocene Cubagua Formation cover the greater part of the island (Padrón et al., 1993). Bermúdez and Bolli (1969) originally recognized two members to the Cubagua Formation, Cerro Verde (lower member) and Cerro Negro (upper member), of which only the Cerro Negro Member is represented in the island, namely at Cañon de las Calderas (Padrón et al., 1993), which is the type section for the Cubagua Formation (Castro and Mederos, 1997). The total thickness of the Cerro Negro member at its type locality of Cerro Negro, western part of the Araya Peninsula is 22 m (Vignali, 1965), and has a stratigraphic range from Lower Pliocene to Upper Pliocene and possibly Pleistocene (Padrón et al., 1993). In the Cañon de las Calderas the exposed section of the upper member of the Cubagua Formation attains 82 m (Padrón et al., 1993). The Cerro Negro Member overlays conformably the Cerro Verde Member (Vignali, 1965; Bermúdez, 1966). For further information

on the stratigraphy of the Cubagua Formation in Cubagua and graphic columnar section of the Cañon de las Calderas see Padrón et al. (1993).

The Tortuga Formation was originally described from Tortuga Island and dated as Middle to Upper Pleistocene (Patrick, 1959; Bermúdez, 1966). Méndez (1997) considered the formation restricted to the nominate Island of Tortuga. Nevertheless, according to Padrón et al. (1993), the Tortuga Formation crops out in Cubagua, consisting of a sequence of Holocene siltstones and limestones, which discontinuously fringe the coastline.

Within the Cerro Negro Member, in Cubagua, the most fossiliferous locality is situated on the eastern side of the Cañon de las Calderas. In this locality, the fossiliferous section consists of about 2 m of poorly consolidated sands, just above a clayey apparently non-fossiliferous layer at the base of the section, approximately 4–5 m above sea level. The fossils look abundant, but are probably concentrated on the surface by erosion of the sandy matrix. In several arroyos the sandy fossiliferous layer is exposed vertically and the fossils are sparsely distributed. According to Padrón et al. (1993) this fossiliferous section is Lower Pliocene in age.

Within the fossiliferous layer the shells occur in poorly defined levels; the lowest is richest in bivalves, the middle level is the thickest and contains the greatest diversity of gastropod species, and the upper level containing an assemblage consisting almost entirely of shells of Turritellidae and Vermetidae. The fossils in all layers are relatively well-preserved, most shells showing some surface erosion, and the early whorls of gastropod shells are almost invariably missing.

On mainland Venezuela a second locality, also belonging within the Cubagua Formation, occurs at Cerro Barrigón, about 1 km south of the village of Araya on the westernmost Araya Peninsula (see Padrón et al., 1993 and Jung, 1989 for location map). According to Vignali (1965) the Cubagua formation at Cerro Barrigón cannot be subdivided into its members the Cerro Verde and Cerro Negro. However, both Gibson-Smith and Gibson-Smith (1974) and Jung (1989) positioned the type locality of *Strombina arayana* Gibson-Smith and Gibson-Smith, 1974 in the Cerro Negro Member. We would agree with Gibson-Smith and Gibson-Smith (1974) in that the Cerro Negro Member can be clearly distinguished from the underlying Cerro Verde Member at Cerro Barrigón, where it consists of a lower level of fine, poorly consolidated sands (type bed for *S. arayana*), and an upper level of coarser, more consolidated sediments, in which the fossils are less well preserved. Both have a rich fossil molluscan assemblage, very similar to that found at Cañon de las Calderas on Cubagua Island.

The Lower Pliocene gastropod assemblage encountered in Cubagua indicates a tropical shallow-water, marine environment of normal salinity and with a sandy substrate (Landau, Capelo and Silva, in press). These conclusions agree with Aguilera and Aguilera (2001: 733): 'the sediments of the lower part (of the Cubagua Formation, i.e., Cerro Verde Member) appear to have been deposited in deep water, and the upper part (i.e., Cerro Negro Member) in shallow tropical water.'

Biostratigraphic Setting

Bolli and Saunders (1985) proposed a zonal scheme for the Cenozoic of low latitudes developed in the areas of Trinidad and Venezuela, based on the assemblage of planktonic foraminifera. Five biostratigraphic zones and three subzones have been recognised in the Cubagua Formation. According to these authors, the assemblage of planktonic forams present in the Cerro Negro Member sediments at the Cañon de las Calderas indicates placement in the *Globorotalia margaritae* Zone of Bolli and Bermúdez (1965).

The Cubagua Formation ranges from the lower part of the Upper Miocene to the lower part of the Upper Pliocene, from Zone NN10, of *Discoaster calcaris* up to Zone NN17, of *Discoaster pentaradiatus* (Castro and Mederos, 1997). The *Gr. margaritae* Zone corresponds to the Lower Pliocene (Bolli and Saunders, 1985). Aguilera et al. (2001) in their work on the fish fauna of the Cubagua Formation used a preliminary age of 4.2 Ma (Lower Pliocene) throughout their paper, based on the median value of the age ranges of planktonic foraminifera obtained from all sampled areas. In the Cañon de las Calderas section the fossiliferous beds lie almost at the very base of the stratigraphic section, and are dated as Lower Pliocene by Padrón et al. (1993).

MATERIAL AND METHODS

The material described herein was collected in 2005 and 2006 on Cubagua Island and 2006 on the Araya Peninsula. Field sampling was conducted with the collaboration and field support of the Estación de Investigaciones Marinas de Margarita (EDIMAR), Fundación La Salle de Ciencias Naturales, Venezuela, which kindly put its facilities at our disposal, and are the result of an ongoing collaboration between the Fundacion La Salle and the Department of Geology of the Faculty of Sciences of the Lisbon University for the study of the Pliocene Cubagua Island malacological assemblages.

The types are deposited in the Museo de la Estación de Investigaciones Marinas de Margarita, EDIMAR (EDIMAR coll.), in the Type Collection in the Invertebrate Paleontology Division of the Florida Museum of Natural History (FLMNH) at the University of Florida (UF). Other specimens figured

are in the Bernard Landau collection, Portugal (BL coll.).

SYSTEMATIC PALAEONTOLOGY

Superfamily Cancellarioidea Forbes & Hanley, 1851

Family Cancellariidae Forbes & Hanley, 1851

Subfamily Cancellariinae Forbes & Hanley, 1851

The classification adopted here is according to Harasewych & Petit *in* Beesley et al. (1998) and Jung and Petit (1990). Most current workers (Ponder and Warén, 1988; Petit and Harasewych, 2005; Bouchet and Rocroi, 2005) follow Ponder (1973) in regarding Cancellarioidea as a superfamily within the Neogastropoda. More recently Kantor and Harasewych (1992) reported similar modifications in the anterior alimentary system of the muricoidean family Volutomitridae and suggested a re-assessment of the taxonomic rank and systematic position of the Cancellarioidea. Rosenberg et al. (1994) suggested the Cancellariidae originated within the Muricoidea on the basis of RNA sequence data.

Genus *Cancellaria* Lamarck, 1799

Subgenus *Cancellaria* Lamarck, 1799

Cancellaria (Cancellaria) capeloi nov. sp.

Figures 1–6

Dimensions and material: Holotype; MOBR-M-3359, 22.8 mm (EDIMAR coll.).

Other material: Paratype 1, height, 30.9 (BL coll.); paratype2, height, 24.6 mm MOBR-M-3360 (EDIMAR coll.); paratype 3, UF 116699, height 26.6 mm; paratype 4, height, 20.6 mm (BL coll.), 12 further specimens, maximum height 32.7 mm (BL coll.).

Etymology: For our colleague Juan Carlos Capelo, malacologist of the Estación de Investigaciones Marinas de Margarita, EDIMAR, Fundación La Salle de Ciencias Naturales, Venezuela, without whose support and enthusiasm this work would not have been possible.

Type locality: Cañon de las Calderas, Cubagua Island, Nueva Esparta State, Venezuela.

Type section: Cerro Negro Member, Cubagua Formation, Lower Pliocene.

Diagnosis

A small to medium-sized *Cancellaria* s.s., with a somewhat scalate spire, narrowly canaliculated suture, medium mesh reticulate sculpture with the axial component very slightly stronger, three non-bifurcate columellar folds, a well developed narrow siphonal fasciole and relatively broad umbilicus.

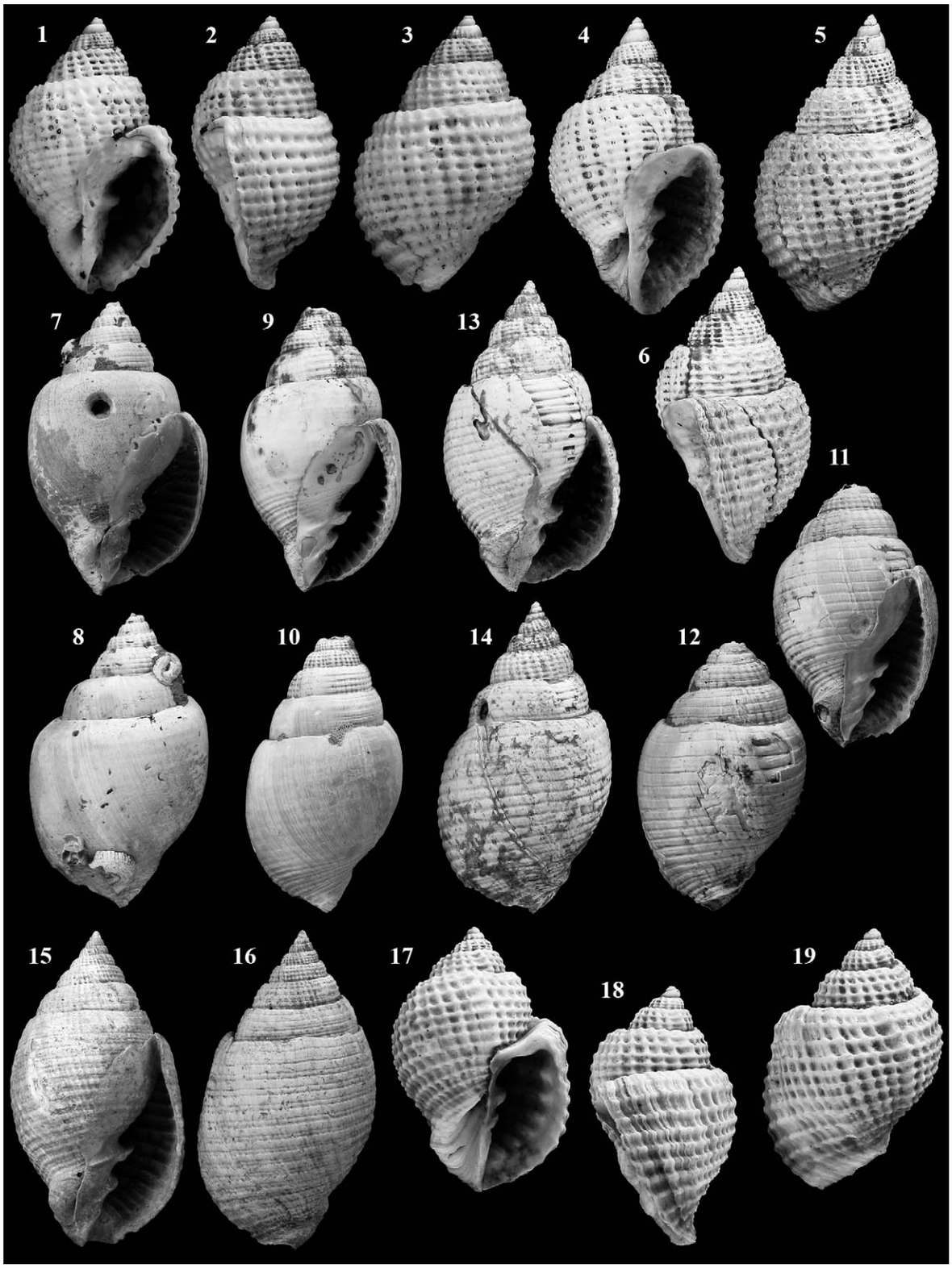
Description

Shell small to medium-sized, solid, ovate, with a medium mesh reticulate sculpture, of which the axial component is slightly stronger. Protoconch missing in all specimens. Teleoconch consists of 4.5–5 weakly convex whorls, with the periphery at the abapical suture. Suture deeply impressed and narrowly canaliculated, giving the spire a somewhat scalate appearance. Sculpture on first teleoconch whorls eroded in all specimens. On the third whorl spiral sculpture consists of five subequal cords, slightly narrower than their interspaces. Axial sculpture consists of about 22 strongly prosocline cords, slightly narrower than their interspaces. The spiral sculpture overrides the axial ribs forming tubercles at the intersections, varices absent. Whorl surface covered by fine prosocline growth lines. Last whorl inflated, regularly convex, with twelve spiral cords above the siphonal fasciole, 26–30 axial ribs, and weakly constricted behind the fasciole. Aperture approximately 50% of total height, sub-oval and elongate. Outer lip simple, not thickened by labial varix, weakly prosocline in profile, stromboid notch absent. Lip with a crenulate edge, strongly and deeply lirate within, but the lirae do not extend to the outer edge. Anal canal poorly developed; siphonal canal short, narrow and slightly recurved. Columella bears three non-bifid folds, the adapical fold largest, overlying the siphonal fasciole. Parietal callus thin, adherent onto the ventral aspect of the last whorl, the whorl sculpture visible through the callus. Columella callus thicker, detached forming the medial wall of the umbilical chink. Siphonal fasciole well developed, narrow, rounded and elevated, bearing four or five spiral cords. Umbilical chink relatively wide and deep for genus.

Discussion

Although *Cancellaria* s.s. usually has a bifid adapical columellar fold, some species characterized by shells lacking that feature, but possessing the other characters of the nominate subgenus, are considered to be part of the nominate subgenus. Several such species were so treated by Jung and Petit (1990).

Several American Neogene Caribbean taxa; *Cancellaria (Cancellaria) barretti* Guppy, 1866, *Cancellaria (Cancellaria) guppyi* Gabb, 1873, *Cancellaria (Cancellaria) petiti* Olsson, 1967, *Cancellaria (Cancellaria) acalypta* Woodring, 1970 are immediately distinguished from *C. (C.) capeloi* nov. sp. in having a clearly bifurcate adapical columellar fold. The shell of *Cancellaria (C.) harrisi* Maury, 1917, from the Upper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Miocene Cercado Formation of the Dominican Republic, which shows a bifid adapical fold, although only slightly so at its terminal portion, is similar in size and shape, but is more elongated and the whorls shouldered close to the suture. *C. epistomifera sathra* Woodring, 1973 (new name for *C. e. lipara* Woodring, 1970) (Woodring, 1973: 481) from the Upper Gatun Formation of Panama is similar to the new species with a scalate spire and slightly umbilicate, these features far more prominent in *C. (C.) capeloi* nov. sp., but differs in having a weakly bifid abapical fold, and being more constricted at the base. We do not consider *C. epistomifera sathra* to be a subspecies of the *C. epistomifera*, widespread in the Dominican Republic Neogene (Jung & Petit, 1990), which is quite different, with a *non* scalate spire, a far more globose last whorl and flaring outer lip with a deep stromboid notch.

Cancellaria (Cancellaria) dariena Toula, 1909 is a *Cancellaria* s.s. with a shell showing a narrow, slightly bifid adapical fold. This species was described from the Gatun area of Panama, and is not particularly similar to *C. (C.) capeloi*, the greatest difference seen at the base, where *C. dariena* is far more constricted with the umbilicus poorly developed, also the posterior fold is much sharper and bifid.

Weisbord (1929, pl. 6, figure 8) figured a specimen as *Cancellaria dariena* Toula, 1909 from the Tubará Group of Colombia, which is not conspecific with the Gatun taxon. The Colombian specimen seems to have a non-bifurcate adapical fold. Most of the Tubará specimens are stated by Weisbord (1929: 282) to have a thickened varix at the outer lip or ''about the middle of the body whorl in back,'' a feature not seen in *C. (C.) capeloi*. Although the Tubará shell assigned to *C. dariena* is extremely close to *C. (C.) capeloi*, it has slighty fewer axial ribs, less evenly reticulated sculpture and the spire is less scalate.

Of the Lower Miocene species of *Cancellaria* s.s. with a non-bifid adapical fold, *Cancellaria (Cancellaria) rowelli* Dall, 1896 from the Baitoa Formation of the Dominican Republic has a shell with a taller spire, somewhat finer sculpture, the last whorl strongly constricted behind the siphonal fasciole and although the fasciole is also well developed, the umbilicus is narrower than in *C. (C.) capeloi*. *Cancellaria (Cancellaria) hodsonae* Landau and Petit, 1997 from the Cantaure Formation of Venezuela is even more elongate, taller spired, with strong spiral sculpture at the shoulder.

Two further species with non-bifurcate columellar folds occur in the Upper Miocene Cercado Formation of the Dominican Republic; *Cancellaria (Cancellaria) mauryae* Olsson, 1922 and *Cancellaria (Cancellaria) juncta* Jung and Petit, 1990. Both have larger and thinner shells, with a more inflated body whorl, a much finer sculpture, a much less elevated the siphonal fasciole, and a very small umbilical chink. Weisbord (1962) described *Cancellaria torula* from the Lower Mare Formation, Middle Pliocene of Venezuela. The type material consisted of a single incomplete and very poorly preserved juvenile specimen. Weisbord (1962: 398) distinguished this mutilated *Cancellaria* shell from its congeners on the basis of a ''strong, irregularly thickened, *Distorsio*-like ridge on the parietal wall.'' Gibson-Smith & Gibson-Smith (1979) placed *C. torula* in the synonymy of *C. reticulata* (Linnaeus, 1767) on the basis of the fact that the parietal ridge that Weisbord (1962) used to differentiate *C. torula* from *C. reticulata* and other *Cancellaria* s.s. was absent in an adult specimen but present in a juvenile collected by the Gibson-Smiths. They declared the ridge to be an ''intermittent resting stage in the juveniles but is absent in the adults'' (Gibson-Smith & Gibson-Smith, 1979: 26). This ridge is indeed present in juvenile shells of *C. reticulata*, and a trace of one is present in some adult specimens (Petit, personal observation). On the basis of the specimen illustrated by Weisbord (1962), it is impossible to say with any certainty what is meant by *C. torula*, however, the posterior ridge is finer than that seen in *C. capeloi* (although Weisbord's shell is probably juvenile), and the parietal ridge is not present in any of the Cubagua shells, even at the juvenile stage. The Gibson-Smith & Gibson-Smith (1979) Mare material of *Cancellaria (C.) torula* is not available but, based on sculpture visible on the type figure of *C. torula*, the specimen is unlikely to be conspecific with *C. reticulata*, and possibly closer to

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Figures 1–19. Figures 1–3. *Cancellaria (Cancellaria) capeloi* nov. sp. Holotype; MOBR-M-3359 (EDIMAR coll.), Locality 1, Cañon de las Calderas. Height 22.8 mm. Figures 4–6. *Cancellaria (Cancellaria) capeloi* nov. sp. paratype; BL coll., Locality 1, Cañon de las Calderas. Height 30.9 mm. Figures 7–8. *Cancellaria (Cancellaria)* sp. Specimen 1. BL coll., Lower sandy bed, Cerro Barrigón, Araya Peninsula, Venezuela. Height 44.9 mm. Figures 9–10. *Cancellaria (Cancellaria)* sp. Specimen 2. BL coll., Lower sandy bed, Cerro Barrigón, Araya Peninsula, Venezuela. Height 47.4 mm. Figures 11–12. *Cancellaria (Cancellaria)* sp. Specimen 2. BL coll., Upper bed, Cerro Barrigón, Araya Peninsula, Venezuela. Height 41.2 mm. Figures 13–14. *Cancellaria (Cancellaria)* sp. Specimen 2. BL coll., Lower sandy bed, Cerro Barrigón, Araya Peninsula, Venezuela. Height 37.1 mm. Figures 15–16. *Cancellaria (Cancellaria)* sp. Specimen 2. BL coll., Locality 1, Cañon de las Calderas. Height 46.2 mm. Figures 17–19. *Cancellaria (Bivetiella) lugogonzalezorum* Holotype; MOBR-M-3361 (EDIMAR coll.), Casa Cantaure, east of San Jose, Paraguaná Peninsula, Falcón State, Venezuela, Cantaure Formation, Lower Miocene.

C. capeloi. Due to the fact that *C. torula* has been formalized on a single incomplete and very poorly preserved juvenile specimen, we consider the Weisbord taxon to be a *nomen dubium*. Moreover, few species are common to both Mare and Cubagua. The supposed conspecificity of *C. torula* and *C. reticulata* argues against uniting it with *C. capeloi* which cannot be confused with *C. reticulata*.

Distribution

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela.

Cancellaria (Cancellaria) ssp.

We have five shells from the Cerro Negro Member of the Cubagua Formation tentatively placed in the nominate subgenus; all have a bifurcated posterior columellar fold except for one (Figures 7–8). One is from Cañon de las Calderas (Specimen 5; Figures 15–16) and the other four from Cerro Barrigón on the Araya Peninsula, three from the 'lower bed' (Specimens 1, 2 and 4; Figures 7–8, 9–10 and 13–14), one from the 'upper bed' (Specimen 3; figure 11–12).

All five specimens are slightly different requiring a short description of the salient features of each;

Specimen 1 (Figures 7–8)

Shell ovate, spire mid-height, strongly scalate. Six teleoconch whorls preserved, shouldered, last whorl strongly shouldered; axial sculpture consisting of prosocline ribs, 20 on the fourth whorl, weakening abapically, obsolete after the first quarter of the penultimate whorl; spiral sculpture of primary cords obsolete after the first quarter of the penultimate whorl, persisting only on the base.

Specimen 2 (Figures 9–10)

Shell ovate-fusiform, spire tall and somewhat scalate. Four teleoconch whorls preserved, somewhat shouldered; axial sculpture consisting of close-set prosocline ribs, 29 on the second preserved whorl (probably the fourth whorl), weakening abapically, obsolete after the first quarter of the penultimate whorl; spiral sculpture of primary cords obsolete on the second half of the penultimate whorl, persisting only on the base.

Specimen 3 (Figures 11–12)

Shell ovate-fusiform. Protoconch worn, but consisting of at least two elevated whorls. Six teleoconch whorls, not shouldered; axial sculpture consisting of close-set prosocline ribs, 26 on the fourth whorl, weakening abapically, obsolete on the second half of the penultimate whorl; spiral sculpture of primary cords only strongly developed throughout.

Specimen 3 (Figures 13–14)

Shell ovate-fusiform. Three teleoconch whorls preserved, weakly shouldered; axial sculpture consisting of close-set prosocline ribs, 28 on the first preserved whorl (probably the fourth whorl), weakening abapically, obsolete on the last quarter of the penultimate whorl; spiral sculpture of primary cords developed throughout, with a tendency for the cords mid-whorl to subdivide.

Specimen 5 (Figures 15–16)

Shell ovate-fusiform. Protoconch worn. Seven teleoconch whorls, not shouldered; axial sculpture consisting of close-set prosocline ribs, 47 on the fourth whorl, weakening abapically, but persisting onto the first half of the last whorl; spiral sculpture of primary and secondary cords strongly developed throughout.

Although the sculpture weakens considerably on the last whorl of most of these five shells, as seen in the subgenus *Pyruclia*, the posterior columellar fold is bifid in four of the five shells and not large and broadly divided, giving the appearance of an additional fold, as in *Pyruclia* (Jung and Petit, 1990).

Compared to other Caribbean taxa with fusiform rather than pyriform shells; *C. (Pyruclia?) uva* Jung and Petit, 1990 from the Lower Miocene, Baitoa Formation of the Dominican Republic has closely packed axial cords on the early whorls, similar to our specimen 5, but the axial ribs disappear at the end of the penultimate whorl and the spiral sculpture is subobsolete on the last whorl, the shell shape is similar to our specimen 1. *Cancellaria (P.?) laevescens* Guppy, 1866 is closely similar in shell shape to our specimen 1, with a similar number of ribs on the fourth whorl as our specimens 2–4, which persist until the end of the penultimate whorl. All the Pliocene Pacific species from Ecuador; *C. (P.?) lacondamini, C. (P.?) picta, C. (P.?) telemba* all Olsson, 1964 have shells with lower-spires and more globose last whorls.

Our series of shells is similar to the Recent eastern Pacific group comprising *C. (C.) obesa* Sowerby, 1832 and *C. (C.) ovata* Sowerby, 1832, our broader shells with smooth last whorls similar to the former, the more fusiform shells with spiral sculpture persisting on the last whorl to the latter. The Pacific Pleistocene *C. (C.) coronadoensis* Durham, 1950, which is not consistently different from the Recent Pacific *C. (C.) obesa* Sowerby, 1832, is similar to our specimen 1, but the axial sculpture is much finer, and confined to the early teleoconch whorls.

With the scant material from the Cubagua Formation available to us we are unable to conclude if we are dealing with a single variable taxon or several distinct sympatric species. Nevertheless, these shells again reflect the strongly paciphile character of the Cubagua cancellarid fauna.

Subgenus *Bivetiella* Wenz, 1943

Cancellaria (Bivetiella) lugogonzalezorum nov. sp.

Figures 17–19

Cancellaria (Cancellaria?) lavelana H. K. Hodson - Jung, 1965, p. 550, pl. 75, Figures 5–6 (*non* H. K. Hodson in Hodson and Hodson, 1931).

Dimensions and material: Holotype; MOBR-M-3361, height, 17.6 mm (EDIMAR coll.).

Other material: Paratype1 MOBR-M-3362 (EDIMAR coll.), height, 17.6 mm; paratype 2, UF 116700, height, 16.3 mm; paratype 3, height, 16.5 mm (BL coll.), plus 29 further paratypes (BL coll.).

Etymology: For the family Lugo Gonzalez of San Jose de Cocodite, Paraguaná Peninsula, Venezuela, owners of the Cantaure property, for their generous hospitality during our numerous trips.

Type locality: Casa Cantaure, east of San Jose de Cocodite, Paraguaná Peninsula, Falcón State, Venezuela.

Type section: Cantaure Formation, Lower Miocene.

Description

Shell small, solid, ovate, with a fine mesh reticulate sculpture, the axial component slightly stronger. Protoconch consists of about three smooth, strongly convex whorls, with a small nucleus. Junction with teleoconch sharply delimited by a prosocline scar. Teleoconch consists of four convex whorls, with the periphery at the abapical suture. Suture deeply impressed and narrowly canaliculated. Sculpture consists of prosocline rounded axial rib, about half the width if their interspaces, 9–14 on the first teleoconch whorl, 17–22 on the penultimate. Weakly developed varices present at about 120° intervals. Spiral sculpture consists of rounded spiral cords, about half the width if their interspaces, three on the first teleoconch whorl, 5–6 on the penultimate. The two adapical cords on the later adult whorls are more closely set than the remaining cords. The spiral sculpture overrides the axial ribs forming small tubercles at the intersections. Whorl surface covered by fine prosocline growth lines. Last whorl strongly inflated, regularly convex, with 12–14 spiral cords above the siphonal fasciole, about 35 axial ribs and moderately constricted behind the fasciole. Aperture approximately 50% of total height, sub-oval and elongate. Outer lip simple, not thickened by labial varix, slightly flared abapically, strongly prosocline in profile, stromboid notch absent. Lip with a crenulate edge, bearing six strong denticles a short distance inside the lip, which continue as lirae within. Anal canal poorly developed; siphonal canal short, narrow and slightly recurved. Columella bears three bifid folds, the adapical fold largest. Parietal callus thin, adherent onto the ventral aspect of the last whorl, the whorl sculpture visible through the callus. Columella callus thicker, detached forming the medial wall of the umbilical chink. Siphonal fasciole well developed, rounded and elevated, bearing three cords. Umbilical chink relatively wide for genus.

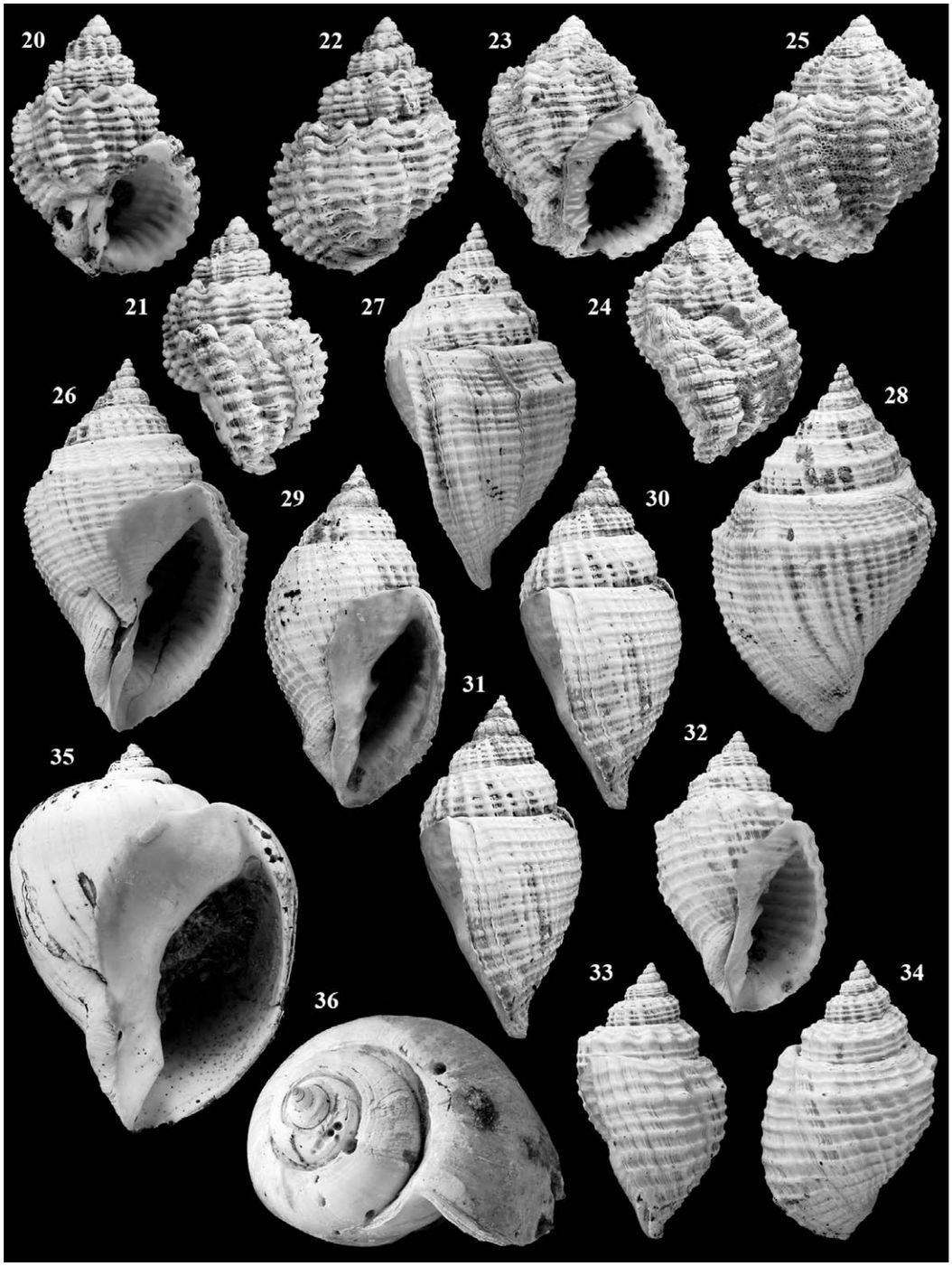
Discussion

The holotype of *C. (B.) lugogonzalezorum* nov. sp. is almost certainly conspecific with the shell illustrated by Jung (1965) as *Cancellaria (Cancellaria?) lavelana* H. K. Hodson. However, Hodson's (1931, pl. 24, figure 12) shell is a species of *Massyla* H. and A. Adams, 1854. Landau and Petit (1996) discussed and renamed some of the Cantaure cancellarids described by Jung (1965).

Cancellaria (Bivetiella) lugogonzalezorum nov. sp. again illustrates the difficulty in placing Caribbean Neogene species of the Cancellariidae neatly within subgenera, and this species is herein tentatively placed within the subgenus *Bivetiella*. The shell has weak varices and bifid second and third folds, seen in some species within the subgenus *Bivetiella*, but the adapical fold is also bifid. A stromboid notch, a typical feature of *Cancellaria* s.s., is not present. The outer lip is slightly flared abapically, but not as clearly everted as in most *Bivetiella* species. In view of the small size and relatively inflated last whorl we have opted for the subgenus *Bivetiella*.

C. (B.) lugogonzalezorum nov. sp. shows great variability in shell features. In gerontic specimens the last whorl is more elongated, the outer lip slightly more flared. The reticulate sculpture is of somewhat variable mesh size, with a tendency in some specimens to have a few cords crowded together below the adapical suture, followed by one or two cords more widely spaced than the rest, whilst in others the reticulation is regular. The height of the spire, width of the umbilicus and strength of the labral denticulation are all variable as are the folds, clearly bifid to incipiently so.

Despite this great variability, the shells of this new species are very characteristic, being the smallest in the subgenus, and the intermediate features outlined above distinguish them from other members of *Cancellaria* and *Bivetiella*. We draw particular attention to the strongly prosocline outer lip profile.



Figures 20–37. Figures 20–22. *Cancellaria (Bivetopsia) pachia* M. Smith, 1940. BL coll., Locality 1, Cañon de las Calderas. Height 24.6 mm. Figures 23–25 *Cancellaria (Bivetopsia) herberti* nov. sp. Holotype; MOBR-M-3419 (EDIMAR coll.), Casa Cantaure, east of San Jose, Paraguaná Peninsula, Falcón State, Venezuela, Cantaure Formation, Lower Miocene, Height 18.8 mm. Figures 26–28. *Cancellaria (Euclia) codazzii* Anderson, 1929. BL coll., Locality 1, Cañon de las Calderas. Height 41.9 mm. Figures 29–31. *Cancellaria (Euclia) leuzingeri* Rutsch, 1934. BL coll., Locality 1, Cañon de las Calderas. Height 44.2 mm. Figures 32–34. *Cancellaria (Euclia) montserratensis* Maury, 1925. BL coll., Locality 1, Cañon de las Calderas. Height 37.0 mm. Figures 35–37. *Cancellaria (Pyruclia) scheibei* Anderson, 1929. BL coll., Locality 1, Cañon de las Calderas. Height 49.9 mm.

Cancellaria (B.) lugogonzalezorum is superficially similar to *C (C.) capeloi*, but is immediately distinguished by the bifid columellar folds and strongly prosocline outer lip.

With the description of this new species, and the record of an undescribed *Cancellaria (Bivetopsia)* nov. sp. (Figures 23–25), the number of cancellarids known from the Lower Miocene Cantaure Formation is increased to 14 (see Landau and Petit, 1996).

Distribution

Lower Miocene: Cantaure Formation, Paraguaná Peninsula, Falcón State, Venezuela.

Subgenus *Bivetopsia* Jousseaume, 1887

Cancellaria (Bivetopsia) pachia M. Smith, 1940

Figures 20–22

Cancellaria pachia M. Smith, 1940, p. 45, pl. 2, figure 2.
non Bivetopsia pachia (M. Smith, 1940) - Petuch, 1994, p. 222, pl. 90, figure C.

Material and dimensions: Maximum height 25.9 mm. 14 specimens Cañon de las Calderas, Cubagua Island; 3 specimens 'upper bed,' Cerro Barrigón, Araya Peninsula (BL coll.).

Discussion

The characteristics of the subgenus *Bivetopsia* Jousseaume, 1887 were discussed by Jung and Petit (1990), similar to *Bivetiella* Wenz, 1943, but usually smaller shelled, without a stromboid notch at the outer lip, and the last whorl strongly constricted behind a well developed siphonal fasciole.

Although Jung and Petit (1990) cited *Bivetopsia pachia* (M. Smith, 1940) as a subspecies of *B. moorei* (Guppy, 1866) they are separate species. *C. (B). moorei* has a shell with a more attenuate profile lacking the strong shoulder and thickened out lip of *C. (B). pachia*. However, the major and most easily noted difference is the presence of wider spiral cords on the shells of *C. (B). pachia*, all of which are bifurcated by a deep narrow groove, a feature not prominent in other species. *Cancellaria (B.) plectilis* (Jung and Petit, 1990) has even heavier spiral cords with multiple grooves. The Recent species *Cancellaria (Bivetopsia) rugosa* (Lamarck, 1822), distinguished by its rounded form and low sculpture, also has grooves in the spiral cords but they are neither as pronounced nor prominent as they are in the shells of other species and are sometimes absent on most of the cords. The specimen figured by Petuch (1994, pl. 90, figure C) as *Bivetopsia pachia* does not correspond to that species and cannot be clearly identified from the illustration, but it appears to be a shell of either *C. (B). rugosa* or of a very closely related unnamed species.

The subgenus *Bivetopsia* is American, the few known species confined to the Neogene of Florida, the Caribbean and Ecuador, and the Recent fauna of the Caribbean and the Panamic-Pacific provinces. Cahuzac et al. (2004) suggested *Scalptia spinosa* (Grateloup, 1827) from the Lower Miocene of Landes, France, had some features of this taxon, but the shell shape and aperture characteristics are not those of *Bivetopsia*. The group first appeared in the Lower Miocene Cantaure Formation of Venezuela, represented by *Cancellaria (Bivetopsia) herberti* nov. sp. (Figures 23–25), which differs from both *C. (Bivetopsia) pachia* and *C. (B.) moorei* in being smaller, squatter, with a more depressed spire, with fewer axial ribs, a similar number of spiral cords, but with a secondary cord in some of the interspaces and the suture is less depressed and not canaliculated. The Cantaure specimen is more similar in shape to the Recent *C. (B.) chrysostoma* Sowerby, 1832, type species of *Bivetopsia*, but the umbilicus is wider and the suture again somewhat canaliculated in the Recent species. The presence of *C. (B.) pachia* in Cubagua is interesting, making it one of the most long-lived Caribbean Neogene cancellarids, Early Pliocene to Pleistocene, with a wide geographical distribution. Only *Extractrix hoerlei* Olsson, 1967 has a wider distribution in the Pliocene, reported from the Lower Pliocene of Punta Gavilán, mainland Venezuela (Jung, 1977) and the Lower-Middle Pliocene of Virginia, USA (Campbell, 1993).

Distribution

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela.

Plio-Pleistocene: Florida (M. Smith, 1940).

Cancellaria (Bivetopsia) herberti nov. sp.

Figures 23–25

Dimensions and material: Holotype; Holotype; MOBR-M-3419, 18.8 mm (EDIMAR coll.).

Other material: Paratypel, height, 19.0 mm (BL coll.).

Etymology: For Gregory Herbert of the University of South Florida in recognition of his wonderful work on Neogene Caribbean taxonomy.

Type locality: Casa Cantaure, east of San Jose de Cocodite, Paraguaná Peninsula, Falcón State, Venezuela.

Type section: Cantaure Formation, Lower Miocene.

Description

Shell small, solid, ovate, squat, with a predominantly axial sculpture. Protoconch consists of about three and a half smooth, strongly convex whorls, with a small nucleus. Junction with teleoconch sharply delimited by a prosocline scar. Teleoconch consists of three and a half convex whorls, with the periphery at the abapical suture. Suture deeply impressed and undulating. Sculpture on the first teleoconch whorl somewhat eroded. Second teleoconch whorl bears 12 prosocline axial ribs, of very irregular strength, about half the width of their interspaces. Last whorl bears eight, every second or third rib thickened into a varix. Spiral sculpture consists of six narrow, elevated spiral cords on the first and second whorls, with secondary threads intercalated towards the end of the second whorl. Last whorl with 12 primary spiral cords, secondary threads in some, but not all interspaces, some of the primary cords mid-whorl weakly bifid. On the last whorl the sculptural intersections at the shoulder are developed into small, horizontally-elongated, adapically-pointing rounded tubercles, giving the whorl a somewhat shouldered appearance. Whorl surface covered in prosocline growth lamellae, giving the shell a somewhat scabrous appearance. Last whorl globose, squat, moderately constricted behind the fasciole. Aperture approximately 60% of total height, sub-oval and elongate. Outer lip thickened by a broad labial varix, flared abapically, prosocline in profile and angled at the rather narrow, but distinct stromboid notch. Lip with a crenulated edge, strongly and deeply lirate within, 13 lirae, the abapical lirae ending almost at the lip edge in a slightly thickened denticle. Columella bears three non-bifid folds, the adapical fold largest. Columellar and parietal calluses strongly thickened, sharply delimited, moderately expanded and adherent onto the ventral aspect of the last whorl. The entire callus is covered in numerous irregular folds and tubercles. Siphonal canal damaged. Siphonal fasciole well developed, rounded and elevated, bearing six cords. Umbilical chink present, of average size for genus.

Discussion

Although this species is represented only by the holotype with a damaged siphonal canal, and a subadult damaged specimen (paratype 1, BL coll.), it is distinctive enough to be certain it is different from all other known *Bivetopsia* species. For comparison with other related species see above.

Distribution

Lower Miocene: Cantaure Formation, Paraguaná Peninsula, Falcón State, Venezuela.

Cancellaria (Euclia) codazzii Anderson, 1929

Figures 26–28

Cancellaria codazzii Anderson, 1929, p. 116, pl. 14, Figures 4–7; Barrios, 1960, p. 291, pl. 11, figure 5.
Cancellaria karsteni Anderson, 1929, p. 114, pl. 10, Figures 7–9.
Cancellaria hettneri Anderson, 1929, p. 114, pl. 10, Figures 5–6.
Cancellaria (Euclia) cf. *codazzii* Anderson - Jung, 1969, p. 541, pl. 58, figure 8.
Cancellaria (Euclia) codazzii Anderson - Woodring, 1970, p. 339, pl. 54, Figures 3, 4, 7, 8, 11, 12.

Material and dimensions: Maximum height 41.9 mm. 6 specimens Cañon de las Calderas, Cubagua Island (BL coll.).

Discussion

As discussed by Woodring (1970), the shells of this species are very variable, with the angulation at the shoulder of the last whorl and the spines more or less developed. Woodring (1970) considered *C. (E.) karsteni* Anderson and *C. (E.) hettneri* Anderson to be synonyms of *C. (E.) codazzii*. As first reviser he selected the name *C. codazzii* as the senior synonym, considering the other two nominal species to represent variability extremes. Woodring also included in his synonymy *C. (E.) maldonadoi* Olsson, 1964 from the Pacific Upper Miocene Angostura Formation of Ecuador. That synonymy was not accepted by Jung & Petit (1999) as *C. (E.) maldonadoi* has a rounded body whorl whereas the shells of *C. (E.) codazzii* have a sharp shoulder with a flat or concave area posterior to the shoulder. Our specimens from Cubagua have a flat or concave shoulder posterior to the angled shoulder and match the type specimen of *C. (E.) codazzii*.

The subgenus *Euclia* H. and A. Adams, 1854 is characterized by having swollen axial ribs on the last whorl with a tendency to form nodules at the shoulder. Both *Euclia* and *Pyruclia* Olsson, 1932 represent species groups which were present in the Neogene Caribbean but are now restricted to the Pacific. In this particular case the lineage starts in the Early Miocene with *C. (E.) werenfelsi* Jung, 1965 from the Cantaure Formation of Venezuela. This is a species with a relatively small, elongated shell, with fine axial sculpture and relatively well-developed spines at the shoulder. *Cancellaria (E.) codazzii* is then present in both the Atlantic and Pacific in the Late Miocene giving rise to the Pacific Tropical American species of *Euclia* of which *C. (E.) balboae* Pilsbry, 1931 is the most similar, but differs in having fewer axial ribs on the spire whorls (Woodring, 1970). The shell of the more common Pacific Pleistocene to Recent *C. (E.) cassidiformis* Sowerby, 1832 is larger, more spinose and has angular spire whorls as well on the last whorl.

Distribution

Upper Miocene: Gatun Formation, Panama (Woodring, 1970).

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela; Tubará Group, northern Colombia (Anderson, 1929; Barrios, 1960); Melajo Clay Member of Springvale Formation, Trinidad (Jung, 1969).

Cancellaria (Euclia) leuzingeri Rutsch, 1934

Figures 29–31

Cancellaria reticulata leuzingeri Rutsch, 1934, p. 89, pl. 7, Figures 10–11, pl. 8, Figures 1, 2, 5.

Material and dimensions: Maximum height 50.1 mm. 11 specimens (BL coll.), 10 specimens (EDIMAR coll.), Cañon de las Calderas, Cubagua Island; 8 specimens 'lower bed,' Cerro Barrigón, Araya Peninsula (BL coll.).

Discussion

Cancellaria (Euclia) leuzingeri Rutsch, 1934 is common at both its type locality, at Punta Gavilán, and at Cañon de las Calderas, but has not been found outside of Venezuela. Originally described as a subspecies of *Cancellaria reticulata* (Linnaeus, 1767), the affinity between the two is superficial. The adapical columellar fold in *C. reticulata* is bifurcate, a character of *Cancellaria* s.s. The form of the columellar folds and the shell outline clearly place *C. leuzingeri* in the subgenus *Euclia*. The species is very close to the Recent *C. (E.) laurettae* Petit and Harasewych, 1998 from bathyal depths in the Golfo de Chiriqui, Panama (Pacific). A characteristic of the shells of most species of the subgenus is the ''stretched out'' shape of the aperture.

Petit and Harasewych (1998, p. 113) listed the Cenozoic and Recent species of *Euclia* known from Panamic faunas, as well as Cenozoic species from the Caribbean, where the subgenus no longer occurs (i.e., a paciphile genus). Unfortunately *C. (E.) leuzingeri* was omitted from that list.

Distribution

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela; Punta Gavilán Formation, Falcón, Venezuela (Rutsch, 1934).

Cancellaria (Euclia) montserratensis Maury, 1925

Figures 32–34

Cancellaria montserratensis Maury, 1925, p. 346, pl. 35, Figures 6, 8; Rutsch, 1942, p. 163, pl. 9, figure 7.

Cancellaria epistomifera Guppy - Maury, 1925, p. 345, pl. 35, figure 7 (*non C. epistomifera* Guppy, 1876).

Cancellaria springvaleensis Mansfield, 1925, p. 31, pl. 2, figure 12.

Cancellaria (Cancellaria) couvana Vokes, 1938, p. 20, figure 21.

Cancellaria (Euclia) montserratensis Maury - Jung, 1969, p. 539, pl. 58, Figures 6–7.

Material and dimensions: Maximum height 41.2 mm. 17 specimens (BL coll.), 8 specimens (EDIMAR coll.), Cañon de las Calderas, Cubagua Island; 2 specimens 'upper bed,' Cerro Barrigón, Araya Peninsula (BL coll.).

Discussion

Cancellaria (Euclia) montserratensis Maury, 1925 is one of the commoner cancellarids found at Cañon de las Calderas. It is easily distinguished from *Cancellaria (Euclia) codazzii* Anderson, 1929, which has a shell with a less scalate spire, finer spiral sculpture, less angular whorls, with the shoulder placed further from the suture. Maury (1925) compared it to *Cancellaria harrisi* Maury, 1917, from the Miocene of the Dominican Republic, but this is a much smaller shell with finer sculpture.

Distribution

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela; Tubará Group, northern Colombia (Anderson, 1929; Barrios, 1960); Savaneta Glauconitic Sandstone Member and Melajo Clay Member of Springvale Formation, Trinidad (Maury, 1925; Mansfield, 1925; Vokes, 1938; Rutsch, 1942; Jung, 1969).

Subgenus *Pyruclia* Olsson, 1932

Cancellaria (Pyruclia) scheibei Anderson, 1929

Figures 35–37

Cancellaria scheibei Anderson, 1929, p. 115, pl. 10, Figures 1–4.

Cancellaria (Pyruclia) diadela Woodring, 1970, p. 338, pl. 53, Figures 7, 9.

Material and dimensions: Maximum height 77.2 mm. 9 specimens (BL coll.), 4 specimens (EDIMAR coll.), Cañon de las Calderas, Cubagua Island; 2 specimens 'upper bed,' Cerro Barrigón, Araya Peninsula (BL coll.).

Discussion

Cancellaria (Pyruclia) scheibei Anderson, 1929 is not uncommon at Cañon de las Calderas, where the shells reach a large size, but are rarely complete. Although the deep sutural canal is not evident in the figure of the holotype (Anderson, 1929, pl. 10, Figures 1–2), our specimens match the original description, also having weak axial sculpture confined to the first two to three

teleoconch whorls. Woodring (1970) described a very close species based on a single shell from the upper part of the Gatun Formation of Panama, *Cancellaria (Pyruclia) diadela*, said to differ in having a lower spire and a more angular last whorl. The height of the spire and strength and position of the shoulder is rather variable in the Cubagua specimens and, therefore, we consider the latter a junior synonym of *C. (P.) scheibei*.

Jung and Petit (1990) discussed the characters of the subgenus *Pyruclia*, and stressed that only the species with a pyriform shell could be assigned to it with certainty. *Cancellaria (Pyruclia) scheibei* is somewhat unusual and can easily be distinguished from its congeners by the extremely wide and deeply channelled sutural canal. The *Pyurclia* s.s. species group seems to have appeared in the Late Miocene simultaneously on both sides of the Central American Seaway, and survived in the Atlantic only into the earliest Pliocene. Today it is represented in the Pacific by two species; *C. (P.) solida* Sowerby, 1832 and *C. (P.) bulbulus* Sowerby, 1832. *Cancellaria (P.) solida* is the most similar, but lacks the deep sutural canal.

Distribution

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela; Tubará Group, northern Colombia (Anderson, 1929); Gatun Formation, Panama (Woodring, 1970).

Subgenus *Massyla* H. and A. Adams, 1854

Cancellaria (Massyla) cubaguaensis nov. sp.

Figures 38–44

Dimensions and material: Holotype; MOBR-M-3363, height, 25.9 mm (EDIMAR coll.).

Other material: Paratype 1 24.6 mm MOBR-M-3364 (EDIMAR coll.); paratype 2, UF 116701, height 22.4 mm; 6 further specimens (BL. coll.).

Etymology: From its type locality of Cubagua.

Type locality: Cañon de las Calderas, Cubagua Island, Nueva Esparta State, Venezuela.

Type section: Cerro Negro Member, Cubagua Formation, Lower Pliocene.

Diagnosis

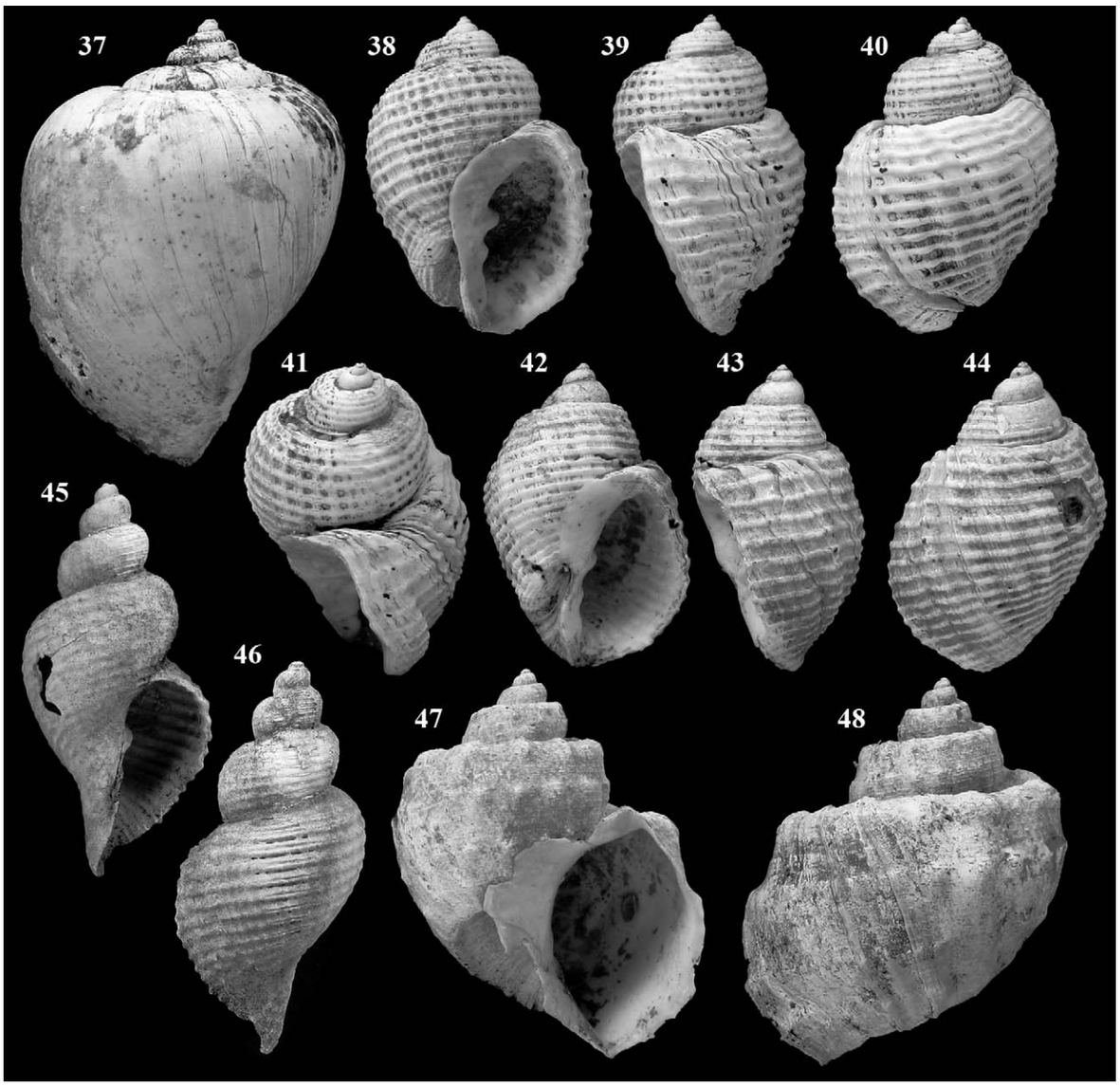
A medium sized *Cancellaria (Massyla)* with a shell with a relatively depressed spire and strongly inflated last whorl, which is hardly constricted behind the siphonal fasciole, predominant spiral sculpture, strongly developed parietal callus, broad siphonal fasciole and very short siphonal canal.

Description

Protoconch missing. Teleoconch consists of 5.5 convex whorls, with the periphery at the abapical suture. Sculpture on the first two teleoconch whorls worn. Sculpture on the third teleoconch whorl consists of five prominent subequal spiral cords, equal in width to their interspaces, and close-set, strongly prosocline axial lamellae. The number of spiral cords increases abapically, seven on the penultimate whorl, 14–16 on the last whorl, and the axial lamellae become more prominent, about 23 on the last whorl, developing into broad axial folds on the last half whorl. The strength of the axial sculpture is variable, relatively strong in the holotype, giving the last whorl a reticulate appearance, but with the spiral cords predominant, whereas the axial sculpture is much weaker in the paratype. The whole shell surface is covered by very close-set prosocline growth lines. Suture well rounded and deeply impressed. Last whorl strongly inflated, rounded, somewhat barrel-shaped, with the periphery just above mid-whorl, hardly constricted behind the siphonal fasciole. Aperture ovate, outer lip prosocline, thickened by labial varix, strongly and deeply lirate within. Columella straight, with two strong folds, the adapical one much larger, which extends almost to the edge of the thick, well-developed, sharply delimited parietal callus, which is expanded some distance onto the ventral portion on the last whorl, behind which there is a moderately small but deep umbilicus. Siphonal fasciole broad and well developed, bearing six to seven close-set, rounded spiral cords. Siphonal canal extremely short and slightly recurved. The adapical portion of the outer lip bears a strong fold apressed to the body whorl, forming a small anal canal.

Discussion

The Lower Pliocene *Cancellaria (Massyla) cubaguaensis* nov. sp. is closely related and probably descended from the *C. (M.) cantaurana* Landau and Petit, 1996 from the Lower Miocene Cantaure Formation of Venezuela, but has a larger shell, the spire is squatter, the axial sculpture weaker, the spiral cords stronger, the parietal callus more strongly developed and the siphonal fasciole broader. *Cancellaria (Massyla) lopezana* Jung and Petit, 1990 from the Lower Miocene, Baitoa Formation of the Dominican Republic is of similar size and also has a low spire, however it differs from *C. (M.) cubaguaensis* nov. sp. in having finer, more numerous spiral cords, the parietal callus is less developed, the siphonal canal is narrower and more elevated, the last whorl constricted behind the fasciole,



Figures 38–48. Figures 38–41. *Cancellaria (Massyla) cubaguaensis* nov. sp. Holotype; MOBR-M-3363 (EDIMAR coll.), Locality 1, Cañon de las Calderas. Height 25.9 mm. Figures 42–44. *Cancellaria (Massyla) cubaguaensis* nov. sp. Paratype, BL coll., Locality 1, Cañon de las Calderas. Height 22.4 mm. Figures 45–46. *Cancellaria (Charcolleria) terryi* Olsson, 1942. BL coll., Locality 1, Cañon de las Calderas. Height 46.0 mm. Figures 47–48. *Trigonostoma (Ventrilia) rucksorum* (Petuch, 1994). BL coll., Locality 1, Cañon de las Calderas. Height 35.9 mm.

and the siphonal canal much longer. *Cancellaria (Massyla) jadisi* Olsson, 1964 from the Upper Miocene Angostura Formation of northwestern Ecuador is also closely similar, with a low spire and a very short siphonal canal, however it differs mainly in the shape of the last whorl, which is more rounded, the periphery at rather than above mid-whorl and more constricted behind the siphonal fasciole. The holotype of *C. (M.) jadisi* has a parietal callus consisting only of a weak wash as contrasted to the heavy and well-defined callus of *C. (M.) cubaguaensis*. The Floridian Neogene species, such as *C. (M.) venusta* (Tuomey and Holmes, 1856) and *C. (M.) propevenusta* (Mansfield, 1933) all have shells with much longer siphonal canals.

The subgenus *Massyla* H. and A. Adams, 1854 was well represented and diversified in the Caribbean Neogene, but disappeared from the Atlantic during the Pliocene. Two Recent species occur in fairly shallow water in the southern part of the Panamic-Pacific Province, *C. (M.) corrugata* Hinds, 1843 and *C. (M.) obtusa* Deshayes, 1830. There is a third nominal species, *C. (M.) cumingiana* (Petit de la Saussaye, 1844) that is probably a synonym of *C. (M.) obtusa*.

Subgenus *Charcolleria* Olsson, 1942

Cancellaria (Charcolleria) terryi Olsson, 1942

Figures 45–46

Cancellaria (Charcolleria) terryi Olsson, 1942, p. 62, pl. 8, figure 1; Olsson, 1964, p. 124, pl. 22, figure 2; Jung, 1965, p. 556, pl. 75, Figures. 17–19; Woodring, 1970, p. 343, pl. 54, Figures 5, 6, 9, 10.
Cancellaria (Charcolleria) sp. - Olsson, 1964, p. 124, pl. 22, figure 1.

Material and dimensions: Single specimen 46.0 mm, Cañon de las Calderas, Cubagua Island (BL coll.).

Discussion

Represented by a single, large, somewhat abraded specimen showing the coarse sculpture characteristic of the species.

Distribution: Atlantic

Lower Miocene: Cantaure Formation, Venezuela (Jung, 1965).

Upper Miocene: Gatun Formation, Panama (Olsson, 1964; Woodring, 1970).

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela; Punta Gavilán Formation, Falcón, Venezuela (Woodring, 1970).

Distribution: Pacific

Lower Pliocene: Esmeraldas Formation, Ecuador (Olsson, 1964).

Pliocene (indeterminate): Charco Azul Formation, Burica Peninsula, Costa Rica (Olsson, 1942).

Genus *Trigonostoma* Blainville, 1827

Subgenus *Ventrilia* Jousseaume, 1887

Trigonostoma (Ventrilia) rucksorum (Petuch, 1994)

Figures 47–48

Ventrilia rucksorum Petuch, 1994, p. 351, pl. 88, figure K
Ventrilia kissimmeensis Petuch, 1994, p. 350, pl. 89, figure B

Material and dimensions: Height 36.3 mm. 1 specimen, Cañon de las Calderas, Cubagua Island (BL coll.).

Discussion

A single specimen, in excellent condition, of a *Trigonostoma (Ventrilia)* shell was collected from the Cañon de las Calderas locality. Although this genus had not been recorded from the Lower Pliocene southern Caribbean, other specimens (BL coll.) collected from coeval deposits at Punta Gavilán, on mainland Venezuela, and in the Springvale Formation of Trinidad are almost certainly conspecific with the one from Cubagua. The shell clearly belongs to the *Trigonostoma (Ventrilia) tenerum* (Philippi, 1848) species group. The specimen from Cubagua is characterised by its thin shell, weak sculpture and relatively strongly canaliculated infrasutural platform.

Within the *tenerum* species group Petuch (1994) introduced two new fossil taxa from the Plio-Pleistocene of Florida; *Ventrilia kissimmeensis* and *V. rucksorum*. A single dorsal view of the shell of each of the new species is given, no information on intraspecific variability is presented, and the new taxa are compared only to other new taxa. Neither is compared to *T. (V.) tenerum*, which also occurs in the Florida fossil record.

We have examined specimens of *T. (V.) tenerum* from two Upper Pleistocene, Bermont Formation, localities in Florida, and Pleistocene deposits from Lee Creek Mine in North Carolina. They differ from our shell from Cubagua in having slightly stronger sculpture and a flatter infrasutural platform. We have six specimens (BL coll.) from the Pliocene Pinecrest Beds, from the same locality at the Kissimmee River Canal dig at Okeetantie, Okeechobee County as the shell described by Petuch (1994) as *Ventrilia kissimmeensis*. They are slightly weaker sculptured than *T. (V.) tenerum* and the infrasutural platform is more concave similar to our shell from Cubagua. *Ventrilia rucksorum* described from the Late Pliocene Caloosahatchee Formation is said to differ in having stronger shoulder knobs and having a larger beaded cord around the mid-whorl. If our material from the Kissimmee River is representative of the population, the specimen illustrated as the holotype for *V. kissimmeensis* is unusually smooth and the shell illustrated as *V. rucksorum* is more representative of the species. We provisionally accept *Trigonostoma (Ventrilia) rucksorum* (Petuch, 1994) as distinct, and possibly the predecessor of *T. (V.) tenerum*, and as first revisers (ICNZ, Art. 24.2) choose this name over *V. kissimmeensis*, which we consider an unusually smooth form.

It is not unusual in the Plio/Pleistocene assemblages of Florida to find two congeneric 'species,' occurring

sometimes in the same unit, which are identical except for one consistent difference in sculpture. Vermeij & Vokes (1997) touched on this in their discussion on *Pterorhytis (Pterorhytis) fluviana* Dall, 1903, and pointed out that specimens found along the Kissimmee River developed elaborately recurved varices (*Pterorhytis lindae* of Petuch, 1994, pl. 10, figure 7). A similar situation can be observed with the presence or absence of axial lamellae in *Eupleura* and *Vokesinotus* species pairs within the same units (Greg Herbert, personal communication 12/07/06 unpublished). This pattern does not seem to be limited to any specific taxonomic group, and probably reflects environmental differences (e.g., wave energy, depth) rather than actual species differences.

Distribution

Lower Pliocene: Cubagua Formation, Cubagua Island, Venezuela.

Plio/Pleistocene: Florida (Petuch, 1994).

CONCLUSIONS

As with previous works dealing with the family Cancellariidae in the Neogene Caribbean faunas (Jung and Petit, 1990; Landau and Petit, 1996), this study shows that, unlike today, a rich and diversified fauna of cancellarids thrived in the Caribbean Pliocene. The number of species known from the Lower Miocene Cantaure formation of Venezuela increases to 14, with the addition of *Cancellaria (Bivetiella) lugogonzalezorum* nov. sp. and *Cancellaria (Bivetopsia) herberti* nov. sp., placed in nine subgenus-group taxa. For the Lower Pliocene Cubagua Formation nine species are identified to species-level, plus a group which may contain more than one species, including two new taxa *Cancellaria (Cancellaria) capeloi* nov. sp. and *Cancellaria (Massyla) cubaguaensis* nov. sp. These are placed in eight subgenus-group taxa.

The composition of the Neogene southern Caribbean cancellarid fauna is strongly paciphile, with most of the subgenera now restricted to the eastern Pacific. *Bivetiella*, *Bivetopsia*, *Charcolleria*, *Euclia*, *Pyruclia*, *Massyla* and *Narona*, which are present in the Venezuelan Neogene, all have at least one representative in the Panamic-Pacific faunal province. To this list we can add *Extractrix* Korobkov, 1955, which has been recorded from the Lower Pliocene Punta Gavilán Formation of mainland Venezuela (Jung, 1977). Indeed, of the list of paciphile cancellarid subgenus-level taxa given by Jung and Petit (1990) only *Hertleinia* Marks, 1949, *Sveltia* Jousseaume, 1887 and *Perplicaria* Dall, 1890 have yet to be found in the Venezuelan fossil assemblages. The Caribbean cancellarid fauna suffered a severe impoverishment following the uplift of the Panama Isthmus and closure of the Central American seaway, with only *Cancellaria* (s.s.) and *Cancellaria (Ventrilia)* of the larger-shelled taxa present in the Recent faunas.

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